## **Warming Real/Anthropogenic**

### **Scientific Consensus**

#### **There’s scientific consensus on anthropogenic global warming. Those in denial don’t study**

CNN 2009 (Surveyed scientists agree global warming is real, CNN news, <http://articles.cnn.com/2009-01-19/world/eco.globalwarmingsurvey_1_global-warming-climate-science-human-activity?_s=PM:WORLD>, 1/19/2009)

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### **Climate Deniers Wrong**

#### **Deniers of Climate Change are motivated by pro-market paranoia that rejects pure scientific fact in all spheres**

Herbert 7/19 (Wray, Wray Herbert is the author of the book On Second Thought: Outsmarting Your Mind's Hard-Wired Habits. He is an award-winning journalist who has been writing about psychological science for more than 25 years, including many years as science editor of US News & World Report, regular columns for Newsweek and Scientific American Mind, and his two popular blogs, We’re Only Human and Full Frontal Psychology, A Climate for Conspiracy: Imaginary Plots and Global Warming, Huffington Post, <http://www.huffingtonpost.com/wray-herbert/climate-change-denial-_b_1686437.html>, 2012)

Psychological scientists are very interested in this particular brand of irrational thinking -- especially the link between conspiratorial thinking and anti-science world views. These plots and conspiracies may seem laughable at first glance, but they are not inconsequential. At the very least, conspiracy theorists waste a lot of time and money -- think of the "birthers" -- and at worst, they pose real dangers to society. Just think of how many parents, alarmed by the bogus link between vaccines and autism, have left their children unprotected against serious disease.¶ Or consider global warming. More than 90 percent of climate scientists agree that the global climate is shifting, largely as a result of human activity. Scientifically, this is essentially a closed case. Yet conspiracy theorists continue to spin wild tales of government agents surreptitiously destroying thermometers and burying contradictory evidence. What are the motives of these climate deniers, who reject even overwhelming scientific consensus? Do they have a specific agenda having to do with the environment or economics, or are climate deniers the same people who fantasize about the second gunman on the grassy knoll?¶ Cognitive psychologist Stephan Lewandowsky of the University of Western Australia has been studying climate deniers and conspiratorial thinking -- and the link between the two. He suspected that climate deniers -- as opposed to climate "skeptics," who actually use the tools of science to verify facts -- are highly prone to unrelated kinds of conspiracy thinking, and also to a conservative, pro-business ideology. He decided to test these ideas by questioning people who write and read blogs related to global warming.¶ He chose blogs because people with an anti-science bias have found a welcoming home on the Internet. Science denial is difficult to practice in the mainstream, peer-reviewed literature, but such contrarian views can be freely expressed in the blogosphere, where conspiracy theorists can feed one another's feelings of persecution. Lewandowsky surveyed blog denizens about their views on climate science, other scientific propositions, and their environmental leanings; their perceptions of what scientific "consensus" means; their beliefs about free-market economics; and finally, their views on a number of well-known conspiracy theories. The conspiracies covered the political spectrum, from fears of a world government (a right-wing idea) to the belief that 9/11 was an "inside job" (typically embraced on the left).¶ The results were unambiguous, and unsettling. First, those who hold a laissez-faire view of unfettered free markets were much more likely to strongly reject climate science. Lewandowsky believes that, because the fundamental importance of fossil fuels (and CO2 emissions) to modern economics, climate science in general (and evidence for global warming in particular) is a threat to free market advocates. Free marketers were also more likely to reject other established scientific findings, even the (undisputed) facts that smoking causes lung cancer and HIV causes AIDS.¶ Second, conspiracy thinking was clearly linked to climate denial -- and to the rejection of scientific propositions in general. This was true even of conspiracy theories unrelated to the environment or climate -- the belief that NASA staged the moon landing, for example, or that the CIA killed Martin Luther King. In other words, conspiracy thinking is not simply a convenient way to dismiss a particularly bothersome scientific consensus. Instead, some people seem to have a general personality trait or cognitive style, which leads them to endorse any conspiracy. This paranoid thinking in turn predisposes them to reject completely unrelated scientific facts.¶

#### Climategate was proven wrong and promoters of controversy are funded by oil companies

Markley 2/16 (Stephen, reporter for RedEye News, “ Heartland, Climate Denial, and Memos that Surprise No One,” RedEye News, <http://blogs.redeyechicago.com/off-the-markley/2012/02/16/heartland-climate-denial-and-memos-that-surprise-no-one/> 2/16/12)

In 2009, on the eve of climate talks in Copenhagen, a scandal broke known as “Climategate.” It managed to capture the media and public’s attention, and while perhaps not torpedoing those talks, certainly lowered the chances of success. Climategate was debunked almost immediately. What essentially happened was hackers managed to find a few mildly inappropriate lines amidst thousands and thousands of e-mails sent over the course of a decade, none of which actually called into question any of the science behind climate change. Who wants to bet the media will give anything resembling equal weight to the recently leaked memos from the libertarian climate denialist organization the Heartland Institute? Any takers? Heartland, which is right here in Chicago, and which I’ve previously rained shit over, specializes in taking shady money from unknown sources (i.e. fossil fuel interests) and distributing it among climate denial organizations and blogs to influence the public’s opinion on this frightening and rapidly unfolding disaster. Here are some of the highlights of the recently leaked memos from DeSmogBlog: • “Proposing to spend $100,000 to hire David Wojick, a senior consultant to the Energy Department’s Office of Scientific and Technical Information, to work on alternative classroom materials on climate science for kindergartners through 12th graders.” • Plans to spend “about $388,000 on the Nongovernmental International Panel on Climate Change, a team of writers paid ‘to undermine’ the latest scientific reports from the U.N. Intergovernmental Panel on Climate Change.” • Payments to several “high-profile” climate skeptics “‘who regularly and publicly counter the alarmist [anthropogenic global warming] message’ including $11,600 per month to Craig Idso, $5,000 per month plus expenses to Fred Singer and $1,667 per month to Robert Carter.” • Plans to counter high-profile climate writers on blogs like Forbes, while cultivating “neutral voices” such as The New York Times Andy Revkin (it was Revkin who confirmed the authenticity of the memos). Now, follow me on this: the reason this is such a scandal is because it will be viewed as such a non-scandal. Got it? On one side of the climate “debate” you have 98% of the scientists working in the field, screaming at the top of their lungs for the public and policy-makers to pay attention to what’s going on and how dire the situation is becoming. On the other side, you have propaganda machines like Heartland that are not engaged in anything even resembling science, but rather that serve as conduits for money from fossil fuel and corporate interests like the Koch Foundation, R.J. Reynolds, and General Motors to activists willing to say what they are being paid to say. That’s all Heartland is, and that’s the entire intellectual foundation for the “global warming is a myth” faction that also happens to be winning one of the most important public discussions in human history. However, the reason this will not be a scandal is because it’s so typical. The media has fallen into a left-right paradigm where there are two sides to every debate, thus giving the denialsphere ample room to maneuver and a positively preposterous megaphone. When the Wall Street Journal publishes an absurd editorial rife with factual errors that wouldn’t pass muster in the third grade classroom in which Heritage is trying to buy a science curriculum, that should be a scandal. When a Republican congressman bullies EPA head Lisa Jackson over the science of climate change, that should be a scandal. When a “think-tank” takes millions of dollars from anonymous donors and distributes it in a campaign of disinformation, that should be a scandal. Oh, but the stimulus made a loan to a solar company that failed! Yeah, you’re right, let’s talk about that while the world burns.

#### Climate Deniers are funded by oil interests and are paid for their skepticism.

Owen and Bignell 2010 (Jonathan and Paul, environmental journalists for the Guardian, Think-tanks take oil money and use it to fund climate deniers, The Guardian, <http://www.independent.co.uk/environment/climate-change/thinktanks-take-oil-money-and-use-it-to-fund-climate-deniers-1891747.html>, 2/7/2010)

An orchestrated campaign is being waged against climate change science to undermine public acceptance of man-made global warming, environment experts claimed last night. The attack against scientists supportive of the idea of man-made climate change has grown in ferocity since the leak of thousands of documents on the subject from the University of East Anglia (UEA) on the eve of the Copenhagen climate summit last December. Free-market, anti-climate change think-tanks such as the Atlas Economic Research Foundation in the US and the International Policy Network in the UK have received grants totalling hundreds of thousands of pounds from the multinational energy company ExxonMobil. Both organisations have funded international seminars pulling together climate change deniers from across the globe. Many of these critics have broadcast material from the leaked UEA emails to undermine climate change predictions and to highlight errors in claims that the Himalayan glaciers could disappear by 2035. Professor Phil Jones, who has temporarily stood down as director of UEA's climactic research unit, is reported in today's Sunday Times to have "several times" considered suicide. He also drew parallels between his case and that of Dr David Kelly, found dead in the wake of the row over the alleged "sexing up" of intelligence in the run-up to the invasion of Iraq. Professor Jones said he was taking sleeping pills and beta-blockers and had received two death threats in the past week alone. Climate sceptic bloggers broadcast stories last week casting doubts on scientific data predicting dramatic loss of the Amazon rainforest. All three stories, picked up by mainstream media, questioned the credibility of the International Panel on Climate Change (IPCC) and the way it does its work. A new attack on climate science, already dubbed "Seagate" by sceptics, relating to claims that more than half the Netherlands is in danger of being submerged under rising sea levels, is likely to be at the centre of the newest skirmish in coming weeks. The controversies have shaken the IPCC, whose chairman, Dr Rajendra Pachauri, was subjected to a series of personal attacks on his reputation and lifestyle last week. A poll this weekend confirmed that public confidence in the climate change consensus has been shaken: one in four Britons – 25 per cent – now say they do not believe in global warming; previously this figure stood at 15 per cent. Professor Bob Watson, the chief scientific adviser to the Department for Environment, Food and Rural Affairs (Defra) and former chairman of the IPCC, said yesterday that the backlash is the result of a campaign: "It does appear that there's a concerted effort by a number of sceptics to undermine the credibility of the evidence behind human-induced climate change." He added: "I am sure there are some sceptics who may well be funded by the private sector to try to cast uncertainty." A complicated web of relationships revolves around a number of right-wing think-tanks around the world that dispute the threats of climate change. ExxonMobil is a key player behind the scenes, having donated hundreds of thousands of dollars in the past few years to climate change sceptics. The Atlas Foundation, created by the late Sir Anthony Fisher (founder of the Institute of Economic Affairs), received more than $100,000 in 2008 from ExxonMobil, according to the oil company's reports. Atlas has supported more than 30 other foreign think-tanks that espouse climate change scepticism, and co-sponsored a meeting of the world's leading climate sceptics in New York last March. Called "Global Warming: Was It Ever Really a Crisis?", it was organised by the Heartland Institute – a group that described the event as "the world's largest-ever gathering of global warming sceptics". The organisation is another right-wing think-tank to have benefited from funding given by ExxonMobil in recent years.

### Physical Evidence

#### There is physical evidence of global warming – Current Midwest Drought

Krugman 7/22 (Paul, Nobel Prize winner, Professor of Economics and International Affairs at Princeton University, Loading the Climate Dice, New York Times, <http://www.nytimes.com/2012/07/23/opinion/krugman-loading-the-climate-dice.html?_r=1>, 7/22/2012)

Making things much worse, of course, is the role of players who don’t have the best will in the world. Climate change denial is a major industry, lavishly financed by Exxon, the Koch brothers and others with a financial stake in the continued burning of fossil fuels. And exploiting variability is one of the key tricks of that industry’s trade. Applications range from the Fox News perennial — “It’s cold outside! Al Gore was wrong!” — to the constant claims that we’re experiencing global cooling, not warming, because it’s not as hot right now as it was a few years back. How should we think about the relationship between climate change and day-to-day experience? Almost a quarter of a century ago James Hansen, the NASA scientist who did more than anyone to put climate change on the agenda, suggested the analogy of loaded dice. Imagine, he and his associates suggested, representing the probabilities of a hot, average or cold summer by historical standards as a die with two faces painted red, two white and two blue. By the early 21st century, they predicted, it would be as if four of the faces were red, one white and one blue. Hot summers would become much more frequent, but there would still be cold summers now and then. And so it has proved. As documented in a new paper by Dr. Hansen and others, cold summers by historical standards still happen, but rarely, while hot summers have in fact become roughly twice as prevalent. And 9 of the 10 hottest years on record have occurred since 2000. But that’s not all: really extreme high temperatures, the kind of thing that used to happen very rarely in the past, have now become fairly common. Think of it as rolling two sixes, which happens less than 3 percent of the time with fair dice, but more often when the dice are loaded. And this rising incidence of extreme events, reflecting the same variability of weather that can obscure the reality of climate change, means that the costs of climate change aren’t a distant prospect, decades in the future. On the contrary, they’re already here, even though so far global temperatures are only about 1 degree Fahrenheit above their historical norms, a small fraction of their eventual rise if we don’t act. The great Midwestern drought is a case in point. This drought has already sent corn prices to their highest level ever. If it continues, it could cause a global food crisis, because the U.S. heartland is still the world’s breadbasket. And yes, the drought is linked to climate change: such events have happened before, but they’re much more likely now than they used to be. Now, maybe this drought will break in time to avoid the worst. But there will be more events like this. Joseph Romm, the influential climate blogger, has coined the term “[Dust-Bowlification](http://thinkprogress.org/climate/2011/10/26/353997/nature-dust-bowlification-food-insecurity/)” for the prospect of extended periods of extreme drought in formerly productive agricultural areas. He has been arguing for some time that this phenomenon, with its disastrous effects on food security, is likely to be the leading edge of damage from climate change, taking place over the next few decades; the drowning of Florida by rising sea levels and all that will come later.

#### **The world is being set ablaze as physical evidence of global warming continues to mount**

Goodman 7/5 (Amy, Amy Goodman is an award-winning broadcast journalist, columnist, investigative reporter and author. She is the principal host of Democracy Now!, an independent global news programme broadcast daily on radio, television and the internet. Her most recent book is a collection of her weekly columns, Breaking the Sound Barrier, Extreme weather events forecast storm over climate change denial, The Guardian, <http://www.guardian.co.uk/commentisfree/2012/jul/05/extreme-weather-forecast-storm-climate-change>, 2012)

Evidence supporting the existence of climate change is pummeling the United States this summer, from the mountain wildfires of Colorado to the recent "derecho" storm that left at least 23 dead and 1.4 million people without power from Illinois to Virginia. The phrase "extreme weather" flashes across television screens from coast to coast, but its connection to climate change is consistently ignored, if not outright mocked. If our news media, including – or especially – the meteorologists, continue to ignore the essential link between extreme weather and climate change, then we as a nation, the greatest per capita polluters on the planet, may not act in time to avert even greater catastrophe. More than 2,000 heat records were broken last week around the US. The National Oceanic and Atmospheric Administration (NOAA), the government agency that tracks the data, reported that the spring of 2012 "marked the largest temperature departure from average of any season on record for the contiguous United States". These record temperatures in May, NOAA says, "have been so dramatically different that they establish a new 'neighborhood' apart from the historical year-to-date temperatures".¶ In Colorado, at least seven major wildfires are burning at the time of this writing. The Waldo Canyon fire in Colorado Springs destroyed 347 homes and killed at least two people. The High Park fire farther north burned 259 homes and killed one. While officially "contained" now, that fire won't go out, according to Colorado's Office of Emergency Management, until an "act of nature such as prolonged rain or snowfall".¶ The "derecho" storm system is another example. "Derecho" is Spanish for "straight ahead", and that is what the storm did, forming near Chicago and blasting east, leaving a trail of death, destruction and downed power lines.¶ Add drought to fire and violent thunderstorms. According to Dr Jeff Masters, one of the few meteorologists who frequently makes the connection between extreme weather and climate change:¶ "[A]cross the entire continental US, 72% of the land area was classified as being in dry or drought conditions [last week]. We're going to be seeing a lot more weather like this, a lot more impacts like we're seeing from this series of heat waves, fires and storms … This is just the beginning."¶ Fortunately, we might be seeing a lot more of Jeff Masters, too. He was a co-founder of the popular weather website Weather Underground in 1995. Just this week, he announced that the site had been purchased by the Weather Channel, perhaps the largest single purveyor of extreme weather reports. Masters promises the same focus on his blog, which he hopes will reach the much larger Weather Channel audience.¶ He and others are needed to counter the drumbeat denial of the significance of human-induced climate change, of the sort delivered by CNN's charismatic weatherman Rob Marciano. In 2007, a British judge was considering banning Al Gore's movie An Inconvenient Truth from schools in England. After the report, Marciano said on CNN:¶ "Finally. Finally … you know, the Oscars, they give out awards for fictional films, as well … Global warming does not conclusively cause stronger hurricanes like we've seen."¶ Masters responded to that characteristic clip by telling me:¶ "Our TV meteorologists are missing a big opportunity here to educate and tell the population what is likely to happen."¶ Beyond the borders of wealthy countries like the United States, in developing countries where most people in the world live, the impacts of climate change are much more deadly, from the growing desertification of Africa to the threats of rising sea levels and the submersion of small island nations. The US news media have a critical role to play in educating the public about climate change. Imagine if just half the times that they flash "extreme weather" across our TV screens, they alternated with "global warming".

