## Notes

Earth Science:

* Study of the Earth as a system, that integrates research of the atmosphere, hydrosphere, lithosphere, and biosphere
* Treats Earth as an integrated system and seeks a deep understanding of the human interactions that determine the future state of the Earth
* Is a distinct *budget category* within NASA --- along with Planetary (Space) Science, Astrophysics, and Exploration
* Is studied by NASA in a variety of ways, including remote sensing --- using aerial sensors (including satellites) to detect and classify objects on Earth

The DA:

* Basic idea: *exploration* and *Earth science* compete for funding. More for one means less for the other (AKA “zero-sum”). Thus, funding the plan requires *internal trade-offs* that take NASA’s money needed for Earth science programs.
* The impact is planetary extinction via multiple environmental threats --- warming, ozone, loss of biodiversity
* Earth science “solves” environmental collapse in two primary ways:
	1. By detecting threats --- thus, creating *political mobilization* for remedies to ongoing problems. A good example was the Ozone Layer crisis in the 80s. Satellite observations showed a significant “hole” in the ozone layer, which created the impetus for the Montreal Protocol --- a multilateral treaty that reduced the global emission of pollutants linked to ozone depletion.
	2. By creating meaningful predictions that enable adaptation --- for some threats, like food shortages due to climatic variation, there could be responses to alleviate the impact --- i.e. emergency food aid. For rapidly emerging threats, this requires advance notice of change, which NASA satellites provide.

Key issues:

* Uniqueness. It is probably the strongest area of Aff response. Specifically:
	+ New budgets do not contain significant spending increases for NASA
	+ Several “remote sensing” projects have been delayed or cancelled --- with NASA citing financial problems as the cause
	+ Some authors predict a round of cuts in the future

Given this, the Neg needs to win one of the following:

* + Current levels are sufficient to sustain environmental programs
	+ NASA budget levels are declining but Earth science’s relative share is stable or increasing
	+ Future cuts won’t happen / won’t target Earth science

This debate is fairly fluid – and could change during the year. Read evidence closely to determine what budgets it is talking about --- FY09, FY10, FY11, and FY12 could all be referenced and differ dramatically. Also, some evidence produced at other camps talks about budgets for non-NASA Earth sciences --- which obviously doesn’t apply.

* Is the plan supplemental funding (a check from Congress to NASA *in addition* to its current budget) or an internal re-allocation (moving money from one program to the other)? The Aff will say the former, the Neg will say the latter.
* Is NASA key? There are private sector satellites, as well as satellites run by multiple other agenices --- such as the National Oceanic and Atmospheric Administration and Environmental Protection Agency.
* Impact defense: traditionally, “environmental collapse” has been one of the more difficult impacts for debate teams to defend. Thus, it may be strategic to emphasize the warming or ozone components of Earth science in later versions of this DA.

## Earth Science DA – 1NC

### NASA Earth science missions are funded, but the overall budget is tight and carefully calibrated to balance research with exploration

Holdren 11 (John, Director – Office of Science and Technology Policy, “The Budget for the White House Office of Science and Technology Policy”, Congressional Documents and Publications, 5-4, Lexis)

*National Aeronautics and Space Administration (NASA)*This past October, the President signed the 2010 NASA Authorization Act (the "Act", Public Law 111-267), which stands as a statement of bipartisan agreement by Congress and the Administration regarding NASA and its many programs. NASA's programs not only support the grand and inspiring adventures of space exploration, scientific discovery, and aeronautical advancement, but also provide an indispensable platform for observing the Earth to ensure that we have the information we need to cope with weather-related and other environmental threats to human well-being. NASA programs also fuel new technology development and innovation and help launch new products, services, businesses, and jobs with enormous growth potential. The Act will further our joint goal of placing NASA's programs on a more stable footing and enhancing the long-term sustainability of these exciting endeavors as we chart a new path forward in space.
The FY2012 NASA budget reaffirms the Administration's commitment to a bold and ambitious future for NASA. Every initiative called for in the Act is funded, including: a robust program of space science and Earth science, including a commitment to invest in new satellites and programs of Earth observation; a strong aeronautics research program; the Space Launch System (SLS) heavy-lift launch vehicle and Multi-Purpose Crew Vehicle (MPCV) needed to support human spaceflight and exploration missions beyond Earth's orbit; a vigorous technology development program; extension of International Space Station (ISS) activities through at least 2020, coupled with a plan to use this orbiting outpost more effectively; and the development of private-sector capabilities to transport cargo and crew into low Earth orbit, thus shortening the duration of our reliance solely on Russian launch vehicles for access to the ISS.
Within the context of a difficult budget environment and the President's decision to freeze non-security discretionary spending at 2010 levels for five years, NASA's budget remains at $18.7 billion in the 2012 Budget. This budget level demands difficult choices, and those choices were made while keeping in mind the priorities of the Act as well as the collective desire of the Congress and the Administration to have a balanced program of science, research, technology development, safe spaceflight operations, and exploration. One such difficult choice was limiting the budget for the James Webb Space Telescope, keeping the project funded at $375 million in 2012, to assure NASA the opportunity to begin work on new scientific opportunities identified in the National Academies' most recent decadal survey in astronomy and astrophysics. Similarly, the 2012 Budget reduces the planned increases in Earth-science research outlined in the 2011 Budget. The Budget demonstrates the President's continued commitment to our shared priorities even when difficult decisions are required, providing $1.8 billion in FY2012 funding for the Space Launch System and $1.02 billion for the Multi-Purpose Crew Vehicle, thereby laying the critical foundation for these exploration programs. As NASA reported in January of this year, it is still in the process of shaping these efforts and will discuss them in more detail in a report to Congress this spring. Similarly, the Budget provides a solid foundation for the commercial crew and cargo transportation programs that are necessary to provide safe and cost-effective access to low Earth orbit, including sufficient support for the operations of the ISS.

### Plan forces spending trade-offs that crush effective Earth sciences --- risks catastrophic climate change

Haymet 7 (Tony, Director of the Scripps Institution of Oceanography – University of California, San Diego, Mark Abbott, Dean of the College of Oceanic and Atmospheric Science – Oregon State University, and Jim Luyten, Acting Director – Woods Hole Oceanographic Institution, “The Planet NASA Needs to Explore”, Washington Post, 5-10, [http://www.washingtonpost.com/wp-dyn/content/article/2007/05/09/AR2007050902451.html](http://www.lexis.com/research/retrieve))

Decades ago, a shift in NASA priorities sidelined progress in human space exploration. As momentum gathers to reinvigorate human space missions to the moon and Mars, we risk hurting ourselves, and Earth, in the long run. Our planet -- not the moon or Mars -- is under significant threat from the consequences of rapid climate change. Yet the changing NASA priorities will threaten exploration here at home.

NASA not only launches shuttles and builds space stations, it also builds and operates our nation's satellites that observe and monitor the Earth. These satellites collect crucial global data on winds, ice and oceans. They help us forecast hurricanes, track the loss of Arctic sea ice and the rise of sea levels, and understand and prepare for climate changes.

NASA's budget for science missions has declined 30 percent in the past six years, and that trend is expected to continue. As more dollars are reallocated to prepare for missions back to the moon and Mars, sophisticated new satellites to observe the Earth will be delayed, harming Earth sciences.

The National Academy of Sciences has noted that the Landsat satellite system, which takes important measurements of global vegetation, is in its fourth decade of operation and could fail without a clear plan for continuation. The same is true for the QuikSCAT satellite, which provides critical wind data used in forecasting hurricanes and El Niño effects.

In January, a partnership of university and NASA scientists demonstrated that climate change and higher ocean temperatures were reducing the growth of microscopic plants and animals at the heart of the marine food web.

Their analysis was based on nearly a decade of NASA satellite measurements of ocean color, which unfortunately are at risk of being interrupted for several years.

Sea levels are rising, and the Arctic Ocean may be ice-free in summer. The buildup of carbon dioxide in the oceans threatens to make them more acidic, which may in turn hinder the ability of some types of marine life, including corals, to build their shells and skeletons. We must learn as much as we can to assess these threats and develop solutions.

Satellites provide coverage of vast, remote regions of our planet that would otherwise remain unseen, especially the oceans, which play an important role in climate change. Without accurate data on such fundamentals as sea surface height, temperatures and biomass, as well as glacier heights and snowpack thickness, we will not be able to understand the likelihood of dangers such as more severe hurricanes along the Gulf Coast or more frequent forest fires in the Pacific Northwest.

### Climate change is the most critical problem the Earth has ever faced.

Government agencies and the private sector, as well as individual citizens, need to better grasp the risks and potential paths of global climate change. Mitigating these risks and preparing for the effects of warming will require scientific understanding of how our complex planet operates, how it is changing, and how that change will affect the environment and human society.

John F. Kennedy's brilliant call to put a man on the moon by the end of the 1960s set an arbitrary deadline, but the deadline we face today is set by nature. NASA must continue to play a vital role in helping find ways to protect our planet for (and perhaps from) its intelligent life. Exploration of space is a noble quest. But we can't afford to be so starry-eyed that we overlook our own planet.

### Ineffective NASA Earth sciences risk multiple threats of extinction

Killeen 5 (Timothy L., Director – National Center for Atmospheric Research, “NASA Earth Science”, CQ Congressional Testimony, 4-28, Lexis)

The first example is probably well known to you. The ozone "holes" in the Antarctic and Arctic were monitored from space by various NASA satellite systems, including the Total Ozone Mapping Spectrometer (TOMS). The diagnosis of the physical and chemical mechanisms responsible for these dangerous changes to our protective ozone shield was made possible by the combination of observations, modeling, and theory supported by NASA. In fact, it was a NASA high-altitude aircraft that made the "smoking gun" measurements that convinced the scientific and policy communities that chlorine compounds produced by various human activities were centrally responsible for the observed ozone loss. Following these observations, international protocols were put in place that are beginning to ameliorate the global-scale ozone loss. The TOMS instrument has provided an ongoing source of data that permits us to track the level of ozone in the stratosphere, the annual opening and closing of the "ozone hole," and how this phenomenon is changing over time. These continuing measurements and analyses and the effective regulatory response have led, among other things, to a reduction in projected deaths from skin cancer worldwide. Last week, President Bush mentioned proposed rules to limit air pollution from coalfired power plants. Air pollution is clearly an important concern. NASA has played a major role in the development of new technologies that can monitor the sources and circulation patterns of air pollution globally. It is another tremendous story of science serving society through innovation. In this case, through an international collaboration, NASA deployed a one-of-a-kind instrument designed to observe global carbon monoxide and its transport from the NASA Terra spacecraft. These animations show the first global observations of air pollution. Sources of carbon monoxide include industrial processes (see, for example, source regions in the Pacific Rim) and fires (for example in Amazonia). These global-scale data from space have helped change our understanding of the relationship between pollution and air quality - we now know that pollution is not solely or even primarily a local or regional problem. California's air quality is influenced by industrial activity in Asia, and Europe's air quality is influenced by activities here in America. From such pioneering work, operational systems can now be designed to observe pollution events, the global distribution of chemicals and particulate matter in the atmosphere, and the ways in which these substances interact and affect the ability of the atmosphere to sustain life - such a system will undoubtedly underpin future efforts to understand, monitor, and manage air quality globally. Without NASA's commitment to innovation in the Earth sciences, it is hard to believe that such an incredible new capability would be available today. The Promise of Earth Observations in the Next Decade The achievements of the last several decades have laid the foundation for an unprecedented era of discovery and innovation in Earth system science. Advances in observing technologies have been accompanied by vast improvements in computing and data processing. When the Earth Observing System satellites were being designed, processing and archiving the data was a central challenge. The Terra satellite produces about 194 gigabytes of raw data per day, which seemed a daunting prospect at the time of its definition. Now laptop memories are measured in gigabytes, students can work with remote sensing datasets on their laptops, and a large data center like NCAR increases our data holdings by about 1000 gigabytes per day. The next generation of high performance computing systems, which will be deployed during the next five years or so, will be petascale systems, meaning that they will be able to process millions of gigabytes of data. The ongoing revolution in information technology has provided us with capabilities we could hardly conceive of when the current generation of Earth observing satellites was being developed. We have just begun to take advantage of the synergies between these technological areas. The U.S., through NASA, is uniquely positioned to take advantage of this technological opportunity. Example 3: Weather Forecasting Weather forecasting in the Southern Hemisphere has been dramatically improved through NASA's contributions, and this experience illustrates the power of remote sensing for further global improvements in weather prediction. The lack of surface- based data in the Southern Hemisphere once meant that predictive skill lagged considerably behind that achieved in the Northern Hemisphere. The improvement in the accuracy of Southern Hemisphere weather forecasting is well documented and almost entirely due to the increased use of remote-sensing data. But improvements in the quality of satellite data were not sufficient. Improvements in data assimilation a family of techniques for integrating observational results into predictive models were also necessary. The combination has resulted in rapid improvement in Southern Hemisphere forecasting, which is now nearly equal to that in northern regions. Data assimilation capabilities continue to advance rapidly. One can now easily conceive of forecast systems that will fuse data from satellites, ground-based systems, databases, and models to provide predictions with unprecedented detail and accuracy - perhaps reaching natural limits of predictability. A new generation of weather forecast models with cloud-resolving spatial resolution is coming on line, and these models show significant promise for improving forecast skills across the board. Use of new NASA remote sensing data from upcoming missions such as Calipso (Cloud- Aerosol and Infrared Pathfinder Satellite) and CloudSat will be essential to fully validate and tune these new capabilities which will serve the nation in providing improved hurricane and severe storm prediction, and in the development of numerous decision support systems reliant on state-of-the-art numerical weather prediction capabilities. Example 4: Earth System Models Data from NASA missions are central to constructing more comprehensive and detailed models that will more realistically represent the complexity of the Earth system. Cloud observations from MODIS (the Moderate Resolution Imaging Spectroradiometer) and precipitation measurements from GPM (the Global Precipitation Mission), for example, are critical to improving the representation of clouds and the water cycle in such models. Observations from MODIS and Landsat are fundamental to the development of more sophisticated representation of marine and terrestrial ecosystems and atmosphere-land surface interactions. The inclusion of this detail will help in the creation of true Earth system models that will enable detailed investigation of the interactions of Earth system processes and multiple environmental stresses within physically consistent simulated systems. In general terms, Earth system observations represent the only means of validating Earth system model predictions. Our confidence in short-term, regional-scale weather predictions is based on how closely they match observed regional conditions. Assessing the performance of global-scale, longer-term model predictions likewise depends on comparing model results with observational records. Scientific confidence in the ability of general circulation models to represent Earth's climate has been greatly enhanced by comparing model results for the last century with the observational records from that period. At the same time, the sparse and uneven nature of past observational records is an ongoing source of uncertainty in the evaluation of model results. The existence of much more comprehensive and consistent global measurements from space such as the data from the NASA Terra, Aqua, and Aura satellites is a giant step forward in this regard, and, if maintained, will enable much more rigorous evaluation of model performance in the future. In summary, Earth system models, with increasing temporal and spatial resolutions and validated predictive capabilities, will be used by industry and governmental decision makers across a host of domains into the foreseeable future. This knowledge base will drive new economies and efficiencies within our society. I believe that requirements flowing from the needs and capabilities of sophisticated Earth system models will be very useful for NASA in developing strategic roadmaps for future missions. C. The Importance of Careful Planning The central role of NASA in supporting Earth system science, the demonstrated success and impact of previous and current NASA missions, and the promise of continued advances in scientific understanding and societal benefits all argue for a careful, analytical approach to major modifications in the NASA Earth science program. As noted above, the development of space systems is a time-consuming and difficult process. Today's actions and plans will have long-term consequences for our nation's capabilities in this area. The link between plans and actions is one of the most important points I want to address today. From the outside, the interagency planning process seems to be experiencing substantial difficulties in maintaining this link. The NASA Earth science program is part of two major Presidential initiatives, the Climate Change Science Program (CCSP) and the Global Earth Observation System of Systems (GEOSS). With regard to the CCSP, it is not apparent that the strategies and plans developed through the interagency process are having much impact on NASA decision-making. In January 2004, then- Administrator of NASA, Sean O'Keefe, called for acceleration of the NASA Glory mission because of the direct relevance of the mission to understanding the roles of aerosols in the climate system, which is one of the highest-priority science questions defined in the CCSP research strategy. NASA is now proposing cancellation of the mission. As I have emphasized throughout this testimony, the progress of and benefits from Earth system science research are contingent upon close coordination between research, modeling, and observations. The close coordination of program planning among the agencies that support these activities is also a necessity. This coordination currently appears to be fragile. The effect of significant redirections in NASA and reduction in NASA's Earth science effort are equally worrisome in the case of the Administration's GEOSS initiative, which is focused on improving the international coordination of environmental observing systems. Both NASA and NOAA satellite programs are vital to this effort. The science community is very supportive of the GEOSS concept and goals. There are over 100 space-based remote-sensing systems that are either operating or planned by various nations for the next decade. Collaboration among space systems, between space- and ground-based systems, and between suppliers and users of observational data is critical to avoiding duplication of effort and to getting the most out of the investments in observing technology. The tragic example of the Indian Ocean Tsunami demonstrates the need for such coordination. The tsunami was detected and observed before hitting land, but the absence of effective communication links prevented warnings from reaching those who needed them in time. A functioning GEOSS could lead to major improvements in the rapid availability of data and warnings, and the U.S. is right to make development of such a system a priority. But U.S. credibility and leadership of this initiative will be called into question if our nation is unable or unwilling to coordinate and maintain the U.S. programs that make up the core of our proposed contribution. D. Answers to Questions Posed by the Committee My testimony to this point has outlined my views on a series of key issues for the NASA Earth science program. Much of the text found above is relevant to consideration of the specific questions posed by the Committee in its letter of invitation. In this section, I provide more direct answers to these questions to the extent possible and appropriate. How should NASA prioritize currently planned and future missions? What criteria should NASA use in doing so? I believe that NASA should work with the scientific and technical community and its partner agencies to define a NASA Earth science plan that is fully compatible with the overall CCSP and GEOSS science strategies. In my view, the interaction with the scientific and technical community should include both input from and review by the National Research Council (NRC) and direct interaction with the strong national community of Earth science investigators and the aerospace industry who are very familiar with NASA capabilities and developing technological opportunities. Competitive peer review processes should be used appropriately in assessing the merit of competing approaches and in key decision- making. I believe NASA should also find a means of involving users and potential users of NASA-generated data in this process, perhaps through public comment periods or a series of workshops. Sufficient time should be allotted to this process for a careful and deliberative evaluation of options. This science plan should then guide the process of setting mission priorities. Defining criteria to use in comparing and deciding upon potential missions would be an important part of this planning exercise. I would recommend consideration of a set of criteria that include: -- compatibility with science priorities in the CCSP and GEOSS science plans -- potential scientific return from mission -- technological risk -- direct and indirect societal benefits -- cost. I believe that the decadal planning activity underway at the NRC in response to a request from NASA and NOAA is a valuable step in this process. What are the highest priority unaddressed or unanswered questions in Earth science observations from space? I believe this question is most appropriately addressed through the community process suggested above. There are many important Earth science questions, and prioritizing among them is best done in a deliberative and transparent process that involves extensive input from and discussion by the science community. I would personally cite soil moisture, three-dimensional cloud characteristics, global vector tropospheric winds, pollutant characteristics and transport, carbon fluxes, and aerosol distributions as all high priority measurements to make on a global scale. What have been the most important contributions to society that have come from NASA Earth sciences over the last decade (or two)? NASA Earth science programs have played a key role in developing our understanding of the Earth as a coupled system of inter- related parts, and in the identification and documentation of a series of global-scale changes in the Earth's environment, including ozone depletion, land use and land cover change, loss of biodiversity, and climate change. Other examples of societal contributions include improved weather forecasting, improved understanding of the large-scale climate variations, such as the El Nino- Southern Oscillation and the North Atlantic Oscillation that alter seasonal patterns of rainfall, and improved understanding of the status of and changes in marine and terrestrial ecosystems that contributes to more effective management of natural resources. What future benefits to the nation (societal applications) are possible that NASA Earth sciences could provide? What gaps in our knowledge must we fill before those future benefits are possible? In a broad sense, NASA Earth science activities are part of developing a global Earth information system that can provide ongoing and accurate information about the status of and changes in the atmosphere, oceans, and marine and terrestrial ecosystems that sustain life, including the impact of human activities. The continued development of observation systems, sophisticated Earth system models, data assimilation methods, and information technologies holds the promise of much improved predictions of weather and climate variations and much more effective prediction and warning of natural hazards. Much has already been accomplished to lay the groundwork for such a system, but many important questions remain. Some of the most important have to do with the functioning and human alteration of the Earth's carbon, nitrogen, and water cycles, and how these cycles interact; the regional manifestation of global scale climate change; and the reactions of ecosystems to simultaneous multiple stresses.

