# Aff

## Warming Theory

### Warming True

#### Earth is the warmest it has ever historically been.

NOAA News, 7-28-2012, “NOAA: Past Decade Warmest on Record According to Scientists in 48 Countries”, NOAA, <http://www.noaanews.noaa.gov/stories2010/20100728_stateoftheclimate.html>

The 2009 State of the Climate report released today draws on data for 10 key climate indicators that all point to the same finding: the scientific evidence that our world is warming is unmistakable. More than 300 scientists from 160 research groups in 48 countries contributed to the report, which confirms that the past decade was the warmest on record and that the Earth has been growing warmer over the last 50 years. Based on comprehensive data from multiple sources, the report defines 10 measurable planet-wide features used to gauge global temperature changes. The relative movement of each of these indicators proves consistent with a warming world. Seven indicators are rising: air temperature over land, sea-surface temperature, air temperature over oceans, sea level, ocean heat, humidity and tropospheric temperature in the “active-weather” layer of the atmosphere closest to the Earth’s surface. Three indicators are declining: Arctic sea ice, glaciers and spring snow cover in the Northern hemisphere. “For the first time, and in a single compelling comparison, the analysis brings together multiple observational records from the top of the atmosphere to the depths of the ocean,” said Jane Lubchenco, Ph.D., under secretary of commerce for oceans and atmosphere and NOAA administrator. “The records come from many institutions worldwide. They use data collected from diverse sources, including satellites, weather balloons, weather stations, ships, buoys and field surveys. These independently produced lines of evidence all point to the same conclusion: our planet is warming,”

#### Warming is real – massive international consensus

Patriot-News Editorial Board, 4-22-2012, “Global warming,” http://www.pennlive.com/editorials/index.ssf/2012/04/global\_warming\_its\_real\_its\_no.html

Anyone who chalks global warming up to some left-wing conspiracy or dismisses it as a fanciful theory is simply not paying attention. Every single major U.S. and international scientific organization has attested to the basic facts of global warming. These include the American Association for the Advancement of Science, National Academy of Sciences, American Meteorological Society, World Meteorological Organization and dozens more. There are occasional scientists who disagree. But for each one, there are thousands of scientists who say the evidence is overwhelming.

Another common misconception is that global warming doesn’t matter. Who cares if the average global temperature rises by a degree or two? Other than a few oceanfront property owners, who cares if sea levels rise by a foot or two?

#### Warming is happening fast – Arctic sea ice proves

Andrew Burger, 1-31-2012, “The Oceanic Conveyor Belt,” Global Warming Is Real, http://globalwarmingisreal.com/2012/01/

Two new research papers by authoritative climate research teams were announced this week — one on climate change tipping points being reached in the Arctic and a second on warming of long-distance, poleward-moving ocean currents. The results of the studies show that warming of both the Arctic and western boundary currents is happening faster than has been anticipated, prompting the researchers to publicly urge that efforts to adapt to abrupt climate change be intensified globally. Climate Change Tipping Points in the Arctic In “Abrupt climate change in the Arctic,” University of Western Australia (UWA) Ocean Institute researchers lead by director and Winthrop Professor Carlos Duarte found that the Arctic is warming at a rate three times faster than the global average, which has caused Arctic summer sea ice to melt and recede at a pace faster than researchers have forecast. Arctic summer sea ice may be limited to the the waters off northern Greenland and Ellesmere Island in as short a period as the next decade, and is likely to disappear entirely by the middle of the century, according to a WA News report. The warming’s occurring so fast that it’s not only threatening Arctic ecosystems and traditional ways of life, the Arctic may change from being a net carbon sink to a net source of greenhouse gas emissions.

#### Yes warming – new data and physical changes confirm

Jonathan Leake, Environment Editor, 2-14-2010, “World may not be warming, say scientists,” Times Online, http://www.timesonline.co.uk/tol/news/environment/article7026317.ece

Kevin Trenberth, a lead author of the chapter of the IPCC report that deals with the observed temperature changes, said he accepted there were problems with the global thermometer record but these had been accounted for in the final report. “It’s not just temperature rises that tell us the world is warming,” he said. “We also have physical changes like the fact that sea levels have risen around five inches since 1972, the Arctic icecap has declined by 40% and snow cover in the northern hemisphere has declined.” The European Centre for Medium-Range Weather Forecasts has recently issued a new set of global temperature readings covering the past 30 years, with thermometer readings augmented by satellite data. Dr Vicky Pope, head of climate change advice at the Met Office, said: “This new set of data confirms the trend towards rising global temperatures and suggest that, if anything, the world is warming even more quickly than we had thought.”

### Warming Anthropogenic

#### Overwhelming consensus that warming is anthropogenic

John Cook, 5-28-2012, “Is there a scientific consensus on global warming?” Skeptical Science, http://www.skepticalscience.com/global-warming-scientific-consensus-basic.htm

That humans are causing global warming is the position of the Academies of Science from 19 countries plus many scientific organizations that study climate science. More specifically, around 95% of active climate researchers actively publishing climate papers endorse the consensus position. Scientists need to back up their opinions with research and data that survive the peer-review process. A survey of all peer-reviewed abstracts on the subject 'global climate change' published between 1993 and 2003 shows that not a single paper rejected the consensus position that global warming is man caused (Oreskes 2004). 75% of the papers agreed with the consensus position while 25% made no comment either way (focused on methods or paleoclimate analysis). Subsequent research has confirmed this result. A survey of 3146 earth scientists asked the question "Do you think human activity is a significant contributing factor in changing mean global temperatures?" (Doran 2009). More than 90% of participants had Ph.D.s, and 7% had master’s degrees. Overall, 82% of the scientists answered yes. However, what are most interesting are responses compared to the level of expertise in climate science. Of scientists who were non-climatologists and didn't publish research, 77% answered yes. In contrast, 97.5% of climatologists who actively publish research on climate change responded yes. As the level of active research and specialization in climate science increases, so does agreement that humans are significantly changing global temperatures. Most striking is the divide between expert climate scientists (97.4%) and the general public (58%). The paper concludes: "It seems that the debate on the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes. The challenge, rather, appears to be how to effectively communicate this fact to policy makers and to a public that continues to mistakenly perceive debate among scientists." This overwhelming consensus among climate experts is confirmed by an independent study that surveys all climate scientists who have publicly signed declarations supporting or rejecting the consensus. They find between 97% to 98% of climate experts support the consensus (Anderegg 2010). Moreover, they examine the number of publications by each scientist as a measure of expertise in climate science. They find the average number of publications by unconvinced scientists (eg - skeptics) is around half the number by scientists convinced by the evidence. Not only is there a vast difference in the number of convinced versus unconvinced scientists, there is also a considerable gap in expertise between the two groups.

#### Warming is the result of human activity

Diana Liverman, professor of Environmental Science in the School of Geography and Director of the Environmental Change Institute, 10-8-2007**,** “From Uncertain to Unequivocal: The IPCC Working Group I Report: Climate Change 2007—The Physical Science Basis” Environment, http://eldref-publications.metapress.com/index/3P10072NM3722251.pdf

 With the publication of the Fourth Assessment report of the Intergovernmental Panel on Climate Change (IPCC), this year marks some important shifts in our understanding of climate change and its impacts. Three working groups produced reports covering physical science (WGI); impacts, adaptation, and vulnerability (WGII); and mitigation (WGIII). The WGI report on physical science involved more than 550 authors and published a summary for policymakers in February, followed by the full report in May after a long process of review by experts and government departments around the world. The reports have been widely discussed in scientific meetings and will become a major reference source, especially since all the reports are freely available on the Internet.1 The WGI report was published first and attracted considerable media attention because of its apparently definitive conclusions about the rate and causes of climate change. Perhaps the most emphatic conclusion of the WGI report is that “warming of the climate system is unequivocal” and that much (50 percent) of this warming is very likely (more than 90 percent) due to increases in greenhouse gas concentrations associated with human activity. These statements are much more confident than those in the 2001 IPCC report and may seem unsurprising to those who regularly read the scientific literature. But for many people who are not climate science experts, some of the important incremental shifts in the understanding of climate change are less obvious, especially as the issue has been confused by the sustained media and political attention to climate skeptics.

#### Warming is caused by humans.

Andrew **Dessler et. al**,3-7-**10**, , professor of atmospheric sciences Texas A&M University, (Chronicle, “On Global Warming, the science is solid”, Chron, http://www.chron.com/disp/story.mpl/editorial/outlook/6900556.html

In recent months, e-mails stolen from the University of East Anglia's Climatic Research Unit in the United Kingdom and errors in one of the Intergovernmental Panel on Climate Change's reports have caused a flurry of questions about the validity of climate change science. These issues have led several states, including Texas, to challenge the Environmental Protection Agency's finding that heat-trapping gases like carbon dioxide (also known as greenhouse gases) are a threat to human health. However, Texas' challenge to the EPA's endangerment finding on carbon dioxide contains very little science. Texas Attorney General Greg Abbott admitted that the state did not consult any climate scientists, including the many here in the state, before putting together the challenge to the EPA. Instead, the footnotes in the document reveal that the state relied mainly on British newspaper articles to make its case. Contrary to what one might read in newspapers, the science of climate change is strong. Our own work and the immense body of independent research conducted around the world leaves no doubt regarding the following key points: The global climate is changing. A 1.5-degree Fahrenheit increase in global temperature over the past century has been documented by NASA and the National Oceanic and Atmospheric Administration. Numerous lines of physical evidence around the world, from melting ice sheets and rising sea levels to shifting seasons and earlier onset of spring, provide overwhelming independent confirmation of rising temperatures. Measurements indicate that the first decade of the 2000s was the warmest on record, followed by the 1990s and the 1980s. And despite the cold and snowy winter we've experienced here in Texas, satellite measurements show that, worldwide, January 2010 was one of the hottest months in that record. • • Human activities produce heat-trapping gases. Any time we burn a carbon-containing fuel such as coal or natural gas or oil, it releases carbon dioxide into the air. Carbon dioxide can be measured coming out of the tailpipe of our cars or the smokestacks of our factories. Other heat-trapping gases, such as methane and nitrous oxide, are also produced by agriculture and waste disposal. The effect of these gases on heat energy in the atmosphere is well understood, including factors such as the amplification of the warming by increases in humidity. • • Heat-trapping gases are very likely responsible for most of the warming observed over the past half century. There is no question that natural causes, such as changes in energy from the sun, natural cycles and volcanoes, continue to affect temperature today. Human activity has also increased the amounts of tiny, light-scattering particles within the atmosphere. But despite years of intensive observations of the Earth system, no one has been able to propose a credible alternative mechanism that can explain the present-day warming without heat-trapping gases produced by human activities. • • The higher the levels of heat-trapping gases in the atmosphere, the higher the risk of potentially dangerous consequences for humans and our environment. A recent federal report, “Global Climate Change Impacts in the United States,” commissioned in 2008 by the George W. Bush administration, presents a clear picture of how climate change is expected to affect our society, our economy and our natural resources. Rising sea levels threaten our coasts; increasing weather variability, including heat waves, droughts, heavy rainfall events and even winter storms, affect our infrastructure, energy and even our health. The reality of these key points is not just our opinion. The national academies of science of 32 nations, and every major scientific organization in the United States whose members include climate experts, have issued statements endorsing these points. The entire faculty of the Department of Atmospheric Sciences at Texas A&M as well as the Climate System Science group at the University of Texas have issued their own statements endorsing these views (atmo.tamu.edu/weather-and-climate/climate-change-statement; www.ig.utexas.edu/jsg/css/statement.html). In fact, to the best of our knowledge, there are no climate scientists in Texas who disagree with the mainstream view of climate science. We are all aware of the news reports describing the stolen e-mails from climate scientists and the errors in the IPCC reports. While aspects of climate change impacts have been overstated, none of the errors or allegations of misbehavior undermine the science behind any of the statements made above. In particular, they do not alter the conclusions that humans have taken over from nature as the dominant influence on our climate.

#### Warming is anthropogenic, as proven through fingerprinting.

Charles Keller, 5-5-2003, Former Director of the Los Alamos Branch of the University of California's Institute of Geophysics and Planetary Physics and currently Visiting Scientist at Los Alamos National Laboratory, “Global Warming: The Balance of Evidence and Its Policy Implications”, The Scientific World, <http://www.solarstorms.org/ReviewGlobalWarming.html>

Merely reproducing such gross observables as large scale temperature averages is not sufficient for selecting anthropogenic global warming over other possible causes of climate change. It is recognized that different sources of warming might each have unique effects on aspects of the climate. For example, GHG forcing is expected to cause warming preferentially at night and during the winter, and at higher latitudes, as well as causing cooling in the stratosphere at the same time as warming in the troposphere (increased solar activity is expected to cause warming when the sun is shining and simultaneously in both the troposphere and stratosphere.). Aerosol cooling might be expected to cool the NH more than the SH since most industrial and transportation pollution is concentrated in the north. There have been several attempts to find these so-called “fingerprints” of GHG forcing on climate (Barnett et al. 1999). However, because of a variety of factors, such fingerprints are less obvious than originally expected. But important fingerprints are being found. GHG forcing should have an increasing effect going from equator (where water vapor can swamp the small additional GHG forcing) to poles (where, in the relative absence of water vapor, anthropogenic GHGs should dominate). Thus, one might expect (and most models predict) that warming at high latitudes will be larger than at low latitudes. This is observed in both hemispheres over land up to quite high latitudes, but in the polar regions themselves things are more complicated. The Arctic is warming considerably but some of the extra heat seems to be going into the energy necessary to change solid ice to liquid water. The West Antarctic is warming considerably near it is north-trending peninsula, but not over the larger topographically dominated eastern half which is cooled partly by the famous ozone hole’s effect on weather. Attempts to quantify attribution have been published (Karoly and Braganza 2001a, b; Stott et al. 2001). These methods are fairly complicated and, due to space indeed limitations, will only be referenced here. Suffice it so say that they too show the AGHG theory to account for the observations (although other theories have not been subjected to such a test). Attribution has gone beyond just matching temperature change. In a pivotal paper, Santer et al. (2007) look for human-induced changes in atmospheric moisture content. In a formal detection and attribution analysis using the pooled results from 22 different climate models, the simulated “fingerprint” pattern of anthropogenically caused changes in water vapor is identifiable with high statistical confidence in the Satellite SSM/I data. Their conclusions bear quoting: “Models suggest that the large increase in water vapor is primarily due to human-caused increases in GHGs and not solar forcing… These findings, together with related work on continental-scale river runoff, zonal mean rainfall, and surface specific humidity, suggest that there is an emerging anthropogenic signal in both the moisture content of the earth’s atmosphere and in the cycling of moisture between atmosphere, land, and ocean. Detection and attribution studies have now moved beyond “temperature only” analyses and show physical consistency between observed and simulated temperature, moisture, and circulation changes.”

#### Warming is solely anthropogenic

Charles Keller, 8-8-20**08**, Former Director of the Los Alamos Branch of the University of California's Institute of Geophysics and Planetary Physics and currently Visiting Scientist at Los Alamos National Laboratory, “Global warming: a review of this mostly settled issue”, Springer-Verlag, <http://www.webpages.uidaho.edu/envs501/downloads/Keller%202009.pdf>

Alternative ways to reproduce twentieth century temperature record Are there any other forcings that could account equally well for the temperature records both past and present? Basically there are none, but people continue to believe that the sun must be responsible for a much larger fraction of the warming than currently estimated from direct forcing due to changes in TSI. (see Sect. 4). Indeed it is becoming clear that the sun does indeed influence climate by indirect means, but it also seems clear that what influences there are, are small compared with anthropogenic forcings. Solar indirect, especially cosmic ray-driven cloudiness, should vary with the solar cycle enough to show global temperature variations over that cycle which it does not seem to. Attribution of observed global warming has received much attention since it is at the heart of the problem. There are two aspects to this. First is climate sensitivity to increasing CO2 in the atmosphere which strongly involves the positive feedbacks of water vapor, ice albedo, etc. While the models need continued improvement in these areas, comparison with observations of both present and paleo-climates suggests that a sensitivity to doubling CO2 is likely between 2 and 3°C. Second, showing that no other forcing is able to cause the observed warming. This is harder to do because as the adage says, “absence of evidence is not necessarily evidence of absence.” However, the role of the sun, so important in earlier warmings and coolings, is far less effective in the past 25 years during the largest warming but no increases in solar activity. Thus, as IPCC (2007) makes clear, we are now very certain that the observed warming especially in the last 25 years is due mostly to human emissions of GHGs.

#### Greenhouse gases are the cause of global warming.

**EPA**, 6-14-20**12**, “Climate Change Science Overview”, EPA,

<http://www.epa.gov/climatechange/science/overview.html>

Most of the warming of the past half century has been caused by human emissions of greenhouse gases. [1] Greenhouse gases come from a variety of human activities, including: burning fossil fuels for heat and energy, clearing forests, fertilizing crops, storing waste in landfills, raising livestock, and producing some kinds of industrial products. Greenhouse gas emissions are not the only way that people can change the climate. Activities such as agriculture or road construction can change the reflectivity of Earth's surface, leading to local warming or cooling. This effect is observed in urban centers, which are often warmer than surrounding, less populated areas. Emissions of small particles, known as aerosols, into the air can also lead to reflection or absorption of the sun's energy. Learn more about past and present climate trends and their causes.Climate will continue to change unless we reduce our emissions During the 21st century, global warming is projected to continue and climate changes are likely to intensify. Scientists have used climate models to project different aspects of future climate, including temperature, precipitation, snow and ice, ocean level, and ocean acidity. Depending on future emissions of greenhouse gases and how the climate responds, average global temperatures are projected to increase worldwide by 2°F to 11.5°F by 2100.

Climate change impacts our health, environment, and economy

#### Greenhouse gases are at their all-time high.

Environment-National Geographic, 2012. “What Is Global Warming? The Planet Is Heating Up—and Fast”, National Geographic, <http://environment.nationalgeographic.com/environment/global-warming/gw-overview>

Glaciers are melting, sea levels are rising, cloud forests are drying, and wildlife is scrambling to keep pace. It's becoming clear that humans have caused most of the past century's warming by releasing heat-trapping gases as we power our modern lives. Called greenhouse gases, their levels are higher now than in the last 650,000 years. We call the result global warming, but it is causing a set of changes to the Earth's climate, or long-term weather patterns, that varies from place to place. As the Earth spins each day, the new heat swirls with it, picking up moisture over the oceans, rising here, settling there. It's changing the rhythms of climate that all living things have come to rely upon.

### AT: No Warming – Urban Heat Islands

#### Urban heat island effect is small – doesn’t disprove warming

Science Daily, 10-20-2011, “Urban ‘Heat Island’ Effect Is a Small Part of Global Warming,” http://www.sciencedaily.com/releases/2011/10/111020025802.htm

Cities release more heat to the atmosphere than the rural vegetated areas around them, but how much influence these urban "heat islands" have on global warming has been a matter of debate. Now a study by Stanford researchers has quantified the contribution of the heat islands for the first time, showing that it is modest compared with what greenhouse gases contribute to global warming. "Between 2 and 4 percent of the gross global warming since the Industrial Revolution may be due to urban heat islands," said Mark Z. Jacobson, a professor of civil and environmental engineering who led the study. He and graduate student John Ten Hoeve compare this with the greenhouse gas contribution to gross warming of about 79 percent and the black carbon contribution of about 18 percent. Black carbon is a component of the soot created by burning fossil fuels and biofuels and is highly efficient at absorbing sunlight, which heats the atmosphere. Gross global warming is the total amount of warming that has taken place from all sources, mainly greenhouse gases, black carbon particles and heat islands. Net global warming is gross global warming minus the cooling effect of light-colored atmospheric particles that reflect sunlight back into space, which offsets about half of global warming to date. Net, or observed, global warming is what is typically reported in the media. Responding to skeptics Jacobson and Ten Hoeve are authors of a paper describing the research that will be published in Journal of Climate. The paper is available online now. The study modeled climate response from 2005 to 2025. Some global warming skeptics have claimed that the urban heat island effect is so strong that it has been skewing temperature measurements that show that global warming is happening. They have argued that urban areas are a larger contributor to global warming than the greenhouse gases produced by human activity, and thus drastic measures to reduce greenhouse gases are not needed. "This study shows that the urban heat island effect is a relatively minor contributor to warming, contrary to what climate skeptics have claimed," Jacobson said. "Greenhouse gases and particulate black carbon cause far more warming."

#### Urban heat island effect doesn’t affect temperature readings

Richard Black, BBC environment correspondent, “Climate change sceptics 'wrong,'” 11-8-2004 <http://news.bbc.co.uk/2/hi/uk_news/4021197.stm>

A major argument used by sceptics of global warming is flawed, a UK Met Office study in Nature magazine says. This argument maintains that much recorded climate data is inherently unreliable because of where weather instruments are situated. Most are in or near cities, which produce their own heat; so the rapid warming measured over the last century could be just a record of urbanisation. The Met Office believes its study shows this "urban heat island" idea is wrong. The analysis has been done by Dr David Parker. He used data for the last 50 years to create two separate graphs. One plots temperatures observed on calm nights, the other on windy nights. If the urban heat island hypothesis is correct, he says, instruments should have recorded a bigger temperature rise for calm nights than for windy ones - because wind blows excess heat away from cities and away from the measuring instruments. Opposing sides But there is no difference between the curves. "It helps to answer the critics," Dr Parker told BBC News. "There are other kinds of temperature measurements, too, which could not be influenced by urbanisation, such as warming in the oceans. "Different methods of measurement can produce different rates of warming but they all point upwards." Dr Myles Allen, from the atmospheric physics department at Oxford University, agrees: "It's pretty convincing," he said. "It's a sensible analysis which tests a prediction of the sceptical theory; and if it's right, we should see a greater effect on calm nights.

### Yes Feedbacks

#### Permafrost will accelerate global warming

National Snow and Ice Data Center (**NSIDC**), 2-16-20**11**, “Thawing permafrost will accelerate global warming in decades to come, says new study”, NSIDC, http://nsidc.org/news/press/20110216\_permafrost.html

Kevin Schaefer's research team drills permafrost cores on Alaska's North Slope. New findings by the researchers indicate permafrost in Earth's frozen regions is readying to release vast quantities of carbon into the atmosphere, increasing carbon dioxide levels. This is a press release from the National Snow and Ice Data Center (NSIDC), which is part of the Cooperative Institute for Research in Environmental Sciences at the University of Colorado at Boulder. One- to two-thirds of Earth’s permafrost will disappear by 2200, unleashing vast quantities of carbon into the atmosphere, says a study by researchers at the Cooperative Institute for Research in Environmental Sciences (CIRES) National Snow and Ice Data Center (NSIDC). “The amount of carbon released is equivalent to half the amount of carbon that has been released into the atmosphere since the dawn of the industrial age,” said NSIDC scientist Kevin Schaefer. “That is a lot of carbon.”The carbon from permanently frozen ground—known as permafrost —will make its impact, not only on the climate, but also on international strategies to reduce climate change Schaefer said**. “If** we **want to hit a target carbon concentration, then we** have to reduce fossil fuel emissions that much lower than previously calculated to account for this additional carbon from the permafrost**,” Schaefer** said. “Otherwise we will end up with a warmer Earth than we want.” The carbon comes from plant material frozen in soil during the ice age of the Pleistocene: the icy soil trapped and preserved the biomass for thousands of years. Schaefer equates the mechanism to storing broccoli in the home freezer: “As long as it stays frozen, it stays stable for many years,” he said. “But you take it out of the freezer and it will thaw out and decay.” Now, permafrost is thawing in a warming climate and—just like the broccoli—the biomass will thaw and decay, releasing carbon into the atmosphere like any other decomposing plant material, Schaefer said. To predict how much carbon will enter the atmosphere and when, Schaefer and coauthors modeled the thaw and decay of organic matter currently frozen in permafrost under potential future warming conditions as predicted by the Intergovernmental Panel on Climate Change. They found that between 29–59 percent of the permafrost will disappear by 2200. That permafrost took tens of thousands of years to form, but will melt in less than 200, Schaefer said. The scientists used a model to predict how much carbon the thawing will release. They estimate an extra 190 plus or minus 64 gigatons of carbon will enter the atmosphere by 2200—about one-fifth the total amount of carbon currently in the atmosphere today. Carbon emissions from thawing permafrost will require greater reductions in fossil fuel emissions, to limit the atmospheric carbon dioxide to some maximum value associated with a target climate, Schaefer said. “It means the problem is getting more and more difficult all the time,” he said. “It is hard enough to reduce the emissions in any case, but now we saying that we have to reduce it even more.”

**Global Warming is rapidly getting worse.**

**UCS** (Union of Concerned Scientists), 5-27-20**10**, Union of Concerned Scientists, http://www.ucsusa.org/global\_warming/science\_and\_impacts/science/understanding-urgency-climate-change.html

Many circumstances require immediate action: consider a full bladder or a red traffic light. We usually address such circumstances without delay, because the consequences of inaction—physical discomfort or legal troubles—are clear. When it comes to climate change, the urgency of the problem may not seem so obvious, since it doesn't sound an alarm or poke us in the eye. The consequences appear to be far away. And we find it hard to comprehend the significant risks posed by global warming, such as the rapid accumulation of carbon dioxide in our atmosphere or the impending rise in sea levels, because we can't, at the moment, see them with the naked eye. Yet if we fail to reduce heat-trapping emissions, we will cross a threshold, and the changes in our world will be irreversible. Releasing carbon into the atmosphere is sort of like filling a water balloon from an outdoor faucet. If the water is merely trickling in, you can easily remove the balloon from the spout and have room to tie the knot. But if the spigot is gushing and the balloon is swollen with water, you have to act quickly and forcefully to remove it before it bursts. Human activities, such as burning coal and oil in power plants and cars, have poured excessive amounts of carbon dioxide into the atmosphere, and the natural world just can't absorb it all. Like the swollen water balloon, the atmosphere is overloaded. The problem with adding more carbon dioxide, methane, and nitrous oxide gases to Earth's atmosphere is that they trap heat, causing global temperatures to rise. Even a rise of a degree or two makes a difference in many aspects of the world that people care about. Back in 1960, about 40 percent of a metric ton of emitted CO2 would remain in the atmosphere. Now that has risen to 45 percent. This means that a ton of CO2 emissions today traps more heat than it would have fifty years ago.The evidence that global warming is happening now and that human activities are the primary cause is overwhelming. Indeed, recent research indicates that Earth's climate is changing more quickly than scientists had projected just a few years ago. Last week NASA and the National Oceanic and Atmospheric Administration reported that 2010 has been the warmest year worldwide so far recorded.At the request of Congress, the National Academy of Sciences released on May 19, 2010 a series of reports that emphasized the urgency of climate change and why the U.S. should act now to reduce emissions of heat-trapping gases. One central point was this: "The longer the nation waits to begin reducing emissions, the harder and more expensive it will likely be to reach any given emissions target."The panel of scientists at the National Academies determined that we need to go on a carbon budget, recommending that the United States restrict its carbon emissions to a total of 170 to 200 billion tons of global warming gases from 2012 to 2050. That would represent an 80 percent reduction in carbon emissions compared to current projections. In 2008 alone, the U.S. released 7 billion tons of greenhouse gases. If we maintain business as usual, we'll blow our budget in no time. For more than 30 years, scientists have presented their research about climate change and possible solutions to U.S. policymakers, but little action has been taken to reduce carbon-emitting activities. If we continue along the high emissions path, projections show that we risk locking in a rise of 3.6 to 9.9 degrees Fahrenheit by 2100. The upper end of that range is considered catastrophic.Around the world, informed citizens, motivated by an understanding of the science of climate change, are speaking up for urgent action. Cities, countries, and regions are working to limit the magnitude of climate change by lowering carbon dioxide emissions as well as to adapt to the unavoidable impacts of future climate change. Climate change carries serious consequences both for humans and for ecosystems. This is a crisis that will affect our food, our national security, our water, our ability to live where we choose, and other basic human needs. Whether and how we address global warming is not a question of science, it's a question of values.

#### The decline of clouds will accelerate warming.

**NASA**, **’12**, “Solar Radiation and Climate Experiment (SORCE)”, NASA http://earthobservatory.nasa.gov/Features/SORCE/sorce\_04.php

How the Earth’s climate reacts, however, depends on more factors than just greenhouse gases. For instance, some scientists expect that low-level stratocumulus clouds may decrease. Both changes would add to the heating, since an increase in cirrus would trap more infrared, and a decrease of stratocumulous would reflect less sunlight. Such cloud cover changes would intensify global warming. In contrast, an increase of sulfate aerosols created by pollution would likely reflect more sunlight and perhaps also make clouds more reflective, thereby countering global warming especially near pollution sources. Thick, puffy stratocumulus clouds (left) reflect sunlight and cool the Earth’s surface. However, thin cirrus clouds (right) allow most visible light to pass right through them, while blocking thermal radiation, so they warm the Earth. Because of this, how clouds respond to changes in solar energy output is a crucial aspect of the Sun’s influence on climate. (Photographs courtesy Dr. Robert Houze, University of Washington Cloud Atlas).

#### Accelerated global warming will release methane hydrates from the deep ocean, leading to a runaway greenhouse effect

Reuters 11-23-2005, “Can Tipping Points Accelerate Global warming, http://news.mongabay.com/2005/1123-reuters.html

Global warming will cause gasses trapped beneath the ocean floor to release into the atmosphere according to research [1] presented at the Annual Conference of the Royal Geographical Society [2]. The impact could initiate a catastrophic global greenhouse effect. Mark Maslin, Senior Reader in Geography at University College London and a senior researcher for the London Environmental Change Research Centre, looked at the impact of increasing global temperatures on ‘gas hydrates’ such as methane that exist in solid deposits at the bottom of the ocean and in permafrost on land [3][4]. According to Dr. Maslin, such a temperature rise could destabilize these deposits and trigger a massive release of methane gas into the atmosphere. Methane is 21 times more powerful than carbon dioxide as a greenhouse gas. This would result in a further rise in global temperatures and in doing so, would initiate the release of even more gas hydrate causing a runaway greenhouse effect. Gas hydrates from total reserves could contain up to 10 times the current amount of carbon into the atmosphere.

### IPCC Prodicts

#### IPCC is a reliable source on climate change.

The Times - United Kingdom, 3-15-2010, “IPCC a reliable source on climate change”, euro topics,

http://www.eurotopics.net/en/home/presseschau/archiv/results/archiv\_article/ARTICLE67068-IPCC-a-reliable-source-on-climate-change

The United Nations has set up a supervisory committee to review the work of the Intergovernmental Panel on Climate Change, or IPCC. The move comes in response to criticism that the Panel's statements tend to be exaggerated. But the dangers of global warming are real, writes the daily The Times: "The IPCC is not a self-selected group of scientists with a political agenda. It was founded in 1988 by the World Meteorological Organisation and the UN Environment Programme with a mandate to produce accurate, balanced assessments about human-induced climate change. ... Perhaps there is a criticism that can be made of IPCC scientists: they have been too slow publicly to defend their integrity. They have not been willing or able to hit the airwaves or make their case in newspapers. But scientists are now faced by powerful lobbies who are working to distort and discredit the science behind climate change."

#### The IPCC is proven reliable.

UCSUSA, 2-10-2010, “Attacks on the Intergovernmental Panel on Climate Change Obscure Real Science”, Union of Concerned Scientists,

<http://www.ucsusa.org/global_warming/science_and_impacts/global_warming_contrarians/attacks-on-the-ipcc.html>

Attacks on the Intergovernmental Panel on Climate Change Obscure Real Science Over the last few months, the Intergovernmental Panel on Climate Change (IPCC) has been attacked for minor errors in its sprawling 2007 report on climate change. To set the record straight and provide appropriate scientific context, the Union of Concerned Scientists has assembled a series of explanatory backgrounders on specific allegations about the report. Overall, the IPCC's conclusions remain indisputable: Climate change is happening now and human activity is causing it. Nations around the world will have to adapt to at least some climate change, including sea level rise, changes in precipitation, disruptions to agriculture, and species extinctions. But if we dramatically reduce our emissions, we can prevent the worst effects of climate change.

### AT: Climategate

#### ClimateGate does not prove anything.

Stephanie Pappas, Senior Writer, LiveScience.com, 11-22-2011, “Climate Scientist Calls Hacked 'Climategate' Emails 'Truly Pathetic'”, Live Science,

<http://www.livescience.com/17151-climategate-emails-michael-mann.html>

Climate scientist Michael Mann blasted the release of new leaked emails and documents taken from the University of East Anglia's Climatic Research Unit as "truly pathetic" and a "shameless effort to manufacture a false controversy" on Tuesday (Nov. 22) Mann, along with other prominent climate scientists, features in the emails, which consists of conversations among researchers about data and public relations. A previous leak in 2009 released more than 1,000 emails in an episode dubbed "Climategate." According to the University of East Anglia (UEA), the current data dump, if genuine, appears to be culled from emails taken at the same time as the original Climategate documents. Climate-change skeptics have pointed to the emails as evidence that researchers were manipulating data to make global warming look more serious than it is. Multiple investigations by UEA, the U.S. Environmental Protection Agency, the National Science Foundation, the British House of Commons Science and Technology Committee, several independent panels and Mann's home institution, Pennsylvania State University, found no evidence that these claims were true. The House of Commons did criticize the scientists and UEA for not releasing raw data and for handling freedom-of-information requests poorly. A 2011 parliamentary report concluded that it was time to "move on" from Climategate. That seems unlikely, given the release of the new emails just days before an annual United Nations climate summit set to begin Nov. 28. The files are spreading quickly online, including an accompanying text file, which pulls out quotes allegedly from emails between researchers working on Intergovernmental Panel on Climate Change (IPCC) reports. "Observations do not show rising temperatures throughout the tropical troposphere unless you accept one single study and approach and discount a wealth of others," reads one quote, supposedly from a climate scientist. "This is just downright dangerous. We need to communicate the uncertainty and be honest." In other quotes, researchers allegedly discuss the challenges of communicating with the public. "Somehow we have to leave the[m] thinking OK, climate change is extremely complicated, BUT I accept the dominant view that people are affecting it, and that impacts produces risk that needs careful and urgent attention," one researcher is quoted as having written. "What if climate change appears to be just mainly a multidecadal natural fluctuation?" another quote reads. "They'll kill us probably." Fighting back Mann criticized the emails as being taken out of context and said that those leaking the documents appeared to have little to go on — though he expressed hope that the new leaks would give police more to go on in catching the culprit who originally hacked into the University files. "As for emails that in some way involve me, I hardly see anything damning at all, despite these snippets all being taken out of context," Mann wrote in an email to LiveScience. "I guess they had very little left to work with, having culled in the first round the emails that could most easily be taken out of context to try to make me look bad." "A truly pathetic episode," Mann added. "Agents doing the dirty bidding of the fossil fuel industry know they can't contest the fundamental science of human-caused climate change. So they have instead turned to smear, innuendo, criminal hacking of websites, and leaking out-of-context snippets of personal emails in their effort to try to confuse the public about the science and thereby forestall any action to combat this critical threat."

#### ClimateGate is completely false.

redOrbit, 2-25-2011, “‘Climategate’ Scientists Exonerated”, redOrbit,

http://www.redorbit.com/news/science/2002539/climategate\_scientists\_exonerated/

February 25, 2011

An investigation led by the US Commerce Department has found no evidence of any wrongdoing on the part of federal climate researchers whose emails were leaked in a debate over global climate change. In late 2009, thousands of emails were leaked from the Climate Research Unit (CRU) at the University of East Anglia in the UK. In the days after the incident, allegations spread that the emails revealed the manipulation of scientific data in favor of manmade global warming. While the controversy, dubbed “Climategate,” made headlines around the world, the investigations that have cleared the scientists of any wrongdoing have not had the same impact. Thursday’s report from the Commerce Department’s inspector general is the latest to exonerate the scientists whose communications with the CRU were stolen and made public in 2009. The department reviewed all 1.073 leaked emails, but focused on 289 that involved scientists at the National Oceanic and Atmospheric Administration (NOAA). NOAA’s deputy undersecretary for operations, Mary Glackin, said she welcomed the report since “none of the investigations have found any evidence to question the ethics of our scientists or raise doubts about NOAA’s understanding of climate change science.” An investigation in March 2010 by the British House of Commons’ Science and Technology committee released results of their investigation into the scandal. Their report also revealed that nothing in the 1,000+ emails conflicted with the scientific consensus that “global warming is happening and that it is induced by human activity.” The committee concluded that the scientific reputation of the CRU “remains intact.” Investigations by the National Research Council and Pennsylvania State University have also concluded that there was no indication of scientific misconduct. The new report did question the handling of some freedom of information requests by NOAA and asked the agency to review the circumstances under which funds were transferred to the British researchers. Glackin said monies were used for workshops that assisted the governments of Cambodia, Laos and Vietnam in improving their climate forecasting work. Climate change has raised concerns in recent decades as data continues to show temperatures increasing around the world. Climate experts are concerned that continued global warming could affect agriculture and the environment, increase the spread of diseases and cause disruptions in society and the economy.

### AT: Too Late To Solve

#### We can still slow warming – not too late

Patriot-News Editorial Board, 4-22-2012, “Global warming,” http://www.pennlive.com/editorials/index.ssf/2012/04/global\_warming\_its\_real\_its\_no.html

At this point, it seems impossible — diplomatically, if not scientifically — for mankind to halt the manmade warming of the earth. There are too many competing geopolitical interests at work. But global warming is not an all-or-nothing proposition. Anything that slows the pace of global warming can have a real impact. For example, the U.S. is part of a new (and relatively low-cost) effort to help developing countries reduce soot from diesel exhausts and the burning of wood and agricultural waste. By one estimate, these pollutants cause as many as two million premature deaths a year. The continued development of cleaner energy sources — nonrenewable ones such as the natural gas from Marcellus Shale and renewable ones such as wind power — will decrease our reliance on foreign oil. That reliance is damaging to our economy and risky politically. The federal government has given the oil industry billions in subsidies over the decades. With oil companies making record profits, it only makes sense to shift those dollars to the research and development of renewable energy sources that will strengthen our long-term security. Since the first Earth Day a generation ago, thinking “green” has become an everyday part of life — especially for those under 30. We face huge challenges. Yet there is at least some hope today that, as slowly but inexorably as the world turns, we are embracing the need to defend the health of our air, our water and our planet.

#### We can still stop the worst of global warming – not too late

David Doniger et al, director at Climate Center for the Natural Resources Defense Council, 11-3-2006,“An Ambitious, Centrist Approach to Global Warming Legislation,” Science, http://www.sciencemag.org/cgi/content/full/314/5800/764

There is growing concern that global warming of more than 2°C from pre-industrial levels could have dangerous climatic consequences (1, 2). It is estimated that, to avoid exceeding this 2° target, heat-trapping gas and aerosol concentrations need to be stabilized so that their net radiative effect is less than that of 450 parts per million (ppm) CO2 (3). This could be achieved if the United States and other industrial nations cut current emissions by 60 to 80% by 2050, and if developing countries limit emissions growth and impose similar reductions later in the century.

## Warming Impacts

### Warming Bad – Extinction

#### Runaway warming causes extinction.

Oliver Tickell, British journalist, author and campaigner on health and environment issues, and author of the Kyoto2 climate initiative, 8/11/2008, “On a planet 4C hotter, all we can prepare for is extinction,” The Guardian, http://www.guardian.co.uk/commentisfree/2008/aug/11/climatechange

We need to get prepared for four degrees of global warming, Bob Watson told the Guardian last week. At first sight this looks like wise counsel from the climate science adviser to Defra. But the idea that we could adapt to a 4C rise is absurd and dangerous. Global warming on this scale would be a catastrophe that would mean, in the immortal words that Chief Seattle probably never spoke, "the end of living and the beginning of survival" for humankind. Or perhaps the beginning of our extinction. The collapse of the polar ice caps would become inevitable, bringing long-term sea level rises of 70-80 metres. All the world's coastal plains would be lost, complete with ports, cities, transport and industrial infrastructure, and much of the world's most productive farmland. The world's geography would be transformed much as it was at the end of the last ice age, when sea levels rose by about 120 metres to create the Channel, the North Sea and Cardigan Bay out of dry land. Weather would become extreme and unpredictable, with more frequent and severe droughts, floods and hurricanes. The Earth's carrying capacity would be hugely reduced. Billions would undoubtedly die. Watson's call was supported by the government's former chief scientific adviser, Sir David King, who warned that "if we get to a four-degree rise it is quite possible that we would begin to see a runaway increase". This is a remarkable understatement. The climate system is already experiencing significant feedbacks, notably the summer melting of the Arctic sea ice. The more the ice melts, the more sunshine is absorbed by the sea, and the more the Arctic warms. And as the Arctic warms, the release of billions of tonnes of methane – a greenhouse gas 70 times stronger than carbon dioxide over 20 years – captured under melting permafrost is already under way.

#### Global warming risks extinction

Jeffrey Mazo, Editor, Survival and Research Fellow at the International Institute for Strategic Studies, 3-2010, “Climate Conflict: How global warming threatens security and what to do about it,” pg. 122

Without early and severe reductions in emissions, the effects of climate change in the second half of the twenty-first century are likely to be catastrophic for the stability and security of countries in the developing world - not to mention the associated human tragedy. Climate change could even undermine the strength and stability of emerging and advanced economies, beyond the knock-on effects on security of widespread state failure and collapse in developing countries.' And although they have been condemned as melodramatic and alarmist, many informed observers believe that unmitigated climate change beyond the end of the century could pose an existential threat to civilisation."

#### Warming causes extinction. [Gender Paraphrased]

Bill Henderson, Environmental Scientist. 8-16-2006. Counter Currents, “Runaway Global Warming Denial.” http://www.countercurrents.org/cc-henderson190806.htm

The scientific debate about human induced global warming is over but policy makers - let alone the happily shopping general public - still seem to not understand the scope of the impending tragedy. Global warming isn't just warmer temperatures, heat waves, melting ice and threatened polar bears. Scientific understanding increasingly points to runaway global warming leading to human extinction. If impossibly Draconian security measures are not immediately put in place to keep further emissions of greenhouse gases out of the atmosphere we are looking at the death of billions, the end of civilization as we know it and in all probability the end of [hu]man's several million year old existence, along with the extinction of most flora and fauna beloved to man in the world we share.