#### **Physical evidence proving GHG caused global warming**

Keefe 7/11 (Bob, Senior Press Secretary at NRDC, the nation’s most effective environmental group, Climate Change Deniers Resurface; Who Will You Believe?, National Resources Defense Council, <http://switchboard.nrdc.org/blogs/bkeefe/climate_change_deniers_resurfa.html>, 2012)

Who to believe?¶ How about climate scientists like Thomas Karl, director of NOAA's National Climatic Data Center, who oversaw a just-released study connecting climate change and man-made greenhouse gases to severe weather. “We believe there is an important human component explaining these record-breaking temperatures, and that's the increase of greenhouse gases in the atmosphere,” Thomas told PBS News’ Judy Woodruff.¶ Or how about the USDA official who oversees the U.S. Forest Service, whose firefighters are on the front lines in Colorado and elsewhere?¶ “The climate is changing, and these fires are a very strong indicator of that,” USDA Undersecretary Harris Sherman told the Washington Post.¶ Or maybe meteorologist Sam Champion, weather editor of ABC News:¶ “If you want my opinion … now’s the time that we start limiting man made greenhouse gases,” Champion told ABC World News Anchor Diane Sawyer.¶ Perhaps instead of listening to politicians like Sen. Inhofe who want us to believe they know more than experts, we should listen to the 378 scientists from 48 countries who just released NOAA’s State of the Climate study that clearly connects 2011’s weather extremes to the dramatic increases in man-made greenhouse gases since the beginning of the Industrial Age. ¶ According to the report, global warming created weather patterns which contributed to extreme severe weather events last year such as: The historic droughts in the Southern United States and Mexico. Devastating floods in Brazil and Thailand. Record destruction by tornadoes in the Midwest Untied States. The longest cold snap in North Korea since 1945. The most powerful tropical cyclone in Australia since 1918 Want more? NOAA scientists also found that last year:¶ Globally averaged carbon dioxide concentrations in the atmosphere surpassed 390 parts per million for the first time.¶ Globally averaged heat stored in the top 2,300 feet of the oceans was the highest since records began in 1993.¶ Global surface temperature has increased at a rate of about 0.31ºF per decade since 1980.¶ September sea ice extent was second smallest since the satellite era began and old ice (4–5 years) reached record low: 81% below average.¶ That was last year.¶ This year, we’ve already faced record heat, freak storms and some of the worst droughts and fires this country has ever seen.¶ Listen to the experts.¶ Read the facts.¶ And then tell the climate change deniers to quit ignoring what’s happening, and start doing something about it.¶

#### Arctic ice melting proves that global warming exists

Gayle 6/19(Damien, Science Journalist at Daily Mail, “Global warming is changing Arctic seas from where CO2 is absorbed to where it is produced, new study warns” <http://www.dailymail.co.uk/sciencetech/article-2161467/Global-warming-changing-Arctic-seas-CO2-sink-source-greenhouse-gas-new-study-warns.html?ito=feeds-newsxml> 6/19/12)

The Arctic coastal seas are changing from a sink for atmospheric carbon dioxide to a source of the greenhouse gas because of global warming, new research warns.

Research into two seas bordering the polar region has shown that they are absorbing ever smaller amounts of atmospheric CO2 and, at points of the year, even becoming a source of the gas. The shock finding suggests that climate change could be fast becoming a vicious, inescapable cycle which can only further accelerate the damage to the environment. Most scientists agree that changes to the Earth's climate are caused by increasing amounts of greenhouse gases released by humans from, for example, the combustion of fossil fuels. Carbon dioxide plays a major role in this process. But, until 1994, approximately half for the world's CO2 emissions from human combustion of fossil fuels was absorbed by the oceans. As the amount of carbon dioxide in the oceans rises, however, their capacity to absorb the gas falls, and it remains in the atmosphere. Iréne Wåhlström, a marine researcher from the University of Gothenburg, Sweden, investigated two of the coastal seas off Siberia, the Laptev Sea and the East Siberian Sea, in a ship-borne expedition, and – in the case of the Laptev Sea – by mathematical modelling. 'The greenhouse gases raise the temperature of the Earth and this increase is particularly noticeable in the Arctic,' said Miss Wåhlström. 'It is even more pronounced in Siberia and its coastal seas.' The increase in temperature has an impact on the environment in the Arctic – the cover of sea ice is lower, for example, and the supply of water from rivers increases, the permafrost thaws and the rate of coastal erosion increases. 'One consequence is that organic matter that has been stored in soil is carried to the seas, where it is partially broken down to carbon dioxide,' said Miss Wåhlström. The East Siberian Sea has a western part and an eastern part, into which water flows from the Pacific Ocean. 'The level of marine photosynthesis is high in these waters during the summer, and carbon dioxide is consumed. This leads to the level in the sea being lower than in the air, and the sea absorbs carbon dioxide from the air,' says Iréne Wåhlström. The western East Siberian Sea receives also a major contribution from rivers, both directly from the land and from the neighbouring Laptev Sea. 'The river water contains high levels of organic matter, which is partially broken down to carbon dioxide in the sea. This leads to the level in the sea being higher than in the air, and thus carbon dioxide flows from the sea into the air, accelerating climate change.' The East Siberian Sea: Water temperatures have warmed so much that the seas around the Arctic are no longer able to absorb as much carbon dioxide The Laptev Sea had an excess of carbon dioxide during the late summer of 2008 that was of the same order of magnitude as the western East Siberian Sea, probably caused by the breakdown of organic matter from the land. The results suggest that the Laptev Sea has changed from being a sink for atmospheric carbon dioxide to become a source of carbon dioxide during the late summer. Miss Wåhlström's work is the latest to suggest that changes in the Arctic climate have the potential to play havoc with the Earth's delicate ecosystem. Yesterday MailOnline Science reported how scientists have warned that global warming could be accelerated by new trees growing in the warming regions of the Arctic tundra. By stimulating decomposition rates in soils, the expansion of forest into tundra in arctic Sweden could result in the release of carbon dioxide to the atmosphere.

#### Warming is anthropogenic, reversible, and even if you win natural causes, human-made emissions are the biggest factor

Fitzpatrick et al 2006 (Melanie, Earth and Space Sciences and Atmospheric Sciences at the University of Washington and UCS consultant Brenda Ekwurzel, Union of Concerned Scientists, Philip Mote, Climate Impacts Group at the University of Washington and Washington's state climatologis), Richard Gammon, Chemistry, Oceanography, and Atmospheric Sciences at the University of Washington, and Peter Frumhoff, Union of Concerned Scientists, “Human Fingerprints,” http://www.ucsusa.org/global\_warming/science\_and\_impacts/science/global-warming-human.html, 5/11/2006)

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Earth's surface has undergone unprecedented warming over the last century, particularly over the last two decades. Astonishingly, every single year since 1992 is in the current list of the 20 warmest years on record.[1,2] The natural patterns of climate have been altered. Like detectives, science sleuths seek the answer to "Whodunnit?" — are humans part of the cause? To answer this question, patterns observed by meteorologists and oceanographers are compared with patterns developed using sophisticated models of Earth's atmosphere and ocean. By matching the observed and modeled patterns, scientists can now positively identify the "human fingerprints" associated with the changes. The fingerprints that humans have left on Earth's climate are turning up in a diverse range of records and can be seen in the ocean, in the atmosphere, and at the surface. In its 2001 report, the Intergovernmental Panel on Climate Change stated, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." [3] Carbon dioxide from fossil fuel burning and land clearing has been accumulating in the atmosphere, where it acts like a blanket keeping Earth warm and heating up the surface, ocean, and atmosphere. As a result, current levels of carbon dioxide in the atmosphere are higher than at any time during the last 650,000 years. [4,5,6] influenced by many factors, both natural and human. [7] Things that increase temperature, such as increases in heat-trapping emissions from cars and power plants or an increase in the amount of radiation the sun emits, are examples of "positive" forcings or drivers. Volcanic events and some types of human-made pollution, both of which inject sunlight-reflecting aerosols into the atmosphere, lower temperature and are examples of "negative" forcings or drivers. Natural climate drivers include the sun's energy output, aerosols from volcanic activity, and changes in snow and ice cover. Human climate drivers include heat-trapping emissions from cars and power plants, aerosols from pollution, and soot particles. Much as the Air Force develops computer programs to simulate aircraft flight under different conditions, climate scientists develop computer programs to simulate global climate changes under different conditions. These programs use our knowledge of physical, chemical, and biological processes that occur within Earth's atmosphere and oceans and on its land surfaces. Mathematical models allow scientists to simulate the behavior of complex systems such as climate and explore how these systems respond to natural and human factors. The world's oceans have absorbed about 20 times as much heat as the atmosphere over the past half-century, leading to higher temperatures not only in surface waters but also in water 1,500 feet below the surface. [8,9] The measured increases in water temperature lie well outside the bounds of natural climate variation. Recent research shows that human activities have lifted the boundary of Earth's lower atmosphere. Known as the troposphere (from the Greek tropos, which means "turning"), this lowest layer of the atmosphere contains Earth's weather. The stable layer above is called the stratosphere. The boundary that separates the two layers, the tropopause, is as high as nine miles above the equator and as low as five miles above the poles. In an astounding development, a 2003 study showed that this tropopause has shifted upward over the last two decades by more than 900 feet. [10] The rising tropopause marks another human fingerprint on Earth's climate. In their search for clues, scientists compared two natural drivers of climate (solar changes and volcanic aerosols) and three human drivers of climate (heat-trapping emissions, aerosol pollution, and ozone depletion), altering these one at a time in their sophisticated models. Changes in the sun during the twentieth century have warmed both the troposphere and stratosphere. But human activities have increased heat-trapping emissions and decreased stratospheric ozone. This has led to the troposphere warming more because the increase in heat-trapping emissions is trapping more of Earth's outgoing heat. The stratosphere has cooled more because there is less ozone to absorb incoming sunlight to heat up the stratosphere. Both these effects combine to shift the boundary upward. Over the period 1979-1999, a study shows that human-induced changes in heat-trapping emissions and ozone account for more than 80 percent of the rise in tropopause height. [10] This is yet another example of how science detectives are quantifying the impact of human activities on climate. Measurements show that global average temperature has risen by 1.4 degrees Fahrenheit in the last 100 years, with most of that happening in the last three decades. [1,2] By comparing Earth's temperature over that last century with models comparing climate drivers, a study showed that, from 1950 to the present, most of the warming was caused by heat-trapping emissions from human activities [3]. In fact, heat-trapping emissions are driving the climate about three times more strongly now than they were in 1950. The spatial pattern of where this warming is occurring around the globe indicates human-induced causes. Even accounting for the occasional short-lived cooling from volcanic events and moderate levels of cooling from aerosol pollution as well as minor fluctuations in the sun's output in the last 30 years, heat-trapping emissions far outweigh any other current climate driver. Once again, our scientific fingerprinting identifies human activities as the main driver of our warming climate. The identification of humans as the main driver of global warming helps us understand how and why our climate is changing, and it clearly defines the problem as one that is within our power to address. Because of past emissions, we cannot avoid some level of warming from the heat-trapping emissions already present in the atmosphere, some of which (such as carbon dioxide and nitrous oxide) last for 100 years or more. However, with aggressive emission reductions as well as flexibility in adapting to those changes we cannot avoid, we have a small window in which to avoid truly dangerous warming and provide future generations with a sustainable world. This will require immediate and sustained action to reduce our heat-trapping emissions through increased energy efficiency, expanding our use of renewable energy, and slowing deforestation (among other solutions).