## Earth Science DA – Uniqueness – Yes Funding

### Earth science programs are growing because of strong funding

Morrissey 11 (Susan R., Assistant Managing Editor – CEN, “NASA: Funding Is Flat, But Earth Science Programs Grow”, Chemical & Engineering News, 2-28, [http://pubs.acs.org/cen/coverstory/89/8909cover7.html](http://posey.house.gov/UploadedFiles/NASAAppropsLetter-Feb2011.pdf))

The President’s 2012 request holds the National Aeronautics & Space Administration’s budget flat at $18.7 billion. The agency is not reporting budget breakdowns for 2011. Instead, gains and losses are being measured against the 2010 budget.

The request provides continued support for the International Space Station (ISS), setting its 2012 budget at $2.8 billion, a 22.8% increase from 2010. The support would allow expanded use of the station’s research capabilities. The request also outlines a plan for research oversight by a nonprofit organization.

Earth science programs would also see growth—increasing 24.9% from 2010 to $1.8 billion in 2012. This boost would enable continued development of Earth-observing satellites such as the Orbiting Carbon Observatory-2, which would provide information about the planet’s carbon cycle, and the Ice, Cloud & Land Elevation Satellite-2, which is an orbiting laser altimeter.

### Support for Earth sciences is strong

Werner 10 (Debra, Staff Writer – Space News, “NASA Ramping Up in Earth Observation”, Space News, 12-28, [http://www.space.com/10555-nasa-ramping-earth-observation.html](http://blog.al.com/breaking/2011/02/congress_will_cut_defense_cong.html))

Strong support from the White House and U.S. Congress will allow NASA to lay the groundwork for a vigorous and extensive Earth science program that includes 16 major missions scheduled for launch between 2011 and 2021, an agency official said.

"What a difference a year makes," Michael Freilich, director of NASA's Earth Science Division, said this month at a meeting of the American Geophysical Union here. "Last year things were a little bit dicey. This year we are moving forward rather dramatically."

In contrast to late 2009 when NASA's Earth Science Division faced growing demands in spite of constrained [funding](http://www.washingtonpost.com/wp-dyn/content/article/2007/05/21/AR2007052101466.html), the current five-year spending plan provides the division with [an additional $2.4 billion](http://www.geoffreylandis.com/Footsteps%20.pdf) over the previous budget blueprint, Freilich said. If approved by Congress, that money will allow NASA "to go from flying one mission every couple of years to flying a couple of missions per year," he said.

### Funding is sufficient to sustain environmental monitoring programs

Werner 10 (Debra, Staff Writer – Space News, “NASA Ramping Up in Earth Observation”, Space News, 12-28, [http://www.space.com/10555-nasa-ramping-earth-observation.html](http://www.lexis.com/research/retrieve))

Increased funding for Earth sciences also is allowing NASA to expand its Venture-class program, which [funds](http://www.floridatoday.com/%20article/20110605/NEWS01/110604013/Telescope-debacle-devours-NASA-funds) targeted, principal investigator-led science initiatives. In 2011, NASA plans to solicit Venture-class proposals for new space-based instruments as well as unique small-satellite projects, Freilich said.

The solicitation for new instruments will offer principal investigator-led teams approximately $65 million to $95 million for a five-year program to develop new scientific instruments. "We will be doing this solicitation every single year between now and time immemorial," Freilich said. "This will put us in a position where we always have instruments under development. That will allow us to respond to partnership opportunities in a more nimble way."

The small satellite solicitation, scheduled to be issued first in 2011 and every four years after that, will seek proposals for Earth science missions that can be developed in five years at a cost of approximately $150 million, Freilich said. The Earth Science Division also plans to solicit proposals for suborbital Venture-class missions in 2013, he added.

"The Venture-class program has expanded," Freilich said. "It is a key part of our program and I pledge to keep those regular opportunities available."

NASA's Earth science program also is expanding its emphasis on providing long-term climate data records. "The administration for the first time gave NASA the mandate to examine how we might contribute to [climate continuity](http://www.spaceref.com/news/viewsr.html)," Freilich said. As a result, NASA plans to mount the third-generation Stratospheric Aerosol and Gas Experiment on the international space station in 2014, he said. That instrument, which has been stored at NASA's Langley Research Center in Hampton, Va., since 2004, is designed to measure ozone, aerosols and water vapor.

### Earth science funding is strong --- new budget

Mikulski 11 (Barbara, Senator – D-MD, “NASA FY2011 Budget”, Federal News Service, 4-22, Lexis)

SEN. MIKULSKI: I know Judiciary Committee is meeting.
Well, we're going to be welcoming Administrator Bolden, of course, our colleague Senator Hatch, and then Mr. John Frost, a member of the NASA Aerospace Safety Advisory Panel, who will be speaking to the committee to ensure that no matter what we decide, we ensure the safety of the astronauts.
The 2011 NASA budget is $19 billion, $276 million more than 2010. The top highlight of this new budget includes major investments in science -- $5 billion in 2011. This is an especially heartened plus- up in Earth science. We'll be talking about that in a minute.
The other that we think is quite heartening is extending the life of the international space station to continue its operation through 2020 and possibly beyond, meaning better value for our dollar and better value for our astronauts' efforts. We have spent a lot of time building the space station; now we've got to spend our time using the space station.
I's time to retire the space shuttle, and the president provides for that at the end of calendar year 2010. Only three more flights to go after 30 years of exceptional and honorable service.
The president's budget also increases funding for aeronautic research, $72 million above 2010, a must-do to keep America competitive.
There are extremely dramatic changes to the Constellation program, and that will be a subject, I know, of a great deal of focus. And in the area of the Constellation program, we want to be sure and clarify, is the president talking about canceling the Constellation program or restructuring the Constellation program? It will be a major source of, I know, the deep-Earth probe from this committee.
I just want to come back to the science budget, which I think, while we're going to focus a lot on Constellation, we must focus on the other aspects of NASA. There is this strong emphasis on Earth science and the budget also includes $1.5 billion for planetary science, for research on asteroids, Mars, Saturn, beyond, all what we need to do in order to get ready to go there.

### Funding is sufficient to enable effective remote sensing and spur private sector developments

Bolden 11 (Charles, Administrator – NASA, “NASA FY2011 Budget”, Federal News Service, 4-22, Lexis)

All of us at NASA appreciate the president making NASA such a high priority at a time when budget realities dictate reductions and freezes for other worthwhile programs.
As we celebrate the 40th anniversary of Earth Day today, I want to note that the proposed budget supports an enhanced, robust program of Earth science research and observation. Earth observation from space produces the critical data sets we need to understand our changing planet.
At the same time, we will continue our robust efforts to observe the rest of the universe through missions like the Hubble telescope and the Solar Dynamics Observatory, for which we released its first stunning images from the sun yesterday.
With the president's new vision, the NASA budget will invest much more heavily on technology, research and development than recent NASA budgets. This will foster new technological approaches, standards and capabilities that are critical to enable next-generation space flight, Earth sensing and aeronautics capabilities. These investments will produce additional opportunities for U.S. industry and spur new businesses such as a recently announced partnership between NASA and General Motors to build an advanced dexterous humanoid robot, R2.

### Key Earth science missions are being adequately funded

Bolden 11 (Charles, Administrator – NASA, “Fiscal 2011 Appropriations”, CQ Congressional Testimony, 3-23, Lexis)

The FY 2011 budget request for Science includes $1,801.7 million for Earth Science. This request increases investment in Earth Science by $1.8 billion from FY 2011 to FY 2014 compared to the FY 2010 budget, for a more aggressive response to the challenge of climate change. NASA will rapidly develop an Orbiting Carbon Observatory-2 mission for launch early in 2013 and a GRACE Follow- On mission for launch in late 2015, respectively, to initiate and extend key global climate data sets. This request accelerates several high-priority Decadal Survey missions that will advance climate research and monitoring.

## Earth Science DA – Uniqueness – Yes Funding – A2: James Webb

### Webb won’t affect other programs

Wired 10 (“Exclusive: NASA’s Plan to Save Astrophysics From Space Telescope’s Budget Overruns”, 11-23, [http://www.wired.com/wiredscience/2010/11/james-webb-overruns/](http://www.gwu.edu/~spi/assets/docs/Socio-EconomicBenefitsFinalREPORT2.pdf))

“It does sound like JWST is going to have to solve its own problems within its own budget,” he said. Where the money will actually come from is still unclear. If the NASA science divisions remain untouched, the James Webb team will probably need to ask Congress for more money, which, in the current financial climate, it is unlikely to receive. Alternatively, the telescope could limp along on its current $400 million per-year budget. Trying to finish the telescope using only the current budget will mean the launch would be pushed even further back, which will mean more budget increases. “They’ll have to spend more, and the launch will be delayed, as usual,” Boss said. “The total cost will go up. But at least they won’t have to add any more money per year to it.” The other option is to cancel James Webb entirely, says Alan Stern, a planetary scientist at the Southwest Research Institute and a former associate administrator in charge of the NASA Science Mission Directorate. “If you kill the project, guaranteed, people across the country will learn that they’d better not put the agency in such a position,” he said. “I think it’s an option for serious consideration. It doesn’t slaughter the innocent to reward the guilty, and it opens up a lot of new funding for astrophysics projects in this decade.” Although others in the astronomical community are frustrated with the cost overruns, an overgrown JWST that leeches funds from the rest of astronomy is better than no JWST at all. “Canceling it would be disastrous for astronomy,” said Elmegreen, who served on the decadal survey committee. The entire astronomy program for the next decade was designed with James Webb in mind, she pointed out. Several planned survey telescopes, including WFIRST and the Large Synoptic Survey Telescope, were designed to work in conjunction with the JWST. “The bottom of our program drops out without Webb,” she said. “I think it’s worse to abandon it at this point.” At a staff meeting at NASA’s Marshall Spaceflight Center, NASA Administrator Charlie Bolden said the agency has no plans to cancel the telescope. “My personal feeling, it is incredibly important, not just to the astrophysics community, but to the world, that we make JWST successful,” he said. “So while everything’s on the table, you know, the cancellation of JWST is not something that’s sitting in my head.” “We will very likely have to find the money inside NASA, but that has not been determined yet,” he added. “We haven’t asked anybody for additional money.” There is precedent for sequestering space telescopes that run over budget into a new NASA division: The same exact thing happened with Hubble. “Nobody now doubts the value of Hubble,” said Matt Mountain, director of the Space Telescope Science Institute, which is responsible for the research done with Hubble and ultimately with JWST.

## Earth Science DA – Uniqueness – Yes Earth Science Focus

### NASA is focusing on Earth science and de-emphasizing exploration

Wakeman 11 (Nick, Editor-in-Chief of Washington Technology – FCW, “NASA Shifts Funds to New Priorities”, Federal Computer Week, 6-8, [http://fcw.com/articles/2011/06/08/nasa-budget-priorities-shift.aspx](http://www.washingtonpost.com/wp-dyn/content/article/2007/05/09/AR2007050902451.html))

As budgets tighten and priorities shift, NASA is cutting $1 billion from its pace operations budget, but spending more on other science and technology areas that will reshape the agency's mission, a new study shows.
“As NASA shifts priorities for human spaceflight from shuttle operations to human exploration capabilities and commercial spaceflight, the budget will be redirected to a range of technology development programs,” said Steve Bochinger, president of Euroconsult North America.
The firm and its partner Omnis Inc. have released a new study, NASA Spending Outlook: Trends to 2016, which analyzes NASA’s budget.
As space operations shrink, the science budget will be redistributed among NASA centers, Bochinger said.
Among the findings:

The Science Mission Directorate saw an 11 percent bump in 2011 and will have a $5 billion through 2016. Goddard Space Flight Center and Langley Research Center will benefit because of the work on Earth science projects.

The Exploration Systems Mission Directorate will hold steady at about $3.9 billion but funds will shift away from human exploration activities.

The new Space Technology Directorate will get $1 billion a year from 2012 to 2016. Langley, Glenn and Ames research centers will benefit because of their work on new technologies for exploration and robotic spaceflight.

NASA is restructuring the Aeronautics Research Mission Directorate to focus on fundamental aeronautics and development of technologies for the Next Generation Air Transportation System.

The study also predicts that NASA’s business practices will have to change with a shift from cost-plus contracting to more fixed-price contracting.

### Spending on exploration is down --- NASA is redirecting money to Earth science

Space Travel 11 (“NASA Spending Shift to Benefit Centers Focused on Science and Technology”, 6-8, http://ww w.space-travel.com/reports/NASA\_Spending\_Shift\_to\_Benefit\_Centers\_Focused\_on\_Science\_and\_Technology\_9 99.htm)

Euroconsult along with the consulting firm Omnis have announced the findings of a study foreseeing a significant shift in NASA spending toward Earth science and R and D programs and away from legacy spaceflight activities. According to the report "NASA Spending Outlook: Trends to 2016," NASA's budget, which will remain flat at around $18.7 billion for the next five years, will also be characterized by significant shifts from space operations to technology development and science. With the shift in budget authority, NASA Centers focused on Earth observation, space technology, and aeronautics will see increases in funding, while those involved in human spaceflight will see major funding reductions. Indeed, the termination of the Space Shuttle program will lead to a budget cut over $1 billion for Space Operations, resulting in a 21% budget cut for the Johnson Space Center. Overall, the agency's budget for R and D will account for about 50% of all NASA spending. "Budget allocation across Centers will vary greatly," said Steve Bochinger, President of Euroconsult North America. "As NASA shifts priorities for human spaceflight from Shuttle operations to Human Exploration Capabilities and commercial spaceflight, the budget will be redirected to a range of technology development programs. Likewise, as NASA shifts its science mission focus away from space science to Earth science, the science budget will be redistributed among centers." This shift in NASA's priorities will also affect the agency's contract spending. As large legacy programs end, new research and development programs will be initiated. This turnover of programs should provide many new contracting opportunities over the next five years, especially at Research Centers. The Euroconsult/Omnis report details these changes. "The uniqueness of this report is that it brings together in one picture NASA's budget, spending and contracting, providing insights into opportunities created by the new NASA direction," said Bretton Alexander, Senior Consultant for Omnis.

## Earth Science DA – Link – General Trade-Off

### NASA funding is zero-sum --- exploration robs funds from Earth science

Robinson 8 (Michael, Professor of History – Hillyer College, “Before We Send a Man to Mars We Should Remember the Wasted Efforts Spent Finding the North Pole”, History News Network, 7-7, [http://hnn.us/node/5138 6](http://www.nytimes.com/cwire/2011/05/04/04climatewire-climate-satellite-programs-scarred-in-budget-76532.html))

But Wellman’s story is worth taking seriously, especially as the United States gears up to replace the aging shuttle fleet. NASA’s course, like Wellman’s, has been shaped by tragic events. The destruction of Challenger in 1986 and Columbia in 2003 brought about much soul searching, and strengthened the agency’s commitment to safety. Yet NASA has focused most of its attention on improving the methods of exploration, rather than assessing its merits. Like Wellman, they have chosen to honor their fallen comrades by focusing on the construction of better machines, not the development of better missions. Consider President Bush’s 2004 speech “A Renewed Spirit of Discovery,” in which he lays out his vision for the U.S. space program. The document runs a little over 1400 words. Boiled down, it says this: send Americans back into space, first to the moon, then Mars. NASA now proceeds accordingly, gearing up, as Americans did a century ago, to send very brave people to very distant places.

But space exploration is a zero-sum game. Sending astronauts to Mars (a planet now studied quite efficiently by rovers, orbiters, and, as of late May, the Phoenix Lander) requires an enormous investment that will come at the expense of smaller, more useful, scientific projects. Already NASA plans to cut millions of dollars from the space science budget over the next five years. The savings will help cover a portion of the staggering costs of the “Constellation Program,” an initiative to design and produce a new generation of launch vehicles (Ares) and crew exploration vehicles (Orion).

### Exploration missions are massively expensive --- forces internal trade-offs with Earth science

NAST 8 (NASA Aeronautics Support Team (Non-Profit Organization of Community Leaders, Business Leaders, and Former NASA Officials), “NASA’s Role in the 21st Century”, Fall, http://nastus.org/documents/NASARole.21st Century.pdf)

The budget needs of the Human Space Flight program (shuttle support, ISS development and assembly and now CEV/Orion) have forced significant reductions in the budgets of its other missions. Aeronautics in particular has been hollowed out (it historically has comprised about 10% of NASA’s budget, but has been slashed by almost 70%, to 3% of the agency’s annual outlay), while the space and Earth science areas are just now also experiencing some of that same budget pain. The economic challenges faced by the US in the 21st century include the rapid development of innovation-driven economies in Europe and Asia, and the restructuring of our energy supply driven by the convergence of peak oil and climate change. Given the right grand challenges and sufficient funding, NASA can help the US maintain its global preeminence by providing the investor/early adopter role in the key technologies that will shape the development of civilization in the coming decades. In that context, our proposed set of grand challenges for NASA is:

1) Intelligent, robotic exploration of the solar system and universe.

