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Plan: The United States federal government should deploy the Climate Absolute Radiance and Refractivity Observatory.

Advantage I: Warming

U.S. climate satellites are battered and outdated—inevitable data gaps destroy environmental monitoring

Bohan 10—Suzanne Bohan, Washington Post writer, Sept 19, 2010, “A dim view for Earth emerges” Washington Post pg. A06

The satellite, Landsat 7, is broken. And it's emblematic of the nation's **battered satellite environmental monitoring program.** The bad news: It's only going to get worse, unless the federal agencies criticized for their poor management of the satellite systems over the past decade **stage a fast turnaround**. Many, however, view that prospect as a long shot. "I would say **our ability to observe the Earth from space is at grave risk of dying from neglect**," said Field, director of the Department of Global Ecology at the Carnegie Institution for Science at Stanford University. Inez Fung, a noted climatologist at the University of California at Berkeley, was shocked as she scanned a recent federal report warning of impending gaps in the country's ability to monitor Earth from space. The federal document, released in May, listed cuts in climate-monitoring sensors from the next generation of Earth-observing satellites. The current satellites beam down many types of indispensable data about the planet, such as ocean currents, ozone levels and snow cover, as well as the pictures viewers see every day on TV weathercasts. But key instruments on the new satellites have been eliminated: Gone is a sensor that would relay new data about the atmosphere and environmental conditions in the ocean and along coastal areas. The movement of pollutants and greenhouse gaseswould have been under the instrument's mechanical gaze, as well. Also absent is a critical sensor that monitors temperature changes over time on Earth. "That's like if you have a sick patient, and then say, 'I have no more thermometers,' " Fung said. In all, nine new climate instruments on the next generation of satellites were canceled or their capabilities scaled back in 2006, according to the Government Accountability Office report. Combined with a five-year delay in launching these next-generation satellites, with the first scheduled to blast off in 2011, these canceled or "degraded" instruments **leave the nation facing critical gaps in satellite monitoring** of the planet beginning in **2015,** the report stated. And a National Academy of Sciences analysis of the disarray in the satellite program stressed that because of Earth's growing population, **it's more crucial than ever to monitor pollution, water quality, land use and other environmental conditions.** Many blame the cuts on Bush administration policies that favored manned moon and Mars missions over shoring up aging Earth-observing satellite systems. Critics cite a 30 percent decline between 2000 and 2006 in NASA's Earth science budget - which funds environmental satellites - as evidence of the administration's lukewarm support of keeping an eye on the planet's condition. The National Academy of Sciences report, along with a chorus of experts in the field, also warns that the country is at risk of losing its worldwide technological leadership in Earth-observing satellites. Other casualties of the 2006 cuts include an instrument for tracking airborne particles such as sea spray, smog, volcanic ash and smoke - all factors contributing to the warming or cooling of the planet. The inclusion of a new instrument for monitoring soil moisture was canceled, which would have yielded information valuable to, among others, farmers and those monitoring the spread of deserts worldwide. These cuts spell a 46 percent decline in data about the Earth's conditions that these new satellites were designed to provide, and the GAO report concluded that because of the trouble-plagued satellite program, "**our nation's ability to understand climate change may be limited."** Those in the field use harsher language. Many Earth-monitoring satellites "are really **in desperate shape**," said Field, with Stanford's Carnegie Institution. In the 1960s, the United States began using satellites to observe its lands, oceans, atmosphere and the space environment near Earth. The satellites continuously monitor the planet's dynamic environment and allow humans to peer into inaccessible places. Information beamed by these spacecraft is now essential for forecasting weather, tracking conditions on Earth and in its atmosphere, and projecting long-term climate trends. With satellite data, rising sea levels can be monitored, helping communities on islands and along coastal areas plan. Satellites help farmers assess soil conditions before planting, allow foresters to examine logging activities, let water managers monitor the mountain snowpack that provides water to cities, and track the migration of wildlife such as buffalo and elephants. **Satellite data are also essential for crafting international agreements for reducing global warming**, said Molly Macauley, an economist with Resources for the Future, a research institute in Washington.

Data gaps impede climate risk-management—monitoring key to prevent tipping point

Government Office for Science 3/14- UK, Tipping Points meeting, London, 14 March 2011 Note prepared on behalf of the Government Office for Science by the Met Office: Peter Good, Jason Lowe, Richard Wood http://www.bis.gov.uk/assets/bispartners/goscience/docs/t/11-974-tipping-points-meeting-london-14-march-2011

There is wide acceptance in the scientific community that there are likely to be “tipping points” in the climate system, where a significant, qualitative change in state occurs in response to a small perturbation. **Crossing such tipping points could lead to accelerated**, committed or **irreversible change**. However there is substantial scientific uncertainty in quantifying the position and likelihood of passing key thresholds, and in terms of associated impacts. Current estimates of the likelihood of triggering large-scale and/or irreversible climate events are largely based on expert judgement, informed by paleo-climatic evidence, computer models and current understanding of the underlying physical processes. The high level of uncertainty, combined with the potential for very significant impacts if one or more “tipping points” were to be triggered, means that the policy response is likely to require a risk management approach. Paleo-climate reconstructions provide evidence of past rapid change events, for example the Paleocene-Eocene Thermal Maximum (PETM), which took place around 50 million years ago and involved a major climatic warming which took place over around 1000 years, possibly driven by rapid methane release. Current cumulative anthropogenic carbon release is around one third of the way towards the level that triggered such events in the past. Climate models are used to provide short term forecasts and longer term projections, to interpret recent climatic variations and paleo-climatic changes, and to understand the physical processes that may drive threshold behaviour. However several examples are known where the models used in the IPCC Fourth Assessment may not represent physical mechanisms of tipping elements correctly, due to limitations in resolution and in the processes that can currently be included in models. ‘Early warnings’ for tipping points through Earth system monitoring may be possible and may help manage the risks, although the uncertainty in modelling such events remains large. Three types of ‘health check’ approach were mentioned: (i) general statistical methods, (ii) process-based identification of key variables to monitor, and (iii) initial value prediction. Each was seen to have different advantages and disadvantages. **The critical need for long-term monitoring was emphasised**, while many existing observations are tied to short-term research programs. A clear set of long term monitoring priorities for tipping points has not yet been developed. It is important to be able to interpret ‘surprises’ in new observations (e.g. the 2007 dip in Arctic sea-ice), so that such observations can be put into context. These interpretations must be developed through careful application of quantitative, process-based knowledge of the climate system. After a high level review of the scientific evidence, the meeting considered how the risk of “tipping points” and system thresholds could be better included in policy development and wider public debate. There was consensus that the science in this area is particularly hard to communicate clearly. In part this is due to the danger of communicating an overly negative message; positive messages that make the public feel part of the solution are more likely to effect behaviour change. There was broad agreement on the requirement for a set of different (but self-consistent) narratives to meet the needs of individual audiences, using metaphors to aid clarity and understanding, and applying a risk-management framework.

Rapid warming now—reaching tipping point

Romm 1/20- Think Progress, Fellow at American Progress and is the editor of Climate Progress, Must-read Hansen and Sato paper: We are at a climate tipping point that, once crossed, enables multi-meter sea level rise this century January 20,2011

http://thinkprogress.org/romm/2011/01/20/207376/hansen-sato-climate-tipping-point-multi-meter-sea-level-rise/#

Right now, we’re headed towards an ice-free planet. That takes us through the Eemian interglacial period of about 130,000 years ago when sea levels were 15 to 20 feet higher, when temperatures had been thought to be about 1°C warmer than today. Then we go back to the “early Pliocene, when sea level was about 25 m [82 feet] higher than today,” as NASA’s James Hansen and Makiko Sato explain in a new draft paper, “Paleoclimate Implications for Human-Made Climate Change.” The question is how much warmer was it in the Eemian and early Pliocene than today — and how fast can the great ice sheets disintegrate? We already know we’re at CO2 levels that risk catastrophe if they are sustained or exceeded for any extended period of time (see Science: CO2 levels haven’t been this high for 15 million years, when it was 5° to 10°F warmer and seas were 75 to 120 feet higher). Hansen and Sato go further, saying we’re actually at or very near the highest temperatures of the current Holocene interglacial — the last 12,000 years of relatively stable climate that has made modern civilization possible. Holocene They argue that the Eemian was warmer than the Holocene maximum by “at most by about 1°C, but probably by only several tenths of a degree Celsius.” Their make the remarkable finding, that sea level rise will be highly nonlinear this century on our current business-as-usual [BAU] emissions that: BAU scenarios result in global warming of the order of 3-6°C. It is this scenario for which we assert that multi-meter sea level rise on the century time scale are not only possible, but almost dead certain. While this conclusion takes them well outside of every other recent prediction of sea level rise (SLR), Hansen deserves to be listened to because he has been right longer than almost anyone else in the field (see “Right for three decades: 1981 Hansen study finds warming trend that could raise sea levels“). Also, at least one recent study that attempts to integrate a linear historically-based analysis with a rapid response term finds we are headed towards SLR of “as much as 1.9 metres (6ft 3in) by 2100″ if we stay on BAU (see “Sea levels may rise 3 times faster than IPCC estimated, could hit 6 feet by 2100“). Hansen and Sato make their case for a strong nonlinear SLR based on a “phase change feedback mechanism,” that, as we’ll see, appears consistent with the recent scientific literature and observations1: There is a simple explanation for why the Eemian and Holsteinian were only marginally warmer than the Holocene and yet had (both) poles several degrees Celsius warmer. Earth at peak Holocene temperature is poised such that additional warming instigates large amplifying high-latitude feedbacks. Mechanisms on the verge of being instigated include loss of Arctic sea ice, shrinkage of the Greenland ice sheet, loss of Antarctic ice shelves, and shrinkage of the Antarctic ice sheets. These are not runaway feedbacks, but together they strongly amplify the impacts in polar regions of a positive (warming) climate forcing. Augmentation of peak Holocene temperature by even 1°C would be sufficient to trigger powerful amplifying polar feedbacks, leading to a planet at least as warm as in the Eemian and Holsteinian periods, making ice sheet disintegration and large sea level rise inevitable. Empirical evidence supporting these assertions abounds. Global temperature increased 0.5°C in the past three decades (Hansen et al., 2010) to a level comparable to the prior Holocene maximum, or a few tenths of a degree higher. Satellite observations reveal rapid reduction of Arctic sea ice (Stroeve et al., 2007) and surface melt on a large growing portion of the Greenland ice sheet (Steffen et al., 2004; Tedesco et al., 2011). Arctic response to human-made climate forcing is more apparent than Antarctic change, because the response time is quicker due to the large proportion of land area and Greenland’s temperature, which allows a large expansion of the area with summer melting. However, we must expect ice sheet mass balance changes will occur simultaneously in both hemispheres. Why? Because ice sheets in both hemispheres were in near-equilibrium with Holocene temperatures. That is probably why both Greenland and Antarctica began to shed ice in the past decade or so, because global temperature is just rising above the Holocene level. Ice sheet disintegration in Antarctica depends on melting the underside of ice shelves as the ocean warms, a process well underway at the Pine Island glacier (Scott et al., 2009). The glacier’s grounding line has retreated inland by tens of kilometers (Jenkins et al., 2010) and thinning of the ice sheet has spread inland hundreds of kilometers (Wingham et al., 2009). The article has a longer discussion of the ‘albedo flip’ underlying their conclusion: Summer melting on lower reaches of the ice sheets and on ice shelves introduces the “albedo flip” mechanism (Hansen et al., 2007). This phase change of water causes a powerful local feedback, which, together with moderate global warming, can substantially increase the length of the melt season. Such increased summer melting has an immediate local temperature effect, and it also will affect sea level, on a time scale that is being debated, as discussed below. We suggest that the warmest interglacials in the past 450,000 years were warm enough to bring the “albedo flip” phenomenon into play, while interglacials in the earlier part of the 800,000 year ice core record were too cool for surface melt on the Greenland and Antarctic ice sheets and ice shelves to be important. Increased surface melting, loss of ice shelves, and reduction of summer and autumn sea ice around the Antarctic and Greenland continents during the warmest interglacials would have a year-round effect on temperature, because the increased area of open water has its largest impact on surface air temperature in the cool seasons. Further, we suggest that the stability of sea level during the Holocene is a consequence of the fact that global temperature remained just below the level required to initiate the “albedo flip” mechanism on Greenland and West Antarctica. One implication of this interpretation is that the world today is on the verge of a level of global warming for which the equilibrium surface air temperature response on the ice sheets will exceed the global mean temperature increase by much more than a factor of two. Coincidentally, a new article in Nature Geoscience, “Radiative forcing and albedo feedback from the Northern Hemisphere cryosphere between 1979 and 2008,” appears to lend support to this thesis. After “synthesizing a variety of remote sensing and field measurements,” the authors find “the albedo feedback from the Northern Hemisphere cryosphere” is “substantially larger than comparable estimates obtained from 18 climate models.” The news release notes: A new analysis of the Northern Hemisphere’s “albedo feedback” over a 30-year period concludes that the region’s loss of reflectivity due to snow and sea ice decline is more than double what state-of-the-art climate models estimate. The findings are important, researchers say, because they suggest that Arctic warming amplified by the loss of reflectivity could be even more significant than previously thought. Also, the Hansen/Sato thesis seems consistent with a 2008 study in Geophysical Research Letters by leading tundra experts, “Accelerated Arctic land warming and permafrost degradation during rapid sea ice loss.” The lead author is David Lawrence of the National Center for Atmospheric Research (NCAR), who I have interviewed a number of times . The study’s ominous conclusion: We find that simulated western Arctic land warming trends during rapid sea ice loss are 3.5 times greater than secular 21st century climate-change trends. The accelerated warming signal penetrates up to 1500 km inland”¦. See also “What exactly is polar amplification and why does it matter?” Back to Hansen/Sato. They have extended discussion of “linear versus non-linear ice sheet disintegration” and conclude: The asymmetry of glacial-interglacial climate cycles, with rapid warming and sea level rise in the warming phase and a slower descent into ice ages, suggests that amplifying feedbacks can make the “wet” ice sheet disintegration process relatively rapid (Hansen et al., 2007). But how rapid? Paleoclimate records include cases in which sea level rose several meters per century, even though known natural positive forcings are much smaller than the human-made forcing. This implies that ice sheet disintegration can be a highly nonlinear process. We suggest that a nonlinear process spurred by an increasing forcing and amplifying feedbacks is better characterized by the doubling time for the rate of mass disintegration, rather than a linear rate of mass change. If the doubling time is as short as a decade, multi-meter sea level rise could occur this century. Observations of mass loss from Greenland and Antarctica are too brief for significant conclusions, but they are not inconsistent with a doubling time of a decade or less. The picture will become clearer as the measurement record lengthens. What constraints or negative feedbacks might limit nonlinear growth of ice sheet mass loss? An ice sheet sitting primarily on land above sea level, such as most of Greenland, may be limited by the speed at which it can deliver ice to the ocean via outlet glaciers. But much of the West Antarctic ice sheet, resting on bedrock below sea level, is not so constrained. And so they end their paper with this prediction and warning: IPCC BAU (business-as-usual) scenarios assume that greenhouse gas emissions will continue to increase, with the nations of the world burning most of the fossil fuels including unconventional fossil fuels such as tar sands. An alternative extreme, one that places a substantial rising price on carbon emissions, would have CO2 emissions beginning to decrease within less than a decade, as the world moves on energy systems beyond fossil fuels, leaving most of the remaining coal and unconventional fossil fuels in the ground. In this extreme scenario, let’s call it fossil fuel phase-out (FFPO), CO2 would rise above 400 ppm but begin a long decline by mid-century (Hansen et al., 2008). The European Union 2°C scenario, call it EU2C, falls in between these two extremes. BAU scenarios result in global warming of the order of 3-6°C. It is this scenario for which we assert that multi-meter sea level rise on the century time scale are not only possible, but almost dead certain. Such a huge rapidly increasing climate forcing dwarfs anything in the peleoclimate record. Antarctic ice shelves would disappear and the lower reaches of the Antarctic ice sheets would experience summer melt comparable to that on Greenland today. The other extreme scenario, FFPO, does not eliminate the possibility of multi-meter sea level rise, but it leaves the time scale for ice sheet disintegration very uncertain, possibly very long. If the time scale is several centuries, then it may be possible to avoid large sea level rise by decreasing emissions fast enough to cause atmospheric greenhouse gases to decline in amount. What about the intermediate scenario, EU2C? We have presented evidence in this paper that prior interglacial periods were less than 1°C warmer than the Holocene maximum. If we are correct in that conclusion, the EU2C scenario implies a sea level rise of many meters. It is difficult to predict a time scale for the sea level rise, but it would be dangerous and foolish to take such a global warming scenario as a goal. If Hansen and Sato are right, we will know within a decade or two. Unfortunately, continuing to do nothing while we wait to find out all but ensures we cross the tipping point and entire the realm of worst-case scenarios. Further delay is beyond immoral.

Climate Change makes disease, war, instability, and nuclear proliferation inevitable

Schwartz and Randall 3- An Abrupt Climate Change Scenario and Its Implications for United States National Security By Peter Schwartz, co-founder and chairman of Global Business Network and Doug Randall, California-based Global Business Network, October 2003 http://www.edf.org/documents/3566\_AbruptClimateChange.pdf

The two most likely reactions to a sudden drop in carrying capacity due to climate change are defensive and offensive. The United States and Australia are likely to build defensive fortresses around their countries because they have the resources and reserves to achieve self-sufficiency. With diverse growing climates, wealth, technology, and abundant resources, the United States could likely survive shortened growing cycles and harsh weather conditions without catastrophic losses. Borders will be strengthened around the country to hold back unwanted starving immigrants from the Caribbean islands (an especially severe problem), Mexico, and South America. Energy supply will be shored up through expensive (economically, politically, and morally) alternatives such as nuclear, renewables, hydrogen, and Middle Eastern contracts. Pesky skirmishes over fishing rights, agricultural support, and disaster relief will be commonplace. Tension between the U.S. and Mexico rise as the U.S. reneges on the 1944 treaty that guarantees water flow from the Colorado River. Relief workers will be commissioned to respond to flooding along the southern part of the east coast and much drier conditions inland. Yet, even in this continuous state of emergency the U.S. will be positioned well compared to others. The intractable problem facing the nation will be calming the mounting military tension around the world. As famine, disease, and weather-related disasters strike due to the abrupt climate change, many countries’ needs will exceed their carrying capacity. This will create a sense of desperation, which is likely to lead to offensive aggression in order to reclaim balance. Imagine eastern European countries, struggling to feed their populations with a falling supply of food, water, and energy, eyeing Russia, whose population is already in decline, for access to its grain, minerals, and energy supply. Or, picture Japan, suffering from flooding along its coastal cities and contamination of its fresh water supply, eying Russia’s Sakhalin Island oil and gas reserves as an energy source to power desalination plants and energy-intensive agricultural processes. Envision Pakistan, India, and China – all armed with nuclear weapons – skirmishing at their borders over refugees, access to shared rivers, and arable land. Spanish and Portuguese fishermen might fight over fishing rights – leading to conflicts at sea. And, countries including the United States would be likely to better secure their borders.With over 200 river basins touching multiple nations, we can expect conflict over access to water for drinking, irrigation, and transportation. The Danube touches twelve nations, the Nile runs though nine, and the Amazon runs through seven.

In this scenario, we can expect alliances of convenience. The United States and Canada may become one, simplifying border controls. Or, Canada might keep its hydropower—causing energy problems in the US. North and South Korea may align to create one technically savvy and nuclear-armed entity. Europe may act as a unified block – curbing immigration problems between European nations – and allowing for protection against aggressors. Russia, with its abundant minerals, oil, and natural gas may join Europe. In this world of warring states, nuclear arms proliferation is inevitable. As cooling drives up demand, existing hydrocarbon supplies are stretched thin. With a scarcity of energy supply – and a growing need for access -- nuclear energy will become a critical source of power, and this will accelerate nuclear proliferation as countries develop enrichment and reprocessing capabilities to ensure their national security. China, India, Pakistan, Japan, South Korea, Great Britain, France, and Germany will all have nuclear weapons capability, as will Israel, Iran, Egypt, and North Korea. Managing the military and political tension, occasional skirmishes, and threat of war will be a challenge. Countries such as Japan, that have a great deal of social cohesion (meaning the government is able to effectively engage its population in changing behavior) are most likely to fair well. Countries whose diversity already produces conflict, such as India, South Africa and Indonesia, will have trouble maintaining order. Adaptability and access to resources will be key. Perhaps the most frustrating challenge abrupt climate change will pose is that we’ll never know how far we are into the climate change scenario and how many more years – 10, 100, 1000 --- remain before some kind of return to warmer conditions as the thermohaline circulation starts up again. When carrying capacity drops suddenly, civilization is faced with new challenges that today seem unimaginable.

Warming is real & anthropogenic – causes extinction

Deibel 7 (Terry L, Professor of IR @ National War College, “Foreign Affairs Strategy: Logic for American Statecraft”, Conclusion: American Foreign Affairs Strategy Today, cut by [presumably] Lexington)

 Finally, there is one major existential threat to American security (as well as prosperity) of a nonviolent nature, which, though far in the future, demands urgent action. It is the threat of global warming to the stability of the climate upon which all earthly life depends. Scientists worldwide have been observing the gathering of this threat for three decades now, and what was once a mere possibility has passed through probability to near certainty. Indeed not one of more than 900 articles on climate change published in refereed scientific journals from 1993 to 2003 doubted that anthropogenic warming is occurring. “In legitimate scientific circles,” writes Elizabeth Kolbert, “it is virtually impossible to find evidence of disagreement over the fundamentals of global warming.” Evidence from a vast international scientific monitoring effort accumulates almost weekly, as this sample of newspaper reports shows: an international panel predicts “brutal droughts, floods and violent storms across the planet over the next century”; climate change could “literally alter ocean currents, wipe away huge portions of Alpine Snowcaps and aid the spread of cholera and malaria”; “glaciers in the Antarctic and in Greenland are melting much faster than expected, and…worldwide, plants are blooming several days earlier than a decade ago”; “rising sea temperatures have been accompanied by a significant global increase in the most destructive hurricanes”; “NASA scientists have concluded from direct temperature measurements that 2005 was the hottest year on record, with 1998 a close second”; “Earth’s warming climate is estimated to contribute to more than 150,000 deaths and 5 million illnesses each year” as disease spreads; “widespread bleaching from Texas to Trinidad…killed broad swaths of corals” due to a 2-degree rise in sea temperatures. “The world is slowly disintegrating,” concluded Inuit hunter Noah Metuq, who lives 30 miles from the Arctic Circle. “They call it climate change…but we just call it breaking up.” From the founding of the first cities some 6,000 years ago until the beginning of the industrial revolution, carbon dioxide levels in the atmosphere remained relatively constant at about 280 parts per million (ppm). At present they are accelerating toward 400 ppm, and by 2050 they will reach 500 ppm, about double pre-industrial levels. Unfortunately, atmospheric CO2 lasts about a century, so there is no way immediately to reduce levels, only to slow their increase, we are thus in for significant global warming; the only debate is how much and how serious the effects will be. As the newspaper stories quoted above show, we are already experiencing the effects of 1-2 degree warming in more violent storms, spread of disease, mass die offs of plants and animals, species extinction, and threatened inundation of low-lying countries like the Pacific nation of Kiribati and the Netherlands at a warming of 5 degrees or less the Greenland and West Antarctic ice sheets could disintegrate, leading to a sea level of rise of 20 feet that would cover North Carolina’s outer banks, swamp the southern third of Florida, and inundate Manhattan up to the middle of Greenwich Village. Another catastrophic effect would be the collapse of the Atlantic thermohaline circulation that keeps the winter weather in Europe far warmer than its latitude would otherwise allow. Economist William Cline once estimated the damage to the United States alone from moderate levels of warming at 1-6 percent of GDP annually; severe warming could cost 13-26 percent of GDP. But the most frightening scenario is runaway greenhouse warming, based on positive feedback from the buildup of water vapor in the atmosphere that is both caused by and causes hotter surface temperatures. Past ice age transitions, associated with only 5-10 degree changes in average global temperatures, took place in just decades, even though no one was then pouring ever-increasing amounts of carbon into the atmosphere. Faced with this specter, the best one can conclude is that “humankind’s continuing enhancement of the natural greenhouse effect is akin to playing Russian roulette with the earth’s climate and humanity’s life support system. At worst, says physics professor Marty Hoffert of New York University, “we’re just going to burn everything up; we’re going to heat the atmosphere to the temperature it was in the Cretaceous when there were crocodiles at the poles, and then everything will collapse.” During the Cold War, astronomer Carl Sagan popularized a theory of nuclear winter to describe how a thermonuclear war between the Untied States and the Soviet Union would not only destroy both countries but possibly end life on this planet. Global warming is the post-Cold War era’s equivalent of nuclear winter at least as serious and considerably better supported scientifically. Over the long run it puts dangers from terrorism and traditional military challenges to shame. It is a threat not only to the security and prosperity to the United States, but potentially to the continued existence of life on this planet.

1AC- Climate Leadership

Advantage II: Climate Leadership

Now is the key time for Obama to assert leadership on climate change

New York Times, 6-22- John M. Broder, June 22, 2011, “Gore Criticizes Obama for Record on Climate”, http://www.nytimes.com/2011/06/23/science/earth/23gore.html

Former Vice President Al Gore sharply criticized President Obama as lacking leadership on climate change in a magazine essay published online Wednesday, saying his policies had been little more effective than those of President George W. Bush. Related in Opinion In the 7,000-word article in Rolling Stone, Mr. Gore said that Mr. Obama clearly understood the threat to the planet posed by global warming and that he had appointed a number of committed environmental advocates to key positions. But Mr. Gore said that in the face of well-financed attacks from fossil fuel industries and denial and delay from Republicans in Congress, Mr. Obama had failed to act decisively to alter the nation’s policies on climate change and energy. Addressing climate change on national and international levels will require forceful American leadership, Mr. Gore said. “Yet President Obama has never presented to the American people the magnitude of the climate crisis,” he wrote. “He has simply not made the case for action. He has not defended the science against the ongoing, withering and dishonest attacks. Nor has he provided a presidential venue for the scientific community — including our own National Academy — to bring the reality of the science before the public.” A White House spokesman defended Mr. Obama’s record in a written statement. “The president has been clear since Day 1 that climate change poses a threat domestically and globally, and under his leadership we have taken the most aggressive steps in our country’s history to tackle this challenge,” said Clark Stevens, a White House press officer. Under Mr. Obama, Mr. Stevens said, the United States has spent billions of dollars on clean-energy technology, imposed tough new emissions standards for cars and trucks and taken the lead in international talks on climate change. Mr. Gore’s extended outburst of frustration signals a public turning point for him, and perhaps for other environmental advocates who have been quietly seething for months over what they view as the administration’s timidity. Mr. Gore, who shared a Nobel Peace Prize for his climate advocacy, praised some of the president’s actions, including the new vehicle standards and the investments in green technology. But in recent months he has told friends that the president has been too passive on climate change and has not been sufficiently supportive of Lisa P. Jackson, the Environmental Protection Agency administrator, who has tried to advance greenhouse gas regulation against stiff Congressional opposition. Much of Mr. Gore’s essay is devoted to criticism of the news media as failing to report accurately on the scientific consensus that climate change is real and that it is most likely caused by human activities. He said the media had been cowed by an aggressive lobbying and public relations campaign financed by the oil, gas and coal industries, or had presented ideological entertainment in the guise of news reporting. Mr. Obama has tried to move the country away from fossil fuels, and has made the connection between oil imports and national security, Mr. Gore wrote. “But in spite of these and other achievements, President Obama has thus far failed to use the bully pulpit to make the case for bold action on climate change,” he said. “After successfully passing his green stimulus package, he did nothing to defend it when Congress decimated its funding. After the House passed cap and trade, he did little to make passage in the Senate a priority.” Paul Bledsoe, a former energy aide in the Clinton White House and now senior adviser at the Bipartisan Policy Center, said: “I entirely disagree with Gore here. Obama has consistently made a compelling case for climate action based on the science and has fought in Congress and internationally for robust policies to cut emissions and promote clean energy. The administration’s failing on climate has in fact been political.” Mr. Gore also turned to public officials of both parties. “Many politicians, unfortunately, also fall into the same two categories: those who cheerlead for the deniers and those who cower before them,” he wrote. “The latter group now includes several candidates for the Republican presidential nomination who have felt it necessary to abandon their previous support for action on the climate crisis; at

least one has been apologizing profusely to the deniers and begging for their forgiveness.” Mr. Gore does not name them, but Mitt Romney, a former governor of Massachusetts; Jon M. Huntsman Jr., a former governor of Utah and ambassador to China; and Tim Pawlenty, a former governor of Minnesota, have backtracked on their support for state and federal action to address global warming. Near the end of the article, Mr. Gore acknowledged that he might be hobbling a president trying to do the right thing in a difficult environment. “All of his supporters understand that it would be self-defeating to weaken Obama and heighten the risk of another step backward,” he wrote. But he said he felt compelled to speak out because the stakes were incalculable. “The climate crisis, in reality, is a struggle for the soul of America,” Mr. Gore concluded, using the voice of prophet and teacher that he has assumed on this topic for more than 20 years. “It is about whether or not we are still capable — given the ill health of our democracy and the current dominance of wealth over reason — of perceiving important and complex realities clearly enough to promote and protect the sustainable well-being of the many. What hangs in the balance is the future of civilization as we know it.”

Earth Observation satellites key to US environmental leadership- near-term support key to long-term credibility

Sabathier and Faith 7- Vincent Sabatheir, senior associate with the CSIS Technology and Public Policy Program. From 2004 to 2009, he was senior fellow and director for space initiatives at CSIS. He is also senior adviser to the SAFRAN group and consults internationally on aerospace and telecommunications; Ryan Faith, associate for the Center for Strategic and International Studies, 31 July 2007, “Minding the Gaps: Keeping Exploration Alive,” Online: http://csis.org/files/media/csis/pubs/070731\_space\_commentary.pdf

Finally, the third challenge relates to the collection of environmental data through earth observation satellites. Global concern with climate change makes the sacrifice of earth observation to support human space exploration a very unappealing option. Further, the United States has already committed to a bold leadership role with the July 2003 launch, by former secretary of state Colin Powell and current National Oceanic and Atmospheric Administration (NOAA) administrator VADM Conrad Lautenbacher (USN, ret.), of a worldwide effort to build the Global Earth Observation System of Systems. If we establish an organization to create a system like GEOSS and then immediately fail to meet our agreed-on commitments, it will be very difficult indeed to generate future support for international projects, and as a consequence, our basic ability to lead in other space-related areas—especially returning to the Moon—will be greatly compromised. Historically, the way that NASA has dealt with such competing priorities is through the senseless cannibalism of one project after another. This may not, however, currently be an option. On one hand, the broad, bipartisan support for a national vision of space exploration and the immediate interest should encourage solid, robust support for human space exploration; on the other hand, the growing concern of global climate change necessitates full support of earth observation. In these space leadership challenges, failure to provide near-term support will immediately erode our credibility, while in the longer term, our leadership role is at great risk.

U.S. environmental leadership leads to global leadership- American policy sends a global signal

Shepard 10- Don Shepard, Natural Resources/Water Resources University Laboratory Teacher & Former Financial Representative and Army National Guard Accountant, ““U.S. Environmental Policy and Leadership,” online: http://www.brighthub.com/environment/science-environmental/articles/39623.aspx

Will Obama Meet New Standards?

Even with these goals and very early achievements it is unclear if the overall “political will”, no matter how different from the last eight years, is sufficient to tackle the challenges of global environmental change, particularly when the will of the presidential administration may not be enough. There are many representatives who do not share Obama’s enthusiasm for environmental issues. As pointed out previously, there have already been compromises made that have decreased funding for environmental initiatives. The American people can help by not letting the environmental agenda once again take a back seat, though only time will tell just how strong the will and influence of the Obama administration is. Opportunity for Leadership in Copenhagen The U.S. is the world superpower. I argue that the latest world economic troubles only serve to accentuate the extent to which this is true, as economies of the world are suffering due to the domino effect triggered by the collapse of the U.S. housing market. The Kyoto treaty was only a piece of paper without the U.S. on board. The other major polluting nations such as China and India will not take the problem of global environmental change seriously until America does. Copenhagen is a chance to right the ship before it is too late. Our nation is just as capable of steering the ship in the right direction as it is in the wrong direction. This means allowing Earth to take the helm, and remembering humanity adapts to her, not her to humanity. Update: Copenhagen; What happened? Dissapointment seems to be the predominant reaction from environmental organizations to the Copenhagen Climate Summit. Indeed, no binding agreement, or even a pledge to make a binding agreement in 2010 was achieved. This was not, however, the true test of the Obama administration's environmental policy. The real test is whether Obama can get a legitimate climate bill through the Senate. U.S. environmental leadership can still be the beacon it needs to be with a strong message from our lawmakers.

**Environmental leadership is the crucial determinant of US primacy—more important than power projection or force posture**

**Carstens 1-** David H. Carstens 1, Chief of Operations, Assistant Chief of Staff, G-2, Eighth US Army, Korea, Spring 2001 (Parameters, <http://carlisle-www.army.mil/usawc/Parameters/01spring/carstens.htm>)

Dramatic events such as the end of the Cold War, the turn of the century, and now a new presidency offer opportunities for the United States to reconsider its national security policy.[1] The notion that the focus should be limited to defending against an emerging peer competitor or rogue state is flawed, however, and current analyses of emerging threats are generally too narrowly defined. Internal regional strife, not power-projecting challengers to US primacy, will likely spark the crises of the 21st century for which US strategy must be prepared. A tidal wave of public outcry over the deteriorating state of regional economies and the global environment is rushing toward the shores of the world's most powerful nations. In an era in which there are few imminent threats to US security, government as well as corporate leaders praise the superpower status of our nation. In such times it is not surprising that labor and environmental reform issues are often placed on the back burner. Nevertheless, these are the issues that will take center stage in the coming decades. From its current position of vast global power, the United States can either choose to meet this challenge head on, or be overcome by it. My intent is not to dismiss the current theories of strategy, but rather to add to them. Four such strategies (and many variations on these) compete for relevancy in the current public debate: neo-isolationism, selective engagement, cooperative security, and primacy.[2] The implications of each are normally outlined in a traditional analysis of foreign affairs in which there exists a constant competition for power between states. Although this tradition continues, the real danger the world now faces "stem[s] not from conflicts between countries but from conflicts within them."[3] Such internal strife over distribution of wealth, labor inequality, scarcity of resources, and declining environmental conditions will spill over into neighboring states, creating chaos. The new grand strategy of the United States, therefore, needs to respond to regional internal weaknesses, not to the external strengths of perceived rogue and competitor states. [continues] With the rising inequality brought on by globalization comes a torrent of economic, labor, and environmental problems which, if left unchallenged, will fuel the fires of regional crisis in the 21st century. For the global market to survive, nations need to collectively establish and maintain economic, labor, and environmental policies that provide for the common good. Such standards also need to be collectively enforced with the same zeal as is currently reserved for defense against armed attack. In the eyes of the world, American leadership diminishes every time we choose not to act upon a potentially devastating human crisis. To the contrary, successful actions in support of regional economic and environmental well-being bolster confidence in American leadership at home and abroad. Further, immediate action today may prevent the wars of tomorrow, especially in those areas where imminent chaos is most pronounced. The United States cannot afford to look away from global economic and environmental despair, saving its strength for the "big fight." The future US grand strategy, if not entirely based on environmental and economic internationalism, should expand the definition of US interests to include global economic reform and environmental standards enforcement. The greatest danger America faces is neither China nor Iraq. It is indifference to this emerging crisis.

Climate change is a severe detriment to readiness- disrupts electricity grid, energy, military bases and battle ground conditions

CNA 7- The CNA Corporation is a nonprofit institution that conducts in-depth, independent research and analysis, National Security and the Threat of Climate Change May 30, http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf

Severe weather has a direct effect on military readiness. Ships and aircraft operations are made more difficult; military personnel themselves must evacuate or seek shelter. As Army Gen. Paul Kern explained of his time dealing with hurricanes in the U.S. Southern Command: “A major weather event becomes a distraction from your ability to focus on and execute your military mission.” In addition, U.S. forces may be required to be more engaged in stability operations in the future as climate change causes more frequent weather disasters such as hurricanes, flash floods, and extended droughts. A warming Arctic holds great implications for military operations. The highest levels of planetary warming observed to date have occurred in the Arctic, and projections show the high northern latitudes warming more than any other part of the earth over the coming century. The Arctic, often considered to be the proverbial “canary” in the earth climate system, is showing clear signs of stress [33]. The U.S. Navy is concerned about the retreat and thinning of the ice canopy and its implications for naval operations. A 2001 Navy study concluded that an ice-free Arctic will require an “increased scope of naval operations” [35]. That increased scope of operations will require the Navy to consider weapon system effectiveness and various other factors associated with operating in this environment. Additionally, an Arctic with less sea ice could bring more competition for resources, as well as more commercial and military activity that could further threaten an already fragile ecosystem. The DoD is almost completely dependent on electricity from the national grid to power critical missions at fixed installations and on petroleum to sustain combat training and operations. Both sources of energy and their distribution systems are susceptible to damage from extreme weather. The national electric grid is fragile and can be easily disrupted. Witness the Northeast Blackout of 2003, which was caused by trees falling onto power lines in Ohio. It affected 50 million people in eight states and Canada, took days to restore, and caused a financial loss in the United States estimated to be between $4 billion and $10 billion [36]. People lost water supplies, transportation systems, and communications systems (including Internet and cell phones). Factories shut down, and looting occurred. As extreme weather events becomes more common, so do the threats to our national electricity supply. One approach to securing power to DoD installations for critical missions involves a combination of aggressively applying energy efficiency technologies to reduce the critical load (more mission, less energy); deploying renewable energy sources; and “islanding” the installation from the national grid. Islanding allows power generated on the installations to flow two ways—onto the grid when there is excess production and from the grid when the load exceeds local generation. By pursuing these actions to improve resiliency of mission, DoD would become an early adopter of technologies that would help transform the grid, reduce our load, and expand the use of renewable energy. For deployed systems, the DoD pays a high price for high fuel demand. In Iraq, significant combat forces are dedicated to moving fuel and protecting fuel supply lines. The fuel delivery situation on the ground in Iraq is so limited As extreme weather events becomes more common, so do the threats to our national electricity supply that that the Army has established a “Power Surety Task Force” to help commanders of forward operating bases cut the number of fuel convoys by using energy more efficiently. Maj. Gen. Richard Zilmer, USMC, commander of the multinational force in the Anbar province of Iraq, asked for help in August 2006. His request was for renewable energy systems. According to Gen. Zilmer, “reducing the military’s dependence on fuel for power generation could reduce the number of road-bound convoys … ‘Without this solution [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success.…’ ” Along a similar vein, Lt. Gen. James Mattis, while commanding general of the First Marine Division during Operation Iraqi Freedom, urged: “Unleash us from the tether of fuel.” Energy-efficiency technologies, energy conservation practices and renewable energy sources are the tools forward bases are using to stem their fuel demand and reduce the “target signature” of their fuel convoys. Numerous DoD studies dating from the 2001 Defense Science Board report “More Capable Warfighting Through Reduced Fuel Burden” have concluded that high fuel demand by combat forces detracts from our combat capability, makes our forces more vulnerable, diverts combat assets from offense to supply line protection, and increases operating costs. Nowhere are these problems more evident than in Iraq, where every day 2.4 million gallons of fuel is moved through dangerous territory, requiring protection by armored combat vehicles and attack helicopters [37]. DoD planners estimate that it costs $15 to deliver one gallon of fuel from its commercial supplier to the forward edge of the battlefield and about $26 to deliver a gallon of fuel from an airborne tanker, not counting the tanker aircraft cost. Furthermore, DoD’s procedures for determining the types of systems it needs do not take these fuel burden considerations into account. DoD should require more efficient combat systems and should include the actual cost of delivering fuel when evaluating the advantages of investments in efficiency [38, 39]. DoD should have an incentive to accurately account for the cost of moving and protecting fuel and to invest in technologies that will provide combat power more efficiently. Deploying technologies that make our forces more efficient also reduces greenhouse gas emissions. The resulting technologies would make a significant contribution to the vision President Bush expressed in his State of the Union speech when he said, “America is on the verge of technological breakthroughs that will … help us to confront the serious challenge of global climate change.” Given the human and economic cost of delivering fuel to combat forces and the almost total dependence on the electric grid for critical missions, DoD has strong operational economic incentives to aggressively pursue energy efficiency in its combat systems and its installations. By investing at levels commensurate with its interests, DoD would become an early adopter of innovative technologies and could stimulate others to follow. Climate change threats also create opportunities for constructive engagement such as stability operations and capacity building. The U.S. military helped deliver relief to the victims of ... reducing the military’s dependence on fuel for power generation could reduce the number of road-bound convoys … 41 the 2005 Indian Ocean tsunami because it is the only institution capable of rapidly delivering personnel and materiel anywhere in the world on relatively short notice. DoD Directive 3000.05, issued in 2006, provides the mandate to conduct military and civilian stability operations in peacetime as well as conflict to maintain order in states and regions. The Combatant Command’s Theater Security Cooperation Program, which seeks to engage regional states, could be easily focused on climate change mitigation and executed in concert with other U.S. agencies through U.S. embassy country teams. The objective would be to build the host nation military’s capabilities and capacity to support civilian government agencies. It also enhances good governance and promotes stability, making failed states and terrorist incursion less likely. Because many climate change problems cross borders, it could also promote regional communication and cooperation. If the frequency of natural disasters increases with climate change, future military and political leaders may face hard choices about where and when to engage. Deploying troops affects readiness elsewhere; choosing not to may affect alliances. And providing aid in the aftermath of a catastrophic event or natural disaster can help retain stability in a nation or region, which in turn could head off U.S. military engagement in that region at a later date.

Loss of U.S. hegemony causes nuclear wars around the globe

Kagan 7 – Robert Kagan, senior associate at the Carnegie Endowment for International Peace and senior transatlantic fellow at the German Marshall Fund, August/September 2007, “End of Dreams, Return of History,” The Hoover Policy Review, online: <http://www.hoover.org/publications/policyreview/8552512.html>

The jostling for status and influence among these ambitious nations and would-be nations is a second defining feature of the new post-Cold War international system. Nationalism in all its forms is back, if it ever went away, and so is international competition for power, influence, honor, and status. American predominance prevents these rivalries from intensifying — its regional as well as its global predominance. Were the United States to diminish its influence in the regions where it is currently the strongest power, the other nations would settle disputes as great and lesser powers have done in the past: sometimes through diplomacy and accommodation but often through confrontation and wars of varying scope, intensity, and destructiveness. One novel aspect of such a multipolar world is that most of these powers would possess nuclear weapons. That could make wars between them less likely, or it could simply make them more catastrophic. It is easy but also dangerous to underestimate the role the United States plays in providing a measure of stability in the world even as it also disrupts stability. For instance, the United States is the dominant naval power everywhere, such that other nations cannot compete with it even in their home waters. They either happily or grudgingly allow the United States Navy to be the guarantor of international waterways and trade routes, of international access to markets and raw materials such as oil. Even when the United States engages in a war, it is able to play its role as guardian of the waterways. In a more genuinely multipolar world, however, it would not. Nations would compete for naval dominance at least in their own regions and possibly beyond. Conflict between nations would involve struggles on the oceans as well as on land. Armed embargos, of the kind used in World War i and other major conflicts, would disrupt trade flows in a way that is now impossible. Such order as exists in the world rests not merely on the goodwill of peoples but on a foundation provided by American power. Even the European Union, that great geopolitical miracle, owes its founding to American power, for without it the European nations after World War II would never have felt secure enough to reintegrate Germany. Most Europeans recoil at the thought, but even today Europe’s stability depends on the guarantee, however distant and one hopes unnecessary, that the United States could step in to check any dangerous development on the continent. In a genuinely multipolar world, that would not be possible without renewing the danger of world war. People who believe greater equality among nations would be preferable to the present American predominance often succumb to a basic logical fallacy. They believe the order the world enjoys today exists independently of American power. They imagine that in a world where American power was diminished, the aspects of international order that they like would remain in place. But that ’s not the way it works. International order does not rest on ideas and institutions. It is shaped by configurations of power. The international order we know today reflects the distribution of power in the world since World War ii, and especially since the end of the Cold War. A different configuration of power, a multipolar world in which the poles were Russia, China, the United States, India, and Europe, would produce its own kind of order, with different rules and norms reflecting the interests of the powerful states that would have a hand in shaping it. Would that international order be an improvement? Perhaps for Beijing and Moscow it would. But it is doubtful that it would suit the tastes of enlightenment liberals in the United States and Europe. The current order, of course, is not only far from perfect but also offers no guarantee against major conflict among the world ’s great powers. Even under the umbrella of unipolarity, regional conflicts involving the large powers may erupt. War could erupt between China and Taiwan and draw in both the United States and Japan. War could erupt between Russia and Georgia, forcing the United States and its European allies to decide whether to intervene or suffer the consequences of a Russian victory. Conflict between India and Pakistan remains possible, as does conflict between Iran and Israel or other Middle Eastern states. These, too, could draw in other great powers, including the United States. Such conflicts may be unavoidable no matter what policies the United States pursues. But they are more likely to erupt if the United States weakens or withdraws from its positions of regional dominance. This is especially true in East Asia, where most nations agree that a reliable American power has a stabilizing and pacific effect on the region. That is certainly the view of most of China ’s neighbors. But even China, which seeks gradually to supplant the United States as the dominant power in the region, faces the dilemma that an American withdrawal could unleash an ambitious, independent, nationalist Japan. In Europe, too, the departure of the United States from the scene — even if it remained the world’s most powerful nation — could be destabilizing. It could tempt Russia to an even more overbearing and potentially forceful approach to unruly nations on its periphery. Although some realist theorists seem to imagine that the disappearance of the Soviet Union put an end to the possibility of confrontation between Russia and the West, and therefore to the need for a permanent American role in Europe, history suggests that conflicts in Europe involving Russia are possible even without Soviet communism. If the United States withdrew from Europe — if it adopted what some call a strategy of “offshore balancing” — this could in time increase the likelihood of conflict involving Russia and its near neighbors, which could in turn draw the United States back in under unfavorable circumstances. It is also optimistic to imagine that a retrenchment of the American position in the Middle East and the assumption of a more passive, “offshore” role would lead to greater stability there. The vital interest the United States has in access to oil and the role it plays in keeping access open to other nations in Europe and Asia make it unlikely that American leaders could or would stand back and hope for the best while the powers in the region battle it out. Nor would a more “even-handed” policy toward Israel, which some see as the magic key to unlocking peace, stability, and comity in the Middle East, obviate the need to come to Israel ’s aid if its security became threatened. That commitment, paired with the American commitment to protect strategic oil supplies for most of the world, practically ensures a heavy American military presence in the region, both on the seas and on the ground. The subtraction of American power from any region would not end conflict but would simply change the equation. In the Middle East, competition for influence among powers both inside and outside the region has raged for at least two centuries. The rise of Islamic fundamentalism doesn ’t change this. It only adds a new and more threatening dimension to the competition, which neither a sudden end to the conflict between Israel and the Palestinians nor an immediate American withdrawal from Iraq would change. The alternative to American predominance in the region is not balance and peace. It is further competition. The region and the states within it remain relatively weak. A diminution of American influence would not be followed by a diminution of other external influences. One could expect deeper involvement by both China and Russia, if only to secure their interests. 18 And one could also expect the more powerful states of the region, particularly Iran, to expand and fill the vacuum. It is doubtful that any American administration would voluntarily take actions that could shift the balance of power in the Middle East further toward Russia, China, or Iran. The world hasn ’t changed that much. An American withdrawal from Iraq will not return things to “normal” or to a new kind of stability in the region. It will produce a new instability, one likely to draw the United States back in again. The alternative to American regional predominance in the Middle East and elsewhere is not a new regional stability. In an era of burgeoning nationalism, the future is likely to be one of intensified competition among nations and nationalist movements. Difficult as it may be to extend American predominance into the future, no one should imagine that a reduction of American power or a retraction of American influence and global involvement will provide an easier path.

1AC- Adaptation

Advantage III: Adaptation

Current uncertainty about climate change prevents adaptation

Gifford 11 - Robert Gifford, Professor of psychology at University of Victoria, May – June 2011, “The dragons of inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation,” American Psychologist Vol. 66, No. 4, 290–302 DOI: 10.1037/a0023566

Experimental research on resource dilemmas demonstrates that perceived or real uncertainty reduces the frequency of pro-environmental behavior (e.g., de Kwaadsteniet, 2007; Hine & Gifford, 1996). Individuals tend to interpret any sign of uncertainty, for example in the size of a resource pool or the rate at which the resource regenerates, as sufficient reason to harvest at a rate that favors self-interest rather than that of the environment. Uncertainty about climate change also quite likely func- tions as a justification for inaction or postponed action related to climate change. In the climate change context, presentations of the very carefully chosen level-of-confi- dence phrases (such as “likely” or “very likely,” p. 3) from the 2007 assessment report of the United Nations Intergov- ernmental Panel on Climate Change (IPCC) led many individuals to interpret the phrases as having a lower like- lihood than the IPCC experts intended (Budescu, Broomell, & Por, 2009). Thus, well-intended efforts by climate change scien- tists to fairly characterize the degree of certainty about climate change seem to lead to a general underestimation of climate change risk on the part of the lay audience. Yet the scientific and ethical reality is that a certain degree of uncertainty is an inescapable element of any climate model—or any model, for that matter. Thus, climate sci- entists are left with a very perplexing problem: how to present the likelihood of climate change outcomes honestly without promoting misguided optimism on the part of the lay audience, which of course helps to justify inaction on the part of the public.

CLARREO accurate data can end this uncertainty

Madigan 11 – Jay Madigan, Senior Engineer and Web Development - Science Programmer at SSAI /NASA, 03/15/2011, “Societal Benefits,” online: http://clarreo.larc.nasa.gov/about-SocietalBenefits.php

In 2007, the National Research Council (NRC) conducted a survey of Earth science and its applications from space, identifying key scientific questions and societal objectives on which to focus Earth observations beginning in 2005. The Council organized the science missions into three time-phased tiers, identifying the mission(s) most appropriate to answer key science questions and address societal objectives. In addition to the NRC’s Decadal Survey, a summary of the policy documents that support the science goals of the CLARREO mission can be found here. Selected as a high-priority, tier one mission, the Climate Absolute Radiance and Refractivity Observatory (CLARREO) is a climate mission that will bring revolutionary accuracy to climate measurement—and provide a global benchmark measurement for conclusively determining long-term climate trends. The urgency for CLARREO results from the growing need for higher accuracy, long-term climate change observations than current instruments are capable of providing. Data from CLARREO will dramatically increase how accurately we define the real climate future that society faces—and assist policy makers in formulating more informed decisions about how to respond. The timing of the CLARREO mission is a result of recent advances in a wide range of scientific, measurement, and technological areas. These advances combine to enable CLARREO to be a completely new type of climate mission: a mission focused on accuracy at decade time scales. Because CLARREO measurements will cover the majority of the solar and infrared spectrum, CLARREO will provide this accuracy for most of the climate variables essential for assessing climate change, greatly expanding the uses of existing space-based data sets for societal benefit. Previous Earth science missions have focused on providing data for one aspect of the climate system such as clouds or aerosols. CLARREO will provide a global perspective of climate change, becoming the first mission to collect data that provide a single and highly accurate view of the entire climate system. By obtaining this global view, CLARREO will be used by climate modelers and decision makers to accurately predict climate change and to develop intelligent plans and methods to minimize and adapt to it. Kevin Brown, CLARREO Project Manager who is leading the CLARREO mission states, “The integrity of CLARREO measurements and their ability to accurately portray the Earth’s climate on a global scale, allows for greater confidence in policy derived from CLARREO observations.” CLARREO differs from other satellites because its measurements are tied to internationally-recognized standards, the same type of rigorously-tested standards used by National Metrology Institutes to determine the temperature of a material or length of a second. Using these international standards, measurements from CLARREO, as well as other satellites, may be pooled into one long-term observational record that is free from small drifts in measurements due to slight differences between satellites. This allows scientists to test the satellite observations for small errors that mirror the variability of the climate itself. Testing for these errors provides for a clear interpretation of measurement trends, greatly enhancing confidence in the data’s accuracy.

And, Failure to adapt to climate change guarantees war scarcity which will escalate to water wars- improved climate technology is crucial to avoiding them

Al Jazeera, 6-29- Chris Arsenautl, June 29, 2011, “Water wars: 21st century conflicts?”, <http://english.aljazeera.net/indepth/features/2011/06/2011622193147231653.html>

As global warming alters weather patterns, and the number of people lacking access to water rises, millions, if not billions, of others are expected to face a similar fate as water shortages become more frequent. Presently, Hassain is one of about 1.2 billion people living in areas of physical water scarcity, although the majority of cases are nowhere near as dire. By 2030, 47 per cent of the world’s population will be living in areas of high water stress, according to the Organisation for Economic Co-operation and Development's Environmental Outlook to 2030 report. Some analysts worry that wars of the future will be fought over blue gold, as thirsty people, opportunistic politicians and powerful corporations battle for dwindling resources. Dangerous warnings Governments and military planners around the world are aware of the impending problem; with the US senate issuing reports with names like Avoiding Water Wars: Water Scarcity and Central Asia’s growing Importance for Stability in Afghanistan and Pakistan. With rapid population growth, and increased industrial demand, water withdrawls have tripled over the last 50 years, according to UN figures."The war was also a reason why we left," Hassain said. "There was a lot of fighting near my village." "Water scarcity is an issue exacerbated by demographic pressures, climate change and pollution," said Ignacio Saiz, director of Centre for Economic and Social Rights, a social justice group. "The world's water supplies should guarantee every member of the population to cover their personal and domestic needs." "Fundamentally, these are issues of poverty and inequality, man-made problems," he told Al Jazeera. Hassain was forced to flee his village in Somalia due to a lack of water [Photo: Save the Children] Of all the water on earth, 97 per cent is salt water and the remaining three per cent is fresh, with less than one per cent of the planet's drinkable water readily accessible for direct human uses. Scarcity is defined as each person in an area having access to less than 1,000 cubic meters of water a year. The areas where water scarcity is the biggest problem are some of the same places where political conflicts are rife, leading to potentially explosive situations. Some experts believe the only documented case of a "water war" happened about 4,500 years ago, when the city-states of Lagash and Umma went to war in the Tigris-Euphrates basin. But Adel Darwish, a journalist and co-author of Water Wars: Coming Conflicts in the Middle East, says modern history has already seen at least two water wars. "I have [former Israeli prime minister] Ariel Sharon speaking on record saying the reason for going to war [against Arab armies] in 1967 was for water," Darwish told Al Jazeera. Some analysts believe Israel continues to occupy the Golan heights, seized from Syria in 1967, due to issues of water control, while others think the occupation is about maintaining high ground in case of future conflicts. Senegal and Mauritania also fought a war starting in 1989 over grazing rights on the River Senegal. And Syria and Iraq have fought minor skirmishes over the Euphrates River. Middle East hit hard UN studies project that 30 nations will be water scarce in 2025, up from 20 in 1990. Eighteen of them are in the Middle East and North Africa, including Egypt, Israel, Somalia, Libya and Yemen. Darwish bets that a battle between south and north Yemen will probably be the scene of the next water conflict, with other countries in the region following suit if the situation is not improved. Yemen's capital Sanaa, from where president Ali Saleh left the country after he was injured during protests, could effectively run out of water by 2025, hydrology experts say. Water shortages could cost the unstable country 750,000 jobs, slashing incomes in the poorest Arab country by as much as 25 per cent over the next decade, according to a report from the consulting firm McKinsey and Company produced for the Yemeni government in 2010. Living in one of the driest countries on earth, Yemenis depend on fresh water from rapidly depleting underground aquifers and infrequent rainfall. "We expect many of the private wells to dry up soon," Yemen's then minister for water resources Abdul Rahman Fadhl Iryani, told The Los Angeles Times newspaper in 2009. "After that, we will have to find a new source, or keep drilling deeper." It is a story being repeated with various degrees of severity across the Middle East, parts of Asia and even the American south-west. Iryani recently resigned his post to protest president Saleh’s crackdown on protesters. Commentators frequently blame Yemen's problems on tribal differences, but environmental scarcity may be underpinning secessionist struggles in the country's south and some general communal violence. "My experience in the first gulf war [when Iraq invaded Kuwait] is that natural resources are always at the heart of tribal conflicts," Darwish told Al Jazeera. "The world Sharia [Islamic law] has its linguistic origins in 'water from a well'." Al Jazeera examines conflicts over water on the Nile River The Nile is another potential flash point. In 1989, former Egyptian president Hosni Mubarak threatened to send demolition squads to a dam project in Ethiopia. The current tenuous political situation in Egypt means that "if the army wants to divert attention away from criticism it would probably do something against Ethiopia," Darwish said. "The Egyptian army still has jungle warfare brigades, even though they have no jungle." On the Nile, cooperation would benefit all countries involved, as they could jointly construct dams and lower the amount of water lost to evaporation, says Anton Earle, director of the Stockholm International Water Institute think tank. "If you had an agreement between the parties, there would be more water in the system," he told Al Jazeera. The likelihood of outright war is low, he says, but there is still "a lot of conflict" which "prevents joint infrastructure projects from going ahead". Differing views Water scarcity, and potential conflicts arising from it, is linked to larger issues of population growth, increasing food prices and global warming. There are two general views about how these problems could unfold. The first dates back to the work of Thomas Malthus, an eighteenth century British clergyman and author who believed that: "The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race." In other words, more people and scant resources will invariably lead to discord and violence. Recent scholars, including Thomas Homer-Dixon, have analysed various case studies on environmental degradation to conclude that there is not a direct link between scarcity and violence. Instead, he believes inequality, social inclusion and other factors determine the nature and ferocity of strife. "Unequal power relations within states and conflicts between ethnic groups and social classes will be the greatest source of social tensions rising from deprivation," said Ignacio Saiz from the social justice group. "Water too often is treated as a commodity, as an instrument with which one population group can suppress another." Bolivia, South Africa, India, Botswana, Mexico and even parts of the US have seen vigorous water related protests, says Maude Barlow, author of 16 books and a former senior adviser to the UN on water issues. "The fight over water privatisation in Cochobamba, Bolivia did turn into a bit of a water war and the army was called in," Barlow told Al Jazeera. "In Botswana, the government smashed bore holes as part of a terrible move to remove [indigenous bushmen] from the Kalahari desert. Mexico City has been forcibly taking water from the countryside, confiscating water sources from other areas and building fotresses around it, like it's a gold mine. In India, Coke will get contracts and then build fortresses around the water sources," taking drinking and irrigation water away from local people. "In Detroit 45,000, officially, have already had their water cut off." Human rights Strife over water, like conflicts more generally, will increasingly happen within states, rather than between them, Barlow says, with large scale agribusiness, mining and energy production taking control over resources at the expense of other users. Back in the Kenyan refugee camp, on the front line of the world’s water crisis, Hassain hopes to start a new life, away from the parched fields, dead cattle and social violence ruining

communities in his native Somalia. "I have never been to school," he said. "I want to go now that I am here." Dealing with water refugees like Hassain is a global challenge, and it is expected to get worse. The IPPC, the UN panel which analyses climate science, concluded that: "Water and its availability and quality will be the main pressures on and issues for, societies and the environment under climate change." Dealing with these pressures will require improved technologies, political will and new ideas about how humans view their relationship with the substance that sustains life.

There are signs of water wars coming that will go global

Rasmussen 4/12 – Erik Rasmussen, CEO, Monday Morning; Founder, Green Growth Leaders, 4/12/11, “Preparing for the Next Conflict: Water Wars,” http://www.huffingtonpost.com/erik-rasmussen/water-wars\_b\_844101.html

For years experts have set out warnings of how the earth will be affected by the water crises, with millions dying and increasing conflicts over dwindling resources. They have proclaimed -- in line with the report from the US Senate -- that the water scarcity is a security issue, and that it will yield political stress with a risk of international water wars. This has been reflected in the oft-repeated observation that water will likely replace oil as a future cause of war between nations. Today the first glimpses of the coming water wars are emerging. Many countries in the Middle East, Africa, Central and South Asia -- e.g. Afghanistan, Pakistan, China, Kenya, Egypt, and India -- are already feeling the direct consequences of the water scarcity -- with the competition for water leading to social unrest, conflict and migration. This month the escalating concerns about the possibility of water wars triggered calls by Zafar Adeel, chair of UN-Water, for the UN to promote "hydro-diplomacy" in the Middle East and North Africa in order to avoid or at least manage emerging tensions over access to water. The gloomy outlook of our global fresh water resources points in the direction that the current conflicts and instability in these countries are only glimpses of the water wars expected to unfold in the future. Thus we need to address the water crisis that can quickly escalate and become a great humanitarian crisis and also a global safety problem.

And, Loss of biodiversity is inevitable without adaptation

Nawn et al., 11 – Jonathan Nawn; Amy Stevenson; Jeffrey Selleck; July 13, 2011, Information Crossfile, “Bracing for climate change in the U.S. National Wildlife Refugee System”, ParkScience 28(1) :16–17, http://www.nature.nps.gov/parkscience/index.cfm?ArticleID=491&ArticleTypeID=5

How should the largest system of wildlife refuges in the world preserve its biological integrity in the face of climate change? The answer: begin adapting immediately. Glibness aside, the authors of a recent management review probe this question with genuine concern and offer many effective solutions. In a thorough exploration of the National Wildlife Refuge System’s (NWRS) options, Griffith et al. (2009) suggest that the U.S. Fish and Wildlife Service, which manages 635 units in the refuge system, begin making changes on both small and large scales, organizationally and managerially. Encompassing more than 60 million hectares (150 million acres) in tundra, wetlands, tropical rain forests, coral reefs, and many other habitats, the NWRS faces the very serious threat of climate change and all the accompanying impacts: changes in precipitation, cloud cover, diurnal temperature extremes, biome boundaries, and ocean chemistry and sea-level rise. The authors note that habitat specialists—animal and plant species that do not adapt easily to change, but are tied to a certain type of habitat—are especially vulnerable. Also likely to be affected are those populations that exist at the edge of their range, species that are hampered in colonization or dispersing, and those that occupy fragmented or restricted ranges. These kinds of species commonly come under the stewardship of the U.S. Fish and Wildlife Service at refuges created to protect them individually or as groups, and climate change could marginalize some of these specialized habitats. As various species adapt to meet or accommodate new conditions, so must NWRS managers. Griffith et al. (2009) suggest they adjust priorities of their actions and account for uncertainties in future impacts of climate change. Developing a vision of conservation targets in a dynamic future, extending budgeting and planning horizons, and rewarding effective responses to climate change are all put forward. In particular, the authors call attention to the relatively small size of refuges and their inability to continue providing certain benefits under climate change for which they were designated. Therefore, they recommend “expanding the conservation footprint” of refuges either by increasing their number, size, and redundancy or by improving their “functional connectivity” and distribution through cooperative conservation measures. Managers should prioritize prospective land acquisitions and conservation partnerships based on models projecting where the most valuable habitats are likely to be located under a warmer climate. The goal of these approaches is to allow for increased resilience, biological integrity and diversity, and environmental health. In addition to climate change, challenges to refuges encompass habitat loss and fragmentation, competition for water, invasive species and species imbalances, urbanization, agricultural activities, natural disasters, transportation corridors, industrial development, and pollution. All of these factors, but especially water quality degradation and availability, disease, and nonnative species invasions, are expected to increase and become more complex under the influence of climate change. Of greatest concern for wildlife refuges are the effects of altered hydrology: precipitation and the availability of seasonal surface waters.