### Must Act Now/Tipping Points

#### We must act now to stop global warming – soon we will hit the tipping point. Solving Global Warming is try or die

Hari 2010 (Johaan, Johann Hari is a columnist for the Independent in London and a contributing writer for Slate. He has been named Newspaper Journalist of the Year by Amnesty International for his reporting from the war in Congo, The Wrong Kind of Green, <http://www.oursantaferiver.org/archives/OSFR%20March%206%202010_files/march-6-2010.pdf>, 3/6/2010)

This pattern was bad enough when it affected only a lousy household cleaning spray, or a single¶ rare forest. But today, the stakes are unimaginably higher. We are living through a brief window of time in which we can still prevent runaway global warming. We have emitted so many warming gases into the atmosphere that the world's climate scientists say we are close to the climate's "point of no return." Up to 2 degrees Celsius of warming, all sorts of terrible things happen--we lose the islands of the South Pacific, we set in train the loss of much of Florida and Bangladesh, terrible drought ravages central Africa--but if we stop the emissions of warming gases, we at least have a fifty-fifty chance of stabilizing the climate at this higher level. This is¶ already an extraordinary gamble with human safety, and many climate scientists say we need to aim considerably lower: 1.5 degrees or less.¶ Beyond 2 degrees, the chances of any stabilization at the hotter level begin to vanish, because the earth's natural processes begin to break down. The huge amounts of methane stored in the Arctic permafrost are belched into the atmosphere, causing more warming. The moist¶ rainforests begin to dry out and burn down, releasing all the carbon they store into the air, and causing more warming. These are "tipping points": after them, we can't go back to the climate in which civilization evolved. So in an age of global warming, the old idea of conservation--that you preserve one rolling¶ patch of land, alone and inviolate--makes no sense. If the biosphere is collapsing all around you,¶ you can't ring-fence one lush stretch of greenery and protect it: it too will die.¶ You would expect the American conservation organizations to be joining the great activist¶ upsurge demanding we stick to a safe level of carbon dioxide in the atmosphere: 350 parts per¶ million (ppm), according to professor and NASA climatologist James Hansen. And--in public, to¶ their members--they often are supportive. On its website the Sierra Club says, "If the level stays higher than 350 ppm for a prolonged period of time (it's already at 390.18 ppm) it will spell disaster for humanity as we know it."¶ But behind closed doors, it sings from a different song-sheet. Kieran Suckling, executive director¶ of the Center for Biological Diversity, in Arizona, which refuses funding from polluters, has seen¶ this from the inside. He told me, "There is a gigantic political schizophrenia here. The Sierra¶ Club will send out e-mails to its membership saying we have to get to 350 parts per million and¶ the science requires it. But in reality they fight against any sort of emission cuts that would get¶ us anywhere near that goal."¶ For example, in 2009 the EPA moved to regulate greenhouse gases under the Clean Air Act,¶ which requires the agency to ensure that the levels of pollutants in the air are "compatible with¶ human safety"--a change the Sierra Club supported. But the Center for Biological Diversity¶ petitioned the EPA to take this commitment seriously and do what the climate science says¶ really is "compatible with human safety": restore us to 350 ppm. Suckling explains, "I was¶ amazed to discover the Sierra Club opposed us bitterly. They said it should not be done. In fact,¶ they said that if we filed a lawsuit to make EPA do it, they would probably intervene on EPA's¶ side. They threw climate science out the window."¶ Indeed, the Sierra Club's chief climate counsel, David Bookbinder, ridiculed the center's¶ attempts to make 350 ppm a legally binding requirement. He said it was "truly a pointless¶ exercise" and headed to "well-deserved bureaucratic oblivion"--and would only add feebly that¶ "350 may be where the planet should end up," but not by this mechanism. He was quoted in¶ the media alongside Bush administration officials who shared his contempt for the center's¶ proposal.¶ Why would the Sierra Club oppose a measure designed to prevent environmental collapse? The¶ Club didn't respond to my requests for an explanation. Climate scientists are bemused. When¶ asked about this, Hansen said, "I find the behavior of most environmental NGOs to be¶ shocking.... I [do] not want to listen to their lame excuses for their abominable behavior." It is¶ easy to see why groups like Conservation International, which take money from Big Oil and Big¶ Coal, take backward positions. Their benefactors will lose their vast profits if we make the¶ transition away from fossil fuels--so they fall discreetly silent when it matters. But while the¶ Sierra Club accepts money from some corporations, it doesn't take cash from the very worst¶ polluters. So why is it, on this, the biggest issue of all, just as bad?¶ It seems its leaders have come to see the world through the funnel of the US Senate and what¶ legislation it can be immediately coaxed to pass. They say there is no point advocating a¶ strategy that senators will reject flat-out. They have to be "politically realistic" and try to¶ advocate something that will appeal to Blue Dog Democrats.¶ This focus on inch-by-inch reform would normally be understandable: every movement for¶ change needs a reformist wing. But the existence of tipping points--which have been¶ overwhelmingly proven by the climate science--makes a mockery of this baby-steps approach¶ to global warming. If we exceed the safe amount of warming gases in the atmosphere, then the earth will release its massive carbon stores and we will have runaway warming. After that, any cuts we introduce will be useless. You can't jump halfway across a chasm: you still fall to your death. It is all or disaster.

#### Current emissions will push us to a point that is unsustainable if we want to survive. We must act now to curb emissions

Hansen 5/9 (James, James Hansen is member of the National Academy of Sciences, an adjunct professor in the Department of Earth and Environmental Sciences at Columbia University and at Columbia’s Earth Institute, and director of the NASA Goddard Institute for Space Studies, Game Over for the Climate, New York Times, <http://www.nytimes.com/2012/05/10/opinion/game-over-for-the-climate.html?_r=3&ref=opinion>, 5/9/12)

Canada’s tar sands, deposits of sand saturated with bitumen, contain twice the amount of carbon dioxide emitted by global oil use in our entire history. If we were to fully exploit this new oil source, and continue to burn our conventional oil, gas and coal supplies, concentrations of carbon dioxide in the atmosphere eventually would reach levels higher than in the Pliocene era, more than 2.5 million years ago, when sea level was at least 50 feet higher than it is now. That level of heat-trapping gases would assure that the disintegration of the ice sheets would accelerate out of control. Sea levels would rise and destroy coastal cities. Global temperatures would become intolerable. Twenty to 50 percent of the planet’s species would be driven to extinction. Civilization would be at risk.¶ That is the long-term outlook. But near-term, things will be bad enough. Over the next several decades, the Western United States and the semi-arid region from North Dakota to Texas will develop semi-permanent drought, with rain, when it does come, occurring in extreme events with heavy flooding. Economic losses would be incalculable. More and more of the Midwest would be a dust bowl. California’s Central Valley could no longer be irrigated. Food prices would rise to unprecedented levels.¶ If this sounds apocalyptic, it is. This is why we need to reduce emissions dramatically. President Obama has the power not only to deny tar sands oil additional access to Gulf Coast refining, which Canada desires in part for export markets, but also to encourage economic incentives to leave tar sands and other dirty fuels in the ground.¶ The global warming signal is now louder than the noise of random weather, as I predicted would happen by now in the journal Science in 1981. Extremely hot summers have increased noticeably. We can say with high confidence that the recent heat waves in Texas and Russia, and the one in Europe in 2003, which killed tens of thousands, were not natural events — they were caused by human-induced climate change.¶ We have known since the 1800s that carbon dioxide traps heat in the atmosphere. The right amount keeps the climate conducive to human life. But add too much, as we are doing now, and temperatures will inevitably rise too high. This is not the result of natural variability, as some argue. The earth is currently in the part of its long-term orbit cycle where temperatures would normally be cooling. But they are rising — and it’s because we are forcing them higher with fossil fuel emissions.¶ The concentration of carbon dioxide in the atmosphere has risen from 280 parts per million to 393 p.p.m. over the last 150 years. The tar sands contain enough carbon — 240 gigatons — to add 120 p.p.m. Tar shale, a close cousin of tar sands found mainly in the United States, contains at least an additional 300 gigatons of carbon. If we turn to these dirtiest of fuels, instead of finding ways to phase out our addiction to fossil fuels, there is no hope of keeping carbon concentrations below 500 p.p.m. — a level that would, as earth’s history shows, leave our children a climate system that is out of their control.¶ We need to start reducing emissions significantly, not create new ways to increase them. We should impose a gradually rising carbon fee, collected from fossil fuel companies, then distribute 100 percent of the collections to all Americans on a per-capita basis every month. The government would not get a penny. This market-based approach would stimulate innovation, jobs and economic growth, avoid enlarging government or having it pick winners or losers. Most Americans, except the heaviest energy users, would get more back than they paid in increased prices. Not only that, the reduction in oil use resulting from the carbon price would be nearly six times as great as the oil supply from the proposed pipeline from Canada, rendering the pipeline superfluous, according to economic models driven by a slowly rising carbon price.

#### Warming tipping point is in 10 years. We must act now

Hamilton 2009 (Clive, Professor, Royal Society of Arts, Is It Too Late to Prevent Catastrophic Climate Change?, <http://www.clivehamilton.net.au/cms/media/documents/articles/rsa_lecture.pdf>, 10/21/09)

Most leading climate scientists now believe that 2°C of warming would pose a substantial risk both because of its direct impacts on climatically sensitive Earth systems and because of the potential to trigger irreversible changes in those systems. The latter include the disappearance of Arctic summer sea-ice, the melting of the Himalayan-Tibetan glaciers and the melting of much of the Greenland ice-sheet.19 The relationship between the amount of warming and certain climate tipping points is shown in Figure 1. Note that the authors estimate that, as at 2005, the Earth was already committed to 2.4°C of warming above the pre-industrial level, irrespective of any actions we now take.20 Even so, James Hansen has declared the goal of keeping warming at 2°C ‘a recipe for global disaster’.21 He believes the safe level of CO2 in the atmosphere is no more than 350 ppm. The current level of CO2 is 385 ppm, rising at around 2 ppm each year, so that we have already overshot our target and must somehow draw down large volumes of CO2 from the atmosphere.22 Despite these serious doubts, is aiming to limit warming to even 2°C a feasible goal? What do we have to do to stop emissions pushing temperatures above this level? Just before the Bali climate change conference at the end of 2008 climate scientists released a new assessment arguing that in order to have a good chance of avoiding the 2°C threshold rich countries must by 2020 reduce their greenhouse-gas emissions by 25-40 per cent below 1990 levels.23 The 25 per cent target quickly became entrenched internationally as the benchmark against which the commitment of rich countries is judged. The fact that aiming for 25 per cent instead of 40 per cent means developing countries will have to do a lot more was conveniently passed over. We have seen that rather than declining, or even growing more slowly, global emissions have been accelerating over the last decade. To have any hope of avoiding catastrophe, global emissions must peak within the next few years, and certainly no later than 2020, then begin a rapid decline to the point where all energy generation and industrial processes are completely carbon free. Hansen has put it bluntly: Decision-makers do not appreciate the gravity of the situation. … Continued growth of greenhouse gas emissions, for just another decade, practically eliminates the possibility of near-term return of atmospheric composition beneath the tipping level for catastrophic effects. 24 Meeting in March 2009 the world’s leading climate scientists reached a similar conclusion: ‘immediate and dramatic emission reductions of all greenhouse gases are needed if the 2°C guardrail is to be respected’.25 The urgent question we must now ask ourselves is whether the global community is capable of cutting emissions at the speed required to avoid the Earth passing a point of no return beyond which the future will be out of our hands. It is this irreversibility that makes global warming not simply unique among environmental problems, but unique among all of the problems humanity has faced. Beyond a certain point it will not be possible to change our behaviour to control climate change no matter how resolved we are to do so. If global emissions must reach a peak within 5-10 years then decline rapidly until the world’s energy systems are all but decarbonised, are the institutions of government in the major nations of the world capable of responding in time? Are international institutions capable of agreeing on a global plan adequate to the task? These are questions on which climate scientists have little useful to say; they are in the domain of political and behavioural scientists. However, confidence in the ability of humans to respond with the required urgency is dashed when we understand fully how near we are to the point of no return.

#### Warming tipping points will be reached within the decade. Failure to act now causes uncontrollable CO2 emissions and runaway warming

Chestney 3/26 (Nina, Senior Environmental Markets Correspondent, Global warming close to becoming irreversible-scientists, Reuters, <http://www.reuters.com/article/2012/03/26/us-climate-thresholds-idUSBRE82P0UJ20120326>, 3/26/2012)

Scientific estimates differ but the world's temperature looks set to rise by six degrees Celsius by 2100 if greenhouse gas emissions are allowed to rise uncontrollably. As emissions grow, scientists say the world is close to reaching thresholds beyond which the effects on the global climate will be irreversible, such as the melting of polar ice sheets and loss of rainforests. "This is the critical decade. If we don't get the curves turned around this decade we will cross those lines," said Will Steffen, executive director of the Australian National University's climate change institute, speaking at a conference in London. Despite this sense of urgency, a new global climate treaty forcing the world's biggest polluters, such as the United States and China, to curb emissions will only be agreed on by 2015 - to enter into force in 2020. "We are on the cusp of some big changes," said Steffen. "We can ... cap temperature rise at two degrees, or cross the threshold beyond which the system shifts to a much hotter state." 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. Most climate estimates agree the Amazon rainforest will get drier as the planet warms. Mass tree deaths caused by drought have raised fears it is on the verge of a tipping point, when it will stop absorbing emissions and add to them instead. Around 1.6 billion tonnes of carbon were lost in 2005 from the rainforest and 2.2 billion tonnes in 2010, which has undone about 10 years of carbon sink activity, Steffen said. One of the most worrying and unknown thresholds is the Siberian permafrost, which stores frozen carbon in the soil away from the atmosphere. "There is about 1,600 billion tonnes of carbon there - about twice the amount in the atmosphere today - and the northern high latitudes are experiencing the most severe temperature change of any part of the planet," he said. In a worst case scenario, 30 to 63 billion tonnes of carbon a year could be released by 2040, rising to 232 to 380 billion tonnes by 2100. This compares to around 10 billion tonnes of CO2 released by fossil fuel use each year.

#### We need to act within the decade to prevent runaway global warming

Tohill 3/30 (Joseph, Professor at Ryerson University, On The Verge Of Irreversible Global Warming: Tipping Points Draw Near, The 9 Billion, <http://www.the9billion.com/2012/03/30/on-the-verge-of-irreversible-global-warming-tipping-points-draw-near/>, 3/30/2012)

The world is on the verge of hitting global “tipping points” that could make global warming irreversible, warned scientists at a London conference this week. Their message was firm but clear: if we don’t act quickly this decade, we may irreversibly be sending the Earth hurtling towards 6 degrees of warming in 100 years.¶ Global Tipping Points¶ The “global tipping points” they are referring to include the melting polar ice caps, the loss of rainforests, and the release of methane in the Arctic. Once a tipping point is reached, no action we take can reverse global warming.¶ Take the melting of sea ice in the Arctic, for instance.¶ Recently, a group of Arctic researchers have raised alarm about the devastating effect large-scale sea ice melt could have, as it would release massive amounts of methane – a much more potent greenhouse gas than CO2. Although the exact implications of large-scale sea ice melt is still unclear, they claim it could begin to happen within the next decade.¶ As the Earth warms, the Amazon rainforest will become drier, leading to drought and eventual mass tree deaths. And while the Amazon rainforest extracts more carbon than it emits now (a carbon sink), warming could reverse the process and turn it into a carbon source instead.¶ Finally, scientists are still unaware of the effect melting permafrost in Siberia will have. Currently large amounts of carbon are stored under the frozen Siberian surface. If global warming melts the permafrost, it could release large amounts of carbon into the air.¶ Is there much to be optimistic about?¶ Although the recent climate talks in Durban resulted in a legally binding plan to curb carbon emissions, the CO2 cuts won’t happen until 2020, which could be too late to reverse climate change.¶ Meanwhile, climate modeller Peter Cox claims we could buy ourselves a bit of time if we focus current efforts on reducing methane emissions. But even he acknowledges that this would give us only a 15 year window to really tackle greenhouse gas emissions.¶ If there was ever a time to urgently slash rising greenhouse emissions, this is it. Yet the legally-binding global framework for tackling global warming may have come a decade too late, leaving us only with a hope that countries will take it upon themselves to embrace the necessary environmental policies (Germany is already leading the way in this regard).¶ As a recent (and provocative) piece by Brian Merchant seems to suggest, perhaps there is not much left to be done – there are no real solutions left to offer.