2) Monitoring and predicting climate change and the impact of mitigation strategies.

3) Stimulating the reinvention of the US air transportation system into an environmentally friendly, safe and energy efficient system.

4) Development of the replacement for the Space Shuttle and continuation of human space exploration.

*1) Intelligent, robotic exploration of the solar system and universe*

There is still the spirit of exploration in much of what NASA does today, no more so than the programs that produce the robotic explorers of the universe. While no one disputes that exploration and discovery in our universe and beyond must remain a key part of NASA, it is a very real question as to how best to achieve the maximum amount of exploration/discovery given real budget, technology and time constraints. Given that human space exploration is massively expensive, one should ask the obvious question, “Should NASA’s continued exploration of the Moon, Mars, and other worlds involve just a handful of humans (astronauts), or should this exploration program be restructured so that it will provide the opportunity for all humans to explore?” Robotic explorers will increasingly provide, through the technologies of machine intelligence,8 virtual reality, and high bandwidth communication, a near-real-time space exploration experience to all citizens, making everyone a virtual astronaut instead of a privileged few. Further, not requiring the development and fielding of future exploration systems that protect humans from the harsh environment of space will radically reduce the cost and time required to explore other worlds. With current projections showing that machine intelligence will begin to rival human intelligence by the beginning of the third decade of this century, the argument that human intelligence is required as the primary emphasis in space exploration is greatly diminished.

### Cost overruns will cause funding raids on Earth science accounts --- devastates the program

Chyba 11 (Christopher, Professor of Astrophysical Sciences and International Affairs – Princeton University, “Hearing on Contribution of Space to National Imperatives”, Space Ref, 5-19, [http://www.spaceref.com/news/viewsr.html?pid=37102](http://www.lexis.com/research/retrieve?pid=37102))

Second, the report insists on scientific integrity. Each option presented for consideration was examined for its impact on science, and all else being equal options that did a better job furthering science were rated more highly. But human spaceflight should not be justified with exaggerated claims about its scientific payoff. Exploration with astronauts can have significant scientific benefits in several areas beyond the tautological justification of studying what happens to humans in space. As was emphasized by scientists' testimony to the committee, astronauts have a tremendous advantage over robot spacecraft when it comes to field geology in particular. The ability to pick up a rock, turn it over, expose a fresh surface with a hammer and then use geological expertise to decide whether to move on or instead to "dig in" and examine the current site in detail is a human capability that far exceeds anything robot rovers can currently do. In a similar way, the ability to service and repair space[observatories](http://www.spacenews.com/civil/nasa-budget-frozen-presidents-request.html?pid=37102) that face unanticipated problems favors the astronaut over the robot.
But astronauts are also far more expensive than robot spacecraft or rovers, and have their greatest advantage in the most complex environments and circumstances. Mars is the most complicated surface environment we will face in the foreseeable future, so it is where astronauts will provide the greatest advantage. But it will be decades before humans walk on that world--if we are lucky--and for most other science in space, humans often get in the way.
Moreover, if NASA's [space science](http://hnn.us/node/51386?pid=37102) budget is not protected, it could be raided to fund cost overruns in the human program. Human spaceflight, if it is to be justified and sustained, needs to be aligned with national priorities. Were key space-based research to be cut to fund human spaceflight, human spaceflight would be put into opposition with those priorities. This would serve neither science nor the future of human spaceflight well.

### Overall NASA budget is extremely tight --- new exploration missions trade-off with Earth science

NAST 8 (NASA Aeronautics Support Team (Non-Profit Organization of Community Leaders, Business Leaders, and Former NASA Officials), “NASA’s Role in the 21st Century”, Fall, http://nastus.org/documents/NASARole.21st Century.pdf)

From its humble beginning as NACA in 1915 to its glorious period of moon landings, to its post cold-war doldrums, the agency has had one singular calling card, innovation in aerospace contributing to the economic and military superiority for the United States. In recent years, a new exploration vision has been launched, but it requires little innovation, and the science missions that have generated the most new knowledge and innovation within NASA have declined due to budget cuts. In the process the internal capacity of the agency to innovate has seriously eroded. It is time to reawaken NASA’s spirit of innovation in aerospace before it is no longer possible. In so doing, NASA will once again become a vital contributor to our national capacity to innovate, the only sure way to maintain our global economic and military leadership in a world economy rapidly evolving into innovation and knowledge driven economy. The reawakening of NASA’s spirit and capacity to innovate will involve a major reinvention and reconstitution of the Agency. A major challenge that must be faced in such a reinvention is commitment of the bulk of the Agency’s budget to replacement of the Space Shuttle through the Constellation program, so as to be able to guarantee nearterm full utilization of the International Space Station for meaningful scientific research. Current plans also call for a lunar landing by the end of the next decade (c. 2020). It is clear that the next President will review the strategic value and operational challenges to make that objective the next critical milestone beyond the Shuttle’s retirement. Whether the next Administration decides to continue on the current path of the moon first and then on to Mars for human exploration, it is critical that this mission plan not come at the expense of NASA’s other historical and continually relevant missions in space science, Earth science, and aeronautics, which form the core of NASA knowledge creation and innovation. As a result, the next evolution of space policy should carefully assess how these multiple missions can progress so that NASA’s core missions are not compromised by the evolution of the Agency’s human exploration objectives1.

### Exploration siphons-off funds from climate modeling --- its zero-sum

Chameides 9 (Bill, Dean and Nicholas Professor of the Environment – Duke University, “Is NASA Spacing Out?”, The Green Grok, 7-20, [http://www.nicholas.duke.edu/thegreengrok/moonwalk](http://www.cato.org/pub_display.php))

*Do Manned Space Expeditions Make Sense?*

Now there’s a plan afoot to again send humans where only [12 men](http://global-warning.org/main/satellites/) have boldly gone before. The new [mission](http://www.wired.com/wiredscience/2010/11/james-webb-overruns/) would first send people to the Moon for weeks and weeks at a time, and graduate to a manned mission to Mars.

Cool, just like landing men on the moon was cool back in the ‘60s and ‘70s, even to a long-haired college student crisscrossing Europe. But I have to ask, given today’s budget crunch and the advancements in robotics, is cool enough of a reason to send humans to the moon and beyond?

Don’t get me wrong; learning about the planets and stars, [dark matter](http://www.nytimes.com/cwire/2011/05/04/04climatewire-climate-satellite-programs-scarred-in-budget-76532.html) and [dark forces](http://www.space.com/10555-nasa-ramping-earth-observation.html?id=909) is one of humanity’s greatest intellectual endeavors. Not only should we fix our gaze on space; we must. But manned missions are not the only way to learn about our world. Virtually all of the aforementioned information about the Earth was obtained using unmanned space-borne platforms. And unmanned missions to the planets have provided us with a wealth of information (at a fraction of the [cost](http://www.spaceref.com/news/viewsr.html)) — for example we've been able to do detailed, [complex analyses](http://www.wired.com/wiredscience/2010/11/james-webb-overruns/) of soil from Mars without the benefit of a human hand.

Deciding what NASA does with its funds has always been somewhat of a zero sum game. Doing more of one thing generally means doing less of another. And there's a clear trade-off between high-visibility, manned, space exploration and unmanned missions that are able to bring home the scientific bacon without all the hoopla.

Already grumbles from my colleagues at NASA indicate that the push to prepare for a Mars mission is siphoning off funds from already [beleaguered](http://www.21stcenturysciencetech.com/Articles_2011/Obama_Kill_Space.pdf) Earth-observing programs. Given all the issues we face right here at home (did anyone say climate change?), this doesn't make sense.

## Earth Science DA – Link – Political Backlash

### Funding exploration creates a *political opportunity* to defund Earth sciences --- Congress will cut the program to keep overall budgeting level

Space Politics 11 (“Human Spaceflight versus Earth Sciences?”, 2-9, [http://www.spacepolitics.com/2011/02/09/human-spaceflight-versus-earth-sciences/](http://www.space.com/10555-nasa-ramping-earth-observation.html))

A letter signed by several members of Congress is the latest evidence that a new battle line is forming over NASA funding: human spaceflight versus Earth sciences. In [a letter to House Appropriations committee chairman Rep. Hal Rogers and CJS subcommittee chairman Frank Wolf](http://spacenews.com/commentaries/110418-cuts-environmental-intelligence-risk.html), six Republican members of Congress asked the appropriators to prioritize NASA funding on what they consider to be the agency’s primary mission, human spaceflight. To do that, they argue that funding for NASA’s climate change research be redirected to human spaceflight accounts. “With your help, we can reorient NASA’s mission back toward human spaceflight by reducing funding for climate change research and reallocating those funds to NASA’s human spaceflight accounts, all while moving overall discretionary spending towards FY2008 levels,” the letter’s authors—Reps. Bill Posey (R-FL), Pete Olson (R-TX), Rob Bishop (R-UT), Jason Chaffetz (R-UT), Sandy Adams (R-FL), and Mo Brooks (R-AL)—argue.

There are a number of issues with the letter. They claim that NASA spent “over a billion dollars” on “studying global warming/climate change” in FY2010. The agency got about $1.4 billion for all Earth sciences research in FY10, [according to agency budget documents](http://www.nicholas.duke.edu/thegreengrok/satellitenetwork). There’s no breakout for how much of that went specifically to climate change research, though. The letter also claims that the “lion share” of NASA’s share of stimulus funding went to climate change studies. In fact, only about a third of the agency’s stimulus funding, $325 million, [went to Earth sciences programs](http://www.spacenews.com/civil/101228-nasa-ramping-earth-obs.html?agency_code=80&progplanid=7540), to accelerate development of Earth science spacecraft. Human spaceflight got even more:[$400 million](http://www.recovery.gov/Transparency/agency/reporting/agency_reporting5program.aspx?agency_code=80&progplanid=7541), including $50 million for the CCDev program. And their claim that NASA’s core mission is human spaceflight is not supported by other documents, ranging from the [National Aeronautics and Space Act](http://www.llewellyn.com/bookstore/article.php) from 1958 to the latest [NASA authorization act](http://www.nicholas.duke.edu/thegreengrok/moonwalk), which declared that NASA “is and should remain a multi-mission agency with a balanced and robust set of core missions in science, aeronautics, and human space flight and exploration” and that “NASA plays a critical role through its ability to provide data on solar output, sea level rise, atmospheric and ocean temperature, ozone depletion, air pollution, and observation of human and environment relationships”.

A bigger issue, though, is that this letter may be indicative of a bigger battle some in Congress want to wage between human spaceflight and Earth science. Some members have openly expressed their skepticism about the validity of climate change research, questioning either the existence of global warming or the role of human activities in causing climate change. The letter to appropriators makes no judgment on the quality of validity of such research, only NASA’s role in supporting it, but some might see that unspoken argument there. For example, one of the letter’s signers, Rep. Brooks, said last week in regards to NASA funding that [there would be “hearings soon on global warming” by the House science committee](http://www.livescience.com/environment/top10-crazy-environ-ideas.html) without going into more details. An attack on Earth sciences funding to support human spaceflight could create or reinvigorate opponents of human spaceflight programs, reminiscent of previous debates between human spaceflight and robotic space exploration advocates—a battle that the agency presumably would want to avoid.

## Earth Science DA – Link – Asteroid Detection

### Asteroid surveys steal funds from other NASA programs

National Academies 9 (“Near-Earth Object Surveys and Hazard Mitigation Strategies: Interim Report”, http://www.nap.edu/catalog.php?record\_id=12738]

Currently, the U.S. government spends a relatively small amount of money funding a search and survey program to discover and track near-Earth objects, and virtually no money on studying methods of mitigating the hazards posed by such objects.3 Although Congress has mandated that NASA conduct this survey program and has established goals for the program, neither Congress nor the administration has sought to fund it with new appropriations. As a result, NASA has supported this activity by taking funds from other programs, while still leaving a substantial gap between the goals established by Congress and the funds needed to achieve them.

### Asteroid programs trade-off within the budget

Johnston 9 (Casey, Associate Writer – Ars Technica and B.S. in Applied Physics – Columbia University, “NASA Asteroid-Tracking Programs Stalled Due to Lack of Funds”, August, [http://arstechnica.com/science/news/2009/08/nasa-asteroid-tracking-program-stalled-due-to-lack-of-funds.ars](http://www.space.com/10555-nasa-ramping-earth-observation.html))

The risk of an asteroid rending civilization into bits is a favorite scenario in disaster movies, but it has been none too popular with the United States government. Eleven years ago, Congress tasked NASA with detecting, tracking, and classifying large asteroids and comets that pose a threat to Earth; these are generically termed near earth objects, or NEOs. Since then, save for a small grant, NASA has funded the project on its own. Now Congress has created new goals for the program and requested that they be achieved by 2020. The National Research Committee has put out an interim report on the NEO project, and it indicates that very little progress has been made since 2005, primarily due to a lack of funding. Congress kicked off the NEO-tracking project in 1998, requiring that NASA's equipment be able to locate and identify at least 90 percent of all NEOs one kilometer in diameter or larger. Congress selected this size as the lower bound because it is the smallest size that might be globally catastrophic if it ran into Earth. To guarantee a catastrophe, an asteroid would have to be even larger, perhaps 1.5 to 2 kilometers. On impact, an asteroid of this size would create a fireball the size of a continent and a crater fifteen times the asteroid's diameter; if it hits the ocean, there would be an enormous tsunami. Congress awarded NASA a $1.6 million grant in 1999 to put towards the NEO discovery program. Unfortunately, this was the only funding Congress gave to NASA to pursue this goal; nonetheless, NASA continued the project on its own, and has since successfully achieved the objective of a 90 percent track rate for 1km NEOs. The problem now, the NRC report asserts, is that we shouldn't be satisfied with this. What NASA has accomplished so far will largely enable us to at least attempt to prevent any impacts that would ultimately cause the majority of humans that survive the initial blow to die of starvation. However, asteroids smaller than 1km in diameter are not sufficiently less disastrous than their larger counterparts that we can happily ignore them. For example, the NRC report states that the body that caused the 1908 Tunguska explosion and destroyed 2,000 square kilometers of Siberian forest was only 30-40 meters in diameter. This realization is what led Congress to change its mind and decide that NASA should track even smaller asteroids. The new goal: track 90 percent of NEOs 140 meters or larger in diameter by 2020. The NRC report primarily takes issue with the lack of action on this goal from anyone involved: Congress has not volunteered funding for their mandate, and NASA has not allotted any of their budget to it, either. The equipment currently in use to track NEOs can easily see the 1km monsters, but it's not sensitive enough to track the 140m asteroids. As a result, if a Tunguska-sized body were headed for Earth today, its arrival would probably be a complete surprise.

### Even basic methods of NEO detection cost hundreds of millions and are likely to need more

NRC 2010 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

The near-Earth object (NEO) survey, characterization, and mitigation approaches that the committee asked SAIC to assess were at various levels of definition and in some cases were largely conceptual. As a result, it is too early in the NEO program development and design of most of the eight representative projects for the committee to develop confidence in either the projects themselves or the SAIC’s cost estimates. As one example, the committee notes the mission to place a 0.5-meter infrared telescope in a Venus-trailing orbit costed by a special team at the Jet Propulsion Laboratory (JPL). Internal analysis by JPL yielded a range of approximately $600 million to $650 million, including 5 years of operations and a 20 percent contingency, whereas the SAIC analysis yielded corresponding costs of $550 million to $1.8 billion. The Large Synoptic Survey Telescope (LSST) is a second example in which, by contrast, the SAIC cost model predicts a significantly lower cost than the LSST team’s estimate. The LSST project estimated the construction budget at $390 million in 2007 dollars, whereas the SAIC cost range (for a replicate telescope, construction only) was between $140 million and $340 million in 2009 dollars. These examples demonstrate that the initial cost estimates produced by SAIC for this study contain many uncertainties. It was not within the scope of this committee’s tasks to conduct the more thorough mission definitions required to produce more accurate cost estimates and, in particular, to resolve the above differences. The committee concluded that the primary value of the technical and cost assessments of the eight projects was not to provide a cost estimate of the potential solutions, but to identify the technical maturity and requirements of these options. The eight projects chosen by the committee are shown in Table A.1. These include three groundbased telescope concepts for NEO detection, two space-based systems for NEO detection, one space-based NEO characterization mission, and two space-based NEO mitigation systems. The results are presented in a range of costs meant to give decision makers some idea of the inherent technological risks and the range of resources that might be required to undertake such projects. However, given the conceptual level of definition of many of these projects, the end points of the range of costs will very likely change significantly as the designs are matured.

### Err Neg --- Aff studies massively underestimate the costs

NRC 2010 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies,

Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

The committee was asked to produce independent cost estimates of typical solutions that it considered for survey completion and mitigation. To this end, the NRC contracted with Science Applications International Corporation to use parametric models and other statistical techniques to produce estimates of these options. However, the committee notes that many of these options are technically immature and that cost estimates at this early stage of development are notoriously unreliable. At best, these cost estimates provide only crude approximations of final costs of pursuing any of these options, so the committee did not use these cost estimates in reaching its conclusions. The cost estimates are included in Appendix A.