Loss of biodiversity causes extinction

Fowler 8 - Charles W. Fowler, National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries, January 25, 2008, “Maximizing biodiversity, information and sustainability,” Biodiversity Conservation 17:841–855 853

This study responds to world-wide concern by scientists, policy makers and the public about the variety of observed global changes, including lost biodiversity and anthropogenic extinction (e.g., Millennium Ecosystem Assessment 2005a, b). Many of these changes are seen as degradation that leads to risk, not only for other species, ecosystems, and the biosphere, but also for humans (including the risk of human extinction; Boulter 2002). Such observations justify taking management action to account for ecosystems, the biosphere and the Earth. Management at the level of the biosphere cannot be ignored (Lubchenco et al. 1991; Mangel et al. 1996; Fowler and Hobbs 2002, 2003; Fowler 2003); the inherent complexity of nature cannot be ignored.

And, Climate change could cause up to 1 billion refugees

Tacoli 10 - Cecilia Tacoli, Acting Head, Human Settlements Group, Team Leader, Rural-urban @ international institute for environment and development, December 2010, “Moving to adapt to climate change,” reflect and act, IIED

By 2050, climate change is expected to push hundreds of millions of people — up to 1 billion, by some estimates — to leave their homes seeking better land, jobs and other resources. The figures are intimidating — but they don’t offer the specifics needed to prepare for the transformation. Uncertainties about local impacts of climate change, as well as thin data on migration today, make it difficult or impossible to precisely predict future mobility patterns. But we can better understand how environmental change in fragile areas affects people’s livelihoods and influences migration — and how governments and civil society can take these links into account. In 2009, IIED, in partnership with three local NGOs — Mainumby, IED Afrique and Tamasha — began case studies looking at these questions in Bolivia, Senegal and Tanzania.

Displacement causes conflict which will escalate

Jacques 10 – Bahati Ntama Jacques, Policy Analyst @ Africa Faith and Social Justice Network, February 9, 2010, “Climate Change: What About the Displaced?” Around Africa, http://afjn.org/focus-campaigns/other/other-continental-issues/82-general/792-climate-change-what-about-the-displaced.html

Climate change-related disasters not only affect ecosystems, but cause people to relocate either by choice or by force. Some will be displaced within the boundaries of their affected countries (Internal Displacement or ID) and others will cross state borders. Some will be displaced because of sudden-onset hydro-meteorological disasters, such as flooding, hurricanes, landslides, etc. Others will be affected by slow-onset disasters, like desertification, rising sea levels and droughts. Sea level rise will, in some cases, lead to permanent loss of small state islands, Maldives being an example, which means permanent displacement of the inhabitants of the island. In high-risk zones authorities have to choose between the cost of rebuilding every time a disaster hits or of just displacing the people permanently. Furthermore, as a result of displacement, disputes over resources such as water and land will cause violence. It is more than likely that some of the violence will end up in armed conflict.

Stress caused by migration could trigger nuke war

Campbell et al. 7 - Kurt M. Campbell is CEO and co-founder of the Center for a New American Security and former deputy assistant secretary of defense for Asia and the Pacific. Leon Fuerth is a research professor of international affairs at The George Washington University, and former national security advisor to Vice President Al Gore. Jay Gulledge, Ph.D., is the senior scientist and program manager for science and impacts at the Pew Center on Global Climate Change. Alexander T. J. Lennon is the editor-in-chief of CSIS’s flagship journal, The Washington Quarterly. J.R. McNeill is a professor of history at Georgetown University. Derek Mix is a research associate in the CSIS Europe Program. Peter Ogden is senior national security analyst at the Center for American Progress. John Podesta is president and CEO of the Center for American Progress and former chief of staff for President Bill Clinton. Julianne Smith is the director of the CSIS Europe Program and the Initiative for a Renewed Transatlantic Partnership. Richard Weitz is a senior fellow and director of program management at Hudson Institute. R. James Woolsey is a vice president for Booz Allen Hamilton and former director of the CIA. NOVEMBER 2007, “The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change,” center for new American security

In the case of severe climate change, projected massive nonlinear events in the global environ- ment give rise to massive nonlinear societal events. In this scenario, nations around the world will be overwhelmed by the scale of change and perni- cious challenges, such as pandemic disease and water and food shortages. The internal cohesion of nations will be under great stress, including in the United States, due to a dramatic rise in migration, changes in agricultural patterns and water avail- ability, and wealthier members of society pulling away from the rest of the population. Protests, civil unrest, and violent upheaval of governments are possible. The flooding of coastal communities around the world, especially in the Netherlands, the United States, South Asia, and China, has the potential to challenge regional and even national identities. Armed conflict between nations over resources and even territory, such as the Nile and its tributaries, is likely, and nuclear war is possible. Globalization could halt and alliances collapse. The catastrophic scenario finds strong and sur- prising intersections between the two great security threats of the day — global climate change and international terrorism waged by Islamist extremists. The catastrophic scenario means the destruction of hope itself, as human society struggles to adapt. Both migration and religious fervor are likely to spike. The scenario notes that understanding the threat in light of the other great threat of our age, terrorism, can be illuminating. Although distinct in nature, both threats are linked to energy use in the industrialized world, and, indeed, the solutions to both depend on trans- forming the world’s energy economy — America’s energy economy in particular. Indeed, aviation fuel and non-nuclear fuel for destroyers could become unobtainable just as logistical issues and the demand for military use are strained.

And, Satellites have the capability to predict where disease epidemics could develop

Kalluri et al 7-Satya Kalluri, PhD in Geography and assistant research scientist at the Department of Geography at the University of Maryland; Peter Gilruth, PhD in Forestry and Forest Product Techniques and has over 20 years of experience as an environmental scientist and project manager and strategist with the US Government and the UN Development Programme (UNDP) and currently in the private sector where he collaborates closely with the US space agency NASA; David Rogers, PhD in Geological and Geotechnical Engineering and Professor at Missouri University of Science and Technology; Martha Szczur, writer of several books on pathogens and health geographics, 2007, “Surveillance of Arthropod Vector-Borne Infectious Diseases Using Remote Sensing Techniques: A Review,” pdf available online: [http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.0030116](http://www.plospathogens.org/article/info%3Adoi/10.1371/journal.ppat.0030116)

Epidemiologists are adopting new remote sensing techniques to study a variety of vector-borne diseases. Associations between satellite-derived environmental variables such as temperature, humidity, and land cover type and vector density are used to identify and characterize vector habitats. The convergence of factors such as the availability of multi-temporal satellite data and georeferenced epidemiological data, collaboration between remote sensing scientists and biologists, and the availability of sophisticated, statistical geographic information system and image processing algorithms in a desktop environment creates a fertile research environment. The use of remote sensing techniques to map vector-borne diseases has evolved significantly over the past 25 years. In this paper, we review the status of remote sensing studies of arthropod vector- borne diseases due to mosquitoes, ticks, blackflies, tsetse flies, and sandflies, which are responsible for the majority of vector-borne diseases in the world. Examples of simple image classification techniques that associate land use and land cover types with vector habitats, as well as complex statistical models that link satellite-derived multi-temporal meteorological observations with vector biology and abundance, are discussed here. Future improvements in remote sensing applications in epidemiology are also discussed. Hematophagous arthropod vectors such as mosquitoes, ticks, and flies are responsible for transmitting bacteria, viruses, and protozoa between vertebrate hosts, causing such deadly diseases as malaria, dengue fever, and trypanosomiasis. Until the early 20th century, vector-borne diseases were responsible for more deaths in humans than all other causes combined. These diseases prevented the development of large areas of the tropics, especially in Africa [1]. Table 1 provides a list of common arthropod vectors, the diseases they carry, and the type of pathogen responsible for the disease. Floods and other natural disasters create environments conducive to the spread of communicable diseases such as malaria, diarrhea, and cholera. Some studies suggest that climate change and increased climate variability are fostering the spread of infectious diseases beyond their traditional geographic domains [2]. For example, West Nile virus, which was previously confined to Africa, Asia, and Europe (i.e., the Old World), has recently spread to North America. The mosquito Aedes albopictus, a vector of both dengue fever and West Nile virus and a native to Asia, has recently established in North America [3]. The ‘‘burden’’ of prominent infectious diseases worldwide transmitted by arthropod vectors is given in Table 2 [4]. Disease burden is expressed in Disability Adjusted Life Years (DALYs), which is the sum of years lost prematurely due to mortality and disability for incidence cases of the disease [5]. One DALY represents the loss of a year of healthy life. Passive disease surveillance involves voluntary reporting by people who are ill enough to go to a treatment center; such centers are therefore only effective for detection and mitigation after a person has been infected. On the other hand, active disease surveillance, which involves ‘‘searching’’ for evidence of disease proactively through routine and continuous monitoring in endemic areas, could help prevent an outbreak, or slow transmission at an earlier stage of an epidemic. Improved methods are required for forecasting, early detection, and prevention of vector-borne diseases due to the increasing trend of large-scale epidemics such as malaria [6]. Of late, satellite remote sensing technology has shown promising results in assessing the risk of various vector-borne diseases at different spatial scales. Satellite measurements and other remote sensing techniques cannot identify the vectors themselves, but may be used to characterize the environment in which the vectors thrive. Environmental variables such as land and sea surface temperature and amount, type, and health of vegetation can be identified and measured from space. A list of environmental factors that can be mapped through remote sensing and their potential linkages with various diseases has been previously described [7]. Satellites have the ability to detect anomalies and deviations from the normal climate patterns that are conducive to the breeding of disease- carrying vectors such as mosquitoes. Techniques to map disease occurrence and risk from satellite data therefore require at least some understanding of the relationships between a vector-borne disease and the air, land, and water environment in which it occurs. The objectives of this review are to summarize developments in the application of remote sensing techniques for studying infectious diseases in humans due to arthropod vectors and to identify future opportunities for further research.

Unanticipated epidemics would cause extinction

Powell 2k – Corey S. Powell, Senior Editor, Discover Magazine; Adjunct Professor, Science Journalism, NYU; Author: God in the Equation: How Einstein Transformed Religion, October 1, 2000, “20 Ways the World Could End,” Discover Magazine, http://discovermagazine.com/2000/oct/featworld

Global epidemics If Earth doesn't do us in, our fellow organisms might be up to the task. Germs and people have always coexisted, but occasionally the balance gets out of whack. The Black Plague killed one European in four during the 14th century; influenza took at least 20 million lives between 1918 and 1919; the AIDS epidemic has produced a similar death toll and is still going strong. From 1980 to 1992, reports the Centers for Disease Control and Prevention, mortality from infectious disease in the United States rose 58 percent. Old diseases such as cholera and measles have developed new resistance to antibiotics. Intensive agriculture and land development is bringing humans closer to animal pathogens. International travel means diseases can spread faster than ever. Michael Osterholm, an infectious disease expert who recently left the Minnesota Department of Health, described the situation as "like trying to swim against the current of a raging river." The grimmest possibility would be the emergence of a strain that spreads so fast we are caught off guard or that resists all chemical means of control, perhaps as a result of our stirring of the ecological pot. About 12,000 years ago, a sudden wave of mammal extinctions swept through the Americas. Ross MacPhee of the American Museum of Natural History argues the culprit was extremely virulent disease, which humans helped transport as they migrated into the New World.

Theory of diffusion means environmental policies will spillover internationally even without international agreements

Busch and Jorgens 5 - Per-Olof Busch, Environmental Policy Research Centre, Free University Berlin, Department of Political Science, Helge Jörgens, Research Fellow, German Advisory Council on the Environment, 2005, “International Patterns of Environmental Policy Change and Convergence,” European Environment Eur. Env. 15, 80–101, DOI: 10.1002/eet.374

While harmonization and imposition were evidently involved in the international and global spread of environmental policy innovations, the analysis of individual proliferation courses has revealed that policy innovations even spread in the absence of these mechanisms. This spread cannot be attributed to inde- pendent national reactions to parallel problem pressures although the latter undoubtedly still plays an important role for the adoption of policies. Rather, these observations point to diffusion, which com- plements harmonization and imposition as an international political driving force for national policy changes and cross-national policy convergence (Busch and Jörgens, in press; Jörgens, 2004; see for similar observations Jänicke and Weidner, 1997; Weidner and Jänicke, 2002; see also Tews in this issue). The essential feature of diffusion as a distinctive mechanism is its voluntary character. It occurs in the absence of formal or contractual obligations and rests on international communication processes. Compared with harmonization and imposition, diffusion processes leave it at the discretion of national decision-makers to accept or refuse the policy choices of another country. Decision-making procedures are decentralized and remain at the national level. National decisions to implement a policy innovation similar to ones already implemented elsewhere are often only loosely coupled – policies of one country can be influential in shaping the policies of another without the country of origin even noticing it (Busch and Jörgens, 2004; Jörgens, 2004). Two basic types of diffusion can be distinguished. On the one hand, direct policy transfer or hori- zontal diffusion describes processes where nations learn from or imitate policies implemented else- where through bilateral communication and direct interaction or exchange of experiences (Tews, 2002a, this issue; Kern, 2000). Indications for this type of diffusion could be found during the spread of 13 environmental policy innovations: environmental agencies, environmental framework laws, laws on access to environmental information, impact assessments, national environmental plans (NEPs), sus- tainability strategies, air protection laws, eco-labels, energy efficiency labels and standards as well as energy carbon taxes, feed-in tariffs and quotas for renewables (for more detail see Busch and Jörgens, in press). In some of the cases (feed-in tariffs and quotas for renewables as well as energy efficiency standards), national governments prepared individual transfers by commissioning studies that system- atically compared experiences, successes and failures in the implementation of such instruments abroad (Busch, 2003). Apart from individual cases of policy transfer, during the proliferation of seven environmental policy innovations role models evolved that were emulated or served as basic blueprints across several coun- tries.The US environmental framework law (the National Environmental Protection Act) and the Amer- ican regulations on environmental impact assessment as well as the US energy efficiency standard were widely acknowledged as policy models and were emulated across a number of mainly industrialized countries (Busch, 2003; CEQ, 1997; Hoberg, 1991). The Dutch National Environmental Policy Plan (NEPP) similarly received much attention outside the Netherlands and rapidly turned into a widely rec- ognized model for the national implementation of sustainable development, which was copied by several industrialized countries (Jörgens, 2004; Liefferink, 1999). The German laws on feed-in tariffs for renew- ables as well as the German eco-label ‘Blauer Engel’ evolved into widely recognized and imitated exem- plary regulations, which served as blueprints for the implementation of feed-in-tariffs and eco-labels in many European countries and beyond (Busch, 2003; Kern et al., 2001; Landmann, 1998). The Thai energy efficiency label quickly gained acceptance as a role model across the Asian-Pacific region (Della Cava et al., 2000). The energy/carbon taxes in Scandinavian countries largely resemble each other and the adoptions took place almost simultaneously (Tews, 2002b). In three cases another sub-type of direct transfer could be observed. The Dutch NEPP ‘diffused’ vertically from the national to the European level when the European Commission directly modelled its Fifth Environmental Action Program on the Dutch example (Jörgens, 2004). The Danish energy efficiency label and the Dutch energy efficiency standard similarly ‘diffused’ from the national to the international level and influenced the content of the European directives harmonizing national labels and standards (Duffy, 1996; Bertoldi, 1999; Harrington and Damnics, 2001). Similar processes took place in the case of packaging regulations, where different national models competed for the transfer to the European level, and for eco-labels, where the EU directive largely drew on the German model (for more details see Busch and Jörgens, in press). On the other hand, internationally institutionalized policy diffusion (Tews, 2002a; Kern, 2000) com- prises political processes at the global or international level and the actions of international organiza- tions or of specific international expert and policy networks. These international actors contribute to a more or less centralized international communication of environmental policy innovations. In doing so, they can directly or indirectly affect national decisions to introduce a certain policy innovation or increase the likelihood that national decision-makers emulate the policies of other countries. In the cases of envi- ronmental ministries and agencies, sustainability commissions, framework laws, laws on access to infor- mation, environmental impact assessment, national environmental strategies, eco-labels, energy efficiency labels and standards, quotas and energy/carbon taxes as well as air, nature and water protec- tion and waste laws, international processes and actors actively promoted or openly favoured these policy innovations. Indicators for an international institutionalization of the policy transfer are the formula- tion of non-binding policy recommendations, the inclusion of particular problems on international agendas, the promotion of particular models through international actors and the creation of specific ‘innovation related’ expert networks.

1AC- Solvency

CLARREO solves climate monitoring—

1) Accuracy—

NASA (No Date)- CLARREO- Social Benefits http://clarreo.larc.nasa.gov/about-SocietalBenefits.php

In 2007, the National Research Council (NRC) conducted a survey of Earth science and its applications from space, identifying key scientific questions and societal objectives on which to focus Earth observations beginning in 2005. The Council organized the science missions into three time-phased tiers, identifying the mission(s) most appropriate to answer key science questions and address societal objectives. In addition to the NRC’s Decadal Survey, a summary of the policy documents that support the science goals of the CLARREO mission can be found here. Get Adobe Acrobat PDF Reader image Selected as a high-priority, tier one mission, the Climate Absolute Radiance and Refractivity Observatory (CLARREO) is a climate mission that will bring revolutionary accuracy to climate measurement—and provide a global benchmark measurement for conclusively determining long-term climate trends. The urgency for CLARREO results from the growing need for higher accuracy, long-term climate change observations than current instruments are capable of providing. Data from CLARREO will dramatically increase how accurately we define the real climate future that society faces—and assist policy makers in formulating more informed decisions about how to respond. The timing of the CLARREO mission is a result of recent advances in a wide range of scientific, measurement, and technological areas. These advances combine to enable CLARREO to be a completely new type of climate mission: a mission focused on accuracy at decade time scales. Because CLARREO measurements will cover the majority of the solar and infrared spectrum, CLARREO will provide this accuracy for most of the climate variables essential for assessing climate change, greatly expanding the uses of existing space-based data sets for societal benefit. Previous Earth science missions have focused on providing data for one aspect of the climate system such as clouds or aerosols. CLARREO will provide a global perspective of climate change, becoming the first mission to collect data that provide a single and highly accurate view of the entire climate system. By obtaining this global view, CLARREO will be used by climate modelers and decision makers to accurately predict climate change and to develop intelligent plans and methods to minimize and adapt to it. Kevin Brown, CLARREO Project Manager who is leading the CLARREO mission states, “The integrity of CLARREO measurements and their ability to accurately portray the Earth’s climate on a global scale, allows for greater confidence in policy derived from CLARREO observations.” CLARREO differs from other satellites because its measurements are tied to internationally-recognized standards, the same type of rigorously-tested standards used by National Metrology Institutes to determine the temperature of a material or length of a second. Using these international standards, measurements from CLARREO, as well as other satellites, may be pooled into one long-term observational record that is free from small drifts in measurements due to slight differences between satellites. This allows scientists to test the satellite observations for small errors that mirror the variability of the climate itself. Testing for these errors provides for a clear interpretation of measurement trends, greatly enhancing confidence in the data’s accuracy. According to CLARREO Project Scientist Dave Young “By accurately capturing the trends early, we will know if the Earth will warm by two degrees or eight. Those would be two very different futures that require two very different societal changes.”

2) Current models—CLARREO solves climate gaps- tests accuracy in global observation systems

Anderson 7- Jim Anderson, Philip S. Weld Professor in the School of Engineering and Applied Sciences, Harvard University, Decadal Survey: CLARREO Workshop <http://www.docstoc.com/docs/30803707/DRAFT-Decadal-Survey-%28DS%29-CLARREO-Workshop-Report-Edited->

CLARREO is a Highly Leveraged Interdisciplinary Climate Change Mission • Accurate decadal-length records are essential for climate change detection, attribution, and for testing climate prediction accuracy. They represent the most critical test of uncertainty in future climate change prediction. • While process study missions (e.g. CALIPSO/CloudSat) are critical to improve underlying climate model physics (e.g. clouds), decadal change observations are critical to determine the impact of those climate model improvements on the accuracy of predicting future climate change. Both elements are critical, and CLARREO is the major Decadal Study mission addressing serious accuracy issues in decadal climate change observation. • The CLARREO mission is unique in its broad interdisciplinary impact on climate change science: the other NRC Decadal Survey missions are primarily focused on one climate process or discipline. • CLARREO provides new solar reflected and infrared emitted high spectral resolution benchmark radiance climate data records that can be used to test climate model predictions, improve climate change fingerprinting, and attribution. • CLARREO provides an orbiting calibration observatory that can be used to calibrate other solar and infrared space-borne sensors (e.g. VIIRS, CrIS, Landsat, Geostationary, CERES) and thereby improve to climate accuracy a wide range of sensors across the GEO observing system. It also improves the scientific value of all of these instruments. • Key climate variable decadal records impacted by CLARREO include: atmospheric temperature and water vapor profiles, land and sea surface temperatures, cloud properties, radiation budget including Earths albedo, vegetation, surface snow and ice properties, ocean color, and aerosols. The data is also relevant to greenhouse gas monitoring. • The absolute accuracy of CLARREO, when used to calibrate other sensors in orbit can dramatically reduce the impact of data gaps on decadal change data records across many climate variables. • CLARREO provides the first spectrally resolved climate observation of the Far-Infrared spectrum from 15 to 50

micron wavelengths, where half of the thermal infrared emission of the earth to space occurs, and the source of almost all of the Earth's water vapor greenhouse effect. • CLARREO's ability to calibrate other instruments across the full solar and infrared spectrum can change the future prioritization of different elements of instrument pre-launch characterization (e.g. spectral response), stability, and calibration, thereby resulting in increased programmatic flexibility and savings.

3) International standards— CLARREO is superior to current satellites for climate records- SI traceability allows a global climate record

Anderson 7- Jim Anderson, Philip S. Weld Professor in the School of Engineering and Applied Sciences, Harvard University, Decadal Survey: CLARREO Workshop http://www.docstoc.com/docs/30803707/DRAFT-Decadal-Survey-%28DS%29-CLARREO-Workshop-Report-Edited-by

The ability of this CLARREO mission to calibrate passive sensors on-orbit via SI traceability and to address sampling issues without subsidiary information is a notable departure from the current strategy pursued for climate satellite records. The necessity for this departure was recognized by the NRC as follows: NRC Objective: Global Benchmark Climate Record Benchmark Observations: What are they? The NRC Decadal Survey recognized that when the global climate record emerges as a significant contributor to public policy (societal) decisions, that record will be attacked relentlessly. If the climate record cannot stand up to those attacks, the record cannot effectively serve society. Recognition of this led to the requirement that the design of climate observing and monitoring systems from space must ensure the establishment of global, long-term climate records, which are of high accuracy, tested for systematic errors on-orbit, and tied to irrefutable standards such as those maintained in the U.S. by the National Institute of Standards and Technology For the NRC report, this mission definition was essential for the prioritization process that fully considered scientific/societal impact, cost, ability to complement other systems, degree of readiness, risk mitigation, and contributions to other thematic areas. The ASIC3 report also chose a CLARREO-like mission as one of its high priority recommendations based on similar requirements. Once the context of responsiveness to societal objectives is understood, the path leading all the way to details of instrument design may be defined. A summary of requirements flowdown from high level science requirements to data products to mission and payload requirements for the IR and GPS components is included below.

And, CLARREO key- broad interdisciplinary impact on climate change science make it unique from other missions

Best et al., 9 – Fred Best, Executive Director for Technology at the University of Wisconsin-Madison Space Science and Engineering Center; Robert Knuteson; Mark Hobson; Winter 2009, “CLARREO: NASA’s New Climate Related Spaceflight Mission”, http://www.ssec.wisc.edu/media/newsletter/winter09/clarreo.pdf

Given the rapid increase of carbon dioxide pumped into the atmosphere by fossil fuel burning, new measurement systems are urgently needed to quantify the impact on the Earth’s climate. To deal with climate change wisely, society needs the best possible understanding of what changes are occurring and accurate predictions of what changes will ensue, depending on the actions we do, or do not, take. A new spaceborne observatory, the CLimate Absolute Radiance and REfractivity Observatory (CLARREO), is being planned to respond to this need. CLARREO was recommended by the 2007 Decadal Survey of the US National Research Council and is being pursued by NASA, with the Langley Research Center as the implementing center (http://clarreo.larc.nasa.gov/). CLARREO is one of NASA’s four highest priority “Tier 1” missions. As a key climate-observing system, CLARREO will initiate an unprecedented, highly accurate record of climate change that is tested, trusted and necessary to provide sound policy decisions. It will provide a record of direct observables with the exacting information content necessary to detect long-term climate change trends and to test and systematically improve climate predictions. CLARREO will observe the spectrally resolved radiance and atmospheric refractivity with the accuracy provided by international standards (SI) and sampling required to assess and predict the impact of changes in climate-forcing variables on the climate. The CLARREO mission is based on new paradigms for making climate benchmark observations. First, radiation measurements for a climate benchmark should be chosen to maximize the information content about atmospheric and surface properties. Previous efforts, particularly climate benchmark missions first designed by Professor Verner E. Suomi at the beginning of the space age (launched in 1959), focused on monitoring the total radiative energy budget. CLARREO will use spectrally resolved radiances to gain sensitivity, because the spectrally integrated total energy budget can miss significant changes that cancel each other out. Observing regional averages and distributions of nadir-viewing spectra will reveal signatures of changes in climate forcing and response related to changes in temperature and water vapor structure, atmospheric stability, cloudiness or aerosols, surface properties, and trace gases. The far infrared region of the spectrum will provide sensitivity to thick ice clouds and upper-level water vapor. Second, to reduce the time to unequivocally resolve climate trends, a new standard in accuracy is needed. The new paradigm is to use SI calibration standards flown on the same spacecraft for on-orbit confirmation of the ultra-high accuracy achieved by careful design and testing on the ground. For infrared radiance spectra, a brightness temperature accuracy of 0.1 K confirmed on orbit is practical (with a 99% confidence that the limit is not exceeded). For refractivity measured using transmissions from the Global Positioning System, the accuracy depends on time measurements that can be made extremely accurately. The accuracy corresponds to an accuracy for upper level temperature that is also better than 0.1 K. Techniques to realize corresponding accuracy for reflected solar radiance spectra are being developed. Establishing highly accurate SI traceable measurements in space alleviates the need to overlap subsequent generations of satellites to establish a climate record. Third, CLARREO needs to achieve spatial and temporal sampling that will maintain this high measurement accuracy in climatically significant regional and seasonal spectral products. Sampling biases have equal importance to measurement errors. A new sampling approach being explored for CLARREO would use three, equally-spaced, truly polar orbits (90º inclination) that do not precess in inertial space. These orbits will cover all latitudes and longitudes, and give equal sampling for all times of day every two months. Recent simulations show that these orbits will also allow CLARREO to be used for highly accurate cross-calibration of operational and research instruments flying in sun-synchronous orbits. SSEC is currently under NASA funding to perform optimal sampling and IR Sounder cross-calibration trade studies that will help define CLARREO science requirements and measurement capabilities. Additionally, we are expecting to start systems engineering studies that will help define the CLARREO IR instrument requirements and a candidate payload concept that will allow estimates to be made of overall mission power, mass, size and cost. The current concept for making the CLARREO infrared spectrally resolved radiance measurements is to use two interferometers: one much like the SSEC-developed Scanning-HIS for the shortwave to midwave (3.3 to 13 microns); and another similar interferometer for the longwave (out to 50 microns). In yet another connection to CLARREO, SSEC is teamed with Harvard University under funding from the NASA Instrument Incubator Program to develop key technologies that will provide on-orbit absolute instrument calibration – a fundamental requirement of the CLARREO mission. At SSEC this work will concentrate on using phase change materials to provide absolute calibration of the instrument blackbody temperature sensors, and on advancing our concept for making highly accurate measurements of blackbody emissivity. We will also be building a prototype interferometer system to demonstrate the performance required by CLARREO. The interferometer will be integrated with state-of-the-art detectors cooled by a pulse tube microcooler. Each element of the prototype system will have strong spaceflight heritage, so that taking the next step to the CLARREO flight system will involve minimal risk. CLARREO’s use of spectrally resolved radiances for more sensitivity, new standards for accuracy, and a three-satellite sampling approach can dramatically reduce the impact of data gaps on decadal change data records across many climate variables. Its ability to calibrate other instruments across the full solar and infrared spectrum can result in increased programmatic flexibility and savings. While other missions may be focused primarily on one climate process or discipline, the CLARREO mission is unique in its broad interdisciplinary impact on climate change science. We have an essential responsibility to current and future generations to develop an operational climate forecast that is tested and trusted. Through a disciplined strategy using state-of-the-art observations with mathematically rigorous techniques, this forecast can be realized. CLARREO will establish a climate benchmark record that is global in its extent, accurate in perpetuity, tested against independent strategies that reveal systematic errors, and pinned to international standards on-orbit.

\*\*2AC Add-Ons\*\*

NASA Leadership Add-On

CLARREO key to NASA credibility—solves political backlash

Dinnerman 9--Taylor, writer for publications such as Ad Astra, The Wall Street Journal, and the American Spectator, former contributor to the Space Review and current writer for the Hudson Institute New York, part-time consultant for the US Defense Department, "NASA, politics, science, and skepticism", The Space Review, September 14, <http://www.thespacereview.com/article/1462/1>

For the moment NASA’s Science Mission Directorate has maintained a pretty good reputation for honest research done openly and reviewed carefully. It’s easy to do this when the stakes involve nothing but pushing back the frontiers of ignorance and expanding the sum total of human knowledge. When politics gets involved things change and the stakes get higher—sometimes very high indeed. In the case of the dispute over anthropomorphic global warming (AGW) the stakes could not be higher. The proponents of the theory believe that the Earth faces a catastrophe on a gigantic scale if nothing is done to reduce carbon dioxide emissions, while skeptics disagree. In the balance are trillions of dollars and a large shift in global political power away from elected leaders and towards the “experts”. NASA’s position as a source of information that both sides can trust is immensely important, both **to the scientific and political credibility** of the agency and to its long-term viability. If NASA is seen as being an organization committed to one side in the debate it automatically becomes the mortal enemy of the other side. Given the difficulties the agency already faces, it does not need to create new foes. For the agency the way it manages the Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission is **critical to its legitimacy.** This mission hopes to, in its words, “**produce irrefutable climate records that will be used to support national and international policy.**” The two satellites will each carry three instruments, one to study planetary infrared emissions, another to measure reflected radiation, and a GPS occultation antenna.

NASA key to Soft power

Dinnerman 9--Taylor, writer for publications such as Ad Astra, The Wall Street Journal, and the American Spectator, former contributor to the Space Review and current writer for the Hudson Institute New York, part-time consultant for the US Defense Department, " NASA and soft power, again", The Space Review, June 15, http://www.thespacereview.com/article/1396/1

As we embark on yet another NASA budgetary roller coaster ride, courtesy of our political masters in Washington, it may be time to step back and examine why NASA is such an important part of America’s image at home and abroad. It is not simply the memories of what the space agency accomplished 40 years ago, and the still-haunting black and white film of John F. Kennedy telling us that “We choose to go to the Moon.” It is more than that. The human spaceflight program is a symbol of the idea that America represents a technologically advanced and optimistic future. It’s easy to belittle this as just PR fluff. What is often misunderstood is the source of soft power. It is more than just prestige—though that is a part of it—but it flows naturally from real achievements. It is built on a foundation of hard power, the ability of a nation to set ambitious goals and then to realize them

Soft power solves laundry list of impacts

Rieffel 5 - Lex Rieffel, Former U.S. Treasury official and a graduate professor at George Washington University, 2005, “Reaching Out: Americans Serving Overseas”, <http://www.brookings.edu/views/papers/20051207rieffel.pdf>

Accordingly, one of the great challenges for the USA today is to build a broad coalition of like-minded nations and a set of international institutions capable of maintaining order and addressing global problems such as nuclear proliferation, epidemics like HIV/AIDS and avian flu, failed states like Somalia and Myanmar, and environmental degradation. The costs of acting alone or in small coalitions are now more clearly seen to be unsustainable. The limitations of “hard” instruments of foreign policy have been amply demonstrated in Iraq. Military power can dislodge a tyrant with great efficiency but cannot build stable and prosperous nations. Appropriately, the appointment of Karen Hughes as Under Secretary of State for Public Diplomacy and Public Affairs suggests that the Bush Administration is gearing up to rely more on “soft” instruments.2

Soft power boosts U.S. hegemony

Nye 5- Joseph S. Nye, Professor of International Relations at Harvard. “Soft Power and American Foreign Policy,” Summer 2004, Political Science Quarterly, Volume 119, Issue 2; page 255, proquest

In the global information age, the attractiveness of the United States will be crucial to our ability to achieve the outcomes we want. Rather than having to put together pick-up coalitions of the willing for each new game, we will benefit if we are able to attract others into institutional alliances and eschew weakening those we have already created. NATO, for example, not only aggregates the capabilities of advanced nations, but its interminable committees, procedures, and exercises also allow these nations to train together and quickly become interoperable when a crisis occurs. As for alliances, if the United States is an attractive source of security and reassurance, other countries will set their expectations in directions that are conducive to our interests. Initially, for ex ample, the U.S.-Japan security treaty was not very popular in Japan, but polls show that over the decades, it became more attractive to the Japanese public. Once that happened, Japanese politicians began to build it into their approaches to foreign policy. The United States benefits when it is regarded as a constant and trusted source of attraction so that other countries are not obliged continually to re-examine their options in an atmosphere of uncertain coalitions. In the Japan case, broad acceptance of the United States by the Japanese public "contributed to the maintenance of US hegemony" and "served as political constraints compelling the ruling elites to continue cooperation with the United States."18 Popularity can contribute to stability. Finally, as the RAND Corporation's John Arquila and David Ronfeldtargue, power in an information age will come not only from strong defenses but also from strong sharing. A traditional realpolitik mind-set makes it difficult to share with others. But in an information age, such sharing not only enhances the ability of others to cooperate with us but also increases their inclination to do so.19 As we share intelligence and capabilities with others, we develop common outlooks and approaches that improve our ability to deal with the new challenges. Power flows from that attraction. Dismissing the importance of at traction as merely ephemeral popularity ignores key insights from new theories of leadership as well as the new realities of the information age. We cannot afford that.

Economy Add-On

Satellite funding cuts are creating gaps in climate data- inhibits weather monitoring and predications

PopSci 05.23.2011- Popular Science News, As Congress Fusses Over Climate Semantics, the U.S. Faces a Weather Satellite Gap Feature Weather monitoring is vital, but don't mention the C-word http://www.popsci.com/technology/article/2011-05/satellite-funding-cuts-us-could-face-weather-satellite-gap

This year has seen some phenomenally bizarre weather, from deadly tornadoes ripping through the Midwest and South to historic snowmelt-related flooding on the Mississippi River. Most hurricane forecasters are saying it’s about to get worse — the National Oceanic and Atmospheric Administration projected Thursday that the Atlantic basin is likely to see 12 to 18 named storms this season. Amid all this, the country’s future weather prediction capabilities could be stymied by a battle in Washington. During the budget battle earlier this spring, Congress cut funding for a new polar-orbiting satellite, which is designed to monitor atmospheric temperatures and pressure, severe weather, fires and other manmade and natural disasters, and to provide continuous climate data. If it does not get built, the country faces a satellite gap, which could affect forecasters’ ability to predict the weather. The key word here is climate. “Weather is apolitical, but climate is unfortunately not,” Bill Sullivan, a director at Raytheon Intelligence and Information Systems and program manager for the new satellite, said in an interview. NOAA Administrator Jane Lubchenco said at a news conference Thursday that the agency’s satellite program is in limbo. This is at least the fourth time in the past few years that a climate-monitoring project has fallen victim to either terrible luck or bad politics. First the Orbiting Carbon Observatory failed to reach orbit, then NASA’s aerosol-monituring Glory mission also died during launch. Last month we told you about the Deep Space Climate Observatory, languishing in a box in Maryland. Now a satellite called JPSS is in danger of losing its funding. Here’s a bit of history: Until last year, NASA, NOAA and the Department of Defense were going to share a brand-new polar-orbiting satellite called the National Polar Orbiting Operational Environmental Satellite System (NPOESS). But after a few years of planning and design work, the government decided the military and civilian agencies didn’t play well together and divorced the project, giving the DOD its own satellite. The existing civilian project, called NPP for NPOESS Preparatory Project, will serve NASA and NOAA only, and is planned for launch in October. It just completed a thermal test. It is supposed to have a companion successor called the Joint Polar Satellite System, and NOAA requested $1.06 billion in this year’s budget to build it. Then the federal budget stalemate happened, and everything was funded at 2010 levels as Congress and the White House wrangled. “The message that was getting to Congress was that NOAA needed a billion dollars to do climate research,” said Sullivan, who is Raytheon’s program manager for the JPSS. As a result, the funding was not approved. Since the funding cuts, NOAA — and contractors like Raytheon — have started marketing the satellite's weather forecasting abilities, not just its utility in informing climate models. Polar-orbiting satellites can provide global weather coverage, which is useful when trying to make future weather predictions. Geostationary satellites, like the ones that provide the satellite radar imagery on your local news, only look at a specific section of the planet. The National Weather Service needs both sets of data to complete accurate forecasting. NPP is a new polar-orbiting satellite that will replace NOAA’s previous orbiters, Sullivan said. It will circle the Earth 512 miles above the surface, completing about 14 orbits every day. “We’re going to see just a huge increase in the amount of data that can be collected ... NPP provides an enormous amount of capability that is currently not on orbit,” Sullivan said. NPP will have a life span of about five years, at which point JPSS should be ready to replace it. Sullivan said NOAA needs funding this year for construction so the JPSS project doesn’t fall behind schedule. NOAA is hoping the project will get funding this year, but it looks doubtful, Sullivan said. Meanwhile, the agency is preparing for a budget battle next year, he said. "If the program doesn't get funded at the appropriate level in 2012, it will fall behind, which is bad for all of us," he said. “Not having satellites and not applying their latest capabilities could spell disaster,” said NOAA's Lubchenko. “We are likely looking at a period of time a few years down the road where we will not be able to do severe storm warnings and long-term weather forecasts that people have come to expect today.”

Satellite data is key to the economy- knowledge of weather patterns can prevent damage to electricity infrastructure

Hertzfeld et al 3- Weather Satellites and the Economic Value of Forecasts: Evidence from the Electric Power Industry Henry R. Hertzfeld, Ray A. Williamson, Avery Sen, George Washington University Washington, D.C Paper Delivered at International Astronautical Conference,

Bremen, Germany, September 2003

For 2000, the U.S. electric power industry earned an estimated total revenue of $247 billion.1 Electric power generation is thus a very large and important industry. Modern society depends on electricity to supply much of the power needed to support manufacturing, and daily heating, cooling, and lighting needs. It is therefore an essential part of the infrastructure of the U.S. economy. Even a very small service disruption can have a large social and economic impact. The 1977 blackout in the Northeast U.S. cost the U.S. economy an estimated $340 million (in then-year dollars); the August 2003 blackout may have cost New York City alone some $1.15 billion (estimates of total cost range from $4 to $6 billion). unusual terrestrial weather patterns nor space weather appear to have caused either of these

Neither two blackouts. However, both types of weather incidents are capable of creating major problems with the electric power infrastructure and therefore have the potential for causing large economic losses. Terrestrial weather conditions, typically, are predictable; better forecasts will lead to more efficient management of the electric power system and, as described in this paper, contribute to sizable cost savings. Incidents caused by space weather are not as predictable and can occur within minutes to a few hours of a coronal mass ejection from the sun, but in the last decade, scientists have made measurable progress in understanding the physical basis of space weather and in extending their ability to predict harmful consequences on Earth. Accurate weather information is only one component of the smooth and efficient operation of the large and complex electric utility industry. Accurate weather information is most important when significant deviations in temperature or storm-caused natural disasters are probable.

Nevertheless, because the industry is very large, because energy prices are volatile, and because of the high cost of capital facilities for energy production, management, and transmission, improvements in predicting and planning for changes in the weather can result in potential annual aggregate savings of hundreds of millions of dollars for the U.S. economy as a whole. In particular, finer, more accurate satellite weather observations from improved instrumentation, when combined with enhanced weather models, can provide the basis for more accurate, short-term and long-term forecasts. Improved forecasts can potentially lead to significant cost savings in electric energy production. The benefits of better terrestrial weather information obtained from satellite data are not limited to the electric power industry. They extend to nearly all socio-economic activities: household, industry, and government.2 Space weather has a more limited, but important, effect on society as a whole because it primarily affects technological systems, and especially the electric power grid. This paper focuses on the electric power industry because it is one of the largest users of weather data and is potentially one of the largest beneficiaries.

Ocean Add-On

US climate leadership spurs international action-solves econ, oceans and soil

Khosla 9- Ashok Khosla, IUCN President (International Union for the Conservation of Nature), 29 January 2009, “A new President for the United States: We have a dream,” Online: http://www.iucn.org/knowledge/news/opinion/?2595/new-President-for-the-United-States-We-have-a-dream

A rejuvenated America, with a renewed purpose, commitment and energy to make its contribution once again towards a better world could well be the turning point that can reverse the current decline in the state of the global economy, the health of its life support systems and the morale of people everywhere. This extraordinary change in regime brings with it the promise of a deep change in attitudes and aspirations of Americans, a change that will lead, hopefully, to new directions in their nation’s policies and action. In particular, we can hope that from being a very reluctant partner in global discussions, especially on issues relating to environment and sustainable development, the United States will become an active leader in international efforts to address the Millennial threats now confronting civilization and even the survival of the human species. For the conservation of biodiversity, so essential to maintaining life on Earth, this promise of change has come not a moment too soon. It would be a mistake to put all of our hopes on the shoulder of one young man, however capable he might be. The environmental challenges the world is facing cannot be addressed by one country, let alone by one man. At the same time, an inspired US President guided by competent people, who does not shy away from exercising the true responsibilities and leadership his country is capable of, could do a lot to spur the international community into action. To paraphrase one of his illustrious predecessors, “the world asks for action and action now.” What was true in President Roosevelt’s America 77 years ago is even more appropriate today. From IUCN’s perspective, the first signals are encouraging. The US has seriously begun to discuss constructive engagement in climate change debates. With Copenhagen a mere 11 months away, this commitment is long overdue and certainly very welcome. Many governments still worry that if they set tough standards to control carbon emissions, their industry and agriculture will become uncompetitive, a fear that leads to a foot-dragging “you go first” attitude that is blocking progress. A positive intervention by the United States could provide the vital catalyst that moves the basis of the present negotiations beyond the narrowly defined national interests that lie at the heart of the current impasse. The logjam in international negotiations on climate change should not be difficult to break if the US were to lead the industrialized countries to agree that much of their wealth has been acquired at the expense of the environment (in this case greenhouse gases emitted over the past two hundred years) and that with the some of the benefits that this wealth has brought, comes the obligation to deal with the problems that have resulted as side-effects. With equitable entitlement to the common resources of the planet, an agreement that is fair and acceptable to all nations should be easy enough to achieve. Caps on emissions and sharing of energy efficient technologies are simply in the interest of everyone, rich or poor. And both rich and poor must now be ready to adopt less destructive technologies – based on renewables, efficiency and sustainability – both as a goal with intrinsic merit and also as an example to others. But climate is not the only critical global environmental issue that this new administration will have to deal with. Conservation of biodiversity, a crucial prerequisite for the wellbeing of all humanity, no less America, needs as much attention, and just as urgently. The United States’ self-interest in conserving living natural resources strongly converges with the global common good in every sphere: in the oceans, by arresting the precipitate decline of fish stocks and the alarming rise of acidification; on land, by regenerating the health of our soils, forests and rivers; and in the atmosphere by reducing the massive emission of pollutants from our wasteful industries, construction, agriculture and transport systems.

Ocean collapse causes exitinction.

Craig 3- Robin Kundis Craig, Associate Professor of Law, Indiana University School of Law, 2003, “Taking Steps Toward Marine Wilderness Protection? Fishing and Coral Reef Marine Reserves in Florida and Hawaii,” Journal: 34 McGeorge L. Rev. 155

Biodiversity and ecosystem function arguments for conserving marine ecosystems also exist, just as they do for terrestrial ecosystems, but these arguments have thus far rarely been raised in political debates. For example, besides significant tourism values - the most economically valuable ecosystem service coral reefs provide, worldwide - coral reefs protect against storms and dampen other environmental fluctuations, services worth more than ten times the reefs' value for food production. n856 Waste treatment is another significant, non-extractive ecosystem function that intact coral reef ecosystems provide. n857 More generally, "ocean ecosystems play a major role in the global geochemical cycling of all the elements that represent the basic building blocks of living organisms, carbon, nitrogen, oxygen, phosphorus, and sulfur, as well as other less abundant but necessary elements." n858 In a very real and direct sense, therefore, human degradation of marine ecosystems impairs the planet's ability to support life. Maintaining biodiversity is often critical to maintaining the functions of marine ecosystems. Current evidence shows that, in general, an ecosystem's ability to keep functioning in the face of disturbance is strongly dependent on its biodiversity, "indicating that more diverse ecosystems are more stable." n859 Coral reef ecosystems are particularly dependent on their biodiversity. [\*265] Most ecologists agree that the complexity of interactions and degree of interrelatedness among component species is higher on coral reefs than in any other marine environment. This implies that the ecosystem functioning that produces the most highly valued components is also complex and that many otherwise insignificant species have strong effects on sustaining the rest of the reef system. n860 Thus, maintaining and restoring the biodiversity of marine ecosystems is critical to maintaining and restoring the ecosystem services that they provide. Non-use biodiversity values for marine ecosystems have been calculated in the wake of marine disasters, like the Exxon Valdez oil spill in Alaska. n861 Similar calculations could derive preservation values for marine wilderness. However, economic value, or economic value equivalents, should not be "the sole or even primary justification for conservation of ocean ecosystems. Ethical arguments also have considerable force and merit." n862 At the forefront of such arguments should be a recognition of how little we know about the sea - and about the actual effect of human activities on marine ecosystems. The United States has traditionally failed to protect marine ecosystems because it was difficult to detect anthropogenic harm to the oceans, but we now know that such harm is occurring - even though we are not completely sure about causation or about how to fix every problem. Ecosystems like the NWHI coral reef ecosystem should inspire lawmakers and policymakers to admit that most of the time we really do not know what we are doing to the sea and hence should be preserving marine wilderness whenever we can - especially when the United States has within its territory relatively pristine marine ecosystems that may be unique in the world. We may not know much about the sea, but we do know this much: if we kill the ocean we kill ourselves, and we will take most of the biosphere with us. The Black Sea is almost dead, n863 its once-complex and productive ecosystem almost entirely replaced by a monoculture of comb jellies, "starving out fish and dolphins, emptying fishermen's nets, and converting the web of life into brainless, wraith-like blobs of jelly." n864 More importantly, the Black Sea is not necessarily unique. The Black Sea is a microcosm of what is happening to the ocean systems at large. The stresses piled up: overfishing, oil spills, industrial discharges, nutrient pollution, wetlands destruction, the introduction of an alien species. The sea weakened, slowly at first, then collapsed with [\*266] shocking suddenness. The lessons of this tragedy should not be lost to the rest of us, because much of what happened here is being repeated all over the world. The ecological stresses imposed on the Black Sea were not unique to communism. Nor, sadly, was the failure of governments to respond to the emerging crisis. n865

Soil Add-On

US climate leadership spurs international action-solves econ, oceans and soil

Khosla 9- Ashok Khosla, IUCN President (International Union for the Conservation of Nature), 29 January 2009, “A new President for the United States: We have a dream,” Online: http://www.iucn.org/knowledge/news/opinion/?2595/new-President-for-the-United-States-We-have-a-dream

A rejuvenated America, with a renewed purpose, commitment and energy to make its contribution once again towards a better world could well be the turning point that can reverse the current decline in the state of the global economy, the health of its life support systems and the morale of people everywhere. This extraordinary change in regime brings with it the promise of a deep change in attitudes and aspirations of Americans, a change that will lead, hopefully, to new directions in their nation’s policies and action. In particular, we can hope that from being a very reluctant partner in global discussions, especially on issues relating to environment and sustainable development, the United States will become an active leader in international efforts to address the Millennial threats now confronting civilization and even the survival of the human species. For the conservation of biodiversity, so essential to maintaining life on Earth, this promise of change has come not a moment too soon. It would be a mistake to put all of our hopes on the shoulder of one young man, however capable he might be. The environmental challenges the world is facing cannot be addressed by one country, let alone by one man. At the same time, an inspired US President guided by competent people, who does not shy away from exercising the true responsibilities and leadership his country is capable of, could do a lot to spur the international community into action. To paraphrase one of his illustrious predecessors, “the world asks for action and action now.” What was true in President Roosevelt’s America 77 years ago is even more appropriate today. From IUCN’s perspective, the first signals are encouraging. The US has seriously begun to discuss constructive engagement in climate change debates. With Copenhagen a mere 11 months away, this commitment is long overdue and certainly very welcome. Many governments still worry that if they set tough standards to control carbon emissions, their industry and agriculture will become uncompetitive, a fear that leads to a foot-dragging “you go first” attitude that is blocking progress. A positive intervention by the United States could provide the vital catalyst that moves the basis of the present negotiations beyond the narrowly defined national interests that lie at the heart of the current impasse. The logjam in international negotiations on climate change should not be difficult to break if the US were to lead the industrialized countries to agree that much of their wealth has been acquired at the expense of the environment (in this case greenhouse gases emitted over the past two hundred years) and that with the some of the benefits that this wealth has brought, comes the obligation to deal with the problems that have resulted as side-effects. With equitable entitlement to the common resources of the planet, an agreement that is fair and acceptable to all nations should be easy enough to achieve. Caps on emissions and sharing of energy efficient technologies are simply in the interest of everyone, rich or poor. And both rich and poor must now be ready to adopt less destructive technologies – based on renewables, efficiency and sustainability – both as a goal with intrinsic merit and also as an example to others. But climate is not the only critical global environmental issue that this new administration will have to deal with. Conservation of biodiversity, a crucial prerequisite for the wellbeing of all humanity, no less America, needs as much attention, and just as urgently. The United States’ self-interest in conserving living natural resources strongly converges with the global common good in every sphere: in the oceans, by arresting the precipitate decline of fish stocks and the alarming rise of acidification; on land, by regenerating the health of our soils, forests and rivers; and in the atmosphere by reducing the massive emission of pollutants from our wasteful industries, construction, agriculture and transport systems.

Soil erosion causes extinction

Globe and Mail 7- John Allemang, feature writer, 12 May 2007, “Planet Earth has a dirty little secret,” Journal: Globe and Mail, pg. F4

Dirt is disappearing, and when it goes, we go. It's a simple fact that we're using up our finite supply of good soil faster than it can be made, and whatever our eyes choose to tell us, a crisis is looming. Of course, like so much else about dirt, even its do-or-die crisis manages to be barely perceptible. In a world prepared to welcome the inconvenient truths of environmental degradation, and even make them the markers of intellectual fashion, poor old untrendy dirt somehow falls to the bottom of the global to-do list. Air pollution, water contamination, the limited lifespan of fossil fuels, the urgent need to confront climate change no matter how far away its worst threats may be - we get it, whatever don't-worry governments and vested interests like to pretend to the contrary. But erosion as the ultimate catastrophe, the dusty death blow? Somehow it's hard to feel apocalyptic about something you buy at a garden centre, scrape off your boots before walking through the door or scrub off your lettuce before the salad can be made. "We take it for granted," agrees David R. Montgomery - which is a pretty hard admission for a man who has made it his goal to alert a distracted world to the crisis of lost soil. To his practised eyes, at least, the best part of the Earth is eroding and the danger signs are everywhere: bare plowed soil carried off by wind or rain, rivers choked by sediment from clear-cut forests, over-irrigated fields turned into salt-contaminated deserts, huge unprotected tracts of wheat or corn dependent on chemical fertilizer to replace the nutrients corporate agriculture discards, the constant stripping of topsoil to create new suburbias. Our complacency is so instinctive, our wastefulness so extreme, that Dr. Montgomery has come up with a disturbing new name for modern agriculture: soil mining. "We only have a fixed amount of soil - and we're digging it up," he says. Dr. Montgomery is a geomorphologist at the University of Washington in Seattle, a well-travelled and well-read monitor of Earth's thin skin who knows that a civilization's lifespan depends on how it treats - or mistreats - its dirt. As a student of the Earth's eons of slow but certain transformations, he is trained to spot the big-picture inevitabilities the rest of us miss, and of this he is certain: "We're on track to lose most of our agricultural soils. And even if we solve the water crisis and the climate crisis, if we don't conserve soil, then that will do us in." You hear that, and you look around at the lushness of life in the spring, and the doomsday scenario seems unconvincing. Dirt is everywhere, the fields are full of crops, the supermarket shelves have their usual cornucopia look of gross overabundance and, if there's a famine in a far-off place, as there always is, can it really all come down to a few inches of topsoil that has gone missing? Yes is the short answer, according to Dr. Montgomery's wide-ranging new book, Dirt: The Erosion of Civilizations, which is to be published this week and has been deemed "a compelling manifesto" by New Scientist magazine. He takes pains to demonstrate the key role played by soil degradation in almost every civilization that once claimed to dominate the Earth - a useful antidote to the Golden Age nostalgia for a more harmonious past that afflicts many in the environmental movement. Wrecking soil, he implies, is something humans do, given the opportunity, because we're programmed to think of immediate issues such as personal survival rather than forgoing our inheritance to benefit the farmers of the future. And one reason we can do this with a clear conscience is our belief that soil is everywhere. "People just don't realize that not all soils are good agricultural soils," Dr. Montgomery says. "And even with good soils, the pace at which it's being lost is slow by human standards even if it's quite rapid by geologic standards." You don't have to be a geologist to spot the problem. At least since the Dust Bowl crisis of the Depression era, when much of North America was blanketed by thick clouds of soil eroded off the drought-ridden prairie, soil specialists have put forward strong arguments for conservation - arguments that are all the more crucial since the western plains, as Dr. Montgomery observes, "are one of the few places on the planet that can produce agricultural surpluses and feed the world."

\*\*Inherency\*\*

CLARREO Inherency

Large scale cuts have been to the earth science climate intiative- specifically the CLARREO mission has been cut- a high priority satellite.

NASA 11**-** Langley's Newest Climate Mission Taken Off the Road 03.11.11 http://www.nasa.gov/centers/langley/news/researchernews/rn\_CLARREOCUT.html

Earth Science Division Director Mike Freilich addressed NASA Langley employees on Thursday in response to large-scale cuts to the proposed President’s 2012 federal budget, which directly affect the CLARREO (Climate Absolute Radiance and Refractivity Observatory) mission, among other programs. The President’s 2012 budget removes $1.2B from the $2.1B Fiscal Year 2011 proposed Earth Science Climate Initiative in years 2012-15. From a difficult meeting with the White House Office of Management and Budget, Freilich was directed to cut NASA Langley-led satellite mission CLARREO, along with the Jet Propulsion Laboratory-led Deformation, Ecosystem Structure and Dynamics of Ice (DESDynI)-Radar and Goddard Space Flight Center-lead DESDynI-Lidar mission. Both CLARREO and DESDynI were Tier 1, or highest priority missions as defined by the National Research Council's Decadal Survey for Earth Science. "I know unequivocally that the decision to focus these cuts on CLARREO [and DESDynI] was not based in any way on perceptions of under performance of the teams or lack of value of the mission for the country," said Freilich. "The cuts are purely budgetary." CLARREO logo. Click to enlarge The Science Directorate at NASA Langley will look for other ways to get the climate measurements that would have been offered by CLARREO. Credit: NASA Scheduled for launch in 2017, CLARREO would have carried on Langley's 30-year legacy of monitoring Earth's climate. The CLARREO mission was slated to carry an instrument suite to measure thermal infrared and reflected solar radiation at high absolute accuracy. Additionally, CLARREO would have carried on-board GPS radio occultation receivers to provide a long-term benchmarking data record for the detection, projection and attribution of changes in the climate system. In addition to developing the science standards, the CLARREO team, made up of employees from across the center, was making significant progress toward mission advancement. Last November, CLARREO reached a major mission milestone when it passed its Mission Concept Review (MCR), an independent assessment that deemed the mission was mature enough to continue into the next stage, Phase A. "I heard from so many people that CLARREO's MCR was one of the best ever – definitely the smoothest of all of the Tier 1 missions," said Lelia Vann, head of the Science Directorate at NASA Langley. "We're all very disappointed by these cuts. However, CLARREO was not cancelled, and there are other opportunities out there for us to aggressively pursue. And we are doing just that." The elimination of CLARREO funding means a major scale-back in the mission’s contractor and civil servant labor, and it also means the mission will not proceed to Phase A as the team had planned. Mike Freilich, science head. Earth Science Division Director Mike Freilich tells NASA Langley employees that the CLARREO mission is a victim of budget cuts in a Thursday meeting. Credit: Jen LaPan "A good analogy for the situation could be a stalled car in traffic," said Freilich. "We're moving the stalled car, CLARREO, into the break down lane and out of the flow of traffic to keep from creating a huge traffic jam of programs." Freilich went on to say that the agency can't be wedded to programs, and that researchers need to look at other climate continuity opportunities and recover from this setback. For now, the continuation of an uninterrupted climate record is not in jeopardy while NASA pursues other climate continuity opportunities. Langley’s Science Directorate is still collecting data with the Clouds and the Earth's Radiant Energy System (CERES) instrument. One flight model, CERES FM-5, is set for launch on NPOESS (National Polar-orbiting Operational Environmental Satellite System) Preparatory Project (NPP) in the fall of this year. Another flight model, CERES FM-6, is in development for delivery in 2012 for a potential flight on the Joint Polar Satellite System (JPSS)-1 in 2016. In addition, NASA Langley is leading the development of SAGE III on ISS in 2015 as well as the new DISCOVER-AQ mission – one of the five Venture Class missions competitively selected last year. While the impact of losing the CLARREO mission is far-reaching, NASA Science leadership is focusing on the positive side. The science team, which was selected through a competitive process, will concentrate on studies to figure out how to get the key climate measurements CLARREO would have provided. Freilich ended his address by saying, "We have to remember the budget still supports a lot of important missions, and from my standpoint, the program may be smaller, but it isn’t slower."

\*\*Case Extenstions\*\*

Warming Uniqueness- Food Shortage

Extreme weather as a result of climate change will affect food output

Bloomberg 5/26- Global Food Output May Be Hurt as Climate Shifts, UN Warns, May 26, 2011, 7:56 AM EDT http://www.businessweek.com/news/2011-05-26/global-food-output-may-be-hurt-as-climate-shifts-un-warns.html

Global food output may be hurt as climate change brings more extreme weather over the next decade, with China likely set for harsher droughts and North America getting heavier rain, said the World Meteorological Organization. “Extreme events will become more intense in the future, especially the heat waves and extreme precipitations,” Omar Baddour, a division chief at the United Nations’ agency, said in a phone interview from Geneva. “That, combined with less rainfall in some regions like the Mediterranean region and China, will affect crop production and agriculture.” The more extreme weather -- including in the U.S., the world’s largest agricultural exporter -- may disrupt harvests, possibly cutting production of grains, livestock and cooking oils and boosting prices. Global food costs reached a record in February, stoking inflation and pushing millions into poverty. “We foresee with high confidence in climate projections that intense precipitation in some parts of the world will be more intense, and drought will be more intense,” said Baddour, who’s tracked the subject for more than two decades. Extreme heat waves “will also be more intense and more frequent.” The UN Food and Agriculture Organization’s World Food Price Index, which tracks 55 food-commodity items, rose nine times in the past 10 months, with the gauge peaking at 237.24 in February. The index climbed to 232.07 last month.

Warming Uniqueness

The tipping point is near- feedback rates prove

Thompson 10- Lonnie G. Thompson The Ohio State University Climate Change: The Evidence and Our Options Byrd Polar Research Center Publication 1402 The Behavior Analyst 2010, 33, 153–170 No. 2 (Fall) http://researchnews.osu.edu/archive/TBA--LTonly.pdf

Positive feedback increases the rate of change. Eventually a tipping point may be reached, after which it could be impossible to restore normal conditions. Think of a very large boulder rolling down a hill: When it first starts to move, we might stop it by pushing against it or wedging chocks under it or building a barrier, but once it has reached a certain velocity, there is no stopping it. We do not know if there is a tipping point for global warming, but the possibility cannot be dismissed, and it has ominous implications. Global warming is a very, very large boulder. Even if there is no tipping point (or we manage to avoid it), the acceleration of warming means serious trouble. In fact, if we stopped emitting greenhouse gases into the atmosphere tomorrow, temperatures would continue to rise for 20 to 30 years because of what is already in the atmosphere. Once methane is injected into the troposphere, it remains for about 8 to 12 years (Prinn et al., 1987). Carbon dioxide has a much longer residence: 70 to 120 years. Twenty percent of the CO2 being emitted today will still affect the earth’s climate 1,000 years from now (Archer & Brovkin, 2008). If, as predicted, global temperature rises another 3u C (5.4u F) by the end of the century, the earth will be warmer than it has been in about 3 million years (Dowsett et al., 1994; Rahmstorf, 2007). Oceans were then about 25 m higher than they are today. We are already seeing important effects from global warming; the effects of another 3u C (5.4u F) increase are hard to predict. However, such a drastic change would, at the very least, put severe pressure on civilization as we know it.