### Warming Bad – Nuclear War

#### Global nuclear war, extinction.

Gro Harlem Brundtland, et. al, is a Norwegian Social democratic politician, diplomat, and physician, and an international leader in sustainable development and public health. She served three terms as Prime Minister of Norway, in partnership with the Conservation International, International institute for Environment and Development, and International Union for the Conservation of Nature. February 20th 2012 “Environment and Development Challenges: The Imperative to Act” http://www.af-info.or.jp/bpplaureates/doc/2012jp\_fp\_en.pdf

We have a dream – a world without poverty – a world that is equitable – a world that respects human rights – a world with increased and improved ethical behavior regarding poverty and natural resources - a world that is environmentally, socially and economically sustainable, and where economic growth is accomplished within the constraints of realising social objectives of poverty eradication and social equity and within the constraints of nature's life support carrying capacity, and a world where the challenges such as climate change, loss of biodiversity and social inequity have been successfully addressed. This is an achievable dream, but the system is broken and our current pathway will not realise it. Unfortunately, humanity‘s behavior remains utterly inappropriate for dealing with the potentially lethal fallout from a combination of increasingly rapid technological evolution matched with very slow ethical-social evolution. The human ability to do has vastly outstripped the ability to understand. As a result civilization is faced with a perfect storm of problems driven by overpopulation, overconsumption by the rich, the use of environmentally malign technologies, and gross inequalities. They include loss of the biodiversity that runs human lifesupport systems, climate disruption, global toxification, alteration of critical biogeochemical cycles, increasing probability of vast epidemics, and the specter of a civilization-destroying nuclear war. These biophysical problems are interacting tightly with human governance systems, institutions, and civil societies that are now inadequate to deal with them. The rapidly deteriorating biophysical situation is more than bad enough, but it is barely recognized by a global society infected by the irrational belief that physical economies can grow forever and disregarding the facts that the rich in developed and developing countries get richer and the poor are left behind. And the perpetual growth myth is enthusiastically embraced by politicians and economists as an excuse to avoid tough decisions facing humanity. This myth promotes the impossible idea that indiscriminate economic growth is the cure for all the world's problems, while it is actually (as currently practiced) the disease that is at the root cause of our unsustainable global practices. In the face of an absolutely unprecedented emergency, society has no choice but to take dramatic action to avert a collapse of civilization. Either we will change our ways and build an entirely new kind of global society, or they will be changed for us. In order to realise our dream of a more sustainable world there is a need to understand the triple interdependence of economic, social and environmental factors and integrate them into decision-making in governments and the private sector. One challenge facing many countries is how to manage natural resources in order to contribute to poverty alleviation while maintaining the ecological life support system. In economics the main issue deals with what, where and how much of the natural resources are required to alleviate poverty, while social issues deal with for whom and how much are resources developed, and environmental issues address how natural resources can be managed with minimum negative impact on ecosystems. The interaction between economic, social and environment are enhanced and its coordination made more effective if their respective goals are translated into quantitative terms within a defined time scale. What is needed is to realize economic growth within the constraints of social and environmental sustainability

#### Global warming causes nuclear conflict

The Guardian, 2-22-2004 “Now the Pentagon tells Bush: climate change will destroy us” http://www.guardian.co.uk/environment/2004/feb/22/usnews.theobserver

Climate change over the next 20 years could result in a global catastrophe costing millions of lives in wars and natural disasters.. A secret report, suppressed by US defence chiefs and obtained by The Observer, warns that major European cities will be sunk beneath rising seas as Britain is plunged into a 'Siberian' climate by 2020. Nuclear conflict, mega-droughts, famine and widespread rioting will erupt across the world. The document predicts that abrupt climate change could bring the planet to the edge of anarchy as countries develop a nuclear threat to defend and secure dwindling food, water and energy supplies. The threat to global stability vastly eclipses that of terrorism, say the few experts privy to its contents. 'Disruption and conflict will be endemic features of life,' concludes the Pentagon analysis. 'Once again, warfare would define human life.' The findings will prove humiliating to the Bush administration, which has repeatedly denied that climate change even exists. Experts said that they will also make unsettling reading for a President who has insisted national defence is a priority. The report was commissioned by influential Pentagon defence adviser Andrew Marshall, who has held considerable sway on US military thinking over the past three decades. He was the man behind a sweeping recent review aimed at transforming the American military under Defence Secretary Donald Rumsfeld. Climate change 'should be elevated beyond a scientific debate to a US national security concern', say the authors, Peter Schwartz, CIA consultant and former head of planning at Royal Dutch/Shell Group, and Doug Randall of the California-based Global Business Network. An imminent scenario of catastrophic climate change is 'plausible and would challenge United States national security in ways that should be considered immediately', they conclude. As early as next year widespread flooding by a rise in sea levels will create major upheaval for millions.

### Warming Bad – Bio-Diversity

#### Warming causes bio-d loss and extinction

Gro Harlem Brundtland, et. al, is a Norwegian Social democratic politician, diplomat, and physician, and an international leader in sustainable development and public health. She served three terms as Prime Minister of Norway, in partnership with the Conservation International, International institute for Environment and Development, and International Union for the Conservation of Nature. February 20th 2012 “Environment and Development Challenges: The Imperative to Act” <http://www.af-info.or.jp/bpplaureates/doc/2012jp_fp_en.pdf>. Page 9.

Biodiversity – the variety of genes, populations, species, communities, ecosystems, and ecological processes that make up life on Earth – underpins ecosystem services, sustains humanity, is foundational to the resilience of life on Earth, and is integral to the fabric of all the world‘s cultures. Biodiversity provides a variety of ecosystem services that humankind relies on, including: provisioning (e.g. food, freshwater, wood and fiber, and fuel); regulating (e.g. of climate, flood, diseases); cultural (e.g. aesthetic, spiritual, educational, and recreational), and supporting (e.g. nutrient cycling, soil formation, and primary production). These ecosystem services contribute to human wellbeing, including our security, health, social relations, and freedom of choice and action, yet they are fragile and being diminished across the globe. We are at risk of losing much of biodiversity and the benefits it provides humanity. As humankind‘s footprint has swelled, unsustainable use of land, ocean, and freshwater resources has produced extraordinary global changes, from increased habitat loss and invasive species to anthropogenic pollution and climate change. Threats to terrestrial and aquatic biodiversity are diverse, persistent, and, in some cases, increasing. The Millennium Ecosystem Assessment concluded that 15 of the 24 ecosystem services evaluated were in decline, 4 were improving, and 5 were improving in some regions of the world and in decline in other regions. Action is critical: without it, current high rates of species loss are projected to continue what is becoming the 6 th mass extinction event in Earth‘s history. It has been estimated that for every 1 C increase in global mean surface temperature, up to 5 10% of species are threatened with extinction. All species count, but some more than others at any given time and place. Losing one key species can have cascading effects on the delivery of ecosystem services. Ecosystem services are ubiquitous, benefiting people in a variety of socioeconomic conditions, across virtually every economic sector, and over a range of spatial scales, now and in the future. The benefits that ecosystems contribute to human well-being have historically been provided free of charge, and demand for them is increasing. Although the global economic value of ecosystem services may be difficult to measure, it almost certainly rivals or exceeds aggregate global gross domestic product, and ecosystem benefits frequently outweigh costs of their conservation. Yet environmental benefits are seldom considered in conventional economic decision-making, and costs and benefits often don‘t accrue to the same community, or at the same time or place. The value of these ecosystem services is being increasingly appreciated by a very large sector of society - extending from local stakeholders, the business community, agriculture, conservation, and governmental policy makers, including development agencies. Their economic value is enormous and a fundamental element of green economic development. However, we are degrading these services and squandering our natural capital for short-term gains. Two thirds of ecosystem services are currently being degraded globally, which will soon amount to an estimated loss of $500 billion annually in benefits. Green economic development will require technology development and technology transfer in order to increase value added from biological resources, especially in developing countries. This would help shift from the resource exploitative method of conventional development to the resource enrichment method of sustainable development.

#### Warming slashes biodiversity, extinction.

Gro Harlem Brundtland, et. al, is a Norwegian Social democratic politician, diplomat, and physician, and an international leader in sustainable development and public health. She served three terms as Prime Minister of Norway, in partnership with the Conservation International, International institute for Environment and Development, and International Union for the Conservation of Nature. February 20th 2012 “Environment and Development Challenges: The Imperative to Act” http://www.af-info.or.jp/bpplaureates/doc/2012jp\_fp\_en.pdf

Emissions of GHG are one of the greatest threats to our future prosperity. World emissions (flows) are currently around 50 billion tonnes of carbon dioxide-equivalent (CO2e) per annum and are growing rapidly. As the terrestrial and oceanic ecosystems are unable to absorb all of the world‘s annual emissions, concentrations (stocks) of GHG emissions in the atmosphere have increased, to over 400ppm of CO2e today (even after taking the offsetting radiative effects of aerosols into account) and increasing at a rate of around 2.5ppm per year. Thus we have a flow-stock problem. Without strong action to reduce emissions, over the course of this century we would likely add at least 300 ppm CO2e, taking concentrations to around 750 ppm CO2e or higher at the end of the century or early in the next. The world‘s current commitments to reduce emissions are consistent with at least a 3 C rise (50-50 chance) in temperature: a temperature not seen on the planet for around 3 million years, with serious risks of 5 C rise: a temperature not seen on the planet for around 30 million years. Given there are some uncertainties present in all steps of the scientific chain (flows to stocks to temperatures to climate change and impacts), this is a problem of risk management and public action on a great scale. 6  Biodiversity has essential social, economic, cultural, spiritual and scientific values and its protection is hugely important for human survival. The rapid loss of biodiversity, unprecedented in the last 65 million years, is jeopardising the provision of ecosystem services that underpin human well-being. The Millennium Ecosystem Assessment concluded that 15 of the 24 ecosystem services evaluated were in decline, 4 were improving, and 5 were improving in some regions of the world and in decline in other regions. Measures to conserve biodiversity and make a sustainable society possible need to be greatly enhanced and integrated with social, political and economic concerns. There is a need to value biodiversity and ecosystem services and create markets that can appropriate the value for these services as a basis for a green‘ economy.

#### Warming means uncontrollable biodiversity loss

Gro Harlem Brundtland, et. al, is a Norwegian Social democratic politician, diplomat, and physician, and an international leader in sustainable development and public health. She served three terms as Prime Minister of Norway, in partnership with the Conservation International, International institute for Environment and Development, and International Union for the Conservation of Nature. February 20th 2012 “Environment and Development Challenges: The Imperative to Act” http://www.af-info.or.jp/bpplaureates/doc/2012jp\_fp\_en.pdf

The Earth‘s climate is projected to change at a faster rate than during the past century. This will likely adversely affect freshwater, food and fiber, natural ecosystems, coastal systems and low-lying areas, human health and social systems. The impacts of climate change are likely to be extensive and primarily negative, and to cut across many sectors. For example, throughout the world, biodiversity at the genetic, species and landscape level is being lost, and ecosystems and their services are being degraded. Although climate change has been a relatively minor cause of the observed loss of biodiversity and degradation of ecosystems, it is projected to be a major threat in the coming decades. There is a limit on the amount of fossil fuel carbon that we can pour into the atmosphere as carbon dioxide without guaranteeing climatic consequences for future generations and nature that are tragic and immoral. Given the decadal time scale required to phase out existing fossil fuel energy infrastructure in favor of carbon-neutral and carbon-negative energies, it is clear that we will soon pass the limit on carbon emissions. The inertia of the climate system, which delays full climate response to human-made changes of atmospheric composition, is simultaneously our friend and foe. The delay allows moderate overshoot of the sustainable carbon load but also brings the danger of passing a point of no return that sets in motion a series of catastrophic events. These could include melting of the Greenland and West Antarctic ice sheets leading to a sea level rise of many meters; melting of permafrost leading to significant emissions of methane, a potent greenhouse gas; and disruption of the ocean conveyor belt leading to significant regional climate changes. These impacts would largely be out of human control

### Warming Bad – Coral Reefs

#### Warming leads to massive coral death

Lee Hannah, Senior Fellow in Climate Change Biology at Conservation International’s (CI) Center for Applied Biodiversity Science, 2012, Saving a Million Species: Extinction Risk from Climate Change, http://books.google.com/books?hl=en&lr=&id=witqmgnRkaUC&oi=fnd&pg=PA103&dq=global+warming+coral+bleaching&ots=Bkze-wbdfz&sig=57sQBuWXqrgMAcXjdlKX0DfOJuo#v=onepage&q=global%20warming%20coral%20bleaching&f=false

Human-induced climate change is warming sea surface waters, causing coral bleaching and widespread coral mortality. Bleaching occurs when corals expel the symbiotic algae that live within their cells. Most reef-building or zooxanthellate corals (i.e., cnidarians engaged in an obligate symbiotic relationship with photoautotrophic dinoflagellates in the genus Symbiodinium) occupy habitats whose temperature conditions are perilously close to their upper thermal tolerance limits (Coles and Brown, 2003; Jokiel and Brown, 2004; McWilliams et al., 2005; Hoegh-Guldberg et al., 2007). A slight elevation in temperature (1 to 1 .5 degrees Celsius above the climatological thermal mean), often in combination with increased duration, can cause coral bleaching and mortality. When corals die and reel structures arc eroded, many of the species raking shelter in reefs also disappear. Coral bleaching episodes are rapidly increasing around the world, and have led to widespread coral mortality ill all oceans, especially after severe El Niño events.

#### Warming is killing coral

Blake Armstrong, Summer 2012, “Maintaining the World's Marine Biodiversity: Using the Endangered Species Act to Stop the Climate Change Induced Loss of Coral Reefs,” University of California, Hastings College of the Law, West-Northwest Journal of Environmental Law & Policy, lexis

Climate change is killing the world's coral reefs. 2 This is happening in two ways: from coral "bleaching" that results from warmer ocean temperatures, and from ocean acidification, a process that is fundamentally changing the chemistry of the oceans. 3 Damage to coral reefs from climate change threatens the livelihoods of 500 million people and puts at risk billions of dollars that coral reefs contribute to the global economy. 4 The loss of coral reefs will also have devastating effects on biodiversity, potentially leading to the extinction of a million species that depend on coral for their survival. 5 Due to the fact that global warming will put much of the world's coral in danger of extinction, 6 it is important to look at the legal tools available to protect coral. One statute is particularly relevant here: the Endangered Species Act. This Note will analyze the ways in which the Endangered Species Act can and cannot be used to prevent the climate change-induced loss of coral reefs. While the Endangered Species Act does provide a means to protect coral from certain threats, the Statute alone is ill equipped to protect coral reefs from the existential threat of climate change.

#### Coral reefs are key to ocean ecosystems

**N**ational **M**arine **F**ishery **S**ervice, 20**00** (most recent date cites), http://www.nmfs.noaa.gov/prot\_res/PR/coralhome.html

Coral reefs are the most complex, species-rich and productive marine ecosystems. Reefs cover 0.2% of the ocean’s area and yet they provide home to one-third of all marine fish species and tens of thousands of other species. Coral reefs provide essential fish habitat, support endangered and threatened species, and harbor protected marine mammals and turtles. Coral reef fisheries yield 6 million metric tons of fish catch annually, with one quarter of the total worldwide fish production in developing countries with coral reefs. On U.S. reefs, over 500 commercially valuable coral reef fishes and invertebrate are under federal management, including four candidate ESA species (Spurgeon 1992; NOAA 1996). Coral reefs provide critical protection to coastlines from storm damage, erosion and flooding by reducing wave action. Coral reefs are crucial sources of income and resources through their role in tourism, fisheries, building materials and as an important source of pharmaceutical compounds

#### Coral reefs are key to marine ecosystems

Peter **Jacques**, is finishing his Ph.D. at Northern Arizona University in global environmental politics, 20**02**, International Journal of Humanities and Peace

Coral reefs receive particular attention for several reasons in biodiversity discussions. First, they are among the oldest forms of life on earth going back 2.5 million years in some cases. Second, they entertain more species than any biome on earth, including tropical rain forests. One quarter of all known fish species use coralreefsas habitat, and make up about 9 million metric tons of the world marine wild fish catch (12%). The loss of reefs has been quantified at US$6,075 for the ecological goods and services they provide, and loss of coral reef may be more than US$36.5 billion per year (Costanza 2000). The loss of these reefs, is, then, a matter of biological survival, food security for people depending on fish, and economic dependence.

### Warming Bad – Sea Level Rise

#### Warming causes sea level rise, economic collapse.

Jan Lundberg, Oil industry analyst and eco-activist , 24 March 2012, “Good news? Global sea level likely to rise as much as 70 feet for future generations.” http://www.culturechange.org/cms/content/view/831/1/

A Science Daily article on March 19, 2012 reported a new study published in the journal Geology that depressed everybody who was paying attention. Get ready for this: even if global warming is limited to 2 degrees C, future generations will have to deal with sea levels of a possible 70 foot rise. But there's a silver lining! Our long-time climate activist and alternative energy businessman, a somewhat private corespondent of Culture Change, sees the source of our climate-change problems ultimately being washed away. Since the vast majority of the population of humans and their civilization is at no higher than 70 feet elevation, this means the machinery of destruction known as the industrial global economy will be wiped out. People will not have to be wiped out, but their high-energy, maximum waste economy will drown. Where are we headed? This is the big question today. So if there is something good to come about as we muddle through the ecocidal sham of the political process, under the thumb of the 1% and the culture of consuming, let us celebrate. Our anonymous correspondent is identified below as AC.

#### The sea level has risen due to global warming.

Athul **Khasnis**, Expert on Rheumatologic and Immunologic Disease and global warming, **and** Mary **Nettleman**, Chair, Department of Medicine, Professor of Medicine, American Board of Internal Medicine, 10-8-20**05**, “Global Warming and Infectious Disease”, ScienceDirect,

<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

To explore long-term trends in global temperatures, Easterling et al. (6) analyzed monthly averaged maximum and minimum temperatures and the DTR (diurnal temperature range) at 5400 observing stations around the world. Each time series from each station was subjected independently to homogeneity analyses and adjustments according to recently developed techniques. The observed trend for maximum temperature was an increase of +0.82°C per 100 years, for minimum temperature was an increase of +1.79°C per 100 years; the DTR trend was an increase of −0.79°C per 100 years. They explained the positive and negative DTR trends as having resulted from daily minimum temperature increasing at a faster rate and decreasing at a slower rate than the daily maximum temperature, respectively. Jones et al. (7) also examined rural-station temperature data for European parts of the Soviet Union, eastern Australia and eastern China and reported similar observations. According to the U.S. Environmental Protection Agency (EPA), the sea level has risen 6–8 in. globally and worldwide precipitation has increased by about 1% during the past century. The EPA also noted a 5–10% increase in precipitation over the U.S. and a 10–15% increase in rainfall over the northern tier states and southern Canada over the last century. The main domain of this precipitation increase was eastern Canada and the adjacent northern regions of the U.S. (8). Increasing concentrations of greenhouse gases are likely to accelerate the rate of this potentially detrimental climate change. Rising temperatures are likely to continue. It is predicted that the average global surface temperature could rise 0.6–2.5°C in the next 50 years, and 1.4° to 5.8°C by the year 2100 (9). The effect on precipitation and soil moisture is uncertain. Initially, evaporation will likely increase, resulting in increased average global precipitation. However, the distribution of rainfall may become more erratic, leading to focal areas of flood and drought. If increases in temperature are sustained, it is also possible that soil moisture may be permanently lost from some areas. Some experts from Stanford University have challenged this prediction as they observed an increase in soil moisture under conditions of increased temperature (10). They hypothesize that the increased temperature results in early death of plants such as grasses and wildflowers, thus reducing the surface area for evaporation. This reduced evaporation results in increased soil moisture. Frozen soil moisture has also been used to estimate the growing season in forests and estimating their efficiency as carbon sinks. Sea levels are predicted to rise 2 ft along most of the U.S. coast.

#### Sea level rise exceeds predicted limits as it is the most serious impact of GW.

Martin **Vermeera**, Professor of Geodesy at TKK's Surveying Departmen, and Stefan **Rahmstorf**, Professor of Physics of the Oceans at Potsdam University, 10-26-20**09**“Global sea level linked to global temperature”, Proceedings of the National Academy of Sciences of the United States of America (PNAS), http://www.pnas.org/content/106/51/21527.full

Sea-level rise is among the potentially most serious impacts of climate change. But sea-level changes cannot yet be predicted with confidence using models based on physical processes, because the dynamics of ice sheets and glaciers and to a lesser extent that of oceanic heat uptake is not sufficiently understood. This limited understanding is seen, e.g., in the fact that observed sea-level rise exceeded that predicted by models (best estimates) by ≈50% for the periods 1990–2006 (1) and 1961–2003 (2). The last Intergovernmental Panel on Climate Change (IPCC) assessment report did not include rapid ice flow changes in its projected sea-level ranges, arguing that they could not yet be modeled, and consequently did not present an upper limit of the expected rise (2). This problem has caused considerable recent interest in semiempirical approaches to projecting sea-level rise (3–8). These approaches are based on using an observable that climate models actually can predict with confidence, namely global mean temperature, and establish with the help of observational data how global mean temperature is linked to sea level. A limitation of this approach is that a response that differs fundamentally from that found in the data used cannot be captured, for example, a large and highly nonlinear ice discharge event of a type not in the observational record. This limitation has to be kept in mind when interpreting the results.

#### The melting of the Greenland ice sheet (from GW) will rapidly increase the rising sea level.

Ian **Sample**, Science correspondant with PhD in biomedical materials from Queen Mary's, University of London, 9-1-20**08**, “Global warming: Sea level rises may accelerate due to melting ice sheet”, theguardian, http://www.guardian.co.uk/science/2008/sep/01/sea.level.rise

The vast Greenland ice sheet could begin to melt more rapidly than expected towards the end of the century, accelerating the rise in sea levels as a result of global warming, scientists warned yesterday. Water running off the ice sheet could triple the current rate of sea level rise to around 9mm a year, leading to a global rise of almost 1 metre per century, the researchers found. Sea levels are already on the rise as a result of increasing temperatures, because the oceans expand as they warm up, but until now scientists have had a poor understanding of how quickly ice sheets such as those in Greenland and Antarctica will begin to disappear. There are signs that the Greenland ice sheet, which covers 1.7 million square kilometres of land, has already begun to melt faster than expected. The reason is thought to be surface water on the ice sheet trickling down through fissures to the underlying bedrock, making the ice sheet less stable, and the loss of buttressing ice shelves along the coastline. Climate scientists are uncertain how susceptible ice sheets are to global warming, largely because they have never witnessed one disappear, so researchers led by Anders Carlson at the University of Wisconsin-Madison decided to look back to the end of the last ice age for clues. Around 20,000 years ago, when the last ice age was at its peak, a giant mass of frozen water called the Laurentide ice sheet covered much of what is now North America. The ice sheet, which was three miles thick in some places, had almost completely melted 6,500 years ago as the world warmed as part of its natural cycle. At the time, surface air temperatures were similar to those that climate scientists predict for 2100. The researchers used evidence in the geological record and computer simulations to reconstruct the demise of the Laurentide ice sheet, which was the last ice sheet to completely disappear in the northern hemisphere. They dated boulders and fossilised organisms left on fresh ground as the ice sheet retreated, and found that it went through two periods of rapid melting. Computer simulations revealed that around 9,000 years ago, water melting off the ice sheet caused sea levels to rise by about 7 metres at a rate of around 1.3cm a year. The second stage of rapid melting began 7,500 years ago, when sea levels rose by 5 metres at a rate of around 0.7cm a year. The reconstruction suggests that the Greenland ice sheet may melt in a similar fashion. "We have never seen an ice sheet retreat significantly or even disappear before, yet this may happen for the Greenland ice sheet in the coming centuries to millenia," said Carlson, whose study appears in the journal Nature Geoscience. "We're not talking about something catastrophic, but we could see a much bigger response in terms of sea level from the Greenland ice sheet over the next 100 years than what is currently predicted," Carlson added.

#### Sea level rise will displace millions of people and cause billions of dollars worth of damage.

Ian **Sample**, Science correspondant with PhD in biomedical materials from Queen Mary's, University of London, 9-1-20**08**, “Global warming: Sea level rises may accelerate due to melting ice sheet”, theguardian, http://www.guardian.co.uk/science/2008/sep/01/sea.level.rise

The most recent report from the UN's Intergovernmental Panel on Climate Change predicts that sea levels will have risen by around 10cm at most by 2100, but according to Carlson's analysis, rapid melting of the Greenland ice sheet could cause much greater rises. "For planning purposes, we should see the IPCC projections as conservative," he said. "We think this is a very low estimate of what the Greenland ice sheet will contribute to sea level." In an accompanying article, Mark Sidall at Bristol University describes how a 1 metre rise in sea level would submerge an estimated 2.2m square kilometres of land, largely in Asia, and displace around 145 million people at a global cost of $944 billion. He points out, though, that while the Laurentide ice sheet completely vanished at the end of the last ice age, the Greenland ice sheet remains, suggesting it is more resistant to warming. "To what extent this dynamic response of the Laurentide ice sheet to past temperature change can be considered analagous to present and future reduction of the Greenland ice sheet remains unresolved," he writes. "But [the researchers'] work suggests that future reductions of the Greenland ice sheet on the order of 1 metre per century are not out of the question."

#### Sea Level Rises lead to infectious human diseases.

Jonathan A. **Patz et al**, Professor of Environmental Studies & Population Health Sciences

Center for Sustainability and the Global Environment University of Wisconsin-Madison, “Global Climate Change and Emerging Infectious Diseases ”, 1996, The JAMA (The Journal of American Medical Association) Network, http://jama.jamanetwork.com/article.aspx?articleid=394508

Climatic factors influence the emergence and reemergence of infectious diseases, in addition to multiple human, biological, and ecological determinants. Climatologists have identified upward trends in global temperatures and now estimate an unprecedented rise of 2.0°C by the year 2100. Of major concern is that these changes can affect the introduction and dissemination of many serious infectious diseases. The incidence of mosquito-borne diseases, including malaria, dengue, and viral encephalitides, are among those diseases most sensitive to climate. Climate change would directly affect disease transmission by shifting the vector's geographic range and increasing reproductive and biting rates and by shortening the pathogen incubation period. Climate-related increases in sea surface temperature and sea level can lead to higher incidence of water-borne infectious and toxin-related illnesses, such as cholera and shellfish poisoning.

### Warming Bad – Disease

#### Global warming boosts disease spread.

Stefano Casalegno, an ecologist with a focus on plant science and spatial ecological modeling. At the Environment and Sustainability Institute he will develop regional-scale models to assess the consequences of future environmental changes for the provision of ecosystem goods and services, September 2011, “Global Warming Impacts, Case studies on the economy, Human health, and on Urban and natural environments.” Downloaded from; http://www.intechopen.com/books/global-warming-impacts-case-studies-on-the-economy-human-health-and-on-urban-and-natural-environments

Global warming is the most evident explanation for the epidemic trend of NE, an emerging rodent-borne hantaviral disease, targeting mainly the kidney in humans. The correlation between higher temperatures, mainly during summers and autumns of the last decade, and higher NE peaks was proven to be highly significant in Belgium. Since occurrence and evolution of NE peaks in three adjacent countries, France, Germany and The Netherlands, was very similar to the situation in Belgium, it can be assumed that similar temperaturedriven ecological mechanisms were likewise operative in these countries. Consequently, NE is now established as the most frequent infectious cause of acute (but self-remitting) kidney injury (AKI) in W.-Europe, as it was already the case in the two other NE-endemic regions in Europe, W.-Russia and Fenno-Scandia. In recent medical literature, global warming has been invoked mainly as a driving force behind some (sub)tropical arthropod-borne infections, such as malaria, dengue, and CongoCrimean haemorrhagic fever (CCHF), via an expansion of the habitat of the responsible vectors, mostly mosquitoes or ticks. This is the first report on the influence of global warming on an “autochthonous” disease, via expansion of the local rodent population. To our knowledge, this study is also the first assessment of a “new” kidney disease by a mathematical formula, or indirectly even by satellite monitoring.

#### Global Warming will increase disease spread – faster incubation and transmission

Andrew Price-Smith, Assistant Professor of Political Science at Colorado College, 5-1-2008

“Global Climate Change: National Security Implications,” http://www.strategicstudiesinstitute.army.mil/pdffiles/PUB862.pdf

Increasing temperatures also affect the biting rate of vectors. As temperatures rise, the vectors (mosquitoes) feed with greater frequency, and therefore increase the transmission rate of the *plasmodium* (the parasite) into human populations. Furthermore, increasing temperatures also affect the extrinsic incubation rate of the pathogen, such that it replicates within the gut of the vector at a greatly augmented rate. Thus, under conditions of higher temperatures, there are greater numbers of plasmodium within the vector, and the vector bites with much greater frequency.2 On a macro level, all of this means that as temperatures increase, the burden of disease (e.g., malaria) is likely to increase to a significant degree. Precipitation and Sea Surface Temperatures (SSTs) are strong predictors of malarial incidence.

#### GW causes infectious diseases to spread.

Athul **Khasnis**, Expert on Rheumatologic and Immunologic Disease and global warming, **and** Mary **Nettleman**, 10-8-20**05**, Chair, Department of Medicine, Professor of Medicine, American Board of Internal Medicine, “Global Warming and Infectious Disease”, ScienceDirect,

<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

It is impossible to quantify the exact risk posed by climate change. With particular reference to infectious diseases, the impact depends on the complex interaction between the human host population and the causative infectious agent. Important human factors include crowding, food scarcity, poverty, and local environmental decline. Some health effects of climate change may result from indirect impacts on natural ecosystems. For example, altered climatic conditions can change the habitats of vectors such as mosquitoes or rats and affect the parasites they carry. Changing the abundance and geographic range of carriers and parasites could shift the seasonal occurrence of many infectious diseases and cause them to spread. The effect of globalwarming depends heavily on the ability of humans and public health systems to adapt. Human migration and economic stresses from climate variability could threaten human settlement and seriously overwhelm the public health infrastructure. This scenario might be worsened further by malnutrition due to crop failure. Facing this complex threat makes interdisciplinary cooperation among health professionals, climatologists, environmental biologists and social scientists imperative to understand and effectively manage this threat that could result from globalwarming. Renewed understanding of linkages between public health and global life-support systems is emerging in the literature (11). New collaborative efforts can confront these tough challenges through advances in preventive medicine. In much of the world, the current increasing life expectancy is likely to be blunted by increased difficulty in accessing basic requirements such as sanitation and potable water. The direct and indirect impacts of climate change on human health have a considerable toll on life, resources (natural and financial) and working manpower. Altered environmental influences would also mean courting environmental disasters such as famines and floods. It known that non-vector-borne infectious diseases—such as salmonellosis, cholera, and giardiasis—can thrive under these circumstances (12). Thus, the impact of climate change depends on several factors. Although exact predictions are impossible, there are significant areas of concern throughout the world (Table 1) (13).

#### GW will cause a water shortage which causes infectious disease.

Athul **Khasnis**, Expert on Rheumatologic and Immunologic Disease and global warming, **and** Mary **Nettleman**, 10-8-20**05**, Chair, Department of Medicine, Professor of Medicine, American Board of Internal Medicine, “Global Warming and Infectious Disease”, ScienceDirect,

<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

Water is a basic necessity and its availability is of paramount importance. Currently, 1.1 billion people do not have access to adequate supplies of safe water (14), and 2.4 billion people do not have access to adequate sanitation (15). Adjusting to new shortages and/or implementing measures to ensure supply under globalwarming will impose a heavy burden on the already stressed national exchequer of developing countries. Various approaches to reduce the potential scarcity of water systems as a result of climate change include policies to eliminate profiteering, efficient management of available water, improved technology, integrated agriculture policies, and urban planning and management. At the national and regional level, integrated water resource management should be prioritized. It is also important that the quality of conserved water be maintained. Water is a core substance used for cooking, dissolution and plain consumption. The infectious disease consequences of contaminated water can be significant. Childhood diarrhea is already a major cause of premature mortality around the globe (16). Epidemics of cholera, typhoid, and similar diseases can be expected if the quality of water deteriorates. It is interesting to note, however, that effective water purification and storage attempts at the household level are superior to attempts at decontaminating water at its source. Gundry et al. (17) reviewed observational studies investigating this relationship, as well as studies of home water treatment and storage interventions. For cholera, a clear relationship was found with contaminated water. Home water treatment and storage interventions were also found to reduce cholera. For general diarrhea, no clear relationship was found with point-of-use water quality, although interventions significantly reduced the incidence of diarrhea. However, they emphasized the simultaneous need for improved public education about water sanitation. Esrey et al. (18) reviewed 144 water and sanitation interventions conducted in various developing countries and in the U.S. to look at the effect improved water supply and sanitation facilities had on ascariasis, diarrhea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma. They showed that improved water supply and sanitation result in substantial reductions in morbidity from diarrhea (26%), ascariasis (29%), guinea worm infection (78%), schistosomiasis (77%), trachoma (27%) and a median reduction of 65% in diarrhea-specific mortality and 55% in general child mortality. They recommended that nearby water supply and hygienic practices be integrated into water supply and health programs.

#### GW will cause disease spread by vectors.

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<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

Global climate change will affect disease vectors, which in turn may alter the current patterns of vector-borne diseases(29). The most common vectors, arthropods, are cold-blooded, meaning that their internal temperature is greatly affected by the temperature of their environment. The incidence of arthropod-borne diseases will depend on both vector and host factors (Table 2) (28). Climate may affect all of these factors to some extent but will have its most direct effect on the size of the vector population. Malaria, dengue, plague, and viruses causing encephalitic syndromes are among the many vector-borne diseases that may be affected. The effect of globalwarming on malaria has been actively debated. In modern times, we tend to think of malaria as a tropical disease. However, malaria has existed in many temperate areas of the world (30). Outbreaks have occurred as far north as the Arctic Circle and the disease has flourished in much of Europe and North America. European visitors to the New World found malaria already firmly established. In Europe, cases of malaria persisted throughout the Little Ice Age, a period of intensely cold winters and cool summers that began in 1564 (30). The mosquito vectors that carried the parasite in these temperate climates still exist. Yet, malaria has almost vanished from developed countries. Clearly, the reason for the dramatic decrease in cases of malaria is not climatologic. Rather, the change is attributed to better mosquito control measures, and more effective antimalarials. Unfortunately, mosquitoes have become alarmingly resistant to control measures and drug-resistant malaria is spreading. Malaria cases have been on the rise (31). We cannot rely on the measure of the past to provide a safe haven for us in the future. Moreover, the lack of malaria in developed countries is sustained in part by the lack of infected human hosts. Mosquitoes rarely encounter an infected host and so rarely acquire the parasite. Will globalwarming reverse these trends? The situation and the risk are most dire in developing countries.

#### Mosquito increase from GW will lead to epidemics.

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<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

Human migration will also bring infected persons into contact with uninfected mosquitoes and subsequently will expose non-immune hosts to newly infected mosquitoes. Deforestation, human migration and agricultural practices have a serious impact on malarial transmission. Urban malaria has become an increasing health concern in many countries (41). Crowding of humans in dwellings is associated with increased indoor mosquito concentrations (43). Humans, after all, are a source of food for mosquitoes. Many globalwarming scenarios include an increase in the frequency and intensity of the El Niño phenomenon (44). The El Niño Southern Oscillation is heralded by warm water flowing off the coast of Peru and Ecuador. It is caused in part by pressure differences in the air over the Pacific Ocean. Although beginning in the Pacific, the climatic effects of El Niño are global. Storms, heavy rain, regional drought, and warm temperatures are more frequent during El Niño (45). El Niño seasons have been associated with outbreaks of malaria in many areas [46] and [47]. However, the association is not constant and outbreaks have been regionally limited. It is important to point out that El Niño is a short-term climate change and that globalwarming implies a prolonged change. Thus, it is hazardous to extrapolate the effects of El Niño to predict the overall results of global climate change (48). However, El Niño events are predicted to become more common and more severe with globalwarming, and it appears likely that this will facilitate local epidemics of malaria. From the standpoint of malaria, the effect of globalwarming will be felt most in areas that are currently on the edges of the range of infected mosquitoes (49). For example, malaria has been shown to march up mountains in response to wetter, warmer weather [50] and [51]. Altitudes that were once safe from mosquitoes will be at risk for epidemics. Tanser and colleagues (33) developed a model to predict the effect of globalwarming on exposure to the mosquito vector for malaria in Africa. The model was based on the historical associate of rainfall and temperature readings from 1920 to 1980 in Africa. Population estimates were overlaid on top of regional temperatures and were assumed to remain constant. The model was validated using existing mosquito surveys. Three potential globalwarming scenarios were considered, based on estimates from the Intergovernmental Panel for Climate Change. In the scenarios, atmospheric carbon dioxide increased by 47, 98, and 126% by the year 2100. Using these estimates, the number of person-months of exposure to the mosquito vector increased by 16, 23, and 28% for each scenario, respectively. The increase was predominately attributable to vector exposure at higher altitudes than currently. Ethiopia, Zimbabwe and South Africa experienced the largest projected changes.

#### GW will cause famine and drought that leaves humans more vulnerable to diseases.

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<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

There was little latitudinal spread into new territories. Increasing precipitation is not always favorable for mosquitoes. Torrential rains may wash away breeding sites and drought may eliminate the small pools of water favored by the mosquitoes for their eggs. On the other hand, drought in very wet areas may slow rapid streams and create pools of stagnant water (45). Globalwarming may also bring famine and drought, leaving populations more susceptible to disease. Early models to predict malaria rates in the 1920s were based on rainfall and prices of wheat (50). When food was scarce, the price of wheat increased, making price a surrogate for crop failure and malnutrition. Finally, unforeseen factors may also influence malaria. The availability of an effective vaccine, better insecticides, or more effective antimalarials would each reduce the prevalence of the disease. Breakdowns in existing public health measures would increase cases of malaria. The balance between these factors may be more important than global climate (52). Dengue is an important mosquito-borne disease affecting humans and is transmitted by Aedes aegypti. This mosquito is well adapted to the urban environment and successfully breeds in containers where water is allowed to accumulate, such as discarded cans, bottles, plastic containers and tires. Aedes mosquitoes thrive in warmer environments but not in dry environments. Thus, the effect of globalwarming on diseases like dengue depends on both precipitation and temperature [53] and [54]. Vezzani et al. (55) studied the breeding of Aedes mosquitoes in Buenos Aires, Argentina. They noted highest abundances in breeding after several months with mean temperatures above 20°C and accumulated rainfalls above 150 mm. A sharp decline in egg laying was observed when monthly mean temperature declined to 16.5°C, and no eggs were found below 14.8°C. As with malaria, changes in the incidence of dengue appear strongly related to non-climatological factors. For example, there is a dramatic difference in the incidence of dengue along the Mexican−U.S. border. States south of the border have a 500-fold increased incidence of disease compared with those just north of the border (48). Thus, climate appears to be only one factor in transmission of the disease. West Nile fever is another emerging viral infectious disease and is transmitted by Culex mosquito species. Its habitat is usually near swamps, ponds and other bodies of stagnant water, waterways, parks, golf courses, undeveloped wood lots, and temporary wetlands in densely populated residential areas (56). Although the life span of the mosquito diminishes with excessive temperatures, viral maturation rates increase with temperature. It has been suggested that, as a result of climate change, there could be a northward shift in western equine and St. Louis encephalitis, with the disappearance of the former in southern endemic regions (57). Other vectors will be affected to different extents. Models to predict tick populations have also shown that arid conditions decrease tick populations. However, epidemics of tick-borne diseases such as Lyme disease have not been associated with climate change (58). As stated above, it is possible that globalwarming will bring stronger or more frequent El Niño events. This will be to the advantage of some vectors. In the strong El Niño of 1997–1998, there was an associated increase in Rift Valley Fever (51). The mosquito vector populations increase during times of flooding, because more eggs are immersed in water (59). Vectors may transmit pathogens to non-human mammalian hosts. Indeed, for some diseases humans are an accidental host. Arboviral encephalitides, such as West Nile encephalitis, St. Louis encephalitis, and LaCrosse encephalitis, infect both human and non-human mammalian hosts (54).

#### Infectious diseases come from numerous factors of GW.

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<http://www.sciencedirect.com/science/article/pii/S0188440905001517>

Other pathogens, such as Borrelia burgdorferi, the cause of Lyme disease, also utilize non-human mammalian hosts. Clearly, the effect of climate on the non-human host will affect human disease. Rodent breeding increases during mild weather and decreases in times of drought or heat. However, drought may drive rodents to seek indoor sources of water. This increases the chances that humans will come in contact with rodents and the insects that feed on rodents, such as lice. Transmission of plague and similar diseases may increase with rodent populations. Moreover, the hantaviruses are spread through secretions or excretions of infected rodents. In summary, vector-borne diseases will be affected by global climate change. Malaria is likely to spread locally, especially into altitudes that are adjacent to current endemic areas. However, for malaria to spread more widely in developed countries, it will be necessary for there to be a breakdown in public health measures that currently keep the disease at bay. Other arthropod-borne diseases are likely to fare similarly. Extreme climate change is not good for humans or vectors, and it is difficult to predict the results. Milder or more gradual climate change would allow both humans and vectors to adapt. Successful adaptation in humans might mean better vector control measures, more effective therapies, vaccines, or public health measures. Discussion Human infections are intricately linked to the global environment. By altering this environment, globalwarming has significant potential to intensify selected infectious diseases. Climatic effects are predicted to include crowding, famine, water contamination, human migration, and alterations in vector ecology, all of which increase infectious diseases. We have dealt with these problems in the past with varying success. Globalwarming will also cause economic strain that may divert public health resources from existing infections. Through planning and research, we can mitigate the health effects of globalwarming. Through policy, politics, and global cooperation, we may reduce the environmental problems that causeglobalwarming.

#### GW causes infectious human diseases.

Jonathan A. **Patz et al**, Professor of Environmental Studies & Population Health Sciences

Center for Sustainability and the Global Environment University of Wisconsin-Madison, “Global Climate Change and Emerging Infectious Diseases ”, 19**96**, The JAMA (The Journal of American Medical Association) Network, <http://jama.jamanetwork.com/article.aspx?articleid=394508>

Human migration and damage to health infrastructures from the projected increase in climate variability could indirectly contribute to disease transmission. Human susceptibility to infections might be further compounded by malnutrition due to climate stress on agriculture and potential alterations in the human immune system caused by increased flux of ultraviolet radiation. Analyzing the role of climate in the emergence of human infectious diseases will require interdisciplinary cooperation among physicians, climatologists, biologists, and social scientists. Increased disease surveillance, integrated modeling, and use of geographically based data systems will afford more anticipatory measures by the medical community. Understanding the linkages between climatological and ecological change as determinants of disease emergence and redistribution will ultimately help optimize preventive strategies.

### Warming Bad – Famine

#### Warming causes resource wars – kills food production

Patriot-News Editorial Board, 4-22-2012, “Global warming,” http://www.pennlive.com/editorials/index.ssf/2012/04/global\_warming\_its\_real\_its\_no.html

If only it were that simple. Continued global warming will threaten food production in some parts of the world, contributing to hunger and malnutrition. Floods and droughts will become more common. Infectious diseases are expected to become more common in less developed countries.

Wars could break out over controlling scarce resources. There is much more.

### Warming Bad – Economy

#### Warming slashes ocean productivity, collapses economy

Stefano Casalegno, an ecologist with a focus on plant science and spatial ecological modeling. At the Environment and Sustainability Institute he will develop regional-scale models to assess the consequences of future environmental changes for the provision of ecosystem goods and services, September 2011, “Global Warming Impacts, Case studies on the economy, Human health, and on Urban and natural environments.” Downloaded from; http://www.intechopen.com/books/global-warming-impacts-case-studies-on-the-economy-human-health-and-on-urban-and-natural-environments

In recent years much evidence has been gathered on climate change and its impact on different sectors and systems. Global warming is one of the main threats to sustainable development and, consequently, one of the most significant environmental challenges in the last decades affecting the economy, health and social welfare. It is necessary, therefore, to identify evidence of the impact of global warming on biodiversity and carry out an economic evaluation. In the specific case of marine ecosystems, changes in rainfall frequency and intensity, acidity, water temperature, wind, dissolved CO2 and salinity, combined with anthropogenic nutrient and toxin contamination, can affect water quality both in coastal regions as well as in the open sea. All of this will consequently affect the productivity of the marine environment. And given that fishing is one of the economic activities which critically depend on natural conditions or characteristics, the influence of environmental changes on fishing is notably higher than that which might occur in other primary activities. Furthermore, climate has a vital impact on the tourism and recreation sector and, therefore, this sector will be affected by any changes in climate. In this chapter, we assess the possible economic effects (losses or gains) of global warming on some of the main economic activities in north-western Spain. The economy of this region specialises in products derived from fishing and aquaculture as well as tourism, among others (IGE – Galician Statistics Institute-, 2010), and both activities are extremely sensitive to environmental conditions. It is highly probable that global warming will alter the intensity and conformation of ocean currents, affect marine organisms and generate coastal alterations (IPCC, 2007). Such environmental changes will have important repercussions on these economic activities.