### Space-based telescopes cost billions more than projections

NPR 6/8/2011 (Scientists Undeterred By Hubble Successor's Costs, lexis)

GREENFIELDBOYCE: The new telescope will let astronomers push past those limits and others. They'll be able to peer at the very first galaxies, search for water on planets that orbit distant stars, see parts of the universe they've never seen before. All that comes with a big price tag. A recent independent review said that the telescope will cost at least a billion and a half more than the $5 billion that NASA had planned to spend. And while James Webb was supposed to launch in 2014, now it's looking like 2018 at the earliest. But Hammel seems unfazed. Ms. HAMMEL: It's clear that it's hard to build. But you've got to do hard things, because that's where the frontiers are. GREENFIELDBOYCE: Unlike Hubble, which orbits close to Earth, James Webb will be far out in space, about a million miles away. This infrared telescope could be blinded by heat, so it needs to be cold - minus 400 degrees Fahrenheit. Matt Mountain is the head of the Space Telescope Science Institute. He ticks off a bunch of technologies invented just to make this telescope work, things like its eighteen gold coated mirrors and its giant five-layer sunshade, the size of a tennis court. Mr. MATT MOUNTAIN (Head of the Space Telescope Science Institute): There's a whole range of these new technologies which had to be brought in, most interesting the technologies we worried least about, are the ones that scare people most, are the unfolding technologies. GREENFIELDBOYCE: Unfolding technologies because this telescope is collapsible. It is the size of a Boeing 737 but it has to fold up to fit inside a slender rocket. NASA videos show how it will unfold. Mountain says some astronomers still can't believe it. Mr. MOUNTAIN: They just think it won't unfold. I mean you watch the video of this sort of Transformer telescope, sort of origami telescope, unfolding and becoming a six meter telescope, you know, a million miles from here and you think, well that can't work. GREENFIELDBOYCE: But it has to. Unlike Hubble, there'll be no repair missions. Not so far out in space. Three billion has already been spent. NASA officials are now hunting around for the extra money it will take to complete the testing and building. They just put a new manager in charge - Rick Howard. He says, some scientists do worry that James Webb could become the telescope that ate NASA's entire astronomy budget. Mr. RICK HOWARD (Manager of James Webb Telescope Program): There are a lot of people that are concerned about that, there's no doubt about that. GREENFIELDBOYCE: He says it won't do that. And it's worth the price. He says it isn't the first telescope to be unexpectedly expensive. Mr. HOWARD: It's interesting to think about James Webb versus Hubble. When Hubble was launched, it was about three times the cost of what it was originally estimated at. GRENEFIELDBOYCE: He says, all in all, the Hubble program has cost about $9 to 10 billion.

### Developing asteroid detection costs billions and would require massive spending to upgrade current infrastructure

IAA 2009 (International Academy of Astronautics, Dealing with the THREAT TO EARTH From ASTEROIDS and COMETS, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

A number of other options were also studied and their performance and costs quantified. Overall the NASA study made clear that the goal was indeed achievable in a number of ways, that the addition of a modest space-based telescope shortened the time required by at least 3 years, and that the cost of all options that meet the goal would be in the vicinity of $1B. In addition the study made clear that the operation of any such system would generate 40 times more impact “warnings” than are currently experienced, up to 2-3 per week, by as early as 2010. The means to deal with such warnings and avoid an intolerable number of false alarms would stress the current operations center and systems. Clearly a major augmentation of these systems would be required to the handle the increased number of warnings.

## Earth Science DA – Link – Constellation

### Funding Constellation is extremely expensive --- trades-off with NASA’s focus on Earth science

Pelton 10 (Joseph N., Research Professor – Institute for Applied Space Research at the George Washington University, “A New Space Vision for NASA—and for Space Entrepreneurs Too?”, Space Policy, 26(2), May, p. 78)

Some have suggested that President Barack Obama's cancellation of the unwieldy and expensive Project Constellation to send astronauts back to the Moon for a few exploratory missions was a blow to NASA and the start of the end of the US space program. The truth is just the reverse. Project Constellation, accurately described by former NASA Administrator Michael Grifﬁn as “Apollo on Steroids” provided little new technology or innovation and had an astronomical price tag. It was clearly too much for too little. If the opportunity costs of Project Constellation are examined (i.e. if we think what could have been done with an extra $100 billion of space funds), dumping it deﬁes argument. With much less invested in a questionable Project Constellation enterprise we can do much more in space astronomy. We can invest more wisely in space science to learn more about the Sun, the Earth and threats from Near Earth Objects. David Thompson, Chairman and CEO of Orbital Sciences said the following in a speech that endorsed the new commercial thrust of the NASA space policies on Nine February 2010: “Let us, the commercial space industry, develop the space taxis we need to get our Astronauts into orbit and to ferry those wanting to go into space to get to where they want to go. We are in danger of falling behind in many critical areas of space unless we shift our priorities” [10].

## Earth Science DA – Link – A2: Supplemental Spending

### NASA’s overall budget is frozen --- increases in exploration must be funded by reducing internal spending

Svitak 11 (Amy, Staff Writer – Space News, “President's Budget Freezes NASA at $18.7 Billion”, Space News, 2-14, [http://www.spacenews.com/civil/nasa-budget-frozen-presidents-request.html](http://fcw.com/articles/2011/06/08/nasa-budget-priorities-shift.aspx))

The White House unveiled a 2012 budget blueprint Feb. 14 that freezes funding for NASA and other federal agencies at 2010 levels while continuing to invest in top priorities, including technology research and development, nurturing commercial space initiatives and building a heavy-lift rocket and multi-purpose crew vehicle for manned space missions beyond low Earth orbit.

The $18.7 billion top-line spending level President Barack Obama is seeking for NASA next year is roughly $300 million less than the 2011 budget plan he sent lawmakers last February and $750 million below the $19.45 billion recommended for the agency in the NASA Authorization Act of 2010, which Obama signed in October.

Obama's budget would put NASA more than $700 million behind the $19.45 billion forecasted for 2012 in the budget proposal the president sent Congress last year but never saw enacted.

Despite the flat request for 2012, the president's NASA budget provides at least some new funding for top priorities directed in the authorization measure, and in some cases exceeds levels set for specific programs. For example, if Obama’s request is approved, NASA would have $850 million to spend on commercial space initiatives in 2012, $350 million more than called for in the authorization act.
The request also calls for spending $1.024 billion on space technology research and exploration technology development, roughly $100 million more than the $923 million called for in the authorization act.
The request would fund $1.8 billion in 2012 to begin development of a new heavy-lift launch vehicle and $1 billion to continue developing NASA’s Orion crew capsule as directed in the NASA Authorization Act of 2010, which Obama signed into law in October. However, the combined $2.8 billion that would fund the development is less than half the roughly $4 billion congressional authorizers directed in the NASA bill.

Obama's proposal includes $1.78 billion for Earth science programs in 2012, some $160 million less than called for in the authorization act but still about $360 million more than the agency's current Earth science budget.

NASA's overall Science budget — which includes Earth science, astrophysics, heliophysics and planetary science —would top $5 billion in 2012, a roughly $500 million increase over the current budget but less than previously forecast.

These and other targeted increases would be funded by reducing NASA's Space Operations budget by $1.8 billion relative to the 2010 level. Those savings would be realized by retiring the space shuttle later this year.

### No appropriations --- NASA’s budget is frozen for five years --- new projects must trade-off

Harwood 11 (William, Author – CNET Blog Network, “NASA 2012 Budget Reflects 'Tough Choices,' Uncertain Outlook”, CNET, 2-14, http://news.cnet.com/8301-19514\_3-20031912-239.html)

Faced with reduced funding and an uncertain outlook, NASA's $18.7 billion fiscal 2012 budget prioritizes the Obama administration's major goals and objectives, focusing on maintaining the International Space Station, retiring the shuttle and ramping up efforts to spur development of commercial manned spacecraft. The budget also reflects the administration's commitment to building a new heavy-lift rocket and a crew capsule that could be used for deep-space exploration. But the budget follows the administration's proposal to freeze federal funding at 2010 levels for the next five years, resulting in a $276 million decrease for NASA compared to the agency's 2011 budget. Until Congress weighs in with actual funding, it's not clear when a viable United States manned spacecraft will emerge to service the station or when eventual deep-space missions might occur. In the meantime, with the shuttle's retirement looming after a final three missions, NASA will continue to rely on Russia to provide transportation to and from the space station aboard Soyuz spacecraft at about $55 million a seat. "This budget requires us to live within our means so we can invest in our future," NASA Administrator Charlie Bolden told reporters. "It maintains our strong commitment to human spaceflight and new technologies. It establishes critical priorities and invests in excellent science, aeronautics research and education programs that will help us win the future." Because "these are tough fiscal times, tough choices had to be made," he said. "Our No. 1 priority is safely flying out the shuttle and maintaining the safety and well being of the American astronauts currently living and working in space."

## Earth Science DA – Internal Link – Stability

### Link threshold is low --- even budgetary *instability* risks disrupting Earth science

Moore 5 (Berian III, Director – Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, “NASA Earth Science”, House Hearing Before the Committee on Science, 4-28, [http://www.access.gpo.gov/congr ess/house/pdf/109hrg/20736.pdf](http://pubs.acs.org/cen/coverstory/89/8909cover7.html))

*Q2b. Is it expected that NASA will continue with the GEOSS initiative in FY 2006 and beyond? At what funding levels?*

A2b. NASA’s plans for research and development of Earth observation systems include support for national and international priorities and goals, including the U.S. IEOS and International GEOSS. The GEOSS is architected to benefit from the full scope of the results of NASA research and development programs, flight missions and applied sciences partnerships on benchmarking enhancements to integrated system solutions for the nine societal benefit areas. Per the response above, the NASA budget for Earth science is the U.S. contribution to the research and development efforts that contribute to the goals and objectives of serving society as documented in the GEOSS 10-Year Implementation Plan.

Q2c. To date, what role has NASA’s Earth Science program played in the Administration’s new GEOSS initiative?

A2c. NASA leadership contributed to developing and refining the framework and architecture of the U.S. IEOS and International GEOSS plans. The plans provide guidance in the direction for evolving research capacity (including NASA contributions) to enable improved future operational systems. NASA contributes to the national interagency activity through participation in the U.S. Group on Earth Observation, a subcommittee of the Committee on Environment and Natural Resources (CENR). NASA senior officials serve in the roles of Co-Chair and other positions of the USGEO and as alternate Co-Chair for the Architecture SubGroup of the international Group on Earth Observations.

NASA missions (e.g., Terra, Aqua, and Aura), program plans (e.g., Earth Science strategies and implementation plans) and results (e.g., collaboration with EPA on enhancing the national air quality Nowcasting system) are recognized through the USGEO and GEO as contributions to the IEOS and GEOSS.

Q3. I also have the privilege of serving on the Financial Services Committee and have had the opportunity to take a close look at the Administration’s changes to housing programs. The Administration wants to consolidate Community Development Block Grants and six other HUD programs as well as ten other programs from federal agencies to move them into the Commerce department, drastically reducing funding in some cases and making minimal cuts in others. I also notice that in the same fashion at the Administration’s request, NASA has decided to combine the Earth Science and solar physics programs into one Earth-Sun Science program that has been incorporated into the new Science Mission Directorate.

*a. Which stand-alone projects within the Earth Science program will sustain the most drastic cuts?*

*b. Do you believe the reorganization of NASA’s Earth Science program is a good idea or a bad idea? Why?*

*c. Would you have any recommendations for improving the effectiveness of NASA’s Earth Science program?*

A3a,b,c. The combination of the former Earth Science Enterprise and Sun-Earth Connection theme of the Space Science Enterprise into a single unified Earth-Sun System Division has not led to cuts in any Earth science projects. Significant reductions were made between FY 2004 and FY 2005 President’s budgets. In FY 2006, the budget submit using the new structure, resulted in no significant reductions to Earth science. The creation of a single unified Science Mission Directorate and the grouping of the former Earth Science Enterprise and the Sun-Earth Connection theme of the former Space Science Enterprise into a single unified Earth-Sun System Division was done to better position us to take advantages of potential synergies between formally different organizations. However, the time elapsed since the agency transformation that effected these changes is too short to determine whether the benefits are being achieved. NASA’s Earth Science budgets are managed overall effectively. We feel that one of the most important things that can be done to improve management is to assure the stability of the program. Firming up of budgets early in the fiscal year is also very important, as it allows for early establishment of targets.

## Earth Science DA – Internal Link – Funding Key

### Even small funding cuts crush the effectiveness of NASA’s programs

Conley 10 (Richard, Professor of Political Science – University of Florida, “The Perils of Presidential Leadership on Space Policy: The Politics of Congressional Budgeting for NASA, 1958-2008”, APSA 2010 Annual Meeting Paper, [http://papers.ssrn.com/sol3/papers.cfm?abstract\_id=1642810](http://www.cbsnews.com/stories/2009/07/17/tech/cnettechnews/main5168126.shtml?abstract_id=1642810))

The situation is that much more problematic given NASA’s size.  NASA is a small agency.  Even relatively small cuts to the agency’s budget requests have considerable ramifications for ongoing and future programs.  Figure 2 shows changes in NASA personnel since 1958.  The first y-axis traces the number of civilian employees.  The second y-axis tracks the percent annual change in NASA civilian personnel.  The data show relative stability in the agency’s workforce at approximately 21,000 in the last four decades.  But the upshot is that a cut of $1 billion to the president’s NASA budget request equates to an annual loss of $47,000 per employee.  The ramifications are also highly significant for NASA contractors in the private sector, who typically number about 40,000—twice the agency’s personnel.  The data accentuate the mismatch between human and financial resources necessary for long-term, large scale space programs and congressional appropriations.

      It is rare that any NASA program that can rely on one year’s worth of funding.  The reality is that the vast majority of space exploration projects require years of commitment while the budgeting process occurs on a yearly basis.  Sharp cuts to a project’s budget in the middle of its lifetime can mean drastic cuts to a program’s capabilities or results.  The space shuttle is a prime example of this phenomenon.  Combined with the tendency of elected representatives to consider their ability to justify programs to their constituents on a two year (House) or six year (Senate) electoral cycle, highly technical and long-term projects within NASA regularly face unstable budgets (Kay 1995).

## Earth Science DA – Internal Link – Satellites Key

### Satellite observations are critical to effective monitoring --- calculated models fail

Huetteman 11 (Emmarie, Medill National Security Reporting Project, “Blind to the Threat”, 1-25, [http://global-warning.org/main/satellites/](http://www.lexis.com/research/retrieve))

If the launch had been successful, OCO would have been the first satellite dedicated to measuring carbon dioxide in the atmosphere and tracking emission reduction efforts, offering crucial insight into the earth’s changing climate. This information is needed not only by scientists monitoring the environment but also federal officials struggling to understand rising threats of those climate changes to national security.

“Here’s a key variable for understanding climate change, the only satellite in the world that will do the kind of global collection we need, [and it] crashes,” said James Lewis, a senior fellow at the Center for Strategic and International Studies and author of an influential report on climate observation. “And we haven’t thought about how to replace it.”

The short, unproductive life of OCO — and the lack of a backup plan — marked another chapter in the long-running story of the nation’s teetering climate observation system. For two decades, the U.S. constellation of earth science satellites has been beset by competing priorities, shrinking budgets and mismanagement, even as intelligence and military officials express serious concerns about the national security threats posed by climate change and the need for accurate data to help assess those threats.

In a world where the Larsen B Ice Shelf in Antarctica is intact one day and collapses into the sea the next, scientists say the need for continuous, reliable satellite observation is vital. It enables more accurate projections, allowing policymakers to decide, for example, whether to build a military base in an area that will flood as sea levels rise; more accurate data also warns the U.S. military that it may have to evacuate people before a devastating tsunami, like the one that killed hundreds of thousands in Indonesia in 2004.

Dr. Berrien Moore III, who co-chaired a National Research Council committee on space-based observation, said calculated climate change predictions failed to capture how fast sea ice would decline, a problem that experts say will threaten national security as it causes mass flooding from rising sea levels. But satellites caught what the models missed.

“Thank God for the [satellite] observations because otherwise we wouldn’t have known this is going on,” said Moore, vice president for weather and climate programs at the University of Oklahoma.

### Ground observations leave gaps and can’t mobilize support for responding to pollution --- satellites are key

Hoff 9 (Raymond M., Professor of Physics – University of Maryland, and Sundar A. Christopher, Professor of Atmospheric Science – University of Alabama, Huntsville, “Remote Sensing of Particulate Pollution from Space: Have We Reached the Promised Land?”, Journal of the Air & Waste Management Association, 6-1, Lexis)

Strengths of satellite measurement are found in emissions identification (fires especially), event tracking and transport, definition of    boundaries of large-scale pollution features, and providing some evidence for profiles of pollutants well above the surface. Satellite observations fill gaps in areas where there are no ground sensors (e.g., much of the third world). Satellite measurements have been very useful in defining production, oxidation, and evolution processes from biomass burning. Satellite imagery can provide iconic views of major events such as forest fires, volcanic plumes, and stagnant haze masses over highly industrialized areas. In conveying the extent of pollution to the public, visual imagery from space is important.

### Satellite observations are necessary for effective sensing --- ground measurements alone can’t fill in

Hoff 9 (Raymond M., Professor of Physics – University of Maryland, and Sundar A. Christopher, Professor of Atmospheric Science – University of Alabama, Huntsville, “Remote Sensing of Particulate Pollution from Space: Have We Reached the Promised Land?”, Journal of the Air & Waste Management Association, 6-1, Lexis)

The recent literature on satellite remote sensing of air quality is  reviewed. 2009 is the 50th anniversary of the first satellite atmospheric observations. For the first 40 of those years, atmospheric composition measurements, meteorology, and atmospheric structure and dynamics dominated the missions launched. Since 1995, 42 instruments relevant to air quality measurements have been put into orbit. Trace gases such as ozone, nitric oxide, nitrogen dioxide, water, oxygen/tetraoxygen, bromine oxide, sulfur dioxide, and formaldehyde, glyoxal, chlorine dioxide, chlorine monoxide, and nitrate radical have been measured in the stratosphere and troposphere in column measurements. Aerosol optical depth (AOD) is a focus of this review and a significant body of literature exists that shows that ground-level fine particulatematter ([PM.sub.2.5]) can be estimated from columnar AOD. Precision of the measurement of AOD is [+ or -]20% and the prediction of [PM.sub.2.5] from AOD is order [+ or -]30% in the most careful studies. Theair quality needs that can use such predictions are examined. Satellite measurements are important to event detection, transport and model prediction, and emission estimation. It is suggested that ground-based measurements, models, and satellite measurements should be viewed as a system, each component of which is necessary to better understand air quality.

## Earth Science DA – Internal Link – NASA Key

### NASA data is key --- it’s indispensible and funds private-sector research

Busalacchi 11 (Tony, Director and Professor of the Earth System Science Interdisciplinary Center – University of Maryland, CQ Congressional Testimony, 3-11, Lexis)

In 2007, the National Academies issued the report, "Earth and Science Applications from Space: National Imperatives for the Next Decade and Beyond." The report found that between 2000 and 2009, funding for Earth Sciences (ES) had fallen substantially. ES research is absolutely critical to understanding climate change, such as the decline of Earth's ice sheets and the health of the global oceans. For this reason, BOAC is heartened by the Administration's request for NASA's expanded and enhanced science mission. Past investments in NASA's science mission have funded university research that has resulted in the development of new instruments and technologies and in valuable advances in weather forecasting, climate projections, and understanding of Earth ecosystems.
Without the tools developed at NASA or with agency support, oceanic, atmospheric, hydrologic and earth-system scientists and the nation would have only a fragmentary picture of the interconnected functioning of the planet's oceans, atmosphere and land. The NASA data archive is a treasure trove of environmental information that researchers have come to depend upon. Through its support for young scientists and graduate students, the NASA science mission supports innovation. BOAC supports the NASA budget and applauds the special attention that the White House has paid to the restoration of NASA science. We also hope that Congress will fund NASA to lead in developing and implementing a scatterometer mission; with fast community access to the data, capability to distinguish between wind and rain and a higher orbit for coverage of Alaskan waters.