Warming- Anthropogenic

**Warming is anthropogenic**

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

There has been speculation for more than a century on how human activity may change the Earth’s climate. The era of speculation is over. If there has been any surprise, it has been that the pace and scope of change caused by “anthropogenic influences” have proven to be more rapid than expected. While skeptics remain, most observers now agree that human activities (particularly the burning of carbon fuels and deforestation) contribute to and accelerate climate change.

Warming- Data Solves Tipping Point

Uncertainty in climate models will make it harder to get off the tipping point

Government Office for Science 3/14- UK, Tipping Points meeting, London, 14 March 2011 Note prepared on behalf of the Government Office for Science by the Met Office: Peter Good, Jason Lowe, Richard Wood http://www.bis.gov.uk/assets/bispartners/goscience/docs/t/11-974-tipping-points-meeting-london-14-march-2011

There is wide acceptance in the scientific community that there are likely to be “tipping points” in the climate system, where a significant, qualitative change in state occurs in response to a small perturbation. Crossing such tipping points could lead to accelerated, committed or irreversible change. However there is substantial scientific uncertainty in quantifying the position and likelihood of passing key thresholds, and in terms of associated impacts. Current estimates of the likelihood of triggering large-scale and/or irreversible climate events are largely based on expert judgement, informed by paleo-climatic evidence, computer models and current understanding of the underlying physical processes. The high level of uncertainty, combined with the potential for very significant impacts if one or more “tipping points” were to be triggered, means that the policy response is likely to require a risk management approach. Paleo-climate reconstructions provide evidence of past rapid change events, for example the Paleocene-Eocene Thermal Maximum (PETM), which took place around 50 million years ago and involved a major climatic warming which took place over around 1000 years, possibly driven by rapid methane release. Current cumulative anthropogenic carbon release is around one third of the way towards the level that triggered such events in the past. Climate models are used to provide short term forecasts and longer term projections, to interpret recent climatic variations and paleo-climatic changes, and to understand the physical processes that may drive threshold behaviour. However several examples are known where the models used in the IPCC Fourth Assessment may not represent physical mechanisms of tipping elements correctly, due to limitations in resolution and in the processes that can currently be included in models. ‘Early warnings’ for tipping points through Earth system monitoring may be possible and may help manage the risks, although the uncertainty in modelling such events remains large. Three types of ‘health check’ approach were mentioned: (i) general statistical methods, (ii) process-based identification of key variables to monitor, and (iii) initial value prediction. Each was seen to have different advantages and disadvantages. The critical need for long-term monitoring was emphasised, while many existing observations are tied to short-term research programs. A clear set of long term monitoring priorities for tipping points has not yet been developed. It is important to be able to interpret ‘surprises’ in new observations (e.g. the 2007 dip in Arctic sea-ice), so that such observations can be put into context. These interpretations must be developed through careful application of quantitative, process-based knowledge of the climate system. After a high level review of the scientific evidence, the meeting considered how the risk of “tipping points” and system thresholds could be better included in policy development and wider public debate. There was consensus that the science in this area is particularly hard to communicate clearly. In part this is due to the danger of communicating an overly negative message; positive messages that make the public feel part of the solution are more likely to effect behaviour change. There was broad agreement on the requirement for a set of different (but self-consistent) narratives to meet the needs of individual audiences, using metaphors to aid clarity and understanding, and applying a risk-management framework.

Reliable data is need to accurately address climate change

O’Malley et al 9 -Robin O'malley, senior fellow and project director for the Heinz Center report on the state of the nation's ecosystems Anne S. Marsh, Program Director for Observations and Understanding at the H. John Heinz III Center for Science Economics and Environment Christine Negra, Program Director at the Heinz Center for Science, Economics and the Environment in Washington, DC, Closing the Environmental Data Gap <http://www.docstoc.com/docs/42969765/Closing-the-Environmental-Data-Gap>

The compelling evidence that the global climate is changing significantly and will continue to change for the foreseeable future means that we can expect to see similarly significant changes in a wide variety of other environmental conditions such as air and water quality; regional water supply; the health and distribution of plant and animal species; and land-use patterns for food, fiber, and energy production. Unfortunately, we are not adequately monitoring trends in many of these areas and therefore do not have the data necessary to identify emerging problems or to evaluate our efforts to respond. As threats to human health, food production, environmental quality, and ecological well-being emerge, the nations leaders will be handicapped by major blind spots in their efforts to design effective policies. In a world in which global environmental stressors are increasingly interactive and human actions are having a more powerful effect, the need for detailed, reliable, and timely information is essential. Yet environmental monitoring continues to be undervalued as an investment in environmental protection. We tolerated inadequate data in the past, when problems were relatively simple and geographically limited, such as air or water pollution from a single plant. But it is unacceptable today, as we try to grapple with far more extensive changes caused by a changing climate. The effects of climate change will be felt across the globe, and at the regional level they are likely to present unique and hard-to-predict outcomes. For example, a small change in temperature in the Pacific Northwest has allowed bark beetles to survive the winter, breed prolifically, and devastate millions of acres of forest Although scientists are working to improve forecasts of the future and anticipate such tipping points, observation of what is actually happening remains the cornerstone of an adequate response. Society needs consistent and reliable information to establish baselines, make projections and validate them against observed changes, and identify potential surprises as early as possible.

Warming- Climate SATs Solve Data Gap

**There are current flaws in climate change data gathering that make it inadequate. Climate sats key to responding to climate change effectively.**

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

Until this year, America’s civil space policies—and the budgets that derive from it—were shaped to a considerable degree by the political imperatives of the past and by the romantic fiction of spaceflight. We believe there is a new imperative—climate change—that should take precedence in our national plans for space and that the goal for space spending in the next decade should be to create a robust and adequate Earth observation architecture. There is unequivocal evidence, despite careless mistakes and noisy protests, that Earth’s climate is warming. While the effects and implications of this are subject to speculation, there should be no doubt that the world faces a major challenge. There are important shortfalls in data and analysis needed to manage this challenge. Inadequate data mean that we cannot determine the scope or nature of change in some key areas, such as the melting of Antarctic sea ice. Long-term changes in daily temperature are not adequately understood, in part because of limited observations of atmospheric changes. Our understanding of how some anthropogenic (man-made) influences affect climate change is still incomplete.1 These shortfalls must be remedied, if only to overcome skepticism and doubt. Climate change now occupies a central place on the global political agenda, and the United States should adjust its space policies to reflect this. Assessing and managing climate change will require taking what has largely been a scientific enterprise and “operationalizing” it. Operationalization means creating processes to provide the data and analysis that governments will need if they are to implement policies and regulations to soften the effects of climate change. Operationalization requires the right kind of data and adequate tools for collecting, analyzing, and disseminating that data in ways that inform decisionmaking at many levels of society. Satellites play a central role in assessing climate change because they can provide a consistent global view, important data, and an understanding of change in important but remote areas. Yet there are relatively few climate satellites—a total of 19, many of which are well past their expected service life. Accidents or failures would expose the fragility of the Earth observation system.2 We lack the required sensors and instruments for the kinds of measurement that would make predictions more accurate and solutions more acceptable. Weather satellites, which take low-resolution pictures of clouds, forests, and ice caps, are not adequate to the task. NASA builds impressive Earth observation satellites for climate change, but these have been experimental rather than ongoing programs.

National efforts for monitoring are necessary to resolve gaps in climate knowledge

O’Malley et al 9 -Robin O'malley, senior fellow and project director for the Heinz Center report on the state of the nation's ecosystems Anne S. Marsh, Program Director for Observations and Understanding at the H. John Heinz III Center for Science Economics and Environment Christine Negra, Program Director at the Heinz Center for Science, Economics and the Environment in Washington, DC, Closing the Environmental Data Gap <http://www.docstoc.com/docs/42969765/Closing-the-Environmental-Data-Gap>

Fortunately, two developments are helping to facilitate the collection of more and better data. First, new technologies and techniques allow us to capture data more efficiently and effectively. Second, society is demanding greater accountability and the demonstration of true value for environmental investments. The ability to easily share large amounts of information, to combine observations from different programs by linking them to specific geographic locations, to monitor many environmental features from space or by using new microscale devices, and other innovations can greatly extend the reach and richness of our environmental baselines. At the same time, many corporations, foundations, and government entities are working to track the effects of their actions in ways that will demonstrate which approaches work and which do not. In much the same way as the medical community is embracing evidence-based medicine, managers are moving toward evidence-based environmental decisionmaking. Recognition of the scale of environmental problems is also spurring increased collaboration among federal, state, local, and private entities. Wildlife managers recognize that species do not respect state or federal agency boundaries and that adequate response demands range-wide information. Likewise, addressing the expanding "dead zone" in the Gulf of Mexico demands collaboration and data from across the Mississippi River basin in order to understand how farmers' actions in Missouri affect shrimpers' livelihood in Louisiana. Evidence of this recognition and the collaboration it demands is growing. For example, state water monitoring agencies, the Environmental Protection Agency (EPA), and the U.S. Geological Survey (USGS) have developed a new multistate data-sharing mechanism that greatly expands access to each others' data. And, public and private entities are increasingly working together in efforts such as the Heinz Center's State of the Nations Ecosystems report, as well as in more local efforts such as the integrated monitoring of red cockaded woodpeckers by private timber companies, the U.S. Fish and Wildlife Service, state agencies, and the Department of Defense. Despite these efforts, a coherent and well-targeted environmental monitoring system will not appear without concerted action at the national level. The nation's environmental monitoring efforts grew up in specific agencies to meet specific program needs, and a combination of lack of funding for integration, fragmented decisionmaking, and institutional inertia cry out for a more strategic and effective approach. Without integrated environmental information, policymakers lack a broad view of how the

Warming- Climate SATs Solve Data Gap

environment is changing and risk wasting taxpayer dollars. Since 1997, the Heinz Centers State of the Nations Ecosystems project has examined the breadth of information on the condition and use of ecosystems in the United States and found that the picture is fragmented and incomplete. By publishing a suite of national ecological indicators, this project has provided one-stop access to high-quality, nonpartisan, science-based information on the state of the nations lands, waters, and living resources, using national data acceptable to people with widely differing policy perspectives. However, there are data gaps for many geographic areas, important ecological endpoints, and contentious management challenges as well as mismatched datasets that make it difficult to detect trends over time or to make comparisons across geographic scales. The depth of these gaps can be seen in three case studies, two of which concern chemical elements (nitrogen and carbon) that play vital roles in global ecosystems but can also create havoc in the wrong times, places, and concentrations. The third case considers the condition of our nations wildlife.

Adeqaute data is necessary to address ecosystem changes

O’Malley et al 9 -Robin O'malley, senior fellow and project director for the Heinz Center report on the state of the nation's ecosystems Anne S. Marsh, Program Director for Observations and Understanding at the H. John Heinz III Center for Science Economics and Environment Christine Negra, Program Director at the Heinz Center for Science, Economics and the Environment in Washington, DC, Closing the Environmental Data Gap <http://www.docstoc.com/docs/42969765/Closing-the-Environmental-Data-Gap>

As the planet warms, we have begun to experience a variety of changes in ecosystems, the first signs of the environment's own potentially bumpy road ahead. To deal with the changes, policymakers need objective, detailed, big-picture data: the type of data that decisionmakers have long relied on to understand emerging economic trends. Yet, as noted above, data gaps still abound, obscuring our understanding of the condition and use of the nation's ecosystems. In The State of the Nation's Ecosystems 2008, only a third of the indicators could be reported with all of the needed data, another third had only partial data, and the remaining 40 indicators were left blank, largely because there were not enough data to present a big-picture view. No responsible corporation would manage an asset as valuable and complex as the ecosystems of the United States without a better stream of information than can currently be delivered. We certainly do not wish to throw rocks at the dedicated professionals who manage environmental monitoring programs. Unfortunately, however, their work has been accorded low priority when it comes to setting environmental budgets, and independence, rather than collaboration, has been the primary strategy for managing these programs. Dealing with the type of gaps we have discussed will require additional investment plus a serious commitment to harnessing the resources of existing environmental monitoring programs into a coherent whole. Identifying a small suite of environmental features that need to be tracked, identifying overlapping and incomplete coverage between programs, and establishing standard methods that can allow different programs to contribute to a larger whole are the kinds of steps that a nation truly committed both to the power of information and the value of our environment would take.

Sats key to accurate predictions and modeling

**Stillman 8**- Dir. At Institute for Global Environmental Strategies, Fall 2008, vol 23, no 3, Imaging Notes, http://imagingnotes.com/go/article\_free.php?mp\_id=146

Hurricanes Gustav and Ike, like other natural disasters in recent years, demonstrated both the nation’s progress and its shortcomings with regard to predicting, preparing for and responding to severe weather and a changing climate. The track forecasts issued by the National Weather Service's National Hurricane Center for both Gustav and Ike were fairly consistent and, as it turned out, quite accurate. The result was adequate advance warning for those who would find themselves in the path of these storms. On the other hand, meteorologists were much less confident in their predictions of storm intensity at landfall. Forecasts fluctuated from Category 1 (74-95 mph winds) to Category 4 (131-155 mph), which translated into significant swings in anticipated damage and overall impacts. Coincidentally, these two devastating and deadly storms ravaged the Gulf Coast just weeks after the University Corporation for Atmospheric Research released its report, "Advice to the New Administration and Congress: Actions to Make our Nation Resilient to Severe Weather and Climate Change." Developed by UCAR together with seven other organizations, the so-called "transition document" is intended to provide guidance to the next administ-ration and Congress. Implementing the report's recommendations would cost an estimated $9.8 billion more than what the nation is currently planning to spend in five specific areas of concern: 1. Observations "Fully fund the Earth observing system from satellite and ground-based instruments as recommended by the National Research Council," the report advises. "Observations from both space and the ground are key to monitoring climate and weather variables and developing climate and weather models. These observations will be essential in monitoring the progress and success of any carbon emission reduction initiative (e.g., cap-and-trade)." The cited NRC recommendations are those included in its 2007 study, "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond," ("The Decadal Study") which identified 17 satellite missions necessary over the next decade to ensure continuity of existing observations, and those expected in "Observing Weather and Climate From the Ground Up, A Nationwide Network of Networks," a study scheduled for an October release. The transition document estimates the recommended satellite missions would cost almost $3.7 billion between 2010 and 2014, with cost estimates for the needed ground-based instruments yet to be determined. John Snow, co-chair of the Weather Coalition, a group that advocates on behalf of the private, public and academic sectors of the weather community, emphasized the importance of observations during a media teleconference about the transition document. "The first step in understanding the climate system is to really do a better job of observing both the atmosphere and the ocean," said Snow, who is also dean of the College of Geosciences at the University of Oklahoma and director of the Oklahoma Weather Center. "We have a good understanding, we think, of what needs to be measured. We have some idea of the technology needed to do it. But to deploy a global observing system of the scale that we need to make the observations is essential. We have to do that to be able to actually use the computers wisely."

Warming- Climate SATs Solve Data Gap

Improved observations of the ocean are critical for better understanding and for predicting weather and climate, according to Robert Gagosian, president of the nonprofit Consortium for Ocean Leadership. "Our ability to accurately predict the path and intensity of storms, so that communities can adequately prepare for these events, requires significant investment in ocean science, access to data though observatories, and computational infrastructure for modeling," Gagosian said. "The ocean is the missing piece of the climate equation. The ocean holds and transfers vast amounts of heat, carbon and water across the globe. Better understanding of these circulation patterns and sea-atmosphere exchange processes are essential for understanding and predicting global and regional climate systems." Figure 2. Satellite image of Hurricane Ike captured on Sept. 13, 2008, one hour prior to landfall in Galveston, Texas. Diameter of the eye is 75 km. Image courtesy of ESA, 2008, captured and processed by CSTARS/University of Miami, under license from Eurimage. The report recommends nearly $2.1 billion in ocean-observing initiatives between 2010 and 2014. 2. Computing "Greatly increase the computer power available for weather and climate research, predictions, and related applications," reads the transition document's second recommendation. "Current climate models do a reasonable job of providing useful information at the global level, but most climate change and severe weather impacts will be managed at local and regional levels (e.g., public health and safety, water and ecosystem management, energy production and use, food production, transportation services, recreation opportunities, military readiness)." Most of today's computer models can only simulate climate changes on scales as small as around 100 kilometers, according to Snow. "Right now we're dealing at resolutions of hundreds of kilometers, which really just barely resolves the Rocky Mount-ains. What we would really like to be able to do is run numerical models of the future climate at scales of tens of kilometers so we can pick up important terrain features and are able to see the level of detail so we can answer people's questions at the county and state level," he said.

Warming- SATs KT Monitoring

Sats key to carbon emissions monitoring

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

■■ To better serve the national interest, the United States should increase its Earth observation capabilities—especially space-based sensors for carbon monitoring—to improve our ability to understand the carbon cycle and to inform any future international agreement. This means that until these capabilities are adequate for monitoring climate change, investment in Earth observation satellites should take precedence over other space programs. Increased spending on Earth observation satellites specifically designed for climate change should be maintained until the current capability shortfall is eliminated.The United States should accelerate the creation of a National Climate Service to improve climate information management and decisionmaking. In a related effort, the United States should support the World Meteorological Organization in its efforts to create a World Climate Service for similar reasons.

Sats key to emissions monitoring

Fisk 9- Professor of Space Science at the University of Michigan, Congressional Documents and Publications,

October 21, 2009, Lexis, Senate Commerce, Science, and Transportation Subcommittee on Science and Space Hearing;The Case for Space: Examining the Value; Testimony by Lennard Fisk, Vice Chair, Committee on the Rationale and Goals of the U.S. Civil Space Program, Space Studies Board, National Research Council, Thomas M. Donahue Distinguished University Professor of Space Science at the University of Michigan

We also live in a world of challenges, one of the main ones being global climate change. Whether or not you agree on the causes of climate change, nonetheless we must all accept that the climate of Earth is changing, and the outstanding question is what are the regional consequences to which we must prepare to adapt. The Department of Defense has stated that global climate change is a strategic threat to the United States, in recognition that climate change in the developing world can be de-stabilizing, and lead to increased threats from, for example, terrorism. The knowledge of global climate change and its regional consequences will come uniquely from the civil space program. Comprehensive observations from the global perspective of space will be required. We may enter into treaties limiting fossil fuel emissions and other contributions to the greenhouse gases in the atmosphere. Only the global perspective of satellite observations will allow us to monitor compliance by the treaty signatories. "Trust but verify" will work equally well in climate treaties as it did for treaties limiting nuclear weapons.

Climate Sats key to identify key emitters and solve warming

The Sunday Mail 9 – The Sunday Mail (Queensland, Australia), January 25, 2009 Sunday, “Carbon Hunting Spy in the Sky”, World Section, Pg. 50, l/n

TOKYO: Japan has launched the world's first greenhouse gas monitoring satellite -- which could help pinpoint which countries are the worst atmosphere polluters. The orbiter, together with a US satellite to be launched next month, will represent an enormous leap in available data on carbon dioxide and methane in the atmosphere, now drawn from scattered ground stations. Inez Fung, an atmospheric scientist at the University of California in Berkeley, said: ``Now, we get 100 observations every two weeks. With the satellite, we'll get a million. Christmas is here!'' And Swiss climatologist Fortunat Joos, of the University of Bern, said that with the ground-level network ``only large-scale regional averages could be determined'' for green-house gas emissions. With satellite readings, he said, ``one would perhaps be able to discriminate carbon emissions from different countries''. Such data could help negotiators in ongoing global climate talks to determine more precisely who would need to reduce emissions by how much to protect the climate. The satellite -- named Ibuki which means ``breath'' -- was sent into orbit on Friday along with seven other probes and Japan's space agency, JAXA, said the launch was a success. Carbon dioxide, the biggest contributor to global warming, is emitted by the burning of fossil fuels by power plants, motor vehicles and industry. Methane has a variety of sources, including livestock manure and rice cultivation. Scientists report that CO2 emissions rose 3 per cent worldwide from 2006 to 2007. If emissions are not reined in, a UN scientific panel says, global temperatures will increase by 2.4C to 6.3C by the year 2100, causing damaging disruptions to the climate. ``Global warming is one of the most pressing issues facing the international community, and Japan is fully committed to reducing CO2,'' said Yasushi Tadami, an official working on the project for Japan's Environment Ministry. ``The advantage of Ibuki is that it can monitor the density of CO2 and methane gas anywhere in the world.''

Warming- SATs KT Monitoring

Sats key to monitor effective implementation of emissions policies

Climate Wire 9 **–** March 4, 2009, “Aging climate satellites ‘a real problem’, academy head tells Congress”, Climate Wire, <http://oco.jpl.nasa.gov/news/index.cfm?FuseAction=ShowNews&NewsID=36>

Want to know how quickly climate change will warm the Earth or how fast sea levels will rise? Don't rely on a steady stream of data from the United States' aging stable of weather and climate satellites, the president of the National Academy of Sciences told Congress yesterday. Nineteen of the 20 U.S. satellites now monitoring Earth's environment are now past their predicted lifetimes, NAS president Ralph Cicerone told members of the House Appropriations Committee. He said there were few replacements being prepared. That leaves the United States in a precarious position, he said. If an older satellite fails before a replacement is launched, the resulting loss of environmental data could hamper efforts to predict future climate change or monitor the effectiveness of policies to slash greenhouse gas emissions. "We've got a real problem with our satellites," Cicerone said, echoing the conclusions of a recent National Academy of Sciences report that warned that cumulative rounds of budget-cutting had put U.S. Earth science programs "at great risk." And last week's crash of a NASA satellite designed to track the ebb and flow of carbon dioxide through the atmosphere didn't help, the scientist said. The $280 million Orbiting Carbon Observatory sank into the ocean near Antarctica after the rocket that was supposed to launch it into space malfunctioned. Scientists had hoped the satellite would help them improve their accounting of CO2 sources and "sinks," including forests and oceans, that pull the greenhouse gas from the atmosphere (ClimateWire, Feb. 25). "I think a strong case can be made that the instrument should be reproduced as soon as possible," Cicerone said, calling the aborted launch "a tragedy." And the United States also needs a national plan to monitor climate change, Cicerone added, as Congress considers enacting new federal policies on global warming and the world prepares to negotiate a successor to the Kyoto Protocol. "Here we are, on the verge of new international agreements, without thinking about how to monitor them," he said. "And we are neglecting climate as an element of national security. We're not getting the information we need. Where are [climate] changes happening, and where are they going to happen?" 'Climate measurements are hanging by a thread'

Warming- Monitoring KT Compliance

Monitoring key to effective compliance

**Vezirgiannidou 9**- Mellon Post-Doctoral Fellow at Dept. of Politics and International Studies, University of Cambridge, “The Climate Change Regime Post-Kyoto: Why Compliance is Important and How to Achieve It”, Sevasti-Eleni Vezirgiannidou, Global Environmental Politics 9:4, November 2009, http://www.mitpressjournals.org/doi/pdf/10.1162/glep.2009.9.4.41

In terms of compliance, the only theoretical strand concerned with the issue is neo-liberal institutionalism. This is because compliance is not a problem in other strands of regime theory: in realism compliance is enforced by powerful countries, and in cognitivism states have no incentives to deviate from what they consider legitimate rules. However, the free rider problem is significant in neo-liberal theory. States have an incentive not to comply with the rules when there is no credible agency to enforce them.54 Non-compliance or free riding is perceived to be in the interest of the deviant state because it allows them to reap the benefits of cooperation without contributing to the costs, or to reap additional benefits through “cheating.” In the climate context, a state could free ride by not reducing its GHG emissions, while others do so. It will thus not face the financial difficulties associated with mitigation, but will benefit from the decreased danger of climate change achieved by others’ efforts.55 According to mainstream neo-liberal theory, the issue of free riding can be dealt with by a strong compliance process based on the ability to punish defectors. 56 In order for this strategy to work effectively, a regime needs to have a strong review mechanism, so that defectors can be easily identified. This works best when it is independent from individual states, whereas self-reporting does not always encourage more compliance.57 There also needs to be a credible punishment available that would hurt only the defector and not the other members of the regime.58 Strategies based on reciprocity can work well in trade agreements. Monitoring is easy given that a country’s trade policies are quite transparent. In addition, if a state fails to comply, there are measures that can be taken against it which will not affect others in the agreement. For example, states can raise their tariffs against the defector, while keeping them low towards all other members. In order for this strategy to work, of course, there need to be only a few non-compliant countries. Reciprocal strategies are more difficult to apply to environmental problems, especially those that apply to (nonexcludable) public goods such as climate change. This is because there are no environmental measures that states can take to punish only the defector. For example, if states increase their GHG emissions in response to a state’s noncompliance, they will suffer equally from the punishment.59 More recent game theoretical literature has shown that raising emissions to counter noncompliance could be a deterrent.60 However, there are certain caveats for this to be the case. First, there is an assumption that states in this model are of equal size so there are no power asymmetries and no asymmetrical payoffs. But more fundamentally, this model rests on the assumption that all states have similar attitudes towards economic and environmental gains and attribute the same value to both. Most of these assumptions do not hold in the real world. In addition, this model does not address the issue of expanding participation. Therefore, whether this would be a credible threat that could deter potential free-riders remains open to interpretation.

Warming- Monitoring KT Solving Climate Change

Effective carbon monitoring is key to solve climate change

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

Monitoring and verifying of greenhouse gas (GHG) emissions is of particular importance. Reaching an agreement to reduce greenhouse gas emissions is complicated because of the inherent scientific uncertainty and incomplete understanding of the carbon cycle and warming of the Earth. Recent scientific advancements, however, allow us to conclude with a high level of certainty that climate change and global warming are unequivocal and that the primary driver is carbon dioxide produced by burning of fossil fuels and, to a lesser degree, by deforestation.

**Better climate monitoring sats is key to an effective response to climate change. Climate sats can solve Copenhagen’s failure of climate research’s incorporation into policymaking also allowing the US to demonstrate global leadership**

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

Better climate information has helped us move beyond the question of whether action to manage climate change is warranted to what types of actions and polices are needed. Information is key to an effective approach to climate change. At a national and international level, many countries are preoccupied with how to ensure that decisionmakers and user communities have access to the types of information that will make the climate efforts successful. This includes coordinated systems for Earth observation, enhanced modeling capabilities, an organizational structure that allows science to be more responsive to relevant policy questions or functions, and places where information can be gathered and made accessible to broad-based user communities. Meeting the needs of climate policy requires a transformation in how climate research is incorporated into public policymaking.4 “Operationalizing” information systems—investing in the Earth observation systems necessary for producing the right data over the right time and space horizons, coordinating data collection, interpreting and sharing to maximize the data’s benefits, focusing on the human and social science effects of climate change, improving modeling capabilities, and making this information accessible and relevant for a wide range of users—is a necessary step in designing effective U.S. climate policy. It also represents an opportunity **for America to demonstrate global leadership** and contribute to building global capacity to understand and more effectively respond to the climate. The climate negotiations in Copenhagen, Denmark, in December 2009, failed because of differences over how to share responsibilities and burdens. The challenges inherent in these negotiations will not be easily overcome. However, the troubled negotiations in Copenhagen present the United States with an opportunity. The 2008 CSIS report, CSIS Commission on Smart Power: A Smarter, More Secure America, called for the United States to use its technology and scientific prowess to engage other nations in efforts that serve both U.S. interests and the interests of the global community. This report identifies Earth observation and climate change as one such opportunity and provides recommendations on how the United States can, working with other nations, acquire the technology and build the institutions needed to assess and manage climate change. It suggests three steps that the United States can take: ■■ expand international cooperation, ■■ consolidate and strengthen its national effort, and ■■ launch civil space policy in a new direction.

Warming- Monitoring KT Solving Climate Change

Climate change efforts are doomed to fail without a method for data gathering to inform climate policymaking and planning

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

Operationalization—making the data and knowledge generated by satellites and science useful for policy and planning—is the real challenge for GCOS and its member states. Without a greater effort to operationalize climate data, the global effort on climate change will most likely fail, an outcome that is not in our national interest. Operationalization requires a new approach. The existing vehicles for international data sharing have been mainly aimed at the scientific community. As the provider of climate-related observations to support the activities of the UNFCCC and national governments, GCOS is the best multilateral entity to own these new responsibilities of managing and expanding the international climate knowledge base.

Emissions reduction is the key internal link to solving warming- the impact of GHG’s stay in our atmosphere for thousands of years

National Research Council et al., 10 – National Research Council is the working arm of the United States National Academies which includes the National Academy of Science, National Academy of Engineering, and Institute of Medicine; Committee on Methods for Estimating Greenhouse Gas Emissions, “Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements”, Pgs. 15-16

Longevity in the Atmosphere

The longevity of a greenhouse gas in the atmosphere is important because it determines the number of years that today’s emissions will affect climate. Short-lived gases, such as the precursors to tropospheric ozone, are rapidly cleared from the atmosphere; thus, the perturbation caused by emissions appears to adjust rapidly to a change in emissions. However, short-lived chemically reactive gases are coupled with the longer-lived greenhouse gases and thus produce long-lived perturbations to radiative forcing that take decades to reach a steady state (Wild et al., 2001). For even small levels of anthropogenic emissions, the atmospheric abundances of very long-lived gases, such as the PFCs, will continue to rise in proportion to emissions and remain well below the steady-state value at which annual emissions are balanced by annual removals. To eventually halt climate changes caused by greenhouse gases, their abundances in the atmosphere must be stabilized. The lifetime of CO2 in the atmosphere cannot be ascribed a single value because the carbon cycle consists of a series of interacting reservoirs, each with a different time scale (see Figure 1.3). For example, although land ecosystems or the oceans take up approximately one-sixth of the CO2 in the atmosphere every year, they also return almost the same amount (IPCC, 2007a). Thus, the lifetime of a pulse increase in the atmospheric abundance of CO2 is set not by the short stay of an individual molecule in the atmosphere, but by the small imbalance that the pulse creates between the uptake and removal rates. For example, CO2 molecules spend thousands of years in the oceans once they have been transported into the abyss. Consequently, dissolved CO2 in the deep oceans reflects the atmospheric abundance before the industrial revolution, rather than the increased abundance caused by fossil-fuel burning in the last 200 years. The upshot is that a fraction of the fossil-fuel CO2 emitted is taken up rapidly by the upper ocean and biosphere, but the remainder of the perturbation acts like a very long-lived gas, requiring thousands of years to decay away (Denman et al., 2007). Methane is short-lived in the atmosphere relative to CO2. A molecule emitted into the atmosphere is oxidized to CO2 in an average of about 8 years, but chemical feedbacks extend this time scale to 12 years (Prather, 1994). This means that the current abundance of methane is derived from the last several decades of emissions. Nitrous oxide has an average residence time of 114 years in the atmosphere before it is photochemically decomposed in the stratosphere. The average atmospheric lifetimes of the other gases considered in this report range from 45 to 1,700 years for CFCs, 1 to 270 years for HFCs, 3,200 years for SF6, and tens of thousands of years for PFCs (Forster et al., 2007).

Warming- Monitoring KT Solving Climate Change

Even if all the nations in the world agreed on a climate treaty, warming can’t be solved without verification measures

Brennan 9 – Science/Environment Editor for The Orange County Register, August 5, 2009, “Can U.S. verify Climate Treaties? No, say UC Irvine Scientists”, <http://greenoc.freedomblogging.com/2009/08/05/can-us-verify-climate-treaties-no-say-uc-irvine-scientists/11243/>

The crash was a scientific black eye: A rocket carrying the $209 million Orbital Carbon Observatory satellite took a dive into the ocean when it was supposed to be lofted into space from Vandenberg Air Force Base in February. The satellite was meant as a first test of technology designed to track carbon emissions from orbit. But according to a UC Irvine climate scientist, the loss of the satellite leaves the nation — and the world — in a bit of a jam. Even if the nations of the world agree in coming months on a treaty to control greenhouse gas emissions, believed responsible for global warming, the United States and other nations have no way to independently verify whether the treaty is working, or being obeyed by individual nations, said Michael Prather, an expert in climate modeling at UCI. “Right now, it’s impossible,” Prather said. A letter sent last week by a nationwide group of experts that includes Prather and UC Irvine climate scientist James Randerson urges NASA’s new administrator, Charles Bolden, to launch a new version of the satellite, known as OCO for short. The project is competing, however, with a variety of other missions in need of funding. “NASA has a whole bunch of Earth System Science missions, with different communities behind many,” Prather said. “The earth science community already established a pecking order, so to speak, for the sequence of satellite launches.” Prather said he knows the OCO satellite was not actually intended to verify climate treaties. Its real mission was to map carbon emission mainly from the earth’s land surfaces. But the spacecraft also was capable of monitoring large sources of greenhouse gas emissions, such as power plants or cities, Prather said. While its two-year lifespan would not have been long enough to do a lot of climate treaty verification, it could have demonstrated the capability of future satellites to monitor emissions globally from space, Prather said. Without independent measurements from space, any such treaty would be verified in the usual way: totting up emission reductions called for in the treaty, and asking each nation to provide data on whether various businesses and government agencies had met their emission-reduction obligations. But such complicated procedures are prone to error, and while they would include present-day surface measurements, those have limited reach, Prather said. It would also be very difficult to check emissions from nations that refused to sign the treaty. Prather, Randerson and the other scientists are part of a National Research Council Committee on Methods for Estimating Greenhouse Gas Emissions, which is preparing a National Academies report on treaty monitoring and verification. The letter, however, signed by the 13-member committee’s chairman, Stephen W. Pacala, was sent before the report was finished because NASA, dealing with scarce funding, is now making decisions about which programs to make priorities. Prather hopes to help persaude Bolden to support resurrecting a new version of OCO. “This will be a political science battle, not a science battle,” said Prather, who for years has been an author of climate reports from the U.N.’s Intergovernmental Panel on Climate Change. “Treaty verification can mean as little as, you follow the rules, to it’s actually working. I think it behooves us on the science side to make sure it’s actually working.”

Warming- Monitoring KT Emissions Reduction

Sats monitoring key to emissions reduction- China proves

The Daily Telegraph 9- Louise Gray, Environment Correspondent in Copenhagen, December 19, 2009, “US warns satellites can check China’s emissions honesty”, Pg. 14, l/n

PRESIDENT Barack Obama last night suggested he would be prepared to use satellite technology to ensure China sticks to carbon emissions commitments agreed in an 11th-hour deal in Copenhagen. More than 192 countries have spent a fortnight in the Danish capital attempting to thrash out an agreement to address climate change. Ultimately, however, it came down to a showdown between the world's two biggest emitters of carbon dioxide to decide how the world will cut greenhouse gases. Earlier in the day Mr Obama had insisted that any deal that did not commit China to a transparent monitoring regime would be "a hollow victory''. But his tough approach angered the Chinese and the talks were bought to a standstill as the two superpowers met in hotel rooms away from the main conference hall to patch up their differences. Wen Jiabao, the Chinese premier, made clear he was unwilling to have international monitors infringe the national sovereignty of the People's Republic. The world was kept waiting while the two superpowers cobbled together an agreement that was acceptable to both. The final accord is widely seen to have acquiesced to Chinese demands by agreeing that emissions can be measured domestically, as long as the results are reported to the rest of the world. However, speaking later, Mr Obama gave a veiled warning that satellite technology could be used for what is likely to be termed "eco-spying'' to ensure countries honoured their commitments. "We can actually monitor what takes place through satellite imagery and so forth, so I think we are going to have a pretty good idea of what people are doing,'' he said. He added that the deal could be successful if "there is a sense of moral obligation and information sharing so that people can see who's serious and who's not''. The showdown between China and America was widely seen as preventing a stronger agreement on carbon reductions. Fredrik Reinfeldt, Sweden's prime minister, said climate change will not be prevented unless China and America make stronger commitments. The EU had hoped the two nations would agree to cut pollution massively and is disappointed not only with the emissions reduction targets but with the weak monitoring regime. However, it is hoped that the use of satellite imagery will increase pressure on every country to do their part once targets are eventually in place. It is expected that the world's leaders will meet again in a year's time in Mexico to decide midterm targets for 2020. New technology enables satellites to measure greenhouse gas emissions being produced over a particular area. Satellite imagery could also be used to monitor forest management commitments; not only keeping track of deforestation in rainforest nations, but, again in China, monitoring whether the promise to plant trees over huge areas is honoured.

Monitoring systems are key to identifying emitters accurately

Carbon Control News 9**-** Nick Juliano, March 29, 2010, “Federal Report Recommends Investments to Improve Emissions Monitoring”, Vol. 4, No. 12, l/n

The council's report, "Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements," outlines several recommendations for improving monitoring and verification capacity, including financial assistance for developing nations to install necessary technology upgrades and a re-launch of a NASA carbon-monitoring satellite that failed last year. Fossil fuel CO2 emissions -- which can generally be monitored and verified with less than 10 percent uncertainty, according to the report -- are the largest source of global GHG emissions, responsible for nearly 57 percent of human-caused GHG emissions. CO2 from land-use, such as agriculture and forestry, and other GHGs like methane (CH4), nitrous oxide (N2O) and fluorinated gases are responsible for the remaining anthropogenic emissions. However, the report notes that these estimates "have uncertainties that are greater than the expected emissions reductions over a treaty's lifetime." International negotiators are struggling to design a new climate treaty to replace the Kyoto Protocol, which expires in 2012, and disputes over monitoring and verification of emissions have been a key sticking point between developed and developing countries, especially the U.S. and China. At last year's UN climate summit in Copenhagen, President Obama and leaders of four of the largest GHG-emitting developing countries eventually arrived at an agreement on language to be included in the Copenhagen Accord requiring countries to report their own emissions, though allowing for "international consultation and analysis" through yet-to-be-designed guidelines that would allow for verification while respecting national sovereignty. Efforts to design those guidelines are expected to be a key focus of negotiations over the course of this year convened under the UN Framework Convention on Climate Change (UNFCCC). The research council report recommends modifying UNFCCC standards to require more regular emissions reports from developing countries and impose the strictest reporting requirements on the top GHG emitters in the developing world; developed nations are already required to submit annual reports under the convention. The report notes that financial and technical assistance will be needed to build the capacity for more stringent monitoring and reporting in developing nations, but notes that "significant improvements" in the 10 largest GHG-emitting developing countries could be achieved with a "relatively modest" investment of about $11 million over 5 years. The report also recommends NASA revive its Orbiting Carbon Observatory (OCO), a state-of-the-art monitoring satellite that failed to launch in February of last year; it estimates a replacement would cost the same as the original attempt, about $278 million. Only the OCO would be able to pinpoint large local GHG sources well enough to attribute emissions to individual countries, the report says. In its fiscal year 2011 budget request, NASA is seeking $170 million to revive the OCO, and NASA Administrator Charles Bolden told Congress this month that the agency aims to launch a new satellite in early 2013. Expanding an international atmospheric sampling network also would provide more robust data about localized GHG contributors, the report says. It recommends the U.S. deploy additional monitoring stations to contribute to the World Meteorological Organization's Global Atmospheric Watch, which in the U.S. is administered by the National Oceanic and Atmospheric Administration (NOAA). "An initial goal could be to deploy instruments at a statistical sample of large emitters (e.g., 5-10 within a research budget of $15 million to $20 million per year) in the United States, but international partners would ideally extend the effort in other countries," the report states. To distinguish emissions generated by fossil fuel combustion from biological emissions, the report recommends incorporating measurements of the isotope carbon-14, which is present only in organic CO2. Such measurements, which the report says could be made at a cost of between $5 million and $10 million, would "enable fossil-fuel use to be estimated at subcontinental scales with uncertainties low enough to be useful for verifying self-reported emissions." Estimates are perhaps most uncertain for land-use emissions of CO2, N2O and CH4, the report notes, recommending the establishment of an interagency working group to design a research program to implement methods for improving monitoring of those emissions. It notes the only existing ecosystem inventory, operated by the U.S. Department of Agriculture (USDA), focuses only on forests. Adding measurements for other land types, such

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as cropland and pastures, would "greatly reduce their emissions uncertainties, which are commonly greater than 100 percent," the report says. Such a program likely would cost "substantially less" than the USDA forest inventory, which costs $65 million annually. -- Nick Juliano

Satellite monitoring is key to effective compliance and emissions reduction

USA Today 11- Dan Vergano, January 26, 2011, “Panel: climate spy satellite needed”, http://content.usatoday.com/communities/sciencefair/post/2011/01/climate-treaty-verification-needs-cooperation/1

Verifying international climate treaty agreements to limit carbon dioxide emissions may require an observation satellite to monitor "non-cooperative" countries, a science panel report concludes. This is an artist's concept of the Orbiting Carbon Observatory-2. The mission, scheduled to launch in February 2013, will be the first spacecraft dedicated to studying atmospheric carbon dioxide, the principal human-produced driver of climate change. It will provide the first global picture of the human and natural sources of carbon dioxide and the places where this important greenhouse gas is stored. Such information will improve global carbon cycle models as well as forecasts of atmospheric carbon dioxide levels and of how our climate may change in the future The "Methods for Remote Determination of CO2 Emissions" study produced by the prestigious JASON scientific advisory panel, and released by Secrecy News Wednesday, finds that: For non-cooperative countries, there is currently no demonstrated capability to estimate country-level emissions using direct measurements of atmospheric CO2 that has sufficient accuracy to support monitoring of compliance with international agreements. Allowing other nations to verify industrial emissions of greenhouse gasses has flared into an area of disagreement between U.S. and Chinese negotiators, most recently in discussions at the Cancun climate treaty meeting last month. "If meaningful international agreements are reached to limit or reduce the emission of greenhouse gases (GHG) such as carbon dioxide that contribute to global warming, then it will be necessary to verify compliance with such agreements," notes Secrecy News analyst Steven Aftergood of the Federation of American Scientists, in a write-up of the report. The report focused on estimating carbon dioxide emissions, the most noteworthy of greenhouse gases linked to global warming, with plus-or-minus 20% certainty for results. "For cooperative countries, the technology currently exists to directly monitor (greenhouse gas) emissions sufficiently well on an annual basis to support U.S. decision-making on international agreements.," says the study. JASON panel members also looked at satellites observing the energy and industrial facilities of nations that won't allow on-the-ground sensor networks or inspections to verify they have met their climate commitments. "This is done by monitoring the energy infrastructure, estimating fossil fuel consumption, and then estimating (carbon dioxide) emissions using appropriate emission factors," says the study. The report says this approach could work for estimating emissions from non-cooperative nations, but needs more study, starting with figuring out the existing industrial sources of greenhouse gases from the largest emitters, such as China and Russia.

Satellite monitoring key to bringing down emissions- lack of invasive spying gets countries on board to climate treaties

Technology Review 9- Kevin Bullis, “A Technical Solution to Monitoring China’s CO2”, December 18, 2009, <http://www.technologyreview.com/blog/energy/24548/>

There may be a technological solution to one of the trickiest issues at the Copenhagen climate change talks--verifying that nations are adhering to the limits on emissions that they agree to when those nations don't want international inspectors snooping around their factories and power plants and ports. Earlier this week Chinese negotiators balked at any kind of international monitoring of its emissions levels, according to multiple news sources, although they've since backed off this absolutist stance. In his address at the talks today, President Obama expressed what seemed like frustration at the resistance of some countries to verification. "I don't know how you have an international agreement where we all are not sharing information and ensuring that we are meeting our commitments. That doesn't make sense." But there may be a way around the concerns of the Chinese and others about verifying emissions. An ideal monitoring scenario would include equipment at power plants and factories, and close tracking of fossil fuel distribution. But if a country objects to monitoring within its borders, it would still be possible to monitor its emissions from outside. A network of ground-based greenhouse gas monitoring stations, weather balloons and satellites could make it possible to accurately monitor the emissions of a country as small France or Germany--without the need for invasive inspections, says Ronald Prinn, a professor of atmospheric science at MIT. It would cost billions, but without it, it could be hard to know if a treaty is actually bringing down emissions as planned. Such a network would build on an existing set of ground monitoring stations around the world that sample greenhouse gas concentrations at a relatively high frequency. While some monitoring stations only collect information on a weekly basis, they can measure concentrations 20 to 30 times a day--enough to keep up with shifting winds that change where the gases are coming from. Paired with detailed monitoring of air circulation from weather monitoring stations and sophisticated computer models of air circulation, it would be possible to get a good idea of where emissions are coming from. Right now, however, there aren't nearly enough greenhouse gas monitoring stations. At best, the estimates these stations produce only work for large areas and come with a large error range of plus or minus 20 to 30 percent. There are only 11 high frequency stations. "We need 10 to 100 times more," says Prinn. It will also be important to have more weather monitoring stations, especially in places such as Africa, which have very few currently. And measurements should be paired with observations from satellites. Satellites can measure carbon dioxide concentrations closer to the sources, and they monitor the entire column of air beneath them, unlike ground-based monitors, which only sample from the lower part of the atmosphere called the boundary layer. A satellite designed to monitor carbon dioxide levels crashed into the sea earlier this year during a failed launch. Prinn says another should be launched. The combination of satellite measurements and a network of weather and greenhouse gas stations could make it possible to monitor countries as small as France or Germany, he says, with an accuracy of plus or minus 5 percent. It

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would work, even if a country such as China wouldn't allow any greenhouse monitoring stations within the country--as long as the neighboring countries do. "This is what is going to be needed," Prinn says. "But we're nowhere near it now."

Sats key to monitoring GHG emissions- current self-reporting data can’t be verified

Climatewire et al, 11- E&E's newest daily publication, ClimateWire, is designed to bring readers unmatched coverage of the debate over climate policy and its effects on business, the environment and society; Lauren Morello, reporter for the Scientific American, January 28, 2011, “Elite Scientific Advisory Panel Says New Technology is Needed to Verify Emissions Cuts”, SCIENTIFIC AMERICAN, <http://www.scientificamerican.com/article.cfm?id=jason-greenhouse-gas-monitoring>

Determining whether individual nations comply with future climate pacts will require a new satellite to keep tabs on countries that resist other forms of monitoring, a government advisory panel says. The elite, independent panel of scientists -- known as JASON -- examined the United States' ability to monitor the progress of international agreements to reduce carbon dioxide emissions produced by burning fossil fuels. Although JASON's work is often classified, the new report is not. Sponsored by the National Nuclear Security Administration, the study was released this week by the Federation of American Scientists' Secrecy News blog. Current U.N. rules require countries to submit national emissions inventories, but the data are self-reported, not required annually from all countries, and there is not always independent information to verify it. The issue of verifying an individual country's emissions is a sensitive one -- a bone of contention for the United States and China at recent U.N. climate talks in Cancun, Mexico, although negotiators eventually agreed to develop a global monitoring system. The JASON report explores the feasibility of using ground monitoring stations, aircraft and satellites to measure CO2, as well as methods to estimate emissions by monitoring a country's energy infrastructure. The group describes a complicated technical problem that can be made simpler by good diplomatic relations. "For cooperative countries, the technology currently exists to directly monitor GHG emissions sufficiently well on an annual basis to support U.S. decision-making on international agreements," the study concludes. A new Japanese satellite may help The JASON report evaluates such methods against a goal of measuring a country or region's CO2 output with a margin of error of plus or minus 20 percent. But for countries that aren't amenable to such monitoring, the United States' options are limited. The JASON report says there is "no demonstrated capability to estimate country-level emissions using direct measurements of atmospheric CO2" with enough accuracy to support monitoring a country's compliance with an international climate agreement. More work is needed to improve the accuracy of estimates derived from inventories of a particular country's energy infrastructure, the report says, recommending that initial efforts focus on large emitters. That list includes the China, the United States, Russia, Japan, India and the European Union.

Warming- Monitoring KT Climate Treaties

Satellite monitoring is crucial to effective international climate treaties- only way to ensure compliance

**USA Today 10**- Dan Vergano, March 19, 2010, “Report: Global Warming Treaty Monitoring Needed”, <http://content.usatoday.com/communities/sciencefair/post/2010/03/report-global-warming-treaty-monitoring-fixes-needed/1>

Satellite and monitor improvements could allow independent monitoring of greenhouse gas emissions within five years, a science panel concluded Friday. That could help ensure compliance with international climate treaties. "The world's nations are moving toward agreements that will bind us together in an effort to limit future greenhouse gas emissions," begins the National Research Council's "Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements," report. However current monitoring, by satellites and self-reports from nations is not sufficient to check whether nations are cheating on any such agreements, the report concludes. By focusing on carbon dioxide emissions and deforestation measures, the report estimates each nation's emissions could be estimated to within 10%, with relatively modest costs. "If only half of the 20 highest-emitting developing countries require support for institutional capacity, the cost to obtain annual estimates of their emissions would be $11 million over 5 years," the report concludes, for example. Along these lines, the report makes a number of recommendations for improving greenhouse gas monitoring worldwide, including NASA launching a $287 million replacement for the failed 2009 Orbiting Carbon Observatory. At a cost of $5 - $10 million a year, the capabilities of about 150 weather stations worldwide should be upgraded to directly measure fossil-fuel-related contributions of carbon dioxide to the atmosphere as well. Last year, United Nations countries failed to produce a worldwide climate agreement at a meeting in Copenhagen. A "Copenhagen Accord" to produce an agreement written by Chinese, U.S. and other nation's leaders at the meeting, has picked up more signatures however, including China and India, ahead of further climate treaty meetings this year.

**Eliminating the uncertainty of data is key for success on an international climate treaty- monitoring and verification are key**

National Research Council et al., 10 – National Research Council is the working arm of the United States National Academies which includes the National Academy of Science, National Academy of Engineering, and Institute of Medicine; Committee on Methods for Estimating Greenhouse Gas Emissions, “Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements”, Pgs. 8-9

IMPLICATIONS FOR AN INTERNATIONAL CLIMATE AGREEMENT

International agreements to limit future greenhouse gas emissions will require that countries be able to monitor and verify emissions as well as removals by sinks. Within a few years of their implementation, the above recommendations would establish rigorous annual national inventories of greenhouse gas emissions as the core of a monitoring and verification system. Procedural verification by an independent international body would be supplemented by independent and transparent checks on fossil-fuel combustion and deforestation, which together are responsible for about three-fourths of all UNFCCC greenhouse gas emissions. Targeted research would ultimately lead to improved monitoring and verification of all greenhouse gases. Realistic near-term goals are to reduce uncertainties of fossil-fuel CO2 emissions to less than 10 percent in annual, national inventories and to provide checks on these emissions, especially from large, highemitting countries—such as the United States, China, or India—using independent methods that are equally accurate. Although national inventories of AFOLU emissions are currently relatively inaccurate, a realistic near-term goal is to reduce uncertainties of AFOLU CO2 emissions and to be able to estimate remotely the most important activities that cause these emissions (deforestation, afforestation, and forest degradation) with <10 percent uncertainty. In contrast, fundamental research is needed before it will be possible to estimate national emissions of N2O, CH4, and the synthetic fluorinated gases with reasonable accuracy using independent methods. The need for fundamental research is especially evident in the high uncertainties for emissions of CH4 and N2O from all important AFOLU sources, even for estimates from improved inventory methods. In addition to improving estimates of AFOLU emissions, the satellite surveys and inventory improvements recommended in this report would allow monitoring of individual projects aimed at creating carbon sinks to offset emissions. The ecosystem inventories would provide the baselines against which an offset project could demonstrate its effect on carbon uptake, which is necessary because carbon fluxes to and from ecosystems fluctuate with the weather and other factors. They would also provide a means for monitoring natural sinks and sources on unmanaged land. An additional benefit of the proposed expansion of the system to monitor greenhouse gases is that it would enhance our ability to monitor and study natural carbon sinks on land and in the oceans. The natural sinks are not counted in UNFCCC inventories, but they currently absorb about half of greenhouse gas emissions (approximately evenly divided between land and oceans). Because they are so large, changes in the natural sinks could weaken the impact of a treaty. The proposed additions to atmospheric sampling, inventories, and tracer-transport inversion would significantly improve our ability to monitor and study the natural sinks.

Warming- Monitoring KT Climate Treaties

Monitoring and Verification of emissions is key to compliance on a climate treaty

National Research Council et al., 10 – National Research Council is the working arm of the United States National Academies which includes the National Academy of Science, National Academy of Engineering, and Institute of Medicine; Committee on Methods for Estimating Greenhouse Gas Emissions, “Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements”, Pgs. 11

For any international agreement to limit greenhouse gas emissions, monitoring and verification of emissions will be essential to assess the effectiveness of emissions reductions and overall compliance with the terms of the treaty and to give nations confidence that their neighbors are also living up to their commitments. As former president Ronald Reagan said: “Trust but verify.” Emissions verification will also be important for correcting errors in reporting.

Adaptation- Climate Data Bad Uniqueness

Current climate change data isn’t enough – too much uncertainty

Hallegattea 9 - Stéphane Hallegattea, Centre International de Recherche sur l’Environnement et le Développement (CIRED), Ecole Nationale de la Météorologie, May 2009, “Strategies to adapt to an uncertain climate change,” Global Environmental Change Volume 19, Issue 2, May 2009, Pages 240-247

1. Introduction There is an increasing agreement that many decisions already need to take into account climate change. Obviously, many decisions have only short-term consequences or are only weakly climate sensitive. A factory that produces electronic devices has a lifetime of less than a few decades, and climate conditions will not be that different over this timescale. Also, such a factory is not highly sensitive to climate conditions, provided that it is not built in a flood plain or along a coastline. But many decisions come with a long-term commitment and can be very climate sensitive. Examples of such decisions include urbanisation plans, risk management strategies, infrastructure development for water management or transportation, and building design and norms. These decisions have consequences over periods of 50–200 years. Urbanisation plans influence city structures over even longer timescales. These kinds of decisions and investments are also vulnerable to changes in climate conditions and sea level rise. For example, many building are supposed to last up to 100 years and will have to cope in 2100 with climate conditions that, according to most climate models, will be radically different from current ones. So, when designing a building, architects and engineers have to be aware of and account for the future changes that can be expected. Milly et al. (2008) demonstrate why water management cannot keep using the stationarity hypothesis in its investment decisions. Since they report that more than US$ 500 billion are invested every year in this sector, the implementation of new practices cannot be delayed. Also, Nicholls et al. (2007) showed that, in 2070, up to 140 million people and US$ 35,000 billion of assets could be dependent on flood protection in large port cities around the world because of the combined effect of population growth, urbanisation, economic growth, and sea level rise. But previous coastal defence projects (e.g., the Thames Barrier) have shown that implementing coastal protection infrastructure typically has a lead-time of 30 years or more. Also, urbanisation plans are very efficient to influence flooding risk, but they can do so only over many decades. This inertia suggests that action must begin today to protect port cities and to manage flood risk for impacts expected by the middle of this century. To be efficient, however, this action has to take into account sea level rise and possible changes in storminess linked to climate change. Fortunately, there has been a significant rise in awareness worldwide about climate change. The positive outcome of this shift in awareness is that many architects, urban planners, water managers, and other planners are now concerned about how climate change will influence their activities. Laboratories working on climate change are well aware of this shift, as demands for information about future climates are becoming more frequent. Even though this new awareness is very positive, it is hardly enough. Climate change represents more than a just change in climate conditions. For decision-makers, climate change represents, more importantly, a dramatic increase in uncertainty. In the past, the climate parameters pertinent to most activities could be observed and measured. In presence of well-posed objectives, statistical analyses and optimization algorithms were able to produce “best” designs as a function of known climate conditions (e.g., dike heights as a function of the return time of certain storm surges, or building characteristics as a function of typical temperature levels). In the future, however, substantial climate uncertainty makes such methods more difficult to apply. It seems, therefore, that new decision-making methods have to be developed. This article discusses the issues we face in the development of these much needed methods.

Predictions uncertain – kills attempts to adapt

Hallegattea 9 - Stéphane Hallegattea, Centre International de Recherche sur l’Environnement et le Développement (CIRED), Ecole Nationale de la Météorologie, May 2009, “Strategies to adapt to an uncertain climate change,” Global Environmental Change Volume 19, Issue 2, May 2009, Pages 240-247

Over the next few decades, the main change global warming will bring us may not be the change in climate itself. It may be the uncertainty regarding future climate conditions, which was marginal during previous centuries and, therefore, was often neglected in decision-making. Now, uncertainty in future climate change is so large that it makes many traditional approaches to designing infrastructure and other long-lived investments inadequate.

Adaptation- Climate Data Bad Uniqueness

Uncertainty hinders adaptation

Gifford 11 - Robert Gifford, Professor of psychology at University of Victoria, May – June 2011, “The dragons of inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation,” American Psychologist Vol. 66, No. 4, 290–302 DOI: 10.1037/a0023566

Experimental research on resource dilemmas demonstrates that perceived or real uncertainty reduces the frequency of pro-environmental behavior (e.g., de Kwaadsteniet, 2007; Hine & Gifford, 1996). Individuals tend to interpret any sign of uncertainty, for example in the size of a resource pool or the rate at which the resource regenerates, as sufficient reason to harvest at a rate that favors self-interest rather than that of the environment. Uncertainty about climate change also quite likely func- tions as a justification for inaction or postponed action related to climate change. In the climate change context, presentations of the very carefully chosen level-of-confi- dence phrases (such as “likely” or “very likely,” p. 3) from the 2007 assessment report of the United Nations Intergov- ernmental Panel on Climate Change (IPCC) led many individuals to interpret the phrases as having a lower like- lihood than the IPCC experts intended (Budescu, Broomell, & Por, 2009).

Thus, well-intended efforts by climate change scien- tists to fairly characterize the degree of certainty about climate change seem to lead to a general underestimation of climate change risk on the part of the lay audience. Yet the scientific and ethical reality is that a certain degree of uncertainty is an inescapable element of any climate model—or any model, for that matter. Thus, climate sci- entists are left with a very perplexing problem: how to present the likelihood of climate change outcomes honestly without promoting misguided optimism on the part of the lay audience, which of course helps to justify inaction on the part of the public.

Uncertainty limits adaptation

Bedsworth and Hanak 10 - Louise W. Bedsworth, research fellow at the Public Policy Institute of California. Her research focuses on climate change, air quality, and transportation issues & Ellen Hanak, senior fellow at PPIC. Her research interests include water and land use policy, infrastructure finance, and climate change, September 23, 2010, “Adaptation to Climate Change,” Journal of the American Planning Association, 76:4, 477-495

Uncertainties about the extent and nature of some climate-related impacts pose a significant barrier to deci- sions on appropriate adaptation measures. For example, scientific projections of the pace of sea-level rise differ because of uncertainties in the role of melting ice sheets.8 The fourth IPCC report estimated a sea-level rise of from 7 to 23 inches by 2100, depending on future emissions and the sensitivity of the climate to them (IPCC, 2007a). Soon afterward, a model taking into account recent ob- served trends projected a significantly higher range of from 20 to 55 inches for the same time frame (Rahmstorf, 2007). Even using this latest projection, it is unclear what portion of the range to plan for. Planning for the upper end is more conservative, but also implies higher costs, either in foregone use of coastal property or higher invest- ments in protective structures, which also have environ- mental costs. For instance, Neumann and Hudgens (2006) find that the costs of shoreline protection would increase five-fold if sea-level rise were assumed to be 40 inches rather than 20 inches. A second example concerns precipitation changes and adaptation in the water sector. While there is considerable certainty that temperature increases will shift winter and spring runoff patterns by reducing the share of total precipitation that falls as snow, climate models are in disagreement about whether the future will be wetter or dryer in this region (Luers & Mastrandrea, 2008). The value of one costly adaptation tool, building new surface reservoirs to replace the lost storage in the snowpack, depends critically on the answer; in a drier future, there will be few occasions when this storage can be put to use (Tanaka et al., 2006). Some windows of planning uncertainty can be re- duced through more focused analysis using currently available climate models. For instance, more refined, local impact assessments can help translate global and regional climate model results to scales better suited for local adaptation planning. Similarly, additional air quality modeling and analysis can help ascertain whether new emission controls would be appropriate to address the regional impacts of higher temperatures on air quality. But in other cases, such as the effects of climate change on precipitation levels, better information will only come with time, either as analytical tools improve or as the actual changes become more apparent. Since one of the predicted outcomes of climate models is more variability, we are unlikely to have a clear sense of the scale of some changes until we are in the midst of them.

Gaps in data coverage are inevitable

Scientific American 4/14- Science Magazine, Budget Cuts Open Earth Observation Gap Earth observing satellites delayed or scrapped by government cutbacks http://www.scientificamerican.com/article.cfm?id=budget-cuts-earth-observation-gap

The fiscal 2011 budget compromise crafted by the White House and congressional leaders would delay a key federal climate and weather satellite program, making a lengthy gap in critical environmental data a near certainty. Cuts contained in the 2011 budget plan would push back the launch of the first Joint Polar Satellite System (JPSS) orbiter by at least 18 months past the current 2016 target, National Oceanic and Atmospheric Administration chief Jane Lubchenco said yesterday. That would halt the flow of crucial weather and climate data -- handicapping environmental forecasts, severe storm warnings and search-and-rescue operations, Lubchenco warned a Senate Commerce subcommittee. "It's safe to say there will almost certainly be a gap in coverage that, at this point, looks like it may be at least 18 months, based on the fact that the launch date will now slip at least 18 months," she said. That projected gap has grown by at least four months since early February. NOAA officials said then that they expected a 12- to 14-month delay (ClimateWire, Feb. 15). The problem stems from the series of stopgap funding measures that have kept the federal government operating since October. That hand-to-mouth existence has taken its toll on JPSS, Lubchenco said, since those temporary spending bills did not include the full $910 million that President Obama sought for the satellite program in 2011. "There is great uncertainty now with respect to what the fiscal future of this program is," she said. "We're still in the process of doing planning to try to figure out how we can minimize the damage."

Adaptation- Data KT Adaptation

Key to adaptation policies – unique data

Bowman 10 – Kevin Bowman, Tropospheric Emission Spectrometry AURA TES Deputy Principle Investigator at the Jet Propulsion Lab @ CalTech, May 29, 2010, “CLARREO,” online: http://science.jpl.nasa.gov/projects/CLARREO/

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission, led and developed by NASA and partner organizations, will monitor the pulse of the Earth to better understand climate change. CLARREO is a climate-focused mission that will become a key element of the climate observing system. The foundation for CLARREO is the ability to produce highly accurate and irrefutable climate records. Measurements derived from CLARREO will be used to detect climate trends and to test, validate, and improve climate prediction models. The CLARREO mission will provide accurate, credible, and tested climate records that lay the groundwork for informed decisions on mitigation and adaptation policies that address the effects of climate change on society.