#### Unchecked Warming overloads econ.

Joe Romm, was acting assistant secretary of energy for energy efficiency and renewable energy in 1997, where he oversaw $1 billion in R&D, demonstration, and deployment of low-carbon technology, Progress and holds a Ph.D. in physics from MIT. August 27th 2010 “Rhetorical Adaptation, however, is a political winner. Too bad it means preventable suffering for billions.” <http://thinkprogress.org/climate/2010/08/27/206596/adaptation-mitigation-climate-chang/> is a Senior Fellow at American Progress and holds a Ph.D. in physics from MIT.

What is the cost of “adaptation”? It is almost incalculable. The word is a virtually meaningless euphemism in the context of catastrophic global warming. Here is what we now understand we may very well face on our current emissions path: M.I.T. doubles its 2095 warming projection to 10°F “” with 866 ppm and Arctic warming of 20°F Our hellish future: Definitive NOAA-led report on U.S. climate impacts warns of scorching 9 to 11°F warming over most of inland U.S. by 2090 with Kansas above 90°F some 120 days a year “” and that isn’t the worst case, it’s business as usual!“ Ocean dead zones to expand, “remain for thousands of years” Sea levels may rise 3 times faster than IPCC estimated, could hit 6 feet by 2100 Science: CO2 levels haven’t been this high for 15 million years, when it was 5° to 10°F warmer and seas were 75 to 120 feet higher “” “We have shown that this dramatic rise in sea level is associated with an increase in CO2 levels of about 100 ppm.” Nature Geoscience study: Oceans are acidifying 10 times faster today than 55 million years ago when a mass extinction of marine species occurred And that isn’t the worst case: UK Met Office: Catastrophic climate change, 13-18°F over most of U.S. and 27°F in the Arctic, could happen in 50 years, but “we do have time to stop it if we cut greenhouse gas emissions soon.” NOAA: Climate change “largely irreversible for 1000 years,” with permanent Dust Bowls in Southwest and around the globe How exactly do you adapt to that? What precisely do you plan for in your adaptation strategy? You need to determine at some point whether you can save Miami, say, because you wouldn’t want to waste $100 billion trying only to find out you planned for the wrong scenario and it was hopeless. Then again, who is going to get people out of their cities as long as one political party is devoted to shouting down anybody who claims humans are actually warming the planet. And how exactly do Muscovites “adapt” to the possibility of 20°F Arctic warming? What would a 1000-year heat-wave look like in 2100 if the planet is 9°F warmer? How exactly would the world adapt to see levels 4 to 6 feet high in 2100 and then rising 1 foot a decade? Fundamentally, massive prevention plus lots of adaptation (and some misery) is much, much, much cheaper than not bloody much prevention and incomprehensible amounts of adaptation and suffering and misery. And as the IIED reported a year ago, the study Assessing the costs of adaptation to climate change: a review of the UNFCCC and other recent estimates concludes costs will be even more when the full range of climate impacts on human activities is considered. Scientists led by a former co-chair of the Intergovernmental Panel on Climate Change [warn] that the UN negotiations aimed at tackling climate change are based on substantial underestimates of what it will cost to adapt to its impacts. The real costs of adaptation are likely to be 2-3 times greater than estimates made by the UN Framework Convention on Climate Change (UNFCCC), say Professor Martin Parry and colleagues in a new report published by the International Institute for Environment and Development [IIED]. The study finds that the mean “Net present value of climate change impacts” in the A2 scenario is $1240 TRILLION with no adaptation, but “only” $890 trillion with adaptation. The mean [annual] impacts in 2060 are about $1.5 trillion”¦. As usual, there is a long right tail, with a small probability of impacts as large as $20 trillion. Don’t worry folks, it’s only a “small probability” (in their analysis) “” but that “fat tail” by itself is enough to render all traditional economic analyses useless (see Harvard economist: Climate cost-benefit analyses are “unusually misleading,” warns colleagues “we may be deluding ourselves and others”). Let’s put aside the fact we are on pace to exceed the A2 scenario (which is “only” about 850 ppm atmospheric concentrations of CO2 in 2100): See U.S. media largely ignores latest warning from climate scientists: “Recent observations confirm “¦ the worst-case IPCC scenario trajectories (or even worse) are being realised” “” 1000 ppm. For this country, the A2 scenario means 9 to 11°F warming over most of inland U.S. by 2090 with Kansas above 90°F some 120 days a year. But here’s the key point the media and the authors failed to convey. In the “aggressive abatement” case (450 ppm), the mean “Net present value [NPV] of climate change impacts” is only $410 trillion “” or $275 trillion with adaptation. So stabilizing at 450 ppm reduces NPV impacts by $615 to $830 trillion. But the abatement NPV cost is only $110 trillion “” a 6-to-1 savings or better. Bizarrely, the authors never point this out directly. They are adaptation experts, so rather than focusing on the immense economic benefits of preventing catastrophic global warming in the first place, they offer up this secondary conclusion as their primary finding: Parry and colleagues warn that this underestimate of the cost of adaptation threatens to weaken the outcome of UNFCCC negotiations, which are due to culminate in Copenhagen in December with a global deal aimed at tackling climate change. “The amount of money on the table at Copenhagen is one of the key factors that will determine whether we achieve a climate change agreement,” says Professor Parry, visiting research fellow at the Grantham Institute for Climate Change at Imperial College London. “But previous estimates of adaptation costs have substantially misjudged the scale of funds needed.” Uhhh, not quite. What actually weakened the outcome of the Copenhagen negotiations is that the overwhelming majority of politicians, opinion makers, and journalists in this country (and around the world, I think) don’t get that 1) the cost of inaction is catastrophically high [and potentially beyond calculation] and 2) the cost of action is far, far lower [see also "Intro to climate economics: Why even strong climate action has such a low total cost -- one tenth of a penny on the dollar"].

### Warming Bag – Hegemony

#### Warming ignorance leads to Heg collapse.

Jake Schmidt, is the international climate policy director at Natural Resources Defense Council (NRDC)., September 26th 2011, “US to attend India meeting to try to stop global warming action on aviation… will these countries now lead on efforts for global solution?

The Indian Government has asked a handful of governments to come to New Delhi on Sept. 29-30th for a meeting to discuss the EU’s effort to control carbon pollution from aviation. After 15 years of waiting for global action the EU took the reasonable step of moving forward at home. Now it looks like the US, India, and other major polluters are going to plot on how to undermine this effort. Instead of trying to stop the EU’s effort, will these countries actually agree to lead on efforts to immediately achieve a global solution to aviation’s pollution? If they don’t it is a failure of leadership and a sign that they aren’t serious about addressing aviation’s global warming pollution. Will the “Delhi Declaration” to stop EU climate action strongly urge all countries, including the ones at the meeting, to immediately develop an enforceable global solution to aviation’s carbon pollution? Press reports indicate that countries attending the Delhi meeting are developing a “declaration” and various versions of this declaration are already being circulated to invited countries. The Obama Administration claims that it wants a global solution to aviation’s pollution (or so they’ve told us). Assuming it moves forward, the “Delhi Declaration to stop the EU” should agree on a strong commitment to develop a global solution immediately or it is a failure of US leadership. It isn’t leadership to attempt to stop another country’s action on global warming and then not push for a change in position from the countries that have historically blocked a global solution. After all, President Obama has promised that: “My presidency will mark a new chapter in America's leadership on climate change…”

## AT: CO2 Ag DA

### Warming Bad – Agriculture

#### Climate change devastates agriculture and overwhelms any possible benefits

William Cline, Senior Fellow at the Peterson Institute for International Economics and the Center for Global Development, 3-2008, “Global warming and agriculture” Finance and Development, the quarterly publication of the IMF March 2008,. http://www.imf.org/external/pubs/ft/fandd/2008/03/cline.htm

John Steinbeck's The Grapes of Wrath provides a verbal mural depicting America's experience in the Dust Bowl of the 1930s, with its migration of "Okies" from ruined farmlands in Oklahoma and Texas to a not-so-promised land in California. This historical experience and perhaps the present-day drought of biblical proportions in Australia should alert international policymakers to the risks to world agriculture of a hotter and drier world by late this century as a consequence of unarrested global warming. In the long list of potential problems from global warming, the risks to world agriculture stand out as among the most important. Yet there has been a tendency in the climate economics literature in recent years to downplay this risk, and even to argue that a couple of degrees Celsius warming might benefit world agriculture. But such studies typically have too short a time horizon (generally out to about 2050). They also focus on overall temperature change (which includes oceans), rather than on the changes that will occur over land (which warms more easily and quickly than water)—and specifically agricultural land. It has been widely recognized that developing countries in general stand to lose more from the effects of global warming on agriculture than do industrial countries. Most developing countries have less capacity to adapt than do their wealthier neighbors. Most are in warmer parts of the globe, where temperatures are already close to or beyond thresholds at which further warming will reduce rather than increase agricultural output. And agriculture is a larger share of developing economies than of industrial economies. But it has been difficult to estimate just how much individual countries are likely to be affected.

#### Climate change destroys agriculture through both external and internal factors

William Cline, Senior Fellow at the Peterson Institute for International Economics and the Center for Global Development, 3-2008, “Global warming and agriculture” Finance and Development, the quarterly publication of the IMF March 2008,. http://www.imf.org/external/pubs/ft/fandd/2008/03/cline.htm

For that reason, this study (Cline, 2007) was undertaken both to get a better long-term fix on overall world effects under current policies (the so-called baseline or business-as-usual scenario) and to understand the likely impact on individual countries and regions. The time frame stretched out to the average for 2070–99, what is called the "2080s." Climate model projections are available on a comparable basis for this period, which is far enough in the future to allow sizable warming and potential damage to materialize but close enough to the present to elicit public concern. The study, which is explored in this article, suggests that there is good reason not to downplay the risks to agriculture from global warming. How climate affects agriculture Climate change can affect agriculture in a variety of ways. Beyond a certain range of temperatures, warming tends to reduce yields because crops speed through their development, producing less grain in the process. And higher temperatures also interfere with the ability of plants to get and use moisture. Evaporation from the soil accelerates when temperatures rise and plants increase transpiration—that is, lose more moisture from their leaves. The combined effect is called "evapotranspiration." Because global warming is likely to increase rainfall, the net impact of higher temperatures on water availability is a race between higher evapotranspiration and higher precipitation. Typically, that race is won by higher evapotranspiration. But a key culprit in climate change—carbon emissions—can also help agriculture by enhancing photosynthesis in many important, so-called C3, crops (such as wheat, rice, and soybeans). The science, however, is far from certain on the benefits of carbon fertilization. But we do know that this phenomenon does not much help C4 crops (such as sugar-cane and maize), which account for about one-fourth of all crops by value.

#### CO2 destroys plants – multiple empirical studies prove.

Mark D. Hunter, 20 DEC 2001, Agriculture and Forest Etymology, Volume 3, Issue 3, pages 153-159, “Effects of elevated atmospheric carbon dioxide on insect–plant interactions,” http://onlinelibrary.wiley.com/doi/10.1046/j.1461-9555.2001.00108.x/full

The rarefied atmosphere of US politics has been heating up recently. During March, President George W. Bush contributed significantly to the accumulation of hot air over Washington and elsewhere by announcing two major policy shifts related to the emission of CO2 into the atmosphere. First, President Bush reneged on a campaign pledge to regulate carbon dioxide emissions from U.S. power plants. Soon afterwards, his administration explicitly opposed the Kyoto Protocol, the international agreement setting country-by-country limits on emissions of greenhouse gases. These two policy positions ensure that little will change in the near future to reduce the amounts of CO2 entering the atmosphere from US sources. In short, it is a great time to be in the CO2 business. Entomologists have recognized for some time that elevated concentrations of atmospheric CO2 may influence the distribution, abundance and performance of insects that feed on plants (Lincoln et al., 1984, 1986; Fajer et al., 1989). Major questions remain, however, on the relative importance of changes in weather, changes in plant quality and changes in predation pressure on the dynamics of insect herbivore populations under conditions of elevated CO2. If you grow crops or trees for a living, these questions boil down to one simple concern; will yields increase or decrease as CO2 levels continue to rise? The problem is that we do not really know yet, and it is going to cost significant sums of money to find out. There are too many interacting variables to make simple predictions about changes in pest damage to forestry and agricultural commodities. CO2–mediated changes in temperature or precipitation may affect insects directly and may influence the geographical ranges of agricultural and natural plant communities (Cannon, 1998). The predators, parasites and pathogens that maintain some level of control over insect populations may also be affected by global climate change or changes in plant phenotype (Stiling et al., 1999). Changes in the nutritional and defensive characteristics of host plants may drive changes in levels of insect damage to plants (Bezemer & Jones, 1998) and all of these ecological effects may interact with other sources of environmental variation including drought, nutrient availability and light (Arnone et al., 1995; Roth et al., 1997; Haettenschwiler & Schafellner, 1999; McDonald et al., 1999). In the longer term, elevated CO2 may influence the fundamental ecosystem properties upon which all plant productivity depends (Ball & Drake, 1997; Jones et al., 1998; Kampichler et al., 1998; Kandeler et al., 1998; Hungate et al., 1999; Strand et al., 1999). While presidents and policy makers play Russian roulette with the climate, ecologists and entomologists are exploring with ever-increasing accuracy and complexity the potential ramifications of elevated CO2 for plant–herbivore interactions. Without long-term studies of the crucial variables, we will simply be unprepared for the enriched CO2 atmosphere that is developing (Coviella & Trumble, 1999). Atmospheric CO2 concentrations have already risen by about 25% since the industrial revolution and are expected to increase from current ambient levels of 350–360 p.p.m. (or µL/L) to around 600 p.p.m. by the end of the century (Houghton et al., 1995). All of the potential consequences of elevated CO2 concentrations are too great to cover in detail here. In this paper, I focus upon what we know about changes in plant quality under elevated CO2 and how changing food quality might interact with other ecological variables to alter the performance and abundance of insects on plants. As the principle source of carbon for photosynthesis, it should be no surprise that changes in concentrations of CO2 have marked effects upon the phenotype of plants (Lincoln, 1993; Ceulemans & Mousseau, 1994; Curtis & Wang, 1998). For example, elevated CO2 generally results in increased rates of photosynthesis (Drake et al., 1997; Norby et al., 1999), increased rates of growth (Saxe et al., 1998) and increased biomass (Leadley et al., 1999; Owensby et al., 1999). Assuming no concurrent changes in nutrient availability, the accumulation of biomass under elevated CO2 dilutes concentrations of nitrogen in tissues by 15–25% (Lincoln et al., 1993; Lindroth et al., 1995), thereby increasing C : N ratios (Ceulemans & Mousseau, 1994; Wilsey, 1996; Hughes & Bazzaz, 1997) and the allocation of carbon to some carbon-rich secondary metabolites (Lindroth et al., 1995; Agrell et al., 2000). Elevated concentrations of CO2 may sometimes (Agrell et al., 2000) but not always (Thompson & Drake, 1994; Bezemer & Jones, 1998) decrease the water content of foliage and increase rates of leaf abscission and plant senescence (Paez et al., 1983; Houpis et al., 1988; Baxter et al., 1994; Sicher & Bunce, 1997). Of course, not all plant species respond identically to elevated concentrations of CO2 (Lindroth et al., 1993). For example, elevated CO2 results in reduced foliar nitrogen levels and increased condensed tannin levels in paper birch but not in white pine (Roth & Lindroth, 1994). In further studies with paper birch, quaking aspen and sugar maple (Roth et al., 1998; Agrell et al., 2000), all species show increases in foliar concentrations of condensed tannins under elevated CO2. However, the foliage of quaking aspen also expresses higher concentrations of phenolic glycosides, and sugar maple is the only species to show elevated foliar concentrations of hydrolysable tannins. In a study contrasting a C3 sedge with a C4 grass in marsh habitat, Thompson & Drake (1994) reported CO2-mediated declines in foliar nitrogen only in the sedge. The grass, in contrast, exhibited increases in foliar water concentrations and concomitant increases in fungal infection. Despite the predictions of the carbon-nutrient balance hypothesis (Chapin, 1980; Bryant et al., 1983) that all carbon-rich secondary metabolites should increase under elevated CO2, this appears not to be the case. For example, foliar concentrations of the iridoid glycosides in Plantago lanceolata are unaffected under CO2 enrichment (Fajer et al., 1989, 1991). Likewise, the volatile terpenoids of peppermint (Lincoln & Couvet, 1989), big sagebrush (Johnson & Lincoln, 1990) and loblolly pine (Williams et al., 1997a) do not vary with experimental increases in CO2. Because nitrogen concentrations in foliage are diluted by the increased C : N ratio of plant tissues under elevated CO2, there is the potential for reduced efficacy of nitrogen-based plant defences. In an interesting twist to this hypothesis, Coviella et al. (2000) reported that transgenic cotton grown under elevated CO2 expressed reduced concentrations of Bt protein. In bioassays with Spodoptera, larval performance increased under elevated CO2 because increased larval consumption in response to low nitrogen levels did not compensate for reductions in Bt protein. Before you dash out and sell your biotech stocks, it is obviously far too early to say that the use of Bt transgenes will be compromised under elevated CO2, but it certainly merits further study. The Bt-lovers amongst us may be gratified to learn that the efficacy of conventional topical applications of Bt may be enhanced under elevated CO2. Experiments suggest that increased consumption by insects to compensate for high C : N ratios results in greater exposure to Bt and higher levels of mortality (Coviella & Trumble, 2000). We are dealing with complex organisms and there will be no perfect generalities for the way that plant phenotype changes under elevated CO2. Nonetheless, in nearly every case examined to date, foliar nitrogen concentrations decline under elevated CO2 and, when present, foliar concentrations of condensed tannins increase (Fajer et al., 1989, 1991; Johnson & Lincoln, 1991; Lincoln et al., 1993; Lindroth et al., 1995). This level of generality is somewhat heartening and allows us to predict that overall decreases in foliar quality should induce at least some insect herbivores to eat more. And that prediction usually holds true. Lower levels of nitrogen and higher C : N ratios in plants under elevated CO2 have generally been associated with compensatory feeding and subsequent increases in levels of damage or defoliation (Lincoln et al., 1984, 1986; Fajer et al., 1989; Lincoln et al., 1993; Lindroth et al., 1993, 1995; Salt et al., 1995; Docherty et al., 1996; Kinney et al., 1997; Williams et al., 1997a). Leaf-chewing insects such as grasshoppers (Johnson & Lincoln, 1990, 1991) and caterpillar larvae (Lindroth et al., 1993, 1995) generally consume more leaf area when they are fed plants that have been grown under elevated CO2. Likewise, the area damaged by leaf-mining insects may also increase (Salt et al., 1995). For example, the area of leaf mines on Quercus myrtifolia increased by over 25% under elevated CO2, apparently because nitrogen concentrations fell by over 11% (Stiling et al., unpublished data). However, this is where the first complicating factor arises: simply because per capita consumption of foliage by insects increases under elevated CO2, it does not mean that plants suffer more damage overall. Two additional effects that mediate the ultimate level of damage that plants receive are CO2-induced increases in plant biomass and changes in insect density. It is well established that many plants accumulate more biomass under elevated CO2 (Leadley et al., 1999; Owensby et al., 1999) and that such direct effects of CO2 on plant growth can more than compensate for increases in defoliation (Caulfield & Bunce, 1994). For example, even though per capita rates of consumption by insects on Q. myrtifolia increase with CO2 enrichment, the proportion of leaves damaged by mining and chewing insects actually declines (Stiling et al., unpublished data). The leaf area index on Q. myrtifolia increases by 26% under elevated CO2 but this ignores the impact of reductions in damaged leaf area. Calculations suggest that undamaged leaf area actually increases by 38% when effects on insects are considered. Similarly, leaf area increases of 1.6-fold on milkweed under elevated CO2 jump to 3.6-fold increases in undamaged leaf area when the effects on herbivorous thrips are accounted for (Hughes & Bazzaz, 1997). Ultimately, the effects of increases in atmospheric CO2 on damage by insect pests will depend upon changes in insect performance at the individual and population levels. The ability of insects to compensate for CO2-mediated reductions in foliage quality is key to understanding long-term effects on herbivore population dynamics and the injury that will be inflicted upon hosts of economic importance. If eating more allows insects to compensate fully, then defoliation levels will rise while insect fitness remains constant. The question then becomes whether CO2-mediated increases in plant productivity are sufficient to offset increases in defoliation levels and which effect is more important to the part of the crop that is harvested for human use. Some insects can certainly compensate well when foliage quality declines. For example, red-headed pine sawfly larvae increase nitrogen utilization efficiency in response to CO2-mediated declines in foliar nitrogen in loblolly pine (Williams et al., 1994). The result is that their rates of nitrogen accumulation remain unchanged. Potential mechanisms by which insect herbivores may compensate for CO2-mediated changes in plant quality are diverse. For example, the activity of detoxification enzymes may be stimulated by increased concentrations of secondary metabolites in foliage (Lindroth et al., 1993). The good news, if you grow plants for a living, is that most insects appear to be unable to compensate fully for CO2-mediated reductions in plant quality. For example, buckeye butterflies on Plantago lanceolata exhibit both higher rates of mortality and increased development time when fed on plants grown under elevated CO2 (Fager et al., 1989; Fajer et al., 1991). Higher rates of insect mortality have been associated with nutritional deficiency that results from reduced foliar nitrogen concentrations under elevated CO2 (Brooks & Whittaker, 1999; Stiling et al., 1999). However, direct effects of changes in plant quality on insect performance are not always dramatic. For example, Lindroth et al. (1995) explored the performance of three species of saturniid moths feeding on paper birch under elevated CO2. Birch leaves were lower in nitrogen (23%), higher in condensed tannin (two-fold increase) and foliar C : N ratios increased from 12.7 to 28.1. Despite these significant reductions in foliage quality, survival of first-instar larvae declined only marginally, while fourth-instar larvae exhibited moderate increases in rates of consumption and decreases in rates of growth, development and food processing efficiency. Brooks & Whittaker (1998, 1999) have studied multiple generations of insects reared on plants under elevated CO2. In their first experiment (Brooks & Whittaker, 1998), Gastrophysa leaf beetles grown on Rumex plants for three consecutive generations exhibited relatively minor effects of elevated CO2 on performance, despite measurable declines in indices of foliage quality. Fecundity and egg size were reduced by the end of the second generation, which led to fewer, smaller larvae in the third generation. In the second study (Brooks & Whittaker, 1999), they reported reductions in the survival of nymphal spittlebugs in two sequential generations under elevated CO2. There were also declines in the rate of development in consecutive years. Such multigenerational studies are crucial if we are to develop any kind of realistic predictions of long-term population dynamics (Williams et al., 1997a). Perhaps more dramatic effects upon insect performance will be mediated by the third trophic level. Given that rates of insect growth also seem to decline under elevated CO2 (Fajer et al., 1989; Lindroth et al., 1995; Smith & Jones, 1998), we might expect that the risk of mortality from natural enemies will increase. However, two laboratory studies have failed to provide evidence for greater mortality imposed by natural enemies under elevated CO2 (Roth & Lindroth, 1995; Bezemer et al., 1998). For example, effects of parasitism by Cotesia melanoscela on the performance of gypsy moth larvae do not differ between ambient and elevated CO2 treatments (Roth & Lindroth, 1995). Nonetheless, field studies using open-top chamber technology have demonstrated that rates of leaf-miner parasitism increase under elevated CO2 (Stiling et al., 1999; Stiling et al., unpublished). Nitrogen concentrations in the foliage of two dominant oak species, Quercus myrtifolia and Q. geminata, decline under elevated CO2 and densities of leaf-mining insects are lower because of the combined effects of reduced foliage quality and increased rates of attack by parasitoids. Overall, death from plant effects increases by 50% and death from parasitoids by over 50% under elevated CO2. We have barely begun to study the effects of elevated CO2 on the efficacy of natural enemies and much work needs to be done. Effects of CO2 enrichment on insect–pathogen interactions have rarely been considered, although links between foliar phenolic concentration and viral infection of caterpillars are well established (Keating & Yendol, 1987; Hunter & Schultz, 1993). However, in at least one study (Lindroth et al., 1997), susceptibility of gypsy moth larvae to NPV was unaffected by CO2-mediated changes in foliar phenolics. Effects upon parasites, predators and pathogens under field conditions would appear to be a priority for future research. If declines in foliar nitrogen and increases in foliar C : N ratios are generally predictable responses of plants to elevated concentrations of CO2, there seems to be less predictability in the responses of insects. Although levels of consumption by insects usually rise under elevated CO2, additional effects upon performance appear to be somewhat idiosyncratic. For example, reductions in gypsy moth performance on aspen are associated with CO2-induced increases in phenolic glycosides (McDonald et al., 1999). Although nutrient and secondary chemistry of birch and maple are also affected by CO2, there are no parallel changes in gypsy moth performance. In other words, CO2-mediated effects on insect herbivores will depend both on the species of plant and the species of insect under study (Lindroth et al., 1995; Traw et al., 1996; Coviella & Trumble, 1999). In experiments with white marked tussock moth, Agrell et al. (2000) have shown that it is possible to rank host plants based upon their deleterious effects on insects under elevated CO2. Effects on larvae were most pronounced when fed upon quaking aspen, followed by paper birch, and least pronounced on sugar maple. Moreover, effects of elevated CO2 may vary seasonally as both leaves and herbivores age. On oaks, increases in foliar C : N ratios become more pronounced as leaves age, yet negative effects on caterpillars are more pronounced in early instars on younger foliage. Older larvae appear to be better able to compensate for reductions in foliar quality than are young larvae (Williams et al., 1998). On evergreen species such as loblolly pine, elevated concentrations of CO2 can interact with natural between-year differences in foliage quality to influence the palatability of leaf resources for insect larvae (Williams et al., 1997b). Finally, not all insects respond negatively to the changes in plant phenotype that are mediated by elevated concentrations of CO2. At least some phloem-feeding insects exhibit increases in performance when provided with plants grown under elevated CO2 (Awmack et al., 1997; Bezemer & Jones, 1998). As before, however, there appears to be qualitative variation in the responses of phloem-feeding insects to changes in plant quality. For example, the same clone of the aphid Aulacorthum solani responds differently to elevated CO2 on two different plant species (Awmack et al., 1997). On bean plants, the daily rate of nymph production increases by 16%, whereas rates of development are unaffected. In contrast, aphids on tansy exhibit faster rates of development and no change in reproductive rate. Overall, aphid responses are positive under elevated CO2 on both host plants, but the mechanisms differ between hosts. What this suggests to me is that we are a long way from being able to predict changes that may occur in the population dynamics of important crop pests under elevated concentrations of atmospheric CO2. Initial laboratory studies under controlled conditions were necessary to determine the general responses of plant phenotype to elevated CO2 and their potential effects on insect herbivores. However, most laboratory studies provide grossly artificial environments in which plants are not limited by nutrient availability or light, where communities are simplified to two or three interacting species, where behavioural choices of herbivores are limited, and where stochastic fluctuations in the environment are eliminated (Lincoln et al., 1993; Arnone et al., 1995). In other words, they are free of any ecological complexity. In reality, the effects of elevated CO2 on plant phenotype, and subsequent insect responses, will be mediated by the availability of resources to plants such as water (Roth et al., 1997), light (McDonald et al., 1999) and nutrients (Arnone et al., 1995; Haettenschwiler & Schafellner, 1999) and modified by climatic and biotic variability. Interactive effects of light and CO2 on tree growth and secondary chemistry have been studied by McDonald et al. (1999). Reductions in insect performance on aspen grown under high light and elevated CO2 were dramatic. When tussock moth were reared on treatment foliage for the entire larval period, survival fell by 62% with concomitant decreases in growth rate and pupal weight. Reductions in gypsy moth performance on aspen were associated with both CO2- and light-induced increases in phenolic glycosides. The key finding of these studies is the degree to which phenotypic changes in plants under elevated CO2, and the subsequent effects on insect herbivores, depend upon the availability of light (McDonald et al., 1999; Agrell et al., 2000). This suggests that successional stage and community composition will influence the response of plants, and their insect herbivores, to elevated CO2. Nutrient availability is also likely to affect plant and insect responses to atmospheric change (Arnone et al., 1995). At the very least, nutrient limitation is likely to set limits on the gains in plant biomass that generally result from elevated CO2 environments (Johnson & Lincoln, 1991; Saxe et al., 1998). Given natural variation in nutrient availability and uptake by plants, and increasing levels of nitrogen deposition from anthropogenic sources, we should be aware of potential interactions between elevated CO2 and nutrient availability. Indeed, nitrogen deposition may mitigate the effects of elevated CO2 on insect performance. In one experimental study, Haettenschwiler & Schafellner (1999) exposed larvae of the nun moth to spruce trees grown under three levels of nitrogen deposition and three levels of CO2. The effects of the treatments on plant phenotype were generally opposite. Nitrogen deposition caused reductions in starch, condensed tannins and total phenolics and increases in sugar and nitrogen concentrations in spruce needles − the direct opposite of responses to elevated CO2. As a consequence, nitrogen deposition was able to mitigate, in part, the deleterious effects of elevated CO2 on nun moth performance. In contrast, Kinney et al. (1997) found relatively few interactions between nutrient availability and CO2 concentration in their studies of gypsy moth performance on aspen, oak and maple. Effects of the treatments were strongly host-specific rather than predictably opposing. In some systems, the consequences of nitrogen deposition may greatly outweigh those of elevated CO2. For example, Kerslake et al. (1998) have demonstrated that the defensive and nutritional phenotype of heather, Calluna vulgaris, does not change after 20 months of growth under elevated CO2. In contrast, simulated nitrogen deposition results in decreases in foliar C : N ratio and increases in shoot growth. Unlike other studies (Lindroth et al., 1995; Haettenschwiler & Schafellner, 1999; Agrell et al., 2000), neither elevated CO2 nor nitrogen deposition influenced the foliar phenolics of heather. Consistent with phenotypic changes in the plants, the performance of winter moth larvae was increased by nitrogen deposition and unaffected by elevated CO2. One dominant consequence of elevated levels of atmospheric CO2 is the predicted increase in global temperature. Yet studies that combine effects of CO2-enriched plants and elevated temperatures on insect performance are still remarkably rare. In one such study (Dury et al., 1998), a 3 °C increase in temperature reduced the nutritional quality of oak leaves by reducing foliar nitrogen concentrations and increasing foliar concentrations of condensed tannin. In other words, elevated temperature resulted in phenotypic changes in plants that were broadly similar to those mediated by elevated CO2. In combination with CO2-mediated reductions in the quality of primary and secondary leaf flushes, the elevated temperatures associated with global warming may significantly reduce the quality of plant food for insect herbivores. However, complex interactions among temperature, plant quality, insect performance and range expansion make predictions of pest problems in future global environments extremely difficult (Cannon, 1998). For example, the reduced rates of insect growth that have been observed under elevated CO2 may disappear as temperature increases in response to rising levels of atmospheric CO2 (Fajer et al., 1991). The bottom line? We need long-term, multifactorial experiments under field conditions to have any hope of predicting the interactive effects of CO2 and other ecological variables on the insect pests of crops and trees. Given this complexity, can we make any generalizations about the effects of elevated CO2 on insects that feed on plants? While there are always going to be effects that are species- and system-specific (Traw et al., 1996; Kinney et al., 1997; Roth et al., 1998; Coviella & Trumble, 1999; Agrell et al., 2000), we should not shy away from synthesis when justified (Fajer & Johnson, 1993). For example, Bezemer & Jones (1998) analysed data from 61 plant–herbivore combinations and found some compelling patterns. First, they confirmed the general decreases in foliar nitrogen concentration (15%) and increases in carbohydrate (47%) and phenolic-based secondary metabolites (31%) reported in many individual studies. Second, consumption by herbivores was related primarily to changes in nitrogen and carbohydrate levels. Third, no differences were found between CO2-mediated herbivore responses on woody and herbaceous plant species. Fourth, leaf-chewing insects generally increased their consumption of foliage (30%) under elevated CO2 to compensate for reduced nutritional quality and suffered no adverse effects upon pupal weights. Fifth, leaf-mining insects could only partially compensate by increased consumption and their pupal weights did decline. Finally, phloem-feeding and whole-cell-feeding insects responded positively to elevated CO2, with increases in population size and decreases in development time. Of course, there will be exceptions to these general patterns, but they provide a benchmark from which to develop hypotheses for future studies. To proceed further, we require more comparative studies of a large variety of plant–insect combinations in diverse ecosystems under field conditions (Saxe et al., 1998). There remain fundamental gaps in our understanding of plant and insect responses to elevated concentrations of atmospheric CO2. For example, we know very little about the responses of below-ground herbivores to increases in atmospheric CO2. Although the number of studies addressing CO2-mediated changes in the dynamics of soil communities is increasing (Ball & Drake, 1997; Jones et al., 1998; Kampichler et al., 1998; Kandeler et al., 1998), effects on insects that feed on plant roots are poorly understood. In at least some cases, elevated CO2 results in increases in root growth (Day et al., 1996) and increases in root nodule production of nitrogen-fixing plants (Hungate et al., 1999). However, the quality of these resources for insects that feed below ground are generally unknown. Likewise, we know almost nothing about the effects of CO2-mediated changes in plant quality on aquatic insects. Questions of water temperature aside, many aquatic insects in heterotrophic streams depend upon litter inputs as sources of carbon to drive food web dynamics. Changes in litter quality as the result of elevated CO2 have the potential to influence decomposition processes and resource availability in streams. However, in the one study I could find to date, litter from oak and birch grown under elevated CO2 had equivalent effects on mosquito growth and reproduction, as did litter from ambient atmospheric conditions (Strand et al., 1999). We desperately need more information on CO2-mediated changes in litter quality and subsequent effects on stream food webs. In reference to forest trees, we do not really know whether the studies of seedlings and saplings that have dominated the literature reflect accurately the responses that we should expect from mature trees. The increasing availability of open-top chamber (OTC) and free-air carbon enrichment (FACE) technologies should provide us with the ability to conduct long-term experiments on mature plants and the insects that they support. Field studies that challenge insects with quasi-natural communities of plants, animals and microbes under fluctuating environmental conditions may be more likely to reveal future effects of elevated CO2 on insect distribution and abundance (Fajer & Johnson, 1993; Stiling et al., 1999). I have already mentioned how little we know about the responses of natural enemies to CO2 enrichment. OTC and FACE studies have considerable potential to address the kinds of complex multitrophic interactions that are pervasive in both natural and production ecosystems. Effects of natural enemies (Stiling et al., 1999), mutualists (Marks & Lincoln, 1996) and complex plant communities (Arnone et al., 1995) on insect behaviour and performance cannot be understood in the ecological vacuum of the laboratory. Perhaps most important of all, we need long-term studies that integrate multiple generations of both insects and plants. Such studies are prerequisites for assessing responses such as parental effects on offspring quality (Rossiter, 1994) and adaptation by herbivore species to a CO2-enriched atmosphere. Long-term studies under field conditions are, of course, expensive. But they represent a fraction of the cost that big business is willing to pay to elect the politicians who will close their eyes to unacceptable levels of CO2 emissions.

#### Increased CO2 will harm food production and destroy biodiversity

David Chandler, Knight Science Journalism Fellow at MIT, and Michael Le Page, Atmospheric Science Meteorologist, 5-16-2007, “Climate myths: Higher CO2 levels will boost plant growth and food production,” NewScientist, http://environment.newscientist.com/channel/earth/dn11655-climate-myths-higher-cosub2sub-levels-will-boost-plant-growth-and-food-production.html

According to some accounts, the rise in carbon dioxide will usher in a new golden age where food production will be higher than ever before and most plants and animals will thrive as never before. If it sounds too good to be true, that's because it is. CO2 is the source of the carbon that plants turn into organic compounds, and it is well established that higher CO2 levels can have a fertilising effect on many plants, boosting growth by as much as a third. However, some plants already have mechanisms for concentrating CO2 in their tissues, known as C4 photosynthesis, so higher CO2 will not boost the growth of C4 plants. Where water is a limiting factor, all plants could benefit. Plants lose water through the pores in leaves that let CO2 enter. Higher CO2 levels mean they do not need to open these pores as much, reducing water loss. However, it is extremely difficult to generalise about the overall impact of the fertilisation effect on plant growth. Numerous groups around the world have been conducting experiments in which plots of land are supplied with enhanced CO2, while comparable nearby plots remain at normal levels. These experiments suggest that higher CO2 levels could boost the yields of non-C4 crops by around 13 per cent. Limiting factors However, while experiments on natural ecosystems have also found initial elevations in the rate of plant growth, these have tended to level off within a few years. In most cases this has been found to be the result of some other limiting factor, such as the availability of nitrogen or water. The regional climate changes that higher CO2 will bring, and their effect on these limiting factors on plant growth, such as water, also have to be taken into account. These indirect effects are likely to have a much larger impact than CO2 fertilisation. For instance, while higher temperatures will boost plant growth in cooler regions, in the tropics they may actually impede growth. A two-decade study of rainforest plots in Panama and Malaysia recently concluded that local temperature rises of more than 1ºC have reduced tree growth by 50 per cent (see Don't count on the trees). Another complicating factor is ground level ozone due to air pollution, which damages plants. This is expected to rise in many regions over the coming decades and could reduce or even negate the beneficial effects of higher CO2 (see Climate change warning over food production). In the oceans, increased CO2 is causing acidification of water. Recent research has shown that the expected doubling of CO2 concentrations could inhibit the development of some calcium-shelled organisms, including phytoplankton, which are at the base of a large and complex marine ecosystem (see Ocean acidification: the other CO2 problem). That may also result in significant loss of biodiversity, possibly including important food species. Levelling off Some have suggested that the increase in plant growth due to CO2 will be so great that it soaks up much of the extra CO2 from the burning of fossil fuels, significantly slowing climate change. But higher plant growth will only lock away CO2 if there is an accumulation of organic matter. Studies of past climate changes suggest the land and oceans start releasing more CO2 than they absorb as the planet warms. The latest IPCC report concludes that the terrestrial biosphere will become a source rather than a sink of carbon before the end of the century. What's more, even if plant growth does rise overall, the direct and indirect effects of higher CO2 levels will be disastrous for biodiversity. Between 20 to 30% of plant and animal species face extinction by the end of the century, according to the IPCC report. As for food crops, the factors are more complex. The crops most widely used in the world for food in many cases depend on particular combinations of soil type, climate, moisture, weather patterns and the infrastructure of equipment, experience and distribution systems. If the climate warms so much that crops no longer thrive in their traditional settings, farming of some crops may be able to shift to adjacent areas, but others may not. Rich farmers and countries will be able to adapt more easily than poorer ones. Predicting the world's overall changes in food production in response to elevated CO2 is virtually impossible. Global production is expected to rise until the increase in local average temperatures exceeds 3°C, but then start to fall. In tropical and dry regions increases of just 1 to 2°C are expected to lead to falls in production. In marginal lands where water is the greatest constraint, which includes much of the developing world but also regions such as the western US, the losses may greatly exceed the gains.

#### Effects of GW hurt food stability.

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

“Rocketing food prices—some of which have more than doubled in two years—have sparked riots in numerous countries recently,” Time magazine reported. “Millions are reeling... and governments are scrambling to staunch a fast-moving crisis before it spins out of control. From Mexico to Pakistan, protests have turned violent.” Time attributed events to booming demand from newly affluent Chinese and Indian consumers, freak weather events that had reduced harvests, the spike in oil prices, and growth in the production of farm biofuels.8 In early 2007, thousands of Mexicans turned out on the streets in protest over the “tortilla crisis”—savage increases in the cost of maize flour. Over the ensuing months food riots or public unrest over food prices were reported by media in Haiti, Malaysia, Indonesia, the Philippines, Bangladesh, India, Burkina Faso, Senegal, Cameroon, Morocco, Mauritania, Somalia, Ethiopia, Madagascar, Kenya, Egypt, Ivory Coast, Yemen, the United Arab Emirates, Mexico, and Zimbabwe. In Haiti riots forced the resignation of the prime minister and obliged the United Nations World Food Programme to provide emergency aid to 2.3 million people. The new government of Nepal tottered. Mexico announced plans to freeze the prices of 150 staple foods. The U.K. Guardian reported riots in fifteen countries; the New York Times and the World Bank both said thirty. The FAO declared that thirty-seven countries faced food crises due to conflict or disaster at the start of 2008, adding that 1.5 billion people living in degraded lands were at risk of starvation. The Economist magazine succinctly labeled it a “silent tsunami.”9 The rhetoric reflected the sudden, adventitious nature of the crisis. “It is an apocalyptic warning,” pronounced Tim Costello, the Australian head of the aid agency World Vision. “Until recently we had plenty of food: the question was distribution. The truth is because of rising oil prices, global warming and the loss of arable land, all countries that can produce food now desperately need to produce more.”10 “What we are witnessing is not a natural disaster—a silent tsunami or a perfect storm. It is a man-made catastrophe,” the World Bank group president Robert Zoellick advised the G8 leaders feasting in Japan. Major rice-growing countries, including India, Vietnam, China, and Cambodia, imposed export restrictions to curb rice price inflation at home. Malaysia, Singapore, Sri Lanka, and the Philippines began stockpiling grain while Pakistan and Russia raised wheat export taxes and Brazil, Indonesia, and Argentina imposed export restrictions. Guinea banned all food exports.’’ The panic reached a peak in Asia, where rice prices soared by almost 150 percent in barely a year. “Nobody has ever seen such a jump in the price of rice,” said sixty-eight-year-old Kwanchai Gomez, the executive director of the Thai Rice Foundation. Filipino fast-food outlets voluntarily reduced customer portions by half. In Thailand, thieves secretly stripped rice paddies by night to make a fast profit. India banned the export of all non-basmati rice, and Vietnam embargoed rice exports, period, sending Thai rice prices spiraling upward by 30 percent. The giant ILS retailer Wal-Mart rationed rice sales to customers of its Sam’s Club chain; some British retailers did likewise. Such measures did little to quell the panic, which was originally touched off by a 50 percent drop in surplus rice stocks over the previous seven years. The International Rice Research Institute attributed the crisis to loss of land to industrialization and city sprawl, the growing demand for meat in China and India, and floods or bad weather in Indonesia, Bangladesh, Vietnam, China, and Burma.’2

#### Biofuels and oil are huge contributors to the food problem.

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

By the early twenty-first century, signs of complacency were in evidence. In 1003, a conference of the Consultative Group on International Agricultural Research in Nairobi was told, “According to the Food and Agriculture Organization of the United Nations, the number of food insecure people in developing countries fell from 910 million in 1980 to 799 million in ¡999.” Even in the immediate aftermath of the 2008 food price spike, the FAO itself, along with the Organization for Economic Cooperation and Development, remarked, “the underlying forces that drive agricultural product supply (by and large productivity gains) will eventually outweigh the forces that determine stronger demand, both for food and feed as well as for industrial demand, most notably for biofuel production. Consequently, prices will resume their decline in real terms, though possibly nor by quite as much as in the past.”’4 For some years, reassuring statements such as these had been repeatedly aired in the food policy, overseas aid, and research worlds. Unintentionally, food scientists and policy makers were sending a signal to governments and aid donors around the world that implied, “Relax. It’s under control. We’ve fixed the problem. Food is no longer critical.” Not surprisingly, aid donors rechanneled scarce funds to other urgent priorities— and growth in crop yields sagged as the world’s foot came off the scientific accelerator. Many found the new crisis all the more mysterious for its apparent lack of an obvious trigger. Various culprits were pilloried by blame seeking politicians and media. Biofuels, after being talked tip as one of the great hopes for combating climate change, quickly became a villain accused of “burning the food of the poor,” and from China to Britain, countries slammed the brakes on policies intended to encourage farmers to grow more “green fuel” from grain. According to the World Bank, biofuels could have caused as much as three-quarters of the hike in food prices. Equally to blame, according to other commentators, were oil prices, which had soared six-fold in the five years from mid-2003 to mid2008 (although they fell again sharply as the global recession bit deep), with severe consequences for the cost of producing food, through their impact on farmers’ fuel, fertilizer, pesticide, and transportation costs. In developed countries the financial pain was high, but in developing nations it was agony: farmers simply could not afford to buy fertilizer, and crop yields began to slip. In Thailand rice farmers quietly parked their new but unaffordable tractors in their sheds and went back to plowing with buffalo; buffalo breeders experienced a bonanza. “Energy and agricultural prices have become increasingly intertwined,” commented Joachim von Braun, the head of the International Food Policy Research Institute. “High energy prices have made agricultural production more expensive by raising the cost of cultivation, inputs—especially fertilizers and irrigation—and transportation of inputs and outputs. In poor countries, this hinders production response to high output prices. The main new link between energy and agricultural prices, however, is the competition of grain and oilseed land for feed and food, versus their use for bio energy.”