### Err Neg --- experts agree

Zuber 8 (Maria T., Griswold Professor of Geophysics and Head of the Department of Earth, Atmospheric and Planetary Sciences – Massachusetts Institute of Technology, “NASA at 50: Past and Future”, CQ Congressional Testimony, 7-30, Lexis)

Likewise there are numerous challenging questions about workings of Earth that are appropriate for study by NASA. There seems to be a spectrum of opinion both within and outside the agency as to how much NASA should be involved in Earth science. As head of a pre-eminent Earth Science Department with a view on the most challenging questions in contemporary Earth and atmospheric science and oceanography, I have a strong opinion on this topic. The Earth is a complex, dynamic, system of systems that requires detailed in situ study combined with precise global views over time to unravel its workings. From the point of view of remote observation, no other agency is capable of developing the kind of state-of-the- art sensors and observation strategies that only NASA can provide.  NASA simply must play a role in the essential mission of understanding our Earth.

### Especially true for environmental monitoring --- NASA does the bulk of the work

Bolden 11 (Charles, Administrator – NASA, “Fiscal 2011 Appropriations”, CQ Congressional Testimony, 3-23, Lexis)

At present, NASA Earth-observing satellites provide the bulk of the global environmental observations used for climate change research in the United States and abroad. This year, analyses of NASA satellite measurements quantified the rates of ground water depletion since 2003 in California and in India's Indus River valley rates that are unsustainable for the future. NASA conducted the first ICEBridge airborne campaigns in both Arctic and the Antarctic, to maintain the critical ice measurements during the gap in time between the ICESAT-1 and -2 satellites.

### Other agencies depend on NASA --- can’t produce their own sensing equipment

Zuber 8 (Maria T., Griswold Professor of Geophysics and Head of the Department of Earth, Atmospheric and Planetary Sciences – Massachusetts Institute of Technology, “NASA at 50: Past and Future”, CQ Congressional Testimony, 7-30, Lexis)

NASA's contributions toward understanding the state and workings of our Earth has a tremendously rich history. The most innovative approaches used in remote satellite observation were developed by NASA or by the scientific and technological community under the auspices of NASA support. Satellites and analysis tools originally conceived and built by NASA are commonly distributed to other, more operational, government agencies, such as the National Oceanic and Atmospheric Association of the Department of Commerce, and the U.S. Geological Survey under the Department of the Interior. Among numerous accomplishments NASA can claim credit for the first measurements of the steady but miniscule motions of the Earth's tectonic plates, characterization of the ozone hole, the three-dimensional structure of hurricanes, the general circulation of the oceans, biological ocean productivity, rainfall patterns in the tropics, and the global wind pattern over the oceans and its relationship to wave distribution and height. Efforts are ongoing to study changes on the Earth on decadal time scales - sea level rise, the surface ice volume, and measurement of changes in water reservoirs.

## Earth Science DA – Internal Link – A2: Satellites Fail

### NASA satellite measurements are empirically effective --- multiple examples prove

Zuber 8 (Maria T., Griswold Professor of Geophysics and Head of the Department of Earth, Atmospheric and Planetary Sciences – Massachusetts Institute of Technology, “NASA at 50: Past and Future”, CQ Congressional Testimony, 7-30, Lexis)

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NASA's studies of the Earth's plasma environment have been central in understanding the phenomenon of "space weather", as well as the magnetic character of the Sun and the nature of the solar atmosphere.
The contribution of NASA to scientific knowledge is truly impressive. The respected publication Science News indicates that 5-10% of all scientific discoveries, worldwide, over the past decade, can be traced to NASA. I routinely tell my students that there has never been a better time to be a space or Earth scientist. The web page of NASA's Science Mission Directorate lists nearly a hundred missions currently operating or in development studying the Earth, our solar system, the heliosphere and beyond. With this record of scientific achievement is it any surprise that the rest of the world aspires to be like us?

## Earth Science DA – Impact – Global Environment

### NASA Earth sciences are key to global environmental monitoring --- solves multiple threats

Abdalati 11 (Waleed, Chief Scientist – NASA, “Investing in Federal Research and Development to Spur U.S. Job Growth and Innovation”, Congressional Documents and Publications, 3-17, Lexis)

*Earth Science*
The view from space allows scientists to study planet Earth as a complex system with diverse interacting components: the oceans, atmosphere, land, ice, and life. NASA assets observe processes that are global in nature with local impacts, and that are local in nature with global impacts. By observing the interactions of these various components, we are able to develop a comprehensive picture of how the Earth works, how it is changing, why it is changing, and ultimately, what these changes mean for life on Earth. The knowledge we derive from this comprehensive picture, which is essential for ensuring our well-being as a society, can only be realized when the Earth is viewed in the context, scale, and perspective afforded by these space-based capabilities. From quantifying the impacts of melting ice on sea level, to understanding the inner workings of hurricanes and tropical storms, to assessing the health and amount of global vegetation, NASA Earth Science provides advances in understanding that positively benefit the lives of billions of people all over the world.
In addition to the scientific research and the new knowledge that NASA investments provide, NASA Earth Science also has real-time direct applicability to many national needs. Through our partnerships with other agencies (e.g., the National Oceanic and Atmospheric Administration (NOAA), the United States Geologic Survey (USGS), the Environmental Protection Agency (EPA)) that maintain forecasting and decision support systems, we ensure complementary, not duplicative activities. The result of these partnerships is improved national capabilities for climate predictions, weather, and natural hazards; the management of resources; and development of environmental policy. NASA's Earth Science is an essential part of the national and international efforts to understand the global environment and use Earth observations and scientific understanding in service to society.
There are too many examples of the direct societal benefits gained from NASA's Earth Science missions to list them all here today. However, I would like to highlight a few for your consideration. Once such example is the use of the Thermal Infrared Sensor (TIRS), currently flying on the Landsat 5 and 7 spacecraft and now in development for the Landsat Data Continuity Mission. TIRS plays an important role in the water management efforts in the western United States. In particular, TIRS measurements are used operationally by state agencies to monitor snowpack runoff and water consumption on a field-by-field basis in nine western states (Nevada, Idaho, Wyoming, Montana, Colorado, New Mexico, Nebraska, North Dakota and South Dakota). State water managers call TIRS's data the "gold standard" for the cost-effective administration of water transfer agreements, and an irreplaceable tool for western water managers. In 2012, NASA will begin to work with the Department of the Interior to develop successor Landsat satellites, through an operational program funded by USGS.
The Moderate Resolution Imaging Spectroradiameter, or MODIS instrument, on the Terra and Aqua spacecrafts provides data for the MODIS Rapid Response System developed to provide daily satellite images of the Earth's landmasses within a few hours of acquisition. This capability makes the system a valuable resource for organizations like the U.S. Forest Service and the international fire monitoring community, which use the images to track fires; the United States Department of Agriculture Foreign Agricultural Service, which monitors crops and growing conditions; and the United States Environmental Protection Agency and the United States Air Force Weather Agency, which track dust and ash in the atmosphere. As a final example, NASA-sponsored investigations have developed and demonstrated reliable and accurate detection of volcanic ash clouds using data from instruments on NASA Earth Science satellites, including the MODIS, MISR, OMI, and CALIOP instruments on the Terra, Aqua, Aura, and Cloudsat NASA research missions. The proven utility of these data led to their operational use by the NOAA National Weather Service to formulate Volcanic Ash Advisories. These products were used extensively during the Iceland volcano eruption in April 2010 and more recently, NASA satellite data were used to produce volcanic ash advisories for aviators across the Gulf of Mexico during the February 1 eruption of the Popocatepetl volcano in Mexico.
These practical benefits are not only realized here at home, but also abroad as is currently the case for the recent devastating earthquake in Japan. As with the previous earthquakes in Chile, Haiti, and elsewhere, NASA has been collecting and analyzing data from multispectral, multi-angle, and multiple resolution sensors to support damage assessment and response activities. We will continue the vital work to expand our abilities to observe our planet Earth and make those data available for decision makers and international partners.

## Earth Science DA – Impact – Biodiversity Outweighs

### Extinction results from species loss --- outweighs survivable nuclear war

Tobin 90 (Richard, Professor of Political Science – SUNY-Buffalo, The Expendable Future: U.S. Politics and the Protection of Biological Diversity, p. 13-14)

Every time a human contributes to a species’ extinction, a range of choices and opportunities is either eliminated or diminished. The demise of the last pupfish might have appeared inconsequential, but the eradication of other species could mean that an undiscovered cure for some cancers has been carelessly discarded. The extinction of a small bird, an innocent amphibian, or an unappealing plant might disrupt an ecosystem, increased the incidence and areal distribution of a disease, preclude the discovery of new industrial products, prevent the natural recycling of some wastes, or destroy a source of easily grown and readily available food. By way of analogy, the anthropo-genic extinction of a plant or animal can be compared to the senseless destruction of a priceless Renaissance painting or to the burning of an irreplaceable book that has never been opened. In an era when many people believe that limits to development are being tested or even breached, can humans afford to risk an expendable future, to squander the infinite potential that species offer, and to waste nature’s ability and willingness to provide inexpensive solutions to many of humankind’s problems? Many scientists do not believe so, and they are fearful of the consequences of anthropogenic extinctions. These scientists quickly admit their ignorance of the biological consequences of most individual extinctions, but widespread agreement exists that massive anthropogenic extinctions can bring catastrophic results. In fact, when compared to all other environmental problems, human-caused extinctions are likely to be of far greater concern. Extinction is the permanent destruction of unique life forms and the only irreversible ecological change that humans can cause. No matter what the effort or sincerity of intentions, extinct species can never be replaced. “From the standpoint of permanent despoliation of the planet,” Norman Meyers observes, no other form of environmental degradation “is anywhere so significant as the fallout of species.” Harvard biologist Edward O. Wilson is less modest in assessing the relative consequences of human-caused extinctions. To Wilson, the worst thing that will happen to earth is not economic collapse, the depletion of energy supplies, or even nuclear war. As frightful as these events might be, Wilson reasons that they can “be repaired within a few generations. The one process ongoing…that will take millions of years to correct is the loss of genetic and species diversity by destruction of natural habitats.” David Ehrenfeld succinctly summarizes the problem and the need for a solution: “We are masters of extermination, yet creation is beyond our powers… Complacency in the face of this terrible dilemma is inexcusable.” Ehrenfeld wrote these words in the early 1970s. Were he to write today he would likely add a note of dire urgency. If scientists are correct in their assessments of current extinctions and reasonably confident about extinction rates in the near future, then a concerted and effective response to human-caused extinctions is essential. The chapters that follow evaluate that response in the United States.

### Species loss shreds ecosystem resiliency --- risks crossing an invisible threshold of collapse and human extinction

Diner 94 (Major David N., Judge Advocate General's Corps – United States Army, “The Army and The Endangered Species Act: Who's Endangering Whom?”, Military Law Review, Winter, 143 Mil. L. Rev. 161, Lexis)

*D. The Value of Biological Diversity*
1. Why Do We Care? -- No species has ever dominated its fellow species as man has. In most cases, people have assumed the God-like power of life and death -- extinction or survival -- over the plants and animals of the world. For most of history, mankind pursued this domination with a single-minded determination to master the world, tame the wilderness, and exploit nature for the maximum benefit of the human race. [67](http://www.access.gpo.gov/congress/house/pdf/109hrg/20736.pdf?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a#n67) In past mass extinction episodes, as many as ninety percent of the existing species perished, and yet the world moved forward, and new species replaced the old. So why should the world be concerned now?
The prime reason is the world's survival. Like all animal life, humans live off of other species. At some point, the number of species could decline to the point at which the ecosystem fails, and then humans also would become extinct. No one knows how many  [\*171]  species the world needs to support human life, and to find out -- by allowing certain species to become extinct -- would not be sound policy. In addition to food, species offer many direct and indirect benefits to mankind. [68](http://www.truthnews.net/world/2004080046.htm?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a#n68)
2. Ecological Value. -- Ecological value is the value that species have in maintaining the environment. Pest, [69](http://www.nasa.gov/pdf/490945main_10-10_TFPD.pdf?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a#n69) erosion, and flood control are prime benefits certain species provide to man. Plants and animals also provide additional ecological services -- pollution control, [70](http://www.nasa.gov/pdf/432577main_Earth_Science_R1.pdf?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a#n70) oxygen production, sewage treatment, and biodegradation. [71](http://www.wired.com/science/discoveries/news/2003/05/58966?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a#n71)
3. Scientific and Utilitarian Value. -- Scientific value is the use of species for research into the physical processes of the world. [72](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n72" \t "_self) Without plants and animals, a large portion of basic scientific research would be impossible. Utilitarian value is the direct utility humans draw from plants and animals. [73](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n73" \t "_self) Only a fraction of the  [\*172]  earth's species have been examined, and mankind may someday desperately need the species that it is exterminating today.
To accept that the snail darter, harelip sucker, or Dismal Swamp southeastern shrew [74](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n74" \t "_self) could save mankind may be difficult for some. Many, if not most, species are useless to man in a direct utilitarian sense. Nonetheless, they may be critical in an indirect role, because their extirpations could affect a directly useful species negatively. In a closely interconnected ecosystem, the loss of a species affects other species dependent on it. [75](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n75" \t "_self) Moreover, as the number of species decline, the effect of each new extinction on the remaining species increases dramatically. [76](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n76" \t "_self)
4. Biological Diversity. -- The main premise of species preservation is that diversity is better than simplicity. [77](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n77" \t "_self) As the current mass extinction has progressed, the world's biological diversity generally has decreased. This trend occurs within ecosystems by reducing the number of species, and within species by reducing the number of individuals. Both trends carry serious future implications. [78](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n78" \t "_self)
[\*173]  Biologically diverse ecosystems are characterized by a large number of specialist species, filling narrow ecological niches. These ecosystems inherently are more stable than less diverse systems. "The more complex the ecosystem, the more successfully it can resist a stress. . . . [l]ike a net, in which each knot is connected to others by several strands, such a fabric can resist collapse better than a simple, unbranched circle of threads -- which if cut anywhere breaks down as a whole." [79](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n79" \t "_self)
By causing widespread extinctions, humans have artificially simplified many ecosystems. As biologic simplicity increases, so does the risk of ecosystem failure. The spreading Sahara Desert in Africa, and the dustbowl conditions of the 1930s in the United States are relatively mild examples of what might be expected if this trend continues. Theoretically, each new animal or plant extinction, with all its dimly perceived and intertwined affects, could cause total ecosystem collapse and human extinction. Each new extinction increases the risk of disaster. Like a mechanic removing, one by one, the rivets from an aircraft's wings, [80](http://www.lexis.com/research/retrieve?_m=15aac6482af89f930a3e32f7a8def8da&csvc=le&cform=byCitation&_fmtstr=FULL&docnum=1&_startdoc=1&wchp=dGLbVlW-zSkAA&_md5=37ae2564ed6a714dcd205b0ee5431e9a" \l "n80" \t "_self) mankind may be edging closer to the abyss.

## Earth Science DA – Impact – Biodiversity Outweighs Asteroids

### DA comparatively outweighs asteroids --- the impact is 40,000 times as probable

Boslough 10 (Mark, Mitigation Panel Member of Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, Minority Opinion, “Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies,” pp 126-127, http://www.nap.edu/catalog.php?record\_id=12738)

 The original draft of the table entitled “Expected Fatalities per Year, Worldwide, from a Variety of Causes” (Table 2.2 in Chapter 2 of this final report) included the World Health Organization (WHO)1 estimate of 150,000 deaths per year from climate change. The steering committee made a decision to remove the climate data, giving as reasons (1) caution about having any debate on climate change distract from the issue at hand and (2) irrelevance of climate change numbers to the near-Earth object (NEO) threat.

The first reason is inappropriate. Data should not be removed from a report to avoid the potential for political controversy.

The second reason is incorrect. Climate change is more relevant than the other causes in the table, for several reasons:

The portion of the threat above the global catastrophe threshold—which in the model we quote2 constitutes about one half of the expected annual death rate—is primarily a climate change threat. Estimates of deaths from a large impact are largely based on our model-derived scientific understanding of climate change. The 91 deaths per year assumes a catastrophe threshold significantly lower than the current best estimate (3 kilometer-diameter asteroid). It implicitly assumes a high-sensitivity climate and/or strong dependence of death rate on climate change.

Asteroids and climate change are the only two threats in the original table that can have abrupt and global consequences, and to which everyone on the planet is exposed, regardless of their lifestyle or personal behavior. They are also both to some extent preventable, and in both cases mitigation requires international agreements and cooperation. The climate change death rate is therefore more appropriate to compare to the asteroid death rate than the other threats are. Climate can and has changed abruptly. Evidence from Greenland ice cores and other

 paleoclimate data show that these spontaneous changes take place much more frequently than do large impacts and on time scales that can exceed human adaptive capacities.3

Asteroids and climate change are the only two threats in the original table that include global catastrophe as a possibility. The best estimate of the global catastrophe threshold diameter for an asteroid is 3 km, but according to Alan Harris,4 all NEOs above this threshold, except for long-period comets, have been discovered. The best estimate of the probability of a global catastrophe this century from an asteroid impact is therefore zero. If Earth and its inhabitants are assumed to be much more sensitive to global change, then a low threshold of 1.5 km (a factor of 8 lower in kinetic yield) can be assumed. Harris estimates around 30 undiscovered asteroids larger than 1.5 km. The probability of impact by one of these before the end of the century is 0.0005 percent. However, recent models5,6 suggest a 2 percent probability of global catastrophe from anthropogenic climate change this century, assuming realistic greenhouse gas emissions scenarios and a threshold temperature change or sensitivity of 8°C. If the threshold sensitivity is 4°C, the probability of global catastrophe exceeds 20 percent. With sensitive assumptions, it is therefore 40,000 times more probable that Earth will be faced with an anthropogenic climate change catastrophe than with an asteroid catastrophe. With best assumptions it is infinitely more probable.

The WHO climate change estimate of 150,000 deaths per year is a lower bound, because of its conservative assumptions that do not include increasing temperatures since 2000. It also does not consider the probability of global catastrophe from human-triggered abrupt climate change comparable to the speed or magnitude of the Bölling/Allerød or Younger Dryas boundaries, which are not impact related.7 The Harris (2009) asteroid estimate of 91 deaths per year is an upper bound, because it assumes a low catastrophe threshold. The inclusion of these figures for intercomparison is the only way to provide policy makers with an objective basis for the prioritization and allocation of resources that is commensurate with the relative threat from various causes.