Data key to adaptation policies

CEOS 10 – Committee on Earth Observation Satellites, 2011, “2010 Progress Report: Coordinated Response from Parties that Support Space Agencies Involved in Global Observations to the Needs Expressed in the Global Climate Observing System (GCOS) Implementation Plan of 2004,”

CLARREO is a climate focused mission that will become a key element of the climate observing system. The foundation for CLARREO is the ability to produce highly accurate climate change records through the novel application of onboard traceability and calibration techniques. CLARREO will measure spectral reflected solar energy, emitted infrared radiances and Global Navigation Satellite System (GNSS) Radio Occultation (RO) refractivities. These measurements will provide a long-term benchmarking data record to be used to detect climate change trends and test, validate, and improve climate prediction models. The CLARREO mission will provide accurate, credible, and tested climate change records that lay the groundwork for informed decisions on mitigation and adaptation policies that address the effects of climate change on society.

Broad data key

Sandford 10 – Stephen P. Sandford, staff at NASA Langley Research Center, September 23, 2010, “CLARREO cornerstone of the Earth Observing System: measuring decadal change through accurate emitted infrared and reflected solar spectra and radio occultation,” Paper 7826-33

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) is one of four Tier 1 missions recommended by the recent NRC Decadal Survey report on Earth Science and Applications from Space (NRC, 2007). The CLARREO mission addresses the need to provide accurate, broadly acknowledged climate records that are used to enable validated long-term climate projections that become the foundation for informed decisions on mitigation and adaptation policies that address the effects of climate change on society. The CLARREO mission accomplishes this critical objective through rigorous SI traceable decadal change observations that are sensitive to many of the key uncertainties in climate radiative forcings, responses, and feedbacks that in turn drive uncertainty in current climate model projections. These same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing.

Predict trends better

Standford 09 – Stephen P. Sandford, staff at NASA Langley Research Center, February 11, 2009, “CLARREO Mission Formulation,” 2009 Decadal Survey Symposium

CLARREO will provide spectral radiances and refractivities of sufficient accuracy to detect decadal scale climate trends • The documented, verifiable accuracy of the CLARREO data record will enable trend detection with a shorter time record • Unscrambling the trends has been demonstrated for clear-sky IR and GPS CLARREO Reduces Climate Model Uncertainty • The range of estimates of climate sensitivity arises from uncertainties in the climate models and their internal feedbacks, particularly those related to clouds and related processes. (Excerpted from IPCC 2007) • CLARREO data will be used to test the realistic range of climate predictions • Reducing the range of future scenarios will enable more informed decisions concerning mitigation and adaptation

Adaptation- Data KT Adaptation

Long term studies – better models – better adaptation plans

Wielicki 10 - Bruce Wielicki, Senior Scientist for Radiation Science at the NASA Langley Research Center, led research on clouds and the Earth's radiative energy balance for over 20 years, received the NASA Medal for Exceptional Scientific Achievement as well as the American Meteorological Society Henry G. Houghton Award, September 28, 2010, “In Their Own Words,” online: http://www.nasa.gov/centers/langley/multimedia/5Q4-CLARREO-Wielicki.html

How does CLARREO benefit the public? Well CLARREO's benefit to the public actually is very direct. One is a much more accurate and rigorous understanding of what climate change is really occurring. So the arguments we are having now about how accurate data are will be much better posed with CLARREO in orbit so the public and societal decision makers will know more accurately what's happening as well as our ability to test climate model predictions more accurately. How well are the models performing? So when we try to push those predictions 20, 30, 100 years out, we have a lot more confidence and then can make better decisions on mitigating climate change, adapting to climate change, whatever the best decisions for society are.

Adaptation- SATs Key

Weather satellites are the best way to manage climate change – key to adapting

Fisk 9 – Lennard A. Fisk, Thomas M. Donahue Distinguished University Professor of Space Science, Department of Atmospheric, Oceanic, and Space Sciences, University of Michigan and Vice Chair, Committee on the Rationale and Goals of the U.S. Civil Space Program Space Studies Board and Aeronautics and Space Engineering Board Division on Engineering and Physical Sciences, National Research Council, The National Academies, October 21, 2009, “THE CASE FOR SPACE: EXAMINING THE VALUE,” testimony before the Subcommittee on Science and Space Committee on Commerce, Science and Transportation U.S. Senate

We also live in a world of challenges, one of the main ones being global climate change. Whether or not you agree on the causes of climate change, nonetheless we must all accept that the climate of Earth is changing, and the outstanding question is what are the regional consequences to which we must prepare to adapt. The Department of Defense has stated that global climate change is a strategic threat to the United States, in recognition that climate change in the developing world can be de-stabilizing, and lead to increased threats from, for example, terrorism. The knowledge of global climate change and its regional consequences will come uniquely from the civil space program. Comprehensive observations from the global perspective of space will be required. We may enter into treaties limiting fossil fuel emissions and other contributions to the greenhouse gases in the atmosphere. Only the global perspective of satellite observations will allow us to monitor compliance by the treaty signatories. “Trust but verify” will work equally well in climate treaties as it did for treaties limiting nuclear weapons.

Satellites key to monitoring global warming

Willis, Fu, Lindstrom, and Srinivasan 10 - Josh K. Willis, Lee-Lueng Fu, Jet Propulsion Laboratory, California Institute of Technology, Eric Lindstrom, Margaret Srinivasan, National Aeronautics and Space Agency, 2010, “17 YEARS AND COUNTING: SATELLITE ALTIMETRY FROM RESEARCH TO OPERA TIONS,” IGARSS 2010

In addition to its operational and scientific uses, precision satellite altimeters provide a critical observation of global climate change. As the Earth’s climate enters a new era where it is driven primarily by human activities, it has become vitally important to monitor the impact of human- induced climate forcing. By providing an estimate of global sea level rise with sub-centimeter accuracy, altimeters capture one of the most profound consequences of global warming (see Figure 4). In addition to collecting the excess freshwater from melting glaciers and ice sheets, the oceans store over 80 percent of the excess heat captured by elevated levels of greenhouse gases causing thermal expansion. The resulting global sea level rise is one of the most direct and societally relevant impacts of global warming. Satellite altimeters therefore provide an important yardstick for scientists and policy makers to determine the extent of human-induced climate change and develop strategies to mitigate and adapt. As global warming and climate change continue, satellite altimeters will also provide insight into the long-term changes in ocean circulation that will impact regional climate around the globe. For instance, recent work [7] has suggested that a slowdown of the Atlantic overturning circulation would cause significantly faster sea level rise on the US east coast as the North Atlantic adjusted to the reduced overturning. Although sometimes difficult to distinguish from natural variations, the global, high- precision climate record that is being collected by satellite altimeters provides the perfect tool for monitoring such changes.

Satellites key to track adaptation

Levitt and Chester 8 - James N. Levitt and Charles C. Chester, James Levitt is director of the Program on Conservation Innovation at the Harvard Forest, Harvard University and a research fellow at the Ash Institute for Democratic Governance and Innovation at the Harvard Kennedy School, Charles C. Chester is the author of Conservation Across Borders: Biodiversity in an Interdependent World (Island Press 2006). He teaches the courses International Environmental Conflict and Collaboration at Brandeis University and International Biodiversity Conservation at The Fletcher School of Tufts University, Fall 2008, “Conservation and Climate Change: The Immediate Need to Adapt,” innovations

In addition to essential face-to-face reassessments, adaptation efforts can also benefit from the use of satellite imagery to audit their impact. As has been noted in a previous edition of Innovations, the use of such technology can assist man- agers in keeping track of changes across wide swaths of forests, such as the 762,000 acre (about 308,000 hectare) Pingree Forest in Maine, which is being managed under a Forest Stewardship Council compliant monitoring scheme that provides annual check-ups and in-depth assessments at each five year interval.25

Adaptation- SATs Key

New tech key to adapt

Perry 2 – Tekla Perry, senior editor of Critical Challenges, January 2002, “Capturing Climate Change: Predicting and preparing for the effects of global warming,” Critical Challenges 2002

Cutting emissions isn’t the only answer. Scientists are also working the other half of the equation: increasing the amount of carbon dioxide absorbed on earth. Plants perform this task, growing faster when there is more carbon dioxide in the air. Oceans absorb it, slowly taking it in until they store two orders of magnitude more than the atmosphere. Various schemes have been suggested to increase storage, like feeding iron into the oceans, so that algae that absorb carbon dioxide proliferate. Or one could simply do nothing to stop global warming. “On a pessimistic day,” said Schimel, “it’s not hard to imagine that we’ll just take the easy way out, use fossil fuel indiscrim- inately, and buy a lot of air conditioning. That scenario leads you to carbon dioxide levels of a thousand parts per million and global mean temperatures up many degrees from today.” The good news is that on most days scientists are cau- tiously optimistic. Said NCAR’s Trenberth: “Maybe we can’t make the problem go away, but we can certainly make scien- tific advances, we can slow down the rate of warming and we can gain enough time to allow us to adapt.

Key to monitoring the oceans

Willis, Fu, Lindstrom, and Srinivasan 10 - Josh K. Willis, Lee-Lueng Fu, Jet Propulsion Laboratory, California Institute of Technology, Eric Lindstrom, Margaret Srinivasan, National Aeronautics and Space Agency, 2010, “17 YEARS AND COUNTING: SATELLITE ALTIMETRY FROM RESEARCH TO OPERA TIONS,” IGARSS 2010

In 1992, NASA and the French space agency launched the first high-precision satellite altimeter to measure changes in sea surface height. With it began a new era in oceanography. Data from satellite altimeters continues to be used to estimate global sea level rise, sea surface height, geostrophic velocity, significant wave height and atmospheric water vapor over the global oceans. In combination with other ocean observations such as color, winds, and gravity, as well as temperature, salinity and velocity from profiling floats, researchers continue to discover new insights into a wide variety of ocean processes and are increasingly able to discern more mesoscale structures. Precision satellite altimetry has matured to the stage where responsibility for the observations is being transitioned from research agencies to operational agencies. Maintaining these observations over the long term will have important implications for climate monitoring as well as scientific and operational use.

Will be monitored in the future

Willis, Fu, Lindstrom, and Srinivasan 10 - Josh K. Willis, Lee-Lueng Fu, Jet Propulsion Laboratory, California Institute of Technology, Eric Lindstrom, Margaret Srinivasan, National Aeronautics and Space Agency, 2010, “17 YEARS AND COUNTING: SATELLITE ALTIMETRY FROM RESEARCH TO OPERA TIONS,” IGARSS 2010

Ocean altimetry provides considerable benefits to society, through scientific research, climate monitoring, and operational applications. Here, we have illustrated several of the ways that ocean altimetry data is being used in order to demonstrate its value to potential users and decision makers. We highlight new and innovative ways the data is used for the public good, including timely and critical climate and weather-related applications.

Responsibility for the operation of Jason-2 has now been assumed by NOAA and EUMETSAT, as have plans for the launch and operation of next altimeter mission, Jason-3. NASA and CNES will continue to support instrument and spacecraft operations and will archive select data from the mission. They will also continue to support an international science team that uses the data to do the important work of ocean and climate science, in addition to ensuring the quality of the long-term climate data record.

Adaptation- SATs Key

Adaptation only response to global warming

Levitt and Chester 8 - James N. Levitt and Charles C. Chester, James Levitt is director of the Program on Conservation Innovation at the Harvard Forest, Harvard University and a research fellow at the Ash Institute for Democratic Governance and Innovation at the Harvard Kennedy School, Charles C. Chester is the author of Conservation Across Borders: Biodiversity in an Interdependent World (Island Press 2006). He teaches the courses International Environmental Conflict and Collaboration at Brandeis University and International Biodiversity Conservation at The Fletcher School of Tufts University, Fall 2008, “Conservation and Climate Change: The Immediate Need to Adapt,” innovations

Yet these groups are still striving to decide where they should concentrate their climate change related efforts. As noted above, many already focus advocacy efforts on promoting mitigation to reduce anthropogenic greenhouse gas emissions. Such advocacy efforts include initiatives to advance international agreements, such as as-yet unsuccessful efforts to have the United States adopt the Kyoto Protocol or its emerging successors; programs to implement regional schemes, such as the Regional Greenhouse Gas Initiative, or RGGI (pronounced “Reggie”) in the north- east United States; and a wide array of local initiatives sponsored by cities, villages, schools, and churches to reduce their greenhouse gas footprint. But as the spread of the mountain pine beetle and the widespread transformation of coastal estuar- ies illustrate, under even the most hopeful of mitigation scenarios, disruptive changes to the environment have and will continue to occur, most probably at an accelerating rate. Only in the past several years have major conservation organiza- tions begun to deal with the immediate need to design and implement adaptation strategies. In February 2007, for instance, a panel of eminent scientists, in preparation for a meeting of the United Nations’ Commission on Sustainable Development, pro- duced a report entitled “Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable.” In the report, the lead authors, Rosina Bierbaum (Dean of the School of Natural Resources at the University of Michigan) and Peter Raven (Director of the Missouri Botanical Garden) highlight the inevitability of continued climate change. In the report’s introduction, they make an unequivocal argument for pursuing both mitigation and adaptation strategies: “Because the climate will therefore be changing for many more decades, it is vital that adaptation strategies are adopted in parallel with aggressive mitiga- tion strategies.”10 Since that time, a growing body of work has helped to move forward the con- servation community’s grasp of the immediate need for adaptation strategies. For instance, at a workshop on the topic of Conservation and Climate Change held at the Lincoln Institute of Land Policy in Cambridge, Massachusetts in May 2007, a small group of senior executives and subject experts working in conservation organizations from the public, private, non-profit and academic/research sectors gathered to consider how to develop effective adaptive management strategies. At the conclusion of that meeting, the group decided that the issue was of such sig- nificance that it merited a second gathering in Washington, D.C. to frame the chal- lenge of adaptive management for a larger audience of policy-makers, conserva- tion leaders and their staff members.

US needs to continue funding and deploying tech to maintain leadership

Macauley 10 - Molly K. Macauley, writes for the think tank Resources for the Future, a think tank located in d.c., May 10, “Climate Adaptation Policy: The Role and Value of Information,” Resources for the Future, Issue Brief 10-10

Collecting these kinds of data comes at a cost. The examples above help show precisely which data and information have value for decisionmaking. The investment to date in data collection, particularly from the vantage point of space observations, is large.

Already the U.S. has invested more than $15 billion in climate‐related data collection, modeling, and analysis of fundamental atmospheric, terrestrial, and oceanic processes that together make up the physical climate system. Additional expenditures—on the order of $6 billion—are required annually to operate these systems. The activities involve at least six government agencies: the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Department of Interior, and the U.S. Department of Agriculture. All these agencies operate climate‐related observing systems either in space or on the ground (to measure carbon flux, land use, and so forth). The objectives of these agencies are largely to identify the climate effects most directly related to their missions; for instance, the Department of Interior needs to know the effects on public lands; the Department of Energy needs to know the effects on fossil and renewable energy demand and supply. Other countries have invested additional amounts in their own science‐observing networks. Counting just the space systems—since these represent most of the expenditure so far—the entire international effort of the United States and some other 30 countries now includes 78 spacecraft carrying 125 instruments (see inventory of the efforts in World Meteorological Organization 2008b, Annex 3). The cost of these efforts is not readily available, but assuming an average cost of about $500 million per system, some $39 billion of observing infrastructure is in place. As noted, additional ground and ocean systems collect data that complement and provide “ground truthing” for the satellites.}

Adaptation- SATs Key

Broad data key

Macauley 10 - Molly K. Macauley, writes for the think tank Resources for the Future, a think tank located in d.c., May 10, “Climate Adaptation Policy: The Role and Value of Information,” Resources for the Future, Issue Brief 10-10

These observations point to the usefulness of redirecting the nation’s significant investment in climate science and data collection to include information specifically to support decisions. A step in this direction is to assign an agency or interagency group the task of more closely linking the GCOS climate variables to priorities for decisionmaking to enhance our ability to adapt to a changing climate. Another step is to increase emphasis on the spatial scale of regional, state, and local decisions and give priority to the information they require. At the same time, climate science has advanced to conceptualize Earth as one system. This integrated approach can be exploited to search for climate‐induced, financially relevant microcorrelations over time and different parts of the world. These microcorrelations are particularly important to insurers, whose role figures prominently in managing large risks. We need a more systematic plan than the current piecemeal approach among agencies for balancing information to serve two ends: what people in states and localities need to know, and what scientists who think of the Earth as a system can tell us about global‐scale phenomena that affect states and localities.

Satellites key – need a better program

Committee on Earth observation satellites 10 – UN framework convention on climate change, Nov-Dec 2010, “Progress by space agencies involved in global observations in their coordinated response to the Global Climate Observing System and to relevant needs of the Convention,” Subsidiary Body for Scientific and Technological Advice Thirty-third session

Satellites in space offer a huge source of information for monitoring the climate system, but the full potential of this source has yet to be tapped. To help space agencies involved in Earth observation in that regard, the Global Climate Observing System (GCOS) Programme has prepared a detailed set of requirements for more systematic and coordinated observation of climate from space. Meeting the GCOS requirements will provide a vastly improved information basis from which nations can make more informed decisions on how to respond and adapt to climate change.

New programs show processing this info is key to adapt

Committee on Earth observation satellites 10 – UN framework convention on climate change, Nov-Dec 2010, “Progress by space agencies involved in global observations in their coordinated response to the Global Climate Observing System and to relevant needs of the Convention,” Subsidiary Body for Scientific and Technological Advice Thirty-third session

5.8.2 NOAA’s Climate Sensor and Climate Data Record (CDR) Projects NOAA has restored climate sensors to the manifest for the future Joint Polar Satellite System (JPSS) to provide continuity of observations of the ECVs for solar irradiance, earth radiation and clouds, and sea level rise. This marks the transition of these observation and processing capabilities from research to operations to ensure their sustained production. Maintaining the high quality level required of ECVs entails the continued involvement of the research community as these observations are moved into the operational environment at NOAA. NOAA’s Climate Data Record Project provides for ongoing production of Climate Data Records (CDRs) and Climate Information Records (CIRs). CDRs and CIRs provide authoritative climate reference sets. They are required by scientists to detect, assess, model and predict climate change, and by decision-makers to devise effective strategies to respond, adapt, and mitigate the impacts of climate change. The programme is primarily executed through competitive grants and NOAA Cooperative Institutes and contracts. The programme leverages prior U.S. investment by transitioning research products from the National Aeronautics and Space Administration (NASA) and other agencies into sustained NOAA operations.

Adaptation- Climate Change Increases Refugees

Climate change forces massive displacement of people

Lee 9 – James R. Lee, Professor in the School of International Service, American University, Washington, DC, and Associate Director of American University’s

Center for Teaching Excellence, Routledge Studies in Peace and Conflict Resolution, “Climate Change and Armed Conflict: Hot and Cold Wars”

Global warming can cause displacement of people. In extreme examples, a desiccated ecosystem may cause entire populations to evacuate an area. Displacement, however, can be either a prolonged or a sudden event. The growth of the Sahara Desert was a prolonged trend over many millennia. Drying and desert conditions thousands of years ago slowly nudged people out of the inland region of northern Africa and into great river valleys like the Nile and the Niger. The current degree of climate change will again threaten the ecological and social stability of these great river systems and the people who live there. Incremental but prolonged rises in sea levels will also slowly uproot hundreds of millions of people. Examples of sudden displacement are the 2005 hurricanes “Katrina” and “Rita” in the southern United States. Together, the two events forced millions of people to suddenly leave Louisiana, Mississippi, and Texas, with several thousand dead. Some researchers believe that climate change will lead to more severe extreme weather events, and cite Katrina as an example of things to come. Consider these hurricanes in a different geographic context. In 1991, a cyclone in Bangladesh displaced two million people and killed 138,000. Whether rapidly or slowly, persons displaced by sudden events will eventually stop and settle down. For most of human history, a reservoir of unclaimed lands served as a “pressure valve” that tamped down conflict. Today, this reservoir no longer exists except in the very least hospitable parts of the planet. Areas now largely uninhabitable because of cold temperatures may eventually become habitable due to warming. Displaced persons will move into these places, provoking conflict. In the first millennium, for example, invading Mongols pushed Germanic tribes further west in Europe, where their conflict with the Roman Empire was inevitable. Rapid climate change exacerbates migration trends. Migration is, however, a complicated phenomenon. There are internal and external dynamics, as well as differences between patterns in developing and developed countries. Jon Barnet notes that “Most migration is not international but rather occurs within individual countries, and most international migration occurs between developing countries” (Barnet 2001: 9). Today, most migration is cyclical. In the future, it is more likely to be a permanent condition. Like conflict, causes for migration are complex: “People rarely migrate for environmental reasons alone. A range of factors, including economic opportunity, operate in unison, and these are in flux as a consequence of the economic and cultural effects of globalization” (Barnet 2001: 9). Migration of displaced persons on a short-term basis may not seem significant. However, as migrants accumulate over an extremely long period, perhaps half a century, there will be substantial demographic impact. Shifting demographic patterns due to climate change will eventually force realignments in domestic, regional, and global power relations. Climate change may cause resources to be more or less available, thereby altering relative wealth of individuals and countries. It is during these periods of change in relative power, driven in part by climate change, that conflict is often more likely. Scarcity, therefore, is not an absolute calculus, but a relative one.

Climate change increases refugees

Urama and Ozor 10 - Kevin Chika Urama, Ph.D. (Cambridge) is an Environmental and Ecological Economist developing trans-disciplinary and integrated tools for sustainable management of social, economic and ecological systems. He holds the 2002-3 James Claydon Prize for the most outstanding PhD thesis in Economics or related subjects, St. Edmund’s College, University of Cambridge, and Nicholas Ozor, B. Agric (Nig.,First Class Honours); MSc (Nig., Distinction) Ph.D. (Reading & Nig.), is a Senior Research Officer at the African Technology Policy Studies Network(ATPS) Nairobi, December 2010, “IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN AFRICA: the Role of Adaptation,” African Technology Policy Studies Network (ATPS)

The effects of climate change are certain to displace some populations, with a significant increase in the number of environmental migrants over the coming decades. For example, between 1970 and 2004 about 14 per cent and 22 per cent of the populations in East and West Africa, respectively, were affected by the multiple effects of drought, extreme temperature, floods, slides, wave/surges, and wind storm (Raleigh, et al, 2007). In many countries, the increase in flooding events, submergence, drought, soil degradation and growing water scarcity in combination with high population growth, unstable institutions, poverty or a high level of dependency on agriculture means that there is a particularly significant risk of environmental migration occurring and increasing in scale. People living in low-lying islands and delta regions face the threat of being submerged by water, hence the only coping strategy will be to move out of the risk sites to more habitable areas (Ozor, 2009). This movement will greatly affect such people in many ways, including loss of livelihoods, loss of social systems and values, loss of property and age-long acquired wealth, injuries and sometimes death. At the transit and destination points, migration generates the potential for conflicts of different dimensions, hunger and starvation, and health problems including epidemics (Ozor, 2009). This situation is worsened where there are no effective and efficient emergency management services to take care of the displaced people.

Adaptation- Climate Change Increases Refugees

Climate change will increase refugees – change in water supply – natural disasters

De Sherbinin, Warner, and Ehrhart 11 - Alex de Sherbinin, Senior Staff Associate for Research at Columbia University's Center for International Earth Science Information Network (CIESIN), an environmental data and analysis center within The Earth Institute at Columbia University specializing in the human aspects of global environmental change, Koko Warner, Head of the Environmental Migration, Social Vulnerability and Adaptation Section at the United Nations University, Charles Ehrhart, leading CARE’s response to climate change in 70 developing countries and is a pioneer in the field. He is the author of ‘In Search of Shelter’, a report on the effects of climate change on human migration and displacement, as well as a study on the ‘Humanitarian Implications of Climate Change.’ January 2011, “Casualties of Climate Change,” Scientific American, 00368733, Vol. 304, Issue 1

SINCE THE BEGINNING OF RECORDED TIME, CLIMATE-FORCED MIGRATIONS HAVE RESHAPED CIVILIZATION. Four thousand years ago a prolonged drought and the resulting famine in Canaan drove Jacob and his sons to Egypt, setting the stage for the famous exodus led by Moses. Three millennia later a prolonged dry period and lack of grazing lands helped to push Mongol armies out of Central Asia as far west as Europe, where many settled and intermarried. And in the 20th century the American Dust Bowl, an ecological catastrophe precipitated by drought and compounded by bad land-management policies, displaced 3.5 million people from the Midwest. Today this age-old story has a new twist. We are entering an era marked by rapid changes in climate brought on by man-made greenhouse gas emissions. Anticipated changes include higher rainfall variability, greater frequency of extreme events (such as droughts and floods), sea-level rise, ocean acidification, and long-term shifts in temperature and precipitation--any of which can profoundly disrupt the ecosystems that supply our basic needs. In our more densely settled world, people may be forced from their homes in numbers never seen before. Most attention has centered on the plight of low-lying island states threatened by rising sea levels. Under certain scenarios, many of the world's 38 small island states could disappear by the end of this century. Yet the problem faced by the inhabitants of these states is just the tip of the atoll. In India alone, 40 million people would be displaced by a one-meter sea-level rise. Unfortunately, this coastal flooding is far from the only climate-related challenge in South Asia. Models developed by Arthur M. Greene and Andrew Robertson of Columbia University suggest an increase in total monsoon rainfall but a decrease in the frequency of rain, implying more intense rainfall in fewer days. Shifts in the seasonality of river flows (as winter snowpack declines and glaciers shrink) would affect the agricultural livelihoods of several hundred million rural Asians, as well as the food supplies of an equal number of Asian urbanites. Although it may take decades to understand the full impacts of glacier melting and sea-level rise, the increase in climate-related catastrophes is already a fact. The frequency of natural disasters has increased by 42 percent since the 1980s, and the percentage of those that are climate-related has risen from 50 to 82 percent. The United Nations Office for the Coordination of Humanitarian Affairs and the Internal Displacement Monitoring Center estimates that in 2008, climate-related calamities drove 20 million people from their homes--more than four times the number displaced by violent conflict. Forced migration and displacement prompted by climate change is therefore poised to become the international community's defining-- and potentially overwhelming--humanitarian challenge in coming decades. In this article, we offer a sense of what the future holds by looking at the factors that have already begun to instigate such movements in three regions of the world. First we consider Mozambique, where a combination of catastrophic floods and periodic droughts has caught rural populations in a double bind. Next we examine the Mekong Delta. Floods there have long been part of the rhythm of life, yet the scale in recent years has surpassed historic precedent, and the country is facing catastrophic losses of productive land from projected sea-level rise. We close with Mexico and Central America, where tropical storms and cyclones have displaced thousands, and drought looms as a constant danger.

Number of environmental refugees could reach 1 billion

Myers 1 – Norman Myers, Adjunct Professor of Environmental Science @ University of Oxford, PhD, University of California, Berkeley, May 30, 2001, “Environmental refugees: a growing phenomenon of the 21st century,” the Royal Society, doi 10.1098/rstb.2001.0953

How many environmental refugees can we realistically anticipate in the future—or rather, how many people are likely to become vulnerable to environmental problems that could force them to migrate? Let us consider the out- look for the year 2010. The population of developing countries is projected to have grown from 1995 by well over one billion people, a 24% increase in just 15 years. Sub-Saharan Africa’s total will have expanded by some 240 million, a 42% increase, and the Indian subconti- nent’s by 377 million, 32%. The numbers of people in absolute poverty are predicted to swell from 1.3 billion to 1.6 billion. The 135 million people affected by severe desertification could well increase to 180 million. The populations of water-short countries, 550 million today, are expected to surge to more than one billion. If the 1985 and onwards ‘plateauing’ of crop yields continues, there will be greater, and more widespread, shortfalls in food production (especially in Sub-Saharan Africa and the Indian subcontinent), while international tradable stocks will be increasingly unable to keep up with the fast bur- geoning demand (UNICEF 2000; UN Fund for Popu- lation Activities 2000; World Bank 2000). The 25 million environmental refugees in 1995 had mostly become obliged to migrate since 1980, when their numbers first started to climb rapidly. In the light of pat- terns and trends of environmental decline and its associa- ted problems, such as spreading poverty and population increase, it is probable that by 2010 there will be another 25 million such refugees on top of the 25 million in 1995, if only because the impelling factors will continue to be at least as prominent for the communities concerned. (This supposes, too, that there will be few preventive measures of sufficient scope.) In fact, the increase could be more than another 25 million because of increasingly degraded environments coupled with growing numbers of impover- ished people. For a specific instance of the problem’s scope to expand, consider the prospect for Sub-Saharan Africa until the year 2010. This is already the region with half of the world’s traditional refugees and at least a similar proportion of environmental refugees. Despite some advances in soil conservation (in Kenya and Ethiopia), small-scale agriculture (in Nigeria and Zimbabwe), refor- estation (in Tanzania and Malawi), anti-desertification (in South Africa), and population planning (in Kenya, Zim- babwe and Botswana), the outlook is unpromising. The region’s population is projected to increase to more than 800 million people, fully 42% more than in 1995. Severe desertification might well affect more than 100 million people, half as many again as today. Ten countries are expected to be experiencing chronic water shortages or even acute water scarcity, with collective populations totalling well over 400 million people. Without greatly expanded efforts to tackle the region’s lack of develop- ment, per capita GNP (gross national product) will prob- ably stagnate in real terms at around US$400, or little higher than in 1970 (Myers & Kent 2001;

Adaptation- Climate Change Increases Refugees

Otunnu 1992). Most important of all will be the region’s incapacity to feed itself. Some 20 countries with a total projected popu- lation of 440 million are expected to experience up to 25% shortfall in food supplies, and a further eight countries with a projected 75 million people face more severe defi- cits (Myers & Kent 2001; US Department of Agriculture 1999). The total number of malnourished people will con- tinue to grow, with at least 100 million destitutes obliged to live for the most part off imported food. The food deficit could rise to as high as 30 million tonnes. Because of its exceptional poverty, the region will be increasingly unable to compete in the global grain market. Food aid worldwide in 1995 was only 7.5 million tonnes, enough to make up the diets of only 10 million semi-starving people (Myers & Kent 2001). In addition, there will be problems of global warming. Due largely to sea-level rise and flooding of coastal-zone communities, but also to increased droughts and disrup- tions of rainfall regimes, such as monsoonal systems, glo- bal warming could threaten large numbers of people, with displacement by 2050 or earlier. Preliminary estimates indicate that the total number of people at risk of sea-level rise in Bangladesh could be 26 million, in Egypt 12 million, in China 73 million, in India 20 million, and else- where, including small island states, 31 million, making a total of 162 million. At the same time, at least 50 million people could be at severe risk through increased droughts and other climate dislocations (Myers 1996; see, also, Watson et al. 1998). All in all, the issue of environmental refugees promises to rank as one of the foremost human crises of our times. So far, however, it has been viewed as a peripheral con- cern, a kind of aberration from the normal order of things—even though it is an outward manifestation of pro- found deprivation and despair. Although it derives prim- arily from environmental problems, it generates problems of political, social and economic sorts. As such, it could readily become a cause of turmoil and confrontation, lead- ing to conflict and violence. Yet as the problem becomes more pressing, our policy responses fall further short of measuring up to the challenge. To repeat a key point: environmental refugees have still to be officially recog- nized as a problem at all. At the same time, there are limits to host countries’ capacity, let alone willingness, to take in outsiders. Immigrant aliens present abundant scope for popular resentment, however unjust this reaction. In the wake of perceived threats to social cohesion and national identity, refugees can become an excuse for outbreaks of ethnic tension and civil disorder, even political upheaval. This is already the case in those developed countries where immi- grant aliens increasingly prove unwelcome, as with the experience of Haitians in the United States and North Africans in Europe. Almost one-third of developed coun- tries are taking steps to further restrict immigrant flows from developing countries. Yet measures to relieve the plight of refugees of whatever kind have drastically dimin- ished in relation to the growing scale of the problem. Although the annual budget of the UN High Com- missioner for Refugees has recently been boosted to US$1.3 billion, the agency is increasingly unable to supply food and shelter for refugees of a traditional kind, much less to invest in rehabilitation or repatriation of these refu- gees. Meanwhile, the world’s refugee burden is borne primarily by the poorest sectors of the global community. In 1998, the 20 countries with the highest ratios of official (traditional) refugees had an annual per capita income of only US$750.

Number of people effected

Wolf 1 – S. Rowan Wolf, Sociology Professor, Portland Community College, “Shifting Tides: Migration in the Era of Globalization, Global Conflict, and Environmental Collapse,” Forum on Public Policy

There are currently approximately 163 million forcibly displaced people globally. It is estimated that there will be a billion forcibly displaced by 2050. Another 3.2 billion people will be facing scarce water supplies by 2080 (Christian Aid). The United Nations estimates that there are up to 200 million people currently impacted by desertification, and that another 50 million will be added to that number within the next ten years (Adeel et al 2006). The International Panel on Climate Change (IPCC) Working Group is less optimistic. They project that by 2020 seventy- five to two hundred and fifty million people could be impacted by water shortages in Africa alone, and by 2050 one billion people in Asia alone (Adger 2007).

Adaptation- Refugee Impacts

Causes exploitation

Wolf 1 – S. Rowan Wolf, Sociology Professor, Portland Community College, “Shifting Tides: Migration in the Era of Globalization, Global Conflict, and Environmental Collapse,” Forum on Public Policy

These refugees (many of whom are undocumented) are seen as a cheap and exploitable labor force. They are vulnerable due to their undocumented status. They end up part of an invisible population, often living in substandard conditions on the fringe of the society. Frequently they join the marginalized ranks of others from their home nations or regions. Their marginalization may lead to increasing levels of conflict.

Need to avoid involuntary resettlement – leads to violence

Barnett Et.al. 10 – Jon Barnett - Department of Resource Management and Geography @ The University of Melbourne, april 2010, “Accommodating Migration to Promote Adaptation to Climate Change,” Policy Research Working Paper 5270, Background Paper to the 2010 World Development Report, The World Bank, Development Economics, Office of the Senior Vice President and Chief Economist, http://www.iadb.org/intal/intalcdi/PE/2010/05224.pdf

Involuntary resettlement rarely leads to improvements in the quality of life of those who are moved. People who are resettled lose their land, the understanding of the local environmental and institutional conditions necessary for development, their jobs if they were employed, their trust in social institutions such as government, and their social networks are disrupted. The resettlement process creates opportunities for corruption, and in some circumstances resettled communities are the subjects of sporadic and at times organized violence. For these reasons, resettlement that is anything other than entirely voluntary and consensual would in no way constitute an ‘adaptation’ in the sense of an avoided impact from climate change. Further, there is a danger that powerful actors use climate change as an excuse to conduct forced migrations for political or economic gain, and so careful monitoring of resettlement purportedly to reduce vulnerability to climate change is now required.

Adaptation- International Spillover

Environmental policies spillover – 100 countries implementing similar programs prove

Busch and Jorgens 5 - Per-Olof Busch, Environmental Policy Research Centre, Free University Berlin, Department of Political Science, Helge Jörgens, Research Fellow, German Advisory Council on the Environment, 2005, “International Patterns of Environmental Policy Change and Convergence,” European Environment Eur. Env. 15, 80–101, DOI: 10.1002/eet.374

NATIONS INCREASINGLY TEND TO ADOPT SIMILAR ENVIRONMENTAL POLICY INNOVATIONS, I.E. environmental institutions, laws, policies and instruments. Over the last decades more than 100 countries across the globe have created environmental ministries, adopted environmen- tal framework laws, implemented environmental impact assessments (EIAs) and formulated national environmental strategies (Busch and Jörgens, in press). Environmental policy innovations increasingly spread across nations and the growing number of individual policy adoptions aggregates to a remarkable degree of cross-national environmental policy convergence. This empirical phenome- non begs the question of why and how environmental institutions, laws, policies and instruments spread across nations. To answer this question, this article first identifies distinguishable and recurring pat- terns of spread of environmental policy innovations. It then introduces three analytically distinct polit- ical mechanisms that contribute to the international spread of policy innovations. In a final step, the paper links these mechanisms to the previously identified proliferation patterns.

Adaptation- Climate Change Hurts Biodiversity

Climate change causes decline in biodiversity without adaptation

Bridle and Vines 7 - Jon R Bridle, Institute of Zoology, Zoological Society of London, and School of Biological Sciences, University of Bristol, and Timothy H Vines, Department of Zoology, University of British Columbia, March 2007, “Limits to evolution at range margins: when and why does adaptation fail?” Trends in Ecology & Evolution, Vol. 22, Issue 3, pg. 140-147

Box 1. Extinction and evolution in response to climate change Climate change represents a major immediate threat to biodiversity. Models that project the ecological tolerances of species on future climatic scenarios estimate that at least 11% of species will become extinct during the 21st century, even if one assumes that they can disperse to track the distribution of suitable habitat [69]. However, this figure will be an underestimate in cases where dispersal is limited or if local adaptation already exists throughout a species’ range, meaning that ecological tolerance within a given population will be less than the models assume [70]. Conversely, extinctions will be reduced if species can adapt to changing conditions, particularly at range margins, enabling more widespread habitats to be exploited.

Adaptation- Climate Change Causes Water Wars

Climate change will create water wars

Urama and Ozor 10 - Kevin Chika Urama, Ph.D. (Cambridge) is an Environmental and Ecological Economist developing trans-disciplinary and integrated tools for sustainable management of social, economic and ecological systems. He holds the 2002-3 James Claydon Prize for the most outstanding PhD thesis in Economics or related subjects, St. Edmund’s College, University of Cambridge, and Nicholas Ozor, B. Agric (Nig.,First Class Honours); MSc (Nig., Distinction) Ph.D. (Reading & Nig.), is a Senior Research Officer at the African Technology Policy Studies Network(ATPS) Nairobi, December 2010, “IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN AFRICA: the Role of Adaptation,” African Technology Policy Studies Network (ATPS)

Water resource use for domestic, commercial, or industrial purposes is known to have triggered numerous conflicts across Africa. A water crisis increases the probability of competition between water use sectors and, in the absence of systems regulating such competition, the likelihood of water conflict (WBGU, 2008). Climate change is anticipated to increase conflicts as a result of struggles for water use if increasing supply to meet growing demand for water resources cannot be assured, in addition to other pressures on natural and human systems, e.g. from population growth (Ozor, 2009).

Adaptation- Disease

Internal Link to Malaria-climate satellites can be used with Geographic Information Systems (GIS) to map out mosquito populations.

Sithiprasasna et al 5- Ratana Sithiprasasna, chief of the mosquito biology section at the Entomology Department of the Armed Forces Research Institute of Medical Sciences (AFRIMS); Won Ja Lee, expert on parisitology and frequent contributor to The Korean Journal of Parasitology; Donald M Ugsang, PhD in Engineering specializing in Environmental Remote Sensing and Geoinfo. For Development; Kenneth J Linthicum, PhD in Biology and Director of the Center of Medical, Agricultural and Veterinary Entimology, 13 July 2005, “Identification and characterization of larval and adult anopheline mosquito habitats in the Republic of Korea: potential use of remotely sensed data to estimate mosquito distributions,” online: <http://www.ij-healthgeographics.com/content/pdf/1476-072X-4-17.pdf>

To better asses malaria risk factors further studies are required to address topics that include: 1) testing mos- quito specimens from man-biting collections for the pres- ence of malaria parasite using molecular techniques to determine vectorial capacity and entomological inocula- tion rates, 2) performing proximity analysis of each patient from immature mosquito habitats to quantify risk of living in areas with Anopheles immature habitats, and 3) performing detailed GIS analysis with the input of bio- physical ground truthing and meteorological parameters from climate satellites to define the temporal dynamics of malaria transmission. It is anticipated that in the future the GIS databases will be used to quantify spatial and temporal relationships between larval habitats and character- ization of adult mosquito density in the associated villages. Final products of the GIS will include maps depicting the spatial distribution of larval mosquito habitats for various species and a map depicting potential adult mosquito population in villages proximal to the immature habitats.

Satellites key Internal Link to disease- satellites have a distinct advantage over ground measurements AND cheaper

Kalluri et al 7-Satya Kalluri, PhD in Geography and assistant research scientist at the Department of Geography at the University of Maryland; Peter Gilruth, PhD in Forestry and Forest Product Techniques and has over 20 years of experience as an environmental scientist and project manager and strategist with the US Government and the UN Development Programme (UNDP) and currently in the private sector where he collaborates closely with the US space agency NASA; David Rogers, PhD in Geological and Geotechnical Engineering and Professor at Missouri University of Science and Technology; Martha Szczur, writer of several books on pathogens and health geographics, 2007, “Surveillance of Arthropod Vector-Borne Infectious Diseases Using Remote Sensing Techniques: A Review,” pdf available online: [http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.0030116](http://www.plospathogens.org/article/info%3Adoi/10.1371/journal.ppat.0030116)

Remote sensing satellites provide continuous measurements of the earth and its environment, and offer a synoptic monitoring capability. Satellite measurements have distinct advantages over ground measurements since they can be collected repeatedly and automatically. In the United States, the National Aeronautics and Space Administration (NASA) is the prime agency responsible for developing new remote sensing technologies and remote sensing satellites, collecting earth system science data to study global change, and developing applications to use remotely sensed data. The National Oceanic and Atmospheric Administration (NOAA) operates a series of weather satellites that collect operational data for weather forecasting and climate prediction. Besides NASA and NOAA, several European Union countries, Japan, Canada, and India have remote sensing satellites that provide global observations. A list of different Earth-observing satellite sensors that are discussed in this paper and their spectral, spatial, and temporal characteristics are given in Table 3.

The use of remote sensing techniques to map vector species distribution and disease risk has evolved considerably during the past two decades. The complexity of techniques range from using simple correlations between spectral signatures from different land use–land cover types and species abundance (e.g., [8,9]) to complex techniques that link satellite-derived seasonal environmental variables to vector biology [10]. While a variety of numerical techniques to create maps of vector distribution in time and space from satellite data are available, only those techniques that aid our understanding of biological processes provide meaningful information in epidemiology and vector control. A review of different modeling approaches for mapping vector and vector-borne diseases is discussed by Rogers [11]. The typical modeling approach is to use either logistic regression or discriminant analysis techniques that investigate associations between multivariate environmental data and patterns of vector presence or absence for mapping vectors and vector- borne diseases. Both of these methods are capable of predicting the a posteriori probability of the presence of the dependent variable (e.g., either the vector or the disease) from a set of independent variables (e.g., climate and land cover data) and can be used to make risk maps from sample data sets (i.e., training datasets) based on the observed similarity of environmental conditions to sites. The choice of techniques should be able to accommodate both categorical (e.g., disease presence or absence) as well as continuous data (e.g., surface temperature data) spatial data.

The approach in developing remote sensing applications in epidemiology depends on the spectral, spatial, and temporal characteristics of remote sensing measurements. Environmental satellites that collect earth observations daily or several times a day of the same geographic region (e.g., NOAA’s Polar Operational Environmental Satellites and Geostationary Operational Environmental Satellites) are ideally suited for collecting rapidly changing meteorological variables such as atmospheric moisture and surface temperature. Data from these satellites are valuable in modeling the climate-dependent vector life cycles and sustainability. In general, operational environmental satellites collect more frequent observations at a coarser spatial resolution (;1 km), over large geographic regions, and are cheaper to acquire compared to images from other land imaging satellites such as Landsat or IKONOS that have less frequent revisit capability but have a higher spatial resolution (30 m or higher). A summary of the availability of environmental satellite data for mapping infectious diseases can be found in [12]. A

Adaptation- Disease

combination of high spatial resolution data for land use and land cover classification and frequentcoarse resolution environmental satellite data for monitoring environmental variability would be ideal for studying surface climate conditions for modeling vector populations.

Application of remote sensing data in epidemiology involves retrieving environmental variables that characterize the vector ecosystem such as land cover, temperature, humidity or vapor pressure, and precipitation. Measurements of Earth’s surface reflectances and temperature can be made directly from satellites. However, measuring meteorological and climate variables near the surface is more difficult, and frequently, empirical methods are used. Because of complexities and limitations in estimating meteorological variables through remote sensing, proxy variables such as vegetation indices that measure the abundance, spatial extent, and dynamics of vegetation are used as a surrogate indicator of climate variability in epidemiological studies (e.g., [13]). The Normalized Difference Vegetation Index (NDVI), which exploits the strong contrast in the reflectance of vegetation in the red and near infrared wavelengths, is a commonly used index to study vegetation dynamics (e.g., [14]). Since vegetation dynamics are influenced by variations in climate, strong correlations between vegetation indices and climate variables can be found. A combination of vegetation indices, surface reflectance, and temperature measurements have been used by epidemiologists to model vector ecosystems (e.g., [10]). An earlier discussion of remote sensing techniques used in the study and control of invertebrate hosts and vectors for diseases can be found in [15].

Internal Link to mosquito diseases- empirically proven that satellites can accurately map disease populations.

Kalluri et al 7-Satya Kalluri, PhD in Geography and assistant research scientist at the Department of Geography at the University of Maryland; Peter Gilruth, PhD in Forestry and Forest Product Techniques and has over 20 years of experience as an environmental scientist and project manager and strategist with the US Government and the UN Development Programme (UNDP) and currently in the private sector where he collaborates closely with the US space agency NASA; David Rogers, PhD in Geological and Geotechnical Engineering and Professor at Missouri University of Science and Technology; Martha Szczur, writer of several books on pathogens and health geographics, 2007, “Surveillance of Arthropod Vector-Borne Infectious Diseases Using Remote Sensing Techniques: A Review,” pdf available online: [http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.0030116](http://www.plospathogens.org/article/info%3Adoi/10.1371/journal.ppat.0030116)

Mosquitoes. Diseases and vector habitats. Mosquitoes (Figure 1) are found throughout the world, and mosquito-borne diseases are among the world’s leading causes of illness and death. Despite great strides over the last 50 years, the World Health Organization estimates that more than 300 million clinical cases of mosquito-borne illnesses occur each year. There is a long history of developing disease transmission models by mosquitoes (e.g., [16,17]) and a good summary is provided by Anderson and May [18]. Several factors, such as seasonality, proximity to breeding grounds, vector density, biting rates, and proportion of infectious mosquitoes, contribute to the spread of mosquito-borne diseases.

Mosquitoes require still or slow moving water for completing the larval and pupal stages of their life cycle. Both natural as well as man-made environments of stagnant water are conducive to their breeding. For example, in Asia and America, Aedes aegypti breeds primarily in man-made water containers such as automobile tyres, metal drums, recycling containers, and domestic water storage containers, whereas in Africa, they breed in tree holes and leaf axils [19,20]. Temperature, precipitation, and relative humidity are the three main factors that determine the abundance of mosquitoes and the prevalence of mosquito-borne diseases such as malaria [21]. The optimum temperature for mosquito development of tropical species is 25–27 8C [22], and there is a strong temperature dependence of the development of the parasites within the mosquito vectors. For example, the time needed for the sporozoites of Plasmodium falciparum to reach the salivary glands of mosquitoes is inversely proportional to the air temperature with a difference of 14 days between 30 8C and 10 8C [23]. Mosquito-borne diseases such as malaria are seasonal and case numbers correlate well with rainfall patterns [23]. However, too little rainfall creates fewer breeding habitats, and too much rainfall tends to wash away the mosquito eggs [24]. Irrigated agricultural areas such as paddy fields in Asia and inland tidal waters are also very favorable for the breeding of some mosquito species.

Remote sensing studies of mosquito-borne diseases. Mosquito- borne diseases are prevalent throughout the world, and remote sensing applications in epidemiology have been most widely used to study mosquito-borne diseases. A good summary of mosquito biology and methods to map their habitats from satellites can be found in [25].

Initial studies largely focused on identifying mosquito breeding habitats such as marshes and wetlands through land- use and land-cover mapping using remote sensing data (e.g., [26–31]). For example, Landsat data was used to determine green leaf area index (LAI) over 104 rice fields, and these measurements were compared to larval counts of Aedes freeborni at the edge of the fields and the minimum distance from the center of each field to the nearest livestock pastures that provide the blood-meal source [8,32]. This analysis showed that fields that are near pastures that have high LAI and tiller density produce large numbers of mosquitoes, and fields with low LAI that are further from the pastures have lower numbers of mosquitoes. A combination of spectral measurements from the satellite data and distance measurements to pastures were used in discriminant analysis to identify high mosquito producing areas with 90% accuracy.

Multispectral data from the SPOT (Satellite Probatoire d’Observation de la Terre) satellite was used to map the probability of mosquito presence in Belize by Roberts et al. [33]. This study measured the distance of houses from waterways, altitude above specified waterways, and amount of forest between houses and waterways. Each site was then ranked as high, medium, or low for probability of mosquito infestation based on thresholds of distance, elevation, and forest cover. Areas that were closest to the water in both distance and altitude with no intervening forests were assigned the highest probability of mosquito presence around humans. Their results showed that Anopheles pseudopunctipennis was present in 50% of all the high probability locations and absent in all the low probability locations.

Anopheles darlingi larval habitats were surveyed in Belize by sampling along the Sibun River in Belize and compared with land cover classification from SPOT and IKONOS data [34]. Ground survey showed a strong correlation between positive larval habitats and debris from trees such as fallen trunks, branches, and root systems compared to other landscape features. However, no such correlations could be made between positive larval habitats and different land cover types such as forests and orchards or landscape features such as river bends where one would expect to find fallen tree detritus. Overhanging

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spiny bamboo trees were one of the major sources of floating detritus mats for larval breeding, but the satellite imagery did poorly in discriminating bamboos from other vegetation during classification in this study. The only association between positive and negative A. darlingi sampling sites was their distance to the nearest houses, where the negative sites were 162 m further away from homes compared to the positive sites. The authors conclude that the high cost of high spatial resolution imagery to identify houses along a river would make this technique unsuitable for developing countries. Nevertheless, the use of high spatial resolution data for mapping land use, land cover, and hydrological features to identify suitable vector habitats continues to be a popular approach (e.g., [35]).

Advances in understanding of correlations between multispectral satellite measurements and meteorological variables such as rainfall and temperature have led to the development of statistical models of mapping vector habitats using relationships between satellite-derived climatology and vector ecology. Rift Valley fever (RVF) is a mosquito-borne disease that affects humans and animals in various parts of Africa. Mosquito breeding habitats in East Africa, known locally as ‘‘dambos’’, are frequently flooded during periods of heavy rainfall, which leads to a build-up of mosquito populations and subsequent RVF outbreaks. Since NDVI is known to be correlated with variations in rainfall, variability of NDVI has been shown to be associated with RVF incidence [36]. A discussion on the use of temporal profiles of NDVI and cold cloud duration (CCD) measurements from satellites in models of mosquito distribution and malaria in Africa is found in [37]. Sea surface temperature (SST) variations indicate that El Nin ̃ o Southern Oscillation and concurrent SST elevations in the Pacific and Indian oceans are correlated with increased rainfall in Eastern Africa. When SST data and NDVI were used together as the predictor variables, the incidence of RVF could be forecast up to 5 months in advance [38,39].

Temporal Fourier processed measurements of NDVI, land surface temperature, and CCD were used by Rogers et al. [10] to capture the seasonal climatology of the African landscape. Fourier processing of these variables reduces the dimensionality of the data set while retaining crucial information about habitat seasonality (information that is lost by other methods of data reduction, such as Principal Components Analysis). The Fourier processed images were used in discriminant analytical models to describe both the distribution of five important species in the Anopheles gambiae complex of species in Africa and the risk of malaria as captured by the entomological inoculation rate (EIR, the number of infectious bites per person per year). Relationships observed between EIR and satellite data were used to make a predictive map of EIR across the continent. Similar techniques were used to create risk maps of West Nile virus in the United States [40] and maps of global distributions of yellow fever and dengue [41]. The predicted risk maps showing the maximum likelihood, posterior probability of disease presence or absence had an average kappa index between model predictions and observations of 0.742 for yellow fever and 0.700 for dengue.

Figure 2 shows the potential distribution of four species of West Nile virus–carrying mosquitoes in the United States derived using the techniques described by Rogers et al. [40]. Note the close agreement between the geographic extent of distribution derived from satellite data and the recorded distribution on the ground.

Internal Link to tick diseases- can have world wide economic effect-can predict the emergence of tick “flaviviruses”

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Ticks. Diseases and vector habitats. Ticks are responsible for transmitting a variety of pathogens, including protozoa, rickettsia, bacteria, and viruses, to both humans and livestock [42], which causes substantial economic damage worldwide [43,44]. Lyme disease, Rocky Mountain spotted fever, ehrlichiosis, and babesiosis are some of the more common diseases in humans that are transmitted by ticks. Lyme disease is the most common vector-borne disease of humans in the United States and Europe [45,46].

Unlike other arthropod vectors such as mosquitoes, ticks are hematophagous only once per life cycle stage, taking large blood meals equivalent to 10–100 times their body weight [47]. The primary hosts of Ixodes scapularis (Figure 1), the black-legged tick that carries the bacteria Borrelia burgdorferi, which causes Lyme disease in humans, are the white-footed mice (Peromyscus leucopus) and white-tailed deer (Odocoileus virginianus) [45]. During their life cycle, different Ixodid tick species may use one, two, or three different host species [48]. In their free-living stages, most tick species have specific requirements in terms of microclimate and tend therefore to be picked up only by those hosts that frequent the habitats providing such conditions [48–51]. Tick populations are abundant in deciduous forests with leaf litter and ecosystems with shrubs and tall grasses in temperate climates with high relative humidity. Lyme disease shows strong seasonality, with peaks occurring during the summer and fall months when the nymphs are most active [52]. However, changes in the incidence of tick-borne diseases cannot always be related to climate change; changes in other elements of complex epidemiological cycles may also play a part. For example, Lyme disease within the United States is concentrated mostly in the northeastern Atlantic states [53], and the spread of this disease seems to be closely related to an increase in the population of the white-tailed deer [54], an increase due to a diminution of hunting pressure and an increase in woodland in close proximity to human habitation.

Remote sensing studies of tick-borne diseases. A land cover map derived from a Landsat Thematic Mapper (TM) image of Guadeloupe, French Windward Islands, was used by Hugh- Jones [55,56] to discriminate four grazing regions with different levels of cattle tick Amblyomma variegatum infestation in 103 cattle herds. The four classes were lightly infested dry meadows, moderately infested foothills, heavily infested dry scrub, and rocky grasslands. The spatial variability of pixel values within individual grazing fields also correlated well with tick density; areas where the landscape was variable had more ticks compared to homogenous areas.

Ticks exhibit strong seasonal dependence of mortality and disease transmission, which can be related to temperature and vegetation conditions [47]. A critical factor for egg laying and larval development is temperature and humidity. Since these factors can be related to

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NDVI, multitemporal NDVI measurements from the Advanced Very High Resolution Radiometer (AVHRR) have been correlated with mean mortality during the life cycle between the adult female and subsequent larval stages in Burundi, Uganda, and Tanzania [57].

Using environmental variables obtained at the residences of Lyme disease patients in Baltimore County, Maryland, from 1989 through 1990 within a geographic information system (GIS), Glass et al. [58] showed that many suitable tick habitats in the northeastern United States coincide with residential properties close to wooded areas. Brightness, greenness, and wetness determined from Landsat data [59] were used along with elevation and land cover classes to determine risk for Lyme disease on 337 residential properties in two communities of suburban Westchester County, New York [60]. Spatial analysis of Lyme disease risk indicated that high-risk properties had a greater abundance of green vegetation and/or a higher proportion of woods than lower and no-risk properties, which is consistent with field-based studies of the landscape ecology of Lyme disease.

Ticks are not highly mobile in nature, and they depend on their hosts (e.g., the white-footed mouse) for movement over large distances. However, not all environments that a host might inhabit are suitable for ticks to survive and reproduce. Therefore, the presence of an adequate host population by itself is not a risk factor for the transmission of Lyme disease. To determine what specific environments are conducive for the survival of I. scapularis in the upper Midwest, a survey was conducted of tick populations by collecting samples from vertebrate hosts on the ground, and environmental data from each collection site was compared with tick abundance [61]. Land cover data derived from Landsat TM data was used with maps of soils, geology, elevation, and climate to determine significant associations between tick presence and environmental variables. Discriminant analysis was used to determine the significant environmental factors that differentiate positive and negative tick sites. Logistic regression analysis was used to create maps of habitat suitability for I. scapularis. Areas that had high suitability coincided with the incidence of Lyme disease in Wisconsin. The results of the logistic regression (83.9% classification accuracy) were in agreement with the discriminant analysis (85.7% classification accuracy) and both techniques showed that soil order and land cover were the dominant factors for tick presence.

Using NDVI and surface temperature measurement from AVHRR between 1982 and 2000, Estrada-Pena [62] showed that favorable tick habitats within the United States are increasing. A reduction in biodiversity due to deforestation and forest fragmentation could lead to an increase in the density of the white-footed mouse, and ticks feeding on the white-footed mouse have a higher probability of being infected with B. burgdorferi than any other host [63].

Environmental data derived from satellites was used by Randolph and Rogers [64] to differentiate the eco-climatic zones of six tick-borne flaviviruses. Since only certain environments that can sustain the appropriate natural life cycles of the vector can support the virus transmission cycles, this study suggests that climate may have played a role in directing the evolution of the flaviviruses. By understanding the biotic and abiotic constraints imposed on the evolution and mutation of vector-borne microbes, it may be possible to predict the non-evolutionary emergence of vector-borne diseases under dynamic eco-climatic conditions with a detailed knowledge of vector biology and transmission conditions.

Internal Link to black fly diseases-empirically satellites have mapped them

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Black flies. Diseases and vector habitats. Blackflies are about 1– 6 mm in length and are amongst the smallest blood-sucking Dipterans. They usually breed in well-aerated water bodies such as swiftly moving shallow mountain torrents [48], or sunlit, fast flowing rivers in the tropics [65]. Onchocerciasis or river blindness is caused by the helminth Onchocerca volvulus of the family Filariidae, whose larvae are transmitted between humans by blackflies of the family Simuliidae (Figure 1). Onchocerciasis is the second leading cause of blindness in the world with 96% of the affected people living in 30 countries in sub-Saharan Africa (and Yemen), with the remainder in six countries in Latin America [66]. Several programs such as the Onchocerciasis Control Programme in West Africa [67], the Onchocerciasis Elimination Program for the Americas [68], and the African Programme for Onchocerciasis Control [69] target this dreadful disease which, because its impact is greatest in mature individuals (i.e., the agriculturally productive sector of societies), has a disproportionate effect on human communities.

Remote sensing studies of diseases due to black flies. The African Programme for Onchocerciasis Control developed a program called Rapid Epidemiological Mapping of Onchocerciasis (REMO) to enable communities at high risk to be quickly and cheaply identified and mapped for priority treatment. However, when ivermectin, the drug used to treat onchocerciasis is administered to patients who are also infected with Loa loa, fatal complications have been reported [70]. Therefore, before Ivermectin could be distributed, WHO wanted to map areas with L. loa infection so that drug administration protocols could be modified to avoid complications. Flies of the genus Chrysops (family Tabanidae) that carry the cutaneous filarial parasite L. loa, causing Calabar swellings in humans, are associated with forest and forest fringe habitats with larval stages restricted to wet, organically rich and muddy low-lying areas within the forests [71]. Using forest cover and landcover classes derived from AVHRR along with soil and topography data, the prevalence of L. loa in six African countries was predicted, and the results were compared with priority areas defined by the REMO project [71]. About 50% of the variation in prevalence rates of the infection could be explained by the satellite-derived environmental factors. There were extensive areas of agreement between the satellite derived maps and areas that were identified by REMO as high priority treatment areas in Cameroon and the Democratic Republic of Congo.