## Positive Feedbacks

#### Anthropogenic warming results in the thawing of permafrost—this positive feedback results in a net positive release in CO2 and temperature levels

Von Diemling et al ’11 (T. Schneider von Deimling, Potsdam Institute for Climate Impact Research, M. Meinshausen, Potsdam Institute for Climate Impact Research, A. Levermann, Potsdam Institute for Climate Impact Research and Potsdam University Physics Department, V. Huber, Potsdam Institute for Climate Impact Research, K. Frieler, Potsdam Institute for Climate Impact Research, D. M. Lawrence, Climate and Global Dynamics Division, National Center for Atmospheric Research and V. Brovkin, Potsdam Institute for Climate Impact Research, Max Planck Institute for Meteorology, “Estimating the permafrost-carbon feedback on global warming,” Biogeosciences Discuss. published May 12, 2011,)

The climate response to anthropogenic greenhouse gas emissions is markedly influenced by internal earth system feedbacks. Carbon cycle feedbacks (Sitch et al., 2008; Cramer et al., 2001; Friedlingstein et al., 2006) are among the most prominent examples 5 of such internal feedbacks, where an initial increase in temperature triggers a reaction from land biomass and soils that leads to carbon dioxide emissions, which in turn amplifies the warming. The strength of this carbon cycle – climate feedback (L) is generally measured as cumulative carbon release (or reduced uptake) per degree of warming. This average land carbon sensitivity L is +79 PgC/\_C across the C4MIP 10 generation of carbon cycle models (Friedlingstein et al., 2006) under the high SRES A2 scenario up to 2100. Additional release of carbon from thawed permafrost, referred to as “permafrost-carbon feedback” in the following, would add to this land carbon feedback. At present, the release of additional carbon to the atmosphere as carbon dioxide or methane due to the thawing of permafrost (Lawrence and Slater, 2005) and the sub15 sequent decomposition of the soil organic carbon is not typically represented in carbon cycle models. For example, none of the carbon cycle models participating in C4MIP (Friedlingstein et al., 2006) included this feedback. The carbon feedback from high latitude regions and its importance for the future climate is rather unconstrained, with uncertainties existing in the overall availability 20 and quality of carbon stored in frozen soils, permafrost thawing rates, organic matter decomposition rates and, importantly, the relative proportion of anaerobic decomposition (resulting in CO2 and CH4 emissions) versus aerobic decomposition (resulting in CO2 emissions only). However, the permafrost feedback uncertainties are basically “one-sided”, i.e., the inclusion of the permafrost-carbon feedback will most likely increase future climate impacts (or enhance the mitigation challenge). Although some feedbacks that dampen global warming might be triggered, such as vegetation growth induced by permafrost thaw and nutrients release, there is little reason to believe that the net effect of large-scale permafrost thaw would lower future temperature rise (McGuire et al., 2006). The potential magnitude of the permafrost-carbon feedback is substantial given that around thousand Petagram of organic carbon is stored in the upper 3m of permafrost soil alone (Schuur et al., 2008). The total carbon pool in permafrost areas is as high as 1672 PgC, if deeper Yedoma and Deltaic carbon deposits are included, 88% of which 5 reside in perennially frozen ground, as estimated by a recent and updated meta-data analysis (Tarnocai et al., 2009). These numbers can be put into perspective if one considers that the accumulated anthropogenic fossil fuel CO2 emissions for the mediumlow RCP4.5 scenario is 1000 PgC over yr 2000 to 2300 (cf. Fig. 3b in Meinshausen et al., 2011), and that supposed total (historical and future) anthropogenic emissions 10 of 1000 PgC would result in a most likely CO2-induced warming of 2 \_C (Allen et al., 2009), and that the current atmospheric CO2 content (389 ppm CO2) is \_830 PgC. The purpose of this study is to provide a first probabilistic estimate of the importance of the permafrost-carbon feedback for the global temperature rise. We investigate this question for the set of all four Representative Concentration Pathways (RCPs) (van 15 Vuuren et al., 2011; Moss et al., 2010). For climatic consequences without permafrost feedback refer to (Schewe et al., 2011).

#### We must act now to stop positive feedbacks that make warming irreversible. Time is running out

Sawaya 2010 (Rachel, Rachel Sawaya has a BA with a double major in Anthropology and Philosophy, as well as two years worth of a Biology degree, Positive Feedback Mechanisms and Climate Change, <http://suite101.com/article/positive-feedback-mechanisms-and-climate-change-a189162>, 1/13/2010)

Climate change may unfortunately be prone to several positive feedback loops. So, in that case climate change causes something to happen, and that event causes more climate change and so forth. These mechanisms could quickly grow out of control, causing some of the more serious and frightening doomsday scenarios that scientists have put forth in association with rising global temperatures. Most of these mechanisms will cause runaway reactions, because once they reach a tipping point they would be very difficult to stop. However, most of these mechanisms are not thought to be at a tipping point yet. Potentially, people have time to take action before disaster strikes. One of the positive feedback mechanisms already affecting global warming is due to the fact that when the atmosphere is warm, it holds more water vapor, which is considered to be a greenhouse gas. As more water vapor is held in the atmosphere, the temperature increases due to its influence, and the increase in temperature allows even more water vapor to be held in the atmosphere. The Ocean’s Role in Positive Feedback While the melting polar ice caps cause concern for many reasons, one of the more serious reasons is their role in a positive feedback mechanism. Polar ice has a high “albedo”, or reflection rate, and helps to reflect the sun’s rays back into space. The albedo of ocean water is much lower, so it absorbs the rays, trapping the heat. So, the more ice that melts, the more sea water is exposed, and the less sunlight is reflected, causing temperatures to rise, and causing more ice to melt. Another, lesser known positive feedback mechanism for climate change involves the existence of a substance known as methane hydrate (or methane clathrate) which forms in very cold, high pressure environments, such as on the ocean floor. When exposed to higher temperatures, methane hydrate can release large amounts of methane gas, a potent greenhouse gas. If the oceans are warmed too much from global warming, previously harmless methane hydrates could release gases which would contribute to raising the temperatures even further. Positive Feedback on Land A well known example of positive feedback concerns the large areas of peat in Siberia, which have been, until recently, frozen by permafrost. Higher temperatures will cause them to thaw, releasing methane into the atmosphere. This would cause temperatures to climb, allowing even more peat to defrost. Another mechanism involves the Amazonian Rainforest. As average global temperatures rise, the area containing the forest will become more and more vulnerable to heat waves, droughts, and ultimately fire. As the forest burns, it will release carbon into the atmosphere, causing higher temperatures and so forth. In addition, the carbon dioxide absorbing capacity of the trees will be lost. Human Driven Positive Feedback As climate change becomes a reality, and without restrictions on energy consumption, people may well be inclined to use more and more fuel in an effort to run more air conditioning, to farm more effectively in harsher conditions, and to rebuild areas that may be devastated by more extreme weather. This in turn, might lead to more pollutants entering the air, causing even more disruption of day to day life, as global temperatures rise. Unfortunately, this positive feedback loop may not be stopped until a limit is reached, and that limit may be a disaster for humankind. Climate change is a phenomenon which may quickly grow out of control if it is not stopped before these or other positive feedback loops come into play.

## **Impacts**

### Extinction

#### **Global warming causes extinction**

Molloy 7/6 (Ivan, Associate Diploma of Geology: Royal Melbourne Institute of Technology, Rebuff to Climate Change Denial, <http://www.mysunshinecoast.com.au/articles/article-display/rebuff-to-climate-change-denial,26302>, 2012)

As a former geologist I have to respond to those who deny human induced Climate Change. Yes its true the worlds climate and geomorphology have been continually changing throughout natural history providing favourable conditions for some forms of life at times, while extinguishing others. In recent geological time, the planet has provided favourable conditions for the flourishing of human life, which in turn like other forms of life also contributes to climate and geomorpholigical change. However, unlike no other form of life, the impact of modern human civilisation has greatly distorted and added to global climate change, and impacting heavily on flora and fauna. Human kind through massive over population and industrialisation is now like a cancer on the planet exterminating hundreds of other life species annually, and now it threatens its own survival with massive pollution. The Global Climate has always changed but not at such a massive rate due to human activity which in turn now threatens our survival. But other forms of life, such as cockroaches will continue on.

### **Moral Obligation**

#### The United States is the biggest contributor to emissions and has a moral obligation to act against warming

Claussen 6 (Eileen, “Climate Change: The State of The Question and The Search For The Answer”, President of the PEW center for climate change, [**http://www.pewclimate.org/press\_ room/speech\_transcripts/stjohns2of2.cfm**](http://www.pewclimate.org/press_%20room/speech_transcripts/stjohns2of2.cfm), 10/5/2006)

But Africa produces just 2 to 3 percent of worldwide emissions of greenhouse gases. The United States, by contrast, with just 5 percent of the global population, is responsible for more than 20 percent of worldwide emissions. And there is also the issue of cumulative emissions. The fact is that climate change is a problem that has been decades in the making as carbon dioxide and other gases have accumulated in the atmosphere over time. These gases have a long life and can remain in the atmosphere for decades or even centuries. And, in the span of the last century or so, it was the United States and other already developed countries that were producing the lion’s share of these emissions. Looking only at carbon dioxide, the United States was responsible for more than 30 percent of global emissions between 1850 and 2000. The comparable figure for China: just 7 or 8 percent. Even considering the high rates of projected growth in China’s and India’s emissions, the cumulative contributions of developed and developing countries to climate change will not reach parity until sometime between 2030 and 2065. Clearly all of the major emitting countries need to be a part of the solution to climate change. But saying that all of today’s big emitters should be equally responsible for reducing their emissions is like going to a restaurant and having a nice dinner and then running into a friend who joins you for coffee. And, when the check comes, you make your friend who only had the coffee split the cost of the entire dinner. Yes, developing countries need to do their part, but there is no denying that the developed world, including the United States, has a moral and ethical responsibility to act first. We also have a responsibility to help developing nations adapt to a warming world. No matter what we do, some amount of global warming already is built into the climate system. There will be impacts; there already are impacts. And it is people living in poverty in the developing world who will face the most serious consequences. So it really comes down, again, to a question of responsibility. What is our responsibility? And it is not just our responsibility to our fellow man (or woman). There is also our responsibility to the natural world, to the earth. Beyond human societies, the natural world also will suffer from the effects of climate change. In fact, we are already seeing changes in the natural world due to climate change. Coral reefs are at risk because of warmer and more acidic ocean waters. Polar bears are threatened by declines in sea ice. Species already are disappearing because of new diseases connected to climate change. In short, climate change holds the potential of inflicting severe damage on the ecosystems that support all life on earth. So why, then, have we failed to take responsibility? Why has there been such an absence of political will?

### **Resource Wars**

#### **Global warming leads to resource wars, mass migrations, and state collapse**

Klare 2009 (Micheal T., Michael T. Klare is the Five College Professor of Peace and World Security Studies at Hampshire¶ College. He is a prolific writer and analyst. Klare is a leading expert on resource conflict, and views¶ natural resource competition at the heart of conflicts past, present and future, Energy, Resource Conflict, and the Emerging World Order, Center for Contemporary Conflict, Strategic Insights, 2009)

Global warming will affect resource competition and conflict profoundly. Although global¶ warming's effects cannot be predicted with certainty, it is likely that it will produce diminished rainfall in many parts of the world, leading to a rise in desertification in these areas and a decline in their ability to sustain agriculture. This, in turn, could force people to fight over remaining sources of water and arable land, or to migrate in large numbers to other areas, where their presence may be resented by the existing inhabitants. Indeed, some analysts believe that the conflict in Darfur is partly driven by such phenomena.¶ Global warming is also expected to produce a significant rise global sea levels, and this will result¶ in the inundation of low-lying coastal areas around the world. Again, the result will be the¶ widespread loss of agricultural lands, forcing many millions of people to migrate to higher areas,¶ possible encountering resistance in the process. Because many poor countries will be unable to¶ cope with the catastrophic effects of global warming, state collapse is a likely result along with an¶ accompanying epidemic of warlordism, ethnic violence, and civil disorder.

#### Mass migration leads to escalatory resource wars

Bahati ’10 (Bahati Ntama Jacques, Policy Analyst @ Africa Faith and Social Justice Network Originally published in the Jan-Feb edition of Around Africa, Climate Change: What About the Displaced?, http://afjn.org/focus-campaigns/other/other-continental-issues/82-general/792-climate-change-what-about-the-displaced.html, February 9, 2010.)

Already, as a result of climate change, at least 18 islands have been submerged worldwide. These include Lohachara Island in India, Bedford, Kabasgadi and Suparibhanga Island near India. Other islands are at risk of being submerged.  They include Bangladesh’s Bhola Island, half of which is permanently flooded, Kutubdia in southeastern Bangladesh with thousands of people already displaced and more to be displaced, in Shishmaref and Kivalini of Alaska, and Maldives, a state island in the Indian Ocean whose President wishes to relocate the entire country. Climate change-related disasters not only affect ecosystems, but cause people to relocate either by choice or by force. Some will be displaced within the boundaries of their affected countries (Internal Displacement or ID) and others will cross state borders. Some will be displaced because of sudden-onset hydro-meteorological disasters, such as flooding, hurricanes, landslides, etc.  Others will be affected by slow-onset disasters, like desertification, rising sea levels and droughts. Sea level rise will, in some cases, lead to permanent loss of small state islands, Maldives being an example, which means permanent displacement of the inhabitants of the island.  In high-risk zones authorities have to choose between the cost of rebuilding every time a disaster hits or of just displacing the people permanently. Furthermore, as a result of displacement, disputes over resources such as water and land will cause violence.  It is more than likely that some of the violence will end up in armed conflict.

#### Ice caps melting leads to resource wars

#### Borgerson 2008 **(Scott G., Senior researcher at Columbia University on arctic melting security issues, Arctic Meltdown: The Economic and Security Implications of Global Warming, Foreign Affairs,** <http://www.rhumb-line.com/pdf/BorgersonForeignAffairsarticle.pdf>**) March, 2008)**

Despite the melting icecap’s potential to transform global shipping and energy markets, Arctic issues are largely ignored at senior levels in the U.S. State Department and the U.S. National Security Council. The most recent executive statement on the Arctic dates to 1994 and does not mention the retreating ice. But the Arctic’s strategic location and immense resource wealth make it an important national interest. Although the melting Arctic holds great promise, it also poses grave dangers. The combination of new shipping routes, trillions of dollars in possible oil and gas resources, and a poorly defined picture of state ownership makes for a toxic brew. The situation is especially dangerous because there are currently no overarching political or legal structures that can provide for the orderly development of the region or mediate political disagree- ments over Arctic resources or sea-lanes. The Arctic has always been frozen; as ice turns to water, it is not clear which rules should apply. The rapid melt is also rekindling numerous interstate rivalries and attracting energy-hungry newcomers, such as China, to the region. The Arctic powers are fast approaching diplomatic gridlock, and that could eventually lead to the sort of armed brinkmanship that plagues other territories, such as the desolate but resource- rich Spratly Islands, where multiple states claim sovereignty but no clear picture of ownership exists. There are few legal frameworks that oaer guidance. The Arctic Council does exist to address environmental issues, but it has remained silent on the most pressing challenges facing the region because the United States purposefully emasculated it at birth, in 1996, by prohibiting it from ad- dressing security concerns. Many observers argue that unclos is the correct tool to manage the thawing Arctic. The convention provides mechanisms for states to settle boundary disputes and submit claims for additional resources beyond their exclusive economic zones. Furthermore, unclos sets aside the resources in the high seas as the common heritage of humankind, it allows states bordering ice-covered waters to enforce more stringent environ- mental regulations, and it defines which seaways are the sovereign possessions of states and which international passages are open to unfettered navigation

#### Climate change leads to resource wars

Lee 2009 (James R., Associate Professor Department of Computer Science and Engineering University of Washington, Global Warming Is Just the Tip of the Iceberg, Washington Post, <http://www.washingtonpost.com/wp-dyn/content/article/2009/01/02/AR2009010202280.html>, 1/4/2009)

Defense experts have also started to see the link between climate change and conflict. A 2007 CNA Corp. report, supervised by a dozen retired admirals and generals, warned that climate change could lead to political unrest in numerous badly hit countries, then perhaps to outright bloodshed and battle. One key factor that could stoke these tensions is massive migration as people flee increasingly uninhabitable areas, which would lead to border tensions, greater demands for rescue and evacuation services and disputes over essential resources. With these threats looming, the U.N. Security Council held a precedent-setting debate on climate change in April 2007 -- explicitly casting global warming as a national security issue. Global warming could lead to warfare in three different ways. The first is conflict arising from scarcity. As the world gets hotter and drier, glaciers will melt, and the amount of arable land will shrink. In turn, fresh water, plants, crops and cattle and other domestic animals will be harder to come by, thereby spurring competition and conflict over what's left. In extreme examples, a truly desiccated ecosystem could mean a complete evacuation of a hard-hit region. And the more people move, the more they will jostle with their new neighbors. Such displacement can arise either suddenly or slowly. The growth of the Sahara, for instance, took many millenniums; many thousands of years ago, people were slowly nudged out of the inland region of northern Africa and into such great river valleys as the Nile and the Niger. Over time, incremental but prolonged rises in sea levels will also gradually uproot hundreds of millions of people. But sometimes the displacement happens with shocking speed: Just think of the deadly hurricanes Katrina and Rita, which together drove millions of people to suddenly leave Louisiana, Mississippi and Texas. As global warming and population growth increase, we could see far deadlier storms than Katrina. In 1991, a cyclone in Bangladesh displaced 2 million people and killed 138,000. All this can lead to warfare when it's time for the displaced to find a new home. For most of human history, they could at least theoretically do so in unclaimed lands -- a sort of territorial pressure valve whose existence tamped down conflict. But today, this reservoir of vacant turf no longer exists, except in the least hospitable parts of the planet. So when the displaced start eyeing currently inhabited areas, expect trouble -- and the bigger the displacement, the bigger the fight. The second cause of the coming climate wars is the flip side of scarcity: the problems of an increase in abundance. Suppose that global warming makes a precious resource easier to get at -- say, rising temperatures in northern Canada, Alaska and Siberia make it easier to get at oil and gas resources in regions that had previously been too bone-chilling to tap. (A few degrees of change in temperature can transform a previously inhospitable climate.) But what happens if some tempting new field pops up in international waters contested by two great powers? Or if smaller countries with murky borders start arguing over newly arable land? Finally, we should also worry about new conflicts over issues of sovereignty that we didn't need to deal with in our older, colder world. Consider the Northwest Passage, which is turning into an ice-free corridor from Europe to Asia during the summer months. Canada claims some portions of the route as its own sovereign waters, while the United States argues that these sections lie within international waters. Admittedly, it'd take a lot of tension for this to turn into a military conflict, but anyone convinced that the United States and Canada could never come to blows has forgotten the War of 1812. And not all this sort of resource conflict will occur between friendly countries.

**Resource wars escalate to nuclear war**

**Caldwell, Ph.d. former director of research and development at the US Army Electronic Proving Ground’s Electromagnetic Environmental Test  Facility  2003**

(Joseph George Caldwell, PhD, “The End of the World, and the New World Order: The Likelihood of Global Nuclear War” http://www.foundation.bw/TheEndOfTheWorld.htm)

It would appear that global nuclear war is inevitable, for several reasons. A major factor is the “politics of envy” – the desire for the “have-nots” of the world to destroy what the “haves” have. The gap between the industrialized “west” and the rest of the world is widening, and the hatred and envy are growing as the poorer nations realize that they will never catch up. Each year, millions more human beings are born into direst poverty, overcrowding, misery and hopelessness. The realization is dawning that it is global industrialization that is the root cause of human misery, and the motivation to bring that inhumane system to an end is growing as fast as the global human population. With the proliferation of plutonium from nuclear reactors, terrorists and rogue nations will soon have the capability to produce thousands of suitcase-sized nuclear bombs, and deliver them to any cities in the world. As mentioned earlier, no missiles or airplanes or submarines are required. Another reason why global nuclear war appears inevitable is the fact that nuclear war “dominates” all other proposed solutions as a means of stopping the ongoing species extinction. No other alternative accomplishes this. As long as this situation holds, it is just a matter of time until the global-nuclear-war solution is implemented, since continuing on the present course leads to a “dead” planet. It would appear that global nuclear war will happen very soon, for two main reasons, alluded to above. First, human poverty and misery are increasing at an incredible rate. There are now three billion more desperately poor people on the planet than there were just forty years ago. Despite decades of industrial development, the number of wretchedly poor people continues to soar. The pressure for war mounts as the population explodes. Second, war is motivated by resource scarcity -- the desire of one group to acquire the land, water, energy, or other resources possessed by another. With each passing year, crowding and misery increase, raising the motivation for war to higher levels. There is also a third factor motivating global war, and that involves timing. With the passage of time, less and less benefit accrues to the winner. If anyone is motivated to wage global nuclear war and has the means to do so, sooner is very likely better than later. If delayed too long, there may be nothing left to gain. With each passing year, the planet's biodiversity decreases, another two percent of the planet's remaining petroleum reserves are consumed, and the risk of biospheric extinction (e.g., from a greenhouse effect) increases. Once gone, these resources -- the very reasons for waging war -- are gone forever. Extinct species will never return, and the planet's fossil fuel reserves, once exhausted, are gone forever. In the past 50 years, human industrial activity has consumed about half the world's reserves of petroleum and has led to the extinction of perhaps one million species. In another 50 years, human industrial activity will consume all of the remaining petroleum reserves and destroy millions of species more, including the larger animal species. For those tempted to wage war, the time to strike is now -- in fifty years there will be nothing left to win. With each passing year, 30,000 more species are exterminated by mankind's epidemic numbers and industrial activity (pollution, habitat loss). Many large-animal species are in danger of extinction, becoming so small in number that they are effectively extinct. Each passing year sees a rise in the number of species made extinct, never to roam the Earth again. If global war happens this year, no more species will be made extinct from the habitat destruction and pollution of an exploding industrial human population. If global war happens next year, another 30,000 species are lost -- forever. If global war happens in ten years, another 300,000 species are extinct. Delay simply leads to the loss of more species and increases the likelihood of a “hothouse” destruction of the biosphere. If a global nuclear war happens now, the production of greenhouse gases stops. The point mentioned above about the depletion of the plant's fossil-fuel reserves warrants additional comment. A factor motivating a global nuclear war sooner rather than later is the desire to preserve the planet’s remaining fossil fuels. The world’s total original fossil fuel reserves have been about half used up. At current consumption rates, the remaining petroleum and natural gas will be used up within fifty years, and coal somewhat later. A similar situation holds for nuclear fuel (unless used in fast-breeder reactors, which produce plutonium, which may be used to make nuclear bombs). If global nuclear war occurs this year, and a single industrialized nation of five million takes control of the planet, it can be sustained on the solar energy flux. It would also have available, however, sufficient fossil fuel to last for thousands of years. It could safely burn the fossil fuel over a period of many generations, with a planet once again covered in forest and with healthy seas teeming with phytoplankton. This energy surplus could dramatically help the transition of mankind to the post-fossil-fuel era. Consuming all of the planet’s remaining fossil fuel in the mindless, hedonistic orgy of consumption that is currently in progress is a tragic waste. In summary, global war is increasingly likely because the misery and overcrowding caused by the large human population is rapidly increasing, and the benefits to be derived from war (i.e., a planet with full biodiversity and substantial remaining fossil fuel reserves, or a planet that is still biologically alive, in any condition) are rapidly decreasing. The conditions are ripe for global nuclear war, now. Motive, means, and opportunity are all in abundant supply.

### Bio-D

#### Warming destroys biodiversity—Leads to extinction

Hansen 2009 (James, James Hansen is member of the National Academy of Sciences, an adjunct professor in the Department of Earth and Environmental Sciences at Columbia University and at Columbia’s Earth Institute, and director of the NASA Goddard Institute for Space Studies, “Storms of my Grandchildren”, Published 2009)

As long as the total movement of isotherms toward the poles is much smaller than the size of the habitat, or the ranges in which the animals live, the effect on species is limited. But now the move­ment is inexorably toward the poles and totals more than one hun­dred miles over the past several decades. If greenhouse gases continue to increase at business-as-usual rates, then the rate of isotherm movement will double in this century to at least seventy miles per decade. Species at the most immediate risk are those in polar climates and the biologically diverse slopes of alpine regions. Polar animals, in effect, will be pushed off the planet. Alpine species will be pushed toward higher altitudes, and toward smaller, rockier areas with thinner air; thus, in effect, they will also be pushed off the planet. A few such species, such as polar bears, no doubt will be "rescued" by human beings, but survival in zoos or managed animal reserves will be small consolation to bears or nature lovers. Earth's history provides an invaluable perspective about what is possible. Fossils in the geologic record reveal that there have been five mass extinctions during the past five hundred million years— geologically brief periods in which about half or more of the species on Earth disappeared forever. In each case, life survived and new species developed over hundreds of thousands and millions of years. All these mass extinctions were associated with large and relatively rapid changes of atmospheric composition and climate. In the mostextreme extinction, the "end-Permian" event, dividing the Permian Triassic periods 251 million years ago, nearly all life on Earth— more than 90 percent of terrestrial and marine species—was exterminated. None of the extinction events is understood in full. Research is active, as increasingly powerful methods of "reading the rocks" are being developed. Yet enough is now known to provide an invalu­able perspective for what is already being called the sixth mass ex­tinction, the human-caused destruction of species. Knowledge of past extinction events can inform us about potential paths for the future and perhaps help guide our actions, as our single powerful species threatens all others, and our own. We do not know how many animal, plant, insect, and microbe species exist today. Nor do we know the rate we are driving species to extinction. About two million species—half of them being insects, including butterflies—have been cataloged, but more are dis­covered every day. The order of magnitude for the total is perhaps ten million. Some biologists estimate that when all the microbes, fungi, and parasites are counted, there may be one hundred million species. Bird species are documented better than most. Everybody has heard of the dodo, the passenger pigeon, the ivory-billed woodpecker—all are gone—and the whooping crane, which, so far, we have just barely "saved." We are still losing one or two bird species per year. In total about 1 percent of bird species have disap­peared over the past several centuries. If the loss of birds is repre­sentative of other species, several thousand species are becoming extinct each year. The current extinction rate is at least one hundred times greater than the average natural rate. So the concern that humans may have initiated the sixth mass extinction is easy to understand. However, the outcome is still very much up in the air, and human-made cli­mate change is likely to be the determining factor. I will argue that if we continue on a business-as-usual path, with a global warming of several degrees Celsius, then we will drive a large fraction of species, conceivably all species, to extinction. On the other hand, just as in the case of ice sheet stability, if we bring atmospheric composition under control in the near future, it is still possible to keep human-caus ed extinctions to a moderate level

#### Global Warming is already starting to cause species extinction – We must act now to reduce emissions in order to save the planet

Hansen 7/23 (James, James Hansen is member of the National Academy of Sciences, an adjunct professor in the Department of Earth and Environmental Sciences at Columbia University and at Columbia’s Earth Institute, and director of the NASA Goddard Institute for Space Studies, Perceptions of Climate Change:The New Climate Dice, <http://www.columbia.edu/~jeh1/mailings/2012/20120105_PerceptionsAndDice.pdf>, 7/23/12)

Although extreme heat waves and record floods receive most public attention, we wonder if there is not also a more pervasive effect of warming that affects almost everyone. Natural ecosystems are adapted to the stable climate of the Holocene. Climate fluctuations are normal, but the rapid monotonic global trend of the past three decades, from an already warm level, is highly unusual. The fact that warmer winters have led to an epidemic of pine bark beetles and widespread destruction of forests in Canada and western United States is well known. However, as an anecdotal data piece suggesting the possibility of more widespread effects, consider that several tree species (birch, pin oak, ash, some maple varieties) on the eastern Pennsylvania property of one of us (JH) exhibit signs of stress. Arborists identify proximate causes (borers and other pests, fungus, etc.) in each case, but climate change, including longer summers with more extreme temperature and moisture anomalies, could be one underlying factor. The tree species in this region have existed for millennia; it is implausible that Native Americans had to water the birch trees to keep them alive, as is the case at present during summers with anomalously hot summers. Climate change of recent decades is also having effects on animals, birds and insects that are already noticeable (17, 27, 28). Although species migrate to stay within climate zones in which they can survive, continued climate shift at the rate of the past three decades is expected to take an enormous toll on planetary life. If global warming approaches 3°C by the end of the century, it is estimated that 21-52% of the species on Earth will be committed to extinction (3). Fortunately, scenarios are also possible in which such large warming is avoided by placing a rising price on carbon emissions that moves the world to a clean energy future fast enough to limit further global warming to several tenths of a degree Celsius (29). Such a scenario is needed if we are to preserve life as we know it.

#### Biodiversity loss caused by global warming uniquely destroys any resilience or new species creation

Science Daily 2011 (Global Warming May Cause Higher Loss of Biodiversity Than Previously Thought, Science News, <http://www.sciencedaily.com/releases/2011/08/110824091146.htm>, 8/24/2011)

If global warming continues as expected, it is estimated that almost a third of all flora and fauna species worldwide could become extinct. Scientists from the Biodiversity and Climate Research Centre (Biodiversität und Klima Forschungszentrum, BiK-F) and the SENCKENBERG Gesellschaft für Naturkunde discovered that the proportion of actual biodiversity loss should quite clearly be revised upwards: by 2080, more than 80 % of genetic diversity within species may disappear in certain groups of organisms, according to researchers in the title story of the journal Nature Climate Change. The study is the first world-wide to quantify the loss of biological diversity on the basis of genetic diversity. Most common models on the effects of climate change on flora and fauna concentrate on "classically" described species, in other words groups of organisms that are clearly separate from each other morphologically. Until now, however, so-called cryptic diversity has not been taken into account. It encompasses the diversity of genetic variations and deviations within described species, and can only be researched fully since the development of molecular-genetic methods. As well as the diversity of ecosystems and species, these genetic variations are a central part of global biodiversity.¶ In a pioneering study, scientists from the Biodiversity and Climate Research Centre (BiK-F) and the Senckenberg Gesellschaft für Naturkunde have now examined the influence of global warming on genetic diversity within species.¶ Over 80 percent of genetic variations may become extinct¶ The distribution of nine European aquatic insect species, which still exist in the headwaters of streams in many high mountain areas in Central and Northern Europe, was modelled. They have already been widely researched, which means that the regional distribution of the inner-species diversity and the existence of morphologically cryptic, evolutionary lines are already known.¶ If global warming does take place in the range that is predicted by the Intergovernmental Panel on Climate Change (IPCC), these creatures will be pushed back to only a few small refugia, e.g. in Scandinavia and the Alps, by 2080, according to model calculations. If Europe's climate warms up by up to two degrees only, eight of the species examined will survive, at least in some areas; with an increase in temperature of 4 degrees, six species will probably survive in some areas by 2080. However, due to the extinction of local populations, genetic diversity will decline to a much more dramatic extent.¶ According to the most pessimistic projections, 84 percent of all genetic variations would die out by 2080; in the "best case," two-thirds of all genetic variations would disappear. The aquatic insects that were examined are representative for many species of mountainous regions of Central Europe.¶ Slim chances in the long term for the emergence of new species and species survival Carsten Nowak of the Biodiversity and Climate Research Centre (BiK-F) and the Senckenberg Gesellschaft für Naturkunde, explains: "Our models of future distribution show that the "species" as such will usually survive. However, the majority of the genetic variations, which in each case exist only in certain places, will not survive. This means that self-contained evolutionary lineages in other regions such as the Carpathians, Pyrenees or the German Central Uplands will be lost. Many of these lines are currently in the process of developing into separate species, but will become extinct before this is achieved, if our model calculations are accurate."¶ Genetic variation within a species is also important for adaptability to changing habitats and climatic conditions. Their loss therefore also reduces the chances for species survival in the long term.

### Amazon

#### Global Warming causes mass biodiversity loss in the Amazon through habitat loss that spills over to other species

Nogué et al 2009 (Sandra, PhD in palaeoecology and biodiversity conservation at the Botanical Institute of Barcelona, Dr. Valenti Rull is an extremely prolific author on the subject of tepui ecosystems and natural history, Teresa Vegas-Vilarrúbia2. Department of Animal Biology, Plant Biology and Ecology, Autonomous University of Barcelona, Modeling biodiversity loss by global warming on Pantepui, Northern South America: projected upward migration and potential habitat loss, <http://s3.amazonaws.com/publicationslist.org/data/vrull/ref-104/2009%20CLIMCH%20Pantepui.pdf>, 2/24/2009)

Due to the scarcity of ecological information available so far for the study area,¶ our results should be considered a first approach to the potential effects of the¶ global warming in Pantepui. SAR estimates are congruent, but EAR ones are¶ not (Table 1). Given the higher correlation coefficient of EA’R1, this equation is¶ tentatively preferred to EAR2. Estimates of potential extinction for endemic species¶ based on EAR are consistently higher than those obtained using ARD. This would¶ be due to the fact that ARD only measures habitat loss, while EAR implicitly¶ includes other ecological forcings into play. It should be noted that both PAR¶ and PAA are merely spatial components of the corresponding species’ niches, so¶ they should be considered as maximum (habitat) conditions for life. The inclusion¶ of other components, such as substrate availability and biotic interactions, would¶ constrain the potential niche and reduce the survival expectation. Other possible warming-related causes of extinction are secondary extinction, due to the extinction of dominant and keystone species (Ebenman and Jonsson 2005), and competitive exclusion because of the upward migration of successful invaders from lowlands and midlands (Clubbe 1996). Hence, the potential extinction estimated according to PAR¶ and PAA modeling should be viewed as a minimum expectation.¶ In summary, according to the SAR/EAR models, the expected extinction by global warming for Pantepui vascular plant species byAD2100 is of the order of 80% (>1,700 species), and the extinction of Pantepui endemics would be between around¶ 30–50% (ca. 200 to 400 species). The risk of total habitat loss would affect between 20% and 45% of endemics (ca. 170 to 340 species), which have been identified¶ individually. The relatively flat topography of the tepui summits (Fig. 2) is a crucial differential feature that enhances habitat loss because it prevents the threatened species to migrate upwards (Rull and Vegas-Vilarrúbia 2006). Moreover, the PAA¶ maps obtained should be analyzed to evaluate potential additional extinction risk¶ by critical habitat reduction and fragmentation. Pantepui is considered to be an important speciation center for the Guayana and the Amazon regions (Rull 2005).¶ Therefore, a reduction of 70–90% in its surface, as predicted by our analyses, would seriously compromise the capacity of generating new biodiversity in the future¶ (Rosenzweig 2001).

## Food/Agriculture

#### Global Warming causes rising food costs, hurting the economy

Lobell et al 2011 (David,Department of Environmental Earth System Science and Program on Food Security and the Environment, Stanford University, Wolfram Schlenker, Department of Economics and School of International and Public Affairs, Columbia University, Justin Costa-Roberts, National Bureau of Economic Research, Climate Trends and Global Crop Production Since 1980, <http://www.sciencemag.org/content/333/6042/616.full#aff-1>, 5/5/2011)

The fact that climate impacts often exceed 10% of the rate of yield change indicates that climate changes are already exerting a considerable drag on yield growth. To further put this in perspective, we have calculated the impact of climate trends on global prices using recent estimates of price elasticities for global supply and demand of calories (23). The estimated changes in crop production excluding and including CO2 fertilization (subtotal and total columns in Table 1, respectively) translate into average commodity price increases of 18.9% and 6.4% when we use the same bootstrap procedure as used in table 3 of (22). Our study considers production of four major commodities at national scales. There are many important questions at subnational scales that our models cannot address, many important foods beyond the four modeled here, and many important factors other than food production that determine food security. Nonetheless, we contend that periodic assessments of how climate trends are affecting global food production can provide some useful insights for scientists and policy makers. This type of analysis should be accompanied by studies that evaluate the true pace and effectiveness of adaptation responses around the world, particularly for wheat and maize. By identifying countries where the pace of climate change and associated yield pressures are especially fast, our study should facilitate these future analyses. Without successful adaptation, and given the persistent rise in demand for maize and wheat, the sizable yield setback from climate change is likely incurring large economic and health costs.

#### Global Warming destroys crop productivity, leading to hunger, economic crisis, and international conflict

Hanjra and Qureshi 2010 (Munir, International Centre of Water for Food Security, Charles Sturt University, and M. Ejaz, Fenner School of Environment and Society, The Australian National University, Global water crisis and future food security in an era of climate change, <http://www.sciencedirect.com/science/article/pii/S030691921000059X>, Science Direct 6/5/2010)

Climatechange poses significant threats to global food security and peace due to changes in water supply and demand ( [Alcamo et al., 2007], [Barnett et al., 2005], [Döll and Siebert, 2002] and [Spash, 2008a]), impacts on crop productivity ( [Droogers, 2004] and [Droogers and Aerts, 2005]), impacts on food supply ( [Arnell et al., 2004] and [Rosenzweig and Parry, 1994]), and high costs of adaptation to climatechange (Kandlikar and Risbey, 2000).¶ Climate change may affect agriculture and food security by altering the spatial and temporal distribution of rainfall, and the availability of water, land, capital, biodiversity and terrestrial resources. It may heighten uncertainties throughout the food chain, from farm to fork and yield to trade dynamics, and ultimately impact on the global economy, food security and the ability to feed nine billion people by 2050. Modelling by IIASA (Fischer et al., 2007) shows that future socioeconomic development and climate change may impact on regional and global irrigation requirements and thus on agricultural water withdrawals. Net irrigation requirements may increase by 45% by 2080. Even with improvements in irrigation efficiency, gross water withdrawals may increase by 20%. Global irrigation requirements with climate change will increase by 20% above the reference base case scenario (without climatechange). The simulation shows that the global impacts of climatechange on irrigation water requirements could be as large as the projected increase in irrigation due to socioeconomic development.¶ The impacts of climatechange on global food production are small but geographically very unevenly distributed, with losses felt mostly in arid and sub-humid tropics in Africa and South Asia (Parry et al., 2001) and particularly in poor countries with low capacity for adaptation (Kurukulasuriya et al., 2006). Some fairly robust conclusions that emerge from climatechange analysis on agriculture and food availability ( [Parry et al., 2001] and [Tubiello and Fischer, 2007]) show that: (a) there will be food shortages due to decrease in net global agricultural production and disrupted access to water and energy; (b) a likely increase in the number of people at risk of hunger; (c) the impact on undernourishment will depend mainly on the level of economic development and poverty reduction achieved in the future and its positive effects on distribution, and human responses to climatechange; (d) mitigation of climatechange can have significant positive effects on agricultural productivity and food security; and (e) current production and consumption gaps between developed and developing countries will deepen; and unmitigated climatechange and the small risk of abrupt climatechange may cause “human carrying capacity deficit”, suggesting insufficient resources leading to economic menace, global conflict and population contraction (Alley et al., 2005).¶ Climatechange will impact on crop productivity, with implications for food security ( [Spash, 2008a] and [Spash, 2008b]). Globalwarming has been speculated to increase yields due to the “fertilizer effect” of rising atmospheric carbon, but the impacts are likely to be net negative for poor countries. For example, globalwarming will reduce food production in countries closer to the equator (Droogers and Aerts, 2005). African countries will experience prolonged droughts and further food shortages. It is likely that the Pacific Islands and Indonesia will be more dependent on imports and face more poverty and other social problems. A recent IWMI study (de Fraiture et al., 2008) anticipates a 50% decline in South Asian wheat production by 2050 – equal to about 7% of the global crop production. The Peterson Institute (Cline, 2007) states that agricultural production in developing countries may fall between 10% and 25%, and if globalwarming is unabated, India’s agricultural capacity could fall by as much as 40%.Climatechange could impact on rainfall and runoff and the availability of water for irrigation in many regions and countries in the world. A decline in rainfall along with an increase in temperature will increase crop water requirement due to high evapotranspiration while less rainfall will increase crop net irrigation water requirements. As a result, the already existing water scarcity problem will exacerbate in many regions and countries, and affect food production. The hardest hit will be the areas with intense water scarcity and food security issues, such as the arid countries of sub-Saharan Africa and parts of South Asia, which are already prone to malnutrition, poverty, and even episodes of hunger ( [Brown and Lall, 2006], [Brown and Funk, 2008] and [Funk et al., 2008]).

## Sea Level Rise

#### Global warming causes sea levels to rise – Cutting emissions would stabilize sea level rise

Eco News 6/25 (Zeenews.com , “Global warming can lead to significant sea level rise” <http://zeenews.india.com/news/eco-news/global-warming-can-lead-to-significant-sea-level-rise_783685.html> 6/25/2012)

Berlin: If global temperatures continue to go up unabated, sea levels around the world could rise by up to five metres in coming centuries, which will severely affect low-lying countries like Bangladesh and several small islands nations, a new study has claimed. The study, published in journal Nature Climate Change, is the first to give a comprehensive projection for such long perspective, based on observed sea-level rise over the past millennium, as well as on scenarios for future greenhouse-gas emissions.

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"Sea-level rise is a hard to quantify, yet critical risk of climate change," said lead study author Michiel Schaeffer of Wageningen University in the Netherlands. "Due to the long time it takes for the world's ice and water masses to react to global warming, our emissions today determine sea levels for centuries to come," said Schaeffer, also the director of Climate Analytics in Germany. Study co-author Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research in Germany described the potential impacts of rising temperatures as very significant. "As an example, for New York City it has been shown that one metre of sea level rise could raise the frequency of severe flooding from once per century to once every three years," Rahmstorf said. Also, low lying deltaic countries like Bangladesh and many small island states are likely to be severely affected, Rahmstorf added. However, the scientists said, limiting global warming could considerably reduce sea-level rise. While the study suggests that even at relatively low levels of global warming, the world will have to face significant sea-level rise, it also demonstrates the benefits of reducing greenhouse-gas emissions, they said. Limiting global warming to below 1.5 degrees Celsius and subsequent temperature reductions could halve sea-level rise by 2300, compared to a two-degree scenario, they said. But, if temperatures are allowed to rise by 3 degrees, the expected sea-level rise could range between two and five metres, with the best estimate being at 3.5 metres, they warned. The scientists further stated that the warmer the climate gets, the faster the sea level climbs and coastal communities have less time to adapt if sea-levels rise faster. "In our projections, a constant level of 2-degree warming will sustain rates of sea-level rise twice as high as observed today, until well after 2300," Schaeffer said. "But much deeper emission reductions seem able to achieve a strong slow-down, or even a stabilisation of sea level over that time frame." The researchers also pointed out that past multi-century projections of sea-level rise by the Intergovernmental Panel on Climate Change (IPCC) were limited to the rise caused by thermal expansion of the ocean water as it heats up, which the IPCC found could reach up to a metre by 2300. However, this estimate didn't include the potentially larger effect of ice melting. The new study is using a complementary approach, called semi-empirical, that is based on using the connection between observed temperature and sea level during past centuries in order to estimate sea-level rise for scenarios of future global warming, they stated. "Of course it remains open how far the close link between temperature and global sea level found for the past will carry on into the future," Rahmstorf said. "Despite the uncertainty we still have about future sea level, from a risk perspective our approach provides at least plausible, and relevant, estimates."

#### Sea level rise threatens to erase coastal and island communities

Oliver-Smith 2009 (Anthony, Anthony Oliver-Smith holds the Munich Re Foundation Chair on Social Vulnerability at the United Nations University Institute for Environment and Human Security in Bonn, Germany. He is also Professor Emeritus of Anthropology at the University of Florida, Sea Level Rise and the Vulnerability of Coastal Peoples, <http://indiaenvironmentportal.org.in/files/sea%20level%20rise%20and%20vulunerability.pdf>, July 2009)

In the total range of effects of significant sea level rise it is only¶ possible at the extreme of complete and permanent inundation to¶ state that people will be unequivocally displaced. If the land that a¶ community occupies and exploits is completely and permanently¶ submerged, displacement will occur. However, there are many aspects¶ of sea level rise that will affect the sustainability of coastal peoples and communities, but may or may not pressure people to move.¶ Coastal storm surges, subsidence and erosion, salinization of ground water and rising water tables, and impeded drainage all may seriously impact both residence and agricultural production in vulnerable communities. Wetlands, estuaries and mangroves, constituting both the ecological and economic base, of many coastal communities may be seriously damaged by sea level rise, requiring adaptation, mitigation or forcing people to leave. In resilient communities, sea level rise¶ changes that fall short of total submergence may be adapted to¶ and/or mitigated by a variety of strategies. Mitigation and adaptation¶ will generally be characterized by changes in technology and social¶ (and economic) organization. Restoration of mangroves and wetlands¶ or protective structures (dikes, levies, etc) may afford sufficient defenses¶ from storm surges. Or adaptive strategies, such as adoption of new¶ forms of economic activities, may enable people to adapt to changing¶ conditions. However, while the effects of sea level rise may in many¶ cases be gradual, they will probably not be gradual enough to avoid the disorientation that comes from the loss of familiar staple crops,¶ the failure of traditional livelihoods or the transformation of known environments. People may adapt, but the process promises to be disruptive and difficult, particularly for indigenous peoples whose relationship to their environment tends to provide a key element in their identity.

#### Sea Level Rise threatens small island nations who are largely unresponsible for warming. Failure by rich nations, the ones responsible for emissions, is genocide

RNW 2009 (Radio Netherlands Worldwide, Small island nations call global warming suicide, AOSIS, <http://www.rnw.nl/english/article/small-island-nations-call-global-warming-suicide>, 9/22/2009)

AOSIS met this morning before today's one-day Summit on Climate Change to be held at the United Nations in New York. World leaders will try to agree on the general conditions of a new deal to combat global warming due to be hammered out in Copenhagen in December.¶ UN Secretary General Ban Ki-moon will lead today's discussions. US President Barack Obama is to address the summit. It is expected that Chinese President Hu Jintao will unveil measures to tackle his country's emissions, the "carbon intensity targets".¶ ¶ The small island nations of AOSIS, which include the Maldives, Tuvalu and Papua New Guinea, are some of the most vulnerable countries - subject to flooding from rising seas as ice melts from global warming. They are also among the least responsible for the emissions blamed for warming the planet. The small island countries could also face more frequent devastating storms as a result of temperature increases. Prime Minister Tillman Thomas of AOSIS-member Grenada said that a failure to act by rich countries would be tantamount to a kind of "benign genocide".¶ ¶ In July of this year, the G8 countries and a 17-country group of the world's biggest greenhouse gas emitters, the Major Economies Forum, agreed in Italy that average global temperatures should not be allowed to rise more than 2 degrees Celsius above pre-industrial levels.

#### Favoring of economics by developed emission source states has lead to indigenous populations being forced from their homes in order to benefit developed states

UN General Assembly 2008 (Department of Public Information, 63rd General Assembly, REELING FROM IMPACTS OF GLOBAL WARMING, SMALL ISLAND STATES URGE GENERAL ASSEMBLY TO TAKE COMPREHENSIVE ACTION, <http://www.un.org/News/Press/docs/2008/ga10754.doc.htm>, 9/25/2008)

Already threatened by environmental degradation, rising sea levels and other threats posed by climate change, small island developing States were now being pummelled by soaring fuel prices that made transportation of food and other essential commodities prohibitively expensive, leaders of those nations told the General Assembly today. In the Marshall Islands, for example, the high fuel prices had curtailed the distribution of food and essential services, crippling the country’s ability to sustain normal public services, that country’s President, Litokwa Tomeing, told world leaders gathered in New York for the third day of the sixty-third General Assembly’s annual general debate. Acknowledging that his country had had to declare a state of economic emergency, he urged Assembly delegations to create a comprehensive financial facility that would help the 51 small island developing States spread around the globe, often in very remote areas, to cope during the crises. Such a plan might also help such countries shift from the use of fossil fuels to more affordable renewable energy sources. He said the Marshall Islands could not alter the size or height of the islands to deal with rising sea levels. If the sea level rose by two metres, Tokelau, Tuvalu and the Marshall Islands would be completely submerged under the sea. The issue, therefore, demanded an effective and immediate global response, and he urged the United Nations to elevate that threat as “justification for all-out war against climate change”. For his part, Anote Tong, President of Kiribati, said that, for years, island States had “tirelessly” pleaded with the United Nations to provide solutions for those seriously affected by the detrimental impacts of global warming. Those pleas had failed to produce practical solutions, especially for people living in low-lying small island developing States like Kiribati. The science on the matter was now irrefutable, as the fourth assessment report of the Intergovernmental Panel on Climate Change had projected an increase in sea-level rise of 0.4 metres within this century. Low-lying small island developing States, like Kiribati, were on the “frontlines” of the global warming calamity, and mitigation efforts would not be able to reverse their situation, he said. Though it was not a major emitter of greenhouse gasses, Kiribati, with its limited resources, would still do its part to explore renewable and efficient energy technologies. Meanwhile, island States would need to face up to the reality of being unable to support life, and plan accordingly. His Government had developed a long-term relocation strategy for people forced to leave their homes, “so that when people migrate, they will migrate on merit and with dignity”. Seychelles’ President James A. Michel said it was not right that small islands risked being submerged by rising seas while other nations refused to acknowledge their responsibility for the environmental pollution that threatened the planet’s resources. With the support of international non-governmental organizations, Seychelles had started a global movement –- the Global Island Partnership -- to get all small island States, and nations with islands, to devote part of their natural resources to environmental resilience and sustainability. He also criticized the skewed nature of global trade and foreign investors’ exploitation of the country’s natural resources. “Of the total value of tuna – our ‘blue gold’ - caught and transhipped in our waters by foreign fishing vessels every year, the Seychelles receives only 7 per cent in revenue, comprising license and transhipment fees. This to my mind is unacceptable,” he said.

## AT: Carbon Sinks

#### AmazonToo Late – Warming already caused two unnatural droughts that reversed the Amazon carbon sink effect, emitting as much CO2 as cars

Smoucha 2011 (Emily, University of Missouri Bachelor of. Journalism, minor in Biology, Scientists fear drought could reverse ‘carbon sink’ effect of Amazon, GreenWise Business, <http://www.greenwisebusiness.co.uk/news/scientists-fear-drought-could-reverse-carbon-sink-effect-of-amazon-2091.aspx>, 2/4/2011)

The Amazon, which acts as a 'carbon sink’ – absorbing billions of tonnes of CO2 from the atmosphere – was hit by a "once a in century" drought in 2005. Only five years later, the 2010 drought may have been even more devastating, according to rainfall analysis by researchers from the UK and Brazil. This is leading to concerns that the area will release more carbon than it absorbs.¶ As well as millions of plants and animals, the drought has killed off millions of trees. Instead of working to reduce CO2 levels, the now rotting trees release CO2 back into the atmosphere as they decay. ¶ Rising CO2 levels are of major concern. The Amazon rainforest, which is about 25 times the size of the UK, acts as a natural defence against rising CO2 levels because the trees absorb approximately 1.5 billion tonnes each year.¶ "If greenhouse gas emissions contribute to Amazon droughts that in turn cause forests to release carbon, this feedback loop would be extremely concerning," said Dr. Simon Lewis of the University of Leeds. "Put more starkly, current emissions pathways risk playing Russian roulette with the world's largest rainforest."¶ Research findings¶ The researcher’s estimates are certainly grim. For both 2010 and 2011, they don’t expect the forest to absorb the 1.5 billion tonnes of CO2 it usually does. In fact, as the trees rot, they expect the forest to release more than five billion tonnes, almost as much as the United States released in fossil fuel emissions in 2009.¶ After the drought in 2005, the research team, co-led by Lewis and Dr. Paulo Brando from Brazil’s Amazon Environmental Research Institute, estimated an additional five billion tonnes of CO2 would be released. ¶ "We will not know exactly how many trees were killed until we can complete forest measurements on the ground," Brando said. "It could be that many of the drought susceptible trees were killed off in 2005, which would reduce the number killed last year. On the other hand, the first drought may have weakened a large number of trees so increasing the number dying in the 2010 dry season."¶ The concern swells with the possibility that "rare" droughts of this magnitude may become more frequent.¶ "Having two events of this magnitude in such close succession is extremely unusual, but is unfortunately consistent with those climate models that project a grim future for Amazonia," Lewis said.

### Permafrost

#### Climate change is eliminating the carbon sink effect

England, Gupta, and Pitman 2009 (Matthew, Alexander, and Andrew, Climate Change Research Centre, University of New South Wales, Constraining future greenhouse gas emissions by a cumulative target, PNAS, <http://www.pnas.org/content/106/39/16539.full>, 9/22/2009)

The anthropogenic carbon stored in the oceans and terrestrial biosphere has acted as a tremendous buffer of climate change to date; these systems have absorbed more than half of our industrial emissions (6). Yet the ability of these stores to sequester carbon is changing over time. Fifty years ago natural carbon sinks removed ≈600 kg of every ton of CO2 emitted to the atmosphere. Today, these sinks remove only ≈550 kg per ton emitted (6), and this amount is expected to continue to fall (3, 4). There are also risks of abrupt change in the terrestrial carbon sink; for example, climate change could trigger Amazon forest die-back (7), and permafrost melt could expose northern peatlands to large releases of carbon (8), both resulting in strong positive feedbacks. In short, the carbon sinks that have served us so well are by no means stable: they are changing and, unfortunately, changing in the wrong sense. Add to this land clearing and the associated release of CO2 and loss of natural carbon storage (9), and the combined land–ocean sink is showing diminishing returns in time.

### Oceans

#### Ocean sinks only work if we act now to reverse global warming. Otherwise, carbon sinks will become carbon sources

Venkataramanan and Smitha 2011 (M., Department of Economics, D.G. Vaishnav College “Causes and effects of global warming, Indian Journal of Science p.226-229 http://www.indjst.org/archive/vol.4.issue.3/mar11-pages159-265.pdf March 2011)

Causes of global warming: The buildup of carbon dioxide in the atmosphere, mainly from your fossil fuel emissions, is the most significant human cause of global warming. Carbon dioxide is released every you burn something, be it a car, airplane or coal plant. This means you must burn less fossil fuel if you want the Earth's climate to remain stable! And unfortunately, we are currently destroying some of the best known mechanisms for storing that carbon-plants. Deforestation increases the severity of global warming as well. Carbon dioxide is released from the human conversion of forests and grasslands into farmland and cities. All living plants store carbon. When those plants die and decay, carbon dioxide is released back into the atmosphere. As forests and grasslands are cleared for your use, enormous amounts of stored carbon enter the atmosphere. An unstoppable feedback loop may happen if you let this continue. If the activities mentioned above warm the Earth just enough, it could cause natural carbon sinks to fail. A "carbon sink" is a natural system that stores carbon over thousands of years. Such sinks include peat bogs and the arctic tundra. But if these sinks destabilize, that carbon will be released, possibly causing an unstoppable and catastrophic warming of the Earth. The oceans are no longer able to store carbon as they have in the past. The ocean is a huge carbon sink, holding about 50 times as much carbon as the atmosphere. But now scientists are realizing that the increased thermal stratification of the oceans has caused substantial reductions in levels of phytoplankton, which store CO2. Increased atmospheric carbon is also causing an acidification of the ocean, since carbon dioxide forms carbonic acid when it reacts with water. The tiny plants of the ocean, the very bottom of that vast watery food chain, are suffering from the effects of global warming, which means they are becoming less able to store carbon, further contributing to climate change. As carbon sinks fail, the amount of carbon in the atmosphere climbs!

#### Climate change destroys oceans ability to uptake carbon

McKinley 2011 (Galen, Assistant Professor of Atmospheric and Oceanic Sciences at the University of Wisconsin-, Climate change reducing ocean's carbon dioxide uptake <http://www.eurekalert.org/pub_releases/2011-07/uow-ccr070711.php>, July 10th)

How deep is the ocean's capacity to buffer against climate change? As one of the planet's largest single carbon absorbers, the ocean takes up roughly one-third of all human carbon emissions, reducing atmospheric carbon dioxide and its associated global changes. But whether the ocean can continue mopping up human-produced carbon at the same rate is still up in the air. Previous studies on the topic have yielded conflicting results, says University of Wisconsin-Madison assistant professor Galen McKinley. In a new analysis published online July 10 in *Nature Geoscience,* McKinley and her colleagues identify a likely source of many of those inconsistencies and provide some of the first observational evidence that climate change is negatively impacting the ocean carbon sink. "The ocean is taking up less carbon because of the warming caused by the carbon in the atmosphere," says McKinley, an assistant professor of atmospheric and oceanic sciences and a member of the Center for Climatic Research in the Nelson Institute for Environmental Studies. The analysis differs from previous studies in its scope across both time and space. One of the biggest challenges in asking how climate is affecting the ocean is simply a lack of data, McKinley says, with available information clustered along shipping lanes and other areas where scientists can take advantage of existing boat traffic. With a dearth of other sampling sites, many studies have simply extrapolated trends from limited areas to broader swaths of the ocean. McKinley and colleagues at UW-Madison, the Lamont-Doherty Earth Observatory at Columbia University, and the Universite Pierre et Marie Curie in Paris expanded their analysis by combining existing data from a range of years (1981-2009), methodologies, and locations spanning most of the North Atlantic into a single time series for each of three large regions called gyres, defined by distinct physical and biological characteristics. They found a high degree of natural variability that often masked longer-term patterns of change and could explain why previous conclusions have disagreed. They discovered that apparent trends in ocean carbon uptake are highly dependent on exactly when and where you look – on the 10- to 15-year time scale, even overlapping time intervals sometimes suggested opposite effects. "Because the ocean is so variable, we need at least 25 years' worth of data to really see the effect of carbon accumulation in the atmosphere," she says. "This is a big issue in many branches of climate science – what is natural variability, and what is climate change?" Working with nearly three decades of data, the researchers were able to cut through the variability and identify underlying trends in the surface CO2 throughout the North Atlantic. During the past three decades, increases in atmospheric carbon dioxide have largely been matched by corresponding increases in dissolved carbon dioxide in the seawater. The gases equilibrate across the air-water interface, influenced by how much carbon is in the atmosphere and the ocean and how much carbon dioxide the water is able to hold as determined by its water chemistry. But the researchers found that rising temperatures are slowing the carbon absorption across a large portion of the subtropical North Atlantic. Warmer water cannot hold as much carbon dioxide, so the ocean's carbon capacity is decreasing as it warms. In watching for effects of increasing atmospheric carbon on the ocean's uptake, many people have looked for indications that the carbon content of the ocean is rising faster than that of the atmosphere, McKinley says. However, their new results show that the ocean sink could be weakening even without that visible sign. "More likely what we're going to see is that the ocean will keep its equilibration but it doesn't have to take up as much carbon to do it because it's getting warmer at the same time," she says. "We are already seeing this in the North Atlantic subtropical gyre, and this is some of the first evidence for climate damping the ocean's ability to take up carbon from the atmosphere." She stresses the need to improve available datasets and expand this type of analysis to other oceans, which are relatively less-studied than the North Atlantic, to continue to refine carbon uptake trends in different ocean regions. This information will be critical for

## AT: CO2 Fertilization

#### No Increased Food Production from CO2: Drought

Word Press 2009 (Environmental Ethics and News, Increased Carbon Dioxide Emissions? Bye Plants!, <http://jesusandtheorangutan.wordpress.com/2009/01/10/carbondioxideandplants/>, 1/10/2009)

However, with our rising CO2 levels, the situation is quite different. When plants have an increased rate of respiration (they are “breathing” more CO2 to grow faster), they also need more water. It’s like if we were running a race, we need more water than if we were simply walking. Our CO2 excess has not come with increased rainfall. In fact, in many areas of the globe, we’re seeing less rainfall. Sadly, what rainfall these plants do get is increasingly toxic. “Acid rain” is now the norm – which means that the rainwater gets more acidic due to emissions largely from coal plants (sulfur and nitrous oxide). The plants suffer – many studies have documented the die-off of trees in North America due to acid rain (read Dying of the Trees by Charles Little). CO2 is a greenhouse gas – which means it’s contributing to the warming of the earth. This warming means that many plants’ ideal habitats are moving up mountain slopes and towards the poles, where it is cooler. Trees, which take a long time to move, reproductively, will be at a particular disadvantage. Some trees are just beginning to make it back to their ranges before the last glaciation. They can’t keep up with the rapid-change of human-induced global warming. In summary, our CO2 emissions are not good for plants, mainly because they come with a whole host of other toxic chemicals, and they do not come with increased rainfall. Human-induced global warming is also not good for most plants, including the ones we rely on most, because plants cannot move quickly enough to adjust to their moving ideal habitats.

#### CO2 emissions destroy plant nutrients and will decrease crop yield by 20% by 2050

Rudolf 2010 (John Collins, New York Times Journalist, It’s Love-Hate: Plants and Carbon Dioxide, New York Times, <http://green.blogs.nytimes.com/2010/05/21/its-love-hate-plants-and-carbon-dioxide/>, 5/21/2010)

This video, This video, released in 1991 and financed by the Western Fuels Association, a coal supplier, insisted that the unrestrained burning of fossil fuels would be a great thing, ushering in an epoch of bountiful plant growth and soaring grain yields. Its makers earned scorn for their blithe dismissal of the negative consequences of runaway emissions, from melting ice caps and rising seas to ocean acidification and intensified storms. Yet elements of their central thesis – that elevated levels of carbon dioxide would boost plant growth – were widely accepted by the scientific establishment at the time. Two decades later, science takes a far less rosy view. In 2005, Britain’s Royal Society determined that the benefit to crops of added carbon dioxide were far less pronounced under real-world conditions than in laboratory experiments. Other studies have found the nutritional content of crops falling as carbon dioxide levels rose. The promised “greening” of the planet, it seems, is not working out as advertised. “It’s less clear that we’re going to have an overall benefit,” said Arnold J. Bloom, a professor of plant science at the University of California at Davis. “In most cases it seems that the decline in nutrition is going to be greater than anyone expected.” These declines in nutrition content have puzzled investigators. Yet in a study published this month in the journal Science, a team of researchers led by Dr. Bloom may have found a cause. According to their findings, higher levels of carbon dioxide interfere with plants’ ability to process nitrate, a vital soil nutrient, stunting the growth of key proteins. “Nitrogen levels in most plants decline as they are exposed to higher levels of carbon dioxide,” Dr. Bloom said. “That’s a bad thing.” The implications for global food security are profound. If emissions continue to increase at present rates, global yields of wheat and other crops could drop as much as 20 percent by 2050, the study found. Careful adjustments in fertilizer use could blunt these impacts, but would probably be difficult for today’s industrial-scale farms to manage. The steady decline of the earth’s forests – previously linked to increases in air temperature – may also be related to the effect of carbon emissions on nitrogen levels, Dr. Bloom said.

## AT: Ice Age

#### They’ve got it backwards – Global warming is what causes the ice age – Historically proven

Hartmann 2004 (Thom, Radio/TV host, political commentator, author, former psychotherapist, former entrepreneu, How Global Warming May Cause the Next Ice Age…, Common Dreams, <http://www.commondreams.org/views04/0130-11.htm>, 1/30/2004)

What brought on this sudden "disappearance of summer" period was that the warm-water currents of the Great Conveyor Belt had shut down. Once the Gulf Stream was no longer flowing, it only took a year or three for the last of the residual heat held in the North Atlantic Ocean to dissipate into the air over Europe, and then there was no more warmth to moderate the northern latitudes. When the summer stopped in the north, the rains stopped around the equator: At the same time Europe was plunged into an Ice Age, the Middle East and Africa were ravaged by drought and wind-driven firestorms. . If the Great Conveyor Belt, which includes the Gulf Stream, were to stop flowing today, the result would be sudden and dramatic. Winter would set in for the eastern half of North America and all of Europe and Siberia, and never go away. Within three years, those regions would become uninhabitable and nearly two billion humans would starve, freeze to death, or have to relocate. Civilization as we know it probably couldn't withstand the impact of such a crushing blow. And, incredibly, the Great Conveyor Belt has hesitated a few times in the past decade. As William H. Calvin points out in one of the best books available on this topic ("A Brain For All Seasons: human evolution & abrupt climate change"): ".the abrupt cooling in the last warm period shows that a flip can occur in situations much like the present one. What could possibly halt the salt-conveyor belt that brings tropical heat so much farther north and limits the formation of ice sheets? Oceanographers are busy studying present-day failures of annual flushing, which give some perspective on the catastrophic failures of the past. "In the Labrador Sea, flushing failed during the 1970s, was strong again by 1990, and is now declining. In the Greenland Sea over the 1980s salt sinking declined by 80 percent. Obviously, local failures can occur without catastrophe - it's a question of how often and how widespread the failures are - but the present state of decline is not very reassuring." Most scientists involved in research on this topic agree that the culprit is global warming, melting the icebergs on Greenland and the Arctic icepack and thus flushing cold, fresh water down into the Greenland Sea from the north. When a critical threshold is reached, the climate will suddenly switch to an ice age that could last minimally 700 or so years, and maximally over 100,000 years. And when might that threshold be reached? Nobody knows - the action of the Great Conveyor Belt in defining ice ages was discovered only in the last decade. Preliminary computer models and scientists willing to speculate suggest the switch could flip as early as next year, or it may be generations from now. It may be wobbling right now, producing the extremes of weather we've seen in the past few years. What's almost certain is that if nothing is done about global warming, it will happen sooner rather than later.

#### Even if they win that the ice age is coming, global warming can’t stop it

Cocks 2010 (Professor Franklin Hadley, teaches energy technology and climate-related courses at Duke University, Global Warming vs. the Next Ice Age, Technology Review by MIT, <http://www.technologyreview.com/mitnews/416786/global-warming-vs-the-next-ice-age/>, January 2010)

There's little question that global warming is happening. Climate data show that Earth's average temperature has risen at least 0.7 oC (1.3 oF) over the 20th century. Temperature increases over the 21st century will probably be two and a half to five times as large,because greenhouse gases like carbon dioxide allow sunlight to penetrate the atmosphere but make it harder for outgoing infrared radiation to escape. What's more, just as carbonated soda fizzes when it warms up, warmer temperatures cause the ocean to release carbon dioxide taken up during colder periods. Analyses of air trapped in glacial ice over the last 800,000 years show that atmospheric carbon dioxide generally ranged between 200 and 300 parts per million by volume (ppmv); increases in these levels were slightly preceded by increases in temperature caused by natural orbital shifts. During this period, global temperature varied by about 12 oC. Now, carbon levels are approaching 400 ppmv as the burning of fossil fuels pumps more and more carbon dioxide into the atmosphere. Even if the rate of growth could be moderated enough to stabilize levels at about 550 ppmv, average temperatures might well rise by about 5 oC--with devastating effects for us earthlings, such as rising sea levels and dramatic changes in weather patterns. But even that warming will not stave off the eventual return of huge glaciers, because ice ages last for millennia and fossil fuels will not.In about 300 years, all available fossil fuels may well have been consumed.Over the following centuries, excess carbon dioxide will naturally dissolve into the oceans or get trapped by the formation of carbonate minerals. Such processes won't be offset by the industrial emissions we see today, and atmospheric carbon dioxide will slowly decline toward preindustrial levels. In about 2,000 years, when the types of planetary motions that can induce polar cooling start to coincide again, the current warming trend will be a distant memory.

#### Global Warming melts ice caps which causes and ice age

Choi 2009 (Charles Q., Freelance journalist with an MA from the University of Missouri, Big Freeze: Earth Could Plunge into Sudden Ice Age, Live Science, <http://sweetness-light.com/archive/global-warming-could-cause-ice-age>, 12/2/2009)

In the film, "The Day After Tomorrow," the world gets gripped in ice within the span of just a few weeks. Now research now suggests an eerily similar event might indeed have occurred in the past. Looking ahead to the future, there is no reason why such a freeze shouldn’t happen again — and in ironic fashion it could be precipitated if ongoing changes in climate force the Greenland ice sheet to suddenly melt, scientists say. Starting roughly 12,800 years ago, the Northern Hemisphere was gripped by a chill that lasted some 1,300 years. Known by scientists as the Younger Dryas and nicknamed the "Big Freeze," geological evidence suggests it was brought on when a vast pulse of fresh water — a greater volume than all of North America’s Great Lakes combined — poured into the Atlantic and Arctic Oceans. This abrupt influx, caused when the glacial Lake Agassiz in North America burst its banks, diluted the circulation of warmer water in the North Atlantic, bringing this "conveyer belt" to a halt. Without this warming influence, evidence shows that temperatures across the Northern Hemisphere plummeted. No time to react Previous evidence from Greenland ice samples had suggested this abrupt shift in climate happened over the span of a decade or so. Now researchers say it surprisingly may have taken place over the course of a few months, or a year or two at most. "That the climate system can turn on and off that quickly is extremely important," said earth system scientist Henry Mullins at Syracuse University, who did not take part in this research. "Once the tipping point is reached, there would be essentially no opportunity for humans to react." … Chilly future Looking ahead to the future, [isotope biogeochemist William] Patterson [for the University of Saskatchewan in Canada] said there was no reason why a big freeze shouldn’t happen again. "If the Greenland ice sheet melted suddenly it would be catastrophic," he said. This kind of scenario would not discount evidence pointing toward global warming — after all, it leans on the Greenland ice sheet melting. "We could say that global warming could lead to a dramatic cooling," Patterson told LiveScience. "This should serve as a further warning rather than a pass." "People assume that we’re political, that we’re either pro-global-warming or anti-global-warming, when it’s really neither," Patterson added. "Our goal is just to understand climate." Patterson and his colleagues detailed their findings at the European Science Foundation BOREAS conference on humans in the Arctic, in Rovaniemi, Finland.

## Prodicts

### IPCC

#### **The IPCC is peer-reviewed and mistakes are blown out of proportion by media spin.**

Realclimate ’10 (RealClimate.com, a commentary site on climate science by working climate scientists for the interested public and journalists, “IPCC Errors: Facts and Spin,” http://www.realclimate.org/index.php/archives/2010/02/ipcc-errors-facts-and-spin/, AM)

#### Currently, a few errors –and supposed errors– in the last IPCC report (“AR4″) are making the media rounds – together with a lot of distortion and professional spin by parties interested in discrediting climate science. Time for us to sort the wheat from the chaff: which of these putative errors are real, and which not? And what does it all mean, for the IPCC in particular, and for climate science more broadly? Let’s start with a few basic facts about the IPCC. The IPCC is not, as many people seem to think, a large organization. In fact, it has only 10 full-time staff in its secretariat at the World Meteorological Organization in Geneva, plus a few staff in four technical support units that help the chairs of the three IPCC working groups and the national greenhouse gas inventories group. The actual work of the IPCC is done by unpaid volunteers – thousands of scientists at universities and research institutes around the world who contribute as authors or reviewers to the completion of the IPCC reports. A large fraction of the relevant scientific community is thus involved in the effort. The three working groups are: Working Group 1 (WG1), which deals with the physical climate science basis, as assessed by the climatologists, including several of the Realclimate authors. Working Group 2 (WG2), which deals with impacts of climate change on society and ecosystems, as assessed by social scientists, ecologists, etc. Working Group 3 (WG3) , which deals with mitigation options for limiting global warming, as assessed by energy experts, economists, etc. Assessment reports are published every six or seven years and writing them takes about three years. Each working group publishes one of the three volumes of each assessment. The focus of the recent allegations is the Fourth Assessment Report (AR4), which was published in 2007. Its three volumes are almost a thousand pages *each*, in small print. They were written by over 450 lead authors and 800 contributing authors; most were not previous IPCC authors. There are three stages of review involving more than 2,500 expert reviewers who collectively submitted 90,000 review comments on the drafts. These, together with the authors’ responses to them, are all in the public record (see here and here for WG1 and WG2 respectively). Errors in the IPCC Fourth Assessment Report (AR4) As far as we’re aware, so far only one–or at most two–legitimate errors have been found in the AR4:

### IPCC

#### The errors in the IPCC report are minimal and do not impact the validity of overall conclusions

Realclimate ’10 (RealClimate.com, a commentary site on climate science by working climate scientists for the interested public and journalists, “IPCC Errors: Facts and Spin,” http://www.realclimate.org/index.php/archives/2010/02/ipcc-errors-facts-and-spin/, AM)

*Himalayan glaciers:* In a regional chapter on Asia in Volume 2, written by authors from the region, it was erroneously stated that 80% of Himalayan glacier area would very likely be gone by 2035. This is of course not the proper IPCC projection of future glacier decline, which is found in Volume 1 of the report. There we find a 45-page, perfectly valid chapter on glaciers, snow and ice (Chapter 4), with the authors including leading glacier experts (such as our colleague Georg Kaser from Austria, who first discovered the Himalaya error in the WG2 report). There are also several pages on future glacier decline in Chapter 10 (“Global Climate Projections”), where the proper projections are used e.g. to estimate future sea level rise. So the problem here is not that the IPCC’s glacier experts made an incorrect prediction. The problem is that a WG2 chapter, instead of relying on the proper IPCC projections from their WG1 colleagues, cited an unreliable outside source in one place. Fixing this error involves deleting two sentences on page 493 of the WG2 report. *Sea level in the Netherlands:* The WG2 report states that “The Netherlands is an example of a country highly susceptible to both sea-level rise and river flooding because 55% of its territory is below sea level”. This sentence was provided by a Dutch government agency – the Netherlands Environmental Assessment Agency, which has now published a correction stating that the sentence should have read “55 per cent of the Netherlands is at risk of flooding; 26 per cent of the country is below sea level, and 29 per cent is susceptible to river flooding”. It surely will go down as one of the more ironic episodes in its history when the Dutch parliament last Monday derided the IPCC, in a heated debate, for printing information provided by … the Dutch government. In addition, the IPCC notes that there are several definitions of the area below sea level. The Dutch Ministry of Transport uses the figure 60% (below high water level during storms), while others use 30% (below mean sea level). Needless to say, the actual number mentioned in the report has no bearing on any IPCC conclusions and has nothing to do with climate science, and it is questionable whether it should even be counted as an IPCC error.

#### Indicts of the IPCC and climate science are nothing more than hype-driven media non-sense

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Do the above issues suggest “politicized science”, deliberate deceptions or a tendency towards alarmism on the part of IPCC? We do not think there is any factual basis for such allegations. To the contrary, large groups of (inherently cautious) scientists attempting to reach a consensus in a societally important collaborative document is a prescription for reaching generally “conservative” conclusions. And indeed, before the recent media flash broke out, the real discussion amongst experts was about the AR4 having underestimated**,** not exaggerated, certain aspects of climate change. These include such important topics as sea level rise and sea ice decline (see the sea ice and sea level chapters of the Copenhagen Diagnosis), where the data show that things are changing faster than the IPCC expected. Overall then, the IPCC assessment reports reflect the state of scientific knowledge very well. There have been a few isolated errors, and these have been acknowledged and corrected. What is seriously amiss is something else: the public perception of the IPCC, and of climate science in general, has been massively distorted by the recent media storm. All of these various “gates” – Climategate, Amazongate, Seagate, Africagate, etc., do not represent scandals of the IPCC or of climate science. Rather, they are the embarrassing battle-cries of a media scandal, in which a few journalists have misled the public with grossly overblown or entirely fabricated pseudogates, and many others have naively and willingly followed along without seeing through the scam. It is not up to us as climate scientists to clear up this mess – it is up to the media world itself to put this right again, e.g. by publishing proper analysis pieces like the one of Tim Holmes and by issuing formal corrections of their mistaken reporting. We will follow with great interest whether the media world has the professional and moral integrity to correct its own errors.

### Indicts

**Don’t evaluate the negative’s evidence—they’re paid off by special interests and are not backed by science.**

**NAS ’10** (National Academy of Science, “CLIMATE CHANGE AND THE INTEGRITY OF SCIENCE,” http://www.pacinst.org/climate/climate\_statement.pdf, AM)

Many recent assaults on climate science and, more disturbingly, on climate scientists by climate change deniers, **are typically driven by special interests or dogma,** not by an honest effort to provide an alternative theory that credibly satisfies the evidence. The Intergovernmental Panel on Climate Change (IPCC) and other scientific assessments of climate change, which involve thousands of scientists producing massive and comprehensive reports, have, quite expectedly and normally, made some mistakes. When errors are pointed out, they are corrected. But there is nothing remotely identified in the recent events that changes the fundamental conclusions about climate change: (i) The planet is warming due to increased concentrations of heat-trapping gases in our atmosphere. A snowy winter in Washington does not alter this fact. (ii) Most of the increase in the concentration of these gases over the last century is due to human activities, especially the burning of fossil fuels and deforestation. (iii) Natural causes always play a role in changing Earth's climate, but are now being overwhelmed by human-induced changes. (iv) Warming the planet will cause many other climatic patterns to change at speeds unprecedented in modern times, including increasing rates of sea-level rise and alterations in the hydrologic cycle. Rising concentrations of carbon dioxide are making the oceans more acidic. (v) The combination of these complex climate changes threatens coastal communities and cities, our food and water supplies, marine and freshwater ecosystems, forests, high mountain environments, and far more. Much more can be, and has been, said by the world's scientific societies, national academies, and individuals, but these conclusions should be enough to indicate why scientists are concerned about what future generations will face from business- as-usual practices. We urge our policymakers and the public to move forward immediately to address the causes of climate change, including the unrestrained burning of fossil fuels. We also call for an end to McCarthy- like threats of criminal prosecution against our colleagues based on innuendo and guilt by association, the harassment of scientists by politicians seeking distractions to avoid taking action, and the outright lies being spread about them. Society has two choices: we can ignore the science and hide our heads in the sand and hope we are lucky, or we can act in the public interest to reduce the threat of global climate change quickly and substantively. The good news is that smart and effective actions are possible. But delay must not be an option.