#### GW is a big cause of the food problem.

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

Speculators, fleeing crumbling financial markets and discovering an unlikely haven in booming agricultural commodities, were a favorite target of media fire: “Food was becoming the new gold. Investors fleeing Wall Street’s mortgage-related strife plowed hundreds of millions of dollars into grain futures, driving prices up even more. By Christmas (1007), a global panic was building,” reported the Washington Post. In developing nations, traders and grain dealers were accused of buying up surplus stocks and hoarding them to drive the prices higher still. In the Philippines the government threatened hoarders with charges of economic sabotage and sent armed soldiers to supervise the distribution of subsidized grain.’6 Retirement and hedge funds, casting about for something to invest in that wasn’t going to hell in a handbasket, also jumped on farm commodities and even agribusiness enterprises—areas such investors traditionally shun. Many saw the crisis as simply a result of the growth of human population, the inexorable climb from 3 billion people in 1960 to 6.8 billion by 2008—the hundred million more mouths we have to feed in each succeeding year. Others ascribed it chiefly to burgeoning appetites in China and India, which had in a matter of five years or so together added the consumer equivalent of Europe to global demand for food as their emergent middle classes indulged in the delights of diets containing far more meat, poultry, dairy, and fish than ever before. In China, meat consumption trebled in less than fifteen years, requiring a tenfold increase in the grain needed to feed the animals and fish. One way to visualize the issue is that growth in global food production of 1—1.5 percent a year has more or less kept pace with growth in population—but has fallen short of meeting the growth in demand. One explanation for this is that farmers around the world have not responded by increasing the area of land they plant and harvest or raising their crop yields so rapidly as in the past. The big question is: why? Some blamed the weather. Portentously, many were quick to discern the looming shadow of climate change in the run of droughts, floods, and other natural mishaps that had disrupted global farm production across most continents in recent years. In eastern Australia a ten-year drought slashed grain production and all but obliterated the rice industry; the unprecedented draining of Australia’s food bowl, the Murray-Darling Basin, threatened to eliminate fruit, vegetable, and livestock industries reliant on irrigation. Similar hardship faced producers across sub Sahelian Africa. Floods in China and along the Mississippi River wreaked local havoc with grain production. In Burma, Cyclone Nargis flattened the Irrawaddy Delta rice crop, propelling Asian prices into a fresh spiral. Heat waves in California and torrential rains in India added to perceptions—heightened by media reportage—that the climate was running amok.’7 Other commentators sought villains among the world’s governments, blaming protectionism and hidden trade barriers, farm subsidies, food price controls or taxes, environmental and health restrictions, the ensnaring of farmers in snarls of red rape, along with the perennial failure of trade negotiators to open tip global trade in agricultural products. Supermarkets and globalization of the food trade came in for flak, especially from the political left and from farmers themselves, for driving down farm commodity prices and thus discouraging growers from increasing production. Economic observers read the crisis as primarily due to weaker growth in food production at a time of strong growth in consumer demand, especially in China and India and among affluent populations worldwide. The Green Revolution, whose technologies had delivered the last great surge in global food production in the 1970S and 19805, seemed to be fizzling out, a view supported by the disturbing slide in crop yield advances. Yields of the major crops of wheat, maize, and rice had once increased by as much as 5 and even 10 percent a year—now they were increasing by 1 percent or nothing at all. In the overheated economy of the early twenty-first century, farm costs had soared along with oil prices, hindering farmers from adopting newer, but costlier and more energy intensive, technologies. In advanced countries, some scientists whispered, we might actually he approaching the physical limits of the ability of plants to turn sunlight into edible food. In the general hunt for someone to blame for the short-term food cri sis, a more profound truth was being obscured—that the challenge is far deeper, longer-term, and more intractable than most people, and certainly most governments, understand. It stems from the magnifying and interacting constraints on food production generated as civilization presses harder against the finite bounds of the planet’s natural resources, combined with human appetites that seem to know no bounds. This challenge is more pressing even than climate change. A climate crisis may emerge over decades. A food crisis can explode within weeks— and kill within days. But the two are also interlocked. “If the world were to experience a year of bad weather similar to that experienced in 1971, the current ‘food crisis’ would pale in comparison to the crisis that would arise as a result. This should be taken as a warning that advance planning ought to be done if total chaos is to be avoided,” observes the resource analyst Bruce Sundquisr.’9

#### Impact: Nuclear world war III

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

The Great Irish Famine may belong to the nineteenth century, but it carries undeniable messages for the twenty-first. It reveals the effect of over-reliance on a major food source, and even though few countries today are as dependent on a single crop, many crops around the world are vulnerable to the loss of critical inputs such as water, fuel, or fertilizer, to disease, or to weather disaster. Any of these can unleash a local or regional famine—and the famine, in turn, will release an outpouring of refugees. In a world as heavily populated as ours, it is not hard to imagine how refugee tsunamis could result from a general food failure in the Indian subcontinent, Central Asia, China, sub-Saharan or North Africa, or Southeast or East Asia. Events of this scale arc beyond all previous human experience for the simple reason that the world has never been so populous or its resources so fragile. The possibility of regional crises involving twenty, fifty, even as many as two hundred or three hundred million refugees must now be seriously contemplated. Such floods are unlikely to be stemmed by military force. They will alter the politics, demography, and culture of entire regions. They will change history. This is the most likely means by which the coming famine will affect all citizens of Earth, both through the direct consequences of refugee hoods for receiving countries and through the effect on global food prices and the cost to public revenues of redressing the problem. Coupled with this is the risk of wars breaking out over local disputes about food, land, and water and the dangers that the major military powers may be sucked into these vortices, that smaller nations newly nuclear-armed may become embroiled, and that shock waves propagated by these conflicts will Jar the global economy and disrupt trade, sending food prices into a fresh spiral. Indeed, an increasingly credible scenario for World War III is not so much a confrontation of superpowers and their allies as a festering, self-perpetuating chain of resource conflicts driven by the widening gap between food and energy supplies and peoples’ need to secure them. RISING THREATS Round the world, defense departments are already planning for what they anticipate as an era of rising instability and threats as populations swell, resources become scarcer, and climatic impacts hit home. Among the most notable examples is a U.K. Ministry of Defense Strategic Trends study that, among other insightful predictions, anticipated the collapse of global financial markets and the U.S. stock market by almost two years. Relevant findings from this report include: increased risk of food price spikes and shortages, water scarcities contributing to tensions in already volatile regions, mass population displacement due to climate or resource scarcities, possible collapse in fish stocks, increased risk of development failure in some countries and “megacity failure,” and greater societal conflict involving civil war, intercommunal violence, insurgency, pervasive criminality, and widespread disorder (see map 2).32 Another important report, this time from a U.S. perspective, is ‘The Age of Consequences.” This study explores the risks of a similarly destabilized world, erupting out of three different possible scenarios for climate change. Under the conservative scenario envisaged by the Intergovernmental Panel on Climate Change, this report anticipates ‘heightened internal and cross-border tensions caused by large-scale migrations; conflict sparked by resource scarcity, particularly in the weak and failing states of Africa.” Under severe climate change, it foresees that “the internal cohesion of nations will be under great stress... both as a result of a dramatic rise in migration and changes in agricultural patterns and water availability. The flooding of coastal communities around the world has the potential to challenge regional and even national identities. Armed conflict between nations over resources, such as the Nile and its tributaries, is likely and nuclear war is possible.” The catastrophic scenario, the report simply says, “would pose almost inconceivable challenges as human society struggled to adapt,” adding, “No precedent exists for a disaster of this magnitude—one that affects entire civilizations in multiple ways simultaneously.”

### Warming Bad – Crop Quality

#### Higher temps decrease crop quality.

GCRP, United States Global Research Program, 2009, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/agriculture#key1>

temperature extremes will also pose problems. Even crop species that are well-adapted to warmth, such as tomatoes, can have reduced yield and/or quality when daytime maximum temperatures exceed 90°F for even short periods during critical reproductive stages (see maps page 34).112 For many high-value crops, just hours or days of moderate heat stress at critical growth stages can reduce grower profits by negatively affecting visual or flavor quality, even when total yield is not reduced.238

### Warming Bad – Water

#### GW would lead to water problems in agriculture.

GCRP, United States Global Research Program, 2009, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/agriculture#key1>

Extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth. One of the most pronounced effects of climate change is the increase in heavy downpours. Precipitation has become less frequent but more intense, and this pattern is projected to continue across the United States.112 One consequence of excessive rainfall is delayed spring planting, which jeopardizes profits for farmers paid a premium for early season production of high-value crops such as melon, sweet corn, and tomatoes. Field flooding during the growing season causes crop losses due to low oxygen levels in the soil, increased susceptibility to root diseases, and increased soil compaction due to the use of heavy farm equipment on wet soils.In spring 2008, heavy rains caused the Mississippi River to rise to about 7 feet above flood stage, inundating hundreds of thousands of acres of cropland. The flood hit just as farmers were preparing to harvest wheat and plant corn, soybeans, and cotton. Preliminary estimates of agricultural losses are around $8 billion.213 Some farmers were put out of business and others will be recovering for years to come. The flooding caused severe erosion in some areas and also caused an increase in runoff and leaching of agricultural chemicals into surface water and groundwater.233 Another impact of heavy downpours is that wet conditions at harvest time result in reduced quality of many crops. Storms with heavy rainfall often are accompanied by wind gusts, and both strong winds and rain can flatten crops, causing significant damage. Vegetable and fruit crops are sensitive to even short-term, minor stresses, and as such are particularly vulnerable to weather extremes.193 More rainfall concentrated into heavy downpours also increases the likelihood of water deficiencies at other times because of reductions in rainfall frequency. Drought frequency and severity are projected to increase in the future over much of the United States, particularly under higher emissions scenarios.90,91 Increased drought will be occurring at a time when crop water requirements also are increasing due to rising temperatures. Water deficits are detrimental for all crops.233 Temperature extremes will also pose problems. Even crop species that are well-adapted to warmth, such as tomatoes, can have reduced yield and/or quality when daytime maximum temperatures exceed 90°F for even short periods during critical reproductive stages (see maps page 34).112 For many high-value crops, just hours or days of moderate heat stress at critical growth stages can reduce grower profits by negatively affecting visual or flavor quality, even when total yield is not reduced.238 Weeds, diseases, and insect pests benefit from warming, and weeds also benefit from a higher carbon dioxide concentration, increasing stress on crop plants and requiring more attention to pest and weed control. Weeds benefit more than cash crops from higher temperatures and carbon dioxide levels.193 One concern with continued warming is the northward expansion of invasive weeds. Southern farmers currently lose more of their crops to weeds than do northern farmers. For example, southern farmers lose 64 percent of the soybean crop to weeds, while northern farmers lose 22 percent.239 Some extremely aggressive weeds plaguing the South (such as kudzu) have historically been confined to areas where winter temperatures do not drop below specific thresholds. As temperatures continue to rise, these weeds will expand their ranges northward into important agricultural areas.240 Kudzu currently has invaded 2.5 million acres of the Southeast and is a carrier of the fungal disease soybean rust, which represents a major and expanding threat to U.S. soybean production.234 Controlling weeds currently costs the United States more than $11 billion a year, with the majority spent on herbicides;241 so both herbicide use and costs are likely to increase as temperatures and carbon dioxide levels rise. At the same time, the most widely used herbicide in the United States, glyphosate (RoundUp®), loses its efficacy on weeds grown at carbon dioxide levels that are projected to occur in the coming decades (see photos below). Higher concentrations of the chemical and more frequent spraying thus will be needed, increasing economic and environmental costs associated with chemical use.233 Many insect pests and crop diseases thrive due to warming, increasing losses and necessitating greater pesticide use. Warming aids insects and diseases in several ways. Rising temperatures allow both insects and pathogens to expand their ranges northward. In addition, rapidly rising winter temperatures allow more insects to survive over the winter, whereas cold winters once controlled their populations. Some of these insects, in addition to directly damaging crops, also carry diseases that harm crops. Crop diseases in general are likely to increase as earlier springs and warmer winters allow proliferation and higher survival rates of disease pathogens and parasites.193,234 The longer growing season will allow some insects to produce more generations in a single season, greatly increasing their populations. Finally, plants grown in higher carbon dioxide conditions tend to be less nutritious, so insects must eat more to meet their protein requirements, causing greater destruction to crops.193 Due to the increased presence of pests, spraying is already much more common in warmer areas than in cooler areas. For example, Florida sweet corn growers spray their fields 15 to 32 times a year to fight pests such as corn borer and corn earworm, while New York farmers average zero to five times.193 In addition, higher temperatures are known to reduce the effectiveness of certain classes of pesticides (pyrethroids and spinosad). A particularly unpleasant example of how carbon dioxide tends to favor undesirable plants is found in the response of poison ivy to rising carbon dioxide concentrations. Poison ivy thrives in air with extra carbon dioxide in it, growing bigger and producing a more toxic form of the oil, urushiol, which causes painful skin reactions in 80 percent of people. Contact with poison ivy is one of the most widely reported ailments at poison centers in the United States, causing more than 350,000 cases of contact dermatitis each year. The growth stimulation of poison ivy due to increasing carbon dioxide concentration exceeds that of most other woody species. Given continued increases in carbon dioxide emissions, poison ivy is expected to become more abundant and more toxic in the future, with implications for forests and human health.234 Higher temperatures, longer growing seasons, and increased drought will lead to increased agricultural water use in some areas. Obtaining the maximum “carbon dioxide fertilization” benefit often requires more efficient use of water and fertilizers that better synchronize plant demand with supply. Farmers are likely to respond to more aggressive and invasive weeds, insects, and pathogens with increased use of herbicides, insecticides, and fungicides. Where increases in water and chemical inputs become necessary, this will increase costs for the farmer, as well as having society-wide impacts by depleting water supply, increasing reactive nitrogen and pesticide loads to the environment, and increasing risks to food safety and human exposure to pesticides. Higher temperatures, longer growing seasons, and increased drought will lead to increased agricultural water use in some areas. Obtaining the maximum “carbon dioxide fertilization” benefit often requires more efficient use of water and fertilizers that better synchronize plant demand with supply. Farmers are likely to respond to more aggressive and invasive weeds, insects, and pathogens with increased use of herbicides, insecticides, and fungicides. Where increases in water and chemical inputs become necessary, this will increase costs for the farmer, as well as having society-wide impacts by depleting water supply, increasing reactive nitrogen and pesticide loads to the environment, and increasing risks to food safety and human exposure to pesticides.

### Warming Bad – Pests Outweigh

#### Increased CO2 would benefit pests more than agriculture.

GCRP, United States Global Research Program, 2009, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/agriculture#key1>

Weeds, diseases, and insect pests benefit from warming, and weeds also benefit from a higher carbon dioxide concentration, increasing stress on crop plants and requiring more attention to pest and weed control. Weeds benefit more than cash crops from higher temperatures and carbon dioxide levels.193 One concern with continued warming is the northward expansion of invasive weeds. Southern farmers currently lose more of their crops to weeds than do northern farmers. For example, southern farmers lose 64 percent of the soybean crop to weeds, while northern farmers lose 22 percent.239 Some extremely aggressive weeds plaguing the South (such as kudzu) have historically been confined to areas where winter temperatures do not drop below specific thresholds. As temperatures continue to rise, these weeds will expand their ranges northward into important agricultural areas.240 Kudzu currently has invaded 2.5 million acres of the Southeast and is a carrier of the fungal disease soybean rust, which represents a major and expanding threat to U.S. soybean production.234 Controlling weeds currently costs the United States more than $11 billion a year, with the majority spent on herbicides;241 so both herbicide use and costs are likely to increase as temperatures and carbon dioxide levels rise. At the same time, the most widely used herbicide in the United States, glyphosate (RoundUp®), loses its efficacy on weeds grown at carbon dioxide levels that are projected to occur in the coming decades (see photos below). Higher concentrations of the chemical and more frequent spraying thus will be needed, increasing economic and environmental costs associated with chemical use.233 Many insect pests and crop diseases thrive due to warming, increasing losses and necessitating greater pesticide use. Warming aids insects and diseases in several ways. Rising temperatures allow both insects and pathogens to expand their ranges northward. In addition, rapidly rising winter temperatures allow more insects to survive over the winter, whereas cold winters once controlled their populations. Some of these insects, in addition to directly damaging crops, also carry diseases that harm crops. Crop diseases in general are likely to increase as earlier springs and warmer winters allow proliferation and higher survival rates of disease pathogens and parasites.193,234 The longer growing season will allow some insects to produce more generations in a single season, greatly increasing their populations. Finally, plants grown in higher carbon dioxide conditions tend to be less nutritious, so insects must eat more to meet their protein requirements, causing greater destruction to crops.193 Due to the increased presence of pests, spraying is already much more common in warmer areas than in cooler areas. For example, Florida sweet corn growers spray their fields 15 to 32 times a year to fight pests such as corn borer and corn earworm, while New York farmers average zero to five times.193 In addition, higher temperatures are known to reduce the effectiveness of certain classes of pesticides (pyrethroids and spinosad). A particularly unpleasant example of how carbon dioxide tends to favor undesirable plants is found in the response of poison ivy to rising carbon dioxide concentrations. Poison ivy thrives in air with extra carbon dioxide in it, growing bigger and producing a more toxic form of the oil, urushiol, which causes painful skin reactions in 80 percent of people. Contact with poison ivy is one of the most widely reported ailments at poison centers in the United States, causing more than 350,000 cases of contact dermatitis each year. The growth stimulation of poison ivy due to increasing carbon dioxide concentration exceeds that of most other woody species. Given continued increases in carbon dioxide emissions, poison ivy is expected to become more abundant and more toxic in the future, with implications for forests and human health.234 Higher temperatures, longer growing seasons, and increased drought will lead to increased agricultural water use in some areas. Obtaining the maximum “carbon dioxide fertilization” benefit often requires more efficient use of water and fertilizers that better synchronize plant demand with supply. Farmers are likely to respond to more aggressive and invasive weeds, insects, and pathogens with increased use of herbicides, insecticides, and fungicides. Where increases in water and chemical inputs become necessary, this will increase costs for the farmer, as well as having society-wide impacts by depleting water supply, increasing reactive nitrogen and pesticide loads to the environment, and increasing risks to food safety and human exposure to pesticides.

### Warming Bad – Fruit

#### CO2 ruins fruit production.

Erik Madsen, Loyola University of Chicago, AAlborg School of Economics, DENMARK, Odence School of Agriculture, 07 Sep 2009, Acta Agriculturae Scandinavica, “Effect of CO2 concentration on Growth and Fruit Production of Tomato Plants,” http://www.tandfonline.com/loi/saga19

The development of the plants in the 2 series through 97 and 94 days respectively revealed a deformation of the plant leaves under the-given growing conditions; the deformation increased with the CO2, concentration in the air. The highest COO concentrations caused so severe a deformation that a total withering of the plants could be expected shortly after the end of the trial. The deformation of the leaves corresponded to that of leaves from 1-month-old plants grown under the same conditions (Madsen; 1973a), although at this age the plants showed no significant destructive tendency even at the highest CO, concentrations in the air. -However, the 6 times increased starch content (Madsen, 1968), the very deformed chloroplasts (Madsen, 1971 a) and the declining photosynthesis rate in leaves of the young plants (Madsen; 19716) made it probable that a mechanical destruction of the plants would set in at the highest CO, concentrations, if the plants were grown for a longer period. Apparently the amount of produced starch is greater than the quantity that the plant is able to utilize for growth and fruit production. The large starch accumulation causes a destruction of the chloroplasts with a consequent withering of the leaves. The total fruit production increased with the CO2, concentration up to 0.10-0.15 vol% CO2,. Above this concentration the fruit production decreased with increasing CO2, concentration. In a CO, concentration of 0.32 vol% the fruit production was less than that in the atmospheric air. This is in close agreement with the results found by Bierhuizen & Ploegman (1965). The result indicates that the optimal CO, concentration for plants at the generative stage is lower than that for plants at the vegetative stage where the optimal CO2, concentration was found to be 0.22 vol% CO2, (Madsen, 19734. This is in good agreement with the examination results of the photosynthesis rate (Madsen, 19706), where the leaves of younger plants (15-17 days old) had a maximum photosynthesis rate at a higher CO, concentration than the Acta Agriciiltiir& Scandinavica 24 (1974) Madsen leaves from older plants (27-32 days old), in which the starch accumulation in the chloroplasts had a hampering effect on the photosynthesis. The results obtained seem to indicate that tomato plants are unable to develop normally in air with CO2 concentrations above 0.10 vol%, if CO2, is added day and night. When grown in air with CO2, concentrations above 0.1 volO,;, the plants will be exposed to a slow self-destruction with a consequent smaller fruit yield. Below 0.1 vol% CO2, there was a positive correlation between dry matter content of young plants and fruit production of older plants on the one side and the concentration of CO2, on the other side. These results are in good agreement with the experience from practical tomato production, where it has been found to be desirable that tomato plants at the vegetative stage have high dry matter content, and where C02 concentrations from 0.1 to 0.15 vol% are used to obtain a maximum yield (Wittwer & Robb, 1964; Smith, 1966). At the time of the year when the day length increases the temperature will increase too, and it is therefore necessary to ventilate the greenhouses in the middle of the day to moderate the temperature. During such a ventilation the CO2, concentration will be close to that of normal atmospheric air. This means that the maximum photosynthesis rate in practical tomato production does not increase essentially with the advanced length of day, and thus the risk of overproduction of starch with a consequent destruction of the chloroplasts is reduced. The periodically high growth temperature in the 2 trial series, in which extra CO2, was added throughout 24 hours, seems to have promoted the destruction and thereby also the senility. The increased earliness of ripe fruits is in conformity with the results of other examinations (Wittwer & Robb, 1964; Morgan, 1971). It is probably due to the quicker growth and development achieved by plants grown in air with higher CO2, concentration (Wittwer & Robb, 1964; Morgan, 1971; Madsen, 1973b). Consequently the CO2, application will promote the physiological age of the plants and thereby also time of fruit setting.

### AT: CO2 Good For Agriculture

#### Their Science is wrong – CO2 Reduces Ag

Associated Press, an international news and reporting agency ,20th August 2010. “Global Warming Linked to decline in plant growth.” http://www.dallasnews.com/news/20100820-Global-warming-linked-to-decline-in-525.ece

WASHINGTON - Plant growth that had been spurred by global warming has reversed, despite temperatures that continue to rise. Researchers say the change could affect food security and development of biofuels. The amount of carbon taken up by growing plants increased from 1982 through 1999 as temperatures rose and the amount of carbon dioxide in the atmosphere increased. But a new study in today's edition of the journal Science found a drought-related decline in such plant growth from 2000 to 2009, even though temperatures continued to climb. As drought caused by warming reduces the land's ability to take up carbon, the result could be more carbon dioxide left in the atmosphere, and thus more warming, Maosheng Zhao of the University of Montana explained in a telephone interview. "This is a pretty serious warning that warmer temperatures are not going to endlessly improve plant growth," co-author Steven W. Running, also of the University of Montana, said in a statement. "We see this as a bit of a surprise, and potentially significant on a policy level because previous interpretations suggested global warming might actually help plant growth around the world," he said. Instead, he and Zhao found a small but measurable decline of about 1 percent, compared to a 6 percent increase in the 1980s and '90s. Their study, based on data collected by NASA satellites, found that northerly areas continued to increase plant growth, thanks to warmer temperatures and a longer growing season. But that was more than offset by warming-associated drought in the Southern Hemisphere. The research was supported by NASA and the National Oceanic and Atmospheric Administration.

#### New Science destroys their claim – CO2 results in net plant **Loss**

Zhuoting Wu et. al, Department of Biological Sciences and Merriam-Powell Center for Environmental Research March 8th 2012. Biogeochemical and ecological feedbacks in grassland responses to warming. Nature Climate Change, 2012; DOI: 10.1038/nclimate1486

Plant growth often responds rapidly to experimentally simulated climate change1, 2. Feedbacks can modulate the initial responses3, but these feedbacks are difficult to detect when they operate on long timescales4. We transplanted intact plant–soil mesocosms down an elevation gradient to expose them to a warmer climate and used collectors and interceptors to simulate changes in precipitation. Here, we show that warming initially increased aboveground net primary productivity in four grassland ecosystems, but the response diminished progressively over nine years. Warming altered the plant community, causing encroachment by species typical of warmer environments and loss of species from the native environment—trends associated with the declining response of plant productivity. Warming stimulated soil nitrogen turnover, which dampened but did not reverse the temporal decline in the productivity response. Warming also enhanced N losses, which may have weakened the expected biogeochemical feedback where warming stimulates N mineralization and plant growth1, 5, 6. Our results, describing the responses of four ecosystems to nearly a decade of simulated climate change, indicate that short-term experiments are insufficient to capture the temporal variability and trend of ecosystem responses to environmental change and their modulation through biogeochemical and ecological feedbacks.

### AT: CO2 Makes Plants Bigger

#### Bigger isn’t always better.

GCRP, United States Global Research Program, 2009, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/agriculture#key1>

Plants need adequate water to maintain their temperature within an optimal range. Without water for cooling, plants will suffer heat stress. In many regions, irrigation water is used to maintain adequate temperature conditions for the growth of cool season plants (such as many vegetables), even in warm environments. With increasing demand and competition for freshwater supplies, the water needed for these crops might be increasingly limited. If water supply variability increases, it will affect plant growth and cause reduced yields. The amount and timing of precipitation during the growing season are also critical, and will be affected by climate change. Changes in season length are also important and affect crops differently.193 Higher carbon dioxide levels generally cause plants to grow larger. For some crops, this is not necessarily a benefit because they are often less nutritious, with reduced nitrogen and protein content. Carbon dioxide also makes some plants more water-use efficient, meaning they produce more plant material, such as grain, on less water.193 This is a benefit in water-limited areas and in seasons with less than normal rainfall amounts.

### AT: CO2 Increases Yields

#### GW greatly reduces harvest time.

GCRP, United States Global Research Program, 2009, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/agriculture#key1>

The grain-filling period (the time when the seed grows and matures) of wheat and other small grains shortens dramatically with rising temperatures. Analysis of crop responses suggests that even moderate increases in temperature will decrease yields of corn, wheat, sorghum, bean, rice, cotton, and peanut crops.193 Some crops are particularly sensitive to high nighttime temperatures, which have been rising even faster than daytime temperatures.68 Nighttime temperatures are expected to continue to rise in the future. These changes in temperature are especially critical to the reproductive phase of growth because warm nights increase the respiration rate and reduce the amount of carbon that is captured during the day by photosynthesis to be retained in the fruit or grain. Further, as temperatures continue to rise and drought periods increase, crops will be more frequently exposed to temperature thresholds at which pollination and grain-set processes begin to fail and quality of vegetable crops decreases. Grain, soybean, and canola crops have relatively low optimal temperatures, and thus will have reduced yields and will increasingly begin to experience failure as warming proceeds.193 Common snap beans show substantial yield reduction when nighttime temperatures exceed 80°F.

## AT: SO2 Screw DA

### SO2 Causes Warming

#### SO2 causes warming not cooling – bigger than CO2

Peter Ward, Ph.D. from Colombia University and natural scientist for more than 40 years, 02/11/2009, tetontectonics.org, http://www.tetontectonics.org/Climate/Ward2009SulfurDioxide.pdf

These sulfate signals corresponding closely to known anthropogenic emissions prove that SO2 emitted from smokestacks around the world rises high enough and remains in the troposphere long enough to reach regional ice ﬁelds but not long enough to be thoroughly homogenized worldwide. Barrie and Hoff conclude that the residence time for industrial SO2 from Eurasia in the Arctic is 14– 20 days in late fall, 16–32 days at mid-winter and 10–19 days in April. Laj et al. found that high concentrations of sulfate in Greenland were associated with local depletions in H2O2, suggesting that the SO2 remained a gas until oxidized as it was deposited in Greenland. All authors agree that the majority of anthropogenic sulfate in Greenland originated from northern Eurasia. The amount of sulfate deposited in each layer (1.7 years) in Greenland had risen by 1962 to 50 ppb, the equivalent to one “large” volcanic eruption. Humans burning fossil fuels have raised the background SO2 levels in the atmosphere to levels that throughout the past 46 k.y. have caused global warming. Since 2000, the world reached a peak in global warming. There is no change in the rate of increase of CO2 since 1970 except for a small decrease and then increase after the Pinatubo eruption in 1991 caused by eruption induced global cooling. There is no change in the rate of change of CO2 concentration in the atmosphere that precedes or is contemporaneous with the ﬂattening of the temperature proﬁle since 2000. Thus it seems reasonable to accept the hypothesis that global warming during the 20th century was primarily initiated by a rapid increase in the rate of anthropogenic emission of sulfur by man, that the SO2 reduced the oxidizing capacity of the atmosphere, leading to an increase in methane, water, and other greenhouse gases. This does not mean that CO2 did not have any role, but it does not appear to have had a lead role. Humans burning fossil fuels and manufacturing cement are releasing 7.8 Gt of carbon into the atmosphere yearly. If all this carbon were in the form of CO2, it would be 28.6 Gt, or 122 to 681 times greater than the amount of CO2 emitted in the 1991 eruption of Pinatubo. Humans are putting two to three orders of magnitude more CO2 into the atmosphere every year than one “large” volcanic eruption.

#### Both SO2 and CO2 need to be reduced – SO2 causes warming

Peter Ward, Ph.D. from Colombia University and natural scientist for more than 40 years, 02/11/2009, tetontectonics.org, http://www.tetontectonics.org/Climate/Ward2009SulfurDioxide.pdf

There have been two dozen times during the past 46,000 years when major volcanic eruptions occurred every year or two or even several times per year for decades. Each of these times was contemporaneous with very rapid global warming. Large volumes of SO2 erupted frequently appear to overdrive the oxidizing capacity of the atmosphere resulting in very rapid warming. Such warming and associated acid rain becomes extreme when millions of cubic kilometers of basalt are erupted in much less than one million years. These are the times of the greatest mass extinctions. When major volcanic eruptions do not occur for decades to hundreds of years, the atmosphere can oxidize all pollutants, leading to a very thin atmosphere, global cooling and decadal drought. Prior to the 20th century, increases in atmospheric carbon dioxide (CO2) followed increases in temperature initiated by changes in SO2. By 1962, man burning fossil fuels was adding SO2 to the atmosphere at a rate equivalent to one “large” volcanic eruption each 1.7 years. Global temperatures increased slowly from 1890 to 1950 as anthropogenic sulfur increased slowly. Global temperatures increased more rapidly after 1950 as the rate of anthropogenic sulfur emissions increased. By 1980 anthropogenic sulfur emissions peaked and began to decrease because of major efforts especially in Japan, Europe, and the United States to reduce acid rain (which SO2 also causes). Atmospheric concentrations of methane began decreasing in 1990 and have remained nearly constant since 2000, demonstrating an increase in oxidizing capacity. Global temperatures became roughly constant around 2000 and even decreased beginning in late 2007. Meanwhile atmospheric concentrations of carbon dioxide have continued to increase at the same rate that they have increased since 1970. Thus SO2 is playing a far more active role in initiating and controlling global warming than recognized by the Intergovernmental Panel on Climate Change. Massive reduction of SO2 should be a top priority in order to reduce both global warming and acid rain. But man is also adding two to three orders of magnitude more CO2 per year to the climate than one “large” volcanic eruption added in the past. Thus CO2, a greenhouse gas, is contributing to global warming and should be reduced. We have already signiﬁcantly reduced SO2 emissions in order to reduce acid rain. We know how to do it both technically and politically. In the past, sudden climate change was typically triggered by sudden increases in volcanic activity. Slow increases in greenhouse gases, therefore, do not appear as likely as currently thought to trigger tipping points where the climate suddenly changes. However we do need to start planning an appropriate human response to future major increases in volcanic activity.

#### SO2 warming outweighs SO2 cooling

Teton Tectonics, collaborative effort of many natural scientists, 2009, http://www.tetontectonics.org/Climate.html

As SO2 concentrations decreased, hydroxyl radical (OH) concentrations increased, oxidizing methane, causing methane concentrations to stop increasing. This implies that the increase in methane concentrations during the 20th century may have been caused by increasing amounts of SO2 emissions decreasing the oxidizing capacity of the atmosphere rather than increased emissions of methane. During the 20th century, humans burning fossil fuels warmed the lower atmosphere and therefore the ocean ~0.8oC, resetting the thermostat for the earth. There is no proven way to cool the ocean similar amounts within decades. Continued melting of ice and snow, most notably in the Arctic is the result of the ocean and atmosphere slowly approaching equilibrium after this sudden change in the earth's thermostat. Solar intensity decreased (global dimming) in response to increasing SO2 and decreased (global brightening) in response to decreasing SO2. SO2 absorption is greater in polar regions due to increased length of the paths of photons within the atmosphere. This fact helps explain why temperature increases have been so much greater, especially in the Arctic where Arctic haze increased with increasing SO2 emissions.

#### A large amount of SO2 causes extinction

Peter Ward, Ph.D. from Colombia University and natural scientist for more than 40 years, 02/11/2009, tetontectonics.org, http://www.tetontectonics.org/Climate/Ward2009SulfurDioxide.pdf

Most paleontologists conclude that mass extinctions are not instantaneous; they tend to occur over at least thousands of years. While a meteorite may have complicated the extinction around 65.5 Ma, it is now clear that radiation did not kill the dinosaurs and that large percentages of animals could have survived a large impact by sheltering. Mass extinctions typically involve runaway greenhouse warming, major changes of acidity of air and water, dramatic increases in light carbon isotopes, and anoxia over hundreds to tens of thousands of years. Given that massive increases in SO2 appear to have caused mass extinctions in the past and that there has been a signiﬁcant increase in SO2 gases since 1925, we should not be too surprised to discover that we are currently in the midst of a major mass extinction. In 2005, more than 1360 scientists under the auspices of the United Nations, completed the Millennium Ecosystem Assessment. This was followed by the Global Biodiversity Outlook 2 under the Convention on Biological Diversity, a legally binding global treaty created in 1992 with nearly universal participation of countries. Among their conclusions are: 1. “15 out of 24 ecosystem services are in decline including the ability to provide fresh water and the ability of the atmosphere to cleanse itself of pollutants.” 2. “Trends among 3000 wild populations of species show a consistent decline in average species abundance of about 40% between 1970 and 2000.” 3. “Between 12% and 52% of species within well-studied higher taxa are threatened with extinction.” 4. “The global demand for resources exceeds the biological capacity of the Earth to renew these resources by some 20%.” 5. “Humans are currently responsible for the sixth major extinction event in the history of the earth, and the greatest since the dinosaurs disappeared, 65 million years ago.”

### AT: SO2 Solves Warming – SO2 Decline

#### Not-unique – SO2 will inevitably decline because of unrelated pollution control, and CO2 warming outweighs

IPCC, you know, 2001, Full Text of Third Assessment, 5.5.4, www.ipcc.ch

Concerns about aerosols derive from a number of other considerations. These include visibility, toxic affects and human health, interactions of aerosols with chemical processes in the troposphere and stratosphere, acid deposition, and air pollution. Of these concerns, those associated with toxic effects and visibility have led the industrialised countries to promulgate standards to reduce the concentrations of aerosols in urban and also more pristine locations. Also, concerns about the effect of acid rain have led to increased controls over the emmisions of S02. As shown above, the SRES scenarios for the future (Nakic’enovic’ et al., 2000) have all assumed that emissions of SO2 will eventually decrease, and the AlT and B2 scenarios predict that sulphur emissions start decrease on a global average basis almost immediately.

### AT: SO2 Solves Warming – Ecosystems Turn

#### S02 causes acid rain which destroys ecosystems

Clive Spash, prof. Enc. And Rural Economics at Aberdeen and pres. European

Society for Ecological Economics, 2002 “Greenhouse Economics”

One result of the new power stations was to inject sulphur dioxide and nitrous oxides high into the atmosphere, where they were out of sight and out of mind. That was until the 1970s when Scandinavian scientists began to publicise the link between the changes in their forests and water ecosystems due to acidic deposition. A decade of dispute and research led to the more general acceptance that the long-range transportation of air pollutants form the UK and Germany to Scandinavia was possible, but there was no action by the major emitters. Emissions were given more serious attention by the German government as their own forests began to die and environmentalists began to successfully move into mainstream politics. The main impact on emissions in the UK was due to the changing political and economic fortunes of the coal industry with Conservative administrations determined to break the power of the mining unions. The availability of cheaper natural gas and a move away from heavy industry aided this political agenda. Thus, political and structural change was affecting emissions rather than any concern for environmental damagers inflicted on others. Acidic deposition remains a serious problem which has destroyed and is destroying ecosystems across Europe. In the late 1990s the Scandinavians were forced to issue health warnings against pregnant women eating fish due to the heavy metals released into the water by acidic deposition, which then accumulates in the body of the fish. The developing human foetus is particularly vulnerable to the toxic effects of these heavy metals. Of course decades of acidic deposition have also contaminated water supplies, in a similar fashion, and Scandinavian household in remote areas dependent upon ground water are at risk. The Norwegian and Swedish programmes for liming vast areas on a regular basis merely maintain a life line for ecosystems (similar to the geo-engineering options offered to counter climate change), which can only stand a change of recovery if acidic deposition from burning fossil fuels in the United Kingdom and Germany are strictly curtailed. In the meantime ecosystems are degraded. Biodiversity lost and once vibrant communities disappear as fish die and ecosystems degrade. However, attention has moved away form that ongoing environmental disaster and many seem to believe the problem has gone away because the media rarely seems to report on it anymore.

## AT: Ice Age DA

### Global Warming 🡪 Ice Age

#### Warming shifts Atlantic currents resulting in ice age, extinction

Miranda Huey, a writer for Greeniac, an environmental association concerned with the consequences of anthropogenic global warming, June 15th 2010, “Thermohaline Circulation – Why it matters for all of us” <http://www.greeniacs.com/GreeniacsArticles/Global-Warming/Thermohaline-Circulation.html>

Thermohaline circulation isn’t a phrase you hear everyday. That is, not unless you’re an oceanographer. This fundamental ocean process supports three-fourths of marine life and shapes regional climates around the world.1 Climate change, often referred to as Global Warming, however, could slow or shut down entirely the essential ocean process, creating potentially disastrous consequences for life on earth. Most climatologists warn that global warming will most likely slow down the thermohaline circulation cycle by 10-50%% within the next 100 years.2 A warming climate could speed up the melting of Arctic glaciers, diluting the salty surface water with a large amount of freshwater. In addition, a changing northern climate could mean more rain and snow over the region, diluting the surface water even further. A warmer planet could also mean a warmer Arctic climate, which would warm the surface waters relative to the cooler seawater below. If the surface water never gets denser than the water below it, it may not sink below the cool and salty seawater below, preventing the current from ever entering the “global ocean conveyor belt.” So, first of all, what exactly is thermohaline circulation? It’s a cycle that drives of what is commonly known as the “ocean’s conveyor belt”—a 1,600 year long process in which all ocean water will flow—twisting and turning around the globe, rising and falling in sea depth, and eventually returning to the same spot to start the cycle over again.3 Put simply, this “conveyor belt” runs because cold water is denser than warm water and salt water is denser than fresh water. In warm, tropical climates, the sun will heat up the surface of the ocean, making the top layer of seawater less dense. In the Atlantic, the warm water then flows northward onto the colder, denser waters of cooler, northern regions. The water below it can then rise to the surface and get warmed as well, continuing the process. As the seawater travels north, it encounters more wind and evaporates some, getting saltier and cooler. Eventually, near the Arctic, the surface water gets so cold and salty that it sinks down to the ocean floor, where it flows all the way south to the Antarctic and then through equatorial areas the Indian Ocean or Pacific Ocean, where the seawater warms up again and rises to the surface, flowing back to the Atlantic to start the cycle over again.4 The consequences for both marine life and life on land could be drastic if thermohaline circulation slowed down. Thermohaline circulation which mixes ocean layers is key to providing nutrients to marine life on the ocean surface. For example, phytoplankton only live on the surface of the ocean’s waters because it largely subsists off the energy it receives from natural sunlight. Phytoplankton that die slowly sink to the ocean floor, decomposing and carrying nutrients that make it back up to the surface through thermohaline circulation. Without enough nutrients, phytoplankton growth could be limited, cutting off the bottom of the food chain for marine ecosystems.5 As bad as a slowing thermohaline circulation would be, it would not be nearly as disastrous as the ocean conveyor belt stopping completely and abruptly. Most scientists deem that worst-case scenario as a “low-probability, high-impact” event.6 Interestingly, BP CEO Tony Hayward said the same exact thing about the Gulf of Mexico oil spill.7 Although an abruptly stopped thermohaline circulation event was made famous in the movie The Day After Tomorrow, the Union of Concerned Scientists have made assurances that it will not be nearly as quick, widespread, or cause another Ice Age.8 Even under the fastest climate model, it would instead take a few decades and cause only regional cooling. Why would scientists think that thermohaline circulation stop abruptly? It already happened once, 8,200 years ago.9 According to evidence from ice cores, a century long cold spell during the Younger Dryas coincided with a flood of freshwater from melting glaciers, as well as the halting of the thermohaline circulation.10 Many scientists theorize that the rapid introduction of freshwater into ocean surfaces immediately stopped thermohaline circulation, inducing the massive global cooling of an average of 15 degrees.11 Some scientists predict that global warming will cause enough glacial melting to trigger another abrupt cold spell. Other scientists counter that the melting glaciers, cold spell, and halting thermohaline circulation were caused by separate factors or a broader natural cycle. Nevertheless, if an abrupt shut-down occurred, the consequences would be catastrophic. Thermohaline circulation is responsible for Europe’s warm temperatures relative to other countries at the same latitude. Warm surface waters from the south drift north towards Europe from equatorial regions, providing a moderate climate.12 Shutting it off could mean a regional ice age for northern latitudes. To a smaller degree, the same could go for the East Coast of the United States, since the warmer tropical current also flows northward along the coast.13 It could disrupt ecosystems, reducing agriculture, and increasing storms. A global warming trend could minimize or reverse some of these effects. Equatorial regions, on the other hand, could heat up and experience massive drought and famine.