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Internal Link to tsetse fly diseases-African diseases

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Tsetse flies. Diseases and vector habitats. Tsetse flies (genus Glossina), which are found only in Africa, transmit various protozoan parasites of the genus Trypanosoma, which cause sleeping sickness in humans and ‘‘nagana’’ in domestic animals. There are 30 species or subspecies of tsetse, classified into three groups: the fusca group, found mostly in forests, the palpalis group, found in forests and riverine vegetation, and the morsitans group, found in woodland areas of savannah regions. Human sleeping sickness is caused by Trypanosoma brucei gambiense and Trypanosoma brucei rhodesiense, which threaten up to 60 million people in 36 countries of sub- Saharan Africa [72]. T. b. gambiense is usually transmitted by tsetse of the palpalis group and occurs mostly in cultivated lands within proximity of pools of water in western and central Africa; it is a disease adapted to humans, although other animals—especially domestic ones—may be important reservoir hosts. T. b. rhodesiense, which is the more virulent of the two, is usually transmitted by tsetse of the morsitans group and occurs primarily in the savannah woodlands of eastern and central/southern Africa [13,73]; it is a disease that occurs naturally in a large number of domestic and wildlife hosts [74]. In humans, as the disease progresses, the parasite crosses the blood–brain barrier and invades the central nervous system, causing neurological problems [75]. Compared to other arthropod vectors such as mosquitoes, tsetse flies have a very low reproductive rate and a longer life expectancy. The mortality and reproductive rates of tsetse flies are highly dependent upon microclimatic conditions, with high survival rates in cool, moist areas [76]. Animal trypanosomiasis occurs more or less throughout the area of Africa inhabited by one or more species of tsetse (an area of approximately 10 million km2), while human sleeping sickness, which has a much higher threshold for transmission [77], occurs only in a relatively few, but very persistent, disease foci. Remote sensing studies of diseases due to tsetse flies. Predictive, process-based models of disease transmission based on the biology of the insect vectors are in general more robust than statistical models, which do not necessarily describe causal relationships between the predictor variables and the predicted phenomena. Air temperature and vapor pressure deficit from climatology records have been successfully used to model the birth and death rates, and density, of tsetse flies over Africa [76]. Since these environmental variables can be related to NDVI, land surface temperature, and cold cloud top temperature duration (CCD) observed from meteorological satellites, techniques have been developed for modeling tsetse distribution in Africa using multi-temporal satellite data [78–80]. The techniques used in these analyses include Fourier analysis of the time series data to reduce the dimensionality while capturing the seasonality of variables, and classifying the images using linear and non-linear discriminant analysis to predict species distribution. These methods were able to predict the distribution of tsetse with accuracies of greater than 80%. Among the different variables used in modeling tsetse distribution, NDVI was considered to be the most important variable, followed by CCD, surface temperature, and elevation. Analysis of habitats and species’ distributions from these studies indicated that different species of tsetse flies are differently but closely adapted to local climate conditions. In some cases, the presence or absence of flies was shown to be dependent upon temperature differences of 1 8C or less, and the importance and number of environmental variables in determining tsetse distribution differed from region to region. A review of different methods used in tsetse modeling from satellite data is provided by Rogers [80], and this review contains the first ever satellite-driven, process-based model of disease transmission (trypanosomiasis) based upon a satellite-driven, processed-based model for its insect vector (tsetse flies).Sandflies. Diseases and vector habitats. Visceral leishmaniasis (kala-azar), mucocutaneous leishmaniasis, and cutaneous leishmaniasis are three diseases caused by Leishmania protozoa (close relatives of trypanosomes) that are spread through the bite of about 30 different species of sandflies of the subfamily Phlebotominae (super-family Psychodoidea) [81]. Sandflies feed mostly at night, when they are most active, and breed in dark, humid environments with organic matter that serves as food for the larvae [48]. Studying their life cycle is difficult because the larvae, which are tiny, are very hard to find, even in areas of high disease prevalence [82]. Sandflies are restricted to tropical and temperate climates (hot and humid), and therefore leishmaniasis is endemic to these areas, which include northern Africa, the Middle East, parts of Europe, and central South America [73]. Leishmaniasis is primarily a zoonotic disease, affecting mostly rodents and dogs, and humans are incidental hosts. Factors such as deforestation, population migration from endemic rural areas, and increased population in areas with low sanitation have caused a resurgence of leishmaniasis by increasing the contact between the vectors and the hosts [83]. Remote sensing studies of diseases due to sandflies. Leishmaniasis transmitted by sandflies was reported as a health hazard for troops deployed in the Middle East both during World War II and in the 1991 Persian Gulf War. The spatial distribution of sandflies is, however, not well understood, mainly because the larvae are so difficult to find. The distribution of Phlebotomus papatasi using NDVI and meteorological data in the Middle East has been modeled [84]. In this study [84], published reports of leishmaniasis and sandfly fever in the Middle East were used to determine the presence of sandflies and their location. Meteorological data were collected on the ground from 114 weather stations in nine countries, including Saudi Arabia, Kuwait, Iran, and Iraq. Meteorological data were not available for all of the locations that had leishmaniasis and sandfly fever. The objective, therefore, was to develop a technique that would determine the probability of disease for those areas where there were no weather data. Using discriminant analysis, the probability of vector occurrence was determined for all 114 locations that had weather data. For those areas that were determined to be positive for sandfly presence, NDVI measurements from AVHRR were analyzed for a 12-year period from 1982. Analysis indicated that the range of NDVI that was associated with vector presence was 0.0–0.06, and this information was used to create a map showing the areas where sandflies could be present. This map was able to identify accurately all the areas where sandflies were present, including those areas that had no meteorological data. Comparison of sandfly (P. argentipes) densities with different land use land cover types derived from IRS LISS3 (Indian Remote Sensing Satellite Linear Imaging Self-Scanning System 3) data over two are areas that were endemic and non- endemic to visceral leishmaniasis (kala-azar) in Northern India showed that the endemic areas had a higher percentage of water bodies [85]. The endemic areas also had a higher proportion of marshes compared to the non-endemic areas, and there were also significant differences in vegetation and soil types among the two areas. Succulent vegetation was more prominent in endemic areas, whereas non-endemic areas had predominantly thorny and hard-

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stemmed plants. In endemic areas, the vector density (as described by the man hour density) was higher during the summer (March–June) and rainy seasons (July–October) compared to non-endemic areas. This study was useful for the health authorities in prioritizing their visits to specific sites.

Internal Link to disease-satellites are better than AVHRR (Advanced Very High Resolution Radiometer-ground system)-more satellites needed-risk in US high

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Improvements in both sensor capabilities and data processing algorithms are enabling estimates of parameters such as precipitation from space directly rather than using surrogate variables. The availability of moderate resolution imagery from new NASA satellites such as Terra and Aqua at up to 250-m spatial resolution offers improved capabilities in modeling epidemiology from space at a finer spatial resolution than AVHRR. Technologies such as global positioning systems and GIS provide geolocation and mapping capabilities on the ground at unprecedented accuracies, making it possible to merge more accurately ground observations of vector demographics and disease incidence with satellite data. A wide choice of powerful image processing, GIS and statistical software packages are available within an affordable desktop computing environment, making it feasible for epidemiologists and biologists to experiment with new spatial analysis techniques. Anthropogenic factors such as land cover conversion and increase in greenhouse gases are resulting in global climate change, which could expand the ecosystem boundaries of disease-carrying vectors, resulting in an increase in infectious diseases [86]. Maps showing seasonal risks of vector-borne diseases will be necessary to monitor the impacts of global change on vector ecologies. Our ability to forecast climate trends and events such as El Nin ̃ o and La Nin ̃ a and their impact on rainfall patterns in regional environments, combined with an understanding of vector-environmental relationships, will help us to improve forecasts of epidemics. Automation of satellite data processing could lead to the generation of risk maps in near real-time to warn local health care professionals. A complex set of biotic and abiotic factors influence the emergence and spread of vector-borne diseases. While it is not possible to predict the evolution of new vector-borne pathogens, remote sensing techniques can aid in determining the influence of abiotic environmental factors on their spread. Although multitemporal satellite data are available for an extended time period, the availability of georeferenced and spatially explicit disease data for the same temporal record is still less common, especially in developing countries that have a high burden of vector-borne diseases. Other issues that are impacting the routine use of remote sensing in epidemiology include accessibility to high resolution and low- cost imagery [87,88], as well as issues with data continuity in terms of consistencies in spatial, spectral, and temporal resolutions among satellite sensors during different years. Unforeseen problems, such as the failure of Landsat 7 satellite and delays in the launch of new earth observing satellites such as the National Polar-orbiting Operational Environmental Satellite System, as well as shifting priorities of space agencies, could impact our ability to routinely use satellite data in epidemiology and other applications [89]. However, these issues with remote sensing data are not unique to epidemiological applications alone. It should be noted that the use of remote sensing techniques for modeling and forecasting vector-borne diseases is an emerging field, and a sustained use of these applications could be ensured by collaboration between remote sensing scientists and epidemiologists from the onset of research projects [87]. Remotely sensed environmental variables such as air temperature, humidity, and rainfall should be processed and made available to epidemiologists in real-time and in a format that they can readily use as inputs to their modeling by agencies and organizations that collect and archive satellite data. Within the United States, remote sensing data have potential applications in modeling risk from West Nile fever, dengue fever, and Lyme disease. The potential for epidemic dengue transmission within the United States still exists because of the presence of A. albopictus and A. aegypti mosquitoes that transmit the disease [1]. Application of remote sensing techniques to map areas at risk for dengue fever within the United States is yet to be done. The predictive maps of diseases need to be verified on the ground for accuracy. While several studies have shown correlations between global climate change and variations in the number of people infected with a particular vector-borne disease, it not yet clear how much change in disease would have occurred without environmental change. Efforts therefore should also focus on the development of stochastic, process- based models that rely on vector biology as predictors of diseases and their risk, instead of statistical models that do not clearly explain causal relationships between satellite data and disease. Nevertheless, simple statistical models could be a good starting point for linking the limited number of environmental variables that can be derived from satellite data with spatial and temporal patterns of diseases and vectors. Simple statistical models could help deduce the epidemiological processes from an analysis of the observed spatial patterns of the disease and the environment. Remote sensing of vector ecosystems and interpretation of these patterns is likely to provide both challenges and opportunities in epidemiology. In addition to vector biology, social and behavioral patterns such as the time spent outside, which increases risk of exposure to anthropophilic vectors, types of house constructions, the use of nets and other repellents, as well as the availability of basic sanitation and primary healthcare facilities, which are related to socioeconomic conditions, are important in disease prevention and control. Disease patterns have been shown to be closely linked to poverty and social

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inequalities [90]. These factors cannot be inferred from remote sensing techniques alone. While the studies reviewed in this paper demonstrate the efficacy of remote sensing and other geospatial technologies in disease surveillance, there are however, several factors that need to be considered for these technologies to be routinely adopted for public health management. These include the availability of resources for gathering, processing, and modeling geospatial data, training of personnel on the proper interpretation of results, cost effectiveness of these surveillance techniques, and the continuous availability of remote sensing data in a timely manner. It should also be emphasized that the allocation of resources for these novel monitoring techniques should not come at the cost of basic disease prevention and management activities at the community level.

Internal Link to Malaria-Satellites key for the amount of info needed-empirically has worked at mapping but still more needs to be done.

Connor et al 98-Stehpan J. Connor, Senior Research Scientist at the International Research Institute for Climate and Society; Madeleine C. Thomson, Senior Research Scientist at the International Research Institute for Climate and Society and Director of Impacts Research and Co-Director of the Africa Program at The Earth Institute at Columbia University; Stephane P. Flasse, CANNOT FIND QUALS!; Anita H. Perryman, CANNOT FIND QUALS!, 1998, “Environmental Information Systems in Malaria Risk Mapping and Epidemic Forecasting,” Online: http://onlinelibrary.wiley.com/doi/10.1111/1467-7717.00074/pdf

While a number of ecological studies on larval breeding sites have been undertaken using high-resolution satellite imagery (Washino and Wood, 1994), so far few studies of malaria transmission have involved the use of meteorological satellite data. Nevertheless, the evidence gathered by these limited studies suggests that the techniques are eminently suitable for studies of both vector distribution and abundance and may provide valuable information on the timing and length of the malaria trans- mission season (Thomson et al., 1996, 1997). Some of the ways that meteorological satellite data may contribute to malaria control are indicated below.

As mentioned earlier, it is important to emphasise that satellite data contributes to existing and local knowledge on the malaria situation. Both types of information should be used in a complementary way. On one hand, remote sensing information provides a unique spatial and temporal framework on which local knowledge can be built; while, on the other hand, this information can be best interpreted when placed in its local context. Integration of both sources of information is increasingly achieved within geographical information systems (GIS is a widely used computer software tool) where they are placed, along with other information, in relational databases. GIS, therefore, allows the user to analyse and establish the inter-relationships between the variables within their spatial and temporal context, and use the results in prediction models. A GIS can eventually become a unique tool for data analysis, information management and decision-making. While GIS technologies have been in existence for a number of years, they have only recently been exploited by workers in health research and operations (de Savigny and Wijeyaratne, 1995; Bertrand and Mock, 1995). They allow health centre records from an existing database to be entered and correlated, for instance, with proximity of villages to river flood margins, forest fringe and other environmental characteristics. The analysis of environmental data from satellites can be used in a GIS to plan where entomological surveys should be focused, such as larval surveys of dry-season breeding sites or vector refugia. Only in such a framework can satellite data be used efficiently.

Information on environmental characteristics is required to stratify malaria trans- mission at the national and local level. Characteristics which may be important include the normal timing and length of the transmission season. To obtain an idea of what might be considered normal, archived data covering a number of years can be used. Archived satellite data from the NOAA-AVHRR sensor now goes back 15 years and can be processed to produce information on the mean, amplitude and variation of a product such as a VI for a particular period (month, season or year). As discussed above, three factors are of paramount importance to determining the timing and length of the transmission season: the availability of breeding sites, an environment suitable to adult survival (high humidity) and an ambient temperature suitable for both parasite and vector development. In many areas the onset of the transmission season is determined by the arrival of the rains or the passing of ‘winter’, i.e. higher ambient temperatures.

Peak vector abundance may directly follow the period of peak rainfall, such as An. gambiae s.l. which breeds in small pools, and therefore the timing of peak vector abundance may be associated with the status of vegetation following peak rainfall. Vector survival is associated with saturation deficit, the drying power of the air. Saturation deficit is shown to be well correlated with VIs in areas of The Gambia away from the coastal influence, and there is evidence to suggest that this relationship may be more general. It is not yet possible to obtain ambient temperature from current remote sensing products but other temperature-based information may be relevant. Topography will undoubtedly be an important co-variable in any analysis used to develop an environmental stratification but this can now be achieved relatively simply by incorporating a digital-elevation model (DEM) into a GIS. At its most basic, an environmental stratification could be developed using the seasonal patterns of NDVI overlaid on a DEM.

In combination with a broad environmental stratification, the key to a strong basis for comparison and forecasting is to build, as a reference base, a historical knowledge of malaria-related elements in order to build an institutional memory. This should include, for example:

• where and when the rains usually fall; • which soil types provide persistent breeding sites; • what is known about the epidemiology of malaria in a particular area; • where there have been epidemics in previous years; • with what environmental, social and economic factors were they associated.

Such information can then be analysed and specific relations established for certain times of the year or climatic situations, as well as for specific locations. A large-scale initiative is currently under way which uses GIS to map the risk of malaria across the whole of Africa (Le Sueur et al., 1997). This initiative, the MARA/ARMA project, will incorporate epidemiological and entomological data from all available sources to determine different malaria epidemiological situations that exist and their respective malaria risk. Environmental satellite data will be used in this project to help determine the implications of seasonal weather patterns and environmental variables acting on malaria transmission intensity. The products of the Mapping Malaria Risk in Africa/ Atlas du risk de la malaria en Afrique collaboration (Le Sueur et al., 1997) will form an important intervention planning framework which will help decision-makers assess the suitability of particular control methods to particular environmental and epidemiological strata.

It is essential that the situation be monitored constantly in terms of disease transmission to be able to assess whether a situation is evolving in a particular location. Consequently, the ability to know the actual situation and compare it with the ‘norm’ or historical records naturally leads into forecasting of an

Adaptation- Disease

event, and from there to early warning of possible malaria outbreaks. Continuous acquisition of data on the malaria-related elements is desirable. It is difficult, however, to gather this type of information regularly and reliably over large regions. Low-resolution remote sensing data offer the frequency, consistency and reliability of data acquisition over large areas which is essential for monitoring change. Since environmental factors play a key role in malaria transmission, satellite observation should improve malaria monitoring and forecasting. Changes in the immune status of the human population as a result of rising or falling malaria rates will have ‘knock-on’ effects in subsequent years. Thus several years of drought may result in a population with low levels of malaria immunity. The return of more normal rainfall patterns may then provoke serious epidemics, as happened in many parts of southern Africa after the period of prolonged drought during the mid-1980s. The extent of flooding in Sudan in 1988, which resulted in an epidemic, was clearly detected using Meteosat thermal imagery. Meteorologists were also able to predict the scale of the floods using satellite imagery depicting water movement down the Nile (J. Williams, pers. comm.). However, much remains to be done if these new technologies are to be fully exploited for malaria control as results may vary from place to place depending, for example, on vector species, local ecology and human behaviour (Thomson et al., 1997).

Sats solve disease

Kuehn 2010- [Bridget M. Kuehn](http://jama.ama-assn.org/search?author1=Bridget+M.+Kuehn&sortspec=date&submit=Submit) 2010, JAMA Senior Staff Writer “Use of Earth-Observing Satellite Data Helps Predict, Prevent Disease Outbreaks” JAMA. 2010;303(5):403-405. doi: 10.1001/jama.2010.32, http://jama.ama-assn.org/content/303/5/403.long

Months before the first human case of Rift Valley fever was identified in Kenya in December 2006, scientists studying satellite data predicte region (a proxy for rainfall) enabled the scientists to zero in on the specific areas in which prolonged flooding would lead to the multiplication of 2 types of mosquitos that contribute to outbreaks among livestock. The information allowed the scientists to give public health officials in these areas several weeks of warning about what was to come (Anyamba A et al. Proc Natl Acad Sci U S A. 2009;106[3]:955-959). In collaboration with the World Health Organization, the US Centers for Disease Control and Prevention, and the Food and Agricultural Organization of the United Nations, Kenyan health authorities launched mosquito-control programs and livestock vaccination efforts, distributed mosquito nets and information to communities to prevent human infections, and restricted movements of livestock to prevent the spread of the virus to unaffected areas. Figure Using satellite data, scientists predicted areas in the Horn of Africa at high risk of a human outbreak of Rift Valley fever (red) and at high risk of an outbreak in animals (green) in late 2006 and early 2007. About 64% of actual human cases (indicated by black dots) occurred within the area predicted; blue dots indicate the minority of human cases that fell outside the predicted area. Adapted from Anyamba A et al. Proc Natl Acad Sci USA. 2009;106(3):955-959. "(Photo credit: National Academy of Sciences)" The predictions were so accurate that about two-thirds of the Rift Valley fever cases occurred within the high-risk area identified by the scientists and 90% occurred within the identified area and a 50-km buffer around it, said Compton J. Tucker, PhD, a senior earth scientist at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center in Greenbelt, Md. The endeavor demonstrates the potential of earth-monitoring satellite data to help public health officials predict and perhaps minimize the effect of infectious disease outbreaks. Other studies are under way to assess the possible use of this information to predict outbreaks of cholera, Ebola virus, hantavirus, and plague. The progress of such efforts was highlighted in a recent review (Ford TE et al. Emerg Infect Dis. 2009;15[9]:1341-1346). “We need better surveillance of emerging infectious diseases, and this is one of the most promising techniques,” said Timothy E. Ford, PhD, lead author of the review and vice president for research and dean of graduate studies at the University of New England in Biddeford, Maine. However, such research relies on an aged fleet of satellites, with few replacements planned. Many scientists fear that without substantial reinvestment in the NASA earth-observing satellite system, the ability to use satellite data for an array of scientific

Climate Leadership- Uniqueness

US climate leadership low now- Satellite crashes and budget cuts prove

Scientific American 11- Scientific American, Magazine focused on science and technology based in the US and Winner of the 2011National Magazine Award for General Excellence, 7 March 2011, “How Failure of Climate Satellite Sets Back Earth Science,” Online: http://www.scientificamerican.com/article.cfm?id=failure-climate-satellite-sets-back-earth-science

The crash Friday of NASA's Glory satellite couldn't have come at a worse time. The incident is a blow for climate science and the space agency's efforts to rebuild an Earth observation program weakened by years of lean budgets. It also comes during a protracted spending fight on Capitol Hill in which science agencies have become prime targets for House Republicans' budget ax. According to NASA, problems with Glory's launch vehicle, a Taurus XL rocket, sent the climate probe crashing into the Pacific Ocean early Friday morning. The agency has begun an investigation, expected to take months, into what went wrong (Greenwire, March 4). Preliminary data suggest that the rocket's fairing, a nose cone designed to shield Glory during the journey through Earth's atmosphere, did not detach the way it was supposed to. A similar problem two years ago caused the crash of another NASA climate satellite, the Orbiting Carbon Observatory (OCO). Both satellites were considered key missions for NASA's Earth observation program, which foundered in recent years as the agency pursued new space exploration projects like the proposed mission to Mars and designing a replacement for the space shuttle. "Working from space is hard, expensive and risky," NASA climate scientist Gavin Schmidt wrote Friday on the blog RealClimate, in a post examining the aftermath of the Glory crash. "We cannot take it for granted, and yet we need that information more than ever." In 2007, the National Academy of Sciences warned that the nation's Earth observing capability was "at great risk" after cumulative rounds of budget cutting. The nation's ability to monitor severe weather, fresh water shortages and climate change all depended on increasing NASA's Earth science budget, the science academy said. The losses of Glory and the Orbiting Carbon Observatory will make rebuilding that capability harder, said Rick Anthes, who co-chaired the committee that wrote the National Academy of Sciences analysis. "When that survey came out, we expected the OCO and Glory to fly and be part of the foundation of Earth observations," said Anthes, the president of the University Corporation for Atmospheric Research. NASA's decision to build and launch a copy of the failed Orbiting Carbon Observatory has taken money away from other key Earth and climate satellite missions, he said, and the loss of Glory could compound that problem. "With the present budget climate in Washington, where a lot of science is at risk, it's just not good at all," Anthes said. "We really needed Glory to be successful. ... I don't think you can sugarcoat it."

Climate Leadership- Env. Ldshp KT Heg

Critical to sustain global leadership

Walter 2 –Norber, Chief Economist at Deutsche Bank – 2002 , New York Times, 8-28

FRANKFURT At present, there is much talk about the unparalleled strength of the United States on the world stage. Yet at this very moment the most powerful country in the world stands to forfeit much political capital, moral authority and international goodwill by dragging its feet on the next great global issue: the environment. Before long, the Bush administration's apparent unwillingness to take a leadership role - or, at the very least, to stop acting as a brake - in fighting global environmental degradation will threaten the very basis of the American supremacy that many now seem to assume will last forever. American authority is already in some danger as a result of America's relative absence from the World Summit on Sustainable Development in Johannesburg - "relative," that is, to its share of both the world economy and global pollution. The absence of President George W. Bush from Johannesburg symbolizes this decline in authority. In recent weeks, newspapers around the world have been dominated by environmental headlines. In Central Europe, flooding killed dozens, displaced tens of thousands and caused billions of dollars in damage. In South Asia, the United Nations reports a brown cloud of pollution that is responsible for hundreds of thousands of deaths a year from respiratory disease. The pollution, 80 percent man-made, also cuts sunlight penetration, thus reducing rainfall, affecting agriculture and otherwise altering the climate. Many other examples of environmental degradation, often related to the warming of the atmosphere, could be cited. What they all have in common is that they severely affect countries around the world and are fast becoming a chief concern for people everywhere. Nobody is suggesting that these disasters are directly linked to anything the United States is doing. But when a country that emits 25 percent of the world's greenhouse gases acts as an uninterested, sometimes hostile bystander in the environmental debate, it looks like unbearable arrogance to many people abroad. The Bush administration seems to believe it is merely an observer - that environmental issues are not its issues. But not doing anything amounts to ignoring a key source of current world tension, and no superpower that wants to preserve its status can go on dismissing such a pivotal dimension of political and economic conflict. In my view, there is a clear-cut price to be paid for ignoring the views of just about every other country in the world today. The **U**nited **S**tates is jettisoning its hard-won moral and intellectual authority and perhaps the strategic advantages that come with being a good steward of the international political order. The United States may no longer be viewed as a leader or reliable partner in policy-making: necessary, perhaps inevitable, but not desirable, as it has been for decades. All of this because America's current leaders are not willing to acknowledge the very real concerns of many people about global environmental issues. No one could expect the United States to provide any quick fixes, but one would like to see America make a credible and sustained effort, along with other countries, to address global environmental problems. This should happen on two fronts. The first is at home in the **U**nited States, through more environmentally friendly policies - for example, greater fuel efficiency standards for cars and light trucks and better insulation for buildings. The second is international, through a more cooperative approach to multilateral attempts at safeguarding the environment.

\*\*Solvency\*\*

**Uniqueness- Satellite Failure Inevitable**

Budget constraints make all other satellite failures and data gaps inevitable

Scientific American 4/14- Science Magazine, Budget Cuts Open Earth Observation Gap Earth observing satellites delayed or scrapped by government cutbacks http://www.scientificamerican.com/article.cfm?id=budget-cuts-earth-observation-gap

Funding 'tight into the future' The proposed 2011 budget compromise, which would fund the government through the end of September, would worsen that problem. It chops NOAA's budget to $4.6 billion, $140 million below the level enacted in fiscal 2010. The agency had sought $5.5 billion this year. Although Congress has yet to vote on the new plan, Mark Begich (D-Alaska), chairman of the Subcommittee on Oceans, Atmosphere, Fisheries and Coast Guard, said there was little chance NOAA would receive full funding for the satellite program this year -- or next. "Funding will remain tight into the future," said Begich, one of a group of Senate Democrats who participated in an unsuccessful last-ditch effort last week to secure a budget boost for JPSS. "You can pretty much assume it's not coming in for 2011. We're moving to the next stage." Lubchenco said her agency believes it has few options for averting a gap in the climate and weather data that JPSS satellites are designed to gather. The current polar-orbiting satellite now in space is slated to be replaced in September by a satellite known as the "NPOESS Preparatory Project," or NPP. Cancel contracts now, pay more later Because NPP was designed as an experimental satellite, its planned lifetime is short -- just five years. The current budget difficulties mean that NPP's replacement, known as JPSS-1, won't be ready to fly in late 2016. "There is no other polar-orbiting satellite that will be flying in the orbit that JPSS[-1] was intended to fly in, and so that's why there will be a data gap," Lubchenco told lawmakers yesterday. "There isn't redundancy." Congress's budget cuts will also have long-term financial consequences for the satellite program. "For every dollar we didn't spend this year on JPSS, we will need to spend $3 to $5 down the road," Lubchenco said. "We have to cancel the contracts we have, to let people go. These are very skilled workers, and then you'd have to bring them back." JPSS's current budget woes are the latest in a string of problems that have bedeviled the satellite program and its predecessor, the National Polar-Orbiting Operational Environmental Satellite System (NPOESS).

CLARREO Key- International Standards

CLARREO addresses key objectives for climate records- has a global framework for data

NASA 7- Jim Anderson,Hank Revercomb Dan Kirk-Davidoif Bill Gibson John Dyke mil Stephen Leroy Dave Toh in Boh Hoi/ Boh Knnieson

Joe Taylor Mark Mulligan Jon Gero Response and Discussion of IR Breakout Discussion Recap of CI.ARREO Workshop 17-19 July 2007

The prioritization process for mission selection involved eight criteria used to set relative rankings: • Contribution to the most important scientific questions facing Harlh sciences today (scientific merit, discovery, exploration) • Contribution to applications and policy making (societal benefits) • Contribution to long-term observational record of the Farth • Ability to complement other observational systems, including national and international plans • Affordability (cost consideration, cither total costs for mission or costs per year) • Degree of readiness (technical, resources, people) • Risk mitigation and strategic redundancy (backup of other critical systems) • Significant contribution to more than one thematic application or scientific discipline Driven by the prioritization process that was applied across all disciplines within the NRC Decadal Survey purview, CLARREO emerged as a top priority for a new start: NRC Final Report: CI.ARREO addresses three key Societal Objectives: 1. The essential responsibility to present and future generations to put in place a benchmark climate record that is global, accurate in perpetuity, tested against independent strategies that reveal systematic errors, and pinned to international standards 2. The development of an operational climate forecast that is tested and trusted through a disciplined strategy using state-of-the-art observations with mathematically rigorous techniques to systematically improve those forecasts to establish credibility 3. Disciplined decision structure that assimilates accurate data and forecasts into intelligible and specific products that promote international commerce as well as \_societal stability' and security spectrally resolved radiance measurements but with the addition of benchmark observations to obtain the reflected solar irradiance and a GPS receiver; and (3) re-flight of the incident solar irradiance and CERES broadband instruments on NPP and NPOESS

CLARREO is superior to current satellites for climate records- SI traceability allows a global climate record

Anderson 7- Jim Anderson, Philip S. Weld Professor in the School of Engineering and Applied Sciences, Harvard University, Decadal Survey: CLARREO Workshop http://www.docstoc.com/docs/30803707/DRAFT-Decadal-Survey-%28DS%29-CLARREO-Workshop-Report-Edited-by

The ability of this CLARREO mission to calibrate passive sensors on-orbit via SI traceability and to address sampling issues without subsidiary information is a notable departure from the current strategy pursued for climate satellite records. The necessity for this departure was recognized by the NRC as follows: NRC Objective: Global Benchmark Climate Record Benchmark Observations: What are they? The NRC Decadal Survey recognized that when the global climate record emerges as a significant contributor to public policy (societal) decisions, that record will be attacked relentlessly. If the climate record cannot stand up to those attacks, the record cannot effectively serve society. Recognition of this led to the requirement that the design of climate observing and monitoring systems from space must ensure the establishment of global, long-term climate records, which are of high accuracy, tested for systematic errors on-orbit, and tied to irrefutable standards such as those maintained in the U.S. by the National Institute of Standards and Technology For the NRC report, this mission definition was essential for the prioritization process that fully considered scientific/societal impact, cost, ability to complement other systems, degree of readiness, risk mitigation, and contributions to other thematic areas. The ASIC3 report also chose a CLARREO-like mission as one of its high priority recommendations based on similar requirements. Once the context of responsiveness to societal objectives is understood, the path leading all the way to details of instrument design may be defined. A summary of requirements flowdown from high level science requirements to data products to mission and payload requirements for the IR and GPS components is included below.

CLARREO Key- International Standards

CLARREO addresses the need for accuracy- addresses variables essential for climate change

NASA (No Date)- CLARREO- Social Benefits http://clarreo.larc.nasa.gov/about-SocietalBenefits.php

In 2007, the National Research Council (NRC) conducted a survey of Earth science and its applications from space, identifying key scientific questions and societal objectives on which to focus Earth observations beginning in 2005. The Council organized the science missions into three time-phased tiers, identifying the mission(s) most appropriate to answer key science questions and address societal objectives. In addition to the NRC’s Decadal Survey, a summary of the policy documents that support the science goals of the CLARREO mission can be found here. Get Adobe Acrobat PDF Reader image Selected as a high-priority, tier one mission, the Climate Absolute Radiance and Refractivity Observatory (CLARREO) is a climate mission that will bring revolutionary accuracy to climate measurement—and provide a global benchmark measurement for conclusively determining long-term climate trends. The urgency for CLARREO results from the growing need for higher accuracy, long-term climate change observations than current instruments are capable of providing. Data from CLARREO will dramatically increase how accurately we define the real climate future that society faces—and assist policy makers in formulating more informed decisions about how to respond. The timing of the CLARREO mission is a result of recent advances in a wide range of scientific, measurement, and technological areas. These advances combine to enable CLARREO to be a completely new type of climate mission: a mission focused on accuracy at decade time scales. Because CLARREO measurements will cover the majority of the solar and infrared spectrum, CLARREO will provide this accuracy for most of the climate variables essential for assessing climate change, greatly expanding the uses of existing space-based data sets for societal benefit. Previous Earth science missions have focused on providing data for one aspect of the climate system such as clouds or aerosols. CLARREO will provide a global perspective of climate change, becoming the first mission to collect data that provide a single and highly accurate view of the entire climate system. By obtaining this global view, CLARREO will be used by climate modelers and decision makers to accurately predict climate change and to develop intelligent plans and methods to minimize and adapt to it. Kevin Brown, CLARREO Project Manager who is leading the CLARREO mission states, “The integrity of CLARREO measurements and their ability to accurately portray the Earth’s climate on a global scale, allows for greater confidence in policy derived from CLARREO observations.” CLARREO differs from other satellites because its measurements are tied to internationally-recognized standards, the same type of rigorously-tested standards used by National Metrology Institutes to determine the temperature of a material or length of a second. Using these international standards, measurements from CLARREO, as well as other satellites, may be pooled into one long-term observational record that is free from small drifts in measurements due to slight differences between satellites. This allows scientists to test the satellite observations for small errors that mirror the variability of the climate itself. Testing for these errors provides for a clear interpretation of measurement trends, greatly enhancing confidence in the data’s accuracy. According to CLARREO Project Scientist Dave Young “By accurately capturing the trends early, we will know if the Earth will warm by two degrees or eight. Those would be two very different futures that require two very different societal changes.”

CLARREO Key- SI Traceability

CLARREO uses an international standard of units that guarantees the greatest accuracy

NASA (no date)- CLARREO- SI traceability http://clarreo.larc.nasa.gov/about-SITrace.php

SI traceability is a technique used for satellite observations that links a satellite’s measurements to internationally-recognized measurement standards. Using this technique, measurements from different satellites may be pooled into one long-term observational record that is free from small drifts in measurements due to slight differences between satellites. Additionally, SI traceability allows scientists to test the satellite observations for small errors that mirror the variability of the climate itself. Testing for these errors provides for a clear interpretation of measurement trends, greater enhancing our confidence in scientific results from satellites. The SI in SI traceability refers to the International System of Units (Système International d'unités in French). This system of units was developed to provide an error-free means of comparing measurements made anywhere in the world, at any time, to one another. To accomplish this task, SI Units are defined by basic properties of matter. For example, the second is defined by the quantum mechanical properties of the Cesium atom. These quantum mechanical properties will be exactly the same, regardless of at what laboratory, or when, they are measured. An understanding of SI traceability may be gained by looking at the measurement principles of the CLARREO mission. One of the CLARREO sensors (the GPS/GNSS-RO sensor) measures the changes in the properties of microwave radiation as it makes its way through the Earth’s atmosphere. These changes are detected using a timing measurement. This timing measurement can be directly compared against the timing standard provided by an atomic clock—a clock that uses the quantum mechanical properties of the Cesium atom as its timing mechanism. In this way, the CLARREO mission creates an index of climate that is directly related to the atomic clock. The principles of the atomic clock are well understood by decades of research, and are used in many different kinds of laboratories all over the world. This link provides evidence that can be understood and applied by all disciplines of natural science, to show that CLARREO measurements are clearly capturing long-term climate trends.

CLARREO Key- Long Term Climate Projections

CLARREO provides credibility to the current climate infrastructure

NASA (no date)- CLARREO- SI traceability http://clarreo.larc.nasa.gov/about-SITrace.php

The trends in the climate system associated with long-term change are covered up in the short term by climate “noise.” This noise arises from short term changes associated with day-to-day and seasonal weather as well as other events such as El Niño. Uncovering the long-term trends from the noise is essential to decadal climate science since knowing the correct strength of the trends is key to testing climate models and to understanding the changes in detail. Identifying the long-term trends requires satellite observations that are free from small measurement errors (that could even slowly change in time themselves) and that are equal from one satellite to the next. SI traceability provides strict methods that guide the creation of satellite data that can meet these specific requirements. These methods are built on decades of practice in measurement science and have been continually tested and strengthened by scientists all over the world. It is this foundation that lends the greatest degree of credibility possible to measurements made with these methods. Past climate change data from satellites have provided invaluable information, but have sometimes been challenged due to controversy related to the accuracy of the measurements. Technological advances of the past decade along with the increasing maturity of the areas of science that support space-based climate measurements, allow scientists to robustly implement SI traceable satellite observations today. By carefully learning from the successes and shortcomings of previous missions, the CLARREO mission looks to directly address the societal objectives of characterizing long-term climate change and testing climate projections to support public and private decision-making with the most reliable information possible.

Climate Data Key- International Warming Efforts

Accurate climate data is necessary to coordinate international efforts against climate change

Sugar 8- Remarks by Dr. Ronald D. Sugar (Chairman of the Board and CEO, Northrop Grumman Corporation) At Center for Strategic and International Studies (December 5th, 2008) “From Climate Data to Knowledge: Informing Our Future Decisions” http://csis.org/files/media/csis/events/081205\_sugar\_remarks.pdf

NASA, NOAA, the U.S. Geological Survey office, the Environmental Protection Agency, the Department of Energy, universities, and others, have been performing an incredible service to the progress of climate science by collecting and analyzing this data. And the sensors they operate must be maintained and expanded. The environmental data they have been producing is largely the reason we can even foresee the next evolution of climate understanding – an evolution that must occur if our efforts to create practical mitigation and adaptation options are to be anything more than an aspiration. With a few worthy exceptions, that evolution has not yet happened. Why not? I believe it is because we still suffer from an excess of data and a deficit of knowledge. Currently, too much of the data generated by these many sensors are segregated from each other, as are too many of the world’s institutions that operate them. And that’s not all. For understandable reasons, these data are highly scientific in nature. They are used to feed the many climate models that are so indispensible to the progress of climate science. But these models are complex and are the province of scientific and academic communities. For the most part, they produce exactly what they were designed to – illustrations of the climate on a global scale and to a generalized timeline. In addition, these models are in their infancy relative to what is yet to come, and relative to what is needed for practical uses. All in all, the ocean of sensor data makes for good science, but its benefits outside that realm remain limited. But what if all that raw environmental data could be turned into practical decision-quality knowledge for use by the greater society? What if the products from all those many sensors and information sources could be integrated and consolidated to provide the next evolution of our climate understanding? – A level of understanding that could open up a new world of benefits and opportunities that we might not now even imagine? And what if that new understanding of our climate were networked beyond the scientific community to help inform public policy and business decisions at a regional or even local level? This is currently being done on a macro level with NOAA’s Global Earth Observing Systems of Systems, or GEOSS. GEOSS will eventually integrate the world’s Earth observing systems on a global basis and make Earth information universally available for the benefit of society. We are fortunate indeed to have with us this morning Admiral Conrad Lautenbacher. Connie is the man who, more than any other, deserves the credit for GEOSS. He has been a true visionary in his understanding of the power of integration and knowledge management and he will be speaking later this morning. I do not advocate duplicating the work of GEOSS, or any other agency or office in the area of data integration. Nor do I contend that the private sector could do it better on its own. I simply contend that it may well be time to take the next step – to create a higherlevel structural mechanism under government leadership, which builds on our scientific successes to date.

American leadership is necessary for climate action

U.S. Senate 9- Climate Services: Solutions from Commerce to Communities Hearing Before the Committee on Commerce, Science, and Transportation United States Senate One Hundred Eleventh Congress First Session JULY 30, 2009 http://www.gpo.gov/fdsys/pkg/CHRG-111shrg54915/html/CHRG-111shrg54915.htm

First, the challenge. The world's climate is unequivocally going through dangerous and unpredictable changes. Surface air and ocean temperatures are increasing, sea levels are rising, and widespread melting of glaciers and Arctic sea ice is accelerating. And, just this month, NOAA reported that the world's ocean surface temperature was the warmest on record for June, breaking the previous high set in 2005. These trends are causing more extreme weather, coastal and agricultural degradation, droughts, and wildfires. And, just yesterday, Seattle reported an all-time high in its temperature, reaching 103 degrees. Vancouver, Washington, reached 107 degrees. Seattle is expected to hover at the 100-degree temperature mark for this entire week. America must take the threat of climate change seriously, but first we have to understand it, and that's where NOAA has been indispensable for decades. NOAA's mandate for climate activities was established in 1978, and its capabilities span operational climate observing networks, global greenhouse gas monitoring, climate predictions and projections, climate research, and climate data stewardship. Indeed, with respect to the World Climate Data Center--that's the world's largest repository of climate and paleoclimate data--that is maintained by NOAA. With all the measurement devices around the world measuring greenhouse gases, 66 percent of the world's measurement systems are maintained by NOAA. So, NOAA has monitored and measured the carbon cycle in the atmosphere and oceans for 40 years. Its measurements and modeling of carbon dioxide and other greenhouse gas concentrations in the atmosphere are among the most comprehensive in the world. Commerce's National Institute of Standards and Technology, NIST, has also worked with NASA and others to develop new satellite instruments that measure the Sun's light ten times more accurately than previous instruments. This information that I've cited isn't merely of academic interest. As you've indicated, these measurements will play an important role in verifying the effectiveness of our domestic and international policies through independent verification of emissions from both domestic and international sources, and allow us to understand whether emission-reduction efforts on the ground, by citizens, business, and government, are having their intended effects on our climate.

US Key- Environmental Leadership

U.S. leadership in environmental policy is eroding- however, once regained is the critical internal link to all global environmental efforts

Ivanova and Esty 8- Maria Ivanova, Assistant Professor of Government and Environmental Policy at The College of William and Mary and the Director of the Global Environmental Governance Project at the Yale Center for Environmental Law and Policy. Daniel C. Esty, Hillhouse Professor of Environmental Law and Policy at Yale University *Reclaiming, U.S. Leadership in Global Environmental Governance* SAIS Review, Volume 28, Number 2, Summer-Fall 2008, pp. 57-75 (Article)- Muse

Recently, the academic and political debates have converged on the need for strengthening the global environmental governance system and reforming the international organizations at its core. Developed and developing countries now agree that the status quo is no longer an option. The public, however, has been fed a story of environmental heroes and villains, of select nations striving together to protect the planet while others selfishly continue on with business as usual. Notably, the current discourse paints the United States as an impediment to global collective action for environmental protection. Yet the global environmental movement is indebted to the efforts of the United States, which helped push the environment onto the international political agenda following a domestic response to unprecedented public concern and pressure. Today’s reformers must rethink environmental mandates, appropriate organizational structures, and necessary financing at the international level, in much the same way as the founding architects of the global environmental governance system did. While the scope and scale of environmental concerns have changed and actors in the environmental field have proliferated, the crux of the debate remains the same—how does the international system implement an effective environmental policy that supersedes shortterm political concerns? The new President’s approach to international institutions in general and global environmental governance in particular must be guided by three conclusions that can be drawn from the analysis in this article. First, substantial effort is required to reverse the picture of the United States as bellicose in its approach to other nations. Multilateralism must be the priority, not the exception. Unilateral action must be used as a last resort and not as the presumed policy of choice. Second, in the face of a set of problems that are inescapably transboundary in scope—security, trade, global health as well as environmental challenges such as climate change—America’s political leaders must explain to the public that international collaboration is essential for successful outcomes to be achieved. America benefits from worldwide cooperation on these issues and must therefore be willing to invest in global governance. Americans stand to gain substantially from a better functioning United Nations and a rejuvenated and well-governed international environmental regime. The new President must lead the way in building domestic support for a foreign policy of engagement. We need not surrender our insistence on better performance by international bodies, but we cannot let skepticism subvert a commitment to an appropriate degree of global cooperation. Third, mere U.S. participation in international environmental efforts will be insufficient. The United States must actively take a leadership role in bringing about a successful response to climate change and other issues. The history of past success in galvanizing the global community into action shows that the United States can and must take the lead. However, any attempt at U.S.-led reform without credible proof of genuine U.S. leadership based on common values and the common good is likely to be met with distrust and opposition. Finally, a commitment to revitalize the international environmental regime should be cast as part of a wider global effort for effective global governance. As the One UN concept29 and strategy are gaining momentum, the United States could lead the establishment of a Global Environmental Reclaiming U.S. Leaders hip in Global Environmental Governance 73 Leadership Commission to examine options for structural reform in the environmental governance system. In conclusion, we turn to the words of Russell Train, one of the early environmental governance architects, who wrote in a memo to Henry Kissinger: “It is our belief that the U.S. currently has a strong position of leadership in environmental matters that should be built on. Specifically we need to develop sharp and substantive proposals that will be of interest not only to the industrialized countries but also to the developing world.”29 While today the U.S. leadership position in international environmental affairs has been eroded, the time has come for a conceptual leap forward under a new administration. The United States can and should become a leader again in the global environmental arena.

US Key- Climate Multilateralism

U.S. leadership on environmental issues is declining- ratification record proves

Ivanova and Esty 8- Maria Ivanova, Assistant Professor of Government and Environmental Policy at The College of William and Mary and the Director of the Global Environmental Governance Project at the Yale Center for Environmental Law and Policy. Daniel C. Esty, Hillhouse Professor of Environmental Law and Policy at Yale University *Reclaiming, U.S. Leadership in Global Environmental Governance* SAIS Review, Volume 28, Number 2, Summer-Fall 2008, pp. 57-75 (Article)- Muse

Recent U.S. involvement in global environmental governance is characterized by a fundamental ambivalence about multilateralism and the inter national institutions that support it. As Edward Luck explains, “Persistent strains of idealism and cynicism, multilateralism and unilateralism, internationalism and isolationism have long coexisted across the spectrum of American thinking. The resulting ambivalence . . . about the soul and shape of America’s place in the world . . . has yet to be resolved either intellectually or politically, leaving Washington unable to abandon the world organization or to give it full support.”15 This dual-edged attitude toward international organizations has clearly diminished the U.S. leadership position and its ability to exert influence in the global environmental domain.16 The recent U.S. track record has overshadowed the nation’s tradition of leadership in the architecture of global environmental governance. Careful historical research, however, shows that a handful of visionary American officials “deeply passionate about the environment”17 drafted in the early 1970s the blueprint for international environmental cooperation that served the world well for many years. Several key figures at the Council on Environmental Quality (CEQ) and the State Department conceptualized the international environmental initiatives that the United States put forth.18 Despite the fact that the 1970s were marked by U.S. dissatisfaction with the United Nations, these leaders recognized that there was “in practice no effective alternative, whether governmental or nongovernmental to working principally through that body to provide a global context for international cooperation on environmental matters.”19 In the nascent stages of global environmental governance, the official U.S. position was progressive and far-reaching. In creating a new international environmental organization, the United States emphasized the importance of leadership, authority, and legitimacy and the UN Environment Programme, a UN-based entity focused on catalyzing environmental action, developing policies and guidelines, establishing a global monitoring system, and offering a mechanism for dispute settlement. The U.S. leaders involved in building the global environmental governance system understood the value to the United States of international treaties. At the same time, the United States possessed sound institutional structures at the domestic level and was positioned to provide analysis and leadership as well as first-rate experts committed to effective global environmental problem solving. Under U.S. leadership, the world had moved forward. During the 1970s and 1980s, a number of international environmental treaties were negotiated. Not only did the United States lead the global efforts at environmental protection, it had ratified the treaties and promoted global compliance.20 However, the U.S. ratification record in the 1990s and 2000s has been poor: as Table 1 illustrates, the United States signed and ratified the first wave of international environmental agreements but has subsequently pulled away from international cooperation.

Empirically proven that U.S. environmental efforts spur international cooperation- unilateral approaches to the environment fail

Ivanova and Esty 8- Maria Ivanova, Assistant Professor of Government and Environmental Policy at The College of William and Mary and the Director of the Global Environmental Governance Project at the Yale Center for Environmental Law and Policy. Daniel C. Esty, Hillhouse Professor of Environmental Law and Policy at Yale University *Reclaiming, U.S. Leadership in Global Environmental Governance* SAIS Review, Volume 28, Number 2, Summer-Fall 2008, pp. 57-75 (Article)- Muse

Instead, the United States has turned increasingly to unilateral action, shown preferences for narrow ‘partnerships’ rather than effective global action, and has placed emphasis on engaging individuals and corporations rather than international organizations in international environmental protection.22 This shift can be explained by several factors. First, the sheer growth and increasing complexity of environmental agreements has led to an international ‘green fatigue’.23 Since the United States is expected to contribute a larger percentage financially to the treaty secretariats than most other countries, there is a growing apprehension of signing into any new agreements. Second, the characteristics of the domestic political process in the United States make the ratification of a treaty a particularly onerous affair. The requirement of support from a two-thirds majority in the U.S. Senate has been a recipe for failure in a context where environmental policy has lost its bipartisan appeal. Third, heightened concerns about national sovereignty sharpened political sensibilities and led to attacks from both the Left and the Right on interference with U.S. domestic affairs.24 Finally, the feeling that Americans are abdicating power to faceless, unelected, and incompetent UN bureaucrats, contributes to negative attitudes toward international organizations and fear mongering about international law as undermining American democracy, sovereignty, and autonomy.25 Ultimately, Americans are afraid of losing control. There is some reason for this concern because accountability is greater when officials are close at hand. But the need to be careful about how international cooperation unfolds is no excuse for systematic disengagement. The one-time U.S. leadership and more recent retreat from the global environmental governance system point to several important lessons for the new Administration. The historical record suggests that when the United States engages in the international arena with a view toward the common good and when American ideals coincide with global values, progress happens. In the 1970s and 1980s, new international environmental organizations were created and old ones reformed, international environmental treaties were initiated and immediately signed, partnerships were forged, and funding mobilized. Moreover, U.S. commitment internationally translated into consistent domestic compliance with international environmental law. At the core of these achievements, lay individual

US Key- Climate Multilateralism

and collective leadership and a vision for the United States as a uniting force in a divided world. The 1990s ushered in a new era where the initial energy and enthusiasm about a global environmental agenda that could unite the world gave way to a ‘sole super-power syndrome’ and a gradual withdrawal from multilateralism. From a promise to internationalize U.S. domestic environmental policy objectives and bring about a greater common good, global environmental governance had become an international regulatory threat to U.S. domestic economic interests.26 Without a rival on the world scene, the United States grew suspect of international initiatives as a way to curb its power and influence. At the close of the twentieth century, American political discourse regained the moralistic, self-righteous rhetoric that stalled the League of Nations at the beginning of the century. In the 21st century, the United States has emerged with a starkly unilateralist approach to international affairs. Ironically, in today’s world, successfully managing our own environmental fate requires more, not less, collaboration with others. Pollution does not respect political boundaries. By their very nature, trans-boundary environmental issues ignore national sovereignty. Chinese greenhouse gas emissions threaten to cause disruptive global warming and severe storms in the United States, just as U.S. emissions of carbon dioxide aggravate climate change in China. The notion of strict territorial sovereignty in an ecologically interdependent world is dangerous fiction in political discourse.

NASA/NOAA Key

NASA and NOAA key- conduct majority of USFG’s climate science research

Climate Wire 9 **–** March 4, 2009, “Aging climate satellites ‘a real problem’, academy head tells Congress”, Climate Wire, <http://oco.jpl.nasa.gov/news/index.cfm?FuseAction=ShowNews&NewsID=36>

And the United States also needs a national plan to monitor climate change, Cicerone added, as Congress considers enacting new federal policies on global warming and the world prepares to negotiate a successor to the Kyoto Protocol. "Here we are, on the verge of new international agreements, without thinking about how to monitor them," he said. "And we are neglecting climate as an element of national security. We're not getting the information we need. Where are [climate] changes happening, and where are they going to happen?" 'Climate measurements are hanging by a thread' Meanwhile, University of Michigan scientist Lennard Fisk -- a former NASA associate administrator -- told lawmakers that the space agency isn't the only agency with a hand in the satellite mess. The National Oceanic and Atmospheric Administration is responsible for the day-to-day management of the National Polar-orbiting Operational Environmental Satellite System, which is designed to provide federal science agencies and the military with weather and climate data. After the program's budget ballooned from $6 billion to $12.5 billion, NOAA and its partner agencies cut costs by eliminating several planned climate sensors and instruments. "That's a major embarrassment, a disaster," Fisk said. "Climate measurements are hanging on by a thread there." The satellite issues point to a larger problem, both scientists told lawmakers, arguing that Congress should boost funding for NASA and the National Oceanic and Atmospheric Administration. The two agencies develop and maintain the nation's environmental satellites and conduct much of the federal government's climate science research. Together, NASA and NOAA received about $1.8 billion in the recent economic stimulus legislation, with much of that money targeted for climate satellites and science programs. Both agencies would see overall budget bumps under the fiscal 2009 omnibus spending bill the House approved last week. And both appear to fare well in President Obama's fiscal 2010 budget request, though most details of the spending plan have not been released. But the trick will be sustaining those increases over the next several years, Cicerone and Fisk said. The 2007 National Academy of Sciences report on climate satellites, for example, recommended an increase of at least $500 million per year for NASA's environmental satellite programs.

CLARREO Solves- Warming

CLARREO provides data for climate change trends

Best et Al (No date) - Fred Best, director of the NASA Center for Space Power at Texas A&M University and a professor of nuclear engineering Robert Knuteson, Space Science and Engineering Center, University of Wisconsin Mark Hobson CLARREO – NASA’s New Climate Related Spaceflight Mission http://www.ssec.wisc.edu/media/newsletter/winter09/clarreo.pdf

Given the rapid increase of carbon dioxide pumped into the atmosphere by fossil fuel burning, new measurement systems are urgently needed to quantify the impact on the Earth’s climate. To deal with climate change wisely, society needs the best possible understanding of what changes are occurring and accurate predictions of what changes will ensue, depending on the actions we do, or do not, take. A new spaceborne observatory, the CLimate Absolute Radiance and REfractivity Observatory (CLARREO), is being planned to respond to this need. CLARREO was recommended by the 2007 Decadal Survey of the US National Research Council and is being pursued by NASA, with the Langley Research Center as the implementing center (http://clarreo.larc.nasa.gov/). CLARREO is one of NASA’s four highest priority “Tier 1” missions. As a key climate-observing system, CLARREO will initiate an unprecedented, highly accurate record of climate change that is tested, trusted and necessary to provide sound policy decisions. It will provide a record of direct observables with the exacting information content necessary to detect long-term climate change trends and to test and systematically improve climate predictions. CLARREO will observe the spectrally resolved radiance and atmospheric refractivity with the accuracy provided by international standards (SI) and sampling required to assess and predict the impact of changes in climate-forcing variables on the climate. The CLARREO mission is based on new paradigms for making climate benchmark observations. First, radiation measurements for a climate benchmark should be chosen to maximize the information content about atmospheric and surface properties. Previous efforts, particularly climate benchmark missions first designed by Professor Verner E. Suomi at the beginning of the space age (launched in 1959), focused on monitoring the total radiative energy budget. CLARREO will use spectrally resolved radiances to gain sensitivity, because the spectrally integrated total energy budget can miss significant changes that cancel each other out. Observing regional averages and distributions of nadir-viewing spectra will reveal signatures of changes in climate forcing and response related to changes in temperature and water vapor structure, atmospheric stability, cloudiness or aerosols, surface properties, and trace gases. The far infrared region of the spectrum will provide sensitivity to thick ice clouds and upper-level water vapor.

CLARREO provides a climate benchmark and accurate data sampling

Best et Al (No date) - Fred Best, director of the NASA Center for Space Power at Texas A&M University and a professor of nuclear engineering Robert Knuteson, Space Science and Engineering Center, University of Wisconsin Mark Hobson CLARREO – NASA’s New Climate Related Spaceflight Mission http://www.ssec.wisc.edu/media/newsletter/winter09/clarreo.pdf

CLARREO’s use of spectrally resolved radiances for more sensitivity, new standards for accuracy, and a three-satellite sampling approach can dramatically reduce the impact of data gaps on decadal change data records across many climate variables. Its ability to calibrate other instruments across the full solar and infrared spectrum can result in increased programmatic flexibility and savings. While other missions may be focused primarily on one climate process or discipline, the CLARREO mission is unique in its broad interdisciplinary impact on climate change science. We have an essential responsibility to current and future generations to develop an operational climate forecast that is tested and trusted. Through a disciplined strategy using state-of-the-art observations with mathematically rigorous techniques, this forecast can be realized. CLARREO will establish a climate benchmark record that is global in its extent, accurate in perpetuity, tested against independent strategies that reveal systematic errors, and pinned to international standards on-orbit.

CLARREO Solves- Climate Data

CLARREO is the best mechanism for addressing climate gaps- tests accuracy in global observation systems

Anderson 7- Jim Anderson, Philip S. Weld Professor in the School of Engineering and Applied Sciences, Harvard University, Decadal Survey: CLARREO Workshop <http://www.docstoc.com/docs/30803707/DRAFT-Decadal-Survey-%28DS%29-CLARREO-Workshop-Report-Edited->

CLARREO is a Highly Leveraged Interdisciplinary Climate Change Mission • Accurate decadal-length records are essential for climate change detection, attribution, and for testing climate prediction accuracy. They represent the most critical test of uncertainty in future climate change prediction. • While process study missions (e.g. CALIPSO/CloudSat) are critical to improve underlying climate model physics (e.g. clouds), decadal change observations are critical to determine the impact of those climate model improvements on the accuracy of predicting future climate change. Both elements are critical, and CLARREO is the major Decadal Study mission addressing serious accuracy issues in decadal climate change observation. • The CLARREO mission is unique in its broad interdisciplinary impact on climate change science: the other NRC Decadal Survey missions are primarily focused on one climate process or discipline. • CLARREO provides new solar reflected and infrared emitted high spectral resolution benchmark radiance climate data records that can be used to test climate model predictions, improve climate change fingerprinting, and attribution. • CLARREO provides an orbiting calibration observatory that can be used to calibrate other solar and infrared space-borne sensors (e.g. VIIRS, CrIS, Landsat, Geostationary, CERES) and thereby improve to climate accuracy a wide range of sensors across the GEO observing system. It also improves the scientific value of all of these instruments. • Key climate variable decadal records impacted by CLARREO include: atmospheric temperature and water vapor profiles, land and sea surface temperatures, cloud properties, radiation budget including Earths albedo, vegetation, surface snow and ice properties, ocean color, and aerosols. The data is also relevant to greenhouse gas monitoring. • The absolute accuracy of CLARREO, when used to calibrate other sensors in orbit can dramatically reduce the impact of data gaps on decadal change data records across many climate variables. • CLARREO provides the first spectrally resolved climate observation of the Far-Infrared spectrum from 15 to 50 micron wavelengths, where half of the thermal infrared emission of the earth to space occurs, and the source of almost all of the Earth's water vapor greenhouse effect. • CLARREO's ability to calibrate other instruments across the full solar and infrared spectrum can change the future prioritization of different elements of instrument pre-launch characterization (e.g. spectral response), stability, and calibration, thereby resulting in increased programmatic flexibility and savings.

CLARREO Solves- Climate Data

GPS and RO receivers in CLARREO detect changes in the climate system with accuracy

NASA 2008- Donald Anderson1, Kenneth W. Jucks1, and David F. Young2, The Nrc Decadal Survey Climate Absolute Radiance and Refractivitiy Observatory: Nasa Implementation http://clarreo.larc.nasa.gov/docs/IGARSS\_08\_paper\_4199.pdf

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) Mission has been recommended in the National Research Council Earth Science Decadal Survey as a key component of the future climate observing system [1]. NASA and NOAA share responsibility for CLARREO. The NOAA component involves the continuity of measurements of incident solar irradiance and Earth energy budget by flying the Total Solar Irradiance Sensor (TSIS) and Clouds and the Earth’s Radiant Energy System (CERES) sensors that were removed from the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The NASA portion involves the measurement of spectrally resolved thermal IR and reflected solar radiation at high absolute accuracy. Coupled with measurements from on-board Global Positioning System (GPS) radio occultation (RO) receivers, these measurements will provide a longterm benchmarking data record for the detection, projection, and attribution of changes in the climate system. In addition, the SI traceable radiances will provide a source of absolute calibration for a wide range of visible and infrared (IR) Earth observing sensors, greatly increasing their value for climate monitoring. CLARREO is identified as one of the four highest priority missions in the Decadal Survey. There is tremendous value in starting these key new climate measurements as soon as possible. NASA is implementing a systematic approach to resolving the remaining scientific and technological challenges for CLARREO. In particular, clear mission requirements that maximize the benefit for using these data to improve climate prediction are needed to ensure that NASA’s performance objectives are met, future costs are contained, and delays are minimized

CLARREO radiation instruments provide accuracy to deal with data gaps

NASA 2008- Donald Anderson1, Kenneth W. Jucks1, and David F. Young2, The Nrc Decadal Survey Climate Absolute Radiance and Refractivitiy Observatory: Nasa Implementation http://clarreo.larc.nasa.gov/docs/IGARSS\_08\_paper\_4199.pdf

The Decadal Survey recommendations were strongly based upon the societal benefits of the missions. The primary benefit from CLARREO will be in strengthened decision support from improved climate predictions. The creation of a benchmark climate record that is global, accurate in perpetuity, pinned to international standards and that can be used to develop trusted, tested climate forecasts is necessary for the decision support structure for responding to climate change. CLARREO will provide this by measuring solar reflected and infrared emitted high spectral resolution benchmark radiance climate data records that can be used to test climate model predictions, improve climate change fingerprinting, and attribution. These climate records will be augmented and complemented by the GPSRO refractivity data record. CLARREO will also provide climate-accuracy calibration for operational sensors, making CLARREO a cornerstone of the Earth observing system. CLARREO data will be used to calibrate other solar and infrared space-borne sensors and thereby improve climate accuracy of a wide range of sensor measurements across the Earth observing system. This is in alignment with the recommendations of the Achieving Satellite Instrument Calibration for Climate Change (ASIC3) and the Global Spacebased Inter- Calibration System (GSICS), both of which call for benchmark instruments in space with appropriate accuracy, spectral coverage and resolution to act as a standard for inter-calibration [2] [3]. CLARREO will also help to address a major issue of our current observing system. Climate data records that are not tied to the accuracy standards of CLARREO cannot produce long-term climate data records without substantial overlap between successive instruments. Without overlap, long-term data records such as the Earth radiation budget will be irretrievably broken if a new instrument cannot be launched prior to the failure of the current instrument. The requirement for redundant and overlapped missions has a great impact on the cost of the entire observing system. The absolute accuracy of CLARREO, when used to calibrate other sensors in orbit can dramatically reduce the impact of data gaps on decadal change data records across many climate variables CLARREO will also potentially provide the first space-based measurements of the Earth’s far infrared spectrum. This opens a new window to 50% of Earth’s IR spectrum with key information on water vapor feedback, cirrus radiative forcing, and the natural greenhouse effect

CLARREO Solves- Climate Data

CLARREO provides more accurate information than normal satellites- monitors climate variables

Cooksey and Datla 2011- Catherine Cooksey and Raju Datla Journal of Research of the National Institute of Standards and Technology Volume 116, Number 1, January-February 2011 Workshop on Bridging Satellite Climate Data Gaps http://nvl.nist.gov/pub/nistpubs/jres/116/1/V116.N01.A02.pdf

Martin Mlynczak clarified that the reflected solar and infrared optical sensors for CLARREO will generate data products different from those of typical weather or climate process satellites. The later satellite missions typically focus on instantaneous retrievals of a geophysical property, such as temperature profile or cloud height. In contrast, CLARREO will provide temporally and spatially averaged top-of-the-atmosphere spectral radiances for the infrared region and spectral reflectances for the reflected solar region. The only instantaneous geophysical parameters generated by CLARREO will be atmospheric temperature, which will be derived from radio occultation measurements. The radiances and reflectances acquired by CLARREO will enable two new types of climate products. First, instantaneous radiance and reflectance measurements will be used to calibrate other satellite sensors and improve the ability of operational sensors to provide high accuracy decadal change data. These measurements will also be made available to the scientific user community for use in deriving instantaneous geophysical data products. Second, averaged infrared radiance and solar reflectance spectra will be used to derive fingerprints to monitor climate change and to establish its causes. These spectral fingerprints can be used to infer, through climate models, which climaterelated physical parameters (e.g., atmospheric temperature, water vapor profile, clouds, radiative fluxes, surface albedo) are changing and how quickly they are changing. This fingerprinting approach can also be used to infer critical climate system feedbacks includ- CLARREO’s science objectives determine which climate variables are monitored. The table below lists the type of feedback or response investigated by models for forecasting and their contributing climate variables. The types of sensors used to monitor the climate variables are also listed Type of Feedback / Response Climate Variables Relevant Sensor Information Cloud feedback and response: Cloud fraction, height, Shortwave and longwave temperature, visible optical broadband radiative fluxes: depth, infrared emissivity, Solar reflective and particle phase / size infrared spectra Water vapor feedback and Water vapor vertical profile Infrared and solar reflective response: spectra Lapse rate feedback: Temperature vertical profile Infrared spectra, GNSSRO: Radio occultation observations using GPS signals Snow / ice albedo feedback: Snow / ice cover and albedo Solar reflective spectra Temperature response: Temperature vertical profile Infrared spectra, GNSS-RO Greenhouse gas feedback: Greenhouse gases Infrared spectra

CLARREO provides important feedback mechanism- GPS allows observations of water vapor and atmospheric pressure

NASA 10- Responding to the Challenge of Climate and Environmental Change: NASA’s Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space June 2010 http://science.nasa.gov/media/medialibrary/2010/07/01/Climate\_Architecture\_Final.pdf

The CLARREO mission is designed to monitor and understand changes in the climate system, and many of the important feedback mechanisms, in unique ways that ensure well-validated traceability to absolute SI-calibrated physical standards. Such precision is necessary to determine small changes in climate-signal strengths while piecing together observations made over decades with no guarantee of overlap, and to account for individual instrument signal drift. The approach for the NASA portion of CLARREO is to obtain spectrally resolved radiances throughout the entire thermal infrared wavelength region and reflected solar from the near infrared to the ultraviolet. Spectrally resolved radiances are needed to fully separate and identify changes in the terrestrial radiation budget from the various feedback mechanisms (for example, the water vapor feedback, cloud feedback, etc.) that are predicted to change as the climate system evolves, yet still have significant uncertainties in models. Each set of data will be collected with instruments optimized to reduce drift and ensure connections to physical standards. CLARREO will also include GPS radio occultation (GPS-RO) measurements to provide a second, and unique, set of observations on changes in the atmospheric temperature and water vapor profile in a way that is traceable to units of time.

CLARREO Solves- Climate Data

CLARREO is critical for climate detection and attribution

NASA 8- CLARREO Science Questions October 20, 2008 http://clarreo.larc.nasa.gov/docs/VII.3\_Science\_Questions\_Draft\_4\_Oct\_20.pdf

The critical and unique role of CLARREO is to serve as the SI traceable benchmark for decadal climate change. The diagram illustrates how the accuracy of this decadal change record directly controls the ability to determine the accuracy of climate change forcing, detection, attribution, and climate prediction accuracy. While process missions are essential to improving the underlying climate model physics and biology, only decadal change observations can determine the accuracy of the resulting climate change predictions. A decadal time scale prediction must be tested on decadal time scale observations. Climate change detection and attribution to anthropogenic forcing also rely critically on decadal time scale observations. The recent IPCC, NRC Decadal Survey, and CCSP assessment reports are all examples of examining climate model process and decadal change tests, resulting in identifying and prioritizing key weaknesses in climate models and climate observations. These reports also rely on the combination of accurate climate change observations and climate model predictions for critical studies of both 1 climate change detection as well as climate change attribution to natural variability or anthropogenic sources. The most critical weakness identified in all of the reports is the limited accuracy of decadal change observations. In Chapter 3 of the NRC Decadal Survey report it states that “Design of climate observing and monitoring systems from space must ensure the establishment of global, long-term records, which are of high accuracy, tested for systematic errors on-orbit, and tied to irrefutable standards such as those maintained in the U.S. by the National Institute of Standards and Technology”. CLARREO is a new “calibration first” approach that addresses the critical weaknesses in the accuracy of current spaceborne observations. Because it covers the entire solar and infrared spectra critical to the Earth’s energy balance, CLARREO will provide this accuracy for most of the climate variables essential for climate change forcing, detection, response, attribution, and prediction. The forcing and response observations are the same observables critical to studies of climate change detection and attribution. In some cases CLARREO will provide these observations by a direct benchmark of CLARREO spectral radiances, in other cases by CLARREO in-orbit intercalibration of other spaceborne instruments not sufficiently accurate for climate change. CLARREO intercalibration of operational instruments will provide the first anchor for retrospective climate focused reanalyses. This new capability should enable the first re-analyses free of the major instrument change artifacts that degrade current climate re-analysis efforts. The CLARREO observations alone cannot be used to predict future climate change or to attribute such change to anthropogenic forcing. Nor can any climate observations. It is only the combination of climate observations and climate models that can provide climate change attribution and predictions with the confidence and scientific rigor needed to guide societal decisions. As a result, the CLARREO science questions are posed in a way to show both the climate model and the observation aspects of each question. The climate model prediction uncertainties will drive science priorities. CLARREO is unique in that its science requirements are being determined using a new approach: climate Observing System Simulation Experiments. The Climate OSSE approach provides a much more rigorous link between prediction uncertainties and observation improvements. OSSE approaches have been used for weather prediction observing systems, but CLARREO will be the pioneer of such approaches for climate detection, attribution, and prediction

SI traceability provide accurate trends

NASA 8- CLARREO Science Questions October 20, 2008 http://clarreo.larc.nasa.gov/docs/VII.3\_Science\_Questions\_Draft\_4\_Oct\_20.pdf

S.I. traceability is described in The International Vocabulary of Basic and General Terms in Metrology (ISO 1993): “Traceability [is] a property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.” In short, “S.I. traceability” is far more than contemporary scientific marketplace jargon; instead it points toward the measurement practice we learned in grade school that observations demand error estimates based on the overall accuracy of our observing apparatus. The only way error estimates can be obtained is by a documented and reproducible chain of comparisons back to the international standard that defines the units of the observations. Two organizations that maintain such standards are the Bureau des Poids et M´esures in Paris and the U.S. National Institutes for Standards and Technology. Climate benchmarks must be S.I. traceable. The great advantage gained is that a climate benchmark can be used for observing climate change even in the case of a discontinuous time series of data. The community’s experience in constructing “climate data records” from instruments whose calibrations were deemed “stable” has not been good. Take, for example, the records of microwave brightness temperature constructed from measurements of the NOAA satellites’ Microwave Sounding Units (MSU) and of total solar irradiance (TSI). The time series can only be formed by bias-correcting the records of individual instruments so that they match the records of overlapping preceding and succeeding instruments. These efforts have failed because multiple versions of climate data records based on the same data have yielded different long term trends and because even a minor break in the time series of observations renders most of the record useless. With S.I. traceability, the record survives breaks in the time series of observations. Moreover, independent efforts at obtaining long term trends based on S.I. traceable observations will yield the same trends to within empirically determined error.

CLARREO Solves- Climate Data

CLARREO builds upon existing data- shows critical changes

NPL 11- The National Physical Laboratory (NPL) is one of the UK's leading science and research facilities. CLARREO, 25 Jan 2011, http://www.npl.co.uk/celebrating-science/clarreo

The CLARREO mission addresses the need to rigorously observe climate change on decade time scales and to use decadal change observations as the most critical method to determine the accuracy of climate change projections such as those used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4). A rigorously known accuracy of both decadal change observations as well as climate projections is critical in order to enable sound policy decisions. The CLARREO mission accomplishes this critical objective through highly accurate and SI traceable decadal change observations sensitive to many of the key uncertainties in climate radiative forcings, responses, and feedbacks that in turn drive uncertainty in current climate model projections. The same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing. The CLARREO breakthrough in decadal climate change observations is to achieve the required levels of accuracy and traceability to SI standards for a set of observations sensitive to a wide range of key decadal change variables. These accuracy levels are determined both by the projected decadal changes as well as by the background natural variability that such signals must be detected against. The accuracy for decadal change traceability to SI standards includes uncertainties of calibration, sampling, and analysis methods. Unlike most other missions, all of the CLARREO requirements are judged not by instantaneous accuracy, but instead by accuracy in large time/space scale average decadal changes. Given the focus on decadal climate change, the NRC Decadal Survey concluded that the single most critical issue for decadal change observations was their lack of accuracy and low confidence in observing the small but critical climate change signals. CLARREO is the recommended attack on this challenge, and builds on the last decade of climate observation advances in the Earth Observing System as well as metrological advances at NIST (National Institute of Standards and Technology), NPL, and other standards laboratories. The CLARREO science team has also developed a new framework to define the level of accuracy needed for decadal change science, and has used this framework in defining instrument and mission requirements ranging from SI traceable accuracy through mission lifetime design

Key – higher accuracy – recommended by NCR

Wielicki 09 – Bruce A. Wielicki, Senior Scientist for Radiation Science at the NASA Langley Research Center, led research on clouds and the Earth's radiative energy balance for over 20 years, received the NASA Medal for Exceptional Scientific Achievement as well as the American Meteorological Society Henry G. Houghton Award, Fall 09, “CLARREO Mission Overview,” American Geophysical Union, abstract #GC51B-01, online: http://adsabs.harvard.edu/abs/2009AGUFMGC51B..01W

CLARREO (Climate Absolute Radiance and Refractivity Observatory) is one of the four Tier 1 missions recommended by the recent NRC decadal survey report on Earth Science and Applications from Space (NRC, 2007). The CLARREO mission addresses the need to rigorously observe climate change on decade time scales and to use decadal change observations as the most critical method to determine the accuracy of climate change projections such as those used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4). A rigorously known accuracy of both decadal change observations as well as climate projections is critical in order to enable sound policy decisions. The CLARREO mission accomplishes this critical objective through highly accurate and SI traceable decadal change observations sensitive to many of the key uncertainties in climate radiative forcings, responses, and feedbacks that in turn drive uncertainty in current climate model projections. The same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing. The CLARREO breakthrough in decadal climate change observations is to achieve the required levels of accuracy and traceability to SI standards for a set of observations sensitive to a wide range of key decadal change variables. These accuracy levels are determined both by the projected decadal changes as well as by the background natural variability that such signals must be detected against. The accuracy for decadal change traceability to SI standards includes uncertainties of calibration, sampling, and analysis methods. Unlike most other missions, all of the CLARREO requirements are judged not by instantaneous accuracy, but instead by accuracy in large time/space scale average decadal changes. Given the focus on decadal climate change, the NRC Decadal Survey concluded that the single most critical issue for decadal change observations was their lack of accuracy and low confidence in observing the small but critical climate change signals. CLARREO is the recommended attack on this challenge, and builds on the last decade of climate observation advances in the Earth Observing System as well as metrological advances at NIST (National Institute of Standards and Technology) and other standards laboratories. The presentation will summarize the planned CLARREO observations, science priorities, requirements, and the dual strategy to provide climate change benchmarks directly from CLARREO observations, as well as to serve as a set of reference spectrometers in orbit capable of improving the calibration of other weather and climate sensors.

CLARREO Solves- Climate Data

Key – wide range of abilities – specific tech – new orbits – calibrating other satellites

Best, Knuteson, and Hobson 09 - Fred Best, Project manager at the Upper Atmospheric Research Program, the Radiation Science Program and the Tropospheric Chemistry Program, Robert Knuteson, Mark Hobson, staff at the space science and engineering center, winter 2009, “CLARREO – NASA’s New Climate Related Spaceflight Mission,” Through the Atmosphere, University of Wisconsin-Madison Space Science and Engineering Center Cooperative Institute for Meteorological Satellite Studies,

Given the rapid increase of carbon dioxide pumped into the atmosphere by fossil fuel burning, new measurement systems are urgently needed to quantify the impact on the Earth’s climate. To deal with climate change wisely, society needs the best possible understanding of what changes are occurring and accurate predictions of what changes will ensue, depending on the actions we do, or do not, take. A new spaceborne observatory, the CLimate Absolute Radiance and REfractivity Observatory (CLARREO), is being planned to respond to this need. CLARREO was recommended by the 2007 Decadal Survey of the US National Research Council and is being pursued by NASA, with the Langley Research Center as the implementing center (http://clarreo. larc.nasa.gov/). CLARREO is one of NASA’s four highest priority “Tier 1” missions. As a key climate-observing system, CLARREO will initiate an unprecedented, highly accurate record of climate change that is tested, trusted and necessary to provide sound policy decisions. It will provide a record of direct observables with the exacting information content necessary to detect long-term climate change trends and to test and systematically improve climate predictions. CLARREO will observe the spectrally resolved radiance and atmospheric refractivity with the accuracy provided by international standards (SI) and sampling required to assess and predict the impact of changes in climate- forcing variables on the climate. The CLARREO mission is based on new paradigms for making climate benchmark observations. First, radiation measurements for a climate benchmark should be chosen to maximize the information content about atmospheric and surface properties. Previous efforts, particularly climate benchmark missions first designed by Professor Verner E. Suomi at the beginning of the space age (launched in 1959), focused on monitoring the total radiative energy budget. CLARREO will use spectrally resolved radiances to gain sensitivity, because the spectrally integrated total energy budget can miss significant changes that cancel each other out. Observing regional averages and distributions of nadir-viewing spectra will reveal signatures of changes in climate forcing and response related to changes in temperature and water vapor structure, atmospheric stability, cloudiness or aerosols, surface properties, and trace gases. The far infrared region of the spectrum will provide sensitivity to thick ice clouds and upper-level water vapor. Second, to reduce the time to unequivocally resolve climate trends, a new standard in accuracy is needed. The new paradigm is to use SI calibration standards flown on the same spacecraft for on-orbit confirmation of the ultra-high accuracy achieved by careful design and testing on the ground. For infrared radiance spectra, a brightness temperature accuracy of 0.1 K confirmed on orbit is practical (with a 99% confidence that the limit is not exceeded). For refractivity measured using transmissions from the Global Positioning System, the accuracy depends on time measurements that can be made extremely accurately. The accuracy corresponds to a accuracy for upper level temperature that is also better than 0.1 K. Techniques to realize corresponding accuracy for reflected solar radiance spectra are being developed. Establishing highly accurate SI traceable measurements in space alleviates the need to overlap subsequent generations of satellites to establish a climate record. 6 Third, CLARREO needs to achieve spatial and temporal sampling that will maintain this high measurement accuracy in climatically significant regional and seasonal spectral products. Sampling biases have equal importance to measurement errors. A new sampling approach being explored for CLARREO would use three, equally-spaced, truly polar orbits (90o inclination) that do not precess in inertial space. These orbits will cover all latitudes and longitudes, and give equal sampling for all times of day every two months. Recent simulations show that these orbits will also allow CLARREO to be used for highly accurate cross-calibration of operational and research instruments flying in sun-synchronous orbits. SSEC is currently under NASA funding to perform optimal sampling and IR Sounder cross-calibration trade studies that will help define CLARREO science requirements and measurement capabilities. Additionally, we are expecting to start systems engineering studies that will help define the CLARREO IR instrument requirements and a candidate payload concept that will allow estimates to be made of overall mission power, mass, size and cost. The current concept for making the CLARREO infrared spectrally resolved radiance measurements is to use two interferometers: one much like the SSEC-developed Scanning-HIS for the shortwave to midwave (3.3 to 13 microns); and another similar interferometer for the longwave (out to 50 microns). In yet another connection to CLARREO, SSEC is teamed with Harvard University under funding from the NASA Instrument Incubator Program to develop key technologies that will provide on- orbit absolute instrument calibration – a funda mental requirement of the CLARREO mission. At SSEC this work will concentrate on using phase change materials to provide absolute calibration of the instrument blackbody temperature sensors, and on advancing our concept for making highly accurate measurements of blackbody emissivity. We will also be building a prototype interferometer system to demonstrate the performance required by CLARREO. The interferometer will be integrated with state-of-the-art detectors cooled by a pulse tube microcooler. Each element of the prototype system will have strong spaceflight heritage, so that taking the next step to the CLARREO flight system will involve minimal risk. CLARREO’s use of spectrally resolved radiances for more sensitivity, new standards for accuracy, and a three- satellite sampling approach can dramatically reduce the impact of data gaps on decadal change data records across many climate variables. Its ability to calibrate other instruments across the full solar and infrared spectrum can result in increased programmatic flexibility and savings. While other missions may be focused primarily on one climate process or discipline, the CLARREO mission is unique in its broad interdisciplinary impact on climate change science.

CLARREO Solves- Climate Data

Solvency – accuracy unique – key to policies

Sandford et al 10 - Stephen. P. Sandford\*a, David F. Younga, James M. Corlissa, Bruce A.Wielickia, Michael J. Gazarika, Martin G. Mlynczaka, Alan D. Littlea, Craig D. Jonesa, Paul W. Spetha, Don E. Shicka, Kevin E. Browna, Kurtis J.Thomeb, Jason H. Hairb, a. NASA Langley Research Center, b. NASA Goddard Space Flight Center, September 2010, “Sensors, Systems, and Next-Generation Satellites XIV,” SPIE Vol. 7826, 782611 doi: 10.1117/12.866353

The CLARREO mission addresses the need to provide accurate, broadly acknowledged climate records that can be used to validate long-term climate projections that become the foundation for informed decisions on mitigation and adaptation policies. The CLARREO mission accomplishes this critical objective through rigorous SI traceable decadal change observations that will reduce the key uncertainties in current climate model projections. These same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing. CLARREO will make highly accurate and SI-traceable global, decadal change observations sensitive to the most critical, but least understood climate forcing, responses, and feedbacks. The CLARREO breakthrough is to achieve the required levels of accuracy and traceability to SI standards for a set of observations sensitive to a wide range of key decadal change variables. The required accuracy levels are determined so that climate trend signals can be detected against a background of naturally occurring variability. The accuracy for decadal change traceability to SI standards includes uncertainties associated with instrument calibration, satellite orbit sampling, and analysis methods. Unlike most space missions, the CLARREO requirements are driven not by the instantaneous accuracy of the measurements, but by accuracy in the large time/space scale averages that are necessary to understand global, decadal climate changes.

Solvency – unique tech – allows wide range of observation

Sandford et al 10 - Stephen. P. Sandford\*a, David F. Younga, James M. Corlissa, Bruce A.Wielickia, Michael J. Gazarika, Martin G. Mlynczaka, Alan D. Littlea, Craig D. Jonesa, Paul W. Spetha, Don E. Shicka, Kevin E. Browna, Kurtis J.Thomeb, Jason H. Hairb, a. NASA Langley Research Center, b. NASA Goddard Space Flight Center, September 2010, “Sensors, Systems, and Next-Generation Satellites XIV,” SPIE Vol. 7826, 782611 doi: 10.1117/12.866353

A significant new characteristic of CLARREO are the scales at which the mission measurements are targeted. For climate records, the normal spatial and temporal resolution of most Earth observing systems is too small and too short. In fact, the CLARREO approach deviates from the traditional deconstructionist method of understanding the parts to build the whole and takes an integrative approach that measures Earth system-level indicators and uses them to draw conclusions. The smallest spatial scale the CLARREO system will address is regional with 1000 k m size. Zonal averages and global averages are the primary spatial scale objectives. The shortest temporal scale CLARREO will address is seasonal with annual and decadal trends being the primary objectives. This has important implications for the instrument design requirements and the CLARREO designers take advantage of this to meet the stringent accuracy and systematic uncertainty goals for the system.

Solvency – accuracy is unique

Wielicki 11 – Bruce A. Wielicki, Senior Scientist for Radiation Science at the NASA Langley Research Center, led research on clouds and the Earth's radiative energy balance for over 20 years, received the NASA Medal for Exceptional Scientific Achievement as well as the American Meteorological Society Henry G. Houghton Award, D. Young, M. Miynczak, R. Baize, all staff at NASA Langley Research Center, January 25, 2011, “CLARREO,” online: http://www.npl.co.uk/celebrating-science/clarreo

The CLARREO mission addresses the need to rigorously observe climate change on decade time scales and to use decadal change observations as the most critical method to determine the accuracy of climate change projections such as those used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4). A rigorously known accuracy of both decadal change observations as well as climate projections is critical in order to enable sound policy decisions. The CLARREO mission accomplishes this critical objective through highly accurate and SI traceable decadal change observations sensitive to many of the key uncertainties in climate radiative forcings, responses, and feedbacks that in turn drive uncertainty in current climate model projections. The same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing. The CLARREO breakthrough in decadal climate change observations is to achieve the required levels of accuracy and traceability to SI standards for a set of observations sensitive to a wide range of key decadal change variables. These accuracy levels are determined both by the projected decadal changes as well as by the background natural variability that such signals must be detected against. The accuracy for decadal change traceability to SI standards includes uncertainties of calibration, sampling, and analysis methods. Unlike most other missions, all of the CLARREO requirements are judged not by instantaneous accuracy, but instead by accuracy in large time/space scale average decadal changes. Given the focus on decadal climate change, the NRC Decadal Survey concluded that the single most critical issue for decadal change observations was their lack of accuracy and low confidence in observing the small but critical climate change signals. CLARREO is the recommended attack on this challenge, and builds on the last decade of climate observation advances in the Earth Observing System as well as metrological advances at NIST (National Institute of Standards and Technology), NPL, and other standards laboratories. The CLARREO science team has also developed a new framework to define the level of accuracy needed for decadal change science, and has used this framework in defining instrument and mission requirements ranging from SI traceable accuracy through mission lifetime design.

CLARREO Solves- Climate Data

Solvency – gives irrefutable data

Young 09 – David F. Young, staff at NASA/LaRC, January 13, 2009, “Initiating a New Highly Accurate Climate Record with CLARREO,” presented at the 16th conference on satellite meteorology and oceanography, online: http://ams.confex.com/ams/89annual/techprogram/paper\_151283.htm

The NRC Decadal Survey calls for long-term climate records of high accuracy that are tested for systematic errors on-orbit, and are tied to irrefutable standards such as those maintained in the U.S. by the National Institute of Standards and Technology (NIST). The Climate Absolute Radiance And Refractivity Observatory (CLARREO) is a climate-focused mission designed to meet these goals. The foundation for CLARREO is the ability to produce irrefutable climate records through the use of exacting on-board traceability of the instrument accuracy and systematic sampling of the Earth for climate records. Spectral reflected solar and infrared radiances and Global Positioning System Radio Occultation refractivities measured by CLARREO will be used to initiate an unprecedented, high accuracy record of climate change that is tested, trusted and necessary to provide sound policy decisions. This record of direct observables will have the high accuracy and information content necessary to detect long-term climate change trends, to test and systematically improve climate predictions, and to assess and predict the impact of changes in climate forcing variables on climate change

CLARREO Solves- Generic

CLARREO Solves

NASA 8- CLARREO Science Questions October 20, 2008 http://clarreo.larc.nasa.gov/docs/VII.3\_Science\_Questions\_Draft\_4\_Oct\_20.pdf

CLARREO is expected to be one of the most cost effective of all the climate related decadal survey missions in terms of science impact. As can be seen in Table 1, CLARREO has the potential for unique value to decadal change observations needed for a wide range of critical climate science questions. The urgency for the CLARREO mission is a result of the rapidly growing societal challenge of current and future climate change. The urgent need to accurately predict climate change, to develop intelligent plans to minimize it, and to plan methods to adapt to it. This urgency is also a result of the growing realization in the climate science community of the critical need for higher accuracy decadal change observations than currently exist. The timing of the CLARREO mission (why now?) is a result of recent advances in a wide range of scientific, metrology, and technological research. These advances combine to enable CLARREO to be a completely new type of climate mission. A mission focused on accuracy at decade time scales through two complementary methodologies: spectral radiance benchmarks, and intercalibration of other orbiting sensors. A mission focused on high spectral resolution and broad spectral coverage throughout the solar and infrared spectrum that drive the Earth’s climate energy system and climate change. A mission able to leverage its capability across a wide range of climate science disciplines, and satellite earth observing systems. CLARREO will be the first mission capable of providing an anchor at decade time scales to a climate observing system 5 which is currently an accident of international weather and research observing systems. As soon as the international science community attempts to “design” a climate observing system, CLARREO or something similar to it will undoubtedly be the cornerstone of that system. Every year we delay is a year lost in beginning that climate observing system. It is not an exaggeration to state that much of a true climate observing system will begin when CLARREO begins its radiance benchmarks, and when CLARREO begins calibrating other less accurate earth viewing sensors in orbit including the new weather, land, and ocean satellite systems.

SATs solve Laundry List of Impacts

**Sats solve a laundry list of impacts- national security, economy, and climate change**

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

If we accept that climate change poses serious risks to regional stability, national security, and economic health, the United States needs to reconsider its funding priorities for civil space. Earth observation is crucial for national security and the economy; manned spaceflight programs provide prestige. The United States must make climate-monitoring satellites its priority for funding if it is serious about managing climate change. In practical terms, this means a reduction in the spending on human spaceflight in order to fund a sustained program of satellite-building to create a robust climate monitoring space system.This is, of course, not an all-or-nothing issue. The United States can fund a range of space programs, manned and unmanned, for exploration and for Earth sciences. It is a question of priorities. Our recommendation is that the funding given to Earth observation should increase, as it is more important now for the national interest to monitor and manage climate change, even if that means a slower pace for other programs, such as manned spaceflight, until a robust Earth observation system has been put in orbit.

SATs Solve Famine

Satellite imaging solves for famine

Africa News 8 – June 5, 2008, “United States, Canada, and Africa; Famine Early Warning System Can Predict Food Shortages”, l/n

USAID established the famine early warning system (FEWS) to help prevent or respond to famine conditions in sub-Saharan Africa by giving decision makers specific information about drought conditions or dwindling crop yields based on satellite remote-sensing data. Satellite sensors acquire images of the Earth and transmit the data to ground receiving stations worldwide. Once the raw images are processed, analysts can document changing environmental conditions like pollution, global climate change, natural resource distribution and urban growth. In this effort, USAID partners with NASA, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS) and the U.S. Department of Agriculture in the United States, and collaborates with international, regional and national partners. Chemonix International, a global development firm, implements the program for USAID. In 2000, the FEWS Network (FEWS NET) was formed to establish more effective, sustainable, African-led food security and partnerships to reduce the vulnerability of at-risk groups to famine and floods. "At the beginning, it was primarily remote sensing," Gary Eilerts, USAID program manager for FEWS NET, told America.gov. "It was pretty much looking at rainfall and vegetation and trying to say what we thought was happening in terms of food security." IMAGERY AND MARKETS Today, he said, the program has 23 offices around the world where analysts combine maps, data and imagery with knowledge of local markets and trade in each country, and information about local livelihoods, to determine what food the market can buy locally, what it can bring in and what people can afford. "Food security is a very complex phenomenon," geographer Molly Brown, who works for the Biospherics Sciences Branch at NASA's Goddard Space Flight Center in Maryland, told America.gov. "Just because you have green stuff on the ground doesn't mean you're producing anything in the way of food." USAID spent $14.9 million on FEWS NET activities in 2007, funding operations in 17 African nations; regional offices in Burkina Faso, Kenya and South Africa; and country offices in Afghanistan, Haiti and Guatemala. In the field offices, analysts study satellite imagery, local livelihoods, food security and vulnerability, markets and trade, early warning systems and agricultural economics. They also plan contingencies for and responses to food issues. An electrical storm lights the night sky above crops on a farm near Groblersdal, South Africa. The USGS employs regional scientists for Central America, East Africa, West Africa and Southern Africa who support FEWS NET activities and strengthen the technical capacity of regional and national institutions. FEWS NET gets its warnings out through a mix of products that are printed and posted online, Charles Chopak, Chemonix's chief of party for FEWS NET activities, told America.gov. These include monthly food-security updates for the 23 countries and three regional offices that are targeted to technical readers in ministries of agriculture, finance and social welfare. Regular food-security outlooks -- maps updated semi-annually -- show projected food insecurity for a country. "When a situation is emerging or evolving," Chopak said, "we put out a one-page food-security alert that describes what's causing the issue and what the impact will be on food security." In a typical year, FEWS NET analysts might be able to give warnings five months to six months in advance of a food problem. In a bad year, they might be able to give a one- to two-month warning. Anyone can sign up for e-mail alerts on the FEWS NET Web site. Audiences for the warnings include local governments, U.N. agencies in FEWS NET countries, USAID missions and embassies, local and international nongovernmental organizations and food-security consultants. FOOD CRISIS The average price of rice worldwide has more than tripled since early 2006 and wheat, corn and soybean prices have more than doubled, triggering food riots and threatening to plunge more than 100 million people into deeper hunger and poverty. The causes of the crisis vary, but the result in many places is famine. (See "Multiple Factors Drive Up Global Food Prices.") The evolving and increasingly advanced work of FEWS NET becomes even more critical during such a crisis, Eilerts said. "I spend about 80 percent of my time now dealing with that crisis," he added. "It's much more important to know what [food] is [available in countries] and what is not. And it's much more important to be able to follow the changes over time because this problem will be with us for several more years, if not 10 more years." "We're developing a series of products specifically to respond to people at various [technical] levels who want to monitor and take action on rising prices," Chopak said. One product will compare the main staple food of the poor in each country with a likely substitute and try to understand the relative price changes of each. Another product will examine a series of price changes in a region and explain the food-security effect of the change.

Climate monitoring solves for famine

Verdin et al., 5- James Verdin, US Geological Survey, National Center for Earth Resources Observation and Science,; Chris Funk, Climate Hazards Group, University of California, Santa Barbara; Gabriel Senay, US Geological Survey, National Center for Earth Resources Observation and Science; Richard Choularton, Famine Early Warning Systems Network, Chemonics International Inc., October 24, 2005, “Climate science and famine early warning system”, http://earlywarning.usgs.gov/fews/pubs/Climate%20Science%20and%20Famine%20EW.pdf

A first step in livelihoods analysis is developing a livelihood zone map by dividing a country into areas with relatively homogeneous patterns of natural resources and food access. Within these zones, livelihood profiles are prepared. They describe the relative importance of various sources of food and income for the principal wealth groups residing there. Finally, the amounts of food and income, as well as expenditure, are quantified and compared to minimum nutritional needs. This information provides the basis for food security scenario modelling that translates a climatic shock, say a drought-induced 50% reduction in cereal production, into consequences that can be expressed in terms of numbers of affected people and tonnes of food shortfall. It also supports assessment of the population’s capacity to mitigate and manage adversity by turning to alternative sources of food and income. Hazards monitoring provides continuous information regarding potential shocks or adverse trends affecting livelihoods. Market prices for food, livestock and cash crops are key economic variables. Climatically speaking, drought, floods and tropical cyclones are of greatest concern. Hazard information products are used as input to food security scenario modelling. Hazards are superimposed on livelihood zones, and each source of food and income for the relevant profiles is evaluated to determine if a food or income gap will result. In this way, logical and informed conclusions can be drawn in an objective and reproducible manner. Population groups at high risk of acute food insecurity can be identified and quantified, as can prospects for the duration of the problem. Food security projections derived from scenario modelling results are the basis of early warning. Contingency and response planning, in turn, use early warning information to identify potential actions to mitigate an emerging crisis. Better informed decisions can be made regarding the use of humanitarian interventions, such as the mobilization of direct food aid from external sources. Climate science applications for FEWS NET are a fundamental component of hazard monitoring because many of the most food insecure groups in Africa are significantly dependent on rainfed subsistence agriculture and pastoralism. The National Oceanic and Atmospheric Administration (NOAA), US Geological Survey (USGS), National Aeronautics and Space Administration (NASA) and others (including the US Department of Agriculture, FEWS NET/Chemonics, US Agency for International Development) routinely review a suite of monitoring and forecast products to produce a weekly Africa Weather Hazards Assessment (AWHA). The AWHA is distributed to partners throughout the international food security community and posted on the web at http://www.fews.net. An example AWHA weekly hazards map is presented in figure 1. Livelihoods analysis is extensively used to understand the implications of routine climate monitoring and weather forecasting results for food security. More recently, it has been applied to develop food security outlooks from seasonal climate forecasts, though this work is still in its early stages. Even less developed is the use of livelihoods analysis for interpretation of hazards posed by long-term climate change. As the prospects for adverse climate change become more credible and imminent, the importance of this approach will grow. Livelihoods analysis offers a practical, scientific way to inform decision makers of the strategic policy options they should be considering to deal with climate change.

Sats early prediction systems prevent famine

Voiland 9 – Adam, earth science writer for NASA, September 15, 2009, “NDVI: Satellites Could Help Keep Hungry Populations Fed as Climate Changes”, http://www.nasa.gov/topics/earth/features/obscure\_data.html

In the early 1980s, scientists at NASA's Goddard Space Flight Center, Greenbelt, Md., developed the Normalized Difference Vegetation Index (NDVI), an innovative combination of two satellite measurements that allowed them to analyze changes in the "greenness" of Earth as viewed from space. Much like measurements from weather satellites allow meteorologists to track and monitor hurricanes, NDVI lets scientists track droughts, crop infestations, and even full-blown crop failures that lead to widespread famine. Few non-scientists have ever heard of NDVI, yet this vital sign of the planet has important implications for everyone, said Molly Brown, a Goddard scientist who has N-D-V-I emblazoned on her car's license plate. NDVI has been used to study everything from the spread of disease to the archaeological remains of ancient Rome. Perhaps most important, Brown said, is that this remote sensing tool will play a key part in helping us to keep food on the table as future populations swell, the climate changes, and pressures on the agricultural system mount. Shades of Green It’s a bit murky as to when, where, and who first developed the equation that scientists use today to calculate NDVI. It first appeared in a 1973 symposium report to NASA from Texas A&M University researchers. The full potential of NDVI didn't become clear until Compton Tucker of NASA -- along with colleagues Brent Holben, Christopher Justice, John Townshend, Sam Goward, and Steve Prince -- developed an image-compositing technique in the 1970s and 1980s that made it possible to assemble cloud-free NDVI maps over large regions. The work culminated with an NDVI map of Africa's vegetation on the cover of Science in 1985. "It was eye-opening," said Forrest Hall, a physicist at Goddard and a veteran NDVI researcher. "With composited NDVI images, suddenly we could see a cloud-free Earth and how all of the different types of vegetation on Earth fit together and how they changed over time." What had Tucker used to create this groundbreaking map of Africa? The satellite instruments measure the infrared and visible light reflected from plant leaves, and Tucker then calculated a normalized ratio of these two “channels." This ratio changes depending on the density of chlorophyll in green leaves of vegetation. Currently the best data for NDVI measurements come from the Moderate Resolution Imaging Spectroradiometer (MODIS) instruments on NASA's Terra and Aqua satellites; earlier data came from the Advanced Very High Resolution Radiometer (AVHRR) instruments deployed on NOAA polar orbiting meteorological satellites. Since chlorophyll -- the green pigment that plants use to turn sunlight into carbohydrates and hence energy -- absorbs visible light, healthy plants reflect less red light and therefore have a higher NDVI than those with sparse or unhealthy leaves. On Tucker's maps, the sparsely vegetated areas of the Sahara and the Sahel region have NDVI values near zero. The dense jungles of Central Africa have an NDVI closer to 1, the highest value. "It's a very simple and elegant measurement, just two channels of information," said Assaf Anyamba, a Goddard scientist who uses NDVI to research climate variability and vector-borne diseases. "We now have almost 29 years of NDVI documenting global land-based photosynthesis." Keeping Food on the Table NDVI is a remarkably versatile measurement, but monitoring the global food supply has emerged as one of its particularly important uses. By comparing NDVI from one year to previous years, scientists can see tell-tale signs that crops are healthy and vigorous or suffering from drought, insect infestation, or some other problem. The largest user of NDVI data is the Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture (USDA), which monitors agricultural production worldwide with a focus on 15 key crops, including wheat, corn, soy beans, and rice. FAS estimates agricultural production to determine the market rate for commodities, the foundation of the economy in both developed and developing countries. The U.S. Agency for International Development's Famine Early Warning Systems Network (FEWS NET) uses NDVI as its primary tool for anticipating food shortages and failed harvests. FEWS NET provides near real-time data to 20 African countries -- as well as Guatemala, Haiti, and Afghanistan -- about the risks of famine based on NDVI and complementary environmental data. Satellite data alone cannot cure the world of famine, Brown notes, but systems like FEWS NET can buy critical time for governments and relief organizations to react when droughts, wars, and infestations strike the food supply. NDVI has proven particularly useful in some of the world’s most contentious hotspots. In 2008, the FAS, FEWS NET, and a number of other partners used NDVI to monitor wheat yields in Iraq and Afghanistan through a persistent drought that led to the worst yields in a decade. Closer to home, NDVI is also used in certain states as a basis for a novel crop insurance program managed by the USDA. And it's used by ranchers in the American Southwest, as part of the "Range View" monitoring network, to locate the best areas for cattle to forage. Solution for a Hungry, Crowded World The United Nations projects Earth’s population will surpass 9 billion people by 2050, up from the current 6.8 billion. Since the 1990s, commodity prices have risen and the amount of cultivated land per person has declined. The result: many poor communities are ending up with less access to locally grown food even as global food supplies are increasing. Already, researchers estimate that 30 percent of the rural populations of developing countries lack reliable access to food because of poverty. Meanwhile, models suggest that climate change could create an El-Niño like effect in the Indian Ocean that causes more droughts in key agricultural areas of the Americas, Africa, and Asia. Such findings cause Brown and others to worry that areas already struggling with food shortages may face even graver problems in the future. But she also remains hopeful that scientific and technological tools like NDVI can provide critical information to help us blunt the worst of the problems. Improving early prediction systems may be as important in preventing famine as improving farming techniques and food aid policies for ensuring a sustainable future.

SATs Solve War

Sats key to global sustainability

**Reibaldi 95** – Giuseppe, European Space Agency, Acta Astronautica, “Contribution of Space Activities to Peace”, 35:8, Science Direct

Space activities can contribute to prevent and reduce military and non-military threats to the world’s security, because of their endless capabilities, their symbol of co-operation between countries and global reach since, in space perspective, the Earth appears as an integrated and independent system. Eventually, space can be regarded as a laboratory for peace. We shall examine some examples of space activities’ contribution to reduce threats to the world’s security. 2. REDUCTION OF MILITARY THREATS Military threats are linked to military confrontations such as: 2. I. War prevention Following the end of the Second World War the United States and the Soviet Union created the “bloc structure”, which was the origin of the bi-polar system. Both superpowers steadily started a military build-up without any precedence, except during war periods. In the early 1950s the Soviet Union managed to acquire the technology of nuclear weapons and this increased the tension between the two superpowers even more. With the advent of the Earth orbit satellites (the first satellite, Sputnik I, was launched in October 1957), the possibility to closely monitor the military assets of the enemy from space was a top priority for the two superpowers in which they succeeded in the early 1960s. Since then, several types of spy satellites have been developed by the U.S. and the U.S.S.R. Those satellites played an important role in peacekeeping because they virtually eliminated the possibility of a surprise attack, since it would be monitored by the satellites. For the future, the continual improvement of space reconnaissance satettites by the U.S. and Russia, on the one hand and the development of new systems by other nations, on the other hand, will have a significant impact on international affairs[2], which, historically speaking, should lead to limit hostility between nations. 2.2. Verification of arms control agreements With the arrival to power of Gorbachev in the U.S.S.R., and later on with the collapse of communism, a new impetus was given to the negotiations on arms control. In 1987 the INF (Intermediate Nuclear Forces) Treaty was signed. This Treaty provided for the total elimination on a global basis, of an entire class of United States and Soviet Union nuclear systems, i.e. ground launched missiles with ranges between 500 and 5500 km. This elimination implied monitoring the destruction of several thousands of nuclear warheads. In 1990 the INF was followed by the signing of the CFE (Conventional Force in Europe) Treaty which stipulated the establishment of weapons ceilings for NATO and the ex-Warsaw Pact countries, as well as the set-up of four zones with sub-limits for each. The CFE Treaty foresaw the destruction of large quantities of ex- Soviet military equipments as well as the monitoring of their position over a large area. In order to insure the respect of those Treaties, verification means are required. Historically, verification of bilateral U.S./ U.S.S.R. arms control agreements has traditionally relied mainly on National Technical Means (NTM)[3]. These systems range from high and loworbiting satellites employed to collect images and signals from space down to submarines, used for tapping into undersea communications lines. The next few years will most likely see an increase in the capability, across the world, to monitor military forces from space. Europe is considering achieving such a capability[4] as are other countries such as Israel and India. This will open up an unprecedented opportunity for confidence building and for the verification of arms control agreements in general. In 1978, a proposal from the French government to the UN General Assembly on Disarmament to create an international satellite monitoring agency was rejected; in consideration of the changed political environment the time seems mature to try again. 2.3. Contain military/nuclear technology proliferation In order to implement the arms control agreements mentioned above, thousands of Inter Continental Ballistic Missiles (ICBMs) are required to be destroyed. As an alternative to destruction, the conversion to civilian space applications can be foreseen, this will allow: -to keep a knowledgeable work force employed, preventing them from migrating to non-friendly countries -generation of an income for the ex-Soviet industries by selling these rockets on the international market and/or giving the ex-Soviet opportunity to form joint ventures with industries in Western countries. Severe measures are already implemented in the Missile Technology Control Regime (MTCR) to control the spread of the most sophisticated missile technology, but civilian space activities can help in containing the proliferation of know-how and hardware, which could ignite local conflicts. The Nuclear Non-proliferation Treaty (NPT), signed by more than 140 countries, is the centerpiece of the nuclear non-proliferation regime. This Treaty relies on several means to contain the spread of nuclear technology, including inspections by the International Atomic Energy Agency (IAEA) [5]. The collapse of communism and the financial difficulties of several research institutes in the ex-Soviet Union have drastically reduced the control of nuclear products which could be used to build an atomic weapon. This, coupled with the increased effort of Third World countries to intensify their military build-up, has created an unprecedented risk of nuclear proliferation. For Iraq and Northern Korea the uncertainty, in the absence of inspections, of whether they have already developed atomic weapons or not, has in one case been brought to the Gulf War and in the other case, arrived very close to it. Space technology and satellites in particular, can play a major role in containing nuclear proliferation, even if it will never totally replace ground inspections and traditional intelligence. A system called “nuclear proliferation sensing network of surveillance satellites” is under study[6]. These satellites should enable detection of the indirect effects of nuclear activities in the making, such as chemical residue released during plutonium reprocessing, signature of a nuclear reactor in a weapon material processing cycle-even before the nuclear material is removed. 2.4. Assistance to UN peace-keeping operations The United Nations were created following the end of the Second World War, the Security Council in particular was given the primary responsibility for the maintenance of international peace. However, during the Cold War period, 1945-1990, its effectiveness to operate was very limited by the two superpowers, the U.S. and the U.S.S.R. With the end of the Cold War the United Nations Security Council was able to operate in a more normal way and several peacekeeping operations were carried out[7]. Following the end of so-called “Gulf War”, the United Nations had the task of monitoring the implementation of the cease-fire agreements. This task was fulfilled with the assistance of observation and telecommunication satellites of the U.S. and other countries. The war in ex-Yugoslavia created the need to bring in the ground UN forces to monitor the numerous cease-fires agreed between the warring factions. Earth observing satellites have been used to help in this task as well as in monitoring the respect of the “no-fly” zone, decided by the UN Security Council. So far, the support function to the UN of this kind of vital information has been carried out more on a “best effort”, basis, rather than on a routine basis. In order to correct this situation the UN Secretary General has demanded more effort from the member states to utilize space technology in order to promote international peace, security and stability[7]. This can be done with co-ordinated efforts from the member states within their existing space capabilities.

SATs Solve Environment

**Climate sats solve environmental issues- prevents violation of climate treaties and detects pollution**

**Reibaldi 95** – Giuseppe, European Space Agency, Acta Astronautica, “Contribution of Space Activities to Peace”, 35:8, Science Direct

3.1. Containing environmental threats The 1970s have seen the rise of ecological movements, originating from the view of the fragile Earth, as photographed by the Apollo astronauts on the way to the Moon. The human species already consumes or destroys 40% of all energy produced by terrestrial photosynthesis, that is, 40% of the food potentially available to living things on land. Predictions for the future indicate that tropical forests will continue to be destroyed, arable land will shrink because of the top soil pollution that cannot be repaired. The control of the environment is no longer the issue of a single state but its implication is international, so it requires close monitoring to avoid disputes in this matter, eventually generating situations of conflict. Governments realized that pollution had reached unsurpassed levels and after several years of futile discussions they agreed on several environmental treaties which limited the use of substances which proved to be dangerous to the environment (i.e. Montreal Accord which seeks to limit the global emission of CFCs to protect the ozone layer). The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 was a significant step in this direction, since it was attended by 118 Heads of State and Government. Delegates from rich and poor countries participating in the Rio Conference worked out agreements to protect biodiversity, control carbon dioxide emission and slow deforestation. Those agreements require verification in order to be credible and binding for the countries which adhere to it. Earth observing satellites can bring awareness of any violation of environmental treaties as an independent source of information. For example, the European Space Agency’s Earth Remote Sensing 1 (ERS-1) satellite can detect, by day and by night, river pollution and identify the potential responsible, or oil leakage generated by a transport ship which is washing its tanks in international waters. Furthermore, space technology can provide easier access to “soft technology” such as education and health care as well as “hard technology” such as telecommunication and discovery of natural resources and this will help developing countries in achieving a policy of sustainable development. 3.2. Monitoring natural disasters

Hurricanes, earthquakes, floods, drought and other disasters are common phenomena in highly populated regions and there is often insufficient warning. In the hours immediately following such a catastrophic event, it is often impossible to communicate with the affected area, in order to obtain a preliminary damage assessment and to initiate relief efforts. The size of the population affected by such disasters is impressive. According to the Office of U.S. Foreign Disaster Assistance a total of 1185 million people were affected between 1964 and 1990. On average, 44 million people had been affected each year over this period. The economic losses are also huge: it is estimated that in 1978 the total cost to the global economy due to natural disasters was at least $40 billion. By a combination of telecommunication and Earth observation satellites it is possible to set up systems like “GEOWARN” that allow co-ordination of data received for relief efforts and creation of a global disaster warning center. This system would be able to save millions of people as well as preserve financial assets making it economically attractive. The GEOWARN system[9], created by the International Space University, is under discussion in the frame of the Committee for the Peaceful Uses of Outer Space (COUPOS) of the United Nations, for possible implementation.

\*\*AT: Impact Turns\*\*

AT: Cooling Good- CLARREO Key

CLARREO is key to accurately monitoring cooling patterns- data isn’t exclusive to warming trends or prevention

Young and Lynch 10- Just 5 questions: Fingerprinting the climate by Dr. Dave Young, NASA Sunday, March 21st 2010, 11:00 AM EDT Interview by Patrick Lynch, NASA Langley Research Center http://climaterealists.com/index.php?id=5401

1. You're project scientist for NASA's CLARREO mission. Tell us about the project. One of the things that prevents us from making definitive statements about climate change is the accuracy of the current observing system we have. A major goal of the CLARREO mission is to provide extremely accurate climate measurements — at the accuracy level of tenths of a percent per decade. By knowing these trends very precisely, we can improve the accuracy of climate change forecasts, which will help society make the tough decisions we're facing. 2. So what sort of data will it collect, and how? CLARREO won't measure individual aspects of our climate, such as changes in carbon dioxide levels or ice sheet changes. Instead, it will look at the climate system as a whole, by tracking the amount of energy entering and leaving the Earth's atmosphere. We'll do this by making measurements of the entire spectrum of electromagnetic radiation in the atmosphere, including wavelengths that are invisible to the eye such as infrared waves (heat) and near-ultraviolet radiation (reflected sunlight). These are the two components of what we call the Earth's "energy budget," which can tell us over time whether or not the planet is getting warmer or cooler. Article continues below this advert: We know the things that can cause our climate to change. They include changes in the intensity of the sun, and increases in heat-trapping gases such as carbon dioxide in our atmosphere. What we want to learn is how the Earth responds to these driving forces, and any other secondary feedback effects that might occur. For example, say the Earth responds to increases in carbon dioxide levels by warming up; a warmer planet causes more water to evaporate and increases the amount of certain types of clouds. Clouds could either accelerate or slow down subsequent global warming. By taking very accurate energy measurements from space over a long period of time, we'll be able to measure these responses and feedbacks on decade-long timescales. 3. CLARREO claims it will produce an "irrefutable climate record." Does that mean it will put an end to climate change controversy? Producing a trusted and tested climate record is one of our goals. First, we will strive for 100 percent transparency. Part of this [recent] email scandal is that people think data and results have been hidden. Second, we will characterize our instruments as thoroughly as anybody has ever done. On board the spacecraft there will be a verification system that's constantly monitoring not only the measurements we make, but also how accurately we're making those measurements. Then I think you'll have as close to an irrefutable measurement as possible. People want to talk in certainty. They want to say climate change is a certainty. Or, climate change is nonsense. That doesn't work. Predicting future climate change is about offering a range of potential scenarios based on a range of present-day factors, and then determining the most likely scenario. We're designing the mission such that if people want to delve into it and question our results, the answers will be there for all to see.

CLARREO IR measurements are used to track cooling patterns

Feldman et al 8- Comparison of mid-IR and far-IR Hyperspectral Information 2 for Clear and Cloudy Scenes Monday, November 03, 2008 4 D.R. Feldman1,† , M.G. Mlynczak2, D.G. Johnson2, K. N. Liou3, Y.L. Yung1 5 1 California Institute of Technology, Pasadena, California, USA 6 2 NASA Langley Research Center, Hampton, Virginia, USA. 7 3 University of California-Los Angeles, Los Angeles, California, USA http://www.gps.caltech.edu/~drf/misc/pubs/first/first\_paper\_draft1.pdf

The far-infrared (15-100 μm) is extremely relevant to Earth’s climate and new developments in observing 11 technology hold promise that it will be measured directly and comprehensively from space in the near 12 future. Recently, the Far Infrared Spectroscopy of the Troposphere (FIRST) instrument [Mlynczak et al., 13 2006] has been built as a prototype FTS which records spectra from 5 to 200 μm. This provides a test14 bed for the development of space-based far-infrared measurements in support of climate change 15 monitoring which is one of the goals of the planned CLimate Absolute Radiance and Refractivity 16 Observatory (CLARREO) mission. We present a comparison of the retrieval capabilities of a notional 17 space-based instrument of comparable performance to FIRST and the currently-operational mid-infrared 18 instrument AIRS under clear conditions. Synthetic temperature and water vapor profile retrievals are 19 compared for tropical conditions along with the relative ability of the retrievals from these two 20 instruments to describe clear-sky cooling rate profiles. The information contained in clear-sky mid-IR 21 spectra is found to be slightly less than that of far-IR spectra. Next, the ability of mid-IR measurements 22 to be used to describe far-IR measurements in the presence of clouds is explored. In general, mid-IR 23 measurements can be used to extrapolate to the far-IR though an error of several degrees Kelvin may be 24 incurred for scenes where only thin cirrus are present in channels with weighting functions peaking at 25 about two kilometers below the cloud base. Finally, a comparison of collocated spectra from FIRST test 2 26 flights and several A-Train measurements is presented in the context of future climate monitoring 27 objectives. The comparison indicates that far-infrared measurements are complementary to the other sets 28 of A-Train instrumentation but the dearth of space-like long-wavelength spectra suggests that more 29 campaigns are warranted for understanding the additional information provided by the spectral region 30 from 15-100 μm.

AT: Cooling Good- Uniqueness

Feedback data proves the trend is warming

Carbon Equity Project 7- Avoiding catastrophe Recent science and new data on global warming Emissions scenarios to avoid catastrophic climate change, A survey by the Carbon Equity Project for Friends of the Earth Australia, January 2007

In some of the less-informed public discussion about global warming, there is casual, seemingly unconcerned, talk of rises of three or four degrees, as if these are small nuisances to which we can easily adapt. The assumption is that there is a simple linear relationship between temperature rise and impact: that going from two to three degrees will require a measure of adaption similar to going from zero to one degree. But the review of global warming in 2006 by the "Independent" newspaper reported that: "During the past year, scientific findings emerged that made even the most doomladen predictions about climate change seem a little on the optimistic side. And at the heart of the issue is the idea of climate feedbacks -- when the effects of global warming begin to feed into the causes of global warming. Feedbacks can either make things better, or they can make things worse. The trouble is, everywhere scientists looked in 2006, they encountered feedbacks that will make things worse -- a lot worse". Things are worse because in part the 2001 report of the IPCC had little to say about positive feedbacks; it tended "to regard the Earth's climate as something that will change gradually and smoothly, as carbon dioxide and global temperatures continue their lockstep rise. But there is a growing consensus among many climate scientists that this may be giving a false sense of security. They fear that feedback reactions may begin to kick in and suddenly tip the climate beyond a critical threshold from which it cannot easily recover" (Connor and McCarthy 2006).

Positive feedback occurs when a change (a rise) in one component (global temperatures) of a system (the climate) leads to other changes (such as the melting on the Arctic floating ice) which then "feed back" to amplify it (increased water temperature as the white ice which reflects heat is replaced by dark water which absorbs heat). The result of the first feedback (increased water temperatures) may trigger another change (the beginning of the melting if the Greenland ice sheet) which will itself produce further feedback (rising sea levels with destabilize further parts of the ice sheets) and so on. An unstoppable chain reaction may be set off (runaway global warming), but this far from inevitable: the system may re-stabilize at higher global temperature. We must prevent that chain reaction from starting. As James Hansen notes, positive feedbacks will be "moderate" but if "global warming becomes larger than that, all bets are off... there seems to be a dichotomy. We either keep the warming small or it is likely to be quite large." (Hansen 2006b)

\*\*AT: Climate Change Defense\*\*

AT: Impact Slow

Global warming is reaching a critical threshold- effects will be produced rapidly and will become irreversible

Carbon Equity Project 7- Avoiding catastrophe Recent science and new data on global warming Emissions scenarios to avoid catastrophic climate change, A survey by the Carbon Equity Project for Friends of the Earth Australia, January 2007

Leading climate scientists and political figures including Sir Nicholas Stern, Dutch prime minister Jan Peter Balkenende, former US vice-president Al Gore, NASA atmospheric research chief Professor James Hansen and the eminent British climatologist Sir John Houghton all warn that unless decisive action to halt global carbon emissions is taken in the next decade, it may simply be too late and the trigger point for irreversible, dangerous climate change will have passed. Even stringent actions after that time will not be able to stop a climate system charged with strong feedback mechanisms running away from our capacity to control it. Anthropogenic greenhouse gas emissions, particularly over the last fifty years, have made us the masters of climate change, but if we go on as we are there will be a swift inversion in which climate change becomes the master of our destiny. A recent report by Christian Aid and EcoEquity concludes that: "the pace of our response has been profoundly inadequate... and the science now tells us that we’re pushing beyond mere ‘dangerous anthropogenic interference with the climate system,’ and are rather on the verge of committing to catastrophic interference. Given the slow progress to date, a heroic effort will now be required to have a high likelihood of averting a climate catastrophe" (Athanasiou et. al. 2006). James Hansen, Director of NASA's Goddard Institute for Space Studies, and one of the world's most eminent climate scientists, says that "we must close that gap (between the science and the policy-makers) and begin to move our energy systems in a fundamentally different direction within about a decade, or we will have pushed the planet past a tipping point beyond which it will be impossible to avoid far-ranging undesirable consequences". Global warming of two to three degrees, he warns, would produce a planet without Arctic sea ice, a catastrophic sea level rise in the pipeline of around 25 metres, and a super-drought in the American west, southern Europe, the Middle East and parts of Africa. "Such a scenario threatens even greater calamity, In 2006, predictions on the final demise of the Arctic's floating ice were brought forward from 2080-2100 to 2030-40. The melting of the floating ice around the north pole is now considered unstoppable. The polar bear's only habitant will be the zoo. Data presented at the American Geophysical Union in December 2006 suggests that the Arctic may be free of all summer ice by as early as 2030, "a positive feedback loop with dramatic implications for the entire Arctic region" according to Dr Marika Holland, because the Earth would lose a major reflective surface and so absorb more solar energy, potentially accelerating climatic change across the world (Amos 2006). "Our hypothesis is that we've reached the tipping point," says Ron Lindsay of the University of Washington in Seattle. "For sea ice, the positive feedback is that increased summer melt means decreased winter growth and then even more melting the next summer, and so on" (Connor and McCarthy 2006). With no ice, the Arctic region will rapidly begin heating, perhaps by as much as 12 degrees, putting further pressure on the Greenland icecap (Flannery 2006). Global warming so far has been greatest in the high latitudes of the northern hemisphere, particularly in the sub-Arctic boreal forests of Siberia and North America (Pearce 2006a), with severe implications for the rate at which vast quantities of methane held in the Siberian permafrost will be released into the atmosphere, driving the level of greenhouse upwards. New research and analysis, in part motivated by the preparatory phase of the 2007 report of the International Panel on Climate Change, is increasingly sombre. Events are happening more rapidly or sooner than expected, atmospheric carbon level rises are higher than expected, and deeper understanding of positive feedback mechanisms is leading some climate change scientists to ring alarm bells more urgently.

Climate Change Impacts- Conflict

Even if they win there is no warming based on scientific data, perception is key- perception of increasing CO2 causes instability and make war permanent

Schwartz and Randall 3- An Abrupt Climate Change Scenario and Its Implications for United States National Security By Peter Schwartz, co-founder and chairman of Global Business Network and Doug Randall, California-based Global Business Network, October 2003 http://www.edf.org/documents/3566\_AbruptClimateChange.pdf

Many point to technological innovation and adaptive behavior as a means for managing the global ecosystem. Indeed it has been technological progress that has increased carrying capacity over time. Over centuries we have learned how to produce more food, energy and access more water. But will the potential of new technologies be sufficient when a crisis like the one outlined in this scenario hits? Abrupt climate change is likely to stretch carrying capacity well beyond its already precarious limits. And there’s a natural tendency or need for carrying capacity to become realigned. As abrupt climate change lowers the world’s carrying capacity aggressive wars are likely to be fought over food, water, and energy. Deaths from war as well as starvation and disease will decrease population size, which overtime, will re-balance with carrying capacity. When you look at carrying capacity on a regional or state level it is apparent that those nations with a high carrying capacity, such as the United States and Western Europe, are likely to adapt most effectively to abrupt changes in climate, because, relative to their population size, they have more resources to call on. This may give rise to a more severe have, have-not mentality, causing resentment toward those nations with a higher carrying capacity. It may lead to finger-pointing and blame, as the wealthier nations tend to use more energy and emit more greenhouse gasses such as CO2 into the atmosphere. Less important than the scientifically proven relationship between CO2 emissions and climate change is the perception that impacted nations have – and the actions they take. Steven LeBlanc, Harvard archaeologist and author of a new book called Carrying Capacity, describes the relationship between carrying capacity and warfare. Drawing on abundant archaeological and ethnological data, LeBlanc argues that historically humans conducted organized warfare for a variety of reasons, including warfare over resources and the environment. Humans fight when they outstrip the carrying capacity of their natural environment. Every time there is a choice between starving and raiding, humans raid. From hunter/gatherers through agricultural tribes, chiefdoms, and early complex societies, 25% of a population’s adult males die when war breaks out. Peace occurs when carrying capacity goes up, as with the invention of agriculture, newly effective bureaucracy, remote trade and technological breakthroughs. Also a large scale die-back such as from plague can make for peaceful times---Europe after its major plagues, North American natives after European diseases decimated their populations (that's the difference between the Jamestown colony failure and Plymouth Rock success). But such peaceful periods are short-lived because population quickly rises to once again push against carrying capacity, and warfare resumes. Indeed, over the millennia most societies define themselves according to their ability to conduct war, and warrior culture becomes deeply ingrained. The most combative societies are the ones that survive. However in the last three centuries, LeBlanc points out, advanced states have steadily lowered the body count even though individual wars and genocides have grown larger in scale. Instead of slaughtering all their enemies in the traditional way, for example, states merely kill enough to get a victory and then put the survivors to work in their newly expanded economy. States also use their own bureaucracies, advanced technology, and international rules of behavior to raise carrying capacity and bear a more careful relationship to it. All of that progressive behavior could collapse if carrying capacities everywhere were suddenly lowered drastically by abrupt climate change. Humanity would revert to its norm of constant battles for diminishing resources, which the battles Abrupt Climate Change 17 themselves would further reduce even beyond the climatic effects. Once again warfare would define human life.

Resource scarcity and energy constraints will inflame conflict

Schwartz and Randall 3- An Abrupt Climate Change Scenario and Its Implications for United States National Security By Peter Schwartz, co-founder and chairman of Global Business Network and Doug Randall, California-based Global Business Network, October 2003 http://www.edf.org/documents/3566\_AbruptClimateChange.pdf

Human civilization began with the stabilization and warming of the Earth’s climate. A colder unstable climate meant that humans could neither develop agriculture or permanent settlements. With the end of the Younger Dryas and the warming and stabilization that followed, humans could learn the rhythms of agriculture and settle in places whose climate was reliably productive. Modern civilization has never experienced weather conditions as persistently disruptive as the ones outlined in this scenario. As a result, the implications for national security outlined in this report are only hypothetical. The actual impacts would vary greatly depending on the nuances of the weather conditions, the adaptability of humanity, and decisions by policymakers. Violence and disruption stemming from the stresses created by abrupt changes in the climate pose a different type of threat to national security than we are accustomed to today. Military confrontation may be triggered by a desperate need for natural resources such as energy, food and water rather than by conflicts over ideology, religion, or national honor. The shifting motivation for confrontation would alter which countries are most vulnerable and the existing warning signs for security threats. There is a long-standing academic debate over the extent to which resource constraints and environmental challenges lead to inter-state conflict.While some believe they alone can lead nations to attack one another, others argue that their primary effect is to act as a trigger of conflict among countries that face pre-existing social, economic, and political

Climate Change Impacts- Conflict

tension. Regardless, it seems undeniable that severe environmental problems are likely to escalate the degree of global conflict. Co-founder and President of the Pacific Institute for Studies in Development, Environment, and Security, Peter Gleick outlines the three most fundamental challenges abrupt climate change poses for national security: 1. Food shortages due to decreases in agricultural production 2. Decreased availability and quality of fresh water due to flooding and droughts 3. Disrupted access to strategic minerals due to ice and storms Abrupt Climate Change 15 In the event of abrupt climate change, it’s likely that food, water, and energy resource constraints will first be managed through economic, political, and diplomatic means such as treaties and trade embargoes. Over time though, conflicts over land and water use are likely to become more severe – and more violent. As states become increasingly desperate, the pressure for action will grow.

Case solves the DA- Climate change turns war- eventually leads to both Hot and Cold Wars

Lee 9 – James R. Lee, Professor in the School of International Service, American University, Washington, DC, and Associate Director of American University’s

Center for Teaching Excellence, Routledge Studies in Peace and Conflict Resolution, “Climate Change and Armed Conflict: Hot and Cold Wars”

Climate change leads to two different conflict types: Hot Wars and Cold Wars. Hot Wars, located around the Equator, have a long historic precedence. Climate change has led to and will exacerbate Hot Wars. Cold Wars, located near the poles, especially in the north, have been relatively rare. Climate change will mark the ascendance of Cold Wars. The Cold and Hot Wars can be conceptualized and compared on eight dimensions (see Table 1.1). The terms “hot” and “cold” with respect to war refer to differing types of response to climate change that may result in conflict. The two zones characterize the basic types of seasonality that occur in the world, one based on wet and dry seasons (Hot War lands) and the other based on warm and cool seasons (Cold War lands). By altering seasonality patterns, climate change will upset prevailing patterns of subsistence. In some instances, this means humans will no longer be able to survive. In other instances, the type of technology and economy must adapt to the new conditions. The role of climate change in conflict can be significant or contributory, meaning that as a causal factor it can be large or small in consequence. Climate change and other factors produce inter-twined, dynamic outcomes. The role of climate change, though, can be one of an instigator of causal trends that have multiple influences. A Hot War is conflict where climatic heating leads to loss of water and desertification of habitats, driven especially by changes in precipitation patterns. While some climate change may lead to increases in precipitation, a Hot War occurs when precipitation declines. There is, of course, feedback: a warming climate will lead to greater evaporation of water and will compound problems of aridity. A Hot War is prone to occur in the Equatorial Tension Belt, and there are three types of such wars, caused by changes in habitat, movement of populations, and adaptations to new types of economic systems. The first type of possible Hot War is the “new desert”, where a semi-arid area transforms into an arid area and the ability to support human populations substantially declines. This might be the case where, for example, fringe areas of the Sahel become even drier and lose what little vegetation exists. This Sahel area would be functionally “annexed” into the Sahara Desert. Nomads who live a meager and marginal existence in Sahel would be forced to move to areas that match their style of subsistence and economy. Other nomads, however, might already be living in these places, or might also be fleeing from other areas of desert annexation. This sets up a possible conflict situation. The second type of hot war is the “new transition zone”, where a temperate or tropical region loses precipitation and becomes semi-arid or Sahel-like. In this circumstance, the size of the population that can be supported substantially decreases. A significant part of the population will need to migrate to other places, and economic systems may be substantially impacted. This might occur due to changes in water availability, through both loss of precipitation and greater evaporation. This is possible in areas of Kurdistan in Iraq (for example), where the region is expected to dry and become more like the marginal areas of western Iraq. The third type of Hot War is when a tropical region dries or deforests and the region transitions from a tropical forest to tropical grassland. Tropical forests are known to create some of their own precipitation patterns, and deforestation would probably combine climate and human pressures. The change would require adjustment of economic and livelihood systems over a long period. Ancient Clovis peoples in North America who depended on the woolly mammoth for survival needed to alter their subsistence patterns and technologies once the creatures died out. Levels of population may not decline – they may actually increase – but there will need to be a transition from one economic type to another. This type of Hot War is already occurring in large parts of Amazonia. The Hot War conflict is usually internal to the state. The Equatorial Tension Belt has generally weaker state governments, and forced movements of people will generally fall along ethnic or tribal lines. The duration of the conflict in a Hot War occurs over the long term, with “push” migration factors. The areas usually have lower levels of development, and resource impacts are generalized into concerns of water, arable land, and forest resources. Conflict drivers are livelihood based, meaning they are often issues of human and not state security, though at some point the two meet. “If climate change results in reduced rainfall and access to the natural capital that sustains livelihoods, poverty will become more widespread, leading to increased grievances and better recruitment opportunities for rebel movements” (Nordas and Gleditsch 2007: 631). A Cold War involves a different process, that of temperature changes. The Cold War also relates to changing patterns of precipitation. In this instance it is not more or less, necessarily, but a frozen versus a liquid form. In a Cold War, an area that is relatively uninhabitable to humans due to cold temperatures becomes habitable. The Cold War type is most often common to the Polar Tension Belt. The degree of change over time in a Cold War is more episodic compared to the long-term nature of Hot War conflict in the Equatorial Tension Belt. The Cold War is driven by temperature increases and the warming of cooler parts of the planet. Where the Hot War is characterized by the breakdown of state functions and internal strife, the Cold War exemplifies conditions of expanding state control and external conflict. These conflicts are often short term, and witness more pronounced swings in climate and habitat conditions. There are two types of Cold War. The first is where lands that are not productive due to the cold weather become arable and capable of supporting much larger populations. One could imagine that the Great Plains of North America will extend north into Canada with warming, and create new areas for grain and other crop cultivation. This new-found arability serves as a pull factor for migration in these areas, often attracting migrants who are pushed out of Hot War regions. The second type of Cold

Climate Change Impacts- Conflict

War is where warming changes the economic calculus of resource extraction so that it becomes economically viable. This situation might occur when known deposits of precious minerals, metals, or energy sources cross a threshold of business profitability. The use of coal for heating became widespread after forests in Europe and China, for example, were cut down. As the price of firewood rose, the coal alternative, along with new technologies, became viable. This transition depends on more than the cost of extracting the resource. The calculus also relies heavily on modes and ease of transportation of people and equipment. In a Cold War, there are high levels of development, conflict drivers are opportunities, and resource types are specific. Conflicts are related to expansion of national interest, and actual periods of warfare may be short but intense. The ability to adapt to climate change in the two conflict dimensions substantially differs, and this differentiation is key to the type of conflict that subsequently emerges. “Cold War” countries, which are largely developed, will face fewer adaptation issues. In fact, livelihoods may be easier in some areas due to a warming temperature. Some adaptations may be required, but these countries susceptible to Cold War conditions (developed countries) have sufficient “stored” resources to allow them to respond. The situation is quite different in “Hot War” countries. There, climate change through loss of precipitation will cause livelihoods to deteriorate. These areas consist largely of developing countries that lack substantial stored resources. The result is that where more adaptability is needed, less ability to adapt exists. The greater the adaptability gap, the greater the chance for conflict. This relationship may not be linear; conflict may be more likely as the gap becomes apparent, rather than at its widest point. By the point of the most extreme gap between resources and demands, simple survival may be paramount. The comparisons reveal, starting with the drivers, two entirely different types of systems and behaviors in Cold and Hot Wars. Precipitation and temperature changes drive the context, but in differing ways. The relation to conflict is the process of adjusting to declining and increasing resources.

Climate Change Impacts- Laundry List

Climate Change makes disease, war, instability, and nuclear proliferation inevitable

Schwartz and Randall 3- An Abrupt Climate Change Scenario and Its Implications for United States National Security By Peter Schwartz, co-founder and chairman of Global Business Network and Doug Randall, California-based Global Business Network, October 2003 http://www.edf.org/documents/3566\_AbruptClimateChange.pdf

The two most likely reactions to a sudden drop in carrying capacity due to climate change are defensive and offensive. The United States and Australia are likely to build defensive fortresses around their countries because they have the resources and reserves to achieve self-sufficiency. With diverse growing climates, wealth, technology, and abundant resources, the United States could likely survive shortened growing cycles and harsh weather conditions without catastrophic losses. Borders will be strengthened around the country to hold back unwanted starving immigrants from the Caribbean islands (an especially severe problem), Mexico, and South America. Energy supply will be shored up through expensive (economically, politically, and morally) alternatives such as nuclear, renewables, hydrogen, and Middle Eastern contracts. Pesky skirmishes over fishing rights, agricultural support, and disaster relief will be commonplace. Tension between the U.S. and Mexico rise as the U.S. reneges on the 1944 treaty that guarantees water flow from the Colorado River. Relief workers will be commissioned to respond to flooding along the southern part of the east coast and much drier conditions inland. Yet, even in this continuous state of emergency the U.S. will be positioned well compared to others. The intractable problem facing the nation will be calming the mounting military tension around the world. As famine, disease, and weather-related disasters strike due to the abrupt climate change, many countries’ needs will exceed their carrying capacity. This will create a sense of desperation, which is likely to lead to offensive aggression in order to reclaim balance. Imagine eastern European countries, struggling to feed their populations with a falling supply of food, water, and energy, eyeing Russia, whose population is already in decline, for access to its grain, minerals, and energy supply. Or, picture Japan, suffering from flooding along its coastal cities and contamination of its fresh water supply, eying Russia’s Sakhalin Island oil and gas reserves as an energy source to power desalination plants and energy-intensive agricultural processes. Envision Pakistan, India, and China – all armed with nuclear weapons – skirmishing at their borders over refugees, access to shared rivers, and arable land. Spanish and Portuguese fishermen might fight over fishing rights – leading to conflicts at sea. And, countries including the United States would be likely to better secure their borders.With over 200 river basins touching multiple nations, we can expect conflict over access to water for drinking, irrigation, and transportation. The Danube touches twelve nations, the Nile runs though nine, and the Amazon runs through seven.

In this scenario, we can expect alliances of convenience. The United States and Canada may become one, simplifying border controls. Or, Canada might keep its hydropower—causing energy problems in the US. North and South Korea may align to create one technically savvy and nuclear-armed entity. Europe may act as a unified block – curbing immigration problems between European nations – and allowing for protection against aggressors. Russia, with its abundant minerals, oil, and natural gas may join Europe. In this world of warring states, nuclear arms proliferation is inevitable. As cooling drives up demand, existing hydrocarbon supplies are stretched thin. With a scarcity of energy supply – and a growing need for access -- nuclear energy will become a critical source of power, and this will accelerate nuclear proliferation as countries develop enrichment and reprocessing capabilities to ensure their national security. China, India, Pakistan, Japan, South Korea, Great Britain, France, and Germany will all have nuclear weapons capability, as will Israel, Iran, Egypt, and North Korea. Managing the military and political tension, occasional skirmishes, and threat of war will be a challenge. Countries such as Japan, that have a great deal of social cohesion (meaning the government is able to effectively engage its population in changing behavior) are most likely to fair well. Countries whose diversity already produces conflict, such as India, South Africa and Indonesia, will have trouble maintaining order. Adaptability and access to resources will be key. Perhaps the most frustrating challenge abrupt climate change will pose is that we’ll never know how far we are into the climate change scenario and how many more years – 10, 100, 1000 --- remain before some kind of return to warmer conditions as the thermohaline circulation starts up again. When carrying capacity drops suddenly, civilization is faced with new challenges that today seem unimaginable.

Climate change is reaching a tipping point- unchecked warming will lead to every global and environmental calamity

Hensen 8- James Hansen, Director of NASA's Goddard Institute for Space Studies (GISS), Global Warming Twenty Years Later: Tipping Points Near http://www.columbia.edu/~jeh1/2008/TwentyYearsLater\_20080623.pdf

What is at stake? Warming so far, about two degrees Fahrenheit over land areas, seems almost innocuous, being less than day-to-day weather fluctuations. But more warming is already “inthe- pipeline”, delayed only by the great inertia of the world ocean. And climate is nearing dangerous tipping points. Elements of a “perfect storm”, a global cataclysm, are assembled. Climate can reach points such that amplifying feedbacks spur large rapid changes. Arctic sea ice is a current example. Global warming initiated sea ice melt, exposing darker ocean that absorbs more sunlight, melting more ice. As a result, without any additional greenhouse gases, the Arctic soon will be ice-free in the summer. More ominous tipping points loom. West Antarctic and Greenland ice sheets are vulnerable to even small additional warming. These two-mile-thick behemoths respond slowly at first, but if disintegration gets well underway it will become unstoppable. Debate among scientists is only about how much sea level would rise by a given date. In my opinion, if emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees. No stable shoreline would be reestablished in any time frame that humanity can conceive. Animal and plant species are already stressed

Climate Change Impacts- Laundry List

by climate change. Polar and alpine species will be pushed off the planet, if warming continues. Other species attempt to migrate, but as some are extinguished their interdependencies can cause ecosystem collapse. Mass extinctions, of more than half the species on the planet, have occurred several times when the Earth warmed as much as expected if greenhouse gases continue to increase. Biodiversity recovered, but it required hundreds of thousands of years. The disturbing conclusion, documented in a paper2 I have written with several of the world’s leading climate experts, is that the safe level of atmospheric carbon dioxide is no more than 350 ppm (parts per million) and it may be less. Carbon dioxide amount is already 385 ppm and rising about 2 ppm per year. Stunning corollary: the oft-stated goal to keep global warming less than two degrees Celsius (3.6 degrees Fahrenheit) is a recipe for global disaster, not salvation. These conclusions are based on paleoclimate data showing how the Earth responded to past levels of greenhouse gases and on observations showing how the world is responding to today’s carbon dioxide amount. The consequences of continued increase of greenhouse gases extend far beyond extermination of species and future sea level rise. Arid subtropical climate zones are expanding poleward. Already an average expansion of about 250 miles has occurred, affecting the southern United States, the Mediterranean region, Australia and southern Africa. Forest fires and drying-up of lakes will increase further unless carbon dioxide growth is halted and reversed. Mountain glaciers are the source of fresh water for hundreds of millions of people. These glaciers are receding world-wide, in the Himalayas, Andes and Rocky Mountains. They will disappear, leaving their rivers as trickles in late summer and fall, unless the growth of carbon dioxide is reversed. Coral reefs, the rainforest of the ocean, are home for one-third of the species in the sea. Coral reefs are under stress for several reasons, including warming of the ocean, but especially because of ocean acidification, a direct effect of added carbon dioxide. Ocean life dependent on carbonate shells and skeletons is threatened by dissolution as the ocean becomes more acid. Such phenomena, including the instability of Arctic sea ice and the great ice sheets at today’s carbon dioxide amount, show that we have already gone too far. We must draw down atmospheric carbon dioxide to preserve the planet we know. A level of no more than 350 ppm is still feasible, with the help of reforestation and improved agricultural practices, but just barely – time is running out.

Solving for climate change solves for global stability and economic security

Lewis, Ladislaw, and Zheng 10- James A. Lewis, senior fellow and director of the Technology and Public Policy Program at CSIS, worked in the federal government as a Foreign Service officer; Sarah O. Ladislaw, senior fellow in the Energy and National Security Program at CSIS, where she concentrates on climate change, the geopolitical implications of energy production and use, energy security, energy technology, and sustainable development; Denise E. Zheng, program coordinator and research assistant in the CSIS Technology and Public Policy Program, June 2010, “Earth Observation for Climate Change”, <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>

There is now broad consensus that national interests are threatened by climate change. Concern over the effect of climate change led to a discussion over its implications for national security and international stability.1 Many studies agreed that climate change creates new risk for national and economic security, as a result of dislocation of populations or a scarcity of resources such as water or food. To the extent climate change is a national security problem, it is a problem that is not amenable to solution by military tools. Instead, progress will depend on diplomacy, science, and technology.

Climate change triggers a laundry list of impacts- destroys regional economies, causes agricultural damage, and increases the threat of disease. Pakistan proves.

The Express Tribune, 6-24 – Sehrish Wasif, “Climate change: Time to step up efforts against global warming”, http://tribune.com.pk/story/195048/climate-change-time-to-step-up-efforts-against-global-warming/

Over the last ten years, Pakistan faced ten big natural disasters, which cost a loss of $14.21 billion. And potentially risking 50 per cent population, said Ministry of Environment Director General Javed Ali Khan. He was addressing the participants of a seminar titled, ‘Climate Change and Future Development’ organised by Pakistan-Norway Association here on Thursday. Khan said the damage cost of these disasters is going up with the top three disasters occurring in the past three years, amounting to a total of $11.55 billion. “Climate Change is a direct threat to security of food, energy and water and it is a serious challenge for the country,” he said. These threats owe to the rapid melting of Hindukush-Himalayan glaciers, increased variability of monsoon and risk of floods and droughts, upstream intrusion of sea water into Indus delta due to Sea Level Rise, reduced productivity in crops and fertility of livestock due to heat-stress. Moreover, they are also responsible for causing health risks such as heat strokes, malaria and other waterborne diseases. Khan further said that Pakistan is not yet a power player in the carbon market. Speaking on the occasion Prof. Iftikharunnisa Hassan, from Karakoram International University , Gilgit said the negative impact of climate change has become so apparent that there is no need to talk about it. However, the surprise to the common person is the severity of its impact. “The recent floods, the untimely rain schedule and related factors affecting the crop cycle, farming and cattles are fast turning Pakistan from a country known as a bread basket of Asia in to a food-scarce country,” she said.

Climate Change Impacts- Laundry List

**Climate change causes multiple impacts- agricultural damage, disease, and biodiversity**

The Express Tribune, 6-21 – June 21, 2011, “Climate change a threat to human security”, <http://tribune.com.pk/story/193166/climate-change-a-threat-to-human-security/>

Comprehensive policies and concerted efforts are necessary to deal with the complex and devastative effects of climate change, which is now a serious threat to human for Pakistan. Experts stated this at a seminar on “Looming dangers of climate change on national and human security”, organised by Sustainable Development Policy Institute (SDPI) here on Monday. SDPI Climate Change Study Centre Senior Research Associate Shakeel Ahmad Ramay said that Pakistan simultaneously faces many problems, such as financial and food challenges, amid the worsening issue of climate change. He said that the biggest manifestation of climate change in Pakistan was the 2010 floods, which caused over US$10 billion in damages and increased the percentage of population facing food insecurity from 48.7 to 58.7 per cent. Ramay said that as a result of climate change, the country particularly faces agricultural and water challenges along with degradation of natural resources. All of Pakistan’s regions except Gilgit-Baltistan are highly vulnerable to the affects of climate change with regard to agricultural production, he added. He said the country has no national agricultural policy or food security policy, except in Khyber-Pakhtunkhwa. The construction of the controversial Baglihar Dam by India and rapid melting of Siachen glacier due to the military presence there will have damaging effects for the people of both India and Pakistan in the short and long run. National Defense University (NDU), Peace and Conflict Studies Department Head Dr Noman Sattar, called climate change “a threat multiplier to national and human security and a complex challenge for the global community, especially for resource-starved developing countries.” “Declining ecosystem services, the threat of climate change, and HIV/AIDS related problems combine to create or exacerbate political instability and economic hardship for millions in Africa, clearly explaining why 90 per cent of current conflicts are found in 30 per cent of the poorest countries,” he added. Global Change Impact Studies Centre (GCISC) Islamabad Executive Director Arshad Muhammad Khan was of the view that anthropogenic influences since the industrial revolution, spiralling population, the high pace of industrialisation, increased use of fossil oils in industry and transportation, and deforestation for agriculture and urbanisation have fuelled climate change. The impacts, he said, are apparent in the shape of uncertainty in water availability, decreasing crop yields, loss of biodiversity, increased health risks, and newer perspectives for sources of energy. Climate change, he explained, includes global warming, increased precipitation and its uneven distribution, melting of glaciers and snow, sea level rise, increase in frequency and sensitivity of extreme weather events

Climate change harms value of life, economy, food security and health

Urama and Ozor 10 - Kevin Chika Urama, Ph.D. (Cambridge) is an Environmental and Ecological Economist developing trans-disciplinary and integrated tools for sustainable management of social, economic and ecological systems. He holds the 2002-3 James Claydon Prize for the most outstanding PhD thesis in Economics or related subjects, St. Edmund’s College, University of Cambridge, and Nicholas Ozor, B. Agric (Nig.,First Class Honours); MSc (Nig., Distinction) Ph.D. (Reading & Nig.), is a Senior Research Officer at the African Technology Policy Studies Network(ATPS) Nairobi, December 2010, “IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN AFRICA: the Role of Adaptation,” African Technology Policy Studies Network (ATPS)

This paper has described in detail the place of water resources in Africa, noting that throughout the continent people value water as much as they value life. It has explained the various forms of water availability in Africa and the different purposes to which the resource is put. Climate change can affect the availability and quality of water resources adversely and the evidence suggests that the causes of climate change are complex, involving both natural forces and anthropogenic activities. Human activities are rated to have significant effects and while African countries have contributed little to the magnitude of the global problem they stand to bear some of the serious consequences.

Climate change consequences on water resources manifested themselves in such events as flooding, drought, sea-level rise, drying up of rivers, poor water quality, changes in surface and groundwater systems, changes in precipitation and water vapour, and changes in snow and land ice. These alterations are already having serious impacts on the economy of several African countries, on food security throughout the continent, as well as on social welfare and the health status of many disadvantaged people.

Climate change leads to species extinction, billions of deaths – starvation, genocide, war

Roddy and Murphy 10 – Michael Roddy and Ian Murphy, January 2010, “2010 climate criminals,” 350 ppm newsletter, vol 3 number 1

THE SCIENCE OF CLIMATE CHANGE IS PRETTY BASIC: humans dig up fossilized carbon to fuel power plants and internal combustion machines, releasing CO2 into the atmosphere. Result: greenhouse effect global heating. Around 50% of all the species on the planet are predicted to become extinct by 2100 in the CO2-as-usual model. Our own species will face drought, famine, rising tides, soaring temperatures, calamity and chaos. Hundreds of millions will become climate refugees. Billions may die from starvation, genocide and war. We have precious little time to mitigate this looming global catastrophe.

Climate Change Impacts- Econ Collapse

Climate change triggers economic collapse- emission, and crop yields

Bernauera et al 10- Climate Change, Economic Growth, and Conflict Thomas Bernauera, Anna Kalbhenna, Vally Koubi and Gabriele Ruoff- ETH Zurich Center for Comparative and International Studies (CIS) and Institute for Environmental Decisions (IED) and University of Bern Department of Economics and Oeschger Institute for Climate Change Research https://ncgg.princeton.edu/IPES/2010/papers/S1115\_paper1.pdf

The existing literature provides ample evidence that climate change affects economic output (GDP) (e.g. Mendelsohn et al., 1998; Mendelsohn, Dinar & Williams, 2006; Nordhaus & Boyer, 2000; Tol, 2002; Deschenes & Greenstone, 2007; Barrios, Bertinelli & Strobl, 2010). This also suggests that climate change should affect economic growth. If climate change affected only the level of economic output, for example by reducing agricultural yields when temperature rises (precipitation falls), this would imply that subsequent temperature decreases (precipitation increases) – due for example to stringent abatement of emissions – should return the GDP to its previous level. But this is not the case if climate change affects economic growth. The reasons are the following. First, economic growth will be lower even if GDP returns to its previous level because of forgone consumption and investment due to lower income during the period of higher temperature (lower precipitation). In addition, as long as countries spend some resources to adapt to climate change, they incur opportunity costs in terms of not spending these resources on R&D and capital investment. This has negative effects on economic growth. Moreover, given the shortness of the times series used in existing research on climate effects on economic conditions, even slightly persistent effects on the level of output will impact on the sample mean of growth. That is, using economic growth rates will also capture the effects on GDP levels. But using the level of GDP instead of its growth rate may miss the effects on the growth rate. For these reasons we concentrate on climate change effects on economic growth. The empirical literature offers some evidence that climate change affects economic growth. For instance, Miguel, Satyanath & Sergenti (2004) find that rainfall growth increases economic growth in Africa. Dell, Jones & Olken (2008), using data on temperature and precipitation for a panel of 136 countries over the period 1950-2003, show that higher temperatures have large negative effects on growth, but only in poor countries, whereas precipitation has no effect. The authors also find that the estimated impact of temperature in poor countries is large – a 1o C temperature increase reduces economic growth by 1.09 percentage points. In summary, we postulate, as supported by the literature, that climate change should have important negative effects on economic growth.

Econ collapse due to climate change causes war- leads to poverty and instable governments

Bernauera et al 10- Climate Change, Economic Growth, and Conflict Thomas Bernauera, Anna Kalbhenna, Vally Koubi and Gabriele Ruoff- ETH Zurich Center for Comparative and International Studies (CIS) and Institute for Environmental Decisions (IED) and University of Bern Department of Economics and Oeschger Institute for Climate Change Research https://ncgg.princeton.edu/IPES/2010/papers/S1115\_paper1.pdf

Previous research has shown that reduced levels of domestic economic activity tend to create incentives for increased conflict.6 Drawing on this research, we posit that climate change, by reducing economic growth (that is, reducing the ability of the economy to grow), affects the utility of individuals and groups to engage in civil conflict. It does so in two ways. First, negative climatic conditions, via their negative effect on economic growth, can reduce resources available to the government (e.g. by reducing tax revenue). The government thus has fewer resources to “invest in people”, for instance to provide better nutrition, schooling, and on-the-job training that would lead to improved living conditions. It also has fewer resources to “provide for the people” in terms of sustaining peace through the maintenance of law and order – the latter, for instance, lowers the probability of rebel victory by increasing the cost of rebellion. Second, climate related phenomena such as lower precipitation, higher temperature, and extreme weather events lead to lower personal income from production and also decrease the opportunity for future employment. Consequently, the opportunity cost of rebellion decreases because the expected returns from peaceful employment, say farming, compared to joining criminal and insurgent groups are lower. In situations like these, when individuals expect to earn more from criminal or insurgent activity than from lawful and peaceful activity, predatory behavior becomes more likely. The latter implicates conditions in which each individual or group’s effort to increase its own welfare reduces the welfare of others and also increases the probability of mutual attacks (Jervis & Snyder, 1999). The argument that poverty breeds conflict and war is supported by several empirical studies (e.g. Hidalgo et al., 2010; Dube & Vargas, 2008; Hegre & Sambanis, 2006; Collier & Hoeffler, 2004; Fearon & Laitin, 2003). For example, Collier and Hoeffler (2004) find that low economic growth, which is a proxy for foregone earnings, has considerable explanatory power in their intrastate conflict regression. They conclude that rapid economic growth reduces the risk of conflict. Dube and Vargas (2008) examine whether violent actions in Colombia in the 1994-2005 period are linked to low opportunity costs of agricultural labor, using crop prices as a proxy for such costs. They show that a drop in the price of coffee substantially increased the incidence and intensity of intrastate conflict in coffee-intensive areas. They attribute this result to the lowering of opportunity costs of joining a rebel movement (via depressed wages) in coffee growing areas. Hidalgo et al. (2010), using a panel data set with over 50,000 municipality-year observations, show that land invasions by the rural poor in Brazil occur immediately after adverse economic shocks, which in the statistical analysis are instrumented by rainfall. Consequently, our argument that reduced economic growth can impact on the likelihood of civil conflict is well supported by the existing literature.

Climate Change Impacts- Water Wars- Middle East

Water shortages are at a critical point in the middle east- shortages due to climate change will cause war

CNA 7- The CNA Corporation is a nonprofit institution that conducts in-depth, independent research and analysis, National Security and the Threat of Climate Change May 30, http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf

Adequate supplies of fresh water for drinking, irrigation, and sanitation are the most basic prerequisite for human habitation. Changes in rainfall, snowfall, snowmelt, and glacial melt have significant effects on fresh water supplies, and climate change is likely to affect all of those things. In some areas of the Middle East, tensions over water already exist. Mountain glaciers are an especially threatened source of fresh water [3]. A modest rise in temperature of about 2° to 4°F in mountainous When climates change significantly or environmental conditions deteriorate to the point that necessary resources are not available, societies can become stressed, sometimes to the point of collapse. regions can dramatically alter the precipitation mix by increasing the share falling as rain while decreasing the share falling as snow. The result is more flooding during the rainy season, a shrinking snow/ice mass, and less snowmelt to feed rivers during the dry season [4]. Forty percent of the world’s population derives at least half of its drinking water from the summer melt of mountain glaciers, but these glaciers are shrinking and some could disappear within decades. Several of Asia’s major rivers—the Indus, Ganges, Mekong, Yangtze, and Yellow—originate in the Himalayas [4]. If the massive snow/ice sheet in the Himalayas—the third-largest ice sheet in the world, after those in Antarctic and Greenland—continues to melt, it will dramatically reduce the water supply of much of Asia.

Most countries in the Middle East and northern Africa are already considered water scarce, and the International Water Resource Management Institute projects that by 2025, Pakistan, South Africa, and large parts of India and China will also be water scarce [5]. To put this in perspective: the U.S. would have to suffer a decrease in water supply that produces an 80 percent decrease in per capita water consumption to reach the United Nations definition of “water scarce.” These projections do not factor in climate change, which is expected to exacerbate water problems in many areas. Access to vital resources, primarily food and water, can be an additional causative factor of conflicts, a number of which are playing out today in Africa. Probably the best known is the conflict in Darfur between herders and farmers. Long periods of drought resulted in the loss of both farmland and grazing land to the desert. The failure of their grazing lands compelled the nomads to migrate southward in search of water and herding ground, and that in turn led to conflict with the farming tribes occupying those lands. Coupled with population growth, tribal, ethnic, and religious differences, the competition for land turned violent. Probably more than any other recent conflict, Darfur provides a case study of how existing marginal situations can be exacerbated beyond the tipping point by climate-related factors. It also shows how lack of essential resources threatens not only individuals and their communities but also the region and the international community at large.

Worldwide food production will be affected by climate change in a variety of ways. Crop ecologists estimate that for every 1.8°F rise in temperature above historical norms, grain production will drop 10 percent [6]. Most of the world’s growth in food demand is occurring on the Indian subcontinent and in sub-Saharan Africa, areas already facing food shortages [6]. Over the coming decades, these areas are expected to become hotter and drier [7].

Climate Change Impacts- Instability/ Terrorism (Leadership Key)

Climate change hurts U.S. readiness- increases tensions and instability- u.s. leadership for mitigation is key

Environment News Service 7- Military Panel: Climate Change Threatens U.S. National Security WASHINGTON, DC, April 16, 2007 http://www.ens-newswire.com/ens/apr2007/2007-04-16-05.asp

Global climate change presents a serious national security threat that could affect Americans at home, impact U.S. military operations, and heighten global tensions, finds a study released today by a blue-ribbon panel of 11 of the most senior retired U.S. admirals and generals. Climate change, national security and energy dependence are a related set of global challenges that will add to tensions even in stable regions of the world, found the panel, known as the Military Advisory Board. Zinni Retired U.S. Marine Corps General Anthony Zinni is a former Commander in Chief of U.S. Central Command. (Photo courtesy U.S. Marine Corps) "We will pay for this one way or another," said retired Marine Corps General Anthony Zinni, former commander of U.S. forces in the Middle East. "We will pay to reduce greenhouse gas emissions today, and we'll have to take an economic hit of some kind. Or, we will pay the price later in military terms. And that will involve human lives. There will be a human toll." "The U.S. should commit to a stronger national and international role to help stabilize climate changes at levels that will avoid significant disruption to global security and stability," the Military Advisory Board recommends. The study, "National Security and the Threat of Climate Change," explores ways in which climate change acts as a "threat multiplier" in already fragile regions of the world, creating the breeding grounds for extremism and terrorism. The CNA Corporation, a nonprofit research and analysis organization, brought together 11 retired four-star and three-star admirals and generals as a Military Advisory Board to provide advice, expertise and perspective on the impact of climate change on national security. CNA writers and researchers compiled the report under the board's direction and review. Members of the Military Advisory Board come from all branches of the armed services. The board includes a former Army chief of staff, commanders-in-chiefs of U.S. forces in global regions, a former shuttle astronaut and NASA administrator, and experts in planning, logistics, underwater operations and oceanography. One member also served as U.S. ambassador to China. "We found that climate instability will lead to instability in geopolitics and impact American military operations around the world," said retired General Gordon Sullivan, chairman of the Military Advisory Board and former Army chief of staff, in releasing the report today at a Washington news conference. Sullivan Retired U.S. Army General Gordon Sullivan is a former Army chief of staff. (Photo courtesy U.S. Army) "People are saying they want to be perfectly convinced about climate science projections," General Sullivan said. "But speaking as a soldier, we never have 100 percent certainty. If you wait until you have 100 percent certainty, something bad is going to happen on the battlefield." Military Advisory Board members said they remain optimistic that climate change challenges can be managed to reduce future risks. As part of its five specific recommendations for action, the Board said "the path to mitigating the worst security consequences of climate change involves reducing global greenhouse gas emissions." The U.S. Environmental Protection Agency today released the national greenhouse gas inventory, which finds that overall emissions during 2005 increased by 0.8 percent from the previous year. Overall emissions have grown by 16 percent from 1990 to 2005. Retired Navy Vice Admiral Richard Truly, a shuttle astronaut and former NASA administrator, said, "Unlike the challenges that we are used to dealing with, these will come upon us extremely slowly, but come they will, and they will be grinding and inexorable." Truly Retired Navy Vice Admiral Richard Truly was NASA administrator from 1989 to 1992 and then served as director of the National Renewable Energy Laboratory. (Photo courtesy NREL) Truly also notes that "maybe more challenging is that climate change will affect every nation, and all simultaneously. This is why we need to study this issue now, so that we'll be prepared and not overwhelmed by the required scope of our response when the time comes." The Military Advisory Board report recognizes that unabated climate change could bring an increased frequency of extreme storms, additional drought and flooding, rising sea levels, melting glaciers and the rapid spread of life-threatening disease. These projected effects are usually viewed as environmental challenges, but now the Military Advisory Board has looked at them from the perspective of national security assessments. They are serious risk factors for massive migrations, increased border tensions, greater demands for rescue and evacuation efforts, and conflicts over essential resources, including food and water, the board said, saying such developments could lead to direct U.S. military involvement. Lopez Retired Admiral Joseph Lopez is one of two flag officers in the history of the U.S. Navy who have achieved four-star rank after direct commission from enlisted service. (Photo courtesy U.S. Navy) "Climate change can provide the conditions that will extend the war on terror," said retired Admiral T. Joseph Lopez, former commander-in-chief, U.S. Naval Forces Europe and of Allied Forces, Southern Europe. "Rising ocean water levels, droughts, violent weather, ruined national economies-those are the kinds of stresses we'll see more of under climate change," he said. "In the long term, we want to address the underlying conditions that terrorists seek to exploit," Admiral Lopez said. "But climate change will prolong those conditions. It makes them worse." The report describes national security implications of climate change in various regions of the world.

Climate Change Impacts- Instability/ Terrorism (Leadership Key)

Climate change exacerbates all pre-existing conflicts

CNA 7- The CNA Corporation is a nonprofit institution that conducts in-depth, independent research and analysis, National Security and the Threat of Climate Change May 30, http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf

One reason human civilizations have grown and flourished over the last five millennia is that the world’s climate has been relatively stable. However, when climates change significantly or environmental conditions deteriorate to the point that necessary resources are not available, societies can become stressed, sometimes to the point of collapse [1]. For those concerned about national security, stability is a primary goal. Maintaining stability within and among nations is often a means of avoiding full-scale military conflicts. Conversely, instability in key areas can threaten our security. For these reasons, a great deal of our national security efforts in the post-World War II era have been focused on protecting stability where it exists and trying to instill it where it does not. This brings us to the connection between climate change and national security. As noted, climate change involves much more than temperature increases. It can bring with it many of the kinds of changes in natural systems that have introduced instability among nations throughout the centuries. In this chapter, we consider some of the ways climate change can be expected to introduce the conditions for social destabilization. The sources of tension and conflict we discuss here are certainly not solely due to climate change; they have been discussed by the national security community for many years. However, climate change can exacerbate many of them [2]. For example: • Some nations may have impaired access to food and water. • Violent weather, and perhaps land loss due to rising sea levels and increased storm surges, can damage infrastructure and uproot large numbers of people. • These changes, and others, may create large number of migrants . When people cross borders in search of resources, tensions can arise. • Many governments, even some that look stable today, may be unable to deal with these new stresses. When governments are ineffective, extremism can gain a foothold. • While the developed world will be far better equipped to deal with the effects of climate change, some of the poorest regions may be affected most. This gap can potentially provide an avenue for extremist ideologies and create the conditions for terrorism.

**Climate Change Impacts- Disease**

Climate change leads to disease in Asia and Africa

CNA 7- The CNA Corporation is a nonprofit institution that conducts in-depth, independent research and analysis, National Security and the Threat of Climate Change May 30, http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf

Climate change is likely to have major implications for human health. While some impacts, such as reduced deaths from cold temperatures in some areas, will be positive, the World Health Organization estimates that the overall impact will be negative [8]. The major concern is significant spreading of the conditions for vector-borne diseases, such as dengue fever and malaria, and food-borne diseases, such as salmonellosis [8]. The decline in available fresh water in some regions will also have an impact, as good health and adequate supplies of clean water are inextricably linked. A health emergency involving large numbers of casualties and deaths from disease can quickly expand into a major regional or global security substantial declines in agricultural productivity because of higher temperatures and more variable rainfall patterns [25]. Net cereal production in South Asia, for example, is projected to decline by 4 to 10 percent by the end of this century under the most conservative climate change projections. But the problem isn’t just water scarcity— too much water can also be a problem. By 2050, snow melting in the high Himalayas and increased precipitation across northern India are likely to produce flooding, especially in catchments on the western side of the Himalayas, in northern India, Nepal, Bangladesh, and Pakistan. Climate change is expected to increase the geographic range of infectious diseases such as malaria, dengue fever, and schistosomiasis and increase the risk of water-borne disease. Climate projections indicate the Asia/Pacific region as a whole is likely to become warmer and wetter in the coming decades, creating conditions more conducive to disease vectors such as mosquitoes. With the exception of east central China and the highlands of west China, much of the Asia/Pacific region is exposed to malaria and dengue or has conditions suitable for their spread. This region will continue to be a hot spot for these diseases in the decades ahead, with certain regions becoming more prone to epidemics

**Climate Change Impacts- Military Readiness**

Climate changes is a sever detriment to readiness- disrupts electricity grid, energy, military bases and battle ground conditions

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Severe weather has a direct effect on military readiness. Ships and aircraft operations are made more difficult; military personnel themselves must evacuate or seek shelter. As Army Gen. Paul Kern explained of his time dealing with hurricanes in the U.S. Southern Command: “A major weather event becomes a distraction from your ability to focus on and execute your military mission.” In addition, U.S. forces may be required to be more engaged in stability operations in the future as climate change causes more frequent weather disasters such as hurricanes, flash floods, and extended droughts. A warming Arctic holds great implications for military operations. The highest levels of planetary warming observed to date have occurred in the Arctic, and projections show the high northern latitudes warming more than any other part of the earth over the coming century. The Arctic, often considered to be the proverbial “canary” in the earth climate system, is showing clear signs of stress [33]. The U.S. Navy is concerned about the retreat and thinning of the ice canopy and its implications for naval operations. A 2001 Navy study concluded that an ice-free Arctic will require an “increased scope of naval operations” [35]. That increased scope of operations will require the Navy to consider weapon system effectiveness and various other factors associated with operating in this environment. Additionally, an Arctic with less sea ice could bring more competition for resources, as well as more commercial and military activity that could further threaten an already fragile ecosystem. The DoD is almost completely dependent on electricity from the national grid to power critical missions at fixed installations and on petroleum to sustain combat training and operations. Both sources of energy and their distribution systems are susceptible to damage from extreme weather. The national electric grid is fragile and can be easily disrupted. Witness the Northeast Blackout of 2003, which was caused by trees falling onto power lines in Ohio. It affected 50 million people in eight states and Canada, took days to restore, and caused a financial loss in the United States estimated to be between $4 billion and $10 billion [36]. People lost water supplies, transportation systems, and communications systems (including Internet and cell phones). Factories shut down, and looting occurred. As extreme weather events becomes more common, so do the threats to our national electricity supply. One approach to securing power to DoD installations for critical missions involves a combination of aggressively applying energy efficiency technologies to reduce the critical load (more mission, less energy); deploying renewable energy sources; and “islanding” the installation from the national grid. Islanding allows power generated on the installations to flow two ways—onto the grid when there is excess production and from the grid when the load exceeds local generation. By pursuing these actions to improve resiliency of mission, DoD would become an early adopter of technologies that would help transform the grid, reduce our load, and expand the use of renewable energy. For deployed systems, the DoD pays a high price for high fuel demand. In Iraq, significant combat forces are dedicated to moving fuel and protecting fuel supply lines. The fuel delivery situation on the ground in Iraq is so limited As extreme weather events becomes more common, so do the threats to our national electricity supply that that the Army has established a “Power Surety Task Force” to help commanders of forward operating bases cut the number of fuel convoys by using energy more efficiently. Maj. Gen. Richard Zilmer, USMC, commander of the multinational force in the Anbar province of Iraq, asked for help in August 2006. His request was for renewable energy systems. According to Gen. Zilmer, “reducing the military’s dependence on fuel for power generation could reduce the number of road-bound convoys … ‘Without this solution [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success.…’ ” Along a similar vein, Lt. Gen. James Mattis, while commanding general of the First Marine Division during Operation Iraqi Freedom, urged: “Unleash us from the tether of fuel.” Energy-efficiency technologies, energy conservation practices and renewable energy sources are the tools forward bases are using to stem their fuel demand and reduce the “target signature” of their fuel convoys. Numerous DoD studies dating from the 2001 Defense Science Board report “More Capable Warfighting Through Reduced Fuel Burden” have concluded that high fuel demand by combat forces detracts from our combat capability, makes our forces more vulnerable, diverts combat assets from offense to supply line protection, and increases operating costs. Nowhere are these problems more evident than in Iraq, where every day 2.4 million gallons of fuel is moved through dangerous territory, requiring protection by armored combat vehicles and attack helicopters [37]. DoD planners estimate that it costs $15 to deliver one gallon of fuel from its commercial supplier to the forward edge of the battlefield and about $26 to deliver a gallon of fuel from an airborne tanker, not counting the tanker aircraft cost. Furthermore, DoD’s procedures for determining the types of systems it needs do not take these fuel burden considerations into account. DoD should require more efficient combat systems and should include the actual cost of delivering fuel when evaluating the advantages of investments in efficiency [38, 39]. DoD should have an incentive to accurately account for the cost of moving and protecting fuel and to invest in technologies that will provide combat power more efficiently. Deploying technologies that make our forces more efficient also reduces greenhouse gas emissions. The resulting technologies would make a significant contribution to the vision President Bush expressed in his State of the Union speech when he said, “America is on the verge of technological breakthroughs that will … help us to confront the serious challenge of global climate change.” Given the human and economic cost of delivering fuel to combat forces and the almost total dependence on the electric grid for critical missions, DoD has strong operational economic incentives to aggressively pursue energy efficiency in its combat systems and its installations. By investing at levels commensurate with its interests, DoD would become an early adopter of innovative technologies and could stimulate others to follow. Climate change threats also create opportunities for constructive engagement such as stability operations and capacity building. The U.S. military helped deliver relief to the victims of ... reducing the military’s dependence on fuel for power generation could reduce the number of road-bound convoys … 41 the 2005 Indian Ocean tsunami because it is the only institution capable of rapidly delivering personnel and materiel anywhere in the world on relatively short notice. DoD Directive 3000.05, issued in 2006, provides the mandate to conduct military and civilian stability operations in peacetime as well as conflict to maintain order in states and regions. The Combatant Command’s Theater Security Cooperation Program, which seeks to engage regional states, could be easily focused on climate change mitigation and executed in concert with other U.S. agencies through U.S. embassy country teams. The objective would be to build the host nation military’s capabilities and capacity to support civilian government agencies. It also enhances good governance and promotes stability, making failed states and terrorist incursion less likely. Because many climate change problems cross borders, it could also promote regional communication and cooperation. If the frequency of natural disasters increases with climate change, future military and political leaders may face hard choices about where and when to engage. Deploying troops affects readiness

**Climate Change Impacts- Military Readiness**

elsewhere; choosing not to may affect alliances. And providing aid in the aftermath of a catastrophic event or natural disaster can help retain stability in a nation or region, which in turn could head off U.S. military engagement in that region at a later date.

Climate change affects readiness- reduces weapon system effectiveness, bases and operations

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Climate change will stress the U.S. military by affecting weapons systems and platforms, bases, and military operations. It also presents opportunities for constructive engagement. Operating equipment in extreme environmental conditions increases maintenance requirements— at considerable cost—and dramatically reduces the service life of the equipment. In Iraq, for instance, sandstorms have delayed or stopped operations and inflicted tremendous damage to equipment. In the future, climate change—whether hotter, drier, or wetter—will add stress to our weapons systems. A stormier northern Atlantic would have implications for U.S. naval forces [34]. More storms and rougher seas increase transit times, contribute to equipment fatigue and hamper flight operations. Each time a hurricane approaches the U.S. East Coast, military aircraft move inland and Navy ships leave port. Warmer temperatures in the Middle East could make operations there even more difficult than they are today. A Center for Naval Analyses study showed that the rate at which U.S. carriers could launch aircraft was limited by the endurance of the flight deck crew during extremely hot weather [34].

During the Cold War, the U.S. established and maintained a large number of bases throughout the world. U.S. bases abroad are situated to provide a worldwide presence and maximize our ability to move aircraft and personnel. Climate change could compromise some of those bases. For example, the highest point of Diego Garcia, an atoll in the southern Indian Ocean that serves as a major logistics hub for U.S. and British forces in the Middle East, is only a few feet above sea level. As sea level rises, facilities there will be lost or will have to relocated. Although the consequences to military readiness are not insurmountable, the loss of some forward bases would require longer range lift and strike capabilities and would increase the military’s energy needs. Closer to home, military bases on the eastern coast of the United States are vulnerable to hurricanes and other extreme weather events. In 1992, Hurricane Andrew ravaged Homestead Air Force Base in Florida so much that it never reopened; in 2004 Hurricane Ivan knocked out Naval Air Station Pensacola for almost a year. Increased storm activity or sea level rise caused by future climate change could threaten or destroy essential base infrastructure. If key military bases are degraded, so, too, may be the readiness of our forces.

Impact Calc- Climate Change o/w War

Climate change poses a larger threat than war

The Express Tribune, 7-9 – July 9, 2011, “Regional cooperation: ‘Climate change bigger threat than wars’”, <http://tribune.com.pk/story/205606/regional-cooperation-climate-change-bigger-threat-than-wars/>

People in South Asian countries are already experiencing the adverse affects of climate change. Policy making in these countries needs to take into account issues pertaining to natural disasters and climate change so that living conditions do not further deteriorate, Lahore University of Management Sciences vice chancellor Prof Adil Najam said on Friday. He was speaking at the first day of the World Economic Forum’s Young Global Leaders Indo-Pakistan Cooperation Initiative. He said sustainable development practices should be adopted to ensure that damage from natural disasters was mitigated. He said efficient management of water resources was a prerequisite for avoiding food and energy shortages and disease outbreaks in future. Referring to a research study, Prof Najam said South Asian countries in the coming days would be threatened more by natural disasters than wars. Earlier, Malini Mehra, the Centre for Social Markets and YGL chief executive officer in India, said India and Pakistan needed to work together to deal with climate change and natural disasters. She said the two countries could identify issues that needed mutual cooperation and share information on them so that the security of future generations could be ensured.

\*\*AT: Topicality\*\*

W/M- Exploration

Earth sciences are a component of the overall exploration mission

National Academy of Sciences 5- Science in Nasa’s Vision for Space Exploration Committee on the Scientific Context for Space Exploration, Space Studies Board Division on Engineering and Physical Sciences, Copyright 2005 by the National Academy of Sciences

In addition, the first-of-its-kind decadal survey-style study for Earth sciences and applications from space mentioned above represents a fresh opportunity to look forward as the era of the Earth Observing System program comes to an end and to consider the implications of NASA’s exploration vision for NASA’s Earth science program. Prior to the completion of that study there will also be an opportunity to apply the criteria listed above as NASA prepares its roadmap for research to understand the Earth system.

Several other reports are particularly relevant for the critical scientific goals and priorities for research that must be conducted to enable human exploration. In the life sciences, the conclusions and 4 The complete sets of major scientific questions posed in the surveys are presented in Appendix A. 15

recommendations presented in A Strategy for Research in Space Biology and Medicine in the New Century (NRC, 1998)5 remain valid today. That report surveyed the current state of research on the physiological and psychosocial responses of humans to spaceflight and identified the highest-priority questions that require attention to improve the feasibility of extended-duration human spaceflight missions. Priority areas included “research aimed at understanding and ameliorating problems that may limit astronauts’ ability to survive and/or function during prolonged spaceflight” (p. 2) and crosscutting research on musculoskeletal and vestibular physiology, radiation hazards, psychological and social issues, and plant and animal sensitivity to gravity.

More evidence

National Academy of Sciences 5- Science in Nasa’s Vision for Space Exploration Committee on the Scientific Context for Space Exploration, Space Studies Board Division on Engineering and Physical Sciences, Copyright 2005 by the National Academy of Sciences

NASA Administrator Sean O’Keefe subsequently wrote to the presidents of the National Academy of Sciences and the National Academy of Engineering proposing that the National Academies and NASA consider how to “collectively address” the commission’s recommendations. He also announced a new strategic planning process in which NASA would develop a “strategic roadmap” for each of the agency’s highestlevel goals. Finally, Congress in its FY2005 appropriation bill for NASA directed “the National Academies’ Space Studies Board to conduct a thorough review of the science that NASA is proposing to undertake under the space exploration initiative and to develop a strategy by which all of NASA’s science disciplines, including Earth science, space science, and life and microgravity science, as well as the science conducted aboard the International Space Station, can make adequate progress towards their established goals, as well as providing balanced scientific research in addition to support of the new initiative.”4

\*\*AT: CP’s\*\*

AT: International CP- Generic

1. Perm do both – this is the only way to solve because other countries/groups use our data

Hayes 10 – David Hayes, Deputy Secretary of the Interior, 11/05/2010, “U.S. Launches Initiatives to Share Climate Science Data,” online: http://www.doi.gov/news/doinews/US-Launches-Initiatives-to-Share-Climate-Science-Data.cfm

For our part, the United States - including the Department of the Interior - already makes open and available to the public the scientific information about our planet that we collect. Data from our Landsat satellites, stream gages, seismic observations, and field work across the continent are up online and accessible to anyone. Farmers use the Landsat data to improve yields. Scientists around the world use stream gage information for climate change research. And first-responders use our satellite imagery to respond to fires, floods, hurricanes, and oil spills.

2. Doesn’t solve the heg adv because the internal link is predicated off an international recognition of US action

3. Doesn’t solve climate change – the US is one of the biggest producers of greenhouse gases and they will need to cooperate to solve climate change – it is highly unlikely that they would agree to rely on another country’s data especially when there is already tension.

4. Even if international action is good, US leadership is necessary to lead other space-faring nations for successful implementation of climate SATs

Friedman 11- Lou, recently stepped down after 30 years as Executive Director of The Planetary Society. He continues as Director of the Society's LightSail Program and remains involved in space programs and policy. Before co-founding the Society with Carl Sagan and Bruce Murray, Lou was a Navigation and Mission Analysis Engineer and Manager of Advanced Projects at JPL, February 14, 2011, “American Leadership”, http://www.thespacereview.com/article/1778/1

American leadership in space is much more desired that resented—except when it gets used unilaterally, as in the past Administration’s call for “dominance in cislunar space.” Asian countries (China, Japan, India) are especially interested in lunar landings; Western countries, including the US, much less so. However, cooperating with Asian countries in lunar science and utilization would be both a sign of American leadership and of practical benefit to US national interests. Apollo 11 astronaut Buzz Aldrin has been a leader advocating such cooperation. At the same time American leadership can be extended by leading spacefaring nations into the solar system with robotic and human expeditions to other worlds. The US can’t do everything alone. Climate monitoring, Earth observation, space weather prediction, and ultimately asteroid deflection are huge and vital global undertakings that require international participation. That is also true with exploration projects sending robots and human to other worlds. American leadership in these areas is welcomed and used by other countries, even as they develop their own national programs. The US government should make more of this and not treat it as an afterthought—or even worse, prohibit American leadership as the House of Representatives is doing this week by banning any China collaboration or cooperation. (The proposed House continuing resolution for fiscal year 2011 prohibits OSTP or NASA funds to be used for anything to do with China.) On a bigger stage I was struck by the demands of the Egyptian protesters over the past few weeks for American leadership and engagement in reforming their country, while at the same time strongly resenting any American interference in their country. This demand for American leadership and opposition to American hegemony may seem inconsistent. It is not: it only emphasizes the need to recognize the difference and use leadership for cooperation and engagement. If we Americans do this in the space program, we will accomplish more in our many Earth, space science, and exploration projects, and we will raise higher the importance of the space program on the national and international political agenda.

5. US and NASA key to climate monitoring-US has better tools than other nations

Williamson et al 2- Ray A. Williamson, esearch Professor of International Affairs and Space Policy in the Space Policy Institute of The George Washington University, focusing on the history, programs, and policy of space–based information systems; Henry R. Hertzfeld, an expert in the economic, legal, and policy issues of space and advanced technological development: Joseph Cordes, Ph.D.in Economics, 2002, “The Socio-Economic Value of Improved Weather and Climate Information,” Online: https://www.gwu.edu/~spi/assets/docs/Socio-EconomicBenefitsFinalREPORT2.pdf

NASA has a major interest in reducing the negative effects of natural disasters in the United States. However modeling of weather and climatic conditions cannot be limited to one nation. Nearly all major weather and climatic changes can be traced to global phenom- ena, for which the vantage point of Earth-circling satellites is especially advantageous. Hence, NASA’s employment of satellite sensors assists in understanding global changes,5 which in turn lead to better predictions of local and regional weather patterns. Further, the development of weather and climate predictive tools also assists other countries to

improve their ability to mitigate the destructive effects of natural disasters and to respond effectively. Many countries, especially the less developed ones, have much less access than the United States to these contemporary information tools.

AT: International CP – China

Chinese expansion in space would kill any chance at international cooperation – this means they can’t solve adaptation or climate change

Richburg 11 – Keith B. Richburg, Jan 23, 2011, “As China eyes the stars, U.S. watches warily,” Washington Post A-section pg.A12

But as China ramps up its space initiatives, the diplomatic talk of cooperation has so far found little traction. The Chinese leadership has shown scant interest in opening up the most sensitive details of its program, much of which is controlled by the People's Liberation Army (PLA). At the same time, Chinese scientists and space officials say that Washington's wariness of China's intentions in space, as well as U.S. bans on some high-technology exports, makes cooperation problematic. For now, the U.S.-China relationship in space appears to mirror the one on Earth - a still-dominant but fading superpower facing a new and ambitious rival, with suspicion on both sides. "What you have are two major powers, both of whom use space for military, civilian and commercial purposes," said Dean Cheng, a researcher with the Washington-based Heritage Foundation and an expert on the Chinese military and space program. NASA's human spaceflight program has been in flux in recent years, fueling particular concern among some U.S. observers about the challenge posed by China's initiatives in that area. There is "a lot of very wary, careful, mutual watching," Cheng said. Song Xiaojun, a military expert and commentator on China's CCTV, said that substantial cooperation in the space field is impossible without mutual trust. Achieving that, he said, "depends on whether the U.S. can put away its pride and treat China as a partner to cooperate on equal terms. But I don't see that happening in the near future, since the U.S. is experiencing menopause while China is going through puberty."

Perm: do both

The CP can’t solve without the plan because China is dependent on US tech

Oberg 4 - James Oberg, Testimony in front of the Senate Committee on Commerce, Science, and Transportation, April 27, 2004, “Senate Science, Technology, and Space Hearing: International Space Exploration Program,” http://www.spaceref.com/news/viewsr.html?pid=12687

The Testimony of Mr. James Oberg, Aerospace Operations Consultant, Soaring Hawk Productions, Inc.

China's Use of Foreign Space Technology A significant factor in China's success, and a major influence on its future space achievements, is the degree to which its program depends on foreign information. The manned Chinese spaceship used the same general architecture of both the Russian Soyuz and the American Apollo vehicles from the 1960s. The cabin for the astronauts, called a Command Module, lies between the section containing rockets, electrical power, and other supporting equipment (the Service Module) and a second inhabitable module, in front, to support the spacecraft's main function (for the Soviets, the Orbital Module, and for Apollo, the Lunar Module). So despite superficial resemblances and widespread news media allegations, the Shenzhou is in no way merely a copy of the Russian Soyuz - nor is it entirely independent of Russia's experience or American experience. Its Service Module, for example, has four main engines, whereas Apollo's service module had only one, and Soyuz has one main and one backup engine. Also, Shenzhou's large solar arrays generate several times more electrical power than the Russian system. And unlike Soyuz, the Chinese orbital module carries its own solar panels and independent flight control system, allowing it to continue as a free-flying unmanned mini-laboratory long after the reentry module has brought the crew back to Earth. On the other hand, one clear example of outright Chinese copying is in the cabin pressure suits, used to protect the astronauts in case of an air leak during flight (A much more sophisticated suit is used for spacewalks.) The Chinese needed a suit with similar functions, so after obtaining samples of Russia's Sokol design they copied it exactly, right down to the stitching and color scheme. Other hardware systems that are derived from foreign designs include the ship-to-ship docking mechanism and the escape system that can pull a spacecraft away from a malfunctioning booster during launching. Chinese officials have made no secret of such technology transfers. A lengthy article on Chinese space plans appeared in the Xinhua News Agency's magazine Liaowang in 2002: "After China and Russia signed a space cooperation agreement in 1996, the two countries carried out very fruitful cooperation in docking system installations, model spaceships, flight control, and means of life support and other areas of manned space flight. Russia's experience in space technology development was and is of momentous significance as enlightenment to China."

Doesn’t solve the heg adv because the internal link is predicated off an international recognition of US action

AT: International CP – Russia

Perm do both – this is the only way to solve because other countries/groups use our data

Hayes 10 – David Hayes, Deputy Secretary of the Interior, 11/05/2010, “U.S. Launches Initiatives to Share Climate Science Data,” online: http://www.doi.gov/news/doinews/US-Launches-Initiatives-to-Share-Climate-Science-Data.cfm

For our part, the United States - including the Department of the Interior - already makes open and available to the public the scientific information about our planet that we collect. Data from our Landsat satellites, stream gages, seismic observations, and field work across the continent are up online and accessible to anyone. Farmers use the Landsat data to improve yields. Scientists around the world use stream gage information for climate change research. And first-responders use our satellite imagery to respond to fires, floods, hurricanes, and oil spills.

Empirically Russian weather satellites have failed

BBC 10 - BBC Monitoring Former Soviet Union – Political, August 19, 2010, “Russia said unable to keep enough weather satellites,” BBC Worldwide Monitoring

Dyadyuchenko said: "We used to have them. We launched one of the first [weather satellites] back in 1967 but, somewhere around 2000, all of our [weather] satellites went out of commission. The Roskosmos [Russian federal Space Agency] was not in any condition to launch a new one. On the one hand, the specialists ran away. On the other hand, the technologies were lost. When funding became available, [the specialists] had to learn them all over again. At first, the theory. Then, the practice. And it took five years to assemble a satellite. And, while the Western counterpart costs 100-200 million dollars, the Russian model costs even more, due the prolonged preparation work. It is necessary for our country to have not less than three polar-orbiting satellites and not less than two geostationary satellites, which are able to hang, for example, over the equator. According to the Federal Space Programme, which started in 2006, the goal was to launch 13 weather satellites before 2013. But, up to the present time, we have launched only one.

Empirics prove Russia won’t successfully launch the satellite

Russian Space 11 – Mar 1, 2011, “Russia's Space Program Suffers Setback In 2010,” Russian Space, online: http://www.spacedaily.com/reports/Russia\_Space\_Program\_Suffers\_Setback\_In\_2010\_999.html

Russia failed to develop its new space systems by timetable last year, but left more to be desired, Russian First Deputy Prime Minister Sergei Ivanov said on Monday. "We failed to change the situation of the creation of a new space system with better satellites," Ivanov told the meeting in Russia's Federal Space Agency, Roskosmos. Ivanov said that only five satellites have been built instead of 11 ordered by Russian space forces and six commercial launches have been put off in 2010. He also criticized Roskosmos and the owners of the satellites for not insuring the launches by market prices. Abortive launch of three Glonass-M communication satellites on Dec. 5 incurred loss of 2.5 billion rubles (86.5 million U.S. dollars) to the federal budget, because they have not been insured, Ivanov noted, calling it a "childish mistake." He also criticized another failed launch of a Russian military satellite, Geo-IK, which was placed into an incorrect orbit on Feb. 1. Ivanov said the satellites have not been used in their full capacity due to various technical malfunctions, and the technical norms violations during design and production process were the main reason of such malfunctions.

Doesn’t solve the heg adv because the internal link is predicated off an international recognition of US action

Doesn’t solve climate change – the US is one of the biggest producers of greenhouse gases and they will need to cooperate to solve climate change – it is highly unlikely that they would agree to rely on another country’s data especially when there is already tension.

AT: International CP – Brazil

Perm do both – this is the only way to solve because other countries/groups use our data

Hayes 10 – David Hayes, Deputy Secretary of the Interior, 11/05/2010, “U.S. Launches Initiatives to Share Climate Science Data,” online: http://www.doi.gov/news/doinews/US-Launches-Initiatives-to-Share-Climate-Science-Data.cfm

For our part, the United States - including the Department of the Interior - already makes open and available to the public the scientific information about our planet that we collect. Data from our Landsat satellites, stream gages, seismic observations, and field work across the continent are up online and accessible to anyone. Farmers use the Landsat data to improve yields. Scientists around the world use stream gage information for climate change research. And first-responders use our satellite imagery to respond to fires, floods, hurricanes, and oil spills.

CP doesn’t solve – Brazil can’t implement the plan because they lack the personnel, training, and funding

Messier 6/22 – Doug Messier, freelance journalist specializing in space, 6/22/11, “Brazil’s Ambitious Space Program Built on Rickety Foundation,” Parabolic Arc, online: http://www.parabolicarc.com/2011/06/22/brazils-ambitious-space-program-built-rickety-foundation/

Brazil’s ambitious space agenda is threatened by a shortage of funding and trained workers, problems that were discussed during a recent public hearing conducted by the House of Representatives. According to an AEB account of the session: The main issues were: the lack of skilled labor that affects the industry as well as replacing those who are about to retire, insufficient budget and the need for the space program to become, in fact, a state program. The AEB president presented a graph that shows a continuing decline in the number of workers. According to Raupp, today the country has a workforce of approximately 3,000 employees, while space programs such as India, Europe and the United States have respectively 16 thousand, 28 thousand and 70 thousand professionals. According to the president of SindCT, the situation may get even worse. “Unattractive salaries, lack of public tenders for the renewal of the framework, discontinuation of actions generate motivation and low self-esteem among professionals and are the causes of this deficit,” said Fernando Moraes. He said if nothing is changed, the PEB is at risk, since half of those currently working are about to retire. The director general of DCTA, Ailton Pohlmann, said that by 2020, all professionals who today work in the PEB, will be out of the Brazilian Space Program. The program budget, another issue listed was explained by the director of INPE in a chart showing the resources allocated to the PEB since 1980. During 13 years (1990-2003), the contingencies were low for the space, which he said gave delays of projects and actions. Only in 2003, Lula’s government, there was a return on investment. The amount, however, is insufficient. Gilberto Camara said that Brazil invests currently about $ 200 million in its program, while countries like India, China and Russia invest at least four times. Raupp, who took over as AEB president in March, is working on a new space plan that would include additional funding and greater participation from industry and universities. “This document entitled ‘Urgent Brazil Space,’ has to be taken seriously. The country has to have this attitude,” Raupp said. The new administrator is also pursuing an effort to get the private sector more involved in the nation’s space program, which has been primarily government led. According to Agency Brazil:

Doesn’t solve the heg adv because the internal link is predicated off an international recognition of US action

Doesn’t solve climate change – the US is one of the biggest producers of greenhouse gases and they will need to cooperate to solve climate change – it is highly unlikely that they would agree to rely on another country’s data especially when there is already tension.

AT: International CP – India

India would use it’s space program for weaponization

Hoey and Johnson-Freese 10 - Matthew Hoey and Joan Johnson-Freese, staff writers at an independent think tank, November 3, 2010, “India: Militarizing Space with U.S. Help” Foreign Policy in Focus, online: http://www.fpif.org/articles/india\_militarizing\_space\_with\_us\_help

India, not surprisingly, says that its space program is for “peaceful” purposes only. The parallels between India’s nuclear program development and its current space program development, however, suggest otherwise. Former Indian President Abdul Kalam was a key developer and explicator of India’s nuclear and missile programs, as well as its current space vision. His definition of “peaceful” provides India considerable latitude. Kalam once stated that, “In the 3,000-year history of India, barring 600 years, the country has been ruled by others. If you need development, the country should witness peace, and peace is ensured by strength. Missiles were developed to strengthen the country.” This philosophy of peace through strength also provides the rationale for developing a wide range of new and emerging space technologies with far-reaching military applications. India considered its nuclear program peaceful right up to and including its 1974 test. Now, India considers its expanding space program peaceful as well. Despite contrary indications, Washington is apparently also willing to do so. India’s space program dates back to the launching of its first sounding rocket in 1963. Recently, however, the character of the Indian program has changed dramatically from utilitarian to more far-reaching. India is developing capabilities, including human exploration of space and expanded utilization of many dual-use technologies, to enhance its geostrategic position. This dual-use space technology can be used not just for military force enhancement but potentially for space weapons as well. Though most Indian politicians profess that India is not pursuing space weapons, some blur the lines. In February 2007, for example, Indian Defense Minister A.K Antony stated that, “It may be difficult to demarcate distinctly between peaceful and military uses. However, we have always advocated peaceful use of technology. Thus, we are of the view that weaponization of space must be discouraged.”

AT: International CP – EU

Solvency Deficit- Satellite Infrastructure

ESA climate satellites suffer from “blinding- inability to completely monitor the globe

Physorg 10- Science News Source, Climate satellite 'blinded' by radio interference October 6, 2010 http://www.physorg.com/news205588842.html

The 315-million-euro (434-million-dollar) Soil Moisture and Ocean Salinity (SMOS) probe "has been bugged by patches of interference from radar, TV and radio transmissions in what should be a protected band," the ESA complained. "Painstaking efforts to reduce these unwanted signals are now paying off," the Paris-based agency said. The SMOS orbits 760 kilometres (470 miles) above Earth, a low-altitude slot enabling it to gauge the impact of climate change on the movement of water across land, air and sea. Soon after it was launched last November 2, scientists realised that interference was "effectively blinding" the probe as it passed over parts of southern Europe, Asia, the Middle East and some coastal zones, ESA said in a press release. The intrusion has two causes. One is a leak into a band of the electromagnetic spectrum (1400-1427 MHz in the L-band) which is assigned to space astronomy and Earth exploration satellites by the International Telecommunications Union (ITU). This source came from overpowerful transmitters in adjacent bands, ESA said. The other cause is illegal transmissions by TV, radio links and networks such as security systems that are blasting into the precious radio band. "Also, terrestrial radars appear to cause interference," ESA said. The agency said it had had to embark upon "the tricky and lengthy process" of having the illegal transmissions shut down and the excessive out-of-band emissions reduced. Its first approach had been to governments in Europe, which were tracking down the sources and having the devices retuned or shut down. As a result, interference "is on the wane," it said. The problem with SMOS has run in parallel with a hitch with the satellite's sister, a probe called Gravity field and steady-state Ocean Circulation Explorer (GOCE). For three months this year, GOCE was able to record data but was unable to send it back to Earth, due to a malfunctioning communications link between the processor and telemetry modules on the satellite's main computer. The ESA announced on September 7 that the problem had been fixed. GOCE and SMOS are on the agency's roster of "Earth Explorer" projects to further fundamental understanding about the Earth. Investigations into ice cover, cloud cover, vertical winds and the planet's magnetic field are either planned or in operation.

AT: Ground CP

Ground is insufficient, can’t cover the whole earth

Selva et al 10- Daniel Selva, Brandon H. Suarez, and Edward F. Crawley, PhD Student, Department of Aeronautics and Astronautics, MIT, MIT Student, and Ford Professor of Engineering at MIT, and is a Professor of Aeronautics and Astronautics and of Engineering Systems. 2010 “SPACE-BASED OBSERVATION PROGRAM IS KEY TO INFORMED CLIMATE CHANGE REMEDIATION” AeroAstro. <http://web.mit.edu/aeroastro/news/magazine/aeroastro7/spacebased-observation.html>

Data collection is key to climate change action. There is now evidence that if governments around the world take no action to combat climate change, the consequences of the increase in anthropogenic greenhouse gas emissions are likely to harm ecosystems, human health, and the world economy. Most governments now understand that this is a real problem that requires a response. Reducing global greenhouse gas emissions, and investing in energy efficiency and renewable energy technologies can offset some of the climate change impact. Yet, mitigating and adapting to the impacts of climate change will require investments that could prove unaffordable for many nations. Therefore, it is crucial to make the right decisions; that is, the most effective decisions in terms of societal benefits and lifecycle costs. A major factor undermining the decision-making process is the large uncertainty regarding both the economic and the scientific nature of the problem. Because of this, policy makers are reluctant to commit to action plans that could represent significant portions of their gross domestic products. To resolve this uncertainty, scientists need long series of high temporal and spatial resolution data as inputs into their climate models. The only system capable of providing this data is a large, coordinated model that includes weather balloons, aircraft, satellites, and a ground data network for data sharing and distribution. Improved and continued space-based observations and measurements of the Earth's atmosphere, land, oceans and ecosystems are essential to this endeavor. The unique nature of space-based measurements lies in their global coverage of the Earth including the poles, the oceans, and non-populated land.

Ground has limited observation capabilities

Climate Central 9, Climate Central, an independent, non-profit journalism and research organization, employs a [team](http://www.climatecentral.org/about/people/) of nationally-recognized journalists and scientists 11-7-2009. “What are the advantages of observations of Earth from space?”

Observations of the Earth from space provide a unique vantage point for gathering information essential to forecasting the weather, assessing environmental hazards, managing natural resources, and improving our understanding of climate. Since the first satellites carried cameras into orbit in the late 1950s, space observations have added a matchless perspective, which has grown richer as our space-based instruments have evolved in terms of both variety and sophistication. Ground, sea, and air-based observing systems that contribute to monitoring our planet are also very important. But they have a major limitation — their view is limited. Even though each piece of surface-based data can be combined into large maps, the data represents only the conditions at one location. Beyond that, while surface observations are relatively numerous in many parts of the world, they are sparse in others — much of Africa, parts of South America, and the oceans. From space, by contrast, you can see the full picture. For example, sensors on Earth observation satellites measure rainfall and cloud cover, the chemistry and temperature of the atmosphere, water levels in lakes and reservoirs, and deforestation around the planet. More importantly, because satellites orbit the planet for years, they can make consistent measurements over long periods of time. That is how we know so confidently that sea level really is rising, that ice shelves keep breaking off Antarctica, that rainforests are disappearing in the Amazon (and just how quickly), and that Greenland is shedding more ice into the sea than it gains in new snowfall (and, once again, how quickly). Earth observation satellites also gave us the first global look at the most fundamental climate measurement — how much energy from the Sun hits the Earth and how much energy leaves the Earth. Scientists perform these measurements by pointing a sensor at the Sun to measure incoming solar irradiance and by pointing a sensor at the Earth to measure the energy that is being re-radiated outward. Other sensors measure properties that influence how much solar energy stays in the Earth’s atmosphere as a result of cloud cover (a major influence). They also measure various gases, ocean currents, and wind patterns. Space is truly an ideal vantage point for monitoring our planet’s climate.

Ground observation can’t observe over time or remote places

ESA No Date, European Space Agency, “How does Earth Observation work?” http://www.esa.int/esaMI/Space\_for\_our\_climate/SEMH2Q1VQUD\_0.html

Earth Observation images show the world through a wide-enough frame so that complete large-scale phenomena can be observed to an accuracy and entirety it would take an army of ground-level observers to match. A single satellite image has the potential to show the spread of air pollution across a continent, the precise damage done in a region struck by an earthquake or forest fires, or the entire span of a 500-km hurricane from the calmness of its eye to its outermost storm fronts. Earth Observation provides objective coverage across both space and time. The same space-based sensor gathers data from sites across the world, including places too remote or otherwise inaccessible for ground-based data acquisition. And because Earth Observation satellites remain in place for long periods of time, they can highlight environmental changes occurring gradually. Looking back through archived satellite data shows us the steady clearing of the world's rainforests, an apparent annual rise in sea level approaching 2 mm a year and the depletion of the ozone layer by atmospheric pollution. In the long term, this monitoring of the Earth’s environment will enable a reliable assessment of the global impact of human activity and the likely future extent of climate change.

Ground observation can’t detect carbon sinks

NASA PRESS RELEASES 9, NASA 2-5-09. “NASA Carbon Mission to Improve Future Climate Change Predictions” http://www.lexisnexis.com.turing.library.northwestern.edu/lnacui2api/returnTo.do?returnToKey=20\_T12387400183

Scientists rely on models to forecast future impacts of carbon dioxide on Earth's climate. When the carbon dioxide concentrations used in, or predicted by, these models are not accurate, the resulting climate projections can have a large degree of uncertainty. To accurately predict atmospheric carbon dioxide concentrations in the future, we need to understand natural and human sources of carbon dioxide, as well as the natural "sinks" that remove this gas from our atmosphere. The rapid buildup of carbon dioxide from the burning of fossil fuels is a relatively well understood and predictable source. Other impacts, however, such as forestry and agricultural practices, which can act as either sources or sinks, are far harder to predict with confidence. More importantly, measurements from a global network of greenhouse gas monitoring stations indicate that more than half of the carbon dioxide emitted by human activities is currently being absorbed by the ocean and by plants on land. But the current ground-based carbon dioxide monitoring network does not have the coverage or resolution needed to identify sufficiently the natural sinks responsible for absorbing this carbon dioxide. In addition, the amount of carbon dioxide absorbed by natural sinks varies dramatically from year to year, for reasons that are largely unknown. Because the nature, location and processes controlling these natural sinks are not well understood, it is impossible to accurately predict how much carbon dioxide they might absorb in the future as the climate changes. The Orbiting Carbon Observatory aims to help resolve these and other open carbon-cycle questions.

Top data analysts conclude that only satellites are truly reliable

Brenhouse 10--HILLARY BRENHOUSE, Staff Writer 10-13-10 “If Earth were powered from space;
Exploration could play big role in the search for alternative supplies for terrestrial energy” The International Herald Tribune http://www.lexisnexis.com.turing.library.northwestern.edu/lnacui2api/results/docview/docview.do?docLinkInd=true&risb=21\_T12388502344&format=GNBFI&sort=BOOLEAN&startDocNo=1&resultsUrlKey=29\_T12388502304&cisb=22\_T12388502335&treeMax=true&treeWidth=0&csi=8357&docNo=19

Satellite-derived data is also being used to identify and assess potential clean energy projects. RETScreen, an analysis software provided free by the Canadian government - and currently employed by about 265,000 users in more than 200 countries - helps individuals and institutions to determine whether or not a proposed renewable energy, energy efficiency or cogeneration venture is viable. Its algorithms depend, in part, on scientific information being gathered by NASA. A satellite can, for instance, verify how much solar radiation is available to help establish the feasibility of introducing solar-powered water pumps in Africa. RETScreen operates about 5,000 ground monitoring stations, but mostly these are located in industrialized countries, at airports or military bases. ''When it comes to the developing world, satellites are really our only reliable source of data,'' said Gregory Leng, director of RETScreen International. Mr. Leng's team has been collaborating with NASA's Langley Research Center in Virginia for more than a decade. ''It was a meeting of the minds,'' he said. ''We had the common objectives of trying to combat climate change and promote socio-economic development. Now, their climate data and our software have become the global standard in clean energy analysis.''

**Ground monitoring lacks consistency and range of satellites**

NRC 8, National Research Council 2008 “Earth observations from space the first 50 years of scientific achievements” pg.98-99 http://www.nap.edu/openbook.php?record\_id=11991&page=98

The advent of satellites revolutionized the Earth sciences. They provided the first complete global record of biological, physical, and chemical parameters such as cloud cover, winds, and ice cover. They provided consistency of coverage not available with ground measurements. Time series data revealed large-scale processes and features that could not have been discovered by other ways. Prior to the availability of satellite-based observations, scientists seeking global perspectives from largely ground-based observations were required to develop international collaborations and launch large-scale field campaigns. Piecing together data points required interpolation and extrapolation to fill data gaps, particularly for remote locations. In addition, large-scale sampling efforts involved extensive logistics and advance planning, which prohibited frequent repetition. Because the rate of change of many parameters of interest is much greater than the rate at which global maps could be produced in the presatellite era, it was impossible to observe the full dynamics of the system. Therefore, the unique and revolutionary vantage point from space provides scientists with global images and maps of parameters of interest unmatched by any ground-based observing technology in terms of frequency and coverage. Because satellites collect data continuously and allow for daily (or at least monthly averaged) global images, changes can be observed at the relevant temporal and spatial scale required to detect Earth system processes. The full dynamics of the system have only been observed or characterized since the advent of satellite observations and have allowed the study of previously inaccessible phenomena such as stratospheric ozone creation and depletion, the transport of air pollution across entire ocean basins from China to the continental United States (Chapter 5), global energy fluxes (Chapter 4), ice sheet flow (Chapter 7), global primary productivity (Chapter 9), ocean currents and mesoscale features (Chapter 8), and global maps of winds (Chapter 8). Prior to the satellite era, even if it was possible to compose a global picture from individual surface observations (e.g., through the World Weather Watch, established in 1963), the coverage and density of the network and lack of vertical resolution left much to be desired. Other geophysical and biological phenomena were sampled much less frequently, often as a partial “snapshot” of an otherwise dynamic set of interacting Earth processes.

\*\*AT: Commercialization/Privitization CP’s\*\*

Commercialized SATs Bad- Economics

Commercialization of climate data leads to market barriers and inaccessible data- the government inevitably becomes the financier- LandSats prove

Johnston and Cordes 3- Public good or commercial opportunity? Case studies in remote sensing commercialization Shaida Johnston,\*, Joseph Cordes NASA, Goddard Space Flight Center, George Washington University Space Policy 19 (2003) 23–31 http://www.sciencedirect.com/science?\_ob=MImg&\_imagekey=B6V52-47VS60X-1-5&\_cdi=5774&\_user=10566479&\_pii=S026596460200070X&\_origin=&\_coverDate=02%2F28%2F2003&\_sk=999809998&view=c&wchp=dGLbVlz-zSkWW&md5=015314240b469115570c48c692f47f34&ie=/sdarticle.pdf

In 1984 the USA had a monopoly on land remote sensing with Landsat. The market pricing for commercial Landsat data, subsequent to the Land Remote Sensing Commercialization Act, reflected that monopoly. 7 The barriers to market entry were, and continue to be, significant because of high development costs and long build times of satellite systems and the high risks involved in launching and operating such technology. Yet, even with market pricing well above marginal costs, recovery of start-up costs was not viable. The best that could be expected was that revenues of data sales would cover the fixed costs of operations. Government subsidy was required for developing the follow-on satellites and sensors for Landsat. Few private operators were interested in competing with a federally funded monopoly. The assumptions necessary to calculate the cost recovery for operations were based on optimistic demand projections and high market growth expectations. The demand elasticity for Landsat data had not been accurately determined at the time. The consequences of a nearly 600% increase in price was not known, although there were indications that demand would fall. In 1981 prices for MSS data increased more than 300%, to $650 per scene,8 which resulted in a significant drop in the number of scenes purchased [5]. The market pricing of Landsat data significantly inhibited users from using them and expanding their potential applications. Researchers chose to use the lower resolution, no cost AVHRR data for global studies. In 1986 France’s Syst"eme Pourl’Observation de la Terre (SPOT) was launched, which provided land remote sensing data with better spatial resolution than Landsat, at less cost to data purchasers. The US monopoly was broken. Then in 1988 India launched the Indian Remote Sensing (IRS-1A) system and the competition expanded. The customer base for Landsat data did not grow as expected and the federal government remained the largest customer for Landsat data, with no individual agency willing to commit sufficient funds to continue its operations [6].

Permutation- Federal Action key

Barriers for private sector development of satellites are higher than government efforts- federal commitment is still necessary

Johnston and Cordes 3- Public good or commercial opportunity? Case studies in remote sensing commercialization Shaida Johnston,\*, Joseph Cordes NASA, Goddard Space Flight Center, George Washington University Space Policy 19 (2003) 23–31 http://www.sciencedirect.com/science?\_ob=MImg&\_imagekey=B6V52-47VS60X-1-5&\_cdi=5774&\_user=10566479&\_pii=S026596460200070X&\_origin=&\_coverDate=02%2F28%2F2003&\_sk=999809998&view=c&wchp=dGLbVlz-zSkWW&md5=015314240b469115570c48c692f47f34&ie=/sdarticle.pdf

In addition to high start-up costs and the long time from conception to revenue stream previously mentioned, additional barriers to market entry exist in the 2001 time frame. The inherent technical risks in developing and operating satellites are high for government systems and even higher for the private sector given that private companies have limited resources and system acquisition experience compared with US government programs [12]. The economic failure of the space telecommunications industry has generated caution among venture capitalists and financing for space ventures is difficult to acquire. The current set of public policies is favorable for private remote sensing companies but, going by recent history, those policies are subject to change. US policy stability is essential to the private sector for credibility, investment strategies and market planning. Less predictability reduces incentives to invest. New emphasis on national and homeland security has the potential to generate new restrictions for remote sensing systems. Then again, it may affect expanded remote sensing use and applications.

NASA is necessary to deploy private sector data for research purposes

Johnston and Cordes 3- Public good or commercial opportunity? Case studies in remote sensing commercialization Shaida Johnston,\*, Joseph Cordes NASA, Goddard Space Flight Center, George Washington University Space Policy 19 (2003) 23–31 http://www.sciencedirect.com/science?\_ob=MImg&\_imagekey=B6V52-47VS60X-1-5&\_cdi=5774&\_user=10566479&\_pii=S026596460200070X&\_origin=&\_coverDate=02%2F28%2F2003&\_sk=999809998&view=c&wchp=dGLbVlz-zSkWW&md5=015314240b469115570c48c692f47f34&ie=/sdarticle.pdf

NASA’s Earth Science Enterprise conducts research and development of aerospace science and technology associated with remote sensing systems to seek answers to fundamental questions about how the Earth system functions (see Fig. 1). NASA uses Earth observation systems to provide detection, monitoring, and mapping solutions for research on the water and energy cycle, the carbon cycle, the chemistry-climate connection, weather and climate predictions, and solid Earth and natural hazards. NASA Earth science results contribute to global change research, advanced weather prediction, and natural hazards research (NASA Office of Earth Science, 2000, 2002).

NASA works with the private sector in partnerships and through procurements to provide the Earth science community with remote sensing data provided by commercially owned and operated aerospace systems. Data purchase projects include the Sea-viewing Wide Field-ofview Sensor (SeaWiFS) Project for ocean color data, the Scientific Data Purchase (SDP) project for high-resolution terrestrial and specialized atmospheric data products. In support of the NASA mission to ‘‘understand and protect our home planet,’’ NASA also partners with federal agencies and national organizations to benchmark the benefits of assimilating results of NASA Earth science research and development to enhance decision support for applications of national priority. The focus is on Earth science and remote sensing’s capacity to contribute to solutions for community growth, energy management, risk assessments for public health, detection of environmental indicators for homeland security and biological invasive species, aviation safety, agricultural efficiency, and management of global to regional issues associated with carbon sequestration, disasters, coastal ecosystems, water, and air quality.

Permutation- Normal Means

The CP does not compete- normal means data collection requires federal and private coordination- also proves a solvency deficit to the cp- no data integration and deployment mechanism exists for the private sector

Johnston and Cordes 3- Public good or commercial opportunity? Case studies in remote sensing commercialization Shaida Johnston,\*, Joseph Cordes NASA, Goddard Space Flight Center, George Washington University Space Policy 19 (2003) 23–31 http://www.sciencedirect.com/science?\_ob=MImg&\_imagekey=B6V52-47VS60X-1-5&\_cdi=5774&\_user=10566479&\_pii=S026596460200070X&\_origin=&\_coverDate=02%2F28%2F2003&\_sk=999809998&view=c&wchp=dGLbVlz-zSkWW&md5=015314240b469115570c48c692f47f34&ie=/sdarticle.pdf

The United States Government has significant responsibilities in providing mapping and monitoring information to meet the needs of its citizens. Traditionally, Federal agencies, including the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense (DoD), have deployed the primary spaceborne sources of remote sensing data for our Nation. Spaceborne remote sensing systems, such as the Advanced Very High Resolution Radiometer (AVHRR) on NOAA’s Polar Orbiting Environmental Satellites and the Landsat satellites jointly managed by NASA and the U.S. Geological Survey (USGS), continue to provide observational data for scientific research, economic security, and operational missions to serve weather prediction, navigation, monitoring, and mapping. Information capacity from U.S. civil government space-based assets, typically of low to moderate spatial resolution (kilometers down to tens of meters), is being complemented by data from commercial remote sensing systems with submeter resolution. The recent growth in commercially deployed multispectral, hyperspectral, radar, LIDAR, and thermal remote sensing systems on airborne and spaceborne platforms offers important sources of timely, quality spatial information that can serve the research and operational needs of our Nation. In response to these new sources of data for research and applications, Federal agencies are evolving national data policies to incorporate these new sources of information into their operations (for a review of Federal policies on commercial remote sensing data, see National Research Council, 2002). Federal agencies are keenly interested in evaluating the potential of commercial remote sensing solutions to meet their requirements for geospatial information and have established activities to verify and validate the characteristics of the data products and their utility to address agency mission needs—particularly those that contribute to the protection of life and property. This review process provides an opportunity for the commercial remote sensing community to establish an understanding of the Nation’s research and operational requirements that may be served by commercially provided solutions. Federal policies have expanded the opportunities for commercial suppliers to augment systems owned and operated by the public sector. Privatization policies of the 1980s evolved to commercialization and licensing policies in the 1990s, including the Land Remote Sensing Policy Act of 1992 (U.S. Government, 1992) and Presidential Decision Directive 23 (OPS, 1994) encouraging private-sector investment in land-related Earth observing systems. The U.S. Commercial Remote Sensing Policy (OSTP, 2003) directs government agencies to ‘‘rely to the maximum practical extent on U.S. commercial remote sensing space capabilities for filling imagery and geospatial needs for military, intelligence, foreign policy, homeland security, and civil users.’’ These policies encourage the U.S. Government to use data provided by the private sector to meet mission requirements and not to compete with commercial suppliers. Executive Order 12906 (Clinton, 1994), calls for a National Spatial Data Infrastructure to support public- and private-sector applications of geospatial data in such areas as transportation, community development, agriculture, emergency response, natural resource management, and communications. This Executive Order established the basis for a national remote sensing strategy that uses civil, commercial, and military assets (including airborne and satellite assets) to support U.S. information needs. A national civil remote sensing strategy could focus on solutions to meet the fundamental needs of these communities to optimize data acquisition and utilization approaches and to extend collaboration in data management and end-user applications.

Permutation- Best Policy Option

The optimal option is a joint government and industry effort- proves cost effective and accurate in data acquirement and deployment

Birk et al 3- Ronald J. Birk,\*, Thomas Stanley, Gregory I. Snyder , Thomas A. Hennig, Matthew M. Fladeland, Fritz Police NASA Office of Earth Science, , USA NASA Earth Science Applications Directorate, Stennis Space Center National Imagery and Mapping Agency, NASA Ames Research CenterGovernment programs for research and operational uses of commercial remote sensing data, Received 14 February 2003; received in revised form 6 June 2003; accepted 30 July 2003 Remote Sensing of Environment pg 3 –16

As discussed earlier, the Joint Agency Commercial Imagery Evaluation (JACIE) team includes NASA, the USGS, and NIMA through an interagency government partnership that works with industry and university affiliates to validate and characterize data from commercial satellite vendors (Zanoni et al., 2003). The cooperation between government and industry has benefited all parties, including the broader user community, in understanding the actual characteristics and performance of remote sensing instruments with respect to both the specifications (verification) and the use in geospatial solutions (validation). Each of the partners brings different requirements and capabilities to the joint evaluation process, allowing the partners to stay focused on their own unique core functions and requirements while benefiting from the contributions and the strengths of other team members. This approach reduces the cost of a full evaluation by minimizing duplication of effort by the government and industry. To date, this joint effort has addressed a variety of independent verification and validation areas including radiometric calibration, image quality, and geometric calibration. The JACIE team is established under a NASA Space Act Agreement to establish interagency collaboration for characterizing commercial imagery. The JACIE team provides a single government interface for data characterization to commercial remote sensing companies. When working with Space Imaging, the JACIE working group characterized the IKONOS system and coordinated its efforts to obtain appropriate system information from the company. The initial effort focused on IKONOS because it was the first commercial remote sensing satellite to achieve operations on orbit, but as each new system becomes available, similar evaluations will be needed. Likewise, periodic re-evaluations will be required so that government and industry can continue to use the systems with the R.J. Birk et al. / Remote Sensing of Environment 88 (2003) 3–16 13 confidence of knowing that the systems are performing according to expectations.

Federal Action Key- Data Acquisition

Federal efforts are key to private data deployment and effectiveness

National Research Council 2002- Toward New Partnerships In Remote Sensing: Government, the Private Sector, and Earth Science Research Steering Committee on Space Applications and Commercialization, National Research Council (2002), Steering Committee on Space Applications and Commercialization Space Studies Board Division on Engineering and Physical Sciences http://www.nap.edu/catalog/10500.html

Government and the private sector have come together on several previous occasions to produce remote sensing data. The relationship between Radarsat 1 and Radarsat International in Canada is that of a joint public-private venture, as is the relationship between System pour l’Observation de la Terre (SPOT) satellite and Spot Image company in France; and in the United States, the federal government privatized the Landsat remote sensing program through a commercial operator, Earth Observation Satellite Company (EOSAT), during the mid-1980s and early 1990s. These arrangements were devised to make it possible to market the data commercially, and the more recent SeaWiFS and SDB programs provide remote sensing data to scientists. The steering committee found significant differences in the operating practices and goals of the three groups—government, the private sector, and the scientific community—involved in public-private partnerships. Because the government is publicly accountable for all its actions, it must operate in a complex regulatory environment. Government agencies are also subject to the policy and fiscal priorities of both the White House and the U.S. Congress. (Although both of the public-private partnerships examined at the workshop were conducted by NASA, this report speaks of the government sector as a whole, since other government agencies may become involved in public-private partnerships for data in the future.) Private sector firms engaged in the development of satellites must recover their investment costs and make a profit, and, as a consequence, they must perceive a new public-private partnership to be financially viable before they will take part in it.

Government acquisition of scientific data for research through an agreement with the private sector involves more than a simple commercial transaction. The partnership of entities with such dissimilar modes of operating inevitably raises complex issues related to how the new organization should function. Differences between the government and the private sector complicate negotiations on intellectual property and licensing agreements related to the use of privately owned remote sensing data, on data management and data continuity, on the development of measures of performance for public-private partnerships, and on realistic cost accounting in these partnerships (see the section below, “General Conclusions and Priority Issues”). These complications are heightened when the partnership is created to serve the needs of a third group—in this case, scientists, who have their own requirements. According to scientists at the workshop, having access to the high-resolution and other commercially produced remote sensing data available through public-private partnerships is extremely valuable and makes new types of research possible. However, scientists also value the free and open exchange of scientific data; the capacity to validate scientific results through reanalysis of the data; the calibration, validation, and verification of satellite data to ensure accuracy; long-term stewardship of data for future research; and continuity of the data over multiple points in time. The intersection of scientific and commercial interests in public-private partnerships can pose challenges to meeting these requirements.

It is not yet clear whether public-private partnerships will become the model for future institutions or are merely a temporary arrangement for obtaining data for research. It is clear, however, that existing public-private partnerships are valuable mechanisms for acquiring data that may not otherwise have been available to scientific researchers, that such partnerships have many advantages, and that they can be improved. Despite differences among the partners, clear benefits can be gained through their collaboration. The two public-private partnerships discussed at the workshop were instructive in terms of identifying both ways to meet the needs of commercial, government, and scientific participants in future partnerships and ways of improving how such partnerships function.

Solvency Deficit- Data Application

Only national agencies have access to climate data and the ability to utilize them for research purposes

National Research Council 2002- Toward New Partnerships In Remote Sensing: Government, the Private Sector, and Earth Science Research Steering Committee on Space Applications and Commercialization, National Research Council (2002), Steering Committee on Space Applications and Commercialization Space Studies Board Division on Engineering and Physical Sciences http://www.nap.edu/catalog/10500.html

At present, a wide array of actors is involved in the production of satellite remote sensing data in the public, private, and scientific sectors. In the federal government, a functional division of labor for civilian remote sensing exists across science and operational agencies. NASA is the science agency responsible for technological innovation in space, including innovations in remote sensing technologies, and for providing remote sensing data for scientific research. NASA also was given responsibility for maintaining data centers for near-term access and dissemination of these research data, although it does not have responsibility for permanently archiving or preserving the data. The National Oceanic and Atmospheric Administration (NOAA) has responsibility for maintaining operational weather satellites, for archiving environmental and climate data,10 and for licensing commercial remote sensing satellite companies, as assigned in the Land Remote Sensing Policy Act of 1992. NOAA works closely with the U.S. Departments of Defense, Interior, and State, and the Central Intelligence Agency in this capacity. The U.S. Geological Survey maintains the National Satellite Land Remote Sensing Data Archive at the Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, South Dakota, for data from Landsats 1 through 5 and 7 and the Advanced Very High Resolution Radiometer (AVHRR), and it plans to hold additional land remote sensing data as well. Other federal agencies, such as the Environmental Protection Agency, the U.S. Departments of Transportation, State, and Agriculture, and the U.S. Army Corps of Engineers, are increasingly found in the ranks of both research and applied data users. The National Imagery and Mapping Agency (NIMA) is a clearinghouse for remote sensing imagery and mapping data collected by the U.S. Department of Defense and the intelligence community. The private sector in this field is divided into a large number of aerial remote sensing firms and a small number of satellite remote sensing firms. There are, at present, more than 200 aerial remote sensing firms in the United States.11 There are also 12 U.S. private sector firms with licenses to launch some 40 satellites for Earth observation.12 The private sector also includes value-added firms that provide services for clients.

The research community consists of scientists and engineers who are generally affiliated with universities and dedicated research centers, but can also be found in the government, the private sector, and nongovernmental organizations. The workshop held in March 2001 by the Steering Committee on Space Applications and Commercialization reflected this mix by including university scientists, government scientists, and those conducting research in the private sector. Several variations of public-private sector interactions and relationships exist. In fact, the examples of partnerships discussed in this report—SeaWiFS and the SDB—represent two different approaches. SeaWiFS is partnership, while the SDB is akin to a redistributor-end user interaction. (The steering committee uses the term “public-private partnerships” to describe these relationships.)

Solvency Deficit- Cost

Private sector data would be too costly for research purposes- means the perm is the best option due to subsidies or the CP can’t solve due to multiple barriers

National Research Council 2002- Toward New Partnerships In Remote Sensing: Government, the Private Sector, and Earth Science Research Steering Committee on Space Applications and Commercialization, National Research Council (2002), Steering Committee on Space Applications and Commercialization Space Studies Board Division on Engineering and Physical Sciences http://www.nap.edu/catalog/10500.html

The model involving the private sector as data provider is a more experimental approach, made possible by recent legislation.5 In this model, the private sector finances, builds, launches, and operates a satellite, making data available on a commercial basis for multiple purposes, including research. The government may be a user of the data, but it does not specify data requirements. At present, the best and possibly only examples of completely private sector Earth observation satellites are IKONOS and QuickBird, although there are 12 fully private sector systems now planned for launch during the next 5 years.6 Transactions between scientists and private sector satellite providers may occur on an individual basis (e.g., scientists may use funds from research grants to procure satellite data from aerial remote sensing firms or commercial satellite remote sensing firms); however, many scientists may not have the funding to purchase research data from the private sector. NASA grantees can submit a competitive proposal and, if selected, receive commercial remote sensing data at no cost through the Science Data Buy (SDB) program, which is managed out of NASA’s Stennis Space Center (see Chapter 3). If funding for the SDB program does not continue, these researchers may no longer be able to obtain commercial data, as they may lack the resources in their grants to purchase the data directly at market prices. However, as the number of private remote sensing satellite data collectors increases, market forces and competitive pricing could make commercial data more affordable to scientists. As the use of commercial remote sensing data for scientific research evolves, several issues must be considered—including data management, data processing, long-term archiving, and intellectual property and data access—if privately collected data are to meet the requirements of and the broader needs for scientific research. (These issues are discussed in Chapter 4.)

\*\*AT: Politics\*\*

2AC Politics-Obama Good

1. No Link-Midwest and Southern Reps like sats-early warning systems prove

Orndaff 7/13- Mary Orndaff, Birmingham News’ Washington DC correspondent since 2000, 13 July 2011, “Weather satellite funding expected to pass key congressional committee,” Online: http://blog.al.com/sweethome/2011/07/weather\_satellite\_funding\_expe.html

WASHINGTON -- Funding for weather satellites that gave Alabamians several days' notice of the April 27 tornadoes, now endangered by federal budget cuts, would be restored with extra money expected to pass a key congressional committee today. The move to restore funds, especially in the current climate of debt reduction, is a sign that storm-weary lawmakers from the South and Midwest were able to convince their colleagues that the loss of the low-orbit satellites was a threat to public safety that should be prevented. The House Appropriations Committee today is expected to add $429.5 million to the Joint Polar Satellite System for 2012. While it's not a full restoration of the cuts the National Oceanic and Atmospheric Administration sustained in 2011, it would speed the process of launching new replacement satellites and shorten the time the country will go without the important atmospheric information they collect. "In NOAA, this bill includes the necessary funding to better protect Americans from natural disasters such as tornadoes, hurricanes and tsunamis," said U.S. Rep. Frank Wolf, R-Va. and chairman of the subcommittee that allocates spending for the U.S. Department of Commerce, which includes NOAA. The polar-orbiting satellites are closer to the Earth than other kinds of satellites, and the data they provide are critical to making weather forecasts beyond 48 hours, according to NOAA. That data was crucial in giving forecasters the ability to warn Alabama residents about the likelihood of a tornado outbreak five days before the April 27 storms killed 244 people in the state. Emergency managers had time to plan, and several schools and government offices closed early, likely saving many more lives. NOAA's satellite budget, like most other federal agencies, was slashed when Congress trimmed $38 billion in spending for the remainder of the 2011 budget year. The cuts slowed down work on replacing the aging satellites and pushed back launch dates for new ones. NOAA's administrator, Jane Lubchenco, has said that, even if Congress granted the $1 billion President Barack Obama requested for the polar satellite system next year, the shortfall in 2011 would cause a gap in coverage after the temporary replacement satellite ended its mission in 2016 or 2017 and before the new one would have been launched. NOAA had estimated the funding cuts could cause about an 18-month gap in weather satellite coverage, but there was no estimate Tuesday on how much of a gap would be left if part of the funding was restored. U.S. Rep. Spencer Bachus, R-Vestavia Hills, has been especially vocal about the need for the satellite coverage, even though the money was cut in a compromise package to avoid a government shutdown that he and the rest of the Alabama delegation voted for. This week, he wrote to Wolf supporting the increase. "The proposed funding represents important progress in addressing two enduring lessons of the storms in the Southeast and Midwest: Lives are saved when there is adequate advanced warning and when citizens have access to safe shelters," Bachus wrote in a Tuesday letter. The legislation being debated today by the House Appropriations Committee would spend about $900 million on the Joint Polar Satellite System, which is $429.5 million more than in 2011 but $168.7 million less than what Obama had requested, according to the bill. A group of 14 senators, including U.S. Sen. Richard Shelby, R-Ala., has urged Senate appropriators to also protect the program, which provides long-range weather information used by farmers, shippers, military planners, pilots and fishermen. "As we enter a predicted above-average hurricane season, we hope that the early warnings these satellites provide will continue to save lives but we are concerned that lack of funding now will bring about unnecessary death and destruction in the future, when there are not accurate multi-day forecasts of severe weather," the group of senators wrote.

2. No Link- New bi-partisan coalition fighting for more weather sats-key to early warning systems and military

Space News International 6/20- Turner Binton, writer and contributor, 20 June 2011, “After Tornado Spate, Fourteen U.S. Senators Call for JPSS Funding,” Online: http://www.spacenews.com/policy/110620-fourteen-senators-call-jpss-funding.html

WASHINGTON — A group of 14 U.S. senators — many from states hard hit by a rash of tornadoes and ongoing flooding — are warning of potentially grave consequences if Congress continues to short change an overdue effort to replace the nation’s polar-orbiting weather satellites. In a June 17 letter to Sens. Daniel Inouye (D-Hawaii) and Thad Cochran (R-Miss.), the chairman and vice chairman, respectively, of the Senate Appropriations Committee, 13 Democrats and one Republican — Sen. Richard Shelby (Ala.) — warn that a projected looming gap in weather satellite coverage will worsen without more support for the U.S. National Oceanic and Atmospheric Administration (NOAA)’s Joint Polar Satellite System (JPSS). “As you know, a harmful loss of satellite coverage is already slated to occur in coming years, and we are deeply concerned that without adequate funding to swiftly implement JPSS, American lives, property, and prosperity will be needlessly endangered,” the senators wrote. They did not call for a specific amount of funding. The JPSS program is an offshoot of the National Polar-orbiting Operational Environmental Satellite System, a joint military-civilian program that the White House dismantled in February 2010. As a result, NOAA was directed to fund a constellation of polar-orbiting weather satellites for civil weather and climate forecasting, the development of which would be managed by NASA. The Air Force was directed to build its own military weather spacecraft. NOAA sought just over $1 billion for JPSS for 2011 but a long-delayed government spending package that finally passed in April provided only $382 million for the program. NOAA’s 2012 budget request, submitted to Congress in February, included $1.06 billion for JPSS. Agency officials, however, have said even if the full amount is provided, the nation still risks a minimum one-year gap in weather satellite coverage Neither the House nor Senate has yet to take up a 2012 spending bill for NOAA. In May, the House Appropriations commerce, justice, science subcommittee — a 12-member panel drafting legislation to fund NOAA and NASA, among other agencies, for the year ahead — received a top-line budget allocation of $50.2 billion, an amount $3 billion below what it appropriated for 2011 and some $7 billion below the amount the White House is requesting. The Senate Appropriations Committee, which is expected to oppose many of the steep budget cuts advocated in the Republican-controlled House, has not released its top-line spending allocations. The letter notes the United States has seen a series of devastating weather events in 2011, including 1,300 tornadoes across multiple states that have killed more than 500 people and caused more than $10 billion in property damage. The results of these storms would have been far worse without early warnings from polar-orbiting weather satellites, the letter said. “As we enter a predicted above-average hurricane season, we hope that the early warnings these satellites provide will continue to save lives, but we are concerned that lack of funding now will bring about unnecessary death and destruction in the future, when there are no accurate multi-day forecasts of severe weather,” they wrote. Polar-orbiting weather satellites also played a role in the planning of the May 1 raid that killed Osama Bin Laden in Pakistan and the recent NATO military actions in Libya, the letter says. “It is worth noting that both the raid to capture Osama Bin Laden and the air strikes on Libya were appropriately delayed due to forecasts of unfavorable weather. It is critical to our national security that we maintain a robust system of satellites to observe the weather and feed forecasts globally – a system that requires both Air Force and NOAA weather satellites.”

3. No Link- even with budget cuts, senators want to keep public safety programs and early warning systems

USA Today 6/17- Bart Jansen, frequent writer and contributor, 17 June 2011, “Looming gap in weather satellites threatens forecasting,” Online: http://www.usatoday.com/weather/news/2011-06-17-weather-satellite-budget-cuts\_n.htm

A polar satellite detects when ingredients such as moisture and winds look ripe for storms. The weather service then posts "outlooks" warning five to eight days ahead of possible violent storms. On storm day, the service's Storm Prediction Center posts "watches" several hours ahead. Forecasters issued warnings five days ahead of tornadoes that struck Tuscaloosa, Ala., and five other states in April. A barrage of 312 tornadoes swept across the Southeast, killing 321 people. On storm day, forecasters gave warnings averaging 27 minutes before actual touchdowns. Likewise, when a tornado struck Joplin, Mo., killing 151 on May 22, forecasters gave warnings averaging 24 minutes before strikes. "The satellites are an important part of that early warning process," said Christopher Vaccaro, a spokesman for the service. Without the replacement polar satellite, forecasters would have half the information to track the moisture and wind patterns that percolate into violent storms. Lubchenco said without information from the polar satellite, forecasts for a massive storm nicknamed "snowmageddon," which hit Washington in February 2010, would have had the location wrong by 200 to 300 miles and would have underestimated the snowfall by 10 inches. Hurricane tracking would also suffer, she said. "Our severe storm warnings will be seriously degraded," Lubchenco testified April 1 before the House Appropriations subcommittee governing the agency. Lawmakers and scientists lauded the value of the program, which provides forecasts for military troop deployments, ocean search-and-rescue missions and farmers tending crops. "It's important for public safety," said Christine McEntee, executive director of the American Geophysical Union. Cutting the funding "would be penny-wise and pound-foolish." Lubchenco credited the satellites with helping save 295 people in 2010 by helping track rescue beacons aboard ships. "That's saving lives, that's saving money," said Rep. Chaka Fattah of Pennsylvania, the top Democrat on the House panel that oversees NOAA funding. But reduced federal spending threatens all domestic programs. Congress cut spending $38.5 billion in the fiscal year that ends Sept. 30. House Republicans propose to cut another $30 billion next year. Obama has proposed $5.5 billion for NOAA in the fiscal year starting Oct. 1, including a $688 million boost for the polar satellite. But the agency received $4.6 billion this year — $947 million less than requested — and lawmakers warned that a hefty increase was unlikely. The House Appropriations subcommittee is to vote on its budget July 7. "The fiscal crisis facing the nation is real and will require a level of austerity that goes beyond the present budget," said Rep. Frank Wolf, R-Va., who heads the panel. Another appropriator, Sen. Mary Landrieu, D-La., said she would fight Republicans for a funding freeze — rather than cuts — to avoid harming programs such as weather satellites. "There are serious cuts being implemented now," Landrieu said. "This senator from Louisiana is willing to try to balance the budget, but I am not willing to do any more reductions without revenues being put on the table."

4. Winners Win for Obama

Singer 9- Jonathan Singer, senior writer and editor for MyDD and has had numerous interviews with important politicians such as John Kerry, Barack Obama, John Edwards, and Tom Vilsack and has been quoted or cited by Newsweek, The New York Times, USA Today, The Politico, and others, 3 March 2009 “By Expending Capital, Obama Grows His Capital,” Online: http://www.mydd.com/story/2009/3/3/191825/0428

From the latest NBC News-Wall Street Journal survey: Despite the country's struggling economy and vocal opposition to some of his policies, President Obama's favorability rating is at an all-time high. Two-thirds feel hopeful about his leadership and six in 10 approve of the job he's doing in the White House. "What is amazing here is how much political capital Obama has spent in the first six weeks," said Democratic pollster Peter D. Hart, who conducted this survey with Republican pollster Bill McInturff. "And against that, he stands at the end of this six weeks with as much or more capital in the bank." Peter Hart gets at a key point. Some believe that political capital is finite, that it can be used up. To an extent that's true. But it's important to note, too, that political capital can be regenerated -- and, specifically, that when a President expends a great deal of capital on a measure that was difficult to enact and then succeeds, he can build up more capital. Indeed, that appears to be what is happening with Barack Obama, who went to the mat to pass the stimulus package out of the gate, got it passed despite near-unanimous opposition of the Republicans on Capitol Hill, and is being rewarded by the American public as a result. Take a look at the numbers. President Obama now has a 68 percent favorable rating in the NBC-WSJ poll, his highest ever showing in the survey. Nearly half of those surveyed (47 percent) view him very positively. Obama's Democratic Party earns a respectable 49 percent favorable rating. The Republican Party, however, is in the toilet, with its worst ever showing in the history of the NBC-WSJ poll, 26 percent favorable. On the question of blame for the partisanship in Washington, 56 percent place the onus on the Bush administration and another 41 percent place it on Congressional Republicans. Yet just 24 percent blame Congressional Democrats, and a mere 11 percent blame the Obama administration. So at this point, with President Obama seemingly benefiting from his ambitious actions and the Republicans sinking further and further as a result of their knee-jerked opposition to that agenda, there appears to be no reason not to push forward on anything from universal healthcare to energy reform to ending the war in Iraq.

5. Reject the neg’s authors-they don’t understand the complexity of PC theory and are unable to define it.

Casey, 8- Kiberly L. Casey, Ph.D. in Political Science from the University of Missouri-St. Louis and graduate teacher of Political Science, Spring 2008, “Defining Political Capital: A Reconsideration of Bourdieu’s Inconvertability Theory,” Online: http://lilt.ilstu.edu/critique/spring%202008/casey.pdf

It is erroneous to refer a “body” of PC literature when seeking a definition. Most writers and concerned actors who invoke the term political capital assume that its meaning is understood. It is inferred to be an entity which political actors possess, build up and spend.1 However, a definition of “political capital” is typically never stated—the reader or observer is left to determine their own definition based upon the politician’s or journalist’s usage of the term (Suellentrop 2004; Kennicott 2004; “A Year of Setbacks” 2005; and Froomkin 2004). The subjectivity is not reflective of what political capital conceptually means in and to the political arena. Without a sound definition that accurately portrays the elements of political capital as it works within a political marketplaces, such as the electoral arena, and among office holders (executive, legislative, and judicial), bureaucracy, and in society in general, the concept is meaningless. Defining and utilizing PC as a viable political variable can evolve from the proliferation of capital theories in various fields of study. Political capital can and should be associated with a wide variety of previous “capital” interpretations. The key to explicating political capital is within capital literatures and how they address materialism, non-materialism, and combining the two elements.

2AC Politics-Obama Bad

1. No Link- Budget crisis makes weather sats unpopular-new spending bill proves

Space News International 7/8- Turner Brinton, frequent writer and contributor, 8 July 2011, “U.S. House Bill Would Boost Funding for JPSS Program,” Online: http://www.spacenews.com/earth\_observation/110708-bill-boost-funding-jpss.html

WASHINGTON — A U.S. House of Representatives appropriations panel that oversees the National Oceanic and Atmospheric Administration (NOAA) approved a spending bill July 7 that would provide just over $900 million in 2012 for a cash-starved polar weather satellite program. Despite the $429.5 million funding increase recommended for the Joint Polar Satellite System (JPSS), the House Appropriations commerce, justice, science subcommittee would provide only $4.5 billion for NOAA next year, $1 billion short of the administration’s request. In total, the panel slashed $7.4 billion from the White House’s $57.7 billion request for all commerce-, justice- and science-related spending. The JPSS program was created last year after the White House in February 2010 dismantled the National Polar-orbiting Operational Environmental Satellite System (NPOESS) that was being jointly developed by NASA and the Defense Department. The program was beset by divergent mission requirements, funding squabbles and technical troubles, resulting in cost growth and a launch schedule that continually slipped to the right. The administration decided to revert to two separate weather satellite constellations, directing NOAA to develop polar-orbiting weather satellites for civil weather and climate forecasting, while the Air Force would pursue a weather constellation for dedicated military purposes, dubbed the Defense Weather Satellite System. NOAA had been responsible for funding half of NPOESS, and taking on JPSS by itself required an infusion of cash. Congress appropriated $382 million for NOAA’s share of NPOESS in 2010, and the agency requested $1.06 billion for JPSS in 2011. Congress was unable to pass any of the 12 conventional federal spending bills for 2011, and instead funded the government with an all-in-one spending bill that generally held spending to 2010 levels. A revised 2011 spending plan NOAA sent to Congress in June proposed a budget of $471.9 million for JPSS, a figure that still falls more than $500 million short of what he agency needs for the program this year. As a result of the 2011 shortfall, launch of the first satellite slipped from late 2014 to 2016, making it highly likely that the nation would experience a gap in polar-orbiting weather satellite coverage, NOAA officials have said. The $901.3 million recommended by the House panel for JPSS in 2012 is about $105 million less than the agency requested. The $4.5 billion that the bill would provide for NOAA is $103 million less than NOAA received last year, ensuring that other NOAA programs would be reduced or eliminated to increase spending on JPSS. The subcommittee noted that National Weather Service programs and operations would be fully funded but did not reveal funding levels for any other NOAA programs. Chairman Frank Wolf (R-Va.), lamented the deep cuts his subcommittee had to make but noted that the nation’s growing debt cannot be tackled alone by cuts to so-called discretionary spending. “There are a number of areas in this bill that, under different circumstances, I would have preferred to fund at different levels,” Wolf said in his opening statement. “However, the House-passed Budget Resolution established our allocation and accordingly this subcommittee produced a strong bill with strategic investments in national security, job creation and science, despite the limited allocation. “In the absence of a comprehensive plan to rein in entitlements and our crushing debt, we are forced to focus only on non-security discretionary spending to achieve savings — which is only 12 percent of the overall budget request. There is never a convenient time to make tough decisions, but the longer we put off fixing the problem, the worse the medicine will be,” Wolf said.

2. No Link-sats unpopular to GOP-new budget proves

Conathon 11- Michael Conathon, Director of Ocean Policy at American Progress, 18 February 2011, “The GOP decides accurate weather forecasting and hurricane tracking are luxuries America can’t afford,” Online: http://thinkprogress.org/romm/2011/02/18/207538/gop-cuts-noaa-satellite-weather-forecasting-and-hurricane-tracking/

The House of Representatives is debating the Full Year Continuing Resolution Act (H.R. 1) to fund the federal government for the remainder of fiscal year 2011. The Republican leadership has proposed sweeping cuts to key programs across the climate change, clean energy, and environmental spectrum. They have also decided that accurate weather forecasting and hurricane tracking are luxuries America can no longer afford. The GOP’s bill would tear $1.2 billion (21 percent) out of the president’s proposed budget for the National Oceanic and Atmospheric Administration, or NOAA. On the surface, cutting NOAA may seem like an obvious choice. The FY 2011 request for the agency included a 16 percent boost over 2010 levels that would have made this year’s funding level of $5.5 billion the largest in NOAA’s history. Even this total funding level, however, is woefully insufficient for an agency tasked with managing such fundamental resources as the atmosphere that regulates our climate, the 4.3 million square miles of our oceanic exclusive economic zone, the ecological health of coastal regions that are home to more than 50 percent of all Americans, response to environmental catastrophes including the Deepwater Horizon oil spill, and fisheries that employ thousands of Americans and annually contribute tens of billions of dollars to the national economy. More than $700 million of the president’s proposed 2011 increase in NOAA funding would be tagged for overhauling our nation’s aging environmental satellite infrastructure. Satellites gather key data about our oceans and atmosphere, including cloud cover and density, miniscule changes in ocean surface elevation and temperatures, and wind and current trajectories. Such monitoring is integral to our weather and climate forecasting and it plays a key role in projections of strength and tracking of major storms and hurricanes””things most Americans feel are worth keeping an eye on

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\*\*AT: Spending/Trade-Off DA\*\*

AT: Spending/Trade-Off DA

The DA is non-unique- billions will be spent on satellites in the status quo

Space News 11- Mon, 14 February, 2011 NOAA Seeks $1 Billion To Minimize Weather Satellite Delays

The U.S. National Oceanic and Atmospheric Administration (NOAA) is requesting $1.07 billion for the Joint Polar Satellite System (JPSS) in its 2012 budget request to Congress. If approved, that money would help program officials trim some, but not all, of what is projected to be a 12- to 14-month delay in the production of the first two weather satellites, which agency officials originally planned to launch in 2014 and 2018, NOAA officials said. That delay is the result of an anticipated lack of funding for JPSS in 2011. The White House requested $1.06 billion for JPSS in 2011 after halting work on the joint civil-military weather satellite, the National Polar-orbiting Operational Environmental Satellite System. The 2011 JPSS money was not provided, however, because the U.S. government has been operating under a series of continuing resolutions, short-term funding measures that freeze spending for most programs at 2010 levels. In the continuing resolutions passed to date, NOAA’s 2011 budget for JPSS has been capped at $382 million. “We have requested the full amount necessary to try to make up some of this time lost,” Maureen Wylie, NOAA chief financial officer, said Feb. 14 in a conference call with reporters. “But in a complex satellite acquisition such as this, we would not be able to buy back all of the effort lost if we are not funded in fiscal year 2011.” As White House and NOAA officials press for their 2012 budget request for JPSS, they also will continue to ask Congress to provide additional JPSS funding in 2011. “We continue to articulate a need for that [request],” Wylie said. If additional money is provided in 2011, some of the delay could be eliminated, she added. If JPSS funding remains at 2010 levels, the 2011 program will be focused largely on completing the ground system needed to obtain data from a JPSS precursor satellite, the National Polar-orbiting Operational Environmental Satellite System Preparatory Project (NPP). “We are focusing our resources on preparing the ground systems,” Wylie said. “When NPP is ready to launch in October of this year, our ground systems will be checked out and ready to go so we can actually begin to take those observations and use them.” The JPSS satellite, which NASA was directed to build, is NOAA’s “highest priority,” Wylie said. “This next generation polar-orbiting satellite will provide 98 percent of the information that goes into our weather models. It is absolutely critical to providing safe and accurate forecasts.” NOAA’s overall budget request for 2012 was $5.5 billion, or $749 million more than the 2010 budget level, which the agency is working under as a result of the continuing resolutions, said Monica Medina, NOAA’s principal deputy undersecretary for oceans and atmosphere. The funding levels included in the 2012 NOAA request are based on the assumption that Congress will not revisit 2011 budget levels and the continuing resolution will continue throughout the year, NOAA Administrator Jane Lubchenco said Feb. 16 during a budget briefing. The 2012 NOAA budget also includes $53 million to continue development of the Jason-3 satellite, a joint effort with Europe’s meteorological satellite agency, Eumetsat, to measure sea surface height and ocean weather. If approved, the 2012 money would allow NOAA and Eumetsat to launch Jason-3 in 2014, Lubchenco said. NOAA plans to provide the spacecraft’s microwave radiometer, precision navigation components, launch services and engineering services for Jason-3, according to documents published Feb. 14 by the White House Office of Management and Budget. Eumetsat and the French space agency, CNES, are expected to provide the Jason-3 spacecraft, altimeter, precision orbit components, ground system and operations. The NOAA budget also includes $34 million for the Geostationary Orbiting Environmental Satellite (GOES)-N and $617.4 million for satellite engineering development and production activities for GOES-R and GOES-S. The proposed 2012 budget for the GOES program is $50 million lower than the 2010 budget level. That reduction reflects improved efficiency in project management and will not delay the scheduled 2015 launch of GOES-R, Wylie said. NOAA’s budget proposes spending $11.3 million on a collaborative effort with the Taiwan National Space Organization to support the launch of 12 satellites that will use GPS radio occultation to measure atmospheric temperature and moisture. The effort, known as Constellation Observing System for Meteorology Ionosphere and Climate-2, or COSMIC-2, follows a joint U.S.-Taiwanese initiative, known as COSMIC, which demonstrated the utility of GPS radio occultation with a constellation of six satellites launched in 2006. The COSMIC program “is a very cost-effective means of obtaining global atmospheric temperature profiles,” Lubchenco said. The data have been shown to make a significant improvement in NOAA’s ability to produce timely weather forecasts, she added. In support of the COSMIC-2 program, NOAA plans to provide 12 radio occultation sensors, offer ground station support and augment tracking station capabilities. Taiwan will provide the spacecraft and integrate the sensors, according to White House budget documents. NOAA’s 2012 budget includes $47.3 million to refurbish the Deep Space Climate Observatory satellite to obtain solar wind data that are used to provide warning of geomagnetic storms. If provided by Congress, that funding would support refurbishment of the satellite — originally built for the canceled Triana Earth observation mission — and development of an instrument designed to detect solar winds, according to White House budget documents. “It is anticipated that NOAA will lose two critical observational data sources for solar storm warnings when NASA’s Advanced Composition Explorer and Solar and Heliospheric Observatory stop working,” Lubchenco said. Since both spacecraft have exceeded their expected lifetime, NOAA needs funding to launch its own solar wind mission “to continue to receive vital data to help anticipate and mitigate space weather damage,” she added. Launched in 1995, the Solar and Heliospheric Observatory was scheduled to perform a two-year mission. The Advanced Composition Explorer, launched in 1997, had a life expectancy of five years.

No Link- NASA will tradeoff budget from other government departments

Space News 11-Amy Svitak, Space News Staff Writer, 29 March 2011, “NASA's Budget Could Get Infusion from Other U.S. Departments,” Online: http://www.space.com/11247-nasa-budget-funding-commerce-justice-departments.html

WASHINGTON — Congressional appropriators could tap the funding accounts of the U.S. departments of Commerce and Justice to help cover what some see as a $1 billion shortfall in NASA’s $18.7 billion spending plan for 2012, which allocates less money for a heavy-lift rocket and crew capsule than Congress directed last year. “There’s over a billion-dollar difference between the budget request and the authorized levels in [20]12 for the launch system and the crew vehicle, and now that falls squarely back on the shoulders of [the appropriations committees] to try and figure out where to come up with that money,” said a panelist at a March 23 breakfast on Capitol Hill. Sponsored by Women in Aerospace (WIA), the breakfast was held under the Chatham House Rule, an 84-year-old protocol fashioned by the London-based nonprofit think-tank to promote frank discussion through anonymity. [What Obama and Congress Should Do for Spaceflight] The panelist, one of six whose names and job titles were circulated by WIA prior to the meeting, said funding requested in NASA’s 2012 spending plan does not square with levels Congress set in the NASA Authorization Act of 2010 that U.S. President Barack Obama signed into law in October. Specifically, the request called for spending $1.2 billion less than the $4 billion Congress authorized for the heavy-lift launch vehicle and crew capsule in 2012. At the same time, the request includes $350 million more than the $500 million Congress authorized to nurture development of commercial vehicles to deliver cargo and crews to the International Space Station after the space shuttle retires later this year. Consequently, the panelist said, it is now up to congressional appropriators “to find a billion dollars in other places in NASA to pay for those activities or to decide to make those tradeoffs and take that money out of the departments of Commerce or Justice or the other agencies that are funded in the same bill as NASA.” NASA’s annual appropriation is part of a broader spending package totaling nearly $65 billion that funds the U.S. Commerce and Justice departments, the National Science Foundation, the National Institute of Standards and Technology and related agencies.

Turn- CLARREO is the most cost effective

NASA 8- CLARREO Science Questions http://clarreo.larc.nasa.gov/docs/VII.3\_Science\_Questions\_Draft\_4\_Oct\_20.pdf

CLARREO is expected to be one of the most cost effective of all the climate related decadal survey missions in terms of science impact. As can be seen in Table 1, CLARREO has the potential for unique value to decadal change observations needed for a wide range of critical climate science questions. The urgency for the CLARREO mission is a result of the rapidly growing societal challenge of current and future climate change. The urgent need to accurately predict climate change, to develop intelligent plans to minimize it, and to plan methods to adapt to it. This urgency is also a result of the growing realization in the climate science community of the critical need for higher accuracy decadal change observations than currently exist.

CLARREO key to NASA credibility

Dinnerman 9--Taylor, writer for publications such as Ad Astra, The Wall Street Journal, and the American Spectator, former contributor to the Space Review and current writer for the Hudson Institute New York, part-time consultant for the US Defense Department, "NASA, politics, science, and skepticism", The Space Review, September 14, <http://www.thespacereview.com/article/1462/1>

For the moment NASA’s Science Mission Directorate has maintained a pretty good reputation for honest research done openly and reviewed carefully. It’s easy to do this when the stakes involve nothing but pushing back the frontiers of ignorance and expanding the sum total of human knowledge. When politics gets involved things change and the stakes get higher—sometimes very high indeed. In the case of the dispute over anthropomorphic global warming (AGW) the stakes could not be higher. The proponents of the theory believe that the Earth faces a catastrophe on a gigantic scale if nothing is done to reduce carbon dioxide emissions, while skeptics disagree. In the balance are trillions of dollars and a large shift in global political power away from elected leaders and towards the “experts”. NASA’s position as a source of information that both sides can trust is immensely important, both **to the scientific and political credibility** of the agency and to its long-term viability. If NASA is seen as being an organization committed to one side in the debate it automatically becomes the mortal enemy of the other side. Given the difficulties the agency already faces, it does not need to create new foes. For the agency the way it manages the Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission is **critical to its legitimacy.** This mission hopes to, in its words, “**produce irrefutable climate records that will be used to support national and international policy.**” The two satellites will each carry three instruments, one to study planetary infrared emissions, another to measure reflected radiation, and a GPS occultation antenna.

CLARREO will increase credibility

NRC 7 - United States National Research Council, Jan 2007, “US Earth Science Decadal Survey Title: Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond,” online: http://www.nap.edu/catalog.php?record\_id=11820

“CLARREO addresses three key societal objectives: (1) provision of a benchmark climate record that is global, accurate in perpetuity, tested against independent strategies that reveal systematic errors, and pinned to international standards; (2) development of a trusted, tested operational climate forecast through a disciplined strategy using state-of-the-art observations with mathematically rigorous techniques to establish **credibility**; and (3) disciplined decision structures that assimilate accurate data and forecasts into intelligible and specific products that promote international commerce and societal stability and security.”

Political support is the only way to get funding

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If the key decision-makers continue to ignore the realities of the American political consensus for space, the future will be filled with frustrations. The mismatch between announced policies and the existing consensus will continue to result in NASA’s proposing grandiose plans without the political support necessary for adequate funding. Investment in enabling technologies will be sacrificed in order to support the bureaucracies metastasizing around the programs. Specifically, the shuttle fleet will age more rapidly than anticipated and the second generation advanced shuttle vehicle will not be ready in time. This could result in another “launch capacity gap” similar to that of the the post- Challenger period, with adverse impact on all aspects of the space program.