## Earth Science DA – Impact – Environment Turns War

### Environmental destruction leads to a global wars

Homer-Dixon 98 (Thomas, Assistant Professor of Political Science and Director of the Peace and Conflict Studies Programme – University of Toronto, World Security Challenges for a New Century, p. 342-343)

Another possibility is that global environmental damage might increase the gap between rich and poor soci­eties, with the poor then violently confronting the rich for a fairer share of the world’s wealth. Severe conflict may also arise from frustration with countries that do not go along with agreements to protect the global envi­ronment, or that “free-ride” by letting other countries absorb the costs of environmental protection. Warmer temperatures could lead to contention over more easily harvested resources in the Antarctic. Bulging populations and land stress may produce waves ofenvironmentalrefugees**,** spilling across borders and disrupting relations among ethnic groups. Countries might fight among themselves because of dwindling supplies of water and the effects of upstream pollution.6 A sharp decline in food crop production and grazing land could lead to conflict between nomadic tribes and seden­tary farmers. Environmental change could in time cause a slow deepening of poverty in poor countries, which might open bitter divisions between classes and ethnic groups, corrode democratic institutions, and spawn revolutions and insurgencies. In general, many experts have the sense that environmental problems will “ratchet up” the level of stress within states and the inter­national community, increasing the likelihood of many different kinds of conflict—from war and rebellion to trade disputes—and undermining possibilities for cooperation.

## Earth Science DA – Impact – Oceans 2NC

### Marine biodiversity is key to human survival

Davidson 3 (Founder – Turtle House Foundation and Award-Winning Journalist, Fire in the Turtle House, p. 47-51)

But surely the Athenians had it backward; it’s the land that rests in the lap of the sea. Thalassa, not Gaia, is the guardian of life on the blue planet. A simple, albeit apocalyptic, experiment suggests Thalassa’s power. Destroy all life on land; the ocean creatures will survive just fine. Given time, they’ll even repopulate the land. But wipe out the organisms that inhabit the oceans and all life on land is doomed. “Dust to dust,” says the Bible, but “water to water” is more like it, for all life comes from and returns to the sea. Our ocean origins abid within us, our secret marine history. The chemical makeup of our blood is strikingly similar to seawater. Every carbon atom in our body has cycled through the ocean many times. Even the human embryo reveals our watery past. Tiny gill slits form and then fade during our development in the womb. The ocean is the cradle of life on our planet, and it remains the axis of existence, the locus of planetary biodiversity, and the engine of the chemical and hydrological cycles that create and maintain our atmosphere and climate. The astonishing biodiversity is most evident on coral reefs, often called the “rain forests of the sea.” Occupying less than one-quarter of 1 percent of the global ocean, coral reefs are home to nearly a third of all marine fish species and to as many as nine million species in all. But life exists in profusion in every corner of the ocean, right down to the hydrothermal vents on the seafloor (discovered only in 1977), where more than a hundred newly described species thrive around superheated plumes of sulfurous gasses. The abundance of organisms in the ocean isn’t surprising given that the sea was, as already mentioned, the crucible of life on Earth. It is the original ecosystem, the environment in which the “primordial soup” of nucleic acids (which can self-replicate, but are not alive) and other molecules made the inexplicable and miraculous leap into life, probably as simple bacteria, close to 3.9 billion years ago. A spectacular burst of new life forms called the Cambrian explosion took place in the oceans some 500 million years ago, an evolutionary experiment that produced countless body forms, the prototypes of virtually all organisms alive today. It wasn’t until 100 million years later that the first primitive plants took up residence on terra firma. Another 30 million years passed before the first amphibians climbed out of the ocean. After this head start, it’s not surprising that evolution on that newcomer-dry land-has never caught up with the diversity of the sea. Of the thirty-three higher-level groupings of animals (called phyla), thirty-two are found in the oceans and just twelve on land.

## Earth Science DA – Impact – Ozone 2NC

### NASA-led monitoring key to continued ozone recovery

Aerospace Daily 95

 (7-21, Lexis)

NASA-funded research results showing a marked decline in an ozone- depleting chemical since an international treaty limiting its production come at an opportune time for agency lobbyists. Researchers at MIT reported in the journal Science last week that methyl chloroform concentrations have dropped at a rate of about 2% a year since mid-1990, the first measured decrease in an ozone-depleting atmospheric chemical since the Montreal Protocol was established as an attempt to protect stratospheric ozone levels. NASA, which faces a determined attack by House Republicans on its Earth Observing System (EOS), was quick to issue a press release highlighting its role in the MIT research. Both the ground-based methyl chloroform study and EOS are funded through NASA's Mission to Planet Earth (MTPE) effort. "Continued monitoring of ozone and the chemicals involved in ozone depletion will be **crucial** over the next several decades to ensure that the treaties continue to work, so that ozone levels ultimately recover," Robert Harriss, head of the Science Div. in the MTPE headquarters office, said in the agency press release yesterday.

### Ozone depletion causes extinction

Greenpeace 95 (Full of Holes: Montreal Protocol and the Continuing Destruction of the Ozone Layer -- A Greenpeace Report with contributions from Ozone Action, http://archive.greenpeace.org/ozone/holes/holebg.html)

When chemists Sherwood Rowland and Mario Molina first postulated a link between chlorofluorocarbons and ozone layer depletion in 1974, the news was greeted with scepticism, but taken seriously nonetheless. The vast majority of credible scientists have since confirmed this hypothesis. The ozone layer around the Earth shields us all from harmful ultraviolet radiation from the sun. Without the ozone layer, life on earth would not exist. Exposure to increased levels of ultraviolet radiation can cause cataracts, skin cancer, and immune system suppression in humans as well as innumerable effects on other living systems. This is why Rowland's and Molina's theory was taken so seriously, so quickly - the stakes are literally the continuation of life on earth.

## Earth Science DA – Impact – Warming

### Warming causes extinction

Brandenberg 99 (Dr. John, Physicist, Dead Mars, Dying Earth, p. 232-233)

The world goes on its merry way and fossil fuel use continues to power it. Rather than making painful or politically difficult choices such as inventing in fusion or enacting a rigorous plan of conserving, the industrial world chooses to muddle through the temperature climb. Let’s imagine that America and Europe are too worried about economic dislocation to change course. The ozone hole expands, driven by a monstrous synergy with global warming that puts more catalytic ice crystals into the stratosphere, but this affects the far north and south and not the major nations’ heartlands. The seas rise, the tropics roast but the media networks no longer cover it. The Amazon rainforest becomes the Amazon desert. Oxygen levels fall, but profits rise for those who can provide it in bottles. An equatorial high pressure zone forms, forcing drought in central Africa and Brazil, the Nile dries up and the monsoons fall. Then inevitably, at some unlucky point in time, a major unexpected event occurs—a major volcanic eruption, a sudden and dramatic shift in ocean circulation or a large asteroid impact (those who think freakish accidents do not occur have paid little attention to life on Mars), or a nuclear war that starts between Pakistan and India and escalates to involve China and Russia… Suddenly, the gradual climb in global temperatures goes on a mad excursion as the oceans warm and release large amounts of dissolved carbon dioxide from their lower depths into the atmosphere. Oxygen levels go down as oxygen replaces lost oceanic carbon dioxide. Asthma cases double and then double again. Now a third of the world fears breathing. As the oceans dump carbon dioxide, the greenhouse effect increases, which further warms the oceans, causing them to dump even more carbon. Because of the heat, plants die and burn in enormous fires which release more carbon dioxide, and the oceans evaporate, adding more water vapor to the greenhouse. Soon, we are in what is termed a runaway greenhouse effect, as happened to Venus eons ago. The last two surviving scientists inevitably argue, one telling the other, “See, I told you the missing sink was in the ocean!” Earth, as we know it, dies. After this Venusian excursion in temperatures, the oxygen disappears into the soil, the oceans evaporate and are lost and the dead Earth loses its ozone layer completely. Earth is too far from the Sun for it to be a second Venus for long. Its atmosphere is slowly lost – as is its water—because of the ultraviolet bombardment breaking up all the molecules apart from carbon dioxide. As the atmosphere becomes thin, the Earth becomes colder. For a short while temperatures are nearly normal, but the ultraviolet sears any life that tries to make a comeback. The carbon dioxide thins out to form a thin veneer with a few wispy clouds and dust devils. Earth becomes the second Mars – red, desolate, with perhaps a few hardy microbes surviving.

## Earth Science DA – Impact – Warming – A2: Inevitable

### NASA Earth sciences are key to effective adaptation

Balstad 11 (Dr. Roberta, Trustee University Corporation for Atmospheric Research, CQ Congressional Testimony, 3-11, Lexis)

National Aeronautics and Space Administration - Science Mission Directorate. The research conducted and data collected by NASA's Science Mission Directorate are essential to atmospheric sciences research and global Earth observations. Through the use of space observatories, satellites, and other probes, NASA helps us achieve a deeper understanding of Earth, including answers to how the Earth's long-term weather patterns may be changing. We urge the Subcommittee to support the President's FY 2012 budget request of $5.017 billion for NASA's Science Mission Directorate, including $1.653 billion for Earth Science.
As the federal government and NASA prioritize among competing priorities, the National Academy of Sciences decadal survey, Earth and Science Applications from Space: National Imperatives for the Next Decade and Beyond, released in 2007, continues to provide a critical set of recommendations of the most compelling needs in Earth observation in the years to come. After years of study and risk reduction, we commend NASA and Congress for enabling the implementation of this report and with it the measurements, science, and applications needed to meet societal needs.
The anticipated launches in 2011 and ongoing development of new satellites as recommended by the scientific survey will contribute to essential support of national priorities regarding the mitigation, assessment, and response to catastrophic natural hazards on the rise globally as well as environmental change observations needed to develop appropriate national and regional responses in the future. Given the critical importance of these measurements to scientists, state and city planners, first responders, and governors, the nation must not allow any further delay in the deployment of these resources needed for our states and localities to wisely and appropriately adapt in the decades to come.

## Earth Science DA – Impact – Climate Leadership 2NC

### NASA’s Earth science missions are critical to effective climate modeling --- boosts U.S. competitiveness and leadership on warming

NAST 8 (NASA Aeronautics Support Team (Non-Profit Organization of Community Leaders, Business Leaders, and Former NASA Officials), “NASA’s Role in the 21st Century”, Fall, http://nastus.org/documents/NASARole.21st Century.pdf)

*2) Monitoring and predicting climate change and the impact of mitigation strategies*

Climate change is likely to be a dominating global issue for the rest of this century. NASA’s Earth science program is already the global leader in the measurement and prediction of climate change. The focus of climate change science/studies is now shifting to better prediction of its evolution and impacts, and developing and monitoring effective mitigation strategies. NASA must next be challenged with dramatically improving its climate prediction capability as well as taking on the new challenge of accurately predicting the impacts of climate change on our civilization and the biosphere. Additionally, there are already many speculative proposals for climatechange mitigation strategies which attempt to introduce climate forcing that acts opposite to the greenhouse effect or which attempt to capture or reduce existing greenhouse gases. Given the complex feedbacks in the climate system, understanding the possible unintended consequences of such mitigation strategies will become more important Impact on Innovation & Competitiveness: NASA is uniquely positioned to take on this challenge of predicting the efficacy of potential mitigation strategies and monitoring their effectiveness once implemented. Innovation will be supported by the development of enormous supercomputing resources needed to both crunch data, and also to model the earth’s climate and atmosphere. Given the massive amounts of national and international wealth that may be invested in mitigation strategies, global competitiveness will either be harmed or advanced by shifting budgetary resources to deal with global warming, or saving those expenditures if little action is warranted. Taking on such a role will provide the US a global leadership position in this most vital effort of our civilization for the remainder of the century8.

### Climate leadership is key to overall hegemony

Walter 2 (Norbert, Chief Economist – Deutsche Bank Group, The New York Times, 8-28, Lexis)

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 good will by dragging its feet on the next great global issue: the environment. Before long, the 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 the Bush administration's decision to send a low-level delegation to the World Summit on Sustainable Development in Johannesburg -- low-level, that is, relative to America's share of both the world economy and global pollution. The absence of President 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 damages. 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 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 world tension, and no superpower that wants to preserve its status can go on dismissing such a pivotal dimension of political and economic -- if not existential -- conflict.

### Leadership sustains U.S. global engagement – this solves terrorism, economic collapse, spread of disease, proliferation, and WMD conflict

Reiss 8 (Mitchell B., Vice Provost of International Affairs – College of William & Mary, “Restoring America's Image: What the Next President Can Do”, Survival, October, 50(5))

But first, there is another question to be answered: why should Americans care if the United States is liked or not? After all, foreign policy is not a popularity contest. Policies that are controversial today may look better in a few years. Perhaps America's unpopularity is just the price that must be paid for being the world's most powerful country. Yet Americans do care, and their desire to be respected by the world has been reflected in the campaign rhetoric of both McCain and Obama. This desire extends beyond the normal, near-universal human wish to be liked, or at least not misunderstood or hated. Americans still believe in John Winthrop's description of America as a 'shining city on the hill' and want others to view the United States that way as well. But there is another, larger reason for caring about the rise of anti- Americanism, one that is related to the United States' status as the world's only superpower. No one country can defeat today's transnational threats on its own. **Terrorism, infectious disease, environmental pollution**, **w**eapons of **m**ass **d**estruction, narcotics and human trafficking - all these can only be solved by states acting together. If others mistrust the United States or actively work against it, building effective coalitions and promoting a liberal international order that benefits both Americans and hundreds of millions of other people around the world will be far more challenging. Ultimately, if the United States has to go it alone or bear most of the costs while others are seen as free riders, the American people are unlikely to sustain engagement with the world with the same intensity, or even at all. The history of the last century demonstrates that when the United States retreats from the world, bad things happen. The United States rejected the League of Nations and turned inwards in the 1920s and 1930s, contributing to the **Great Depression** and the onset of the **Second World War**. After the Vietnam War, a weakened and inward-looking America prompted some Asian countries to start their own nuclear-weapons programmes, emboldened Islamic fundamentalists to attack American interests, and encouraged the Soviet Union to occupy Afghanistan. While there are some who say this couldn't happen today, that America couldn't pull up the drawbridge and retreat behind the parapets, recent opinion polls in the United States reveal a preference for isolationism not seen since the end of the Vietnam War. It is hard to imagine any scenario in which an isolated, disengaged United States would be a better friend and ally to other countries, better promote **global prosperity**, more forcefully endorse **democracy**, social justice and human dignity, or do more to enhance peace and security.

## Earth Science DA – Impact – Economy 2NC

### NASA climate monitoring is key to economic growth

Williamson 2 (Ray A., Space Policy Institute, “The Socio-Economic Value of Improved Weather and Climate Information”, December, [http://www.gwu.edu/~spi/assets/docs/Socio-EconomicBenefitsFinalREPORT2.pdf](http://www.spaceref.com/news/viewsr.html))

Virtually all economic sectors and many public and private activities are affected in some measure by changes in weather and climate. Uncertainties in the scope and severity of these changes pose financial and social risks for individuals, businesses, and government agencies. Hence, achieving more accurate weather and climate forecasts contributes to well being and the economy by reducing risk and creating new opportunities. Over the past four decades the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) have made considerable scientific progress towards enhancing the accuracy of weather and climate predictions. Improved predictions made possible by global satellite data have led to numerous social and economic benefits, including more effective management of energy resources; enhanced natural disaster planning, mitigation, and response; cost savings in aviation, agriculture, and other industries; and in the effectiveness of the U.S. military. Sophisticated instruments on future observation satellites will continue the trend toward achieving a better understanding of Earth’s climate and establishing a continuing basis for expanding domestic and global socio-economic benefits.

### Economic collapse causes global nuclear war

Auslin 9 (Michael, Resident Scholar – American Enterprise Institute, and Desmond Lachman – Resident Fellow – American Enterprise Institute, “The Global Economy Unravels”, Forbes, 3-6, http://www.aei.org/article/100187)

What do these trends mean in the short and medium term? The Great Depression showed how social and global chaos followed hard on economic collapse. The mere fact that parliaments across the globe, from America to Japan, are unable to make responsible, economically sound recovery plans suggests that they do not know what to do and are simply hoping for the least disruption. Equally worrisome is the adoption of more statist economic programs around the globe, and the concurrent decline of trust in free-market systems. The threat of instability is a pressing concern. China, until last year the world's fastest growing economy, just reported that 20 million migrant laborers lost their jobs. Even in the flush times of recent years, China faced upward of 70,000 labor uprisings a year. A sustained downturn poses grave and possibly immediate threats to Chinese internal stability. The regime in Beijing may be faced with a choice of repressing its own people or diverting their energies outward, leading to conflict with China's neighbors. Russia, an oil state completely dependent on energy sales, has had to put down riots in its Far East as well as in downtown Moscow. Vladimir Putin's rule has been predicated on squeezing civil liberties while providing economic largesse. If that devil's bargain falls apart, then wide-scale repression inside Russia, along with a continuing threatening posture toward Russia's neighbors, is likely. Even apparently stable societies face increasing risk and the threat of internal or possibly external conflict. As Japan's exports have plummeted by nearly 50%, one-third of the country's prefectures have passed emergency economic stabilization plans. Hundreds of thousands of temporary employees hired during the first part of this decade are being laid off. Spain's unemployment rate is expected to climb to nearly 20% by the end of 2010; Spanish unions are already protesting the lack of jobs, and the specter of violence, as occurred in the 1980s, is haunting the country. Meanwhile, in Greece, workers have already taken to the streets. Europe as a whole will face dangerously increasing tensions between native citizens and immigrants, largely from poorer Muslim nations, who have increased the labor pool in the past several decades. Spain has absorbed five million immigrants since 1999, while nearly 9% of Germany's residents have foreign citizenship, including almost 2 million Turks. The xenophobic labor strikes in the U.K. do not bode well for the rest of Europe. A prolonged global downturn, let alone a collapse, would dramatically raise tensions inside these countries. Couple that with possible protectionist legislation in the United States, unresolved ethnic and territorial disputes in all regions of the globe and a loss of confidence that world leaders actually know what they are doing. The result may be a series of small explosions that coalesce into a big bang.

## Earth Science DA – Impact – Hegemony

### Earth science is key to hegemony --- otherwise, sun storms will knock out communications and GPS, crippling the military

Busalacchi 11 (Tony, Director and Professor of the Earth System Science Interdisciplinary Center – University of Maryland, CQ Congressional Testimony, 3-11, Lexis)

Advances derived from solar, atmospheric, oceanic, hydrologic, environmental, and data and information harvesting have and will drive expansion of the U.S. economic enterprise. Space weather research and forecasting is a jewel at the NOAA Space Environment Center. Sun storms interfere with the normal operation of communications, can cause large-scale blackouts and could shut down the nation's GPS satellite system and thus the U.S. spatial referencing network. Without research advances in Space Weather, the Nation's military defenses and security, transportation systems, commerce and competitiveness will be severely compromised.
Recently, a NASA scientist developed a new mathematical method to process non-linear and non-stationary data in his basic research and opened up an entire new field of data analysis and information harvesting. He was elected to the U.S. National Academy. However, the scientist has chosen to retire from NASA and has joined a university in Taiwan where the success rate for research proposals is 80 - 90% vs. U.S. rates of 10%. The U.S. has lost a National Academy member to a foreign country because of scarce U.S. research dollars.
While recognizing that difficult budget decisions that must be made for the nation's fiscal health, the President's proposed budget for these three agencies will serve the nation well in advancing science and technology which will subsequently undergird the economy, security and well being of the citizenry of the United States. Outlays in the natural and earth systems' science and technology programs of NOAA, NSF, and NASA will serve to improve and make the nation's surface, air and marine transportation safer and more efficient, advance energy technology, provide the scientific and technological advances to help the defense industry better meet its technology needs, contribute to advances in public health, make the country more resilient to environmental hazards, provide agricultural, energy and transportation sectors with seasonal outlooks, and create the knowledge base upon which society can make wise environmental management decisions. Environmental data collected and distributed by NASA, NSF and NOAA represent a national resource and are used by universities for research, education and outreach and especially by private industry to produce products and services.

### Global nuclear war

Arbatov 7 (Alexei, Member – Russian Academy of Sciences and Editor – Russia in Global Affairs, “Is a New Cold War Imminent?”, Russia in Global Affairs, 5(3), July / September, [http://eng.globalaffairs.ru/numbers/20/1130.html](http://www.spacepolitics.com/2011/02/09/human-spaceflight-versus-earth-sciences/))

However, the low probability of a new Cold War and the collapse of American unipolarity (as a political doctrine, if not in reality) cannot be a cause for complacency. Multipolarity, existing objectively at various levels and interdependently, holds many difficulties and threats. For example, if the Russia-NATO confrontation persists, it can do much damage to both parties and international security. Or, alternatively, if Kosovo secedes from Serbia, this may provoke similar processes in Abkhazia, South Ossetia and Transdniestria, and involve Russia in armed conflicts with Georgia and Moldova, two countries that are supported by NATO. Another flash point involves Ukraine. In the event of Kiev’s sudden admission into the North Atlantic Alliance (recently sanctioned by the U.S. Congress), such a move may divide Ukraine and provoke mass disorders there, thus making it difficult for Russia and the West to refrain from interfering. Meanwhile, U.S. plans to build a missile defense system in Central and Eastern Europe may cause Russia to withdraw from the INF Treaty and resume programs for producing intermediate-range missiles. Washington may respond by deploying similar missiles in Europe, which would dramatically increase the vulnerability of Russia’s strategic forces and their control and warning systems. This could make the stage for nuclear confrontation even tenser. Other “centers of power” would immediately derive benefit from the growing Russia-West standoff, using it in their own interests. China would receive an opportunity to occupy even more advantageous positions in its economic and political relations with Russia, the U.S. and Japan, and would consolidate its influence in Central and South Asia and the Persian Gulf region. India, Pakistan, member countries of the Association of Southeast Asian Nations and some exalted regimes in Latin America would hardly miss their chance, either. A multipolar world that is not moving toward nuclear disarmament is a world of an expanding Nuclear Club. While Russia and the West continue to argue with each other, states that are capable of developing nuclear weapons of their own will jump at the opportunity. The probability of nuclear weapons being used in a regional conflict will increase significantly. International Islamic extremism and terrorism will increase dramatically; this threat represents the reverse side of globalization. The situation in Afghanistan, Central Asia, the Middle East, and North and East Africa will further destabilize. The wave of militant separatism, trans-border crime and terrorism will also infiltrate Western Europe, Russia, the U.S., and other countries. The surviving disarmament treaties (the Non-Proliferation Treaty, the Conventional Armed Forces in Europe Treaty, and the Comprehensive Nuclear Test Ban Treaty) will collapse. In a worst-case scenario, there is the chance that an adventuresome regime will initiate a missile launch against territories or space satellites of one or several great powers with a view to triggering an exchange of nuclear strikes between them. Another high probability is the threat of a terrorist act with the use of a nuclear device in one or several major capitals of the world.

## Earth Science DA – Impact – Food Shortages

### Earth science cuts disrupt the ability to adapt to food shortages --- risks global conflict

Colleton 11 (Nancy, President – Institute for Global Environmental Strategies and Executive Director – Alliance for Earth Observations, “Budget Cuts Put ‘Environmental Intelligence’ At Risk”, Space News, 4-20, [http://spacenews.com/commentaries/110418-cuts-environmental-intelligence-risk.html](http://en.wikipedia.org/wiki/List_of_Apollo_astronauts))

The timing of this potential dumbing down of “environmental intelligence” couldn’t be worse in light of the upward trend in natural disasters, like the recent catastrophic earthquake and tsunami in Japan and last year’s deadly Russian heat wave. The United States alone experienced a record 247 natural disaster events in 2010, according to Munich Re. Meanwhile, international competition is increasing as China has announced a plan to launch 13 weather satellites in the coming decade. And, report after report cautions about the destabilizing impacts of increasingly insufficient water resources, given the linkages between drought, wheat production, the world food crisis and civil unrest.

There’s no doubt that tough choices must be made in tough economic times.

These choices, however, must not compromise our nation’s ability to collect and deliver accurate and timely information about our world that enables governments, communities, companies and individuals to make sound decisions that save lives, protect and grow the economy, strengthen national security and improve our quality of life.

Environmental intelligence is the result of a critical but fragile supply chain that begins with science and observations — ground sensors, ocean buoys, stream gauges, satellites, etc. — and ends with actionable information that allows decision-makers to better respond and adapt to a changing planet. That supply chain is threatened, however, by broad cuts to the nation’s Earth-observing programs.

Most of us benefit from the environmental information supply chain almost every day in the form of that cherished weather report we consult before going to work or sending the kids off to school. The weather information supply chain begins with NASA research and development, which leads to technology that is transitioned to the National Oceanic and Atmospheric Administration (NOAA) for operational purposes. NOAA satellites and other instruments collect and store environmental data that are fed into complex computer models. That model output fuels forecasts provided by NOAA’s National Weather Service and the $1.7 billion private-sector weather services industry, which in turn delivers value-added weather information and alerts to media outlets, farmers and agricultural companies, transportation authorities, and even directly to your smartphone.

What many people do not realize is that the supply chain process that produces that much-valued weather report is years to decades in the making and is threatened by looming gaps in critical data due in large part to funding deficits combined with satellites operating beyond their planned lifetimes, with replacements either not ready or not planned. These same gaps also threaten a similar supply chain process — sometimes involving different players such as the National Science Foundation and the U.S. Geological Survey — that produces a variety of vital information products related to oceans, drought, volcanoes, earthquakes, tsunamis, forests, polar ice, climate and more.

Therefore, each time Earth science investment is reduced, the nation’s ability to monitor and forecast tornadoes and tsunamis, for example, or provide data for the emerging wind energy market is threatened. And it’s not just the satellites and other instruments that monitor the planet that are jeopardized by slash-and-burn budget cuts, but also critical improvements in computing capabilities, efforts to integrate data sets across numerous federal agencies whose formats are incompatible with one another, and the mechanisms by which the public and private sectors deliver data to users and decision-makers in a timely manner.

Significant sacrifices are an unfortunate reality in the face of hard economic challenges. But the proposed U.S. budget cuts lack a nuanced approach that recognizes potential long-term impacts and costs that would far outweigh the benefit of any short-term savings. They also illuminate another important issue: No long-term national vision exists for these vital programs that enable us to see how the planet is changing — to capture and deliver information needed by energy companies to better manage resources, emergency workers to respond to a hurricane or earthquake, military planners to prepare for friction caused by drought-induced food shortages, or government officials to respond to disasters such as the Deepwater Horizon oil spill.

Perhaps the question shouldn’t be what can we cut, but rather how do we better invest to better protect our citizens and grow the economy?

In a time of national budget woes, it’s fantasy to think that any one agency or program is immune to cuts. We must beware, however, that cutting too deep or without care or a plan will almost certainly lead to inadequacies in the information needed to make sound decisions related to our environment, which impacts every sector of the U.S. economy, today and for many years and decades to come.

### That escalates and risks extinction

Klare 6 (Michael, Professor of Peace and World Security Studies – Hampshire College, “The Coming Resource Wars”, 3-11, http://www.waterconserve.org/shared/reader/welcome.aspx?linkid=53710&keybold=water%20 land%20conflict)

"As famine, disease, and weather-related disasters strike due to abrupt climate change," the Pentagon report notes, "many countries' needs will exceed their carrying capacity" -- that is, their ability to provide the minimum requirements for human survival. This "will create a sense of desperation, which is likely to lead to offensive aggression" against countries with a greater stock of vital resources. "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." Similar scenarios will be replicated all across the planet, as those without the means to survival invade or migrate to those with greater abundance -- producing endless struggles between resource "haves" and "have-nots." It is this prospect, more than anything, that worries John Reid. In particular, he expressed concern over the inadequate capacity of poor and unstable countries to cope with the effects of climate change, and the resulting risk of state collapse, civil war and mass migration. "More than 300 million people in Africa currently lack access to safe water," he observed, and "climate change will worsen this dire situation" -- provoking more wars like Darfur. And even if these social disasters will occur primarily in the developing world, the wealthier countries will also be caught up in them, whether by participating in peacekeeping and humanitarian aid operations, by fending off unwanted migrants or by fighting for access to overseas supplies of food, oil, and minerals. When reading of these nightmarish scenarios, it is easy to conjure up images of desperate, starving people killing one another with knives, staves and clubs -- as was certainly often the case in the past, and could easily prove to be so again. But these scenarios also envision the use of more deadly weapons. "In this world of warring states," the 2003 Pentagon report predicted, "nuclear arms proliferation is inevitable." As oil and natural gas disappears, more and more countries will rely on nuclear power to meet their energy needs -- and this "will accelerate nuclear proliferation as countries develop enrichment and reprocessing capabilities to ensure their national security." Although speculative, these reports make one thing clear: when thinking about the calamitous effects of global climate change, we must emphasize its social and political consequences as much as its purely environmental effects. Drought, flooding and storms can kill us, and surely will -- but so will wars among the survivors of these catastrophes over what remains of food, water and shelter. As Reid's comments indicate, no society, however affluent, will escape involvement in these forms of conflict.

# \*\*\* EARTH SCIENCE DA ANSWERS

## Aff – Non-Unique – Cuts Now

### Cuts now --- will disrupt Earth science

Freeman 11 (Marsha, Director of Industrial Engineering – Fusion Energy Foundation and Space Expert, “Obama Proposes to Kill Science, Space Exploration, and Your Future”, Executive Intelligence Review, 4-29, [http://www.21stcenturysciencetech.com/Articles\_2011/Obama\_Kill\_Space.pdf](http://www.nasa.gov/offices/ogc/about/space_act1.html))

For more than a year, the Obama White House has waged warfare against the nation’s leading science and exploration capabilities in our space program. Although that fight has centered around the effort to end the nation’s human space exploration program, now every field of NASA’s research is slated for destruction. If the President is not removed from office, the nation’s scientific capabilities, essential for our future, will be lost. Earth-observing satellites, critical to providing the data for understanding and eventually forecasting shortterm threats, such as severe weather, volcanic eruptions, and earthquakes, are being shut down, and new projects cancelled. Astronomical observatories to shed light on the effect of long-cycle galactic events that, in the longer term, threaten our continued existence on our planet, are being scrapped. Planetary exploration probes, which provide a window into the early history of the Solar System, and a comparison to the development of the Earth, will be delayed, or “descoped.” Most critical, the talents of the teams of thousands of skilled technicians, engineers, and scientists who have created a half-century of new frontiers for humanity are being disbanded. Once gone, these capabilities will take years to rebuild. The White House plan for NASA, released a year ago, proposed to end the Moon/Mars program, and replace NASA’s space transportation programs with amateur rocketeers. Increases proposed in the agency’s budget were to go for these private efforts, and for a missionless technology development program, taking us on the road to nowhere. That was bad enough. But the FY12 budget plan released by the White House on Feb. 14 proposed a flat budget for NASA, for each of the next five years, eliminating the promised increases. Then, one month later, the “compromise” the White House made on April 14, with the faction of austerity driven budget-cutting fanatics elected last November to Congress, propose to shut down every cutting-edge scientific program of the space agency. About $250 million from the FY10 funding level has been cut in the Congressional/White House budget deal, for the remaining months of FY11. For next year, the Administration’s flat NASA budget, at $18.7 billion, means more than half-a-billion dollars in cuts from what had been projected for FY12, just six months ago. It is not the absolute amount of money that is critical. The idiotic argument has been made that NASA “got away lucky” because other Federal agencies’ budgets were cut even more. Leaving aside diminished actual buying power, due to hyperinflation, if the budget of the space program is not significantly increasing, under the Obama budget, new programs cannot be started. Otherwise, NASA is left with just one insane “option”—to shut down fully functioning spacecraft, stop collecting data and making new discoveries, to make room for new projects. Without a dramatic and immediate return to a space program which is limited, not by resources, but only by the pace of our scientific breakthroughs, there will be no future. With President Obama removed from the White House, and a return to an economic policy based on the “common aims of mankind,” which was the basis for the creation of NASA more than a half century ago, we can start to tackle the challenges ahead.

### Spending cuts now --- already disrupting environmental monitoring

Morello 11 (Lauren, “Climate Satellite Programs Scarred in Budget Fight”, New York Times, 5-4, [http://www.nytimes.com/cwire/2011/05/04/04climatewire-climate-satellite-programs-scarred-in-budget-76532.html](http://eng.globalaffairs.ru/numbers/20/1130.html))

The protracted fight over this year's federal budget has left its mark on the nation's climate and weather satellites, experts said yesterday at a conference organized by defense trade publisher IHS Jane's.

Scientists have warned for years that successive rounds of spending cuts have taken their toll on the nation's constellation of Earth-observing satellites. The National Academy of Sciences warned in 2007 that the United States' ability to monitor Earth from space was "at great risk" as the current stable of satellites aged and their replacements were delayed or shelved.

The spending deal hammered out earlier this month by House Republicans, Senate Democrats and the White House adds to that pain.

This year's budget chopped the National Oceanic and Atmospheric Administration's purse to $4.6 billion for fiscal 2011, $140 million less than the agency received in the 2010 budget cycle.

That has forced the agency to delay the launch of Jason-3, a joint mission with the European Organisation for the Exploitation of Meteorological Satellites to monitor sea level rise, by one year.

"It is impacted by the FY '11 budget decision," said Mary Kicza, NOAA's assistant administrator for satellite and information services. "The launch has slipped to 2014."

The spending cuts have also scrambled launch plans for the agency's Joint Polar Satellite System, a series of probes that will supply information for weather and climate forecasts. The launch of the program's first satellite, JPSS-1, will be delayed by at least 18 months beyond the original 2016 target.

Creating gaps in weather and climate records

That will leave a gap in some weather and climate records, creating more difficulties for environmental forecasts, severe storm warnings and search-and-rescue operations.

### Future cuts are coming

Morello 11 (Lauren, “Climate Satellite Programs Scarred in Budget Fight”, New York Times, 5-4, [http://www.nytimes.com/cwire/2011/05/04/04climatewire-climate-satellite-programs-scarred-in-budget-76532.html](http://www.space.com/10555-nasa-ramping-earth-observation.html))

"Right now, we have satellites in orbit," Kicza said. "They are producing important measurements that our modelers are using to provide two-to-five-day weather forecasts and long-term climate forecasts. On the face of things, things don't look broken. But it takes many years to field these systems -- for a complex satellite, on average, it's six to eight years. So you need to make investments now to ensure you don't have a gap in the future."

Satellites have also taken a hit at NASA. The space agency largely evaded lawmakers' budget ax this year, but with another spending fight looming for 2012, the Obama administration did some trimming of its own. The president's fiscal 2012 budget request shelved two climate satellite missions.

## Aff – Non-Unique – James Webb

### Webb telescope will drain funding

FT 11 (Florida Today, “Telescope Debacle Devours NASA Funds”, 6-4, [http://www.floridatoday.com/ article/20110605/NEWS01/110604013/Telescope-debacle-devours-NASA-funds](http://arstechnica.com/science/news/2009/08/nasa-asteroid-tracking-program-stalled-due-to-lack-of-funds.ars))

NASA’s next great space telescope will cost taxpayers at least four times more than planned and launch at least seven years late. Considered by scientists the most important space mission of the decade, the James Webb Space Telescope project is being overhauled for the second time in five years because of skyrocketing costs and cascading schedule delays. Decision-makers initially were told the observatory would cost $1.6 billion and launch this year on a mission to look deeper into space and further back in time than the Hubble Space Telescope, in a quest for new clues about the formation of our universe and origins of life. NASA now says the telescope can’t launch until at least 2018, though outside analysts suggest the flight could slip past 2020. The latest estimated price tag: up to $6.8 billion. NASA admits the launch delay will push the bill even higher. And, scientists are worried the cost growth and schedule delays are gobbling up more and more of the nation’s astronomy budget and NASA’s attention, threatening funding for other space science programs. Some fear the dilemma will get worse if the replanning work this summer forces NASA to shift billions more science dollars to Webb to get it back on track. So, what went wrong? A FLORIDA TODAY review of five years’ worth of budget records, status reports and independent audits show the Webb observatory is plagued by the same, oft-repeated problems that caused most major NASA projects to bust their budgets and schedules. In short, mistakes included: ‡¤NASA and its contractors underestimated the telescope’s cost and failed to include enough reserve cash to handle the kinds of technical glitches that always crop up in development of a complex spacecraft, including many expensive risks managers knew about. --Leaders at agency headquarters in Washington and Goddard Space Flight Center in Baltimore, which led the project before the problems came to light, failed to act on repeated warnings that cash flow was too tight and technical glitches too many to meet the budget or schedule.

### Webb will cannibalize Earth science programs

Wired 10 (“Exclusive: NASA’s Plan to Save Astrophysics From Space Telescope’s Budget Overruns”, 11-23, [http://www.wired.com/wiredscience/2010/11/james-webb-overruns/](http://www.cato.org/pub_display.php))

The James Webb Space Telescope, named for the NASA administrator who oversaw the Apollo missions, will be the largest telescope ever launched into space. With a 21-foot-wide mirror (three times the diameter of Hubble’s), it promises to peer back to the birth of the first stars and galaxies, and will lay the foundation for much of the next generation of astrophysics research. “It’s the cornerstone of all the rest of astrophysics in the next decade,” said Debra Elmegreen, an astronomer at Vassar College and the president of the American Astronomical Society. But an independent review panel charged with investigating budget overruns released a report Nov. 10 announcing that, in the best-case scenario, the telescope will cost $1.5 billion more than its current $5 billion price tag. Even with the extra funds, the telescope’s launch date will slip from June 2014 to Sept. 2015. The telescope will need an extra $250 million per year in 2011 and 2012 in order to make that 2015 launch date, the report said. If those funds are not available, the launch date will be pushed back, and the price tag will balloon further. The new price tag imperiled other projects in NASA’s Astrophysics Science Division, which until this month had managed JWST. Historically, when NASA projects exceeded their budgets, the first place to look for extra funds was within the bloated project’s home division. “That was the context in which I was thinking, ‘Oh my god, this is Hurricane Katrina for astrophysics,’” Boss said. The Astrophysics Division is expected to receive about $1.1 billion a year from 2011 to 2015, and pays for all the astronomy satellites currently in operation, including Hubble, plus all the researchers who analyze the data those satellites collect. Particularly at risk were major projects suggested in the 2010 astronomy decadal survey, a community-wide effort to identify priorities for the next 10 years of research, which announced its intentions in an Aug. 13 report. The report’s top priorities, like the $1.6 billion WFIRST satellite that is designed to look for dark energy, may need to be delayed, cut back or canceled. The next place to look would be the other science divisions, which manage Earth science, heliophysics and planetary science, and then elsewhere in the space agency. But according to Boss, an (unnamed) official at NASA headquarters assured him the Astrophysics Division is safe. The agency has already moved administration of JWST from the Goddard Spaceflight Center in Greenbelt, Maryland, into its own division at NASA headquarters.

## Aff – No Trade-Off

### Normal means is supplemental funding --- not internal trade-offs

Griffin 7 (Michael, Administrator – NASA, “Earth Science Isn’t Slipping at NASA”, Washington Post, 5-22, [http://www.washingtonpost.com/wp-dyn/content/article/2007/05/21/AR2007052101466.html](http://www.lexis.com/research/retrieve))

In their May 10 op-ed, "The Planet NASA Needs to Explore," Tony Haymet, Mark Abbott and Jim Luyten argued that NASA's purportedly changing priorities "will threaten exploration here at home."

The reality is far different. NASA's annual budget for Earth and space science is more than $5.3 billion, almost 32 percent of our expenditures, up from 24 percent in the early 1990s, and 17 percent during the Apollo era.

NASA satellites supply more data on global climate change resulting in more scientific research than is enabled by any other organization in the world.

Fourteen satellites collect information on the Earth's climate variability, atmospheric composition, carbon cycle, water and energy cycles, weather, and the surface and interior of our planet, and NASA will have launched seven new missions by 2011.

Rather than take money from other parts of NASA to pay for Earth-science missions, we should remember that U.S. leadership in space requires NASA to carry a balanced portfolio. We're dedicated to Earth-science research at NASA. We must also be just as dedicated to space exploration, lest our nation's leadership on this new frontier slip away.

### No trade-off --- plan increase the overall NASA budget

Landis 95 (Geoffrey, NASA John Glenn Research Center, “Footsteps to Mars: An Incremental Approach to Mars Exploration”, Journal of the British Interplanetary Society, 48, [http://www.geoffreylandis.com/Footsteps .pdf](http://legislative.nasa.gov/PL%20111-267.pdf))

Recently there has been an alarming tendency in the scientific and space advocacy communities for advocates to attack one project, in the belief that if that project could be canceled, the money saved would be used for their own, more desirable projects. This is false. Quoting from senate staffer Steve Palmer [17]: “What space station and ASRM [advanced solid rocket motor] add up to is a drop in the bucket. If Congress cuts out both space station and ASRM, will the money be used for other programs of interest to the space industry? The short answer is no”. Arguments to cancel space projects are eagerly picked up in Congress, by people who have agendas and pet projects that have nothing to do with space. Further, attacking space projects has the result of making enemies out of allies. When we attack someone else’s project, we can count on having them attack ours. The result is that the arguments against both projects will be remembered by a money-starved Congress. It is not true that manned missions eclipse funds for unmanned science missions. In fact, there is an excellent case to be made for precisely the opposite correlation: the presence of large manned missions increases the funding and opportunities for unmanned science missions. Historically, the science budget of NASA has been a roughly constant fraction of the total budget; any major new initiative which increases the overall space budget is likely to increase the funding for science. If Mars advocates adopt the approach of pushing our initiatives by tearing down other space programs, the likely result is that nothing, neither Mars nor other programs, will be accomplished.

## Aff – No Link – Asteroid Deflection

### Plan’s low-cost and averts more expensive future measures

NAC 10 (“Report of the NASA Advisory Council Ad Hoc Task Force on Planetary Defense”, 10-6, [http://www.nasa.gov/pdf/490945main\_10-10\_TFPD.pdf](http://www.space.com/scienceastronomy/090702-phoenix-soil.html))

The driving philosophy behind the national and international defense against NEOs should be, “Find them early.” Early detection of NEOs (especially those larger than 140 meters in size) is key to mounting an effective--and cost-effective--Planetary Defense effort. An adequate search, detection, and tracking capability could find hazardous objects several years or decades before they threaten impact. Early detection and followup tracking of hazardous NEOs eliminates any need for a standing defense capability by mission-ready deflection spacecraft with their high attendant costs. 6. Accurate orbital predictions based on an adequate and credible search and tracking capability will eliminate many ambiguous impact threats from NEOs, ruling out a collision long before an expensive deflection solution becomes necessary. This requires reducing the uncertainty in any NEO’s observed and predicted position. The Task Force refers to this strategy as “reducing the error ellipse” as rapidly as possible. 7. A relatively low-cost, early investment in search, track, and follow-up observations through ground- and space-based systems (including radar) is a powerful cost-saving strategy. Such a capability will pay off handsomely by enabling more accurate orbit determination; eliminating many predictions of NEOs with a worrisome probability of impact (an uncomfortably high, but uncertain, probability of Earth collision); and avoiding the launch of a deflection or even a transponder tracking spacecraft, each costing hundreds of millions of dollars.

### Plan’s funding comes from the human exploration budget

Kerr 11 (Richard, Staff Writer – Science Magazine, “A Windfall for Defenders of the Planet”, Science, 2-18, 331(6019), p. 843)

Planetary defense may be in line for a boost, but the present Congress is in a serious budget-cutting mood. That's where the human exploration of space could come in. If NASA hopes to meet the president's goal of sending humans to an NEA by 2025, the search for small NEAs will have to be at least as fast as that required to meet the 2020 planetary defense goal. That's because NASA would need to identify potential exploration targets before 2020. And the asteroids easiest for astronauts to reach happen to be the ones most likely to strike Earth. So human exploration could pick up the half-billion-dollar-or-more tab for an NEA search that the NASA task force recommended. In addition, the precursor robotic missions needed to inspect potential targets for later astronaut visits would provide information on the physical makeup of NEAs crucial to deciding how to nudge a threatening NEA off its collision course with Earth.

## Aff – NASA Satellites Not Key

### EPA and private sector satellites fill in

Hudgins 97 (Edward L., Director of Regulatory Studies – Cato Institute, “NASA and Mission to Planet Earth”, Testimony before the House Committee on Science, 3-19, [http://www.cato.org/pub\_display.php?pub\_id=12406](http://papers.ssrn.com/sol3/papers.cfm?pub_id=12406))

NASA in recent years has seen environmental projects as potential cash cows. Mission to Planet Earth is the epitome of such an enterprise. NASA in the late 1980s had to fight turf battles with other agencies for jurisdiction over satellites to monitor the environment. After all, if the Environmental Protection Agency needs data to fulfill its mission, that should be none of NASA's business. NASA in effect muscled in on the territory of EPA and other government agencies. The mindset at NASA still seems to be that any activities that take place in space should be under its jurisdiction and supervision.

Typical of NASA's political tactics, in February, 1992 it made screaming headlines with its announcement that a huge ozone hole could be in the process of opening over the Northern hemisphere. In fine print the data were skimpy at best. Still, the agency got the politically correct headlines as its funding was being debated. There were few headlines months later when no ozone hole developed.

A second reason for not reauthorizing Mission to Planet Earth is that this program continues to cement NASA and the government in exactly the mode of operation that discourages private sector development of space infrastructure, and that in part accounts for the fact that we do not have space stations and Moon bases at this time. If a government agency, say, EPA, needs data, it should purchase the data, not the hardware, from the private sector. Government agencies should not be in the business of launching remote sensing satellites into space nor owning those satellites. There are private sector providers that could collect the data, based on bids submitted to the agency wishing the information. This approach would help in the development of for profit, private sector alternatives to government functions.

### NOAA satellites solve solar flare monitoring

Balstad 11 (Dr. Roberta, Trustee University Corporation for Atmospheric Research, CQ Congressional Testimony, 3-11, Lexis)

National Weather Service (NWS) - NWS is a 24/7 operation, and is this nation's sole authoritative source for issuing warnings and forecasts related to weather, severe weather, and long term weather trends. Every day for the U.S., its territories, adjacent waters and ocean areas the NWS provides vital information regarding transportation safety, marine conditions, fire weather, air quality, agriculture, and flooding. The value of the National Weather Service cannot be overstated, and UCAR urges Congress's continued strong support for its many critical activities.
In upcoming years, solar activity, including flares that release immense magnetic energy that can harm power grids, electronic communication, and satellite systems, is predicted to peak. NOAA's Space Weather Prediction Center (SWPC), part of NOAA's National Weather Service, is the nation's official source of space weather forecasts, alerts, and warnings. With a solar max expected in 2013, this is a critical time when NOAA must continue to provide alerts, watches, warnings, and forecasts to customers to ensure the nation's infrastructure is not disrupted. UCAR asks the Committee to provide the requested $11.6 million for NOAA's Space Weather activities in FY 2012.

## Aff – Remote Sensing Fails

### Satellites fail --- the cook the books to show dangerous environmental trends

Hudgins 97 (Edward L., Director of Regulatory Studies – Cato Institute, “NASA and Mission to Planet Earth”, Testimony before the House Committee on Science, 3-19, [http://www.cato.org/pub\_display.php?pub\_id=12406](http://www.recovery.gov/Transparency/agency/reporting/agency_reporting5program.aspx?pub_id=12406))

The third reason for not reauthorizing Mission to Planet Earth is that its mission itself is of questionable value, based on political considerations rather than real science. It seems aimed more at selectively acquiring data to push politically correct agendas than to collect information that is urgently needed by policymakers but cannot be acquired by other, less costly means.

Fear of global warming was the major impetus behind Mission to Planet Earth. But each year reveals exactly what junk science this mission is based on. Rather than rehearse in detail the reasons why the global warming ideology is highly suspect and certainly does not deserve its own multi-billion dollar federal program, I will call your attention to the work and statements by Prof. Patrick J Michaels of the University of Virginia who has testified before this body on this issue at various times.

I would note that the computer models used in the mid-1980s to make the original global warming predictions also would have predicted, based on the data, that the atmosphere should have warmed up by 2.0° over the past 100 years. In fact, the real amount of warming seems to be about half a degree.

I also note that using ground-based data we find that much of this warming took place before World War II. Yet only about one-third of the greenhouse gas enhancement that supposedly causes global warming took place before the War. Two-thirds occurred after. You cannot have an effect, the warming, before the cause.

I note in addition that an article in the *New York Times* of March 18, 1997 on the influence of ocean currents on global climate suggests that oscillating temperatures are not due to manmade greenhouse gases.

NASA and the contractors working on Mission to Planet Earth want to keep the project going. This is hardly surprising. But thisu program is another example of the federal government's misplaced priorities, an example of a program that never should have been started but possibly will continue on, sucking up taxpayers' dollars. I hope you use this opportunity to reevaluate the mission before it becomes yet another unneeded government activity that policymakers are unable to kill because of the industrial and ideological clients it supports and who, in turn, support the policymakers.

## Aff – Environment Impact Defense

### Environment is resilient

Easterbrook 95 (Gregg, Distinguished Fellow – Fullbright Foundation, A Moment on Earth, p. 25)

In the aftermath of events such as Love Canal or the Exxon Valdez oil spill, every reference to the environment is prefaced with the adjective "fragile." "Fragile environment" has become a welded phrase of the modern lexicon, like "aging hippie" or "fugitive financier." But the notion of a fragile environment is profoundly wrong. Individual animals, plants, and people are distressingly fragile. The environment that contains them is close to indestructible. The living environment of Earth has survived ice ages; bombardments of cosmic radiation more deadly than atomic fallout; solar radiation more powerful than the worst-case projection for ozone depletion; thousand-year periods of intense volcanism releasing global air pollution far worse than that made by any factory; reversals of the planet's magnetic poles; the rearrangement of continents; transformation of plains into mountain ranges and of seas into plains; fluctuations of ocean currents and the jet stream; 300-foot vacillations in sea levels; shortening and lengthening of the seasons caused by shifts in the planetary axis; collisions of asteroids and comets bearing far more force than man's nuclear arsenals; and the years without summer that followed these impacts. Yet hearts beat on, and petals unfold still. Were the environment fragile it would have expired many eons before the advent of the industrial affronts of the dreaming ape. Human assaults on the environment, though mischievous, are pinpricks compared to forces of the magnitude nature is accustomed to resisting.

### No impact to species loss

Sagoff 97 (Mark, Senior Research Scholar – Maryland School of Public Policy, Pew Scholar in Conservation and the Environment, “Do We Consume Too Much?”, Atlantic Monthly, June,

http://www.chem.brown.edu/chem12/readings/atlantic/consume.html)

There is no credible argument, moreover, that all or even most of the species we are concerned to protect are essential to the functioning of the ecological systems on which we depend. (If whales went extinct, for example, the seas would not fill up with krill.) David Ehrenfeld, a biologist at Rutgers University, makes this point in relation to the vast ecological changes we have already survived. “Even a mighty dominant like the American chestnut,” Ehrenfeld has written, “extending over half a continent, all but disappeared without bringing the eastern deciduous forest down with it.” Ehrenfeld points out that thespecies most likely to be endangered are those the biosphere isleast likely to miss. “Many of these species were never common or ecologically influential; by no stretch of the imagination can we make them out to be vital cogs in the ecological machine.”

## Aff – Warming Impact Defense

### Warming’s inevitable

Stern 7 (Nicholas, Head of the British Government Economic Service and I.G. Patel Chair – London School of Economics, The Economics of Climate Change: The Stern Review, p. 11-13)

Additional warming is already in the pipeline due to past and present emissions. The full warming effect of past emissions is **yet to be realised**. Observations show that the oceans have taken up around 84% of the total heating of the Earth’s system over the last 40 years36. If global emissions were stopped today, some of this heat would be exchanged with the atmosphere as the system came back into equilibrium, **causing an additional warming**. Climate models project that the world is **committed** **to** a **further warming** of 0.5° - 1 °C over several decades due to past emissions 37. This warming is smaller than the warming expected if concentrations were stabilised at 430 ppm CO2e, because atmospheric aerosols mask a proportion of the current warming effect of greenhouse gases. Aerosols remain in the atmosphere for only a few weeks and are not expected to be present in significant levels at stabilisation38. If annual emissions continued at today’s levels, greenhouse gas levels would be close to double pre-industrial levels by the middle of the century. If this concentration were sustained, temperatures are projected to eventually rise by 2 – 5ºC or even higher. Projections of future warming depend on projections of global emissions (discussed in chapter 7). If annual emissions were to remain at today’s levels, greenhouse gas levels would reach close to 550 ppm CO2e by 2050.39 Using the lower and upper 90% confidence bounds based on the IPCC TAR range and recent research from the Hadley Centre, this would commit the world to a warming of around 2 – 5°C (Table 1.1). As demonstrated in Box 1.2, these two climate sensitivity distributions lie close to the centre of recent projections and are used throughout this Review to give illustrative temperature projections. Positive feedbacks, such as methane emissions from permafrost, could drive temperatures even higher. Near the middle of this range of warming (around 2 – 3°C above today, the Earth would reach a temperature not seen since the middle Pliocene around 3 million years ago . This level of warming on a global scale is far outside the experience of human civilisation. However, these are conservative estimates of the expected warming, because in the absence of an effective climate policy, changes in land use and the growth in population and energy consumption around the world will drive greenhouse gas emissions far higher than today. This would lead greenhouse gas levels to attain higher levels than suggested above. The IPCC projects that without intervention greenhouse gas levels will rise to 550 – 700 ppm CO2e by 2050 and 650 – 1200 ppm CO2e by 210041. These projections and others are discussed in Chapter 7, which concludes that, without mitigation, greenhouse gas levels are likely to be towards the upper end of these ranges. If greenhouse gas levels were to reach 1000 ppm, more than treble pre-industrial levels, the Earth would be committed to around a 3 – 10°C of warming or more, even without considering the risk of positive feedbacks (Table 1.1).

### Warming can’t be stopped

Stampf 7 (Olaf, Staff Writer – Spiegel Online, “Not the End of the World as we Know it”, Der Spiegel, 5-5, http://www.spiegel.de/international/germany/0,1518,481684,00.html\_

The truth is probably somewhere between these two extremes. Climate change will undoubtedly have losers -- but it will also have winners. There will be a reshuffling of climate zones on earth. And there is something else that we can already say with certainty: The end of the world isn't coming any time soon. Largely unnoticed by the public, climate researchers are currently embroiled in their own struggle over who owns the truth. While some have always seen themselves as environmental activists aiming to shake humanity out of its complacency, others argue for a calmer and more rational approach to the unavoidable. One member of the levelheaded camp is Hans von Storch, 57, a prominent climate researcher who is director of the Institute for Coastal Research at the GKSS Research Center in Geesthacht in northern Germany. "We have to take away people's fear of climate change," Storch told DER SPIEGEL in a recent interview (more...). "Unfortunately many scientists see themselves too much as priests whose job it is to preach moralistic sermons to people." Keeping a cool head is a good idea because, for one thing, we can no longer completely prevent climate change. No matter how much governments try to reduce carbon dioxide emissions, it will only be possible to limit the rise in global temperatures to about 2 degrees Celsius (3.6 degrees Fahrenheit) by the end of the century.