#### Thermohaline Shift means massive 15 degree temperature decline.

Climate.org, an organization set to heighten international awareness of climate change, and identify practical ways of achieving significant emissions reductions. 2010, “Consequences of Climate Change on the Oceans” Oceans & Sea Level Rise http://www.climate.org/topics/sea-level/index.html#thermohaline

Another impact of glacial retreat is the possible effect fresh melt water will have on the thermohaline circulation. Driven by density gradients in ocean waters, the thermohaline (or deep ocean overturning) circulation is made up of the global flow of ocean currents. As ocean waters move around, different water masses are formed as evaporation removes fresh water and precipitation and river runoff add fresh water, each changing ocean salinity and therefore the density of the waters. Surface currents, which are largely driven by wind patterns, take the water masses to areas where they are warmed by high solar radiation (leading to lower density) or cooled in higher latitudes (leading to higher density). When surface water density becomes greater than for waters below, downwelling currents carry the denser surface waters down and push less dense, nutrient rich waters toward the surface, where winds bring them all the way to the surface and create areas rich with marine life. Thus, the density gradients created by temperature (cold water is more dense than water that is warm) and salinity (salt water is more dense than freshwater) are critical to both how ocean waters move and where there are nutrients that promote significant marine life (19). Because both temperature and salinity are influenced by changes in the climate, there are concerns about the ways in which the thermohaline circulation might be affected. The influences can operate in various ways. First, ocean circulation could be influenced by changes in runoff from glaciers and ice sheets. As glaciers melt and release fresh water into the ocean, the influx dilutes saltier waters, likely reducing the rate of bottom water formation because relatively fresh water will not be able to sink (even at higher latitudes where it becomes cold and dense), thus affecting deep ocean currents (20). With the rate at which glaciers are melting and the amount of freshwater that might be introduced into the ocean changing, it is thus quite possible that the intensity of the thermohaline circulation could be reduced. Climate change will not only affect salinity levels, but will also affect ocean temperatures and circulation patterns. First, as ocean temperatures increase, thermal expansion will cause the density to decrease and so increase the volume of ocean waters, raising sea level. Because surface currents are driven by the winds, warm surface waters moved by the winds are generally replaced by the colder waters underneath, with the upwelling bringing up nutrient-rich colder waters that promote flourishing marine life (19). As ocean surface waters warm and become less likely to sink, a smaller amount of cold water is brought up to the surface, impacting circulation patterns and marine life. In addition, warmer temperatures will lead to more evaporation. When the water evaporates, the salt stays behind. An increase in salinity changes the density of the water, and therefore affects circulations patterns (21). Given the interactions of these processes, there are increasing concerns that climate change will reduce the overall intensity of the thermohaline (deep-ocean) circulation. Should the increase in freshwater or the increasing ocean temperatures drastically alter density levels, the path of the thermohaline circulation could be altered or even significantly disrupted. Because the circulation plays a key role in ocean temperature patterns around the globe, weather patterns are also likely to be disrupted. Image from UCAR Changes such as these could be quite important for northern European countries. The Gulf Stream carries warm water from the tropics to the North Atlantic, and the heat it gives off to the atmosphere contributes to the mild temperatures in the region, even though Europe is located at a relatively high latitude. With sufficient cooling, the water sinks near Greenland and further north, pulling more warm waters northward from the tropics. If ocean warming slows the thermohaline circulation, less warm water would be transported north and Europe would likely experience less warming or even a cooling (21). Such a cooling event may have occurred during the Younger Dryas about 12,000 years ago when meltwater release from rapid deglaciation of North America freshened the North Atlantic, likely shutting off the deep ocean circulation (22) and disrupting weather and ocean circulation patterns (23). Within a decade of the shutdown of the thermohaline circulation, global climate patterns were altered significantly and European and North American temperatures dropped by as much as 15ºC. Such a rapid and dramatic shift in climate has not happened since, but with melting of Greenland beginning, there is an increasing risk of a similarly sudden shift in the future (24).

#### Global warming causing an ice age is almost guaranteed

Jeffrey Masters, a Ph.D. in air pollution meteorology from the University of Michigan, co-founder of The Weather Underground, Inc. Last Cite April 2012 “The Science of Abrupt Climate Change: Should we be worried?” http://www.wunderground.com/climate/abruptclimate.asp

Global warming will increase precipitation, river run-off, melting of the Greenland ice sheet, and melting of polar sea ice, all of which will increase the amount of fresh water flowing into the critical deep-water formation areas by Greenland. In the 2007 IPCC Fourth Assessment Report Summary for Policymakers (PDF File) it states that, based on current model simulations, it is very likely (90-99% confidence) that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century. It also confirms the scientific consensus that is very unlikely the MOC will undergo a large abrupt transition during this century. Today's science is such that any long-term assessments of the MOC cannot be made with confidence. A 2012 paper in Proceedings of the National Academy of Sciences used computer modeling to show that abrupt climate events in the past occurred as a result of a change in ocean currents due to the Bering Strait closing off because of low sea levels. The Bering Strait is the 50-mile-wide gap that separates Siberia from Alaska. "As long as the Bering Strait remains open," said lead author Aixue Hu, a climate modeler at the National Center for Atmospheric Research (NCAR), in a telephone interview posted at Climate Central, "we will not see an abrupt climate event." With global sea levels rising due to melting icecaps, closure of the Bering Strait is not likely in the forseeable future.

### AT: Ice Age DA – Far Away

#### Ice age won’t happen

IBTIMES, an international business news corporation, January 9th 2012“Next Ice Age in 1,500 years prevented by carbon dioxide emissions.” http://www.ibtimes.com/articles/279016/20120109/next-ice-age-years-carbon-emissions.htm

The next ice age, due in the next 1,500 years, won't arrive because of high levels of carbon dioxide greenhouse gases in the atmosphere, scientists reported Monday. Researchers already discovered evidence of at least five Ice Ages on Earth and around 3,500, the world will be due for another round of chilling and frozen wastelands. However, because of greenhouse gases that already exist in the atmosphere, another Ice Age likely won't happen. The research appeared in the Monday edition of the journal Nature Geoscience. "At current levels of CO2, even if emissions stopped now we'd probably have a long interglacial duration determined by whatever long-term processes could kick in and bring [atmospheric] CO2 down," Luke Skinner, lead author and professor at Cambridge University told BBC News. The study also included researchers from University College London, Bergen University in Norway and the University of Florida. The study concluded that for an Ice Age to occur, concentrations of carbon dioxide would have to fall to 240 parts per million - a 40 percent reduction of the 390 ppm in the current atmosphere.

#### Ice age won’t happen – laundry list

John Cook, founder of Skeptical science, a climate scince information resource dedicated to publishing articles on current events relating to climate science and climate policy. , January 27th 2010, “The Upcoming Ice Age has been postponed indefinitely.” http://www.skepticalscience.com/upcoming-ice-age-postponed-indefinitely.html

he 9th most popular skeptic argument is that we're heading into an ice age. The whole premise of the website Ice Age Now is that a new ice age could begin any day. Considering the skeptic aversion towards alarmism, it's surprising that this idea has gained so much traction. In the interest of lowering skeptics' stress levels, its time to put all those ice age fears to rest once and for all. Just a few centuries ago, the planet experienced a mild ice age, quaintly dubbed the Little Ice Age. Part of the Little Ice Age coincided with a period of low solar activity termed the Maunder Minimum (named after astronomer Edward Maunder). It's believed that a combination of lower solar output and high volcanic activity were a major contributor (Free 1999, Crowley 2001), with changes in ocean circulation also having an effect on European temperatures (Mann 2002). Could we be heading into another Maunder Minimum? Solar activity is currently showing a long term cooling trend. 2009 saw solar output at its lowest level in over a century. However, predicting future solar activity is problematic. The transition from a period of 'grand maxima' (the situation in the latter 20th century) to a 'grand minima' (eg - Maunder Minimum conditions) is a chaotic process and difficult to predict (Usoskin 2007). Let's say for the sake of argument that the sun does enter another Maunder Minimum over the next century. What effect would this have on Earth's climate? The difference in solar radiative forcing between Maunder Minimum levels and current solar activity is estimated between 0.17 W/m2 (Wang 2005) to 0.23 W/m2 (Krivova 2007). In contrast, the radiative forcing of CO2 since pre-industrial times is 1.66 W/m2 (IPCC AR4), far outstripping solar influence. Add to this the extra CO2 emitted in upcoming decades and other greenhouse gases such as methane. The warming from man-made greenhouse gases far outstrips any potential cooling even if the sun was to return to Maunder Minimum levels. However, our climate has experienced much more dramatic change than the Little Ice Age. Over the past 400,000 years, the planet has experienced ice age conditions, punctuated every 100,000 years or so by brief warm intervals. These warm periods, called interglacials, typically last around 10,000 years. Our current interglacial began around 11,000 years ago. Could we be on the brink of the end of our interglacial? Figure 2: Temperature change at Vostok, Antarctica (Barnola 2003). Interglacial periods are marked in green. How do ice ages begin? Changes in the earth's orbit cause less sunlight (insolation) to fall on the northern hemisphere during summer. Northern ice sheets melt less during summer and gradually grow over thousands of years. This increases the Earth's albedo which amplifies the cooling, spreading the ice sheets further. This process lasts around 10,000 to 20,000 years, bringing the planet into an ice age. Not all interglacials last the same amount of time. An ice core from Dome C, Antarctica offered a glimpse of temperatures going back 720,000 years. Climatic conditions 420,000 years ago were similar to current conditions. At that time, the interglacial lasted 28,000 years, suggesting our current interglacial may have lasted a similar period without human intervention (Augustin 2004). The similar conditions between now and 400,000 years ago are due to similar configurations in the Earth's orbit. At both times, the forcing from orbital variations showed much less change then in other interglacials. Simulations with the current orbit find that even without CO2 emissions, the current interglacial is expected to last at least 15,000 years (Berger 2002). Of course, the question of how long our interglacial lasts without human intervention is moot. We are intervening. So what effect do our CO2 emissions have on any future ice ages? This question is examined in one study that examines the glaciation "trigger" - the required drop in summer northern insolation to begin the process of growing ice sheets (Archer 2005). The more CO2 there is in the atmosphere, the lower insolation needs to drop to trigger glaciation. Figure 3 examines the climate response to various CO2 emission scenarios. The green line is the natural response without CO2 emissions. Blue represents an anthropogenic release of 300 gigatonnes of carbon - we have already passed this mark. Release of 1000 gigatonnes of carbon (orange line) would prevent an ice age for 130,000 years. If anthropogenic carbon release were 5000 gigatonnes or more, glaciation will be avoided for at least half a million years. As things stand now, the combination of relatively weak orbital forcing and the long atmospheric lifetime of carbon dioxide is likely to generate a longer interglacial period than has been seen in the last 2.6 million years. Figure 3. Effect of fossil fuel CO2 on the future evolution of global mean temperature. Green represents natural evolution, blue represents the results of anthropogenic release of 300 Gton C, orange is 1000 Gton C, and red is 5000 Gton C (Archer 2005). So we can rest assured, there is no ice age around the corner. To those with lingering doubts that an ice age might be imminent, turn your eyes towards the northern ice sheets. If they're growing, then yes, the 10,000 year process of glaciation may have begun. However, currently the Arctic permafrost is degrading, Arctic sea ice is melting and the Greenland ice sheet is losing mass at an accelerating rate. These are hardly good conditions for an imminent ice age.

#### New studies reveal another ice age won’t come for 10,000 years

Andrew Revkin, senior editor of Discover, staff writer at the Los Angeles Times,3-2- 2008, “Skeptics on human climate impact seize on cold spell,” New York Times, lexis

Despite the recent trend toward global warming, scientists have long wondered whether the Earth is nearing a new ice age, an end to the 12,000-year temperate spell in which civilizations arose. Some have said such a transition is overdue, given that each of the three temperate intervals that immediately preceded this current one lasted only about 10,000 years. But now, in an eagerly awaited study, a group of climate and ice experts say they have new evidence that Earth is not even halfway through the current warm era. The evidence comes from the oldest layers of Antarctic ice ever sampled. Some scientists earlier proposed similar hypotheses, basing them on the configuration of Earth's orbit, which seems to set the metronome that ice ages dance to. Temperature patterns deciphered in sea sediments in recent years backed the theory. But experts say the new ice data are by far the strongest corroborating evidence, revealing many similarities between today's atmospheric and temperature patterns and those of a warm interval, with a duration of 28,000 years, that reached its peak 430,000 years ago. The findings are described Thursday in the journal Nature in a report by the European Project for Ice Coring in Antarctica. The evidence comes from a shaft of ice extracted over five grueling years from Antarctica's deep-frozen innards, composed of thousands of ice layers formed as each year's snowfall was compressed over time. The deepest ice retrieved so far comes from 10,000 feet deep and dates back 740,000 years. The relative abundance of certain forms of hydrogen in the ice reflects past air temperatures. Many ice cores have been cut from various glaciers and ice sheets around the world, but until now none have gone back beyond 420,000 years. "It's very exciting to see ice that fell as snow three-quarters of a million years ago," said Dr. Eric Wolff, an author of the paper and ice core expert with the British Antarctic Survey.

#### No Ice Age for 70,000 Years

Andre Berger, professor at Universite catholique de Louvain and MF Loutre, professor at Universite catholique de Louvain, 8-2002, “An exceptionally long interglacial ahead?”, science, lexis

When paleoclimatologists gathered in 1972 to discuss how and when the present warm period would end (1), a slide into the next glacial seemed imminent. But more recent studies point toward a different future: a long interglacial that may last another 50,000 years. An interglacial is an uninterrupted warm interval during which global climate reaches at least the preindustrial level of warmth. Based on geological records available in 1972, the last two interglacials (including the Eemian, ~125,000 years ago) were believed to have lasted about 10,000 years. This is about the length of the current warm interval--the Holocene--to date. Assuming a similar duration for all interglacials, the scientists concluded that "it is likely that the present-day warm epoch will terminate relatively soon if man does not intervene" (1, p. 267). Some assumptions made 30 years ago have since been questioned. Past interglacials may have been longer than originally assumed (2). Some, including marine isotope stage 11 (MIS-11, 400,000 years ago), may have been warmer than at present (3). We are also increasingly aware of the intensification of the greenhouse effect by human activities (4). But even without human perturbation, future climate may not develop as in past interglacials (5) because the forcings and mechanisms that produced these earlier warm periods may have been quite different from today's. Most early attempts to predict future climate at the geological time scale (6, 7) prolonged the cooling that started at the peak of the Holocene some 6000 years ago, predicting a cold interval in about 25,000 years and a glaciation in about 55,000 years. These projections were based on statistical rules or simple models that did not include any CO2 forcing. They thus implicitly assumed a value equal to the average of the last glacial-interglacial cycles [~225 parts per million by volume (ppmv) (8)]. But some studies disagreed with these projections. With a simple ice-sheet model, Oerlemans and Van der Veen (9) predicted a long interglacial lasting another 50,000 years, followed by a first glacial maximum in about 65,000 years. Ledley also stated that an ice age is unlikely to begin in the next 70,000 years (10), based on the relation between the observed rate of change of ice volume and the summer solstice radiation. Other studies were more oriented toward modeling, including the possible effects of anthropogenic CO2 emissions on the dynamics of the ice-age cycles. For example, according to Saltzman et al. (11) an increase in atmospheric CO2, if maintained over a long period of time, could trigger the climatic system into a stable regime with small ice sheets, if any, in the Northern Hemisphere. Loutre (12) also showed that a CO2 concentration of 710 ppmv, returning to a present-day value within 5000 years, could lead to a collapse of the Greenland Ice Sheet in a few thousand years. On a geological time scale, climate cycles are believed to be driven by changes in insolation (solar radiation received at the top of the atmosphere) as a result of variations in Earth's orbit around the Sun. Over the next 100,000 years, the amplitude of insolation variations will be small (see the figure), much smaller than during the Eemian. For example, at 65ºN in June, insolation will vary by less than 25 Wm-2 over the next 25,000 years, compared with 110 Wm-2 between 125,000 and 115,000 years ago. From the standpoint of insolation, the Eemian can hardly be taken as an analog for the next millennia, as is often assumed. The small amplitude of future insolation variations is exceptional. One of the few past analogs (13) occurred at about 400,000 years before the present, overlapping part of MIS-11. Then and now, very low eccentricity values coincided with the minima of the 400,000-year eccentricity cycle. Eccentricity will reach almost zero within the next 25,000 years, damping the variations of precession considerably.

### AT: Ice Age DA – Ice Age ≠ Extinction

#### An Ice Age will not result in extinction – US has enough resources to survive – gender modified

Zbigniew Jaworowski, M.D., Ph.D., D.Sc. Chairman of the Scientific Council of the Central Laboratory for Radiological Protection in Warsaw ,Winter 2004, “Solar Cycles, Not CO2, Determine Climate,” 21st Century Science and Technology, http://www.21stcenturysciencetech.com/Articles%202004/Winter2003-4/global\_warming.pdf

Also, it does not seem possible that we will ever gain influence over the Sun’s activity. However, I think that in the next centuries we shall learn to control sea currents and clouds, and this could be sufficient to govern the climate of our planet. The following “thought experiment” illustrates how valuable our civilization, and the very existence of man’s intellect, is for the terrestrial biosphere. Mikhail Budyko, the leading Russian climatologist (now deceased), predicted in 1982 a future drastic CO2deficit in the atmosphere, and claimed that one of the next Ice Age periods could result in a freezing of the entire surface of the Earth, including the oceans. The only niches of life, he said, would survive on the active volcano edges.60 Budyko’s hypothesis is still controversial, but 10 years later it was discovered that 700 million years ago, the Earth already underwent such a disaster, changing into “Snowball Earth,” covered in white from Pole to Pole, with an average tempera- ture of minus 40°C.15 However let’s assume thatBudyko has been right and that everything, to the very ocean bottom, will be frozen. Will [hu]mankind survive this? I think yes, it would. The present technology of nuclear power, based on the nuclear fission of uranium and thorium, would secure heat and electricity supplies for 5 billion people for about 10,000 years. At the same time, the stock of hydrogen in the ocean for future fusion-based reactors would suffice for 6 billion years. Our cities, industrial plants, food-producing greenhouses, our livestock, and also zoos and botanical gardens turned into greenhouses, could be heated virtually forever, and we could survive, together with many other organisms, on a planet that had turned into a gigantic glacier. I think, however, that such a “passive” solu- tion would not fit the genius of our future descendants, and they would learn how to restore a warm climate for ourselves and for everything that lives on Earth.

# Neg

## Warming Theory

### Warming False

#### Major global cooling now – warming alarmists are wrong

Peter Ferrara, Dir. @ Heartland Inst., 5-31-2012, “Sorry Global Warming Alarmists, The Earth Is Cooling,” Forbes, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/

Climate change itself is already in the process of definitively rebutting climate alarmists who think human use of fossil fuels is causing ultimately catastrophic global warming. That is because natural climate cycles have already turned from warming to cooling, global temperatures have already been declining for more than 10 years, and global temperatures will continue to decline for another two decades or more.

#### Global cooling coming now – it’s due to solar variation

Peter Ferrara, Dir. @ Heartland Inst., 5-31-2012, “Sorry Global Warming Alarmists, The Earth Is Cooling,” Forbes, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/

But that is not all. We are also currently experiencing a surprisingly long period with very low sunspot activity. That is associated in the earth’s history with even lower, colder temperatures. The pattern was seen during a period known as the Dalton Minimum from 1790 to 1830, which saw temperature readings decline by 2 degrees in a 20 year period, and the noted Year Without A Summer in 1816 (which may have had other contributing short term causes). Even worse was the period known as the Maunder Minimum from 1645 to 1715, which saw only about 50 sunspots during one 30 year period within the cycle, compared to a typical 40,000 to 50,000 sunspots during such periods in modern times. The Maunder Minimum coincided with the coldest part of the Little Ice Age, which the earth suffered from about 1350 to 1850. The Maunder Minimum saw sharply reduced agricultural output, and widespread human suffering, disease and premature death. Such impacts of the sun on the earth’s climate were discussed at the conference by astrophysicist and geoscientist Willie Soon, Nir J. Shaviv, of the Racah Institute of Physics in the Hebrew University of Jerusalem, and Sebastian Luning, co-author with leading German environmentalist Fritz Vahrenholt of The Cold Sun. Easterbrook suggests that the outstanding question is only how cold this present cold cycle will get. Will it be modest like the cooling from the late 1940s to late 1970s? Or will the paucity of sunspots drive us all the way down to the Dalton Minimum, or even the Maunder Minimum? He says it is impossible to know now. But based on experience, he will probably know before the UN and its politicized IPCC.

#### No warming is happening – doomsday predictions are wrong

Lorrie Goldstein, 6-23-2012, “Green ‘drivel’ exposed,” Toronto Sun, <http://www.torontosun.com/2012/06/22/green-drivel>

Lovelock is a world-renowned scientist and environmentalist whose Gaia theory — that the Earth operates as a single, living organism — has had a profound impact on the development of global warming theory. Unlike many “environmentalists,” who have degrees in political science, Lovelock, until his recent retirement at age 92, was a much-honoured working scientist and academic. His inventions have been used by NASA, among many other scientific organizations. Lovelock’s invention of the electron capture detector in 1957 first enabled scientists to measure CFCs (chlorofluorocarbons) and other pollutants in the atmosphere, leading, in many ways, to the birth of the modern environmental movement. Having observed that global temperatures since the turn of the millennium have not gone up in the way computer-based climate models predicted, Lovelock acknowledged, “the problem is we don’t know what the climate is doing. We thought we knew 20 years ago.” Now, Lovelock has given a follow-up interview to the UK’s Guardian newspaper in which he delivers more bombshells sure to anger the global green movement, which for years worshipped his Gaia theory and apocalyptic predictions that billions would die from man-made climate change by the end of this century. Lovelock still believes anthropogenic global warming is occurring and that mankind must lower its greenhouse gas emissions, but says it’s now clear the doomsday predictions, including his own (and Al Gore’s) were incorrect. He responds to attacks on his revised views by noting that, unlike many climate scientists who fear a loss of government funding if they admit error, as a freelance scientist, he’s never been afraid to revise his theories in the face of new evidence. Indeed, that’s how science advances.

#### There is no warming – sea ice is up

E. Calvin Beisner, 1-12-10, PhD University from St. Andrews, expert witness for US Senate, “Forget Global Warming Mini Ice Age May Be on Its Way”, Right Side News, http://www.rightsidenews.com/201001128144/energy-and-environment/forget-global-warming-mini-ice-age-may-be-on-its-way.html

The UK's MailOnline did just that this week under the headline The mini ice age starts here. Lead paragraph? "The bitter winter afflicting much of the Northern Hemisphere is only the start of a global trend towards cooler weather that is likely to last for 20 or 30 years, say some of the world's most eminent climate scientists." Right. MailOnline reporter David Rose doesn't call them "the world's leading climate skeptics." He calls them "some of the world's most eminent climate scientists"--and he goes on to cite "Mojib Latif, a leading member of the UN's Intergovernmental Panel on Climate Change (IPCC)," "Anastasios Tsonis, head of the University of Wisconsin Atmospheric Sciences Group," and "William Gray, emeritus Professor of Atmospheric Sciences at Colorado State University." Contrary to fears of inexorably diminishing Arctic sea ice, Rose cites the U.S. National Snow and Ice Data Center as reporting that "Arctic summer sea ice has increased by 409,000 square miles, or 26 per cent, since 2007." Though snow's been unusual for most of the southern half of the United Kingdom in recent decades, the Mail published the accompanying satellite photo of Great Britain during the recent cold snap. The island is essentially all covered with snow. Rose reported record lows as far south as Cuba--something I can attest to, living near Miami in south Florida, where we experienced sub-freezing weather over the weekend. He quoted Tsonis as saying that last week 56% of the United States was covered by snow--something that hasn't happened in several decades. And the "'Arctic oscillation'--a weather pattern that sees the development of huge 'blocking' areas of high pressure in northern latitudes, driving polar winds far to the south . . . is at its strongest for at least 60 years. As a result, the jetstream--the high-altitude wind that circles the globe from west to east and normally pushes a series of wet but mild Atlantic lows across Britain--is currently running not over the English Channel but the Strait of Gibraltar." Consequently, most of the Northern Hemisphere is much colder this winter than it's been in decades--and the Southern Hemisphere is cooler, too. According to Rose, Latif, Tsonis, and other scientists attribute the cold shift primarily to a shift in the world's dominant ocean circulations--the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation--from a warm phase to a cool phase, something that happens about every 20 to 30 years. "The scientists' predictions also undermine the standard climate computer models, which assert that the warming of the Earth since 1900 has been driven solely by man-made greenhouse gas emissions and will continue as long as carbon dioxide levels rise. They say that their research shows that much of the warming was caused by oceanic cycles when they were in a 'warm mode' as opposed to the present 'cold mode'." That's a point made by Dr. Roy W. Spencer in the science chapter of the Cornwall Alliance's new document A Renewed Call to Truth, Prudence, and Protection of the Poor: An Evangelical Examination of the Theology, Science, and Economics of Global Warming and illustrated in the graph below. "A significant share of the warming we saw from 1980 to 2000 and at earlier periods in the 20th Century was due to these cycles," said Latif, "perhaps as much as 50 per cent. They have now gone into reverse, so winters like this one will become much more likely. Summers will also probably be cooler, and all this may well last two decades or longer. The extreme retreats that we have seen in glaciers and sea ice will come to a halt. For the time being, global warming has paused, and there may well be some cooling." Tsonis also believes that the ocean current cycles dominated global climate change in the 20th century, including the post-1970s, the period many point to as driven by human greenhouse gas emissions, but he doesn't venture to attribute specific percentages to the natural and human causes. "I do not believe in catastrophe theories," Rose quoted him as saying. "Man-made warming is balanced by the natural cycles, and I do not trust the computer models which state that if CO2 reaches a particular level then temperatures and sea levels will rise by a given amount. These models cannot be trusted to predict the weather for a week, yet they are running them to give readings for 100 years." Gray went farther: "Most of the rise in temperature from the Seventies to the Nineties was natural. Very little was down to CO2--in my view, as little as five to ten per cent." Gray, Tsonis, and Latif all agreed that the findings about the ocean currents undermined the credibility of the computer climate models on which the IPCC and other alarmists rely.

### Warming False – AT: Consensus

#### There’s no consensus – lots of good scientists disagree about global warming

Wall Street Journal, 6-22-2012, “No Need to Panic About Global Warming,” http://online.wsj.com/article/SB10001424052970204301404577171531838421366.html

A candidate for public office in any contemporary democracy may have to consider what, if anything, to do about "global warming." Candidates should understand that the oft-repeated claim that nearly all scientists demand that something dramatic be done to stop global warming is not true. In fact, a large and growing number of distinguished scientists and engineers do not agree that drastic actions on global warming are needed. In September, Nobel Prize-winning physicist Ivar Giaever, a supporter of President Obama in the last election, publicly resigned from the American Physical Society (APS) with a letter that begins: "I did not renew [my membership] because I cannot live with the [APS policy] statement: 'The evidence is incontrovertible: Global warming is occurring. If no mitigating actions are taken, significant disruptions in the Earth's physical and ecological systems, social systems, security and human health are likely to occur. We must reduce emissions of greenhouse gases beginning now.' In the APS it is OK to discuss whether the mass of the proton changes over time and how a multi-universe behaves, but the evidence of global warming is incontrovertible?" In spite of a multidecade international campaign to enforce the message that increasing amounts of the "pollutant" carbon dioxide will destroy civilization, large numbers of scientists, many very prominent, share the opinions of Dr. Giaever. And the number of scientific "heretics" is growing with each passing year. The reason is a collection of stubborn scientific facts. Perhaps the most inconvenient fact is the lack of global warming for well over 10 years now. This is known to the warming establishment, as one can see from the 2009 "Climategate" email of climate scientist Kevin Trenberth: "The fact is that we can't account for the lack of warming at the moment and it is a travesty that we can't." But the warming is only missing if one believes computer models where so-called feedbacks involving water vapor and clouds greatly amplify the small effect of CO2. The lack of warming for more than a decade—indeed, the smaller-than-predicted warming over the 22 years since the U.N.'s Intergovernmental Panel on Climate Change (IPCC) began issuing projections—suggests that computer models have greatly exaggerated how much warming additional CO2 can cause. Faced with this embarrassment, those promoting alarm have shifted their drumbeat from warming to weather extremes, to enable anything unusual that happens in our chaotic climate to be ascribed to CO2.

#### No consensus on climate change

James Murray, writer for the Net News Ledger, 2-11-2011, “Getting off the Climate Change Bandwagon” http://netnewsledger.com/2011/02/11/getting-off-the-climate-change-bandwagon-frontier-centre/

“Scientific theories are never proven by a show of hands anyways, no matter how scientifically esteemed those expressing their views are. If it were otherwise, the Earth would still be considered flat and space travel impossible. It is indeed those who go against the flow—independent, original thinkers—who are usually responsible for our most meaningful advances in science. But, most reporters, politicians and the public understand little of the scientific method and even less about the exceptionally complex field of climate change science. Consequently, they often look for an indication of ‘consensus’ when trying to decide which science should form the basis of important public policies decisions,” states Tom Harris, executive director of the International Climate Science Coalition. “The debate is over”. That message has been repeated often enough when talking about climate change. Yet the number of people who remain doubtful of the science of climate change, or man-made climate change continues to grow. The Winnipeg based Frontier Centre for Public Policy has released Getting off the Climate Change Bandwagon. In the debate on issues, one of the goals should be exploring the issue fully, and never shutting down debate. Think of it, both sides of the debate over creationism or evolution are still discussing the topic. Why Climate Change as a subject should be any different is one that likely raises doubts in the minds of skeptics. This policy study provides an analysis of the current state of research concerning the global warming phenomenon that has been observed in recent decades. Contrary to the claims of certain activists, politicians and members of the media, there are thousands of experts who do not find convincing support in the existing scientific evidence for the hypothesis that human emissions of carbon dioxide are causing or are likely to cause dangerous global warming. In this study, Tom Harris argues that the evidence for catastrophic manmade global warming is far from conclusive, and that claims of an immediate climate crisis are not based on a solid evidentiary base. Harris argues for a new, inclusive approach to the scientific debate in this area – expanding the tent of climate skepticism through non-partisan science communication. Findings: Harris provides 14 examples of open letters and other declarations opposing the manmade climate crisis hypothesis that have, in total, been signed by thousands of scientifically qualified individuals. By providing some details about these declarations and links to their contents and lists of signatories, Harris shows that the science is far from settled in this area and that there are many qualified experts who dispute the notion that manmade climate change constitutes a serious danger to the well-being of humanity. Examples presented by Harris include: ◦2010: SPPI letter to the U.S. EPA—signed by 35 climate and related experts. ◦2009: Copenhagen Climate Challenge which currently lists 166 experts well qualified in climate science plus some in ‘other related disciplines’.2009: Open Letter to the Council of the American Physical Society—signed by 61 experts. ◦2009: Climate Change Reconsidered: 2009 Report of the Nongovernmental Panel on Climate Change (NIPCC), Craig Idso and S. Fred Singer, eds.; 36 contributors listed. Easily read summary may be seen here. ◦2008: Manhattan Declaration on Climate Change, 1,497 endorsers, over half of them well qualified in science and technology and 206 of them climate science specialists or scientists in very closely related fields. ◦2007\*: Open Letter to the Secretary- General of the United Nations (the “2007Bali open letter”), 100 scientist signers. ◦2006: Open Kyoto to Debate—An open letter to Stephen Harper, Prime Minister of Canada, from 60 climate experts. ◦2003: Protocol lacks ‘credible science’—Open letter to Canadian PM Paul Martin,46 leading scientists endorsed this. ◦2002: Open letter to Canadian PM Jean Chretien, 30 scientist signers. ◦1997: Global Warming Petition Project—organized through the Oregon Institute ◦of Science and Medicine, starting in 1997. That document now claims some 31,486 ◦U.S. scientists and technically qualified signers, 9,029 with PhDs—see breakdown. “Public uncertainty about the science backing the global warming scare is higher now than at any time in the past 20 years,” says Harris. “New, more effective strategies need to be developed to help average citizens understand that their skepticism is well founded- many professional scientists, highly qualified in the field, also do not support forecasts of human-caused climate disaster.”

#### No consensus among scientists about global warming.

Victoria Taft, statement from the American physical society, 7-18-2008, “confirmed: NO global warming consensus,” <http://www.victoriataft.com/2008/07/confirmed-no-global-warming-consensus.html>

"With this issue of Physics & Society, we kick off a debate concerning one of the main conclusions of the International Panel on Climate Change (IPCC), the UN body which, together with Al Gore, recently won the Nobel Prize for its work concerning climate change research. There is a considerable presence within the scientific community of people who do not agree with the IPCC conclusion that anthropogenic CO2 emissions are very probably likely to be primarily responsible for the global warming that has occurred since the Industrial Revolution. Since the correctness or fallacy of that conclusion has immense implications for public policy and for the future of the biosphere, we thought it appropriate to present a debate within the pages of P&S concerning that conclusion. This editor (JJM) invited several people to contribute articles that were either pro or con. Christopher Monckton responded with this issue's article that argues against the correctness of the IPCC conclusion, and a pair from Cal Poly San Luis Obispo, David Hafemeister and Peter Schwartz, responded with this issue's article in favor of the IPCC conclusion. We, the editors of P&S, invite reasoned rebuttals from the authors as well as further contributions from the physics community. Please contact me (jjmarque@sbcglobal.net) if you wish to jump into this fray with comments or articles that are scientific in nature. However, we will not publish articles that are political or polemical in nature. Stick to the science!

### Warming Not Anthropogenic – Natural Variation

#### Warming is due to natural variation – doesn’t support their model

Peter Ferrara, Dir. @ Heartland Inst., 5-31-2012, “Sorry Global Warming Alarmists, The Earth Is Cooling,” Forbes, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/

Check out the 20th century temperature record, and you will find that its up and down pattern does not follow the industrial revolution’s upward march of atmospheric carbon dioxide (CO2), which is the supposed central culprit for man caused global warming (and has been much, much higher in the past). It follows instead the up and down pattern of naturally caused climate cycles. For example, temperatures dropped steadily from the late 1940s to the late 1970s. The popular press was even talking about a coming ice age. Ice ages have cyclically occurred roughly every 10,000 years, with a new one actually due around now. In the late 1970s, the natural cycles turned warm and temperatures rose until the late 1990s, a trend that political and economic interests have tried to milk mercilessly to their advantage. The incorruptible satellite measured global atmospheric temperatures show less warming during this period than the heavily manipulated land surface temperatures.

#### Warming isn’t anthropogenic – Pacific Decadal Oscillation

Peter Ferrara, Dir. @ Heartland Inst., 5-31-2012, “Sorry Global Warming Alarmists, The Earth Is Cooling,” Forbes, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/

Central to these natural cycles is the Pacific Decadal Oscillation (PDO). Every 25 to 30 years the oceans undergo a natural cycle where the colder water below churns to replace the warmer water at the surface, and that affects global temperatures by the fractions of a degree we have seen. The PDO was cold from the late 1940s to the late 1970s, and it was warm from the late 1970s to the late 1990s, similar to the Atlantic Multidecadal Oscillation (AMO). In 2000, the UN’s IPCC predicted that global temperatures would rise by 1 degree Celsius by 2010. Was that based on climate science, or political science to scare the public into accepting costly anti-industrial regulations and taxes? Don Easterbrook, Professor Emeritus of Geology at Western Washington University, knew the answer. He publicly predicted in 2000 that global temperatures would decline by 2010. He made that prediction because he knew the PDO had turned cold in 1999, something the political scientists at the UN’s IPCC did not know or did not think significant. Well, the results are in, and the winner is….Don Easterbrook. Easterbrook also spoke at the Heartland conference, with a presentation entitled “Are Forecasts of a 20-Year Cooling Trend Credible?” Watch that online and you will see how scientists are supposed to talk: cool, rational, logical analysis of the data, and full explanation of it. All I ever see from the global warming alarmists, by contrast, is political public relations, personal attacks, ad hominem arguments, and name calling, combined with admissions that they can’t defend their views in public debate. Easterbrook shows that by 2010 the 2000 prediction of the IPCC was wrong by well over a degree, and the gap was widening. That’s a big miss for a forecast just 10 years away, when the same folks expect us to take seriously their predictions for 100 years in the future. Howard Hayden, Professor of Physics Emeritus at the University of Connecticut showed in his presentation at the conference that based on the historical record a doubling of CO2 could be expected to produce a 2 degree C temperature increase. Such a doubling would take most of this century, and the temperature impact of increased concentrations of CO2 declines logarithmically. You can see Hayden’s presentation online as well. Because PDO cycles last 25 to 30 years, Easterbrook expects the cooling trend to continue for another 2 decades or so. Easterbrook, in fact, documents 40 such alternating periods of warming and cooling over the past 500 years, with similar data going back 15,000 years. He further expects the flipping of the ADO to add to the current downward trend.

#### Global warming isn’t anthropogenic – conclusively disproven

John Hinderaker, 6-16-2012, “Anthropogenic Global Warming,” PowerLine, http://www.powerlineblog.com/archives/2012/06/anthropogenic-global-warming-wrong-again.php

A scientific hypothesis is tested by its predictive powers. Scientists reason: if this theory is correct, then X should be the case. They test for X; if they find X to be true, it tends to confirm the theory. If X is not the case, the theory is disproved. Some of a theory’s implications may relate to the future, and thus can only be tested over time. The anthropogenic global warming theory has been with us for quite a while now–I first learned about it circa 1970–so how have its predictions fared over time? We have written a number of times about James Hansen, one of the leading global warming alarmists. In 1988, he authored one of the most influential alarmist papers, titled “Global climate change, according to the prediction of the Goddard Institute for Space Studies.” Hansen and his colleagues modeled the global temperature impact of varying levels of future CO2 emissions. This chart, from Watts Up With That, summarizes Hansen’s 1988 predictions, compared with actually observed temperatures. Briefly, Hansen’s prediction was off by 150%. This is the explanation of the lines on the chart: Figure 1: Temperature forecast Hansen’s group from the year 1988. The various scenarios are 1.5% CO 2 increase (blue), constant increase in CO 2 emissions (green) and stagnant CO 2 emissions (red). In reality, the increase in CO 2 emissions by as much as 2.5%, which would correspond to the scenario above the blue curve. The black curve is the ultimate real-measured temperature (rolling 5-year average). Hansen’s model overestimates the temperature by 1.9 ° C, which is a whopping 150% wrong. While global warming alarmists cloak themselves in the mantle of science, the truth is that there is nothing scientific about their enterprise. The models that are the sole basis for global warming alarmism have been proved conclusively to be wrong. That really is all that needs to be said about the matter. The fact that alarmists and their supporters in the media and in politics continue to try to foist discredited theories onto the public shows that their real interest is not science, but politics and power.

#### Global warming is not caused by humans.

Mark **Morano**, 11/13/**07**, runs the anti-climate-science website ClimateDepot.com for the anti-regulation Committee for a Constructive Tomorrow, “Over 100 Prominent Scientists Warn UN Against 'Futile' Climate Control Efforts”, US Senate Committee on Environment and Public Works, http://epw.senate.gov/public/index.cfm?FuseAction=Minority.Blogs&ContentRecord\_id=d4b5fd23-802a-23ad-4565-3dce4095c360

The scientists, many of whom are current and former UN IPCC (Intergovernmental Panel on Climate Change) scientists, sent an open letter to the UN Secretary-General questioning the scientific basis for climate fears and the UN's so-called "solutions." "Attempts to prevent global climate change from occurring are ultimately futile, and constitute a tragic misallocation of resources that would be better spent on humanity's real and pressing problems," the letter signed by the scientists read. The December 13 letter was released to the public late Thursday. The letter was signed by renowned scientists such as Dr. Antonio Zichichi, president of the World Federation of Scientists; Dr. Reid Bryson, dubbed the "Father of Meteorology"; Atmospheric pioneer Dr. Hendrik Tennekes, formerly of the Royal Netherlands Meteorological Institute; Award winning physicist Dr. Syun-Ichi Akasofu of the International Arctic Research Center, who has twice named one of the "1000 Most Cited Scientists"; Award winning MIT atmospheric scientist Dr. Richard Lindzen; UN IPCC scientist Dr. Vincent Gray of New Zealand; French climatologist Dr. Marcel Leroux of the University Jean Moulin; World authority on sea level Dr. Nils-Axel Morner of Stockholm University; Physicist Dr. Freeman Dyson of Princeton University; Physicist Dr. Zbigniew Jaworowski, chairman of the Scientific Council of Central Laboratory for Radiological Protection in Poland; Paleoclimatologist Dr. Robert M. Carter of Australia; Former UN IPCC reviewer Geologist/Geochemist Dr. Tom V. Segalstad, head of the Geological Museum in Norway; and Dr. Edward J. Wegman, of the U.S. National Academy of Sciences. "It is not possible to stop climate change, a natural phenomenon that has affected humanity through the ages. Geological, archaeological, oral and written histories all attest to the dramatic challenges posed to past societies from unanticipated changes in temperature, precipitation, winds and other climatic variables," the scientists wrote.

### Warming Not Anthropogenic – Sunspots

#### Sunspots are the cause of GW and will lead to the extinction of humans.

**NASA**, **’12**, “Solar Radiation and Climate Experiment (SORCE)”, NASA http://earthobservatory.nasa.gov/Features/SORCE/sorce\_03.php

The number of sunspots on the Sun’s surface is roughly proportional to total solar irradiance. Historical sunspot records give scientists an idea of the amount of energy emitted by the Sun in the past. The above graph shows sunspot data from 1650 to the present. The Maunder Minimum occured from 1650–1700 and may have influenced Europe’s little ice age. (The data from this period are not as reliable as the data beginning in 1700, but it is clear that sunspot numbers were higher both before and after the Maunder Minimum.) Since then, sunspot number have risen and fallen in a regular 11-year cycle. An 11-year running average shows only the long-term variation, which shows a rise in total sunspot numbers from 1700 until today. [Graph by Robert Simmon, based on data compiled by John Eddy (1650-1700) and the Solar Influences Data analysis Center (SIDC)] Lastly, on the time scale of the lifetime of the solar system, measured in billions of years, the Sun is going through the same life and death cycle as any average star. As it uses up its hydrogen fuel, the Sun grows hotter and hotter throughout its lifetime. In a couple of billion years, this gradual heating will melt all the ice on Earth and turn the planet and into a hothouse much like Venus. Since the increase occurs over such an extended period of time, today’s instruments cannot even detect year-to-year changes along this cycle. By the time the effects of this warming trend are felt, it’s possible humans may have become extinct, or found a way to populate distant planets, and in either case may not still be left on Earth worrying about Earth’s demise.

#### Sunspots are the cause of GW.

**NASA**, **’12**, “Solar Radiation and Climate Experiment (SORCE)”, NASA http://earthobservatory.nasa.gov/Features/SORCE/sorce\_04.php

Of the many trends that appear to cause fluctuations in the Sun’s energy, those that last decades to centuries are the most likely to have a measurable impact on the Earth’s climate in the foreseeable future. Many researchers believe the steady rise in sunspots and faculae since the late seventeenth century may be responsible for as much as half of the 0.6 degrees of global warming over the last 110 years (IPCC, 2001). Since pre-industrial times, it’s thought that the Sun has given rise to a global heating similar to that caused by the increase of carbon dioxide in the atmosphere. If the past is any indication of things to come, solar cycles may play a role in future global warming.

Though complex feedbacks between different components of the climate system (clouds, ice, oceans, etc.) make detailed climate predictions difficult and highly uncertain, most scientists predict the release of greenhouse gases from the burning of fossil fuels will continue to block a larger and larger percentage of outgoing thermal radiation emanating from the Earth. According to the 2001 report of the Intergovernmental Panel on Climate Change (IPCC), the resulting imbalance between incoming solar radiation and outgoing thermal radiation will likely cause the Earth to heat up over the next century, possibly melting polar ice caps, causing sea levels to rise, creating violent global weather patterns, and increasing vegetation density (IPCC, 2001).

#### Sunspots and UV radiation are the cause of GW.

**NASA**, **’12**, “Solar Radiation and Climate Experiment (SORCE)”, NASA

http://earthobservatory.nasa.gov/Features/SORCE/sorce\_04.php

Sunspot cycles may sway global warming either way. If long-term cycles in solar radiation reverse course and the Sun’s spots and faculae begin to disappear over the next century, then the Sun could partially counter global warming. On the other hand, if the average number of spots rises, the Sun could serve to warm our planet even more. As to the shorter-term 11-year cycles, they may dampen or amplify the affects of global warming on a year-to-year basis.

The Sun’s affect on global warming can mostly be attributed to variations in the near-infrared and visible wavelengths of solar radiation. As previously stated, these types of radiation are absorbed by the lower atmosphere, the oceans, and the land. UV radiation, on the other hand, interacts strongly with the ozone layer and the upper atmosphere. Though UV solar radiation makes up a much smaller portion of the TSI than infrared or visible radiation, UV solar radiation tends to change much more dramatically over the course of solar cycles.

The impactsof undulating UV solar radiation may be substantial. Since UV radiation creates ozone in the stratosphere, the oscillation in UV levels can affect the size of the ozone hole. Absorption of UV radiation by the ozone also heats up the stratosphere. Many scientists suspect that changes in stratospheric temperatures may alter weather patterns in the troposphere. Finally, an increase in the amount of UV radiation could impact human health, increasing the incidence of skin cancer, cataracts, and other Sun-exposure-related maladies (please see Ultraviolet Radiation: How it Affects Life on Earth for more details).

### No Feedbacks

#### There is no snowball effect for GW

Daily Mail Reporter, 11-26-2010, “Global warming has slowed down over the past 10 years, say scientists”, Mail Online, http://www.dailymail.co.uk/sciencetech/article-1333225/Global-warming-slowing-say-scientists.html#ixzz1yqMPfdCK

The rate at which global temperatures are rising has slowed in the past decade, scientists said today. In a report published today, the Met Office said the slow in the rate of warming was down to a combination of natural variation in the weather and pollution. Scientists say one of the major factors is the rise in heavy industry and pollutant 'aerosols', particularly in Asia. An upsurge in industrial emissions such as sulphur which are being pumped into the atmosphere reflects sunlight and could lead to a cooling effect. A NASA thermal satellite image of the Earth. Measurements from space are used to see how temperatures, particularly in the Arctic, are changing Changes in the amount of water vapour in the stratosphere may also be a factor, the report suggests. The admission will be seized upon by climate sceptics as evidence that man-made global warming has been overstated. Tigers and polar bears most at risk 'because they have to work so hard for their food' Since the 1970s, the long-term rate of global warming has been around 0.16C a decade but that slowed in the last 10 years to between 0.05C - 0.13C depending on which of the three major temperature record series are used. Vicky Pope, head of climate science advice, said: 'The warming trend has decreased slightly. There's still a warming trend but it's not as rapid as it was before. 'The question is why has that happened. It's a question that sceptics often bring up.'

#### Ocean cycles are causing cooling now

E. Calvin Beisner, former professor of interdisciplinary studies in economics, government, and public policy at Covenant College, 1-12-2010, “Forget Global Warming – Mini Ice Age May Be On Its Way” http://www.rightsidenews.com/201001128144/life-and-science/energy-and-environment/forget-global-warming-mini-ice-age-may-be-on-its-way.html

According to Rose, Latif, Tsonis, and other scientists attribute the cold shift primarily to a shift in the world's dominant ocean circulations--the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation--from a warm phase to a cool phase, something that happens about every 20 to 30 years. "The scientists' predictions also undermine the standard climate computer models, which assert that the warming of the Earth since 1900 has been driven solely by man-made greenhouse gas emissions and will continue as long as carbon dioxide levels rise. They say that their research shows that much of the warming was caused by oceanic cycles when they were in a 'warm mode' as opposed to the present 'cold mode'."

\*\* cites Mojib Latif, PhD in Oceanography and professor at the Leibniz Institute of Marine Sciences, and Anastasios Tsonis, head of the University of Wisconsin Atmospheric Sciences Group

#### Oceanic cooling patterns will offset any of global warming

Patrick Michaels, senior fellow in environmental studies at the Cato Institute, 5-16-2008, “Global-warming myth: Politics trumps science,” Lexis

The Keenlyside team found that natural variability in the Earth's oceans will "temporarily offset" global warming from carbon dioxide. Seventy percent of the Earth's surface is oceanic; hence, what happens there greatly influences global temperature. It is now known that both Atlantic and Pacific temperatures can get "stuck," for a decade or longer, in relatively warm or cool patterns. The North Atlantic is now forecast to be in a cold stage for a decade, which will help put the damper on global warming. Another Pacific temperature pattern is forecast not to push warming, either.

#### The earth’s climatic system is organized so as to regulate any increase in temperature – oceans prove

Craig Idso, Ph.D Soil Science, Keith Idso, and Sherwood Idso, 7-16-2008, “New Evidence for a Planetary Temperature Regulator” <http://www.co2science.org/articles/V11/N29/C1.php>

**What was done** The authors looked for evidence of an "ocean thermostat" by analyzing patterns of sea surface temperature (SST) increases in the tropics over the past five decades, focusing their attention on the western Pacific warm pool (WPWP), because, in their words, "this is a region where maximum SSTs are thought to be limited by negative feedbacks," as described in the writings of Reginald Newell (1979) -- who they cite -- and who in collaboration with Thomas Dopplick employed what he had learned of the subject to demonstrate -- nearly three decades ago -- that the degree of CO2-induced global warming predicted by the climate models of that day was far greater (and is greater still today) than what is allowed by the real world (Newell and Dopplick, 1979), as is further described in the historical narrative of Idso (1982). What was learned Kleypas et al. say their analysis indicates that "the warmest parts of the WPWP have warmed less than elsewhere in the tropical oceans," which fact "supports the existence of thermostat mechanisms that act to depress warming beyond certain temperature thresholds." In addition, they report that "coral reefs within or near the WPWP have had fewer reported bleaching events relative to reefs in other regions," which is also indicative of the existence of an upper-limiting temperature above which SSTs typically do not rise, presumably because of the "kicking-in" of the oceanic thermostat when they approach 30°C in the region the three researchers describe as "the center of coral reef biodiversity," which likely merits that description because of the effectiveness of the hypothesized thermostat. What it means These recent findings tend to support the thesis put forward years ago by both Newell and Dopplick (1979) and Idso (1980, 1982, 1989), i.e., that rather than the earth possessing some thermal "tipping point" above which global warming dramatically accelerates, the planet's climatic system is organized so as to do just the opposite and greatly attenuate warming above a certain level.

### IPCC Biased

#### Anti-warming scientists are the ones who are bought off – our scientists are less biased

Wall Street Journal, 6-22-2012, “No Need to Panic About Global Warming,” http://online.wsj.com/article/SB10001424052970204301404577171531838421366.html

Although the number of publicly dissenting scientists is growing, many young scientists furtively say that while they also have serious doubts about the global-warming message, they are afraid to speak up for fear of not being promoted—or worse. They have good reason to worry. In 2003, Dr. Chris de Freitas, the editor of the journal Climate Research, dared to publish a peer-reviewed article with the politically incorrect (but factually correct) conclusion that the recent warming is not unusual in the context of climate changes over the past thousand years. The international warming establishment quickly mounted a determined campaign to have Dr. de Freitas removed from his editorial job and fired from his university position. Fortunately, Dr. de Freitas was able to keep his university job. This is not the way science is supposed to work, but we have seen it before—for example, in the frightening period when Trofim Lysenko hijacked biology in the Soviet Union. Soviet biologists who revealed that they believed in genes, which Lysenko maintained were a bourgeois fiction, were fired from their jobs. Many were sent to the gulag and some were condemned to death. Why is there so much passion about global warming, and why has the issue become so vexing that the American Physical Society, from which Dr. Giaever resigned a few months ago, refused the seemingly reasonable request by many of its members to remove the word "incontrovertible" from its description of a scientific issue? There are several reasons, but a good place to start is the old question "cui bono?" Or the modern update, "Follow the money." Alarmism over climate is of great benefit to many, providing government funding for academic research and a reason for government bureaucracies to grow. Alarmism also offers an excuse for governments to raise taxes, taxpayer-funded subsidies for businesses that understand how to work the political system, and a lure for big donations to charitable foundations promising to save the planet. Lysenko and his team lived very well, and they fiercely defended their dogma and the privileges it brought them. Speaking for many scientists and engineers who have looked carefully and independently at the science of climate, we have a message to any candidate for public office: There is no compelling scientific argument for drastic action to "decarbonize" the world's economy. Even if one accepts the inflated climate forecasts of the IPCC, aggressive greenhouse-gas control policies are not justified economically.

#### Their anti-warming authors are biased government shills

Peter Ferrara, Dir. @ Heartland Inst., 5-31-2012, “Sorry Global Warming Alarmists, The Earth Is Cooling,” Forbes, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/

The conference featured serious natural science, contrary to the self-interested political science you hear from government financed global warming alarmists seeking to justify widely expanded regulatory and taxation powers for government bodies, or government body wannabees, such as the United Nations. See for yourself, as the conference speeches are online. What you will see are calm, dispassionate presentations by serious, pedigreed scientists discussing and explaining reams of data. In sharp contrast to these climate realists, the climate alarmists have long admitted that they cannot defend their theory that humans are causing catastrophic global warming in public debate. With the conference presentations online, let’s see if the alarmists really do have any response.

### Too Late To Solve Warming

#### Too late to stop global warming – we’re already past the tipping point

Christopher Mims, 3-26-2012, “Climate scientists: It’s basically too late to stop warming,” Grist, http://grist.org/list/climate-scientists-its-basically-too-late-to-stop-warming/

If you like cool weather and not having to club your neighbors as you battle for scarce resources, now’s the time to move to Canada, because the story of the 21st century is almost written, reports Reuters. Global warming is close to being irreversible, and in some cases that ship has already sailed. Scientists have been saying for a while that we have until between 2015 and 2020 to start radically reducing our carbon emissions, and what do you know: That deadline’s almost past! Crazy how these things sneak up on you while you’re squabbling about whether global warming is a religion. Also, our science got better in the meantime, so now we know that no matter what we do, we can say adios to the planet’s ice caps. For ice sheets — huge refrigerators that slow down the warming of the planet — the tipping point has probably already been passed, Steffen said. The West Antarctic ice sheet has shrunk over the last decade and the Greenland ice sheet has lost around 200 cubic km (48 cubic miles) a year since the 1990s. Here’s what happens next: Natural climate feedbacks will take over and, on top of our prodigious human-caused carbon emissions, send us over an irreversible tipping point. By 2100, the planet will be hotter than it’s been since the time of the dinosaurs, and everyone who lives in red states will pretty much get the apocalypse they’ve been hoping for. The subtropics will expand northward, the bottom half of the U.S. will turn into an inhospitable desert, and everyone who lives there will be drinking recycled pee and struggling to salvage something from an economy wrecked by the destruction of agriculture, industry, and electrical power production. Water shortages, rapidly rising seas, superstorms swamping hundreds of billions of dollars’ worth of infrastructure: It’s all a-coming, and anyone who is aware of the political realities knows that the odds are slim that our government will move in time to do anything to avert the biggest and most avoidable disaster short of all-out nuclear war. Even if our government did act, we can’t control the emissions of the developing world. China is now the biggest emitter of greenhouse gases on the planet and its inherently unstable autocratic political system demands growth at all costs. That means coal.

#### Too late to stop warming

Gus Lubin, 10-22-2011, “New Study Says It May Be Too Late To Prevent The Global Warming Nightmare Scenario,” Business Insider, http://articles.businessinsider.com/2011-10-22/news/30309712\_1\_global-warming-greenhouse-gases-sea-levels

We've ignored the climate change gurus for too long, and now it's probably too late to avoid dangerous levels of global warming. This is the dire conclusion reached by Joeri Rogelj and other scientists in an article published in Nature Climate Chinage (via Science Magazine). Using the latest data, Rogelj's team modeled 193 proposed emissions plans that were intended to keep global warming below 2°C. They found that most of these plans are already obsolete. The only plans with any hope of preventing dangerous global warming are those in which global emissions peak during this decade. The three plans that are "very likely" to work all require heavy use of energy systems that actually remove greenhouse gases from the atmosphere. "The alarming thing is very few scenarios give the kind of future we want," study co-author Neil Edwards tells Science Magazine. "What we need is at the cutting edge. We need to be as innovative as we can be in every way."

#### Too late to prevent global warming – CO2 cuts aren’t enough

Times Online, 5-23-2008, “Copenhagen Consensus: global warming,” http://www.timesonline.co.uk/tol/news/environment/article3992368.ece

There is unequivocal evidence that humans are changing the planet’s climate. We are already committed to average temperature increases of about 0.6°C, even without further rises in atmospheric carbon dioxide concentration. The world has focused on mitigation — reducing carbon emissions — a close look at the costs and benefits suggests that relying on this alone is a poor approach. Option One: Continuing focus on mitigation Even if mitigation — economic measures like taxes or trading systems — succeeded in capping emissions at 2010 levels, then the world would pump out 55 billion tonnes of carbon emissions in 2100, instead of 67 billion tonnes. It is a difference of 18 per cent: the benefits would remain smaller than 0.5 per cent of the world’s GDP for more than 200 years. These benefits simply are not large enough to make the investment worthwhile.

## Warming Impacts

### Yes Adaptation

#### Humanity will adapt to warming – efforts are already started

Christopher Borick, Prof @ Muhlenberg, and Barry G. Rabe, senior fellow @ Brookings, May 2012, “Americans Cool on Geoengineering Approaches to Addressing Climate Change,” Issues in Governance Studies, Iss. 47, http://www.brookings.edu/~/media/research/files/papers/2012/5/30%20geo%20engineering%20rabe%20borick/30%20geo%20engineering%20rabe%20borick.pdf

With expanding concern that climate change is already impacting environments around the planet there has been increasing discussion and planning for methods of climate adaptation. From measures to fortify coastal areas from rising sea levels to research on agricultural practices during prolonged droughts, climate adaptation efforts are intensifying on an international level. Given the limited success in efforts to mitigate increasing temperatures, some have suggested that governments would be better served if they concentrated on finding ways to adapt to a warmer planet rather than trying to stop warming from happening. This could involve a wide range of initiatives such as adjusting to higher temperatures or rising sea levels. The results of the NSAPOCC, which was fielded in December of 2011, indicate that the American public largely rejects the notion that governments should stop mitigation efforts and turn to adaptation measures. Two out of every three Americans said that they do not agree that we should shift attention away from trying to stop global warming and instead focus on adaptation.

#### Humans can adapt to warming

Joel Connelly, 7-23-2009, “Global warming skeptic,” Seattle P-I, http://www.seattlepi.com/local/connelly/article/Global-warming-skeptic-People-adapt-1305275.php

Michaels is a senior fellow in the public policy school at George Mason University. He was previously a research professor in environmental sciences at the University of Virginia, and jokes about UVA's "local snottiness index." He's also a senior fellow at the libertarian Cato Institute, a scholar whose research has won support from the Western Fuels Association and Edison Electric Institute, and an oft-featured speaker at gatherings of coal operators and mining associations. He has served as an expert witness for the auto industry. Michaels put coal in the stockings of those supporting House-passed climate change legislation, claiming it would precipitate "the greatest alteration of our economy" in the nation's history. "I don't think climate change is unprecedented, I don't think climate change will be unprecedented," he argued. And, to claims that climate change will precipitate death, Michaels answered: "People adapt." Since 1950, Michaels argued, life expectancy in the developed world has doubled on a line of increase parallel to carbon concentrations in the Earth's atmosphere.

#### Major international attention to adaptation now

Chris Berg, research fellow @ Inst. of Public Affairs, 5-8-2012, “We can’t stop climate change,” ABC, http://www.abc.net.au/unleashed/3997798.html

The release of the Productivity Commission's draft report into climate adaptation at the end of last month could have been a spark that changed the debate in Australia. That's because it implicitly suggested that adapting to climate change – regardless of whether its origin is anthropogenic, 'natural', or whatever – is now the main game. And the PC is not alone. In the 2007 report of the Intergovernmental Panel on Climate Change, there was just one chapter on adaptation. The previous report in 2001 was the same: one chapter. Now, according to the outline of the 2013 report, the adaptation section will blow out to four chapters. This new attention on adaptation makes sense. Nobody believes global emissions will be reduced to the extent the IPCC claims is urgent and necessary. Supposed deadlines for action have come and gone, over and over. By 2012, sceptics, alarmists, realists, and optimists should all agree that seriously mitigating climate change is a pipe dream.

### AT: Warming Bad – Bio-D

#### Cutting emissions doesn’t solve – numerous alt cause to biodiversity loss

Gro Harlem Brundtland, et. al, is a Norwegian Social democratic politician, diplomat, and physician, and an international leader in sustainable development and public health. She served three terms as Prime Minister of Norway, in partnership with the Conservation International, International institute for Environment and Development, and International Union for the Conservation of Nature. February 20th 2012 “Environment and Development Challenges: The Imperative to Act” <http://www.af-info.or.jp/bpplaureates/doc/2012jp_fp_en.pdf>. Page 9.

There are a number of other relevant market failures that must also be corrected if we are to manage the risks of climate change: correcting the emissions externality on its own will not be sufficient. For example, there are market failures around research and development (innovation), there are imperfections in capital markets that prevent financing for low-carbon infrastructure, there are network externalities, e.g. around electricity grids and public transport, there are failures in the provision of information, and there are failures in valuing ecosystems and biodiversity. In addition, environmentally-damaging subsidies in areas such as energy, transportation and agriculture, which total about $1 trillion per year, cause further market distortion and are in general leading to environmental degradation and should be eliminated. We must act strongly across all these dimensions. Correcting the biodiversity and ecosystem market failure is particularly urgent and important. The benefits that we derive from the natural world (biodiversity and ecosystem services) and its constituent ecosystems are critically important to human well-being and economic prosperity, but are consistently undervalued in economic analysis and decision making. Contemporary economic and participatory techniques allow us to take into account the monetary and non-monetary values of a wide range of ecosystem services. These techniques need to be adopted in everyday decision-making practice. Failure to include the valuation of non-market values in decision making results in a less efficient resource allocation, with negative consequences for social well-being. Recognising the value of ecosystem services would allow the world to move towards a more sustainable future, in which the benefits of ecosystem services are better realised and more equitably distributed.

#### Cooling kills biodiversity, not warming

NIPCC, Non Intergovernmental Panel on Climate Change, 5-7-2010, “Climate and the Origin and Demise of Species” http://www.nipccreport.org/issues/2010/may.html

Headquartered in the Department of Paleobiology at the National Museum of Natural History in Washington, DC (USA), Erwin writes that "some of the best evidence for a link between biodiversity and climate comes from latitudinal gradients in diversity, which provide an avenue to explore the more general relationship between climate and evolution." In reviewing that evidence, he indicates that "among the wide range of biotic hypotheses, those with the greatest empirical support indicate that warmer climates [1] have provided the energetic foundation for increased biodiversity by fostering greater population size and thus increased extinction resistance, [2] have increased metabolic scope, [3] have allowed more species to exploit specialized niches as a result of greater available energy, and [4] have generated faster speciation and/or lower extinction rates." And he states that "in combination with geologic evidence for carbon dioxide levels and changing areas of tropical seas, these observations provide the basis for a simple, first-order model of the relationship between climate through the Phanerozoic and evolutionary patterns and diversity," while further noting that "such a model suggests that we should expect greatest marine diversity during globally warm intervals," as is typically also found to be the case for terrestrial diversity. Elaborating a bit, Erwin writes that "the three best-studied mass extinction events are associated with sharp changes in climate and support the contention that rapid shifts in climate can reduce global diversity," which sounds a lot like the mantra of the IPCC with respect to global warming. However, the climate shifts Erwin cites consist mostly of cooling; and it is not only the shift to cooling but stagnating in a cool state that bodes badly for earth's biodiversity. As he describes it, "the long interval of stagnant evolution during the Permo-Carboniferous glaciation is consistent with studies of modern-day latitudinal diversity that [indicate that] rates of evolutionary innovation and diversification are higher in high-energy climates than in low-energy climates."

#### Species can adapt to climate change

S. Fred Singer, Atmospheric Physicist at George Mason University and Founder of the Environmental Policy Project, and Dennis T. Avery, Agricultural Economics at Michigan State University and University of Wisconsin and former agricultural analyst for the US Department of State, 2007 “Unstoppable Global Warming: Every 1,500 years,” p. 16

We know that species can adapt to abrupt global warming because the climate shifts in the 1,500-year cycle have often been abrupt. Moreover, the world's species have already survived at least six hundred such warmings and cooling’s in the past million years. The major effect of global warming will be more biodiversity in our forests, as most trees, plants, birds, and animals extend their ranges. This is already happening. Some biologists claim that a further warming of 0.8 degrees Celsius will destroy thousands of species. However, the Earth warmed much more than that during the Holocene Climate Optimum, which occurred 8,000 to 5,000 years ago, and no known species were driven extinct by the temperature increase.

### AT: Warming Bad – Sea Level Rise

#### No rise in sea levels – water will evaporate quicker than ice can melt

S. Fred Singer, Atmospheric Physicist at George Mason University and Founder of the Environmental Policy Project, and Dennis T. Avery, Agricultural Economics at Michigan State University and University of Wisconsin and former agricultural analyst for the US Department of State, 2007 “Unstoppable Global Warming: Every 1,500 years,” p. 47-48

Global warming advocates seem to assume a huge increase in sea level is immediate and inevitable if the planet continues to warm. Sea level rise is a product of conflicting forces, however. Warmer temperatures expand the volume of the water. Warmer temperatures melt more glacier ice. But warmer temperatures also evaporate more water from the oceans and lakes. When the clouds deposit the increased moisture from that rapid evaporation on polar ice caps and glaciers around the world, the ice caps and glaciers will actually grow unless the local temperatures are warm enough to increase local melting. Time is also a critical factor. Ice melts slowly. Glaciers and ice caps can take thousands of years to melt completely because their surfaces reflect away so much of the sun's heat. That's why the West Antarctic ice sheet, at least 10,000 years past its last ice age, still has another 7,000 years worth of ice to melt, according to John Stone of the University of Washington. Stone and his team analyzed the Chemical composition of the rocks left behind on the mountains of Antarctica’s Ford Range when the ice began to retreat. Given the Earth's highly variable climate history, another cooling period is almost certain to intervene before the West Antarctic Ice Sheet disappears. Walter Munk of the Scripps Institute of Oceanography reports that glacial melting due to higher twentieth-century temperatures can account for only four inches of sea level rise or fall per century. Essentially, we do not know why sea levels in recent decades have sometimes risen at double that rate but the average is six inches per century. The tectonically stable coastline of the Chukchi Sea in northwest Alaska shows sea levels there have risen only about a quarter of a millimeter per year over the past 6,000 years. However, there have been several periods of both slower and more rapid increases. The world's longest set of sea-level observations has been faithfully recorded for more than a thousand years at Stockholm, Sweden. According to M. Ekman, they tell us that "sea level changes due to northern hemisphere climate variations since AD. 800 have probably always kept within -1.5 and +1.5 mm/yr, with an average fairly close to zero."13 This result comes about because land surfaces there are rising, thus offsetting the rise in ocean levels. The reason is the rebounding of the land as it adjusts to the removal of the loads from the ice sheets that had covered it earlier. Niels Reeh of the University of Denmark has reported a "broad consensus" among sea level experts that another 1 degree Celsius of warming would create only a tiny change in global sea levels, He says the melting of Greenland's ice sheet would increase sea level by only 0.3 to 0.77 mm per year. Meanwhile, Antarctica would subtract 0.2 to 0.7 mm per year as increased precipitation added to its ice cap.14

### AT: Warming Bad – Coral

#### Coral reefs can adapt to warming

Red Orbit, 3-12-2012, “Coral Reefs May Be Adapting To Global Warming,” <http://www.redorbit.com/news/science/1112491613/coral-reefs-may-be-adapting-to-global-warming/>

As global warming heats up the Earth’s oceans, one ecosystem stands to be severely threatened: Coral reefs. However, new research has given scientists to be hopeful about the fate of these coral reefs. An international team of researchers has studied a coral population in South-East Asian waters that had survived a bleaching event. What was significant about this reef was that it had also survived another bleaching event 12 years earlier in 1998. The researchers published their findings in the journal PLoS ONE. The researchers analyzed three different sites effected by the 2010 bleaching event and found interesting results. It had been previously understood that fast growing coral was more likely to survive these bleachings. However, in some locations, such as Indonesia, fast growing coral (staghorn corals, for example) died off in large numbers. When researchers studied sites at Malaysia and Singapore, however, the fast growing corals were much more colorful and healthy than their bleached and slow-growing counterparts. Dr James Guest, a joint research fellow at the UNSW Centre for Marine Bio-innovation and the Advanced Environmental Biotechnology Centre at Singapore’s Nanyang Technological University is the lead author of the study. Guest writes in the press release “Mass coral-bleaching events, caused by a breakdown in the relationship between the coral animals and their symbiotic algae, are strongly correlated with unusually high sea temperatures and have led to widespread reef degradation in recent decades.” According to Guest, these recent studies have proven certain species of coral to be more susceptible to bleaching events. In previous results, the severity of the bleaching events had very different results on each species. Guest and his team have data that suggests the slower, and larger species of coral will replace the faster, smaller species in the future.

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#### CO2 is key to expanded agricultural yields

Wall Street Journal, 6-22-2012, “No Need to Panic About Global Warming,” http://online.wsj.com/article/SB10001424052970204301404577171531838421366.html

The fact is that CO2 is not a pollutant. CO2 is a colorless and odorless gas, exhaled at high concentrations by each of us, and a key component of the biosphere's life cycle. Plants do so much better with more CO2 that greenhouse operators often increase the CO2 concentrations by factors of three or four to get better growth. This is no surprise since plants and animals evolved when CO2 concentrations were about 10 times larger than they are today. Better plant varieties, chemical fertilizers and agricultural management contributed to the great increase in agricultural yields of the past century, but part of the increase almost certainly came from additional CO2 in the atmosphere.

#### Food conflict would lead to massive global wars.

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

The character of human conflict has also changed: since the early 1990S, more wars have been triggered by disputes over food, land, and water than over mere political or ethnic differences. This should not surprise US: people have fought over the means of survival for most of history. But in the abbreviated reports on the nightly media, and even in the rarefied realms of government policy, the focus is almost invariably on the players—the warring national, ethnic, or religious factions—rather than on the play, the deeper subplots building the tensions that ignite conflict. Caught up in these are groups of ordinary, desperate people fearful that there is no longer sufficient food, land, and water to feed their children—and believing that they must fight ‘the others” to secure them. At the same time, the number of refugees in the world doubled, many of them escaping from conflicts and famines precipitated by food and resource shortages. Governments in troubled regions tottered and fell. The coming famine is planetary because it involves both the immediate effects of hunger on directly affected populations in heavily populated regions of the world in the next forty years—and also the impacts of war, government failure, refugee crises, shortages, and food price spikes that will affect all human beings, no matter who they are or where they live. It is an emergency because unless it is solved, billions will experience great hardship, and not only in the poorer regions. Mike Murphy, one of the world’s most progressive dairy farmers, with operations in Ireland, New Zealand, and North and South America, succinctly summed it all up: “Global warming gets all the publicity but the real imminent threat to the human race is starvation on a massive scale. Taking a 10—30 year view, I believe that food shortages, famine and huge social unrest are probably the greatest threat the human race has ever faced. I believe future food shortages are a far bigger world threat than global warming.”2° The coming famine is also complex, because it is driven not by one or two, or even a half dozen, factors but rather by the confluence of many large and profoundly intractable causes that tend to amplify one another. This means that it cannot easily be remedied by “silver bullets” in the form of technology, subsidies, or single-country policy changes, because of the synergetic character of the things that power it.

### Warming Good – CO2 Ag

#### Global warming is good for humanity both food wise and climate wise. more precipitation, milder climates, more food, fewer deserts.

Thomas Gale **Moore**, senior fellow at the Hoover institution, 19**95**, “Global Warming: A boon to man and animals”, The Public Interest, <http://www.stanford.edu/~moore/Boon_To_Man.html>

Only if warmer weather caused more droughts or lowered agricultural output would even Third World countries suffer. Should the world warm -- and there is little evidence or theory to support such a prognostication -- most climatologists believe that precipitation would increase. Although some areas might become drier, others would become wetter. Judging from history, Western Europe would retain plentiful rainfall, while North Africa and the Sahara might gain moisture. The Midwest of the United States might suffer from less precipitation and become more suitable for cattle grazing than farming. On the other hand, the Southwest would likely become wetter and better for crops. A warmer climate would produce the greatest gain in temperatures at northern latitudes and much less change near the equator. Not only would this foster a longer growing season and open up new territory for farming but it would mitigate harsh weather. The contrast between the extreme cold near the poles and the warm moist atmosphere on the equator drives storms and much of the earth's climate. This difference propels air flows; if the disparity is reduced, the strength of winds driven by equatorial highs and Arctic lows will be diminished. Warmer nighttime temperatures, particularly in the spring and fall, create longer growing seasons, which should enhance agricultural productivity. Moreover, the enrichment of the atmosphere with CO2 will fertilize plants and make for more vigorous growth. Agricultural economists studying the relationship of higher temperatures and additional CO2 to crop yields in Canada, Australia, Japan, northern Russia, Finland, and Iceland found not only that a warmer climate would push up yields, but also that the added boost from enriched CO2 would enhance output by 17 percent.[11] Researchers have attributed a burgeoning of forests in Europe to the increased CO2 and the fertilizing effect of nitrogen oxides.[12] Professor of Climatology Robert Pease writes that we may now be living in an "icehouse" world and that a warming of about two degrees Celsius, which is what his model indicates, may actually make the earth more habitable. The higher temperatures combined with more carbon dioxide will favor plant and crop growth and could well provide more food for our burgeoning global populations. Geologic history reveals that warmer global temperatures produce more, not less, precipitation, a fact reflected by a recent scientific investigation that shows the Greenland ice-cap to be thickening, not melting. So much for the catastrophic prediction that our coastlines will be flooded by a rise in sea level from polar meltwaters.[13]

#### Increased atmospheric CO2 increases agricultural yields – eliminates pests

Craig Idso, Ex-Director of Environmental Science at Peabody Energy in St. Louis, and Ph.D. in Geography from Arizona State University. 1-2-2008 “Effects of Elevated CO2 on Plant-Herbivore Interactions” http://www.co2science.org/articles/V11/N1/B2.php

What was learned With respect to the first subject of their review, Stiling and Cornelissen report that "the densities of all leaf miner species (6) on all host species (3) were lower in every year in elevated CO2 than they were in ambient CO2." With respect to the second subject, they say that "elevated CO2 significantly decreased herbivore abundance (-21.6%), increased relative consumption rates (+16.5%), development time (+3.87%) and total consumption (+9.2%), and significantly decreased relative growth rate (-8.3%), conversion efficiency (-19.9%) and pupal weight (-5.03%)," while noting that "host plants growing under enriched CO2 environments exhibited significantly larger biomass (+38.4%), increased C/N ratio (+26.57%), and decreased nitrogen concentration (-16.4%), as well as increased concentrations of tannins (+29.9%)." What it means With plant biomass increasing and herbivorous pest abundance decreasing (by +38.4% and -21.6%, respectively, in response to an approximate doubling of the atmosphere's CO2 concentration), it would appear that in the eternal struggle to produce the food that sustains all of humanity, either directly or indirectly, man's crops will fare ever better as the air's CO2 content continues its upward climb. Likewise, it would appear there will be a concomitant expansion of the vegetative food base that sustains all of the biosphere.

#### An atmosphere with more CO2 will increase plant growth.

Thomas Gale Moore, Senior Fellow, Hoover Institution, 1995, “GLOBAL WARMING: A Boon to Humans and Other Animals,” http://www.stanford.edu/~moore/Boon\_To\_Man.html

A warmer climate would produce the greatest gain in temperatures at northern latitudes and much less change near the equator. Not only would this foster a longer growing season and open up new territory for farming but it would mitigate harsh weather. The contrast between the extreme cold near the poles and the warm moist atmosphere on the equator drives storms and much of the earth's climate. This difference propels air flows; if the disparity is reduced, the strength of winds driven by equatorial highs and Arctic lows will be diminished. Warmer nighttime temperatures, particularly in the spring and fall, create longer growing seasons, which should enhance agricultural productivity. Moreover, the enrichment of the atmosphere with CO2 will fertilize plants and make for more vigorous growth. Agricultural economists studying the relationship of higher temperatures and additional CO2 to crop yields in Canada, Australia, Japan, northern Russia, Finland, and Iceland found not only that a warmer climate would push up yields, but also that the added boost from enriched CO2 would enhance output by 17 percent.[11] Researchers have attributed a burgeoning of forests in Europe to the increased CO2 and the fertilizing effect of nitrogen oxides.[12] Professor of Climatology Robert Pease writes that we may now be living in an "icehouse" world and that a warming of about two degrees Celsius, which is what his model indicates, may actually make the earth more habitable. The higher temperatures combined with more carbon dioxide will favor plant and crop growth and could well provide more food for our burgeoning global populations. Geologic history reveals that warmer global temperatures produce more, not less, precipitation, a fact reflected by a recent scientific investigation that shows the Greenland ice-cap to be thickening, not melting. So much for the catastrophic prediction that our coastlines will be flooded by a rise in sea level from polar meltwaters.[13] The United States Department of Agriculture in a cautious report reviewed the likely influence of global warming on crop production and world food prices. The study, which assumed that farmers fail to make any adjustment to mitigate the effects of warmer, wetter, or drier weather -- such as substituting new varieties or alternative crops, increasing or decreasing irrigation -- concludes that: The overall effect on the world and domestic economies would be small as reduced production in some areas would be balanced by gains in others, according to an economic model of the effects of climate change on world agricultural markets. The model ... estimates a slight increase in world output and a decline in commodity prices under moderate climate change conditions.[14] [Emphasis added.] Economists Robert Mendelsohn, William D. Nordhous, and Daigee Shaw researched the relationship of climate to land values in the United States.[15] After holding land quality, the proximity to urban areas and the nearest coast, and income per capita constant, they found that climate explained over two-thirds of the value of crop lands. They concluded that for the lower-48 states, a rise in average temperature of about 5deg.F and an 8 percent increase in rainfall stemming from global warming would, depending on their model, reduce the value of output between 4 and 6 percent or boost the value of output slightly. This result ignored the effect of increased CO2 on farm output. It is also consistent with the Department of Agriculture study that suggests the U.S. might see a slight fall in output while the rest of the world increased production. Forestry is another sector that is potentially subject to change due to an increase in world temperatures. Canadian agricultural economists have examined the effect of a doubling of CO2 on forestry production. They concluded that increased carbon dioxide would boost productivity by 20 percent and that overall the harvest of timber in Canada would climb by about 7.5 percent.[16]

#### More CO2 leads to longer growing seasons and more food production.

Patrick J. Michaels, Apple Daily, November 3, 2004, “Is Global Warming Always Bad?” http://www.cato.org/publications/commentary/is-global-warming-always-bad

Have you ever read anything good about global warming? Why is all the news always bad? Objectively speaking, any environmental change should have both positive benefits and negative effects. For example, theory predicts and observations confirm that human-induced warming takes place primarily in winter, lengthening the growing season. Satellite measurements now show that the planet is greener than it was before it warmed. There are literally thousands of experiments reported in the scientific literature demonstrating that higher atmospheric carbon dioxide concentrations -- cause by human activity -- dramatically increase food production. So why do we only hear one side about global warming? Perhaps because there's little incentive for scientists to do anything but emphasize the negative and the destructive. Alarming news often leads to government funding, funding generates research, and research is the key to scientists' professional advancement. Good news threatens that arrangement. This is the reality that all scientists confront: every issue, be it global warming, cancer or AIDS, competes with other issues for a limited amount of government research funding. And, here in Washington, no one ever received a major research grant by stating that his or her particular issue might not be such a problem after all. A recent story is typical. Two American scientists, Thomas Knutson and Robert Tuleya, published an academic paper forecasting an increase in the power of hurricanes (typhoons) because of global warming. Specifically, they used a computer model in which the sea surface temperature was warmed, and they found that nearly 60 percent of the changes in the computer's hurricanes could be attributed to that effect. The real world is not the world of the computer. In reality, only 10 percent of the behavior of hurricanes in the Atlantic Ocean (where there are the best long-term records) is related to sea surface temperatures. When that is factored in, any changes in hurricanes related to global-warming become undetectable over the next century. How could there be such a disconnection between a computer simulation and reality? Why don't scientists check for this before they publish their papers? And why don't other scientists who peer-review the research papers point out inconsistencies before they are published? Computers only do what they are told, and they don't do what they are not told. One factor that was ignored in this study is global warming is likely to increase winds, several kilometers aloft, that actually destroy hurricanes. In fact, as the planet has warmed, maximum winds measured by hurricane-research aircraft in the Atlantic Basin have declined.

#### Higher temps lead to larger, greener plants.

Graham Smith, Masters in Environmental Science, 12 June 2012,

http://www.dailymail.co.uk/sciencetech/article-2158226/The-Arctics-getting-greener-Global-warming-causing-vegetation-grow-taller.html#ixzz1yGTw6XR7

Plants in the Arctic region are growing greener and taller as a result of global warming, scientists claim. Higher temperatures have also seen the proportion of bare ground decrease, according to a study. Lead researcher Dr Robert Björk, from the University of Gothenburg in Sweden, said: 'We've managed to link the vegetation changes observed at the different sites to the degree of local warming.' Greener: Plants in the Arctic region are growing greener and taller as a result of global warming, scientists claim The scientists' comparisons show that the prevalence of vascular species, such as shrubs and plants, is increasing as temperatures rise. The degree of change depends on climate zone, soil moisture and the presence of permafrost, they claim. Researchers working on the International Tundra Experiment (ITEX) have been gathering data for almost 30 years. By analysing changes in vegetation in 158 plant communities at 46 locations across the Arctic between 1980 and 2010, they have been able to identify a number of general trends. Dr Björk said: 'We've managed to show that the vegetation changes in our fixed plots are a result of local warming at numerous sites across the world's tundra.' Researchers working on the International Tundra Experiment (ITEX) have been gathering data from vegetation in the Arctic region for almost 30 years The results indicate strong regional variation in the response of tundra vegetation to rising temperatures. Dr Ulf Molau, another researcher based at the University of Gotherburg, said: 'The response of different plant groups to rising temperatures often varied with summer ambient temperature, soil moisture content and experimental duration, with shrubs expanding with warming only where the ambient temperature was already high, and grasses expanding mostly in the coldest areas studied. 'This means that particularly sensitive regions following the combined effects of long-term warming in the Arctic may see much greater changes than we have observed to date.'

#### More CO2 leads to higher crop yields.

EPA Thursday, June 14, 2012 “Agriculture and Food Supply Impacts & Adaptation” Environmental Protection Agency http://www.epa.gov/climatechange/impacts-adaptation/agriculture.html#impactscrops

Crops grown in the United States are critical for the food supply here and around the world. U.S. exports supply more than 30% of all wheat, corn, and rice on the global market. [2] Changes in temperature, amount of carbon dioxide (CO2), and the frequency and intensity of extreme weather could have significant impacts on crop yields. Warmer temperatures may make many crops grow more quickly, but warmer temperatures could also reduce yields. Crops tend to grow faster in warmer conditions. However, for some crops (such as grains), faster growth reduces the amount of time that seeds have to grow and mature. [1] This can reduce yields (i.e., the amount of crop produced from a given amount of land). For any particular crop, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction. [1] In some areas, warming may benefit the types of crops that are typically planted there. However, if warming exceeds a crop's optimum temperature, yields can decline. •Higher CO2 levels can increase yields. The yields for some crops, like wheat and soybeans, could increase by 30% or more under a doubling of CO2 concentrations. The yields for other crops, such as corn, exhibit a much smaller response (less than 10% increase). [3] However, some factors may counteract these potential increases in yield. For example, if temperature exceeds a crop's optimal level or if sufficient water and nutrients are not available, yield increases may be reduced or reversed. •More extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yields. For example, in 2008, the Mississippi River flooded just before the harvest period for many crops, causing an estimated loss of $8 billion for farmers. [1] •Dealing with drought could become a challenge in areas where summer temperatures are projected to increase and precipitation is projected to decrease. As water supplies are reduced, it may be more difficult to meet water demands.•Many weeds, pests and fungi thrive under warmer temperatures, wetter climates, and increased CO2 levels. Currently, farmers spend more than $11 billion per year to fight weeds in the United States. [1] The ranges of weeds and pests are likely to expand northward. This would cause new problems for farmers' crops previously unexposed to these species. Moreover, increased use of pesticides and fungicides may negatively affect human health. [1]

#### CO2 increases yields and photosynthesis.

Daniel R. Taub, 2010 “Effects of Rising Atmospheric Concentrations of Carbon Dioxide on Plants,” Nature Education Knowledge, <http://www.nature.com/scitable/knowledge/library/effects-of-rising-atmospheric-concentrations-of-carbon-13254108>

One of the most consistent effects of elevated atmospheric CO2 on plants is an increase in the rate of photosynthetic carbon fixation by leaves. Across a range of FACE experiments, with a variety of plant species, growth of plants at elevated CO2 concentrations of 475–600 ppm increases leaf photosynthetic rates by an average of 40% (Ainsworth & Rogers 2007). Carbon dioxide concentrations are also important in regulating the openness of stomata, pores through which plants exchange gasses, with the external environment. Open stomata allow CO2 to diffuse into leaves for photosynthesis, but also provide a pathway for water to diffuse out of leaves. Plants therefore regulate the degree of stomatal opening (related to a measure known as stomatal conductance) as a compromise between the goals of maintaining high rates of photosynthesis and low rates of water loss. As CO2 concentrations increase, plants can maintain high photosynthetic rates with relatively low stomatal conductance. Across a variety of FACE experiments, growth under elevated CO2 decreases stomatal conductance of water by an average of 22% (Ainsworth & Rogers 2007). This would be expected to decrease overall plant water use, although the magnitude of the overall effect of CO2 will depend on how it affects other determinants of plant water use, such as plant size, morphology, and leaf temperature. Overall, FACE experiments show decreases in whole plant water use of 5–20% under elevated CO2. This in turn can have consequences for the hydrological cycle of entire ecosystems, with soil moisture levels and runoff both increasing under elevated CO2 (Leakey et al. 2009). Since photosynthesis and stomatal behavior are central to plant carbon and water metabolism, growth of plants under elevated CO2 leads to a large variety of secondary effects on plant physiology. The availability of additional photosynthate enables most plants to grow faster under elevated CO2, with dry matter production in FACE experiments being increased on average by 17% for the aboveground, and more than 30% for the belowground, portions of plants (Ainsworth & Long 2005; de Graaff et al. 2006). This increased growth is also reflected in the harvestable yield of crops, with wheat, rice and soybean all showing increases in yield of 12–14% under elevated CO2 in FACE experiments (Ainsworth 2008; Long et al. 2006). Elevated CO2 also leads to changes in the chemical composition of plant tissues. Due to increased photosynthetic activity, leaf nonstructural carbohydrates (sugars and starches) per unit leaf area increase on average by 30–40% under FACE elevated CO2 (Ainsworth 2008; Ainsworth & Long 2005). Leaf nitrogen concentrations in plant tissues typically decrease in FACE under elevated CO2, with nitrogen per unit leaf mass decreasing on average by 13% (Ainsworth & Long 2005). This decrease in tissue nitrogen is likely due to several factors: dilution of nitrogen from increased carbohydrate concentrations; decreased uptake of minerals from the soil, as stomatal conductance decreases and plants take up less water (Taub & Wang 2008); and decreases in the rate of assimilation of nitrate into organic compounds (Bloom et al. 2010). Protein concentrations in plant tissues are closely tied to plant nitrogen status. Changes in plant tissue nitrogen are therefore likely to have important effects on species at higher trophic levels. Performance is typically diminished for insect herbivores feeding on plants grown in elevated CO2 (Zvereva & Kozlov 2006). This can lead to increased consumption of plant tissues as herbivores compensate for decreased food quality (Stiling and Cornelissen 2007). Effects on human nutrition are likely as well. In FACE experiments, protein concentrations in grains of wheat, rice and barley, and in potato tubers, are decreased by 5–14% under elevated CO2 (Taub et al. 2008). Crop concentrations of nutritionally important minerals including calcium, magnesium and phosphorus may also be decreased under elevated CO2 (Loladze 2002; Taub & Wang 2008). Effects of Other Environmental Factors on Plant Response to Elevated CO2 The effects of elevated CO2 on plants can vary depending on other environmental factors. While elevated CO2 makes carbon more available, plants also require other resources including minerals obtained from the soil. Elevated CO2 does not directly make these mineral elements more available and, as noted above, may even decrease the uptake of some elements. The ability of plants to respond to elevated CO2 with increased photosynthesis and growth may therefore be limited under conditions of low mineral availability. This effect has been best documented for nitrogen. In FACE experiments, there is less enhancement of photosynthesis by elevated CO2 under low than high soil N conditions (Ainsworth & Long 2005; Ainsworth & Rogers 2007). Crop yield in FACE also appears to be enhanced by elevated CO2 to a lesser extent under low-N than under high-N (Ainsworth & Long 2005; Ainsworth 2008; Long et al. 2006). Across studies using all types of CO2 fumigation technologies, there is a lower enhancement of biomass production by elevated CO2 under low-nutrient conditions (Poorter & Navas 2003). Crops grown with low amounts of N fertilization also show a greater decrease in protein concentrations under elevated CO2 than crops grown with higher N fertilization (Taub et al. 2008). Another environmental factor that interacts with elevated CO2 is atmospheric ozone (O3), a gaseous toxin. Ground-level O3 concentrations have been increasing worldwide (and are expected to continue to increase) due to increased emissions of pollutants that react to produce O3 (Vingarzan 2004). High atmospheric concentrations of ozone can cause damage to leaves and decreased plant growth and photosynthesis (Feng et al. 2008; Morgan et al. 2003). The primary location of O3 injury to plants is the internal tissues of leaves. Decreased openness of stomata under elevated CO2 can therefore decrease exposure of sensitive tissues to ozone. Elevated CO2 substantially decreases the negative effects of high ozone on photosynthesis, growth, and seed yield in both soybeans and rice (Feng et al. 2008; Morgan et al. 2003). Across experiments with all plant species, the enhancement of growth by elevated CO2 is much greater under conditions of ozone stress than otherwise (Poorter & Navas 2003). Differences among Plant Functional Types in Response to Rlevated CO2 The preceding discussion has presented the average effects of elevated CO2, but obscures important patterns of difference in response among plant species. One of the most important determinants of species differences in response to elevated CO2 is photosynthetic type. Most plant species (~90%) utilize a photosynthetic process known as C3 photosynthesis. Other species use either of two physiologically distinct processes known as C4 and CAM photosynthesis (Figure 2). C4 plants include most tropical and sub-tropical grasses and several important crops, including maize (corn), sugar cane, sorghum, and the millets. There has therefore been considerably more research on the responses to elevated CO2 in C4 than in CAM plants. Figure 2: Each plant species utilizes one of several distinct physiological variants of photosynthesis mechanisms, including the variants known as C3 and C4 photosynthesis. C4 plants use a biochemical pump to concentrate CO2 at the locations within the leaf where the RUBISCO enzyme mediates incorporation of CO2 by the Calvin-Benson photosynthetic cycle. Since CO2 concentrations are already high within the bundle sheath cells, increasing atmospheric CO2 concentrations above current levels has little direct effect on photosynthetic rates for C4 species. C4 species do respond to elevated CO2 by decreasing stomatal conductance; this may lead to some indirect enhancement of photosynthesis by helping avoid water stress under drought conditions (Leakey 2009). In FACE experiments, stimulation of photosynthesis by elevated CO2 in C4 plants is only about one-third of that experienced by C3 species. C4 plants also show little or no enhancement of growth (dry matter production) in these studies (Ainsworth & Long 2005). The very limited data available also shows no increase in C4 crop yield in FACE studies (Long et al. 2006). While there is little FACE data available on effects of elevated CO2 on plant nitrogen and protein concentrations, data from chamber experiments shows C4 plants to be much less responsive than C3 plants in this regard (Cotrufo et al. 1998). The picture that emerges is that C4 plants are in general relatively unresponsive to elevation of atmospheric CO2 above current ambient levels. In contrast to C4 species, another group of plants, legumes (members of the botanical family Fabaceae) may be especially capable of responding to elevated CO2 with increased photosynthesis and growth (Rogers et al. 2009). For most plants, growth under elevated CO2 can alter the internal balance between carbon (obtained in extra quantities through enhanced photosynthesis) and nitrogen (either unaffected or taken up in decreased amounts due to decreased uptake of water). In contrast, most legume species participate in close mutualistic relationships with bacteria that live in nodules formed on the plant’s roots. These bacteria are able to "fix" atmospheric nitrogen, chemically reducing it to a form that can be taken up and used by plants. Under elevated CO2 conditions, legumes may be able to shunt excess carbon to root nodules where it can serve as a carbon and energy source for the bacterial symbionts. In effect, legumes may be able to exchange the excess carbon for nitrogen and thereby maximize the benefits of elevated atmospheric CO2. Many studies in controlled environments have shown that, compared to other plant species, legumes show greater enhancement of photosynthesis and growth by elevated CO2 (Rogers et al. 2009). Decreases in tissue nitrogen concentrations under elevated CO2 are also smaller for legumes than for other C3 species (Cotrufo et al. 1988; Jablonski et al. 2002; Taub et al. 2008). In FACE experiments, soybeans (a legume) show a greater response to elevated CO2 than wheat and rice in photosynthesis and overall growth, although not in harvestable yield (Long et al. 2006). Plant Community Interactions under Elevated CO2 A number of experiments have found that some plant species that respond positively to elevated CO2 when grown alone experience decreased growth under elevated CO2 when grown in mixed plant communities (Poorter & Navas 2003). This effect likely results because the direct positive effects of elevated CO2 are outweighed by negative effects due to stimulation of the growth of competitors. Rising atmospheric concentrations of CO2 may therefore lead to changes in the composition of plant communities, as some species reap more of an advantage from the increased CO2 than do others. In mixed-species experiments under high fertility conditions, C4 plants decrease as a proportion of the biomass of plant communities under elevated CO2. Similarly, under low fertility conditions, legumes increase as a proportion of the biomass of plant communities under elevated CO2 (Poorter & Navas 2003). Summary Current evidence suggests that that the concentrations of atmospheric CO2 predicted for the year 2100 will have major implications for plant physiology and growth. Under elevated CO2 most plant species show higher rates of photosynthesis, increased growth, decreased water use and lowered tissue concentrations of nitrogen and protein. Rising CO2 over the next century is likely to affect both agricultural production and food quality. The effects of elevated CO2 are not uniform; some species, particularly those that utilize the C4 variant of photosynthesis, show less of a response to elevated CO2 than do other types of plants. Rising CO2 is therefore likely to have complex effects on the growth and composition of natural plant communities.

### Food Security Impacts

#### Billions will die without expanded agricultural output

Mahendra Shah, Executive Secretary of CGIAR and Maurice Strong, Senior Adviser to UN and World Bank 2000 “Food in the 21st century: from science to sustainable agriculture,” p. 9-10

As the new millennium begins, the world faces another food crisis that is just as dangerous — but much more complex — than the one it confronted thirty years ago. Each year the global population climbs by an estimated 90 million people. This means, at the very least, the world's farmers will have to increase food production by more than 50 percent to feed some two billion more people by 2020. But the numbers don't tell the full story. The challenge confronting the world is far more intricate than simply producing more food, because global conditions are very different than they were on the eve of the Green Revolution. To prevent a crisis, the world community must confront the issues of poverty, food insecurity, environmental degradation, and erosion of genetic resources. Feeding the world in the 21st century will require not only food availability, but food security — access to the food required for a healthy and productive life. It means the ability to grow and to purchase food as needed. It also means that people do not have to rely only on staples such as wheat, rice, potatoes and cassava. Food security focuses attention on areas such as income, markets, and natural resources. The basic statistics on food security are grim. In addition to the expected population growth, the Food and Agricultural Organization of the United Nations (FAO) estimates as many as 840 million people — a number that exceeds the combined populations of Europe, the United States, Canada, and Japan — currently do not have enough to eat. The companion problem of "hidden hunger" — deficiencies of vital micronutrients — affects even more people in the developing world. The shift away from the traditional food staples will make this challenge even more difficult. Simply increasing productivity of wheat and rice alone may not have the impact it did 30 years ago

#### Food crisis is severe.

Caroline Henshaw, staff writer at the Wall Street Journal, May 31, 2011, “Feeding the World’s Hungry Is a Moral Necessity–Oxfam,” The Wall Street Journal, http://blogs.wsj.com/source/2011/05/31/feeding-the-worlds-hungry-is-a-moral-necessity-oxfam/?mod=google\_news\_blog

In his The Annals of the Roman People, the historian Livy famously regarded the glorification of chefs as the sign of a culture in decline. “What had been nothing but a métier was elevated to an art,” he wrote, claiming that such “foreign luxury” heralded a degradation of morality and the decay of empire. Today, Oxfam has taken that argument a step further. In a new report, the international charity argues that the excesses of the rich are tipping the world into a permanent state of food crisis so severe that it could reverse the trajectory of human development. Bloomberg It warns that prices of staple foods will more than double in the next 20 years unless world leaders act now to avert climate change and reform the global food system. Importantly, the cost of key grains such as maize—an essential dietary component in the world’s least-developed continent, Africa—could rise by as much as 180%, with more than half of this rise due to the degrading effects of climate change. Other factors, including rising oil prices, the increasing diversion of crops for biofuels and scarcity of water are also expected to make the forecast 70% rise in production needed by 2050 to feed the world’s population even harder to meet. “The international community is sleepwalking into an unprecedented and avoidable human development reversal,” said Oxfam’s report, Growing a Better Future. Rising food prices have already been blamed for triggering the wave of unrest which has swept the Arab world this year. With crops in Europe and the U.S. now facing severe threats from the weather, the United Nations warns that world food prices—already near record highs—could rise even further. In response, Oxfam said world leaders must act to ensure the world’s bust does not become a new boon for business. Speculation in agricultural derivatives markets must be regulated and the activities of huge grain trading companies, which it characterizes as “global oligopolies,” must be made more transparent. Policies subsidizing biofuels should also be scrapped and instead the money should be ploughed into boosting food reserves and investing in smallholder farmers in the world’s most impoverished countries. This must be done in a sustainable way which limits agriculture’s contribution to the release of greenhouse gases. None of these recommendations is new. Since the last food-price spike of 2007-08, policymakers and farmers alike have been wrestling with how to improve production and G20 leaders have made food security a priority this year. But the apocalyptic tone struck by Oxfam’s report shows an increasing urgency in the pleas of the international aid community for change, as the cost of feeding an ever-growing number of hungry mouths rises despite ever-growing world agricultural production. Addressing the needs of the world’s hungry is not only necessary; it will be the deciding factor in our own moral trajectory. As the UN’s special rapporteur, Olivier de Schutter, says: “The question of global hunger [is] not one of production only, but also one of marginalization, deepening inequalities and social justice.”

#### Food security is a policy priority.

Tim Costello, CEOI of World Vision Australia, economics, law and education at Monash University, Masters Degree, 29 March 2010, The 5th Ideas and Society lecture, http://www.latrobe.edu.au/news/ideas-and-society/the-global-fight-against-hunger/part-2-transcript

Well thank you so much for that introduction Robert. It’s pretty much as I wrote it really. Let me just say that it is always an honour to be both at La Trobe and on a platform with Robert and some of the things he was very generously saying about me are certainly reciprocated in terms of his courage in the stand that he’s taken on issues. You’re right, I was mayor of St Kilda. I did such a good job they abolished the whole council. I am the last mayor ever of St Kilda, so I’ve had my moments in public life. I think you’ve had a very significant overview, none of which I disagree. I might just bring this back home and say now and then when we see some food prices rising in Australia, Australians still don’t make the connection that, if prices go up here, at worst we eat out less, or we buy maybe, and this is good, less takeaway. For the poor who Oxfam, World Vision and other agencies work for, when food prices go up, they don’t eat. And that moral connection in terms of this waterbed of price sensitivity and supply and demand is incredibly important to come home. We live within our own bubble. And I was thinking about this morning as I was listening to AM and the discovery now that maybe junk food is addictive and we need to treat people who eat junk food in the same way we treat smokers or drug addicts, and the sort of debates within our bubble, without making the connection about obesity and any number of diets that we all have a look at, and the extraordinary crisis, the moral seriousness and gravity of a global food crisis. We don’t join the dots and the connections. I say this of myself. I thankfully aren’t a great eater of junk food but I remember rushing into a Hungry Jack’s one day – I hadn’t eaten, I was in a hurry, I had to get to a meeting. I remember ordering a burger, fries and a Coke and being fast food, I remember vividly the woman behind the counter saying to me, “There’ll be a three minute wait for the burger.” I say to my shame, I felt this rage rise up inside me. I actually heard myself say, “Excuse me, but why the delay?” She was very professional. She looked straight back at me and very coolly said: “Because we’re cooking the food.” I remember thinking “What are you cooking the food for? This is meant to be fast, I’m in a hurry, and then sanity broke in, I thought, calm down, Tim, calm down. Even at a fast food place they probably have to cook the food.” Well, it’s surreal and it’s mad and I think it illustrates some of the bubble of our world which is so isolated and connected from the global food crisis. Just today I did a quick skim of the papers around the world. The Moscow Times, the BRIC countries agree food security strategy, the BRIC countries being Brazil, Russia, India and China. Agreed to combat hunger and to boost efforts to promote food security. According to a strategy signed by the countries’ Agricultural Ministers in Moscow on Friday. In order to promote food security, it is necessary to have a well-functioning worldwide food market. And a trade system based on the principles of justice and freedom from discrimination. Something I think we’d agree with. This is what the declaration said: Therefore speeding up the accomplishment of the WTO, Doha round of talks is a primary task. The Doha Round which is sometimes called the Development Round. So in the Moscow Times today the countries collectively known as BRIC agreed on Friday to establish an agricultural information data base that would help countries compute, supply and demand, and establish green reserves. From India, in the Hindu, the headline today: Pathway to Food Security For All. And this is talking about in India a proposed Food Security Bill and a three-pronged strategy of providing public distribution of low-cost food grains to the needy and the delivery of nutrition safety net programs. This is all based on Article 21 of the Constitution which says in India, and the Supreme Court has added: The right to food as a fundamental requirement for the right to life. So here is a magnificent set of rights. It goes on however: Many steps have been taken since Independence to adopt Mahatma Gandhi’s advice for ??, [7.39] I don’t know if that’s the right pronunciation, and approach to eliminate hunger. In spite of numerous measures and programs, the number of undernourished has increased from 210 million in 1990-1992, to 252 million in 2004-2006. India has about half the world’s undernourished children. Also, there has been a general decline in per capita calorie consumption in recent decades. Grain mountains and hungry millions continue to co-exist. Just the picture of that is disturbing, isn’t it? In spite of them listing all the things that they’re doing, the Hindu then says the situation in the field of child nutrition remains bleak. The percentage of children below five years of age who are underweight is now 42.5%. The percentage of children below three years who are undernourished is 40%. From a news alert on Yemen, the 250,000 internally displaced people dependent on food banks and supplies of aid agencies have had their rations cut. Why? Because we ran out of grain, beans, sugar and oil ten days ago. Instead of two sacks of grain and 10kg of beans, we received one sack and 5kg, which all was finished in twelve days. And then here in Australia the headline coming out today from AAP – Barnaby Joyce puts food security above the environment. Nationals Senator Barnaby Joyce has risked inflaming tensions with Liberal MPs and Opposition [Leader] Tony Abbott, saying the priority for order policy must be guaranteeing food production with environment coming second. The article goes on to talk about Mr Abbott competing in the gruelling Iron Man event yesterday. Well, without going over the ground that you’ve already heard and I was just going to take you through some of the figures of where staple prices have gone up, though there has been a little bit of a drop from the spikes, what you are seeing is discussion, but not breakthrough. It’s on the agendas, but it still doesn’t seem to have the moral urgency that a global food crisis should have. We would simply say about a Barnaby comment, that missing the link between the environment and food security is just a profound miss. As we know, some of the response to environmental challenges with the massive shifts to bio-fuels, particularly in the US, Brazil and elsewhere, only intensifies the food crisis. One response, without thinking of the ripple effect. What we certainly know with the global financial crisis, Bob Zoellick of the World Bank I think put it very well when he said: “450,000 children who would not have died because of lack of food, but for the impact of the global financial crisis on food. ” 450,000 kids will die this year. When we worry about our super levels back to 2003 and maybe some price rises in buying your potatoes and bread, we don’t actually see that this is also costing lives. I agree with the last speaker and we’ll allow a bit of time for discussion about this, that this has got to be both a political response as well as a market response. We now profoundly know that markets fail with the aggregation of power in large scale agriculture, the trust-me of markets simply isn’t sufficient. We certainly know that there has been reform happening with the world food program. Often they had been dumping too much food, suppressing local markets. Josette Sheeran of the WFP has really been starting to do a good job of saying: “We have seen the unintended effects of World Food Program just responding to hunger in a way that kills off incentive.” What we know about the World Food Program is when you try and run a global reach that the World Food Program has, and it only reaches under 20% of the nearly billion people who lack food security. It’s actually lower than 20%. And it tries to do that on only eleven weeks ever secure funding. If you listen to Josette Sheeran, she will tell you how impossible the job is, because governments make promises on the never never, they don’t actually keep their funding promises in time, you’ll have to ship grain that could be bought elsewhere much closer to Africa, from Brazil, because cheques weren’t presented for the World Food Program to do its job. The politics of food is terrible. The patchiness of it is terrible. Often in countries of great hunger, there’s actually a harvest storage, over supply in another area of the country. One of the most important things you can do is actually build a bridge, a road, to allow there to be some coherence in dealing with this patchiness. But with a third speaker to come and a little bit of time for questions, let’s me leave it there. But say, joining dots, saying this is a morally serious crisis, that it goes to our humanity is really important and I want to thank you for coming out to this discussion.

#### Food security is concerning.

Emily Rauhala, staff writer for Time, June 1, 2011, “The Looming Food Crisis: Are the World’s Elites to Blame?” Time, http://world.time.com/2011/06/01/the-looming-global-food-crisis-are-the-worlds-elites-to-blame/#ixzz1yeiWfHLB

Julian Cribb’s The Coming Famine opens in Hokkaido, Japan, at a meeting of the G8. It’s 2008, the financial crisis is underway and food prices are soaring. Nonetheless, the attendees tuck into an eighteen course feast of caviar, sea urchin roe, Kyoto beef, conger eels, truffles and champagne, prepared by some sixty chefs. They also release a statement: “We are deeply concerned that the steep rise in global food prices coupled with availability problems in a number of developing countries is threatening global food security.” Of course, the G8 is not alone in its excess — or uniquely worthy of a critique. But I like the anecdote; It captures both the obscene inequality of the global food system and the ham-handed hypocrisy of the establishment response. “With eloquent symbolism, this Petronian banquet made clear that the well-off part of humanity has largely forgotten what it is to go hungry and is awakening to an unpleasant shock,” Cribb wrote. “Starvation and the wars, refugee crises, and collapse of nation-states that often accompany hunger have not been permanently banished after all.” It would be easy, and, indeed, quite reassuring, to dismiss his claims. I certainly bristled at the apocalyptic tone. But at least one new study, a 76-page report by Oxfam International, supports his assertion that a full-blown food crisis is underway — and that the world’s rich minority is, in no small part, to blame. Here, via The Source, is a summary of their findings: …Prices of staple foods will more than double in the next 20 years unless world leaders act now to avert climate change and reform the global food system. Importantly, the cost of key grains such as maize—an essential dietary component in the world’s least-developed continent, Africa—could rise by as much as 180%, with more than half of this rise due to the degrading effects of climate change. Other factors, including rising oil prices, the increasing diversion of crops for biofuels and scarcity of water are also expected to make the forecast 70% rise in production needed by 2050 to feed the world’s population even harder to meet. Oxfam says meeting these needs is impossible without “overhauling” the global food system. They’re calling, among other things, for limits on trading in agricultural futures (which they link to price jumps), ending the disproportionate influence of agro-businesses, and curbing subsidies for biofuels (which they credit with a move toward growing fuel over food) — all things that food experts, rights groups and the International Peasant Movement have been saying for years. Though radical change seems unlikely at present, the Oxfam report comes at a good time. Food factored heavily in this winter’s revolutions and prices are rising in Asia, Africa and the Middle East. Those unmoved by the plain fact of hunger, may well see the wisdom of heeding the Spanish proverb of which Cribb is fond: Lo que separa la civilización de la anarquía son solo siete comidas. ‘Civilization and anarchy are only seven meals apart.’

#### Food a concern now

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

With eloquent symbolism, this Petronian banquet made clear that the well-off part of humanity has largely forgotten what it is to go hungry and is awakening to an unpleasant shock: starvation and the wars, refugee crises, and collapse of nation-states that often accompany hunger have not been permanently banished after all. Indeed, they arc once more at our doorstep. Food insecurity and its deadly consequences are again a pressing concern for every nation and each individual. Despite the global food crisis of 2007—8, the coming famine- hasn’t happened yet. It’s a looming planetary emergency whose interlocked causes and deeper ramification the worId has barely begun to absorb, let alone come to grips with. Experts predict that the crisis will peak by the middle of the twenty-first century: it is arriving even faster than climate change. Yet there is still lime to forestall catastrophe.

#### Food shortages as bad as world market crashes

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

The first foreshocks were discernible soon after the turn of the millennium. In the years from 2001 to 2008 the worId steadily consumed more grain than it produced, triggering rising prices, growing shortages, and even rationing and famine in poorer countries. The global stockpile of grain shrank from more than a hundred days’ supply of food to less than fifty days’.5 It was the difference between a comfortable surplus and alarming shortages in some countries; it was accompanied by soaring prices—and the resulting fury of ordinary citizens. It was mainly this simple fact of each year consuming slightly more than we grew that panicked the long quiescent grain markets, triggering a cycle of price increases that sent shockwaves through consumers in all countries, government, and global institutions such as the United Nations, its FAO, and the World Bank. All of a sudden, food security, having been off the political menu for decades, was heading the bill of fare—not even to be entirely eclipsed by the spectacular crash of the world’s financial markets that followed soon afterward.

#### Unprepared for horror of food crisis

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

That the world was suddenly short if food—after almost a half century of abundance, extravagant variety, year-round availability, and the cheapest real food prices enjoyed by many consumers in the whole of human history—seemed unimaginable. On television, celebrity chefs extolled the virtue of devouring animals and plants increasingly rare in the wild; magazines larded their pages with mouth-watering recipes to tempt their overfed readers’ jaded appetites; food corporations churned out novel concoctions of salt, sugar, fat, emulsifier, extender, and dye; fast-food out lets disgorged floods of dubious nutrition to fatten an already overweight 1.4 billion people. And, in the third world, nearly fifteen thousand children continued to die quietly and painfully each day from hunger-related disease.4 “A brutal convergence of events has hit an unprepared global market, and grain prices are sky high. The world’s poor suffer most,” stated the Washington Post. “The food price shock now ruling world markets is destabilizing governments, igniting street riots, and threatening to send a new wave of hunger rippling through the world’s poorest nations. It is outpacing even the Soviet grain emergency of 1971-75, when world food prices rose 78 percent.” Between 2005 and 2008, food prices rose on average by 80 percent, according to the FAO.7

#### Fed key to impact GW

Oxfam International, June 2011, http://www.oxfam.org/sites/www.oxfam.org/files/cr-growing-better-future-170611-summ-en.pdf

Oxfam was created in 1942 in response to a food crisis. Seventy years on, the world faces another – this time one that threatens us all. The emergency of 1942 was caused by the Second World War; today’s crisis is the product of a grotesque global injustice. Nearly one billion people face hunger every day, while the unsustainable patterns of consumption and production from which they are excluded have placed us all on a collision course with our planet’s ecological limits. The warning signs are clear. We have entered an age of crisis: of food price spikes and oil price hikes; of scrambles for land and water; of creeping, insidious climate change. The 2008 spike in food prices pushed some 100 million people into poverty. Price rises so far in 2011 have done the same to 44 million more.1 These statistics mask millions of individual stories of suffering and heartbreak as families struggle to cope with deepening poverty. Households falling into debt. Mothers going without meals and healthcare. Elderly people abandoned. Hunger is the bellwether of a deeper malaise. Despite huge increases in productivity and incomes over recent decades, global hunger is on the rise. Despite an overwhelming scientific consensus on climate change and a robust economic basis for swift and decisive action, we continue pumping out more and more greenhouse gases. Despite advances in women’s rights and widespread acknowledgement of their key role in ensuring that families eat, women are routinely denied resources, their talents and leadership disallowed. Paralysis is imposed upon us by a powerful minority of vested interests that profit from the status quo. Self-serving elites who amass wealth at the expense of impoverished rural populations. Bloated biofuel lobbies, hooked on subsidies that divert food from mouths to cars. Dirty industries that block action on emissions. Shipping companies that overcharge for freighting emergency food aid, robbing both taxpayers and the very people for whom the aid is intended. Enormous agribusiness companies hidden from public view that function as global oligopolies, governing value chains, ruling markets, accountable to no one. Governments have largely failed to resist these interests – to prevent the capture of policy making, to stop the plunder of public resources, or to regulate powerful companies. And governments have neglected the needs of poor and vulnerable populations, especially those of women, demonstrating an alarming lack of will to address the drivers of hunger, inequality and ecological collapse. We now risk a wholesale reversal in human development. New research commissioned by Oxfam for the report ‘Growing a Better Future: Food justice in a resource constrained world’ forecasts real price rises for staple grains in the range of 120 to 180 per cent within the next two decades, as resource pressures mount and climate change takes hold. The CGIAR – world-leading group of agricultural research centres for developing countries – has an annual budget of $500m, less than half the $1.2bn spent on R&D by the multinational company Monsanto. Worldwide support for biofuels costs $20bn a year. It is estimated that three agribusiness firms – Cargill, Bunge and ADM – control nearly 90% of grain trading between them. Only 40 cents of every US taxpayer dollar spent on food aid actually goes to buying food. Procuring freighting of US food aid on the open market could help feed an additional 3.2 million people in emergencies. Between 1983 and 2006, the share of agriculture in aid fell from 20.4% to 3.7%. During this time rich country governments’ support to their own agricultural sectors spiraled to over $250bn a year – 79 times their agricultural aid. Oxfam’s Grow Campaign has a simple message: another future is possible, and we can build it together. Over the coming years, decisive action across the globe could enable hundreds of millions more people to feed their families and prevent catastrophic climate change from destroying their (and our) futures. But only if we collectively stop our sleepwalk towards ecological disaster. This campaign is Oxfam’s wakeup call. We must bring hope and opportunity to the nearly one billion people living in hunger today. Simultaneously, we must confront the looming disaster threatened by spiraling demand for food and an impending collision between the ecological systems that sustain life and the economic systems that sustain wealth. And we must remake an international regime that is unable to protect the most vulnerable. There are three challenges we must meet. The sustainable production challenge The food system must be transformed. By 2050, there will be 9 billion people on the planet and demand for food will have increased by 70 per cent. This demand must be met despite flatlining yields, increasing water scarcity, and growing competition over land. And agriculture must rapidly adapt to a changing climate and slash its carbon footprint. The amount of arable land per head has almost halved since 1960. Agriculture accounts for up to 30% of worldwide greenhouse gas emissions. The equity challenge We must also address the appalling inequities which plague the food system from farm to fork. We produce more food than we need. In the rich world, we throw much of it away. In the developing world, nearly one billion of us go without. Hunger and poverty are concentrated in rural areas. Unlocking the potential of smallholder agriculture – the backbone of the food system – represents our single biggest opportunity to increase food production, boost food security, and reduce vulnerability. Yet women and men food producers are routinely deprived of the resources they need to thrive: of water, technology, investment and credit, among others. Huge swathes of land in Africa and elsewhere are being handed over to investors at rock bottom prices, in deals that offer little to local communities. Consumers in rich countries may waste as much as a quarter of the food they buy. In more than half of industrialized countries, 50% or more of the population is overweight. 80% of recent land investments remain undeveloped. Providing women farmers with the same access to resources as men could increase their yields by 20–30%. The resilience challenge The food system is increasingly fragile. Oil price shocks are transmitted to food prices through fertilizer and transport costs. Weather events are disrupting supply. Speculative capital is blowing bubbles in commodity markets. Perhaps most shocking is the role of governments in triggering, rather than averting, food price crises. Policies of narrow self-interest and zero-sum competition such as grain-based biofuel programmes and export bans make a bad situation much, much worse. We must dramatically scale up our ability to collectively manage risks and build resilience to shocks and volatility. But the institutions needed to protect the most vulnerable are often inadequate or missing. 40% of the US corn crop ends up in gas tanks instead of stomachs. 4 people in every 5 lack access to social protection of any kind. In 2010, only 63% of UN emergency appeals were funded. A new prosperity Thankfully, the vast transformation needed is already underway – led by individuals, organizations and movements who have taken the future into their own hands. In Brazil, 20 years of activism from civil society and social movements challenged elites, expanded political horizons, and helped to elect politicians with vision and moral purpose. The result was a raft of policies to tackle hunger that delivered remarkable results. Viet Nam has achieved comparable results through land reform and an ambitious programme of investment in smallholder agriculture. In Canada, a concerted public campaign including Oxfam succeeded in untying food aid. Consumers increasingly demand products that are sourced ethically and sustainably. Campaigns on climate change in developed and developing countries have helped galvanize politicians and responsible businesses, upping the pressure on companies that would block ambitious action. These victories, and others like them, point the way to a new prosperity beyond the age of crisis. An era in which we properly value the environment and share the world’s resources fairly. Where governments resist vested interests and instead direct public resources toward public goods, regulating markets in the interests of the many. Where businesses cannot profit from plundering our resource base, but instead find healthy returns from developing solutions to the challenges we face. Where everyone has access to the resources they need to feed themselves and their families. The scale of the challenge is great. A step change is needed if we are to build the new prosperity before the planet is wrecked beyond repair. We need three big shifts: in dealing with crises, in remaking agriculture, and in coming to terms with our environment. Viet Nam achieved the first Millennium Goal – to halve hunger – five years ahead of schedule. In 2009 the USA and Europe added more power capacity from renewables like wind and solar than from conventional sources like coal, gas and nuclear. In 2009 Apple and Nike publicly left the US Chamber of Commerce in protest against its refusal to back US climate legislation. Build a new global governance to avert food crises Governments’ top priority must be to tackle hunger and reduce vulnerability. They must build resilience by creating jobs, adapting to climate change, investing in disaster risk reduction, and extending social protection. We must manage trade to manage risk by building a system of food reserves; increasing transparency in commodities markets; setting rules on export restrictions; and finally putting an end to trade-distorting agricultural subsidies. Financial speculation must be regulated, and support dismantled for biofuels that displace food. And we must reform the international institutions we need to respond to shocks. Food aid must be untied, and the international community must move to a system of 100 per cent funding for emergencies via upfront ‘assessed contributions’. A new global climate fund to finance adaptation in developing countries must be established and funded. Build a new agricultural future The vast imbalance in public investment in agriculture must be righted, redirecting the billions now being ploughed into unsustainable industrial farming in rich countries towards meeting the needs of small-scale food producers in developing countries. For that is where the major gains in productivity, sustainable intensification, poverty reduction, and resilience can be achieved. Donors and international organizations must continue to raise spending on agriculture within overall development assistance and invest in agricultural adaptation. New global regulations are needed to govern investment in land to ensure it delivers social and environmental returns. And national governments must provide public support for small-scale sustainable agriculture, while carefully regulating private investment in land and water to ensure secure access for women and men living in poverty. Companies too must embrace the opportunities offered by smallholder agriculture: to diversify and secure supply; to meet growing demand from consumers concerned with sustainable development; to develop new technologies. And active states must intervene where companies fear to tread: to direct R&D towards the right technologies for poor women and men producers; to help them sell their produce on decent terms; to support them with training; and to provide access to finance. Hunger fell by one-third in Brazil between 2000 and 2007. Build a new ecological future The race to a sustainable future is on, and there will be huge opportunities for those who get there first. National governments must intervene to speed up and direct the transition. They must invest in public goods such as R&D in clean energy. They must create incentives through subsidies and tax breaks to guide private capital to where it is needed. They must tax undesirables – such as greenhouse gas emissions – to direct economic activity towards desirable alternatives. And they must regulate to stop companies polluting and to encourage them to provide goods and services they otherwise would not. Ultimately our success or failure in building a new ecological future will depend on political leaders agreeing a fair and ambitious global deal on climate change. How we get there The scale of the challenge is unprecedented, but so is the prize: a sustainable future in which everyone has enough to eat. Reaching the new prosperity in time will take all the energy, ingenuity and political will that humankind can muster. To build new governance institutions, invest in smallholder agriculture and reduce global greenhouse gas emissions, we must first overcome the vested interests that have paralysed the political process until now. The new prosperity will have to be built simultaneously from the top down and from the bottom up. From the top, ambitious leaders will drive success. Political leaders will resist special interests, inspire their citizens and mobilise support across government to regulate, correct, protect and invest in the interests of the many. Corporate leaders will break ranks with damaging industry lobbies, strengthening the will of politicians and governments genuinely committed to change. They will embrace progressive regulation rather than seek to undermine it or water it down. They will cease to impose their social and environmental costs on others and will flourish by finding ways to make the most of scarce resources, responding to consumer demands and public pressure. From the bottom, networks of citizens, consumers, producers, communities, social movements and civil society organizations will demand change from governments and companies – shifting political and business incentives through the decisions they take and the choices they make. Whether through leading lowcarbon lifestyles, buying Fair Trade goods, or demanding change in the streets or through the ballot box. Oxfam’s campaign will work with these groups, and many others like them, to amass irresistible momentum for change. Together we will challenge the current order and set a path towards a new prosperity. Action for 2011 There is no time to waste, and 2011 provides crucial opportunities. When the G20 leaders meet in November, they will decide whether and how to manage food prices and govern markets in order to protect against future food crises. They must increase transparency in commodities and futures markets, scale up food reserves, regulate financial speculators, and agree innovative market-based mechanisms to raise climate finance, such as a financial transactions tax or levies on international aviation and shipping fuels. When the world’s climate negotiators reconvene in Durban at the end of 2011, they must get the global climate fund that was agreed in 2010 up and running, put women on its board, and ensure it has enough cash to spend, either from new forms of finance or as direct contributions from governments. When the Committee on World Food Security meets in October, it must agree to regulate large-scale land acquisitions to ensure that people living in poverty have secure access to natural resources. As donor governments renegotiate the Food Aid Convention, they must agree to untie food aid, prising it from the clutches of vested interests and at a stroke increasing its efficiency, timeliness, effectiveness and reach. And there are actions that all governments must take today to build resilience at home and begin the transition towards a new agricultural future. In particular, governments should reduce hunger by providing women with equal access to resources, by promoting sustainable agricultural development, job creation and inclusive growth, and by tackling vulnerability via climate adaptation, social protection and disaster risk reduction.

#### Government needed

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

Rocketing food prices—some of which have more than doubled in two years—have sparked riots in numerous countries recently,” Time magazine reported. “Millions are reeling... and governments are scrambling to staunch a fast-moving crisis before it spins out of control. From Mexico to Pakistan, protests have turned violent.” Time attributed events to booming demand from newly affluent Chinese and Indian consumers, freak weather events that had reduced harvests, the spike in oil prices, and growth in the production of farm biofuels.8 In early 2007, thousands of Mexicans turned out on the streets in protest over the “tortilla crisis”—savage increases in the cost of maize flour. Over the ensuing months food riots or public unrest over food prices were reported by media in Haiti, Malaysia, Indonesia, the Philippines, Bangladesh, India, Burkina Faso, Senegal, Cameroon, Morocco, Mauritania, Somalia, Ethiopia, Madagascar, Kenya, Egypt, Ivory Coast, Yemen, the United Arab Emirates, Mexico, and Zimbabwe. In Haiti riots forced the resignation of the prime minister and obliged the United Nations World Food Programme to provide emergency aid to 2.3 million people. The new government of Nepal tottered. Mexico announced plans to freeze the prices of 150 staple foods. The U.K. Guardian reported riots in fifteen countries; the New York Times and the World Bank both said thirty. The FAO declared that thirty-seven countries faced food crises due to conflict or disaster at the start of 2008, adding that 1.5 billion people living in degraded lands were at risk of starvation. The Economist magazine succinctly labeled it a “silent tsunami.”9 The rhetoric reflected the sudden, adventitious nature of the crisis. “It is an apocalyptic warning,” pronounced Tim Costello, the Australian head of the aid agency World Vision. “Until recently we had plenty of food: the question was distribution. The truth is because of rising oil prices, global warming and the loss of arable land, all countries that can produce food now desperately need to produce more.”10 “What we are witnessing is not a natural disaster—a silent tsunami or a perfect storm. It is a man-made catastrophe,” the World Bank group president Robert Zoellick advised the G8 leaders feasting in Japan. Major rice-growing countries, including India, Vietnam, China, and Cambodia, imposed export restrictions to curb rice price inflation at home. Malaysia, Singapore, Sri Lanka, and the Philippines began stockpiling grain while Pakistan and Russia raised wheat export taxes and Brazil, Indonesia, and Argentina imposed export restrictions. Guinea banned all food exports.’’ The panic reached a peak in Asia, where rice prices soared by almost 150 percent in barely a year. “Nobody has ever seen such a jump in the price of rice,” said sixty-eight-year-old Kwanchai Gomez, the executive director of the Thai Rice Foundation. Filipino fast-food outlets voluntarily reduced customer portions by half. In Thailand, thieves secretly stripped rice paddies by night to make a fast profit. India banned the export of all non-basmati rice, and Vietnam embargoed rice exports, period, sending Thai rice prices spiraling upward by 30 percent. The giant ILS retailer Wal-Mart rationed rice sales to customers of its Sam’s Club chain; some British retailers did likewise. Such measures did little to quell the panic, which was originally touched off by a 50 percent drop in surplus rice stocks over the previous seven years. The International Rice Research Institute attributed the crisis to loss of land to industrialization and city sprawl, the growing demand for meat in China and India, and floods or had weather in Indonesia, Bangladesh, Vietnam, China, and Burma.’2

#### Food crisis will drastically effect the entire planet.

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR\_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false

By mid-2009 accelerated by the worldwide financial crash, thirty-three Countries around the world were facing either “alarming” or “extremely alarming” food shortages, a billion people were eating less each day’3—and most of Earth’s citizens were feeling the pinch. Though food prices fell, alongside prices of stocks and most other commodities, in the subsequent months, they fell only a little—and then began to rise again. What happened in 2008 wasn’t the coming famine of the twenty-first century, merely a premonition of what lies ahead. This will not be a single event, affecting all nations and peoples equally at all times, but in one way or another it will leave no person in the world untouched. The reemergence of food scarcity occurs after decades of plenty, accompanied by the lowest real food prices for consumers in history. These bounteous years were the consequence of a food production miracle achieved by the world’s farmers and agricultural scientists from the 1960s on—a miracle of which the urbanized world of today seems largely oblivious and which we have forgotten to renew.

## SO2 Screw DA

### SO2 Screw DA 1NC

#### Emissions cuts cause massive fast warming spikes and makes warming worse in the long run — S02 creates a cooling effect that cancels out warming

New Scientist, 7-24-2004

As well as pumping gases into the atmosphere, we are also filling it with huge volumes of microscopic particles, mostly from burning forests, crop waste and fossil fuels. Depending on their characteristics, these aerosols can scatter or absorb solar radiation and may influence the formation, colour and reflectivity of clouds. The precise nature of their involvement in global temperature has been hotly disputed for a decade. But most researchers now believe that the dominant effect of these aerosols is to suppress warming by shading the planet. “We are dealing with a coiled spring with temperatures being held back by aerosols,” says Solomon. “If you shutoff aerosols, temperatures would increase rapidly, but we don’t yet know exactly how coiled the spring is.” The best guess until recently was that this “parasol effect” was holding back a quarter of the warming so far, or about 0.2 degrees C. But critics say this calculation is little more than a guess. The first efforts at directly measuring the parasol effects suggest the spring maybe much more tightly coiled In an assessment last year, Nobel prize winning atmospheric chemist Paul Crutzen argued that aerosols could be disguising between half and three-quarters of present warming. That suggests the coiled spring is already holding back warming of anything up to 2 degrees C. “The two major pollutants have been almost cancelling each other out” says Cox. This is doubly bad news, first because it shows that cleaning up aerosols, would release a burst of warming. But secondly, it suggests that the climate system is much more sensitive to greenhouse gases than we thought. Crutzen’s estimate would put the true warming effect of doubling C02 at between 7 and 10 degrees C, which Murphy’s graph predicts, albeit at a low probability.

### SO2 Screw Links

#### Emissions cuts cause massive fast warming spikes and makes warming worse in the long run – SO2 creates a cooling effect that cancels out warming.

David Sington, Writer for the BBC, 1/14/2005 “Why the Sun seems to be 'dimming'”, BBC, http://news.bbc.co.uk/2/hi/science/nature/4171591.stm

Perhaps the most alarming aspect of global dimming is that it may have led scientists to underestimate the true power of the greenhouse effect. They know how much extra energy is being trapped in the Earth's atmosphere by the extra carbon dioxide we have placed there. What has been surprising is that this extra energy has so far resulted in a temperature rise of just 0.6 degree Celsius. This has led many scientists to conclude that the present-day climate is less sensitive to the effects of carbon dioxide than it was, say, during the ice age, when a similar rise in CO2 led to a temperature rise of six degrees Celsius. But it now appears the warming from greenhouse gases has been offset by a strong cooling effect from dimming - in effect two of our pollutants have been cancelling each other out. This means that the climate may in fact be more sensitive to the greenhouse effect than previously thought. If so, then this is bad news, according to Dr. Peter Cox, one of the world's leading climate modellers. As things stand, CO2 levels are projected to rise strongly over coming decades, whereas there are encouraging signs that particle pollution is at last being brought under control. "We're going to be in a situation unless we act where the cooling pollutant is dropping off while the warming pollutant is going up. "That means we'll get reducing cooling and increased heating at the same time and that's a problem for us," says Dr Cox. Even the most pessimistic forecasts of global warming may now have to be drastically revised upwards.

#### SO2 causes cooling in the short term – plan would cause spikes

Chris Mooney, U.S. scientific and political journalist and academic, 28/06/2008 Wired magazine, “Can a million tons of Sulfur Dioxide combat climate change?” http://www.wired.com/science/planetearth/magazine/16-07/ff\_geoengineering?currentPage=all

The heating potential of solar-energy absorbing gases such as SO2 and O3 in concentrations of tens of parts per billion is well observed in several ways:

1. Ozone absorbs enough solar energy to heat and form the stratosphere.

2. SO2 in the stratosphere forms aerosols that have major effects on the atmosphere by

reflecting sunlight, cooling the earth ~0.5oC for ~3 years, and absorbing sunlight, raising the temperature of the lower stratosphere ~3oC for more than a year.

Between 1979 and 2000, humans decreased SO2 emissions 18% in an effort to reduce acid rain. The rate of increase in global temperatures and concentrations of methane decreased to zero by 1998. Temperatures have been relatively constant for 12 years while concentrations of CO2 have continued to rise at a constant rate. Clearly global mean surface temperatures are not a direct function of CO2 concentrations as is assumed in most atmospheric models.

#### SO2 causes cooling – aerosol effect

USGS, National Survey Team, 1997. “volcanic plumes”, National Geological Survey, http://volcanoes.usgs.gov/hazards/gas/index.php

Measurements from recent eruptions such as Mount St. Helens, Washington, El Chichon, Mexico, and Mount Pinatubo, and the Philippines, clearly show the importance of sulfur aerosols in modifying climate, warming the stratosphere, and cooling the troposphere. Sulfur dioxide (SO2) condenses rapidly in the stratosphere to form fine sulfate aerosols. The aerosols increase the reflection of radiation from the Sun back into space and thus cool the Earth's lower atmosphere or troposphere; however, they also absorb heat radiated up from the Earth, thereby warming the stratosphere.

## Ice Age DA

### Ice Age DA 1NC

#### CO2 Emissions are key to stop the coming ice age

ScienceDaily, 8-30-2007, “Next Ice Age Delayed By Rising Carbon Dioxide Levels,” http://www.sciencedaily.com/releases/2007/08/070829193436.htm

ScienceDaily (Aug. 30, 2007) — Future ice ages may be delayed by up to half a million years by our burning of fossil fuels. That is the implication of recent work by Dr Toby Tyrrell of the University of Southampton's School of Ocean and Earth Science at the National Oceanography Centre, Southampton. Arguably, this work demonstrates the most far-reaching disruption of long-term planetary processes yet suggested for human activity. Dr Tyrrell's team used a mathematical model to study what would happen to marine chemistry in a world with ever-increasing supplies of the greenhouse gas, carbon dioxide. The world's oceans are absorbing CO2 from the atmosphere but in doing so they are becoming more acidic. This in turn is dissolving the calcium carbonate in the shells produced by surface-dwelling marine organisms, adding even more carbon to the oceans. The outcome is elevated carbon dioxide for far longer than previously assumed. Computer modelling in 2004 by a then oceanography undergraduate student at the University, Stephanie Castle, first interested Dr Tyrrell and colleague Professor John Shepherd in the problem. They subsequently developed a theoretical analysis to validate the plausibility of the phenomenon. The work, which is part-funded by the Natural Environment Research Council, confirms earlier ideas of David Archer of the University of Chicago, who first estimated the impact rising CO2 levels would have on the timing of the next ice age. Dr Tyrrell said: 'Our research shows why atmospheric CO2 will not return to pre-industrial levels after we stop burning fossil fuels. It shows that it if we use up all known fossil fuels it doesn't matter at what rate we burn them. The result would be the same if we burned them at present rates or at more moderate rates; we would still get the same eventual ice-age-prevention result.' Ice ages occur around every 100,000 years as the pattern of Earth's orbit alters over time. Changes in the way the sun strikes the Earth allows for the growth of ice caps, plunging the Earth into an ice age. But it is not only variations in received sunlight that determine the descent into an ice age; levels of atmospheric CO2 are also important. Humanity has to date burnt about 300 Gt C of fossil fuels. This work suggests that even if only 1000 Gt C (gigatonnes of carbon) are eventually burnt (out of total reserves of about 4000 Gt C) then it is likely that the next ice age will be skipped. Burning all recoverable fossil fuels could lead to avoidance of the next five ice ages.

#### Ice age outweighs all other impacts

William H. Calvin, is a theoretical neurophysiologist at the University of Washington in Seattle, the author of such books as How Brains Think and The Cerebral Code. Some background is in the Atlantic Monthly Editor's Column. June 14, 2005. “The Great Climate Flip-Flop” <http://standeyo.com/Reports/Ice_age/050614.ice.age.html>

FUTURISTS have learned to bracket the future with alternative scenarios, each of which captures important features that cluster together, each of which is compact enough to be seen as a narrative on a human scale. Three scenarios for the next climatic phase might be called population crash, cheap fix, and muddling through. The population-crash scenario is surely the most appalling. Plummeting crop yields will cause some powerful countries to try to take over their neighbors or distant lands ˜ if only because their armies, unpaid and lacking food, will go marauding, both at home and across the borders. The better-organized countries will attempt to use their armies, before they fall apart entirely, to take over countries with significant remaining resources, driving out or starving their inhabitants if not using modern weapons to accomplish the same end: eliminating competitors for the remaining food. This will be a worldwide problem ˜ and could easily lead to a Third World War ˜ but Europe's vulnerability is particularly easy to analyze. The last abrupt cooling, the Younger Dryas, drastically altered Europe's climate as far east as Ukraine. Present-day Europe has more than 650 million people. It has excellent soils, and largely grows its own food. It could no longer do so if it lost the extra warming from the North Atlantic. There is another part of the world with the same good soil, within the same latitudinal band, which we can use for a quick comparison. Canada lacks Europe's winter warmth and rainfall, because it has no equivalent of the North Atlantic Current to preheat its eastbound weather systems. Canada's agriculture supports about 28 million people. If Europe had weather like Canada's, it could feed only one out of twenty-three present-day Europeans. Any abrupt switch in climate would also disrupt food-supply routes. The only reason that two percent of our population can feed the other 98 percent is that we have a well-developed system of transportation and middlemen ˜ but it is not very robust. The system allows for large urban populations in the best of times, but not in the case of widespread disruptions. Natural disasters such as hurricanes and earthquakes are less troubling than abrupt coolings for two reasons: they're short (the recovery period starts the next day) and they're local or regional (unaffected citizens can help the overwhelmed). There is, increasingly, international cooperation in response to catastrophe ˜ but no country is going to be able to rely on a stored agricultural surplus for even a year, and any country will be reluctant to give away part of its surplus. In an abrupt cooling the problem would get worse for decades, and much of the earth would be affected. A meteor strike that killed most of the population in a month would not be as serious as an abrupt cooling that eventually killed just as many. With the population crash spread out over a decade, there would be ample opportunity for civilization's institutions to be torn apart and for hatreds to build, as armies tried to grab remaining resources simply to feed the people in their own countries. The effects of an abrupt cold last for centuries. They might not be the end of Homo sapiens ˜ written knowledge and elementary education might well endure ˜ but the world after such a population crash would certainly be full of despotic governments that hated their neighbors because of recent atrocities. Recovery would be very slow.

### Yes Ice Age

#### Brink Now – next sun cycle weakest in over 300 years.

David Rose, writer for dailymail.co.uk , January 29th 2012, “Forget global warming – it’s Cycle 25 we need to worry about (and if NASA scientists are right the Thames will be freezing over again)” Science http://www.dailymail.co.uk/sciencetech/article-2093264/Forget-global-warming--Cycle-25-need-worry-NASA-scientists-right-Thames-freezing-again.html

The supposed ‘consensus’ on man-made global warming is facing an inconvenient challenge after the release of new temperature data showing the planet has not warmed for the past 15 years. The figures suggest that we could even be heading for a mini ice age to rival the 70-year temperature drop that saw frost fairs held on the Thames in the 17th Century. Based on readings from more than 30,000 measuring stations, the data was issued last week without fanfare by the Met Office and the University of East Anglia Climatic Research Unit. It confirms that the rising trend in world temperatures ended in 1997. Meanwhile, leading climate scientists yesterday told The Mail on Sunday that, after emitting unusually high levels of energy throughout the 20th Century, the sun is now heading towards a ‘grand minimum’ in its output, threatening cold summers, bitter winters and a shortening of the season available for growing food. Solar output goes through 11-year cycles, with high numbers of sunspots seen at their peak. We are now at what should be the peak of what scientists call ‘Cycle 24’ – which is why last week’s solar storm resulted in sightings of the aurora borealis further south than usual. But sunspot numbers are running at less than half those seen during cycle peaks in the 20th Century. Analysis by experts at NASA and the University of Arizona – derived from magnetic-field measurements 120,000 miles beneath the sun’s surface – suggest that Cycle 25, whose peak is due in 2022, will be a great deal weaker still. According to a paper issued last week by the Met Office, there is a 92 per cent chance that both Cycle 25 and those taking place in the following decades will be as weak as, or weaker than, the ‘Dalton minimum’ of 1790 to 1830. In this period, named after the meteorologist John Dalton, average temperatures in parts of Europe fell by 2C. However, it is also possible that the new solar energy slump could be as deep as the ‘Maunder minimum’ (after astronomer Edward Maunder), between 1645 and 1715 in the coldest part of the ‘Little Ice Age’ when, as well as the Thames frost fairs, the canals of Holland froze solid. Yet, in its paper, the Met Office claimed that the consequences now would be negligible – because the impact of the sun on climate is far less than man-made carbon dioxide. Although the sun’s output is likely to decrease until 2100, ‘This would only cause a reduction in global temperatures of 0.08C.’ Peter Stott, one of the authors, said: ‘Our findings suggest a reduction of solar activity to levels not seen in hundreds of years would be insufficient to offset the dominant influence of greenhouse gases.’ These findings are fiercely disputed by other solar experts. ‘World temperatures may end up a lot cooler than now for 50 years or more,’ said Henrik Svensmark, director of the Center for Sun-Climate Research at Denmark’s National Space Institute. ‘It will take a long battle to convince some climate scientists that the sun is important. It may well be that the sun is going to demonstrate this on its own, without the need for their help.’ He pointed out that, in claiming the effect of the solar minimum would be small, the Met Office was relying on the same computer models that are being undermined by the current pause in global-warming. CO2 levels have continued to rise without interruption and, in 2007, the Met Office claimed that global warming was about to ‘come roaring back’. It said that between 2004 and 2014 there would be an overall increase of 0.3C. In 2009, it predicted that at least three of the years 2009 to 2014 would break the previous temperature record set in 1998. So far there is no sign of any of this happening. But yesterday a Met Office spokesman insisted its models were still valid. ‘The ten-year projection remains groundbreaking science. The period for the original projection is not over yet,’ he said. Dr Nicola Scafetta, of Duke University in North Carolina, is the author of several papers that argue the Met Office climate models show there should have been ‘steady warming from 2000 until now’. ‘If temperatures continue to stay flat or start to cool again, the divergence between the models and recorded data will eventually become so great that the whole scientific community will question the current theories,’ he said. He believes that as the Met Office model attaches much greater significance to CO2 than to the sun, it was bound to conclude that there would not be cooling. ‘The real issue is whether the model itself is accurate,’ Dr Scafetta said. Meanwhile, one of America’s most eminent climate experts, Professor Judith Curry of the Georgia Institute of Technology, said she found the Met Office’s confident prediction of a ‘negligible’ impact difficult to understand. ‘The responsible thing to do would be to accept the fact that the models may have severe shortcomings when it comes to the influence of the sun,’ said Professor Curry. As for the warming pause, she said that many scientists ‘are not surprised’. She argued it is becoming evident that factors other than CO2 play an important role in rising or falling warmth, such as the 60-year water temperature cycles in the Pacific and Atlantic oceans. ‘They have insufficiently been appreciated in terms of global climate,’ said Prof Curry. When both oceans were cold in the past, such as from 1940 to 1970, the climate cooled. The Pacific cycle ‘flipped’ back from warm to cold mode in 2008 and the Atlantic is also thought likely to flip in the next few years . Pal Brekke, senior adviser at the Norwegian Space Centre, said some scientists found the importance of water cycles difficult to accept, because doing so means admitting that the oceans – not CO2 – caused much of the global warming between 1970 and 1997. The same goes for the impact of the sun – which was highly active for much of the 20th Century. ‘Nature is about to carry out a very interesting experiment,’ he said. ‘Ten or 15 years from now, we will be able to determine much better whether the warming of the late 20th Century really was caused by man-made CO2, or by natural variability.’ Meanwhile, since the end of last year, world temperatures have fallen by more than half a degree, as the cold ‘La Nina’ effect has re-emerged in the South Pacific. ‘We’re now well into the second decade of the pause,’ said Benny Peiser, director of the Global Warming Policy Foundation. ‘If we don’t see convincing evidence of global warming by 2015, it will start to become clear whether the models are bunk. And, if they are, the implications for some scientists could be very serious.’

#### The world is about to enter another ice age

George Kukla, 6-15-2007, PhD micropalentologist and Special Research Scientist at the Lamont-Doherty Earth Observatory of Columbia University, “Forget Warming Beware the Next Ice Age,” http://www.iceagenow.com/Beware\_The\_Next\_Ice\_Age.htm

In the 1970s, leading scientists claimed that the world was threatened by an era of global cooling. Based on what we've learned this decade, says George Kukla, those scientists - and he was among them -- had it right. The world is about to enter another Ice Age. Dr. Kukla, in 1972 a member of the Czechoslovakian Academy of Sciences and a pioneer in the field of astronomical forcing, became a central figure in convincing the United States government to take the dangers of climate change seriously. In January of that year, he and another geologist, Robert Matthews of Brown University, convened what would become a historic conference of top European and American investigators in Providence, R.I. The working conference's theme: "The Present Interglacial: How and When will it End?" Many today speak with derision of the 1970s global-cooling scare, seeing it as a cautionary false alarm. Others see it as an embarrassment -- Newsweek magazine, which published a 1975 article entitled "The Cooling World," even corrected the record with a 2006 follow-up to its 1975 article arguing that scientists now have it right. Dr. Kukla sees it -- and the 1975 Newsweek article -- differently. Although the magazine article indicated that the cooling trend would be continuous, scientists knew otherwise. "None of us expected uninterrupted continuation of the trend," he states. Moreover, thanks to new evidence that Dr. Kukla only recently published, he now knows that global warming always precedes an ice age. That makes the current period of global warming a mere blip that constitutes additional indication of the ice age to come. To Dr. Kukla, the fundamental issue here could not be more clear. For millions of years, the geologic record shows, Earth has experienced an ongoing cycle of ice ages, each typically lasting about 100,000 years, and each punctuated by briefer, warmer periods called interglacials, such as the one we are now in. This ongoing cycle closely matches cyclic variations in Earth's orbit around the sun.

#### Ice Age is coming in 20 years

Theodore Landscheidt, PhD, Founder of the Schroeter Institute for Research in Cycles of Solar Activity, 2003 “New Little Ice Age Instead of Global Warming?,” http://bourabai.narod.ru/landscheidt/new-e.htm

Analysis of the sun's activity in the last two millennia indicates that, contrary to the IPCC's speculation about man-made global warming, that we could be headed into a Maunder minimum type of climate (a Little Ice Age). The probability is high that the minima around 2030 and 2201 will go along with periods of cold climate comparable to the nadir of the Little Ice Age, and La Niñas will be more frequent and stronger than El Niños through 2018 (Landscheidt, 2000). We need not wait until 2030 to see whether the forecast is correct, however. A declining trend in solar activity and global temperature should become manifest long before then. The current 11-year sunspot cycle 23 with its considerably weaker activity seems to be a first indication of the new trend, especially as it was predicted on the basis of solar motion cycles two decades ago. As to temperature, only El Niño periods should interrupt the downward trend, but even El Niños should become less frequent and strong. The total magnetic flux leaving the Sun has risen by a factor of 2.3 since 1901 while global temperature on earth increased by about 0.6°C. Energetic flares increased the Sun's ultraviolet radiation by at least 16 percent. There is “a clear connection between solar eruptions and a strong rise in temperature.” Lake bottom cores from the Yukatan Peninsula covering more than 2,000 years show a similar correlation between recurrent droughts and the Sun's eruptional activity. These results and many earlier ones (Landscheidt, 1981-2001) document the importance of the Sun's eruptional activity on climate. Energetic solar eruptions do not accumulate around the sunspot maximum. In most cycles they shun the maximum phase and can even occur close to a sunspot minimum. I (Landscheidt) have shown for decades that the sun's varying activity is linked to cycles in its irregular oscillation about the centre of mass of the solar system (the solar retrograde cycle). As these cycles are connected with climate phenomena and can be computed for centuries, they offer a means to forecast phases of cool and warm climate. Researchers need to take the sun seriously as a factor in climate change, including warming, droughts, and cold snaps.

#### Brink Now for the ice age

Gregory F. Fegel, a writing and editing professional for pravada.ru, a Russian news organization. November 1st 2009, “Earth on the Brink of an Ice Age” http://english.pravda.ru/science/earth/11-01-2009/106922-earth\_ice\_age-1/

The graph of the Vostok ice core data shows that the Ice Age maximums and the warm interglacials occur within a regular cyclic pattern, the graph-line of which is similar to the rhythm of a heartbeat on an electrocardiogram tracing. The Vostok data graph also shows that changes in global CO2 levels lag behind global temperature changes by about eight hundred years. What that indicates is that global temperatures precede or cause global CO2 changes, and not the reverse. In other words, increasing atmospheric CO2 is not causing global temperature to rise; instead the natural cyclic increase in global temperature is causing global CO2 to rise. The reason that global CO2 levels rise and fall in response to the global temperature is because cold water is capable of retaining more CO2 than warm water. That is why carbonated beverages loose their carbonation, or CO2, when stored in a warm environment. We store our carbonated soft drinks, wine, and beer in a cool place to prevent them from loosing their ‘fizz’, which is a feature of their carbonation, or CO2 content. The earth is currently warming as a result of the natural Ice Age cycle, and as the oceans get warmer, they release increasing amounts of CO2 into the atmosphere. Because the release of CO2 by the warming oceans lags behind the changes in the earth’s temperature, we should expect to see global CO2 levels continue to rise for another eight hundred years after the end of the earth’s current Interglacial warm period. We should already be eight hundred years into the coming Ice Age before global CO2 levels begin to drop in response to the increased chilling of the world’s oceans. The Vostok ice core data graph reveals that global CO2 levels regularly rose and fell in a direct response to the natural cycle of Ice Age minimums and maximums during the past four hundred and twenty thousand years. Within that natural cycle, about every 110,000 years global temperatures, followed by global CO2 levels, have peaked at approximately the same levels which they are at today. Today we are again at the peak, and near to the end, of a warm interglacial, and the earth is now due to enter the next Ice Age. If we are lucky, we may have a few years to prepare for it. The Ice Age will return, as it always has, in its regular and natural cycle, with or without any influence from the effects of AGW. The AGW theory is based on data that is drawn from a ridiculously narrow span of time and it demonstrates a wanton disregard for the ‘big picture’ of long-term climate change. The data from paleoclimatology, including ice cores, sea sediments, geology, paleobotany and zoology, indicate that we are on the verge of entering another Ice Age, and the data also shows that severe and lasting climate change can occur within only a few years. While concern over the dubious threat of Anthropogenic Global Warming continues to distract the attention of people throughout the world, the very real threat of the approaching and inevitable Ice Age, which will render large parts of the Northern Hemisphere uninhabitable, is being foolishly ignored.

#### Ice age coming – glacial growth

Laurence Hecht, editor of 21st century Science & Technology, 2005 “Is a new ice age underway?,” 21st century science and technology magazine, [http://www.21stcenturysciencetech.com/articles/Ice\_Age.html /](http://www.21stcenturysciencetech.com/articles/Ice_Age.html%20/)

“Watch out, Al Gore. The glaciers will get you!” With that appended note, my friend, retired field geologist Jack Sauers, forwarded to me a report that should have been a lead item in every newspaper in the world. It was the news that the best-measured glacier in North America, the Nisqually on Mount Rainier, has been growing since 1931. The significance of the fact, immediately grasped by any competent climatologist, is that glacial advance is an early warning sign of Northern Hemisphere chilling of the sort that can bring on an Ice Age. The last Little Ice Age continued from about 1400 to 1850. It was followed by a period of slight warming. There are a growing number of signs that we may be descending into another Little Ice Age—all the mountains of “global warming” propaganda aside. Our current understanding of the long-term climate cycles shows that for the past 800,000 years, periods of approximately 100,000 years’ duration, called Ice Ages, have been interrupted by periods of approximately 10,000 years, known as Interglacials. (We are now about 10,500 years into the present Interglacial.)

### Ice Age DA Links

#### Warming holds off Ice Age

Mason Inman, , November 12 2008, “New ice Age Predicted – But Averted By Global Warming?” National Geographic News <http://news.nationalgeographic.com/news/pf/29078080.html>

Deep ice sheets would cover much of the Northern Hemisphere thousands of years from now—if it weren't for us pesky humans, a new study says. Emissions of greenhouse gases—such as the carbon dioxide, or CO2, that comes from power plants and cars—are heating the atmosphere to such an extent that the next ice age, predicted to be the deepest in millions of years, may be postponed indefinitely (quick guide to the greenhouse effect). "Climate skeptics could look at this and say, CO2 is good for us," said study leader Thomas Crowley of the University of Edinburgh in Scotland. But the idea that global warming may be staving off an ice age is "not cause for relaxing, because we're actually moving into a highly unusual climate state," Crowley added. In about 10,000 to 100,000 years, the study suggests, Antarctic-like "permanent" ice sheets would shroud much of Canada, Europe, and Asia. "I think the present [carbon dioxide] levels are probably sufficient to prevent that from ever happening," said Crowley, whose study will appear tomorrow in the journal Nature. Permanent Ice Sheets? For the past three million years, Earth's climate has wobbled through dozens of ice ages, with thick ice sheets growing from the poles and then shrinking back again. These ice ages used to last roughly 41,000 years. But in the past half a million years, these big freezes each stretched to about a hundred thousand years long. Meanwhile, the temperature swings during and between these ice ages became more extreme, soaring to new highs and lows. These extreme climate swings don't appear to be easing anytime soon, according to evidence recorded in Earth's rocks, Crowley said. "The latest two glaciations were two of the biggest we've seen." The increasing variability is a sign that Earth's climate will soon move into a new state, according to a computer model used by Crowley and a colleague, William Hyde of the University of Toronto in Canada. They had previously used the model to simulate past ice ages. The researchers found that between 10,000 and 100,000 years from now, Earth would enter into a period of permanent ice sheets—more severe than any seen in millions of years. In some ways the ice age would be like those in the past few hundred thousand years, with a thick ice sheet covering North America, the study predicted. But in the model, Europe and Asia also succumbed to ice sheets up to 2 miles (3.5 kilometers) thick, stretching from England to Siberia—something never before seen in models of past ice ages. "We were surprised," Crowley said. "There's no evidence for this in Asia" during ice ages in the past few million years. Hard to Know Though this extreme ice age would be unusual, so is the climate that people are creating by emitting huge amounts of greenhouse gases, Crowley said (global warming fast facts). "It's hard to say what's going to happen," Crowley said. "The very fact that you have this nonglacial [warming] atmosphere with polar ice caps [still present], presents a bizarre scenario. "I don't know that we have a comparable analogy for it in the geologic record." Prehistoric-climate expert Lorraine Lisiecki said, "This is the only study of which I am aware that suggests the next ice age could be much more extreme than those of the previous one million years." Many more tests are needed to see if the study's prediction seems correct, said Lisiecki, of the University of California, Santa Barbara. But she agreed that we might never find out what would have happened naturally, due to human-caused global warming. "Current greenhouse gas concentrations are probably similar to those that occurred three million years ago and are high enough to prevent an ice age for hundreds of thousands of years," she said.

#### CO2 protecting humanity from imminent Ice Age

Cambridge University Citing Luke Skinner, Researcher and Publisher for the department of Earth Sciences Cambridge University, David Hodell, professor at Cambridge University January 9, 2012, "Ice Age, Interrupted", Research News, <http://www.cam.ac.uk/research/news/ice-age-interrupted/>

In terms of the ebb and flow of the Earth’s climate over the course of its history, the next Ice Age is starting to look overdue. Periods between recent Ice Ages, or ‘interglacials’, average out to be around 11 thousand years, and it’s currently been 11, 600 since the last multi-millennial winter. Although it is almost impossible to predict exactly when the next Ice Age will occur (if it will at all), it is clear that a global freeze is not on the horizon; the amount of CO2 emitted by human activity and the enhanced greenhouse effect that results all but preclude it. But what if we weren’t around and CO2 was lower? In a paper published in Nature Geoscience this week, new research proposes that the next Ice Age would have been kick-started sometime in the next thousand years, just round the corner in the context of the Earth’s lifespan, if CO2 was sufficiently low. By looking at the onset of abrupt flip-flops in the temperature contrast between Greenland and Antarctica (extreme climate behaviour that would have only been possible if vast and expanding ice sheets were disrupting ocean circulation), the researchers believe they have been able to identify the fingerprint of an Ice Age activation, or the ‘glacial inception’. By applying this fingerprinting method to an interglacial period with nearly identical solar radiation, or ‘insolation’, to our own – some 780 thousand years ago – the researchers have been able to determine that glacial inception would indeed be expected to occur sometime soon. “The mystery of the Ice Ages, which represent the dominant mode of climate change over the past few million years, is that while we can identify the various ingredients that have contributed to them, it’s the arrangement of these ingredients, and how they march to the beat of subtle changes in seasonality, that we lack an understanding of,” says Dr Luke Skinner from the Department of Earth Sciences, who helped to conduct the research with Professor David Hodell and their colleague Professor Chronis Tzedakis from University College London. Insolation, the seasonal and latitudinal distribution of solar radiation energy, changes over tens of thousands of years due to the variations in the Earth’s orbit around the sun. It has long been apparent that insolation changes have acted as a pace-maker for the Ice Ages. But, like a metronome paces music, it sets the beat of climate change but not its every movement. The changing concentrations of greenhouse gases, CO2 in particular, are evidently what determine when a shift in insolation will trigger climate change. “From 8,000 years ago, as human civilization flourished, CO2 reversed its initial downward trend and drifted upwards, accelerating sharply with the industrial revolution,” says Skinner. “Although the contribution of human activities to the pre-industrial drift in CO2 remains debated, our work suggests that natural insolation will not be cancelling the impacts of man-made global warming.”

#### Greenhouse emissions only long-term solution to Ice Age.

Curt Stager, is an ecologist, paleoclimatologist, and science journalist with a Ph.D. in biology and geology from Duke University. (2012) What Happens AFTER Global Warming? Nature Education Knowledge 3(3):7 http://www.nature.com/scitable/knowledge/library/what-happens-after-global-warming-25887608

Another potentially confusing situation arises when we consider that atmospheric CO2 concentrations will still be high enough in 50,000 AD to prevent the next ice age, which natural cyclic processes would normally be expected to trigger then (Figure 5; Berger & Loutre 2002, Archer & Ganopolski 2005). The next major cyclic cool period is due in 130,000 AD, by which time a moderate carbon emission will have dissipated. This suggests that preventing an extreme 5000 Gton hothouse scenario now could leave Canada and northern Europe vulnerable to being bulldozed by gigantic ice sheets in the deep future. How do we weigh the winners and losers in such a far-sighted view?

Fortunately, long-term perspectives may also suggest possible win-win situations, as well. For instance, leaving most remaining coal untouched rather than using it all up now would reduce the severity of climate change in the near-term, and would also leave large stores of burnable carbon in the ground that later generations could use as a source of greenhouse gases for the prevention of future ice ages, should they so desire.Whichever emissions scenario we choose-be it moderate or extreme-one thing is now clear. Our influence on the climatic future of the world is geological in scope. Little wonder, then, that many scientists are now referring to our chapter of Earth history with a term coined by ecologist Eugene Stoermer-the "Anthropocene Epoch" or the "Age of Humans" (Crutzen & Stoermer 2000, Stager 2011).

#### Warming counterbalances impending ice age

Terrance Aym, international author citing George Kukla, retired professor of paleoclimatology at Columbia University and researcher at the Lamont-Doherty Earth Observatory. March 28 2011 “Prepare for Ice Age Now, says top paleoclimatologist” http://www.iceagenow.com/Prepare\_for\_Ice\_Age\_Now\_says\_top\_paleoclimatologist.htm

Geologic records show that Ice Ages are the norm, punctuated by brief periods of warming. Now one of the most highly respected paleoclimatologists - George Kukla, 77, retired professor of paleoclimatology at Columbia University and researcher at the Lamont-Doherty Earth Observatory - has weighed in and is warning everyone to prepare for a new Ice Age. The "Earth has experienced an ongoing cycle of ice ages dating back millions of years. Cold, glacial periods affecting the polar to mid-latitudes persist for about 100,000 years, punctuated by briefer, warmer periods called interglacials," says Kukla. Kukla asserts all Ice Ages start with a period of global warming. They are the the harbingers of new Ice Ages. Actually, he explains, warming is good. Ice Ages are deadly and may even kill millions. Can Mankind stop it? No. Just as humanity cannot affect the long term climate of the planet, neither can it stop an Ice Age from happening. The climate is primarily driven by the sun. "I feel we're on pretty solid ground in interpreting orbit around the sun as the primary driving force behind Ice Age glaciation," he says. "The relationship is just too clear and consistent to allow reasonable doubt. It's either that, or climate drives orbit, and that just doesn't make sense." During a lengthy interview with Gelf Magazine, Kukla explained: "What is happening is very similar to the time 115,000 years ago, when the last glaciation started.... Believe it or not, the last glacial started with 'global warming!'" He knows that global warming always precedes an Ice Age. The history of that is in the ice core records repeating itself every 100,000 years or so over millions of years. Generations ago, scientists believed Ice Ages advanced slowly taking tens of thousands of years. Now some researchers have revealed startling evidence that an Ice Age can be triggered in under 10 years. Warming is much more preferable than cooling. Warming would actually help Mankind; cooling will do just the opposite. Kukla and his colleagues warn that as the ice starts marching southward from the Arctic there will be "substantially lowered food production" and evidence will abound of "extreme weather anomalies" in both the northern and southern latitudes. Global superstorms may break out. Some regions may experience anomalous cold spells while others roast from spiking temperatures never before seen by civilization. Those things too are exactly what's happening now. Not taken into Kulka's model of an encroaching Ice Age are the facts and possible impact of the magnetic pole shift, the shifting core of the Earth, or the revelation by NASA and the ESA that the sun is going to fall into a quiet period for the next 30 to 50 years. That exceptional solar minimum cycle is expected to start in 2014, perhaps earlier. It seems the odds are good that the Earth will slip into an extended cooling, or so-called mini-Ice Age. Whether that becomes an extended 100,000 year full-fledged Ice Age even Kulka doesn't know.

#### Warming key to check the ice age

Weekend Australian, 4-26-2008, “A cool idea to warm to,” http://www.theaustralian.news.com.au/story/0,25197,23597729-7583,00.html

The latest countercultural contribution came in The Australian on Wednesday. Phil Chapman is a geophysicist and the first Australian to become a NASA astronaut. He makes the standard argument that the average temperature on earth has remained steady or slowly declined during the past decade, despite the continued increase in the atmospheric concentration of carbon dioxide, with a new twist. As of last year, the global temperature is falling precipitously. All four of the agencies that track global temperatures (Hadley, NASA Goddard, the Christy group and Remote Sensing Systems) report that it cooled by about 0.7C in 2007. Chapman comments: ``This is the fastest temperature change in the instrumental record and it puts us back where we were in 1930. If the temperature does not soon recover, we will have to conclude that global warming is over. It is time to put aside the global warming dogma, at least to begin contingency planning about what to do if we are moving into another little ice age, similar to the one that lasted from 1100 to 1850.'' A little ice age would be ``much more harmful than anything warming may do'', but still benign by comparison with the severe glaciation that for the past several million years has almost always blighted theplanet. The Holocene, the warm interglacial period we've been enjoying through the past 11,000 years, has lasted longer than normal and is due to come to an end. When it does, glaciation can occur quite quickly. For most of Europe and North America to be buried under a layer of ice, eventually growing to a thickness of about 1.5km, the required decline in global temperature is about 12C and it can happen in as little as 20 years. Chapman says: ``The next descent into an ice age is inevitable but may not happen for another 1000 years. On the other hand, it must be noted that the cooling in 2007 was even faster than in typical glacial transitions. If it continued for 20 years, the temperature would be 14C cooler in 2027. By then, most of the advanced nations would have ceased to exist, vanishing under the ice, and the rest of the world would be faced with a catastrophe beyond imagining. Australia may escape total annihilation but would surely be overrun by millions of refugees.'' Chapman canvases strategies that may just conceivably prevent or at least delay the transition to severe glaciation. One involves a vast bulldozing program to dirty and darken the snowfields in Canada and Siberia, ``in the hope of reducing reflectance so as to absorb more warmth from the sun. We may also be able to release enormous floods of methane (a potent greenhouse gas) from the hydrates under the Arctic permafrost and on the continental shelves, perhaps using nuclear weapons to destabilise the deposits''. He concludes: ``All those urging action to curb global warming need to take off the blinkers and give some thought to what we should do if we are facing global cooling instead. It will be difficult for people to face the truth when their reputations, careers, government grants or hopes for social change depend on global warming, but the fate of civilisation may be at stake.'' The 10-year plateau in global temperatures since 1998 has already sunk the hypothesis that anthropogenic greenhouse gas will lead to catastrophic global warming. To minds open to the evidence, it has been a collapsing paradigm for quite some time.

#### Warming prevents an ice age

Andrea Thompson, Staff writer for Livescience, 8-7-2007, “Global Warming Good News: No more Ice Ages,” <http://www.livescience.com/environment/070907_co2_iceage.html>

Ice ages naturally occur about every 100,000 years or so as the pattern of Earth's orbit changes with time and alters the way the sun strikes the planet's surface. When less solar energy hits a given area of the surface, temperatures become cooler (this is what causes the difference in temperatures between summer and winter). Long-term changes in Earth's orbit that cause less solar energy to hit the surface can cool down summer temperatures so that less ice melts at the poles. If ice sheets and glaciers don't melt a bit in the summer, the ice accumulates and starts to advance—in [past ice ages](http://www.livescience.com/environment/050330_earth_tilt.html), sheets of ice covered all of Canada and most of the Northern United States. The level of carbon dioxide in the atmosphere is also an important factor in triggering an ice age. In the past, lower carbon dioxide levels (caused by natural processes) helped cool the Earth and again allowed ice to advance. Rising carbon dioxide levels, as is the case with global warming, can have the opposite effect. **No more ice ages** Through the burning of fossil fuels, carbon dioxide is now accumulating in the atmosphere. Tyrrell and his colleagues used a model to study what would happen if carbon dioxide continued to be emitted and how that would affect the long-term balance of carbon dioxide in the air and the ocean's chemistry. The [ocean is absorbing](http://www.livescience.com/mysteries/070524_carbon_sink.html) some of the carbon dioxide emitted into the air, which is causing it to become more acidic (similarly, the bubbles of carbon dioxide dissolved in your soda are what give it acidity). Tyrrell and his team's model shows that carbon dioxide levels will be higher far into the future than previously predicted, because the acidifying ocean will dissolve more calcium carbonate from the shells of marine organisms, which acts as a buffer against acidification. But this buffer can only help to a certain point, and eventually the ocean won't be able to take up any more carbon dioxide. "It can't just keep taking it up," said Joan Kleypas of the U.S. National Center for Atmospheric Research, who was not involved in the study. The model results, detailed in a recent issue of the journal Tellus, project that 8 to 10 percent of the carbon dioxide emitted into the atmosphere will remain there for thousands of years, causing levels of the greenhouse gas to equilibrate in the atmosphere at twice their pre-industrial levels. "It won't go back to original levels," Kleypas told LiveScience. Even if we burn only a quarter of the Earth's total reserves of fossil fuels (currently we have burned less than one tenth of reserves), the carbon dioxide remaining in the atmosphere could cause the next ice age to be skipped because ice sheets and glaciers [will have melted](http://www.livescience.com/php/multimedia/imagegallery/igviewer.php?imgid=626&gid=42&index=0) and won't be able to reform substantially, Tyrrell found. In fact, burning up all of Earth's reserves would prevent the next five ice ages, the model shows, he said. "Our research shows why atmospheric CO2 will not return to pre-industrial levels after we stop burning fossil fuels," Tyrrell said. "It shows that if we use up all known fossil fuels it doesn't matter at what rate we burn them. The result would be the same if we burned them at present rates or at more moderate rates; we would still get the same eventual ice-age-prevention result."

### AT: Thermohaline Link Turn

#### Thermohaline Circuit won’t fail – Ocean Model Proves

Michael D. Lemonick, covered science and the environment for TIME magazine for nearly 21 years, where he wrote more than 50 cover stories, and has also written for Discover, Scientific American, Wired, New Scientist and The Washington Post. April 10th 2012 “How a Patch of Ocean Helps Keep Europe from Freezing.” http://www.climatecentral.org/news/how-a-patch-of-ocean-off-alaska-helps-keep-europe-from-freezing/

Climate scientists have been explaining for years that the problem with global warming isn’t just warming. It’s also about the other changes warming can bring, including heat waves, droughts, rising seas, intense storms and much more. One of the scariest possibilities is that major ocean currents could abruptly stop entirely, plunging areas like Western Europe into an abrupt deep-freeze. It’s happened before, tens of thousands of years ago, and while climate experts doubt that it will happen again anytime soon, they haven’t had especially powerful evidence to back their optimism. But now they do, thanks to a new paper just published in Proceedings of the National Academy of Sciences. What will save Europe from disaster, say the authors, is the Bering Strait, the 50-mile-wide gap that separates Siberia from Alaska. “As long as the Bering Strait remains open,” said lead author Aixue Hu, a climate modeler at the National Center for Atmospheric Research (NCAR), in a telephone interview, “we will not see an abrupt climate event.” The focus of Hu’s study was the globe-spanning, endlessly looping current known as the ocean conveyor belt, or, more properly, the Atlantic Meridional Overturning Circulation. To oversimplify a bit, the current brings warm surface water from the South Pacific, Indian and South Atlantic northward along the east coast of the Americas; the part that runs along the U.S. coastline is known as the Gulf Stream. At about Massachusetts, the balmy water peels off for Europe where it gives up its remaining heat, making that continent a lot warmer than it would otherwise be (Madrid is at about the same latitude as Chicago, for example but it’s nowhere near as cold in winter). The water cools off, becomes denser, and sinks, turning into a cold subsurface current that returns south, warms and rises, and begins the loop again. If a burst of fresh water enters the North Atlantic, however, say, from melting ice caps, the ocean’s saltiness is diluted, making it harder for surface water to sink even when it’s cold. Melt enough ice and you stop the conveyor belt completely, removing Europe’s source of heat. (This was part of the premise behind the movie “The Day After Tomorrow,” which mangles the science so badly it makes scientists cringe.) The basic scenario, however, is sound. “This has happened several times,” Hu said, “but we weren’t sure why.” So the scientists looked for evidence of what else might have been happening at times when the current shut off. They noticed that it tended to happen when sea level was especially low — specifically when it dropped low enough to expose the sea floor at the Bering Strait, creating a “land bridge” that connected the two continents. (Anthropologists think prehistoric Asians crossed this bridge when they first populated the Americas.) “So we thought maybe,” Hu said, “this played a role.” And so it did, they discovered, when they used a powerful climate model to test their hypothesis. “When the strait is open,” Hu said, “water flows into the Arctic Ocean and eventually out into the North Atlantic.” Pacific Ocean water, it turns out, is somewhat less salty than the Atlantic, so the current is already in a constant state of mild dilution. If more freshwater gets dumped in during these times — by, say, melting a significant amount of ice on Greenland — it only adds to the dilution, slowing the conveyor belt gradually. When the Bering Strait is closed, however, the conveyor belt is undiluted. Dump a lot of freshwater in and it’s such shock to the system that it can cause a total shutdown. The good news is that the Bering Strait is currently open for business, and as sea level continues to rise with global warming, it’s not closing shop any time soon. So an abrupt shutdown of the conveyor belt, leading to sudden cooling in the north along more heat staying bottled in the south — the series of events that may have brought us out of the last Ice Age, a new study in Nature argued last week — is unlikely. Considering all of the disruptions we’re already seeing from climate change, and those that are likely to come over the next century, it’s slightly reassuring to realize that things could be far worse.

#### Thermohaline won’t collapse.

Scott K. Johnson, Scott has a master's in hydrogeology from the University of Wisconsin- Madison. April 11th 2012, “An Open Bering Strait blocks off sudden swings in climate” http://arstechnica.com/science/2012/04/bering-strait-influences-abrupt-changes-in-ocean-circulation/

It had been proposed that the Bering Strait between Alaska and Eastern Russia—which is replaced by a land bridge when sea level drops during glacial periods—could have something to do with these rapid climate shifts. So, a group of researchers set out to test the idea using the latest Community Climate System Model (CCSM3). The model was run under two scenarios—one with modern sea level and an open Bering Strait, and one with a lower sea level and a closed Bering Strait. In each, freshwater was added to the North Atlantic at a slowly increasing rate until the overturning circulation slows down, after which the freshwater input is ramped back down to zero. During the Dansgaard-Oeschger oscillations, the overturning circulation seems to show a sort of double equilibrium. One state is the normal mode, like it behaves today. That seems to collapse to a low-circulation state that can hang around for quite a while before flipping back to full strength. The simulation with an open Bering Strait couldn’t replicate this behavior. The overturning circulation would slow down, but as soon as the freshwater addition started to drop, the circulation would smoothly recover right along with it. With the Bering Strait closed, however, the circulation would collapse more quickly, hold steady there for a while, and then abruptly kick back into gear. Much like the real thing is thought to have done. The Bering Strait exerts its influence by controlling flow between the Arctic and the North Pacific. Normally, fresher water flows into the Arctic, but when freshwater is being added to the North Atlantic some of it leaks into the Arctic and out to the Pacific. That helps keep the overturning circulation in the North Atlantic from clogging up so easily. In contrast, when the Bering Strait is closed, the freshwater in the North Atlantic piles up and lingers. Beyond offering an explanation of why the Dansgaard-Oeschger oscillations happened when they did (during the period when sea level was low enough that the Bering Strait was closed off), this work also has something to say about the future. Since the Bering Strait is open today, an abrupt collapse of overturning circulation in the North Atlantic due to melting Greenland ice could be much less likely. And that’s just one more reason why the day after tomorrow probably won’t resemble The Day After Tomorrow.

### Ice Age Impacts

#### Ice Age causes extinction

Al Fin, an online journalist and writer who primarily writes about the economy and climate threats to humanity. February 8th 2012 “How to Trigger an Ice Age the Easy Way, Killing Billions of People.” <http://alfin2100.blogspot.com/2012/02/how-to-trigger-ice-age-easy-way-killing.html>

The secret to killing billions and billions of people without being too obvious about it, is to make it difficult or impossible to grow enough food to feed them. Geological history demonstrates that the best way of doing this -- short of a global thermonuclear war -- is by triggering a global ice age. If winters are too long and summers are too short and cold, crops cannot be grown, and livestock will starve. Without enough food, billions of people will die, until there are only enough people to match the dwindling food supplies. Who would want to do such a thing? Well, no one will actually come out and admit to planning a great global human dieoff. But there are some people who are playing with the idea of significantly cutting back on Earth's solar allotment, in the name of mitigating "climate change." But since Earth's climate is always changing no matter what humans do, why would a cooler planet -- with shorter growing seasons and less food -- be better than a warming planet, with more food and longer growing seasons?

#### An ice age will lead to extinction

L. David Roper, Physics professor at Virginia Polytechnic Institute and State University, 1-23-2005, http://www.roperld.com/science/tempsolinsatc.pdf

Surely, prior to the Next Glacial Maximum about 100 kiloyears in the future surviving Humans will migrate to European, Asian and also American refugia. (See Figure 12.) Surviving North Americans will probably migrate to Central America. A glance at Figure 12 should convince that an exodus to refugia could happen as early as 50, or even 20, kiloyears in the future. With the Human development of weapons of mass and indiscriminant destruction and demonstrated willingness to use them when challenged by other Humans, it is likely that Humans will contribute to their own die offs as they struggle for survival as the Next Major Ice Age begins to take its Human toll. It is not clear that Humans will survive all of the three predicted coldest periods of the Next Major Ice Age. (See Figure 12.) The first and mildest, at about 20 kiloyears in the future, is probably the most dangerous, as there may be still enough of the destructive technology around then.