# Ice Age

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#### Best climate data proves warming is false and we’re on the brink of another ice age

Peter Ferrara – Forbes – 5/31/12, Sorry Global Warming Alarmists, The Earth Is Cooling, http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/2/

Climate change itself is already in the process of definitively rebutting climate alarmists who think human use of fossil fuels is causing ultimately catastrophic global warming.  That is because natural climate cycles have already turned from warming to cooling, global temperatures have already been declining for more than 10 years, and global temperatures will continue to decline for another two decades or more. That is one of the most interesting conclusions to come out of the seventh International Climate Change Conference sponsored by the Heartland Institute, held last week in Chicago. I attended, and served as one of the speakers, talking about The Economic Implications of High Cost Energy. The conference featured serious natural science, contrary to the self-interested political science you hear from government financed global warming alarmists seeking to justify widely expanded regulatory and taxation powers for government bodies, or government body wannabees, such as the United Nations. See for yourself, as the conference speeches are online. What you will see are calm, dispassionate presentations by serious, pedigreed scientists discussing and explaining reams of data. In sharp contrast to these climate realists, the climate alarmists have long admitted that they cannot defend their theory that humans are causing catastrophic global warming in public debate. With the conference presentations online, let’s see if the alarmists really do have any response. The Heartland Institute has effectively become the international headquarters of the climate realists, an analog to the UN’s Intergovernmental Panel on Climate Change (IPCC). It has achieved that status through these international climate conferences, and the publication of its Climate Change Reconsidered volumes, produced in conjunction with the Nongovernmental International Panel on Climate Change (NIPCC). Those Climate Change Reconsidered volumes are an equivalently thorough scientific rebuttal to the irregular Assessment Reports of the UN’s IPCC. You can ask any advocate of human caused catastrophic global warming what their response is to Climate Change Reconsidered. If they have none, they are not qualified to discuss the issue intelligently. Check out the 20th century temperature record, and you will find that its up and down pattern does not follow the industrial revolution’s upward march of atmospheric carbon dioxide (CO2), which is the supposed central culprit for man caused global warming (and has been much, much higher in the past). It follows instead the up and down pattern of naturally caused climate cycles. For example, temperatures dropped steadily from the late 1940s to the late 1970s. The popular press was even talking about a coming ice age. Ice ages have cyclically occurred roughly every 10,000 years, with a new one actually due around now. In the late 1970s, the natural cycles turned warm and temperatures rose until the late 1990s, a trend that political and economic interests have tried to milk mercilessly to their advantage. The incorruptible satellite measured global atmospheric temperatures show less warming during this period than the heavily manipulated land surface temperatures. Central to these natural cycles is the Pacific Decadal Oscillation (PDO). Every 25 to 30 years the oceans undergo a natural cycle where the colder water below churns to replace the warmer water at the surface, and that affects global temperatures by the fractions of a degree we have seen. The PDO was cold from the late 1940s to the late 1970s, and it was warm from the late 1970s to the late 1990s, similar to the Atlantic Multidecadal Oscillation (AMO). In 2000, the UN’s IPCC predicted that global temperatures would rise by 1 degree Celsius by 2010. Was that based on climate science, or political science to scare the public into accepting costly anti-industrial regulations and taxes? Don Easterbrook, Professor Emeritus of Geology at Western Washington University, knew the answer. He publicly predicted in 2000 that global temperatures would decline by 2010. He made that prediction because he knew the PDO had turned cold in 1999, something the political scientists at the UN’s IPCC did not know or did not think significant. Well, the results are in, and the winner is….Don Easterbrook. Easterbrook also spoke at the Heartland conference, with a presentation entitled “Are Forecasts of a 20-Year Cooling Trend Credible?” Watch that online and you will see how scientists are supposed to talk: cool, rational, logical analysis of the data, and full explanation of it. All I ever see from the global warming alarmists, by contrast, is political public relations, personal attacks, ad hominem arguments, and name calling, combined with admissions that they can’t defend their views in public debate. Easterbrook shows that by 2010 the 2000 prediction of the IPCC was wrong by well over a degree, and the gap was widening. That’s a big miss for a forecast just 10 years away, when the same folks expect us to take seriously their predictions for 100 years in the future. Howard Hayden, Professor of Physics Emeritus at the University of Connecticut showed in his presentation at the conference that based on the historical record a doubling of CO2 could be expected to produce a 2 degree C temperature increase. Such a doubling would take most of this century, and the temperature impact of increased concentrations of CO2 declines logarithmically. You can see Hayden’s presentation online as well. Because PDO cycles last 25 to 30 years, Easterbrook expects the cooling trend to continue for another 2 decades or so. Easterbrook, in fact, documents 40 such alternating periods of warming and cooling over the past 500 years, with similar data going back 15,000 years. He further expects the flipping of the ADO to add to the current downward trend. But that is not all. We are also currently experiencing a surprisingly long period with very low sunspot activity. That is associated in the earth’s history with even lower, colder temperatures. The pattern was seen during a period known as the Dalton Minimum from 1790 to 1830, which saw temperature readings decline by 2 degrees in a 20 year period, and the noted Year Without A Summer in 1816 (which may have had other contributing short term causes). Even worse was the period known as the Maunder Minimum from 1645 to 1715, which saw only about 50 sunspots during one 30 year period within the cycle, compared to a typical 40,000 to 50,000 sunspots during such periods in modern times.  The Maunder Minimum coincided with the coldest part of the Little Ice Age, which the earth suffered from about 1350 to 1850.  The Maunder Minimum saw sharply reduced agricultural output, and widespread human suffering, disease and premature death.

#### GHG emissions key to preventing another Ice Age - replaces natural loss of CO2

MATT RIDLEY - BA and DPhil degrees from Oxford University – 1/14/12, Are We Holding a New Ice Age at Bay?, Wall Street Journal, <http://online.wsj.com/article/SB10001424052970204257504577150812451167538.html>

The entire 10,000-year history of civilization has happened in an unusually warm interlude in the Earth's recent history. Over the past million years, it has been as warm as this or warmer for less than 10% of the time, during 11 brief episodes known as interglacial periods. One theory holds that agriculture and dense settlement were impossible in the volatile, generally dry and carbon-dioxide-starved climates of the ice age, when crop plants would have grown more slowly and unpredictably even in warmer regions.¶ This warm spell is already 11,600 years old, and it must surely, in the normal course of things, come to an end. In the early 1970s, after two decades of slight cooling, many scientists were convinced that the moment was at hand. They were "increasingly apprehensive, for the weather aberrations they are studying may be the harbinger of another ice age," said Time in 1974. The "almost unanimous" view of meteorologists was that the cooling trend would "reduce agricultural productivity for the rest of the century," and "the resulting famines could be catastrophic," said Newsweek in 1975.¶ Since then, of course, warmth has returned, probably driven at least partly by man-made carbon-dioxide emissions. A new paper, from universities in Cambridge, London and Florida, drew headlines last week for arguing that these emissions may avert the return of the ice age. Less noticed was the fact that the authors, by analogy with a previous warm spell 780,000 years ago that's a "dead ringer" for our own, expect the next ice age to start "within about 1,500 years." Hardly the day after tomorrow.¶ Still, it's striking that most interglacials begin with an abrupt warming, peak sharply, then begin a gradual descent into cooler conditions before plunging rather more rapidly toward the freezer. The last interglacial—which occurred 135,000 to 115,000 years ago (named the Eemian period after a Dutch river near which the fossils of warmth-loving shell creatures of that age were found)—saw temperatures slide erratically downward by about two degrees Celsius between 127,000 and 120,000 years ago, before a sharper fall began.

#### Impact is extinction—history proves.

Marsh 12 (Gerald Marsh is a retired physicist from the Argonne National Laboratory and a former consultant to the Department of Defense on strategic nuclear technology and policy in the Reagan, Bush, and Clinton Administration, 2012, The Coming of a New Ice Age, Winningreen, <http://www.winningreen.com/site/epage/59549_621.htm>)

Contrary to the conventional wisdom of the day, the real danger facing humanity is not global warming, but more likely the coming of a new Ice Age. ¶ What we live in now is known as an interglacial, a relatively brief period between long ice ages. Unfortunately for us, most interglacial periods last only about ten thousand years, and that is how long it has been since the last Ice Age ended. ¶ How much longer do we have before the ice begins to spread across the Earth’s surface? Less than a hundred years or several hundred? We simply don’t know.¶ Even if all the temperature increase over the last century is attributable to human activities, the rise has been relatively modest one of a little over one degree Fahrenheit — an increase well within natural variations over the last few thousand years. ¶ While an enduring temperature rise of the same size over the next century would cause humanity to make some changes, it would undoubtedly be within our ability to adapt. ¶ Entering a new ice age, however, would be catastrophic for the continuation of modern civilization. ¶ One has only to look at maps showing the extent of the great ice sheets during the last Ice Age to understand what a return to ice age conditions would mean. Much of Europe and North-America were covered by thick ice, thousands of feet thick in many areas and the world as a whole was much colder. ¶ The last “little” Ice Age started as early as the 14th century when the Baltic Sea froze over followed by unseasonable cold, storms, and a rise in the level of the Caspian Sea. That was followed by the extinction of the Norse settlements in Greenland and the loss of grain cultivation in Iceland. Harvests were even severely reduced in Scandinavia And this was a mere foreshadowing of the miseries to come.¶ By the mid-17th century, glaciers in the Swiss Alps advanced, wiping out farms and entire villages. In England, the River Thames froze during the winter, and in 1780, New York Harbor froze. Had this continued, history would have been very different. Luckily, the decrease in solar activity that caused the Little Ice Age ended and the result was the continued flowering of modern civilization.¶ There were very few Ice Ages until about 2.75 million years ago when Earth’s climate entered an unusual period of instability. Starting about a million years ago cycles of ice ages lasting about 100,000 years, separated by relatively short interglacial periods, like the one we are now living in became the rule. Before the onset of the Ice Ages, and for most of the Earth’s history, it was far warmer than it is today. ¶ Indeed, the Sun has been getting brighter over the whole history of the Earth and large land plants have flourished. Both of these had the effect of dropping carbon dioxide concentrations in the atmosphere to the lowest level in Earth’s long history. ¶ Five hundred million years ago, carbon dioxide concentrations were over 13 times current levels; and not until about 20 million years ago did carbon dioxide levels dropped to a little less than twice what they are today. ¶ It is possible that moderately increased carbon dioxide concentrations could extend the current interglacial period. But we have not reached the level required yet, nor do we know the optimum level to reach. ¶ So, rather than call for arbitrary limits on carbon dioxide emissions, perhaps the best thing the UN’s Intergovernmental Panel on Climate Change and the climatology community in general could do is spend their efforts on determining the optimal range of carbon dioxide needed to extend the current interglacial period indefinitely. ¶ NASA has predicted that the solar cycle peaking in 2022 could be one of the weakest in centuries and should cause a very significant cooling of Earth’s climate. Will this be the trigger that initiates a new Ice Age?¶ We ought to carefully consider this possibility before we wipe out our current prosperity by spending trillions of dollars to combat a perceived global warming threat that may well prove to be only a will-o-the-wisp.

### Yes Ice Age – Consensus

#### Overwhelming climate evidence indicates a coming Ice Age – warming theory false and disregards long-term evidence

Fegel 9 – Gregory F. Fegel, 2009 (“Earth on the Brink of an Ice Age,” Pravda, November 1st 2009, <http://english.pravda.ru/science/earth/11-01-2009/106922-earth_ice_age-1/>)

The earth is now on the brink of entering another Ice Age, according to a large and compelling body of evidence from within the field of climate science. Many sources of data which provide our knowledge base of long-term climate change indicate that the warm, twelve thousand year-long Holocene period will rather soon be coming to an end, and then the earth will return to Ice Age conditions for the next 100,000 years.¶ Ice cores, ocean sediment cores, the geologic record, and studies of ancient plant and animal populations all demonstrate a regular cyclic pattern of Ice Age glacial maximums which each last about 100,000 years, separated by intervening warm interglacials, each lasting about 12,000 years.¶ Most of the long-term climate data collected from various sources also shows a strong correlation with the three astronomical cycles which are together known as the Milankovich cycles. The three Milankovich cycles include the tilt of the earth, which varies over a 41,000 year period; the shape of the earth’s orbit, which changes over a period of 100,000 years; and the Precession of the Equinoxes, also known as the earth’s ‘wobble’, which gradually rotates the direction of the earth’s axis over a period of 26,000 years. According to the Milankovich theory of Ice Age causation, these three astronomical cycles, each of which effects the amount of solar radiation which reaches the earth, act together to produce the cycle of cold Ice Age maximums and warm interglacials.¶ Print version¶ Font Size¶ Send to friend¶ Elements of the astronomical theory of Ice Age causation were first presented by the French mathematician Joseph Adhemar in 1842, it was developed further by the English prodigy Joseph Croll in 1875, and the theory was established in its present form by the Serbian mathematician Milutin Milankovich in the 1920s and 30s. In 1976 the prestigious journal “Science” published a landmark paper by John Imbrie, James Hays, and Nicholas Shackleton entitled “Variations in the Earth's orbit: Pacemaker of the Ice Ages,” which described the correlation which the trio of scientist/authors had found between the climate data obtained from ocean sediment cores and the patterns of the astronomical Milankovich cycles. Since the late 1970s, the Milankovich theory has remained the predominant theory to account for Ice Age causation among climate scientists, and hence the Milankovich theory is always described in textbooks of climatology and in encyclopaedia articles about the Ice Ages.¶ In their 1976 paper Imbrie, Hays, and Shackleton wrote that their own climate forecasts, which were based on sea-sediment cores and the Milankovich cycles, "… must be qualified in two ways. First, they apply only to the natural component of future climatic trends - and not to anthropogenic effects such as those due to the burning of fossil fuels. Second, they describe only the long-term trends, because they are linked to orbital variations with periods of 20,000 years and longer. Climatic oscillations at higher frequencies are not predicted... the results indicate that the long-term trend over the next 20,000 years is towards extensive Northern Hemisphere glaciation and cooler climate."¶ During the 1970s the famous American astronomer Carl Sagan and other scientists began promoting the theory that ‘greenhouse gasses’ such as carbon dioxide, or CO2, produced by human industries could lead to catastrophic global warming. Since the 1970s the theory of ‘anthropogenic global warming’ (AGW) has gradually become accepted as fact by most of the academic establishment, and their acceptance of AGW has inspired a global movement to encourage governments to make pivotal changes to prevent the worsening of AGW.¶ The central piece of evidence that is cited in support of the AGW theory is the famous ‘hockey stick’ graph which was presented by Al Gore in his 2006 film “An Inconvenient Truth.” The ‘hockey stick’ graph shows an acute upward spike in global temperatures which began during the 1970s and continued through the winter of 2006/07. However, this warming trend was interrupted when the winter of 2007/8 delivered the deepest snow cover to the Northern Hemisphere since 1966 and the coldest temperatures since 2001. It now appears that the current Northern Hemisphere winter of 2008/09 will probably equal or surpass the winter of 2007/08 for both snow depth and cold temperatures.¶ The main flaw in the AGW theory is that its proponents focus on evidence from only the past one thousand years at most, while ignoring the evidence from the past million years -- evidence which is essential for a true understanding of climatology. The data from paleoclimatology provides us with an alternative and more credible explanation for the recent global temperature spike, based on the natural cycle of Ice Age maximums and interglacials.¶ In 1999 the British journal “Nature” published the results of data derived from glacial ice cores collected at the Russia’s Vostok station in Antarctica during the 1990s. The Vostok ice core data includes a record of global atmospheric temperatures, atmospheric CO2 and other greenhouse gases, and airborne particulates starting from 420,000 years ago and continuing through history up to our present time. The graph of the Vostok ice core data shows that the Ice Age maximums and the warm interglacials occur within a regular cyclic pattern, the graph-line of which is similar to the rhythm of a heartbeat on an electrocardiogram tracing. The Vostok data graph also shows that changes in global CO2 levels lag behind global temperature changes by about eight hundred years. What that indicates is that global temperatures precede or cause global CO2 changes, and not the reverse. In other words, increasing atmospheric CO2 is not causing global temperature to rise; instead the natural cyclic increase in global temperature is causing global CO2 to rise.¶ The reason that global CO2 levels rise and fall in response to the global temperature is because cold water is capable of retaining more CO2 than warm water. That is why carbonated beverages loose their carbonation, or CO2, when stored in a warm environment. We store our carbonated soft drinks, wine, and beer in a cool place to prevent them from loosing their ‘fizz’, which is a feature of their carbonation, or CO2 content. The earth is currently warming as a result of the natural Ice Age cycle, and as the oceans get warmer, they release increasing amounts of CO2 into the atmosphere.¶ Because the release of CO2 by the warming oceans lags behind the changes in the earth’s temperature, we should expect to see global CO2 levels continue to rise for another eight hundred years after the end of the earth’s current Interglacial warm period. We should already be eight hundred years into the coming Ice Age before global CO2 levels begin to drop in response to the increased chilling of the world’s oceans.¶ ¶ Print version¶ Font Size¶ Send to friend¶ The Vostok ice core data graph reveals that global CO2 levels regularly rose and fell in a direct response to the natural cycle of Ice Age minimums and maximums during the past four hundred and twenty thousand years. Within that natural cycle, about every 110,000 years global temperatures, followed by global CO2 levels, have peaked at approximately the same levels which they are at today.¶ Today we are again at the peak, and near to the end, of a warm interglacial, and the earth is now due to enter the next Ice Age. If we are lucky, we may have a few years to prepare for it. The Ice Age will return, as it always has, in its regular and natural cycle, with or without any influence from the effects of AGW.¶ The AGW theory is based on data that is drawn from a ridiculously narrow span of time and it demonstrates a wanton disregard for the ‘big picture’ of long-term climate change. The data from paleoclimatology, including ice cores, sea sediments, geology, paleobotany and zoology, indicate that we are on the verge of entering another Ice Age, and the data also shows that severe and lasting climate change can occur within only a few years. While concern over the dubious threat of Anthropogenic Global Warming continues to distract the attention of people throughout the world, the very real threat of the approaching and inevitable Ice Age, which will render large parts of the Northern Hemisphere uninhabitable, is being foolishly ignored.

#### Ice age is coming now

Tailor, 12, (writer for Weekly World News, but he quotes scientists from NASA and U of A scientists), 1/30/12, “Scientists predict coming Ice Age”, <http://weeklyworldnews.com/headlines/43321/scientists-predict-coming-ice-age/>

According to the world’s top scientists the world hasn’t warmed in 15 years and we are headed for a new ice age!¶ Statistics and data suggest we are headed for a new ice age to rival the 70-year temperature drop that saw frost fairs held on the Thames in the 17th Century.¶ Based on readings from more than 30,000 measuring stations, the data was issued last week without fanfare by the Met Office and the University of East Anglia Climatic Research Unit. It confirms that the rising trend in world temperatures ended in 1997.¶ Meanwhile, leading climate scientists said that, after emitting unusually high levels of energy throughout the 20th Century, the sun is now heading towards a ‘grand minimum’ in its output, threatening cold summers, bitter winters and a shortening of the season available for growing food.¶ Solar output goes through 11-year cycles, with high numbers of sunspots seen at their peak.¶ We are now at what should be the peak of what scientists call ‘Cycle 24’ – which is why last week’s solar storm resulted in sightings of the aurora borealis further south than usual. But sunspot numbers are running at less than half those seen during cycle peaks in the 20th Century.¶ Analysis by experts at NASA and the University of Arizona – derived from magnetic-field measurements 120,000 miles beneath the sun’s surface – suggest that Cycle 25, whose peak is due in 2022, will be a great deal weaker still.¶ According to a paper issued last week by the Met Office, there is a 92 per cent chance that both Cycle 25 and those taking place in the following decades will be as weak as, or weaker than, the ‘Dalton minimum’ of 1790 to 1830. In this period, named after the meteorologist John Dalton, average temperatures in parts of Europe fell by 2C.¶ However, it is also possible that the new solar energy slump could be as deep as the ‘Maunder minimum’ (after astronomer Edward Maunder), between 1645 and 1715 in the coldest part of the ‘Little Ice Age’ when, as well as the Thames frost fairs, the canals of Holland froze solid.

#### Ice age is coming- 3 reasons

**Aym, 12** (Terrance Aym is a writer at Helium) “Experts: Food and fuel shortages imminent as New Ice Age dawns” <http://www.helium.com/items/2051424-food-and-fuel-shortages-imminent-as-new-ice-age-dawns?page=2>

Other scientists concur and some see the speed at which the temperatures will drop as frightening.¶ Casy's organization has been at the forefront of the climate change controversy, correctly predicting in advance three important changes in the climate that many others missed: the end of global warming cycle (1999), a long term drop in the Earth’s temperatures (starting in 2006 to 2007) the unsettling prospect of an historic contraction of the Sun’s energy resulting in a never-before-seen solar hibernation. The hibernation is now recognized by NASA's Long Range Solar Forecast through 2022 and as well as the stunning slowdown of sun's activity.¶ At the urging of colleagues from around the globe that concur with him, Casey has taken an unprecedented step. "In view of the importance of this new forecast I have notified the Secretary of Agriculture to take immediate actions to prepare the nation’s agricultural industry for the coming crop damage.”¶ Mini or major Ice Age - either are a disaster¶ While Casey sees a so-called mini-Ice Age occurring and lasting about 40 to 50 years, others like Robert Felix believes the data is there that supports a real possibility of a major Ice Age that could last several thousands of years. Felix believes the Earth's already entered the first stages of the mini-Ice Age and a bigger one might be close on its heels.¶ Felix warns: " The next Ice Age could begin any day. Next week, next month, next year...it's not a question of if, only when. One day you'll wake up—or you won't wake up, rather—buried beneath nine stories of snow. It's all part of a dependable, predictable cycle, a natural cycle that returns like clockwork every 11,500 years."¶ The last Ice Age happened to end almost exactly 11,500 years ago. ¶ Casey explains that "The present [solar] hibernation is proceeding in almost lock step as the last one which occurred from 1793 to 1830. If it continues on present course, while the cold weather impacts on food and fuel announced today are certainly important, they do not compare with what is to follow later. At the bottom of the cold cycle of this hibernation in the late 2020’s and 2030’s there will likely be years with devastating to total crop losses in the Canadian and northern US grain regions.”

#### Astrophysicist confirms Ice Age is coming

**Ice Age Now, 12** (Cites Piers Corbin an astrophysicist at Queens Mary College) 5/6/12 “Now heading into a Little Ice Age, says Astrophysicist” <http://iceagenow.info/2012/05/heading-ice-age-astrophysicist/>

“Little Ice Age (Maunder- Dalton) circulation patterns are emerging and more rapid world cooling is taking over,” says astrophysicist Piers Corbin. The Sun’s magnetic field is getting into a muddle as one half of it changes out of step with the other and this muddled behavior is likely to become very marked in MAY,” says Corbyn, of WeatherAction.com. “The sun is entering a ‘muddled’ magnetic state. This strange behavior was pointed out by Japanese researchers from the National Astronomical Observatory of Japan and the Riken research foundation\* who say this was the sort of behavior which probably took place during low periods of solar activity in the past\*\* and which drove the world into a cold state of longer winters, cold Spring months and lousy summers. “At the same time independent observers have noticed an increase in Little Ice Age type (Maunder-Dalton type) weather events and circulation patterns around the world such as more extreme hailstorms and cyclonic cold weather in Britain and Ireland with the Jet stream shifted well south\*\*\*. “These changes and findings increase our confidence in our forecast made two years ago of general world cooling and our specific forecasts for individual months and regions such as for an exceptionally cold May this year in central and east Britain and West Europe – and which comes with the present very warm weather in East Europe which we predicted 4 weeks ahead. “Although these developing circulation patterns are generally cold the wide-amplitude swings of the jet stream of which they are part also mean there will be some warm or very warm spots. This happened in March with a generally cold or very cold Northern Hemisphere while the UK and USA were warm and extremely warm respectively. “May will also see dramatic contrasts and we will have more of a grasp on the boundaries between contrasting parts in our detailed May forecasts for Britain and Ireland, Europe and the USA issued at the end of April.

#### Physicists at NASA, agree, we are going into another Ice Age

**Page, 11** (Cites Physicists at NASA), “Earth may be heading into a mini Ice Age within a decade” June 14th, 2011, <http://www.theregister.co.uk/2011/06/14/ice_age/>

What may be the science story of the century is breaking this evening, as heavyweight US solar physicists announce that the Sun appears to be headed into a lengthy spell of low activity, which could mean that the Earth – far from facing a global warming problem – is actually headed into a mini Ice Age. ¶ The announcement made on 14 June (18:00 UK time) comes from scientists at the US National Solar Observatory (NSO) and US Air Force Research Laboratory. Three different analyses of the Sun's recent behaviour all indicate that a period of unusually low solar activity may be about to begin.¶ The Sun normally follows an 11-year cycle of activity. The current cycle, Cycle 24, is now supposed to be ramping up towards maximum strength. Increased numbers of sunspots and other indications ought to be happening: but in fact results so far are most disappointing. Scientists at the NSO now suspect, based on data showing decades-long trends leading to this point,that Cycle 25 may not happen at all.¶ This could have major implications for the Earth's climate. According to a statement issued by the NSO, announcing the research:¶ An immediate question is whether this slowdown presages a second Maunder Minimum, a 70-year period with virtually no sunspots [which occurred] during 1645-1715.¶ As NASA [notes](http://solarscience.msfc.nasa.gov/SunspotCycle.shtml):¶ Early records of sunspots indicate that the Sun went through a period of inactivity in the late 17th century. Very few sunspots were seen on the Sun from about 1645 to 1715. Although the observations were not as extensive as in later years, the Sun was in fact well observed during this time and this lack of sunspots is well documented. This period of solar inactivity also corresponds to a climatic period called the "Little Ice Age" when rivers that are normally ice-free froze and snow fields remained year-round at lower altitudes. There is evidence that the Sun has had similar periods of inactivity in the more distant past.¶ During the Maunder Minimum and for periods either side of it, many European rivers which are ice-free today – including the Thames – routinely froze over, allowing ice skating and even for armies to march across them in some cases.¶ "This is highly unusual and unexpected," says Dr Frank Hill of the NSO. "But the fact that three completely different views of the Sun point in the same direction is a powerful indicator that the sunspot cycle may be going into hibernation."

#### Mounting evidence of global cooling

Vardiman 10 – Larry Vardiman is Chair of the Department of Astro/Geophysics at the Institute for Creation Research and holds a PhD in Atmospheric Science, 2010 (“New Evidence for Global Cooling,” ICR, 2010, <http://www.icr.org/article/5482/>)

Evidence continues to accumulate that we may have turned the corner on global warming. The earth may be entering a period of cooling. A group of solar physicists in Europe has found a strong association between solar activity and temperatures in central England in weather records as far back as the Maunder Minimum, a 50-year period in which there were no sunspots between about 1650 and 1700 A.D.1 The Little Ice Age in Europe coincided with the Maunder Minimum and has long been thought to have been associated in some way with sunspots.¶ Recent solar activity has fallen to levels unknown during the previous century. Motivated by recent relatively cold winters in the United Kingdom, the team of solar physicists investigated the possible connection with solar activity. They identified the anomalously cold winters in England by conducting complex statistical studies on the Central England Temperature (CET) records constructed by Manley2 and Parker et al.3 The CET record is the world's longest instrumental record of temperature and extends back to 1659 A.D., at the start of the Maunder Minimum. It is composed of three stations located in London, Bristol, and Lancaster, England. The CET covers a spatial scale in the shape of a triangle on the order of about 190 miles (300 kilometers). This small scale makes it a "regional" climate indicator and to some extent it will reflect changes on both European and northern hemispheric scales.

#### Studies of expanding Arctic ice suggest we are entering another Ice Age

Ridenour 2 – Amy Ridenour is President of The National Center for Public Policy Research, 2002 (“New Research Indicates the Earth May Be Cooling,” National Policy Analysis, February 2002, <http://www.nationalcenter.org/NPA388.html>)

After a decade of warnings that the Earth's temperature may be rapidly warming, and that this supposed warming may result in a surge of catastrophic flooding and lethal storms, it now appears that we may be in for global cooling instead.¶ The mammoth west Antarctic ice sheet, which contains enough water to lift the world's sea levels by 20 feet, isn't melting after all. Instead, it's actually thickening and Antarctica itself is getting cooler.1¶ A new study by researchers from the California Institute of Technology's Jet Propulsion Laboratory and the University of California at Santa Cruz, published in the respected journal Science, found that the ice sheets of Antarctica, far from melting, actually are expanding by some 26.8 billion tons of ice a year.2¶ The scientists, Ian Joughlin, a geologist at CIT, and Slawek Tulaczyk, a professor of earth sciences at UC Santa Cruz, speculate the thickening ice sheets are repeating a pattern that occurred from 1650 -1850 when the Earth went through what became known as the Little Ice Age.3

#### Ice age coming – scientific research proves

Dini 11 – Jack Dini writes on science and environmental issues for Plating & Surface Finishing and is the author of Challenging Environmental Mythology, 2011 (“Is An Ice Age Coming?” Canada Free Press, October 24th 2011, <http://www.canadafreepress.com/index.php/article/41636>)

US solar physicists announced in June 2011 that the Sun appears to be headed into a lengthy spell of low activity, which could mean that the Earth—far from facing a global warming problem—is actually headed into a mini Ice Age. The announcement came from scientists at the US National Solar Observatory (NSO) and the US Air Force Research Laboratory. Three different analyses of the Sun’s recent behavior all indicated that a period of unusually low solar activity may be about to begin. (1)¶ ¶ “This is highly unusual and unexpected,” said Dr. Frank Hill of the NSO. “But the fact that three completely different views of the Sun point in the same direction is a powerful indicator that the sunspot cycle may be going into hibernation.” (1)¶ Fred Dardick reports, “We are in the midst of the convergence of three major solar, ocean, and atmospheric cycles all heading in the direction of global cooling. Last year the Southern Hemisphere experienced its coldest winter in 50 years and Europe just went through two particularly cold winters in a row, and the cooling trend has just begun. The likelihood of a repeat of the great frost of 1709 is growing every day. (2) This was the time of the Maunder Minimum (1645-1715) and for periods either side of it, many European rivers which are ice-free today—including the Thames—routinely froze over, allowing ice skating and even for armies to march across them in some cases. (1)¶ ¶ More recently other papers confirm that solar effects could bring on little ice ages. Sarah Ineson and her colleagues report that changes in the Sun’s emissions of ultraviolet radiation coincided with observed cold winters over southern Europe and Canada between 2008 and this year. (3) And Katja Matthes and colleagues report that simulations with a climate model using new observations of solar variability suggest a substantial influence of the Sun on the winter climate in the Northern Hemisphere. (4)¶ Couple this with scientists saying an anticipated cold blast will be due to the return of a disruptive weather pattern called La Nina. Latest evidence shows La Nina, linked to extreme weather in America and with a knock-on effect on Britain, is in force and will gradually strengthen as the year ends. This climate phenomenon, characterized by unusually cold ocean temperatures in the Pacific, was linked to Britain’s icy winter last year—one of the coldest on record. (5)

#### Satellite data supports global cooling theory

SSRC 11 – The Space and Science Research Center is an independent scientific research organization on the subject of the science and planning for the next climate change, 2011 (“Global Cooling Begins and Global Warming Ends with Record Drop in Temperatures,” SSRC, February 4th 2011, <http://www.spaceandscience.net/sitebuildercontent/sitebuilderfiles/ssrcpressrelease2-2011globalcooling.pdf>)

The Space and Science Research Center (SSRC) announces today that the most recent global temperature ¶ data through January 31, 2011 using NASA and NOAA weather satellites supports the previous forecast ¶ from the SSRC that a historic drop in global temperatures is under way and that the previously predicted ¶ climate change to one of a long and deep global cooling era has begun.¶ SSRC Director John L. Casey explains, “Based on the data from the AMSR-E instrument on board the ¶ NASA Aqua satellite, sea surface temperatures just posted this week showed their steepest decline since ¶ the satellite was made operational in 2002. This major drop from the warm temperature levels seen in ¶ 2010 is also echoed by a dramatic decline in atmospheric temperatures in the lower troposphere, where ¶ we live, with the data coming from NOAA satellites. At present rates of descent, both ocean and ¶ atmospheric temperatures are likely to soon surpass the temperature lows set in the 2007-2008 period.¶ Even with a small correction that is usually seen after such a rapid drop, there is no doubt that the Earth is ¶ entering a prolonged global cooling period and will soon set another record drop in temperatures by the ¶ November-December 2012 time frame as was forecast in the SSRC press release from May 10, 2010.”¶ As to the long term implications, of this significant drop in global temperatures, Director Casey clarifies ¶ by adding, “While we always see a reduction from a previous El Nino high, this time the decline is ¶ different, very different. What is happening now is the effect of the natural La Nina cooling is being ¶ overpowered and accelerated by a once every 206 year solar cycle that has entered its cold phase. In 2007 ¶ after discovering this cycle, I was the first to announce to the White House, Congress, and the main ¶ stream media that this cycle would produce a “solar hibernation,” a major reduction in the output of the ¶ Sun which in turn would bring a new climate change to a cold era lasting 20-30 years. This hibernation ¶ also called a grand minimum was recently verified by NASA data using sunspot measurements and was ¶ announced in another SSRC press release January 25th of this year. In quick succession here in early ¶ 2011 we have seen two of the strongest possible validations of the global cooling phase of the 206 year ¶ cycle and the “Relational Cycle Theory” of climate change which I developed to account for the pattern ¶ of alternating cold and warm periods that we have seen for over two hundred years now. Although we ¶ will continue to see highly variable weather, the punishing winters the world has seen the past few years ¶ including the on-going record setting winter of 2010-2011, are just a sample of what is to come. Though the conclusions of my research and that of many others around the world has shown a new and ¶ potentially dangerous cold weather period is coming, the recent NASA data about the Sun going into ¶ hibernation and this week’s global temperature figures have provided critical evidence for our leaders and ¶ the public to finally see that the next cold climate era is here. ¶ It is also important to recognize that there has been no effective growth in the Earth’s temperatures for ¶ twelve years now and according to my calculations, the statistical peak of the long term curve of the past ¶ Sun-caused global warming was probably between 2005 and 2007. Global temperatures have suddenly ¶ returned to the same level they were in 1980 and are expected to drop much further. Given the momentum ¶ of the solar hibernation, it is now unlikely that our generation or the next one will return to the level of ¶ global warming that we have just passed through. Again, global warming has ended. It was always caused ¶ by the Sun and not mankind. The global cooling era has begun.

### Yes Ice Age – Solar Variation

#### Solar Irradiance decrease leads to Ice Age

**Abdussamatov, 12** (Habibullo I. Abdussamatov is a Head of Space research laboratory of the Pulkovo Observatory) “Bicentennial decrease of the total solar irradiance leads to unbalanced thermal budget of the Earth and a Little Ice Age”, 2012, <http://www.ccsenet.org/journal/index.php/apr/article/view/14754/10140>

From early 1990s the values of both eleven-year and bicentennial components of TSI variations are decreasing at¶ accelerating (at present) rate (Fig. 2), and hence a fraction of TSI absorbed by the Earth is declining at practically¶ the same rate (e.g., Fröhlich, 2011; Abdussamatov, 2007b, 2009a, b). Average value of TSI in the 23rd cycle was¶ by 0.17 W/m2 less than in the 22nd cycle. Smoothed value of TSI in the minimum between the cycles 23/24¶ (1365.24 ± 0.02 W/m2) was by 0.26 W/m2 and by 0.33 W/m2 less than in the minima between cycles 22/23 and¶ 21/22, respectively. However, forming from early 1990s long-term deficit of TSI (see Fig. 2) was not¶ compensated by decrease in the emission of the Earth intrinsic thermal energy into space which practically¶ remains on the same high level during 14±6 years due to thermal inertia of the World Ocean. Since the Sun is¶ now entering a bicentennial long-term phase of low luminosity (e.g., Abdussamatov, 2004, 2005, 2007b; Penn¶ and Livingston, 2010; American-astronomical-society, 2011) such energy imbalance of the system (E<0) will¶ continue further for the next few 11-year cycles. As a result, the Earth as a planet will henceforward have¶ negative balance (E<0) in the energy budget. This gradual consumption of solar energy accumulated by the¶ World Ocean during the whole XX century will result in decrease of global temperature after 14±6 years because¶ of a negative balance in the energy budget of the Earth. This, in its turn, will lead to the rise of Earth albedo, the¶ drop of atmospheric concentration of the most important greenhouse gas – water vapor, as well as of carbon¶ dioxide and other gases. Let us note that water vapor absorbs ~68% of the integral power of the intrinsic¶ long-wave emission of the Earth, while carbon dioxide – only ~12%. As a consequence, a portion of solar¶ radiation absorbed by the Earth will gradually go down together with manifestations of the greenhouse effect¶ caused by the secondary feedback effects. The influence of the growing consecutive chain of such changes will¶ cause additional decrease of the global temperature exceeding the effect of a bicentennial TSI decrease.¶ Since the Sun is now approaching the phase of decrease of bicentennial luminosity on the basis of observed¶ accelerating drop in both the 11-year and bicentennial components of TSI from early 90s, we can forecast its¶ further decline similar to a so called Maunder minimum down to 1363.4±0.8 W/m2, 1361.0±1.6 W/m2 and down¶ to a deep minimal level 1359.5±2.4 W/m2 in the minima between the cycles 24/25, 25/26 and 26/27, respectively¶ (Fig. 3). Assuming an expected increase in the duration of the eleven-year cycles during the phase of decline of a¶ bicentennial cycle (Abdussamatov, 2006, 2009a,b), we can expect the approximate moment of minimum¶ between the cycles 24/25, 25/26 and 26/27 in 2020.3±0.6, 2031.6±1.2 and 2042.9±1.8, respectively. Under these circumstances the maximal smoothed for 13 months level of sunspot number in the cycles 24, 25 and 26 can¶ reach 65±15, 45±20 and 30±20, respectively (Abdussamatov, 2007b, 2009a,b). Hence, we can expect the onset of a deep bicentennial minimum of TSI in approximately 2042±11 and of the 19th deep minimum of global¶ temperature in the past 7500 years – in 2055±11 (Fig. 4). In the nearest future we will observe a transition¶ (between global warming and global cooling) period of unstable climate changes with the global temperature¶ fluctuating around its maximum value reached in 1998-2005. After the maximum of solar cycle 24, from¶ approximately 2014 we can expect the start of the next bicentennial cycle of deep cooling with a Little Ice Age¶ in 2055±11. Thus, long-term variations of TSI (with account for their direct and secondary, based on feedback¶ effects, influence) are the main fundamental cause of climate changes since variations of the Earth climate is¶ mainly determined by a long-term imbalance between the energy of solar radiation entering the upper layers of¶ the Earth's atmosphere and the total energy emitted from the Earth back to space.

#### Sunspots disappearing, means another Ice Age

**Daily Mail, 11** (Quotes scientists from the National Solar Observatory and Air Force Research Observatory) “ Earth facing a mini- Ice Age ‘within ten years’ due to rare drop in sunspot activity” <http://www.dailymail.co.uk/sciencetech/article-2003824/Earth-facing-mini-Ice-Age-years-rare-drop-sunspot-activity.html#ixzz21ZaugFpf>

The sun is heading into an unusual and extended period of hibernation that could trigger a mini-Ice Age on Earth, scientists claim.¶ A decrease in global warming might result in the years after 2020, the approximate time when sunspots are expected to disappear for years, maybe even decades.¶ While the effects of a calmer sun are mostly good - there'd be fewer disruptions of satellites and power systems - it could see a sharp turnaround in global warming.

#### Maunder Minimum proves Ice Age is coming

**Carbon Brief, 11** (Cites Feulner, Deputy Chair of PIKS research domain), “Maunder Minimum, solar activity and the little Ice Age” 8/24/11, <http://www.carbonbrief.org/blog/2011/08/maunder-minimum,-solar-activity-and-the-little-ice-age-new-research>

This summer the skeptic notion that changing solar activity has caused global warming has been pedalled widely in the mainstream media. Consider, for example, notorious US skeptic Joe Bastardi's wild claims on Fox News earlier this month:¶ "We have warmed up overall over the last 20 to 30 years, or the last 200 years because of sunspot cycles, you can trace it to the sunspot cycle."¶ The promotion of this misconception is not limited to the US. Skeptic commentators in the British press have proclaimed that a new ice age is nearly upon us thanks to an approaching 'solar minimum' - suggestions that have been soundly rejected by scientists, as we reported here.¶ A previous period of low sunspot activity, the Maunder Minimum, lasted 70 years in the late 17th to early 18th century and coincided with part of the 'Little Ice Age' - a period of cooling affecting parts of the globe that lasted around 300 years.¶ In spite of evidence that a new solar minimum cannot significantly counteract the current man-made warming, some commentators incorrectly assumed that an approaching Maunder-style solar minimum meant we were on the verge of a new ice age. ¶ The new research tries to ascertain exactly how the sun was behaving during the Little ice Age. In a paper titled "Are the most recent estimates for Maunder Minimum solar irradiance in agreement with temperature reconstructions?" Dr Georg Feulner of the Potsdam Institute examined two estimates of the amount of sunlight reaching the Earth (Total Solar Insolation - TSI) during the Maunder Minimum. He used these estimates to simulate temperatures over the last thousand years, and then compared the simulated temperatures with the actual temperature record to see which which estimate of TSI gave the most accurate temperature reconstuction.

#### PDO cycles and lack of sun spots= Ice Age

**Ferrara, 12**(Cites Easterbrook a [geology](http://en.wikipedia.org/wiki/Geology) professor emeritus at [Western Washington Universit](http://en.wikipedia.org/wiki/Western_Washington_University)y) 5/31/2012, “Sorry Global Warming Alarmists the Earth is Cooling” <http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/2/>

Climate change itself is already in the process of definitively rebutting climate alarmists who think human use of fossil fuels is causing ultimately catastrophic global warming. That is because natural climate cycles have already turned from warming to cooling, global temperatures have already been declining for more than 10 years, and global temperatures will continue to decline for another two decades or more.¶ That is one of the most interesting conclusions to come out of the seventh International Climate Change Conference sponsored by the Heartland Institute, held last week in Chicago. I attended, and served as one of the speakers, talking about The Economic Implications of High Cost Energy.¶ The conference featured serious natural science, contrary to the self-interested political science you hear from government financed global warming alarmists seeking to justify widely expanded regulatory and taxation powers for government bodies, or government body wannabees, such as the United Nations. See for yourself, as the conference speeches are online.¶ What you will see are calm, dispassionate presentations by serious, pedigreed scientists discussing and explaining reams of data. In sharp contrast to these climate realists, the climate alarmists have long admitted that they cannot defend their theory that humans are causing catastrophic global warming in public debate. With the conference presentations online, let’s see if the alarmists really do have any response.¶ The Heartland Institute has effectively become the international headquarters of the climate realists, an analog to the UN’s Intergovernmental Panel on Climate Change (IPCC). It has achieved that status through these international climate conferences, and the publication of its Climate Change Reconsidered volumes, produced in conjunction with the Nongovernmental International Panel on Climate Change (NIPCC).¶ Those Climate Change Reconsidered volumes are an equivalently thorough scientific rebuttal to the irregular Assessment Reports of the UN’s IPCC. You can ask any advocate of human caused catastrophic global warming what their response is to Climate Change Reconsidered. If they have none, they are not qualified to discuss the issue intelligently.¶ Check out the 20th century temperature record, and you will find that its up and down pattern does not follow the industrial revolution’s upward march of atmospheric carbon dioxide (CO2), which is the supposed central culprit for man caused global warming (and has been much, much higher in the past). It follows instead the up and down pattern of naturally caused climate cycles.¶ For example, temperatures dropped steadily from the late 1940s to the late 1970s. The popular press was even talking about a coming ice age. Ice ages have cyclically occurred roughly every 10,000 years, with a new one actually due around now.¶ In the late 1970s, the natural cycles turned warm and temperatures rose until the late 1990s, a trend that political and economic interests have tried to milk mercilessly to their advantage. The incorruptible satellite measured global atmospheric temperatures show less warming during this period than the heavily manipulated land surface temperatures.¶ Central to these natural cycles is the Pacific Decadal Oscillation (PDO). Every 25 to 30 years the oceans undergo a natural cycle where the colder water below churns to replace the warmer water at the surface, and that affects global temperatures by the fractions of a degree we have seen. The PDO was cold from the late 1940s to the late 1970s, and it was warm from the late 1970s to the late 1990s, similar to the Atlantic Multidecadal Oscillation (AMO).¶ In 2000, the UN’s IPCC predicted that global temperatures would rise by 1 degree Celsius by 2010. Was that based on climate science, or political science to scare the public into accepting costly anti-industrial regulations and taxes?¶ Don Easterbrook, Professor Emeritus of Geology at Western Washington University, knew the answer. He publicly predicted in 2000 that global temperatures would decline by 2010. He made that prediction because he knew the PDO had turned cold in 1999, something the political scientists at the UN’s IPCC did not know or did not think significant.¶ Well, the results are in, and the winner is….Don Easterbrook. Easterbrook also spoke at the Heartland conference, with a presentation entitled “Are Forecasts of a 20-Year Cooling Trend Credible?” Watch that online and you will see how scientists are supposed to talk: cool, rational, logical analysis of the data, and full explanation of it. All I ever see from the global warming alarmists, by contrast, is political public relations, personal attacks, ad hominem arguments, and name calling, combined with admissions that they can’t defend their views in public debate.¶ Easterbrook shows that by 2010 the 2000 prediction of the IPCC was wrong by well over a degree, and the gap was widening. That’s a big miss for a forecast just 10 years away, when the same folks expect us to take seriously their predictions for 100 years in the future. Howard Hayden, Professor of Physics Emeritus at the University of Connecticut showed in his presentation at the conference that based on the historical record a doubling of CO2 could be expected to produce a 2 degree C temperature increase. Such a doubling would take most of this century, and the temperature impact of increased concentrations of CO2 declines logarithmically. You can see Hayden’s presentation online as well.¶ Because PDO cycles last 25 to 30 years, Easterbrook expects the cooling trend to continue for another 2 decades or so. Easterbrook, in fact, documents 40 such alternating periods of warming and cooling over the past 500 years, with similar data going back 15,000 years. He further expects the flipping of the ADO to add to the current downward trend.¶ But that is not all. We are also currently experiencing a surprisingly long period with very low sunspot activity. That is associated in the earth’s history with even lower, colder temperatures. The pattern was seen during a period known as the Dalton Minimum from 1790 to 1830, which saw temperature readings decline by 2 degrees in a 20 year period, and the noted Year Without A Summer in 1816 (which may have had other contributing short term causes).¶ Even worse was the period known as the Maunder Minimum from 1645 to 1715, which saw only about 50 sunspots during one 30 year period within the cycle, compared to a typical 40,000 to 50,000 sunspots during such periods in modern times. The Maunder Minimum coincided with the coldest part of the Little Ice Age, which the earth suffered from about 1350 to 1850. The Maunder Minimum saw sharply reduced agricultural output, and widespread human suffering, disease and premature death.¶ Such impacts of the sun on the earth’s climate were discussed at the conference by astrophysicist and geoscientist Willie Soon, Nir J. Shaviv, of the Racah Institute of Physics in the Hebrew University of Jerusalem, and Sebastian Luning, co-author with leading German environmentalist Fritz Vahrenholt of The Cold Sun.¶ Easterbrook suggests that the outstanding question is only how cold this present cold cycle will get. Will it be modest like the cooling from the late 1940s to late 1970s? Or will the paucity of sunspots drive us all the way down to the Dalton Minimum, or even the Maunder Minimum? He says it is impossible to know now. But based on experience, he will probably know before the UN and its politicized IPCC.

#### Vanishing of sunspots will ensure another Ice Age—history proves

Easterbrook 11 – Professor Don Easterbrook has PhD in geology at the University of Washington and is the geology professor emeritus at Western Washington University, 2011 (“Easterbrook on the potential demise of sunspots,” June 16th 2011, <http://myweb.wwu.edu/dbunny/pdfs/Easterbrook-potential-demise-of-sunspots.pdf>)

The three studies released by NSO’s Solar Synoptic Network this week, predicting the virtual ¶ vanishing of sunspots for the next several decades and the possibility of a solar minimum similar to ¶ the Maunder Minimum, came as stunning news. According to Frank Hill,¶ “the fact that three completely different views of the Sun point in the same direction is a powerful ¶ indicator that the sunspot cycle may be going into hibernation.”¶ The last time sunspots vanished from the sun for decades was during the Maunder Minimum from ¶ 1645 to 1700 AD was marked by drastic cooling of the climate and the maximum cold of the Little Ice ¶ Age.¶ What happened the last time sunspots disappeared?¶ Abundant physical evidence from the geologic past provides a record of former periods of global ¶ cooling. Geologic records provide clear evidence of past global cooling so we can use them to project ¶ global climate into the future—the past is the key to the future. So what can we learn from past ¶ sunspot history and climate change?¶ Galileo’s perfection of the telescope in 1609 allowed scientists to see sunspots for the first time. From ¶ 1610 A.D. to 1645 A.D., very few sunspots were seen, despite the fact that many scientists with ¶ telescopes were looking for them, and from 1645 to 1700 AD sunspots virtually disappeared from the ¶ sun (Fig. 1). During this interval of greatly reduced sunspot activity, known as the Maunder ¶ Minimum, global climates turned bitterly cold (the Little Ice Age), demonstrating a clear ¶ correspondence between sunspots and cool climate. After 1700 A.D., the number of observed ¶ sunspots increased sharply from nearly zero to more than 50 (Fig. 1) and the global climate warmed. The Maunder Minimum was not the beginning of The Little Ice Age—it actually began about 1300 ¶ AD—but it marked perhaps the bitterest part of the cooling. Temperatures dropped ~4º C (~7 º F) in ¶ ~20 years in mid-to high latitudes. The colder climate that ensued for several centuries was ¶ devastating. The population of Europe had become dependent on cereal grains as their main food ¶ supply during the Medieval Warm Period and when the colder climate, early snows, violent storms, ¶ and recurrent flooding swept Europe, massive crop failures occurred. Winters in Europe were bitterly ¶ cold, and summers were rainy and too cool for growing cereal crops, resulting in widespread famine ¶ and disease. About a third of the population of Europe perished.¶ Glaciers all over the world advanced and pack ice extended southward in the North Atlantic. Glaciers ¶ in the Alps advanced and overran farms and buried entire villages. The Thames River and canals and ¶ rivers of the Netherlands frequently froze over during the winter. New York Harbor froze in the winter ¶ of 1780 and people could walk from Manhattan to Staten Island. Sea ice surrounding Iceland ¶ extended for miles in every direction, closing many harbors. The population of Iceland decreased by ¶ half and the Viking colonies in Greenland died out in the 1400s because they could no longer grow ¶ enough food there. In parts of China, warm weather crops that had been grown for centuries were ¶ abandoned. In North America, early European settlers experienced exceptionally severe winters.¶ So what can we learn from the Maunder? Perhaps most important is that the Earth’s climate is related ¶ to sunspots. The cause of this relationship is not understood, but it definitely exists. The second thing ¶ is that cooling of the climate during sunspot minima imposes great suffering on humans—global ¶ cooling is much more damaging than global warming.¶ Global cooling during other sunspot minima¶ The global cooling that occurred during the Maunder Minimum was neither the first nor the only such ¶ event. The Maunder was preceded by the Sporer Minimum (~1410–1540 A.D.) and the Wolf ¶ Minimum (~1290–1320 A.D.) and succeeded by the Dalton Minimum (1790–1830), the unnamed ¶ 1880–1915 minima, and the unnamed 1945–1977 Minima (Fig. 2). Each of these periods is ¶ characterized by low numbers of sunspots, cooler global climates, and changes in the rate of ¶ production of ¶ 14C and ¶ 10Be in the upper atmosphere. As shown in Fig. 2, each minimum was a time of ¶ global cooling, recorded in the advance of alpine glaciers. What can we learn from this historic data? Clearly, a strong correlation exists between solar variation ¶ and temperature. Although this correlation is too robust to be merely coincidental, exactly how solar ¶ variation are translated into climatic changes on Earth is not clear. For many years, solar scientists ¶ considered variation in solar irradiance to be too small to cause significant climate changes. However, ¶ Svensmark (Svensmark and Calder, 2007; Svensmark and Friis-Christensen, 1997; Svensmark et al., ¶ 2007) has proposed a new concept of how the sun may impact Earth’s climate. Svensmark recognized ¶ the importance of cloud generation as a result of ionization in the atmosphere caused by cosmic rays. ¶ Clouds reflect incoming sunlight and tend to cool the Earth. The amount of cosmic radiation is greatly ¶ affected by the sun’s magnetic field, so during times of weak solar magnetic field, more cosmic ¶ radiation reaches the Earth. Thus, perhaps variation in the intensity of the solar magnetic field may ¶ play an important role in climate change.¶ Are we headed for another Little Ice Age?¶ In 1999, the year after the high temperatures of the 1998 El Nino, I became convinced that geologic ¶ data of recurring climatic cycles (ice core isotopes, glacial advances and retreats, and sun spot ¶ minima) showed conclusively that we were headed for several decades of global cooling and presented ¶ a paper to that effect (Fig. 5). The evidence for this conclusion was presented in a series of papers ¶ from 2000 to 2011 (The data are available in several GSA papers, my website, a 2010 paper, and in a ¶ paper scheduled to be published in Sept 2011). The evidence consisted of temperature data from ¶ isotope analyses in the Greenland ice cores, the past history of the PDO, alpine glacial fluctuations, ¶ and the abrupt Pacific SST flips from cool to warm in 1977 and from warm to cool in 1999. Projection ¶ of the PDO to 2040 forms an important part of this cooling prediction. So far, my cooling prediction seems to be coming to pass, with no global warming above the 1998 ¶ temperatures and a gradually deepening cooling since then. However, until now, I have suggested that ¶ it was too early to tell which of these possible cooling scenarios were most likely. If we are indeed ¶ headed toward a disappearance of sunspots similar to the Maunder Minimum during the Little Ice ¶ Age then perhaps my most dire prediction may come to pass. As I have said many times over the past ¶ 10 years, time will tell whether my prediction is correct or not. The announcement that sun spots may ¶ disappear totally for several decades is very disturbing because it could mean that we are headed for ¶ another Little Ice Age during a time when world population is predicted to increase by 50% with ¶ sharply increasing demands for energy, food production, and other human needs. Hardest hit will be ¶ poor countries that already have low food production, but everyone would feel the effect of such ¶ cooling. The clock is ticking. Time will tell!

#### Studies of weakening solar activity support ice age theory

Hecht 11 – Laurence Hecht is the editor of 21st Century Science & Technology writing for the Executive Intelligence Review, 2011 (“Studies Show Weakening Sun, Possible New Ice Age,” Executive Intelligence Review Science, June 24th 2011, <http://www.21stcenturysciencetech.com/Articles_2011/WeakSun.pdf>)

In the words of the National Solar Observatory¶ report: “An immediate question is whether this slowdown presages a second Maunder Minimum, a 70-year¶ period with virtually no sunspots between 1645 and¶ 1715.” As established by American astronomer John¶ Eddy, that period coincided with a sharp drop in temperature, now known as the “Little Ice Age.”¶ 2¶ The serious threat of a decline in solar activity bringing on a new Little Ice Age had been raised earlier by¶ Russian solar astronomer Habibullo Abdussamatov, director of the Space Research Laboratory of the Pulkovo¶ Observatory in St. Petersburg. The work of Abdussamatov constitutes a fourth line of evidence that the Sun¶ may be going into decline, and the climate into a profound cooling phase. Among the ominous warning signs, Abdussamatov¶ has pointed to the work of the St. Petersburg geophysicist Eugen Borisenkov, who showed in 1988, that¶ solar minima of the Maunder type follow an approximately 200-year cycle, and have done so through 18¶ documentable epochs of deep minima for the past¶ 7,500 years. In a 2004 paper,¶ 3¶ Abdussamatov shows¶ that a change in size of the solar radius follows the¶ change in the Total Solar Irradiance (TSI) through the¶ 11-year solar cycle. He cites the work of M.L. Sveshnikov, showing that the amplitude of the radius variations declines during periods of reduced solar activity.¶ Abdussamatov has also noted the variation in the amplitude of changes in the TSI, from 1978 to 2008,¶ showing an accelerating decline from Solar Cycle 21 (1976-86) to the present. These changes in solar radius¶ and TSI, he supposes to be indicators of the energetic¶ activity of the Sun’s core, the Sun being a variable¶ star.¶ In a 2006 paper,¶ 4¶ Abdussamatov had already forecast a delayed onset and reduced activity for the present Solar Cycle 24 (Figure 2). There, Abdussamatov¶ proposed that the duration of the short-term solar cycle, which has varied from 9¶ to 13.4 years, is determined by¶ a parent, or secular, cycle of¶ longer duration. Our understanding of the precise nature¶ of the parent cycle is limited by¶ the small number of reliably¶ studied cycles (there have been¶ only 13 such cycles). However,¶ a trend of rise, maximum, and¶ descent of the secular cycle¶ could be noted in the periods¶ from 1755 to 1810, 1810 to¶ 1913, and 1913 to 2006, the¶ year of publication. The 11-¶ year cycles at the descending¶ phase of the secular cycle¶ showed a tendency to be longer¶ than the cycles at the rising and¶ maximum phases. On this¶ basis, he had forecast a prolonged Cycle 23 lasting to July¶ 2007.The cycle was prolonged,¶ but by more than Abdussamatov had expected, not ending¶ until December 2008. In a 2008 paper,¶ 5¶ Abdussamatov forecastseverely reduced¶ activity in Cycles 25 and 26:¶ “The earth is no longer¶ threatened by the catastrophic¶ global warming forecast by¶ some scientists; warming¶ passed its peak in 1998-2005,¶ while the value of the TSI by¶ July-September of last year¶ had already declined by 0.47 watts per square meter,”¶ Abdussamatov wrote. “Consequently, we should fear¶ a deep temperature drop, but not catastrophic global¶ warming. Humanity must survive the serious economic, social, demographic and political consequences of a global temperature drop, which will directly affect the national interests of almost all¶ countries and more than 80% of the population of the¶ Earth.”

### Yes Ice Age – Brink

#### Ice age coming any day now

**Goessling, 11** (Shannon Goessling is executive director and chief legal counsel for the Southeastern Legal Foundation.) “Rather than spiraling into a meltdown, we may be heading into the next ice age” <http://www.iceagenow.com/Rather_than_spiraling_into_a_meltdownwe_may_be_heading_into_next_ice_age.htm>

The U.S. National Solar Observatory, the U.S. Air Force Research Laboratory and astrophysicists across the planet report that the nearly all-time low sunspot activity may result in a sustained cooling period on Earth.¶ Many reputable scientists have been warning for decades that we are nearing the end of the 11,500-year average period between ice ages. And the last similar crash in sunspot activity coincided with the so-called "Little Ice Age" in the 1600s that lasted nearly a century.¶ What happens during a "Little Ice Age?" Food-producing land becomes scarcer, food-growing seasons become shorter, and the world becomes a much more arid and less hospitable place. Think food shortages and the social unrest that follows.¶ The forces at work behind the global warming regulatory regime have, at worst, covered up, ignored and manipulated climate evidence to make the case that humans cause global warming and therefore humans should be punished.¶ At best, the mainstream scientific community is continuing to weigh the climate data as it becomes available. Caught in the flux are millions of Americans suffering under an economic tsunami that is anything but a theory.¶ Despite increasing evidence that "global warming" climate change is not the unified scientific theory it has been promoted to be, vested interests continue to push for stringent limits on carbon dioxide emissions.¶ Certain investment banks and trading houses that stand to make billions on so-called "carbon credits," and the environmental sociologists who have as a stated purpose to change our way of life, are a powerful bloc.¶ In the Obama administration, this cabal has a willing "big stick" in the form the U.S. Environmental Protection Agency, which has enacted draconian measures that will, by President Obama's admission, make energy costs "skyrocket."¶ The EPA regulations were enacted this year without congressional approval as required by the Clean Air Act and other laws. Estimates put the economic damage of these regulations at $1 trillion over the next 20 years, with a loss of between four and 10 million jobs.¶ Moving forward with global warming regulations is truly "absurd."

#### Ice Age will occur in the next couple years

**Aym, 12** (Terrance Aym is a writer at Helium) “Scientists: Sun’s approaching “Grand Cooling” assures new Ice Age”<http://www.helium.com/items/2094726-scientists-suns-approaching-grand-cooling-assures-new-ice-age>

NASA and the ESA agree, and so does the Russian space agency, Roscosmos—the sun is headed for a Grand Solar Minimum and a Grand Cooling will commence.¶ The aptly named Grand Cooling is exactly what it implies: the sun is going to cool. That cooling will also cool off the Earth. It will last from 30 to 50 years.¶ What exactly does global cooling mean? Well for one, Al Gore was sure wrong! The Earth isn't going to warm, it's going to get colder. Much colder. So cold a little or full-blown Ice Age will ensue. As a matter of fact, some scientists claim we're already in the early stages of an Ice Age.¶ Maybe the Nobel Committee and the Academy of Motion Picture Arts and Sciences should ask Mr. Gore to return his awards.¶ Dutch Professor Cees de Jager, a prominent astronomer and solar expert, forcefully asserts that we the world is indeed entering for a long period of very low solar activity. The professor and his colleagues are certain Earth is heading for a "long Grand Minimum"—defined as either a Solar Wolf-Gleissberg or a Maunder Minimum—"not shorter than a century." His 2010 paper, "The forthcoming Grand Minimum of solar activity," outlined the extended period of time that the diminished solar radiation would affect the Earth. ¶ The Maunder minimum lasted from 1645 to 1715. It was marked by a period of general cooling over the entire planet. The Minimum coincided with the coldest year of the Little Ice Age. ¶ The astronomer, formerly the head of the Utrecht University Observatory in the Netherlands, has laid out the basis for the upcoming Ice Age.¶ Another very respected scientist, the late Dr. Theodor Landscheid, founder of the Schroeter Institute for Research in Cycles of Solar Activity in Waldmuenchen, Germany, was considered a giant in the field of climate research.¶ A prodigious author of many research papers, leader of studies, and the author of several books, Landscheidt investigated the Gleissberg Minimum. He rejected the now proven flawed science of anthropogenic global warming and even the concept of long-term global warming itself.¶ "Contrary to the IPCC's speculation about man-made global warming as high as 5.8° C within the next hundred years," he said, "a long period of cool climate with its coldest phase around 2030 is to be expected."¶ Referring to the sun's cycles, he pointed to their correlation with other periods of prehistory when ice spread across the northern hemisphere. "It can be seen that the Gleissberg minimum around 2030 and another one around 2200 will be of the Maunder Minimum type accompanied by severe cooling on Earth."¶ A few of the doctor's many papers on the sun's relation to Earth's climate include "Solar activity: A dominant factor in climate dynamics," and "New confirmation of strong solar forcing of climate." Both show the sun's relationship to Earth's climate and abrupt changes in that climate during periods of transition from warming to cooling and back to warming.¶ It is unfortunate that Al Gore's inconvenient truth turned out to be a fallacy. Global warming is much preferable to the climate the Earth actually seems on the verge of slipping into within a few short years.

#### Ice Age coming

**Marsh, 08** (Gerald Marsh is a retired physicist from the Argonne National Laboratory and a former consultant to the DoD on strategic nuclear technology and policy) <http://www.winningreen.com/site/epage/59549_621.htm>, 2/24/08, “The coming of the New Ice Age”

Contrary to the conventional wisdom of the day, the real danger facing humanity is not global warming, but more likely the coming of a new Ice Age. ¶ What we live in now is known as an interglacial, a relatively brief period between long ice ages. Unfortunately for us, most interglacial periods last only about ten thousand years, and that is how long it has been since the last Ice Age ended. ¶ How much longer do we have before the ice begins to spread across the Earth’s surface? Less than a hundred years or several hundred? We simply don’t know.¶ Even if all the temperature increase over the last century is attributable to human activities, the rise has been relatively modest one of a little over one degree Fahrenheit — an increase well within natural variations over the last few thousand years. ¶ While an enduring temperature rise of the same size over the next century would cause humanity to make some changes, it would undoubtedly be within our ability to adapt. ¶ Entering a new ice age, however, would be catastrophic for the continuation of modern civilization. ¶ One has only to look at maps showing the extent of the great ice sheets during the last Ice Age to understand what a return to ice age conditions would mean. Much of Europe and North-America were covered by thick ice, thousands of feet thick in many areas and the world as a whole was much colder. ¶ The last “little” Ice Age started as early as the 14th century when the Baltic Sea froze over followed by unseasonable cold, storms, and a rise in the level of the Caspian Sea. That was followed by the extinction of the Norse settlements in Greenland and the loss of grain cultivation in Iceland. Harvests were even severely reduced in Scandinavia And this was a mere foreshadowing of the miseries to come.¶ By the mid-17th century, glaciers in the Swiss Alps advanced, wiping out farms and entire villages. In England, the River Thames froze during the winter, and in 1780, New York Harbor froze. Had this continued, history would have been very different. Luckily, the decrease in solar activity that caused the Little Ice Age ended and the result was the continued flowering of modern civilization.¶ There were very few Ice Ages until about 2.75 million years ago when Earth’s climate entered an unusual period of instability. Starting about a million years ago cycles of ice ages lasting about 100,000 years, separated by relatively short interglacial perioods, like the one we are now living in became the rule. Before the onset of the Ice Ages, and for most of the Earth’s history, it was far warmer than it is today. ¶ Indeed, the Sun has been getting brighter over the whole history of the Earth and large land plants have flourished. Both of these had the effect of dropping carbon dioxide concentrations in the atmosphere to the lowest level in Earth’s long history. ¶ Five hundred million years ago, carbon dioxide concentrations were over 13 times current levels; and not until about 20 million years ago did carbon dioxide levels dropped to a little less than twice what they are today. ¶ It is possible that moderately increased carbon dioxide concentrations could extend the current interglacial period. But we have not reached the level required yet, nor do we know the optimum level to reach. ¶ So, rather than call for arbitrary limits on carbon dioxide emissions, perhaps the best thing the UN’s Intergovernmental Panel on Climate Change and the climatology community in general could do is spend their efforts on determining the optimal range of carbon dioxide needed to extend the current interglacial period indefinitely. ¶ NASA has predicted that the solar cycle peaking in 2022 could be one of the weakest in centuries and should cause a very significant cooling of Earth’s climate. Will this be the trigger that initiates a new Ice Age?¶ We ought to carefully consider this possibility before we wipe out our current prosperity by spending trillions of dollars to combat a perceived global warming threat that may well prove to be only a will-o-the-wisp.

### Yes Ice Age – AT: Earth is Warming

#### Global temperatures are falling – warming models can’t account for the pause

DAVID ROSE – Globe and Mail – 1/29/12, Forget global warming - it's Cycle 25 we need to worry about (and if NASA scientists are right the Thames will be freezing over again), <http://www.dailymail.co.uk/sciencetech/article-2093264/Forget-global-warming--Cycle-25-need-worry-NASA-scientists-right-Thames-freezing-again.html>

The supposed ‘consensus’ on man-made global warming is facing an inconvenient challenge after the release of new temperature data showing the planet has not warmed for the past 15 years.¶ The figures suggest that we could even be heading for a mini ice age to rival the 70-year temperature drop that saw frost fairs held on the Thames in the 17th Century.¶ Based on readings from more than 30,000 measuring stations, the data was issued last week without fanfare by the Met Office and the University of East Anglia Climatic Research Unit. It confirms that the rising trend in world temperatures ended in 1997.¶ Meanwhile, leading climate scientists yesterday told The Mail on Sunday that, after emitting unusually high levels of energy throughout the 20th Century, the sun is now heading towards a ‘grand minimum’ in its output, threatening cold summers, bitter winters and a shortening of the season available for growing food.¶ Solar output goes through 11-year cycles, with high numbers of sunspots seen at their peak.¶ We are now at what should be the peak of what scientists call ‘Cycle 24’ – which is why last week’s solar storm resulted in sightings of the aurora borealis further south than usual. But sunspot numbers are running at less than half those seen during cycle peaks in the 20th Century.¶ Analysis by experts at NASA and the University of Arizona – derived from magnetic-field measurements 120,000 miles beneath the sun’s surface – suggest that Cycle 25, whose peak is due in 2022, will be a great deal weaker still. ¶ According to a paper issued last week by the Met Office, there is a 92 per cent chance that both Cycle 25 and those taking place in the following decades will be as weak as, or weaker than, the ‘Dalton minimum’ of 1790 to 1830. In this period, named after the meteorologist John Dalton, average temperatures in parts of Europe fell by 2C.¶ However, it is also possible that the new solar energy slump could be as deep as the ‘Maunder minimum’ (after astronomer Edward Maunder), between 1645 and 1715 in the coldest part of the ‘Little Ice Age’ when, as well as the Thames frost fairs, the canals of Holland froze solid.¶ Yet, in its paper, the Met Office claimed that the consequences now would be negligible – because the impact of the sun on climate is far less than man-made carbon dioxide. Although the sun’s output is likely to decrease until 2100, ‘This would only cause a reduction in global temperatures of 0.08C.’ Peter Stott, one of the authors, said: ‘Our findings suggest a reduction of solar activity to levels not seen in hundreds of years would be insufficient to offset the dominant influence of greenhouse gases.’¶ These findings are fiercely disputed by other solar experts.¶ ‘World temperatures may end up a lot cooler than now for 50 years or more,’ said Henrik Svensmark, director of the Center for Sun-Climate Research at Denmark’s National Space Institute. ‘It will take a long battle to convince some climate scientists that the sun is important. It may well be that the sun is going to demonstrate this on its own, without the need for their help.’¶ He pointed out that, in claiming the effect of the solar minimum would be small, the Met Office was relying on the same computer models that are being undermined by the current pause in global-warming.¶ CO2 levels have continued to rise without interruption and, in 2007, the Met Office claimed that global warming was about to ‘come roaring back’. It said that between 2004 and 2014 there would be an overall increase of 0.3C. In 2009, it predicted that at least three of the years 2009 to 2014 would break the previous temperature record set in 1998.¶ So far there is no sign of any of this happening. But yesterday a Met Office spokesman insisted its models were still valid.¶ ‘The ten-year projection remains groundbreaking science. The period for the original projection is not over yet,’ he said.¶ Dr Nicola Scafetta, of Duke University in North Carolina, is the author of several papers that argue the Met Office climate models show there should have been ‘steady warming from 2000 until now’.¶ ‘If temperatures continue to stay flat or start to cool again, the divergence between the models and recorded data will eventually become so great that the whole scientific community will question the current theories,’ he said.

### Ice Age DA Links

#### Increase In Carbon dioxide levels Necessary To Prevent Ice Age

redOrbit- Trusted News source which offers Science, Space, Technology, Health news, videos, images and reference information- 1/9/2012, “CO2 Emissions Could Prevent Next Ice Age”- RedOrbit- http://www.redorbit.com/news/science/1112451871/co2-emissions-could-prevent-next-ice-age/

Increases in carbon dioxide emissions will prevent us from experiencing the next Ice Age, which experts believe would have occurred within the next millennium, according to research published in this week’s edition of the journal Nature Geoscience.¶ ¶ An international team of scientists examined variations in the Earth’s orbit, as well as global weather and climate patterns, determining that the next worldwide deep-freeze should begin within the next 1,500 years, the Telegraph reported on Monday. However, that Ice Age will not occur due to the impact of human CO2 emissions on the environment.¶ ¶ “The period between the end of an ice age and the beginning of the next is typically about 11,000 years due to a natural cycle related to the Earth’s orbit,” the UK newspaper said. “The temperate stretch in between global freezes can be longer or shorter depending on a number of factors, but with the last ice age having ended 11,600 years ago the arrival of another already appears overdue.”¶ ¶ The research team, which included scientists from Cambridge University, University College London, the University of Florida, and Bergen University in Norway, calculated that atmospheric carbon dioxide concentration levels would have to fall below 240 parts per million (ppm) in order for glaciations to begin, BBC News Environmental Correspondent Richard Black said.¶ ¶ Currently, the level is approximately 390 ppm, he added.¶ ¶ “At current levels of CO2, even if emissions stopped now we’d probably have a long interglacial duration determined by whatever long-term processes could kick in and bring [atmospheric] CO2 down,” Cambridge University’s Luke Skinner told BBC News.¶ ¶ “From 8,000 years ago, as human civilization flourished, CO2 reversed its initial downward trend and drifted upwards, accelerating sharply with the industrial revolution,” he added. “Although the contribution of human activities to the pre-industrial drift in CO2 remains debated, our work suggests that natural insulation will not be cancelling the impacts of man-made global warming.”¶ ¶ The Global Warming Policy Foundation, an organization supporting sustained greenhouse-effect conditions to maintain the present global climate, told the Telegraph that the study proved that man-made carbon dioxide emissions were helping to prevent a “global disaster.”¶ ¶ Skinner told Black that he and his colleagues expected such a reactions and called it “an interesting philosophical discussion,” but that such believes were “missing the point” of the research.¶ ¶ “Where we’re going is not maintaining our currently warm climate but heating it much further, and adding CO2 to a warm climate is very different from adding it to a cold climate,” he added. “The rate of change with CO2 is basically unprecedented, and there are huge consequences if we can’t cope with that.”¶

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

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

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

#### Increased CO2 Emissions Stop/Prevent Ice Ages- Empirics Prove

Gideon Polya, Biochemistry Major Australian University. Published 130 scientific works,4/5/12- “CO2 Rise ended Ice Age”- MWC News- http://mwcnews.net/focus/analysis/18031-co2-rise.html

US scientists have recently found that a rise in atmospheric carbon dioxide (CO2) preceded the global warming that brought about the end of the last Ice Age. This finding debunks the claims of climate change skeptics that climate change is not happening or if it is then the increased atmospheric CO2 is a consequence and not a cause of global warming. Back during the last major deglaciation event atmospheric CO2 rose from 160 parts per million (ppm) to an eventual 260 ppm.¶ However since the start of the Industrial Revolution CO2 has risen through fossil fuel burning to a current 392 ppm, this being associated with an average surface temperature rise of 0.8 degree C. These latest findings debunk obfuscation of the climate emergency by fossil fuel corporations, some Mainstream media (notably the Murdoch media) and other climate change contrarians and reinforce calls by top climate scientists for urgent action to cease greenhouse gas (GHG) pollution and to return atmospheric CO2 concentration to about 300 ppm CO2 ( a level not exceeded for 800,000 years until the last century). phere. The most useful single thing one can do is to vote 1 Green.

#### Humanity needs to burn more fossil fuels- stops next 5 ice ages

University of Southampton- 8/29/7, “Next Ice Age delayed by rising CO2 levels”, University of Southampton,

<http://www.southampton.ac.uk/mediacentre/news/2007/aug/07_100.shtml>

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

#### Increasing Anthropogenic warming checks radiation reductions- delays ice age’s

UCL- UK news source which provides news on the latest studies in science- 1/10/12, “Next ice age delayed by global warming”, UCL News, <http://www.ucl.ac.uk/news/news-articles/January2012/10012012-ice-age-delayed>

Without human carbon dioxide emissions the next ice age would be imminent, according to a Nature Geoscience study led by a UCL scientist.¶ In the paper, scientists led by Professor Chronis Tzedakis (UCL Geography) have been able to ‘fingerprint’ the timing of past ice age activations, or ‘glacial inceptions’ by identifying the onset of abrupt temperature changes in Greenland and Antarctica.¶ By applying this ‘fingerprint’ method to a nearly identical interglacial period with similar levels of summer solar radiation to our own current period, some 780 thousand years ago, the researchers have been able to determine that glacial inception would indeed be expected to occur sometime within the next 1500 years, a blink of an eye in the context of the Earth’s lifespan. But due to high CO2 levels, and associated radiative forcing of global temperatures, it is expected to be delayed.¶ Professor Tzedakis said: “Uncertainty over an imminent hypothetical ice age arises from the unusually weak minimum in summer solar radiation, which characterises the present situation. It has thus been proposed that times of weak solar radiation force interglacials to last 20 thousand years or more.”¶ “Uncertainty over an imminent hypothetical ice age arises from the idea unusually weak minimum in summer solar radiation, which characterises the present situation.”¶ Professor Chronis Tzedakis¶ A reduction in summer solar radiation energy, or insolation, is the primary trigger for the start of a new ice age. The team found that the onset of the ice age around 780 thousand years ago occurred when the reduction in summer solar radiation was very weak (like today), but CO2 levels were lower than pre-industrial concentrations, thereby offsetting the effect of the weak solar radiation forcing. ¶ CO2 concentrations are another factor that impacts on the start of ice ages. With the rise of human civilisation, agriculture and the industrial revolution, CO2 levels have increased over the past few thousand years, preventing the onset of the next ice age. ¶ Professor Tzedakis added: “While verification of an imminent glacial inception will elude us at current CO2 concentrations, it is important to reiterate that the current solar radiation forcing and lack of new ice growth mean that natural variability will not be moderating the effects of anthropogenically-induced global warming.”¶

#### Sustained Greenhouse Emissions Necessary to Hold Back Ice Age

Richard Black-Environment correspondent, BBC News- 1/9/12, “Carbon emissions 'will defer Ice Age”- BBC- http://www.bbc.co.uk/news/science-environment-16439807

The broad conclusions of the team were endorsed by Lawrence Mysak, emeritus professor of atmospheric and oceanic sciences at McGill University in Montreal, Canada, who has also investigated the transitions between Ice Ages and warm interglacials.¶ "The key thing is they're looking about 800,000 years back, and that's twice the 400,000-year cycle, so they're looking at the right period in terms of what could happen in the absence of anthropogenic forcing," he told BBC News.¶ He suggested that the value of 240ppm CO2 needed to trigger the next glaciation might however be too low - other studies suggested the value could be 20 or even 30ppm higher.¶ "But in any case, the problem is how do we get down to 240, 250, or whatever it is? Absorption by the oceans takes thousands or tens of thousands of years - so I don't think it's realistic to think that we'll see the next glaciation on the [natural] timescale," Prof Mysak explained.¶ Groups opposed to limiting greenhouse gas emissions are already citing the study as a reason for embracing humankind's CO2 emissions.¶ The UK lobby group the Global Warming Policy Foundation, for example, has flagged up a 1999 essay by astronomers Sir Fred Hoyle and Chandra Wickramasinghe, who argued that: "The renewal of ice-age conditions would render a large fraction of the world's major food-growing areas inoperable, and so would inevitably lead to the extinction of most of the present human population.¶ "We must look to a sustained greenhouse effect to maintain the present advantageous world climate. This implies the ability to inject effective greenhouse gases into the atmosphere, the opposite of what environmentalists are erroneously advocating."¶ Luke Skinner said his group had anticipated this kind of reception.¶ "It's an interesting philosophical discussion - 'would we better off in a warm [interglacial-type] world rather than a glaciation?' and probably we would," he said.¶ "But it's missing the point, because where we're going is not maintaining our currently warm climate but heating it much further, and adding CO2 to a warm climate is very different from adding it to a cold climate.¶ "The rate of change with CO2 is basically unprecedented, and there are huge consequences if we can't cope with that."

#### The increase in temperature will prevent the next ice age – empirically proven

Tierney Smith, Tierney specialises in writing on nature, living and learning for RTCC. She studied multi-media journalism at Bournemouth University, graduating in 2010. While there she won a BJTC Best Website Award for her analysis of the debate surrounding nuclear energy in the UK, “Research Breakthrough: CO2 rises caused warming that ended the last ice age”. 4/4/2012. RTCC, <http://www.rtcc.org/learning/research-breakthrough-co2-rises-caused-warming-that-ended-last-ice-age/>

Research break through: CO2 rises caused warming that ended last ice age¶ 4 April 2012¶ By Tierney Smith¶ Compelling new evidence suggests that rising CO2 caused much of the global warming responsible for ending the last ice age.¶ The study, published in Nature, confirms what scientists have believed for sometime, and further supports the view that current rises in human-driven CO2 will lead to more global warming.¶ “CO2 was a big part of bringing the world out of the last Ice Age and it took about 10,000 years to do it,” said Jeremy Shakun from Harvard University and lead-author of the report.¶ The study found that globally carbon dioxide rises preceded rising tempuratures at the end of the last Ice Age (©23am.com/Creative Commons)¶ “Now CO2 levels are rising again, but this time an equivalent increase of CO2 has occurred in only about 200 years, and there are clear signs that the planet is already beginning to respond.”¶ “While many of the details of future climate change remain to be figured out, our study bolsters the consensus view that rising CO2 will lead to more global warming.”¶ While previous studies only compared carbon dioxide levels to local temperatures in Antarctica, the current study aimed to reconstruct global average temperature changes, using 80 core samples from around the world.¶ Looking only at local temperatures in Antarctica, warming appears to precede rising CO2, an argument often adopted by sceptics to disprove carbon dioxide’s role in global warming.¶ Shakun however, says this is leaving a huge gap in the research.¶ Putting all these records together into a reconstruction of global temperature shows a beautiful correlation with rising CO2 at the end of the Ice Age,” said Shakun. “Even more interesting, while CO2 trails Antarctica warming, it actually precedes global temperature change, which is what you would expect if CO2 is causing warming.”¶ Most scientists, according to Shakun, now believe the first factor in rising temperatures in Antarctica was not carbon dioxide emissions but a change in the Earth’s orbit, which resulted in more sunlight hitting the northern hemisphere.¶ As ice sheets over North America and Europe melted, millions of gallons of freshwater flooded into the North Atlantic Ocean and disrupted the cyclical flow of ocean currents.¶ Atmospheric CO2 compared to Antarctic temperature and global mean temperature at the end of the last ice age (© Jeremy Shakun)¶ This meant the current which normally brings warm water north from the tropics – and today keeps Europe mild – was blocked, and the Southern Hemisphere warmed at the expense of the Northern Hemisphere – melting Antarctic ice and drawing up CO2 from the deep water.¶ Shakun says this all points towards CO2 being an amplifier for warming in the Southern Hemisphere.¶ He said: “If it was an amplifier, the question is how big an amplifier? Does it explain a lot of climate change, or was it a small piece and other factors were more important? I think this research really points a strong finger at the idea that CO2 was a major player.”

#### Human increase in temps warming oceans- preventing ice sheets from accumulating

Seth Borenstein, Science climate writer Associated Press, “Ice Age Thawing and Carbon Dioxide Levels Linked in New Study”, 4/4/2012, Huffington Post, <http://www.huffingtonpost.com/2012/04/04/ice-age-carbon-dioxide-levels_n_1403222.html>

WASHINGTON (AP) — The dramatic temperature increases that thawed the last ice age followed spikes in carbon dioxide levels in the air, a new study finds. Researchers say that further strengthens the scientific case explaining current man-made global warming.¶ In the new study, scientists show the atmospheric concentration of that heat-trapping greenhouse gas jumped more than 40 percent. Then global temperatures went up about 6 degrees Fahrenheit (3.5 degrees Celsius).¶ What is remarkable is that when the two are plotted they rise, plateau and rise again in a striking similar way with a slight lag. The warming over 6,000 years follows the greenhouse gas increase, just as scientific theory has long held.¶ This is important because, until this study, the two curves weren't quite so in sync. At some points, it seemed that the temperatures warmed before the carbon dioxide levels increased, something that climate skeptics seized upon.¶ How could carbon dioxide cause warming if the temperatures warmed first, argue skeptics, who are in the scientific minority.¶ Earlier studies had looked at carbon dioxide levels and temperature readings from Antarctica, not the entire world. A study published Wednesday in the journal Nature estimated global temperatures using 80 different proxies — ice and mud samples from dozens of places around the world — and found that globally, temperatures clearly went up only after carbon dioxide jumped.¶ "You end up with something that looks remarkably similar to the pattern of rising carbon dioxide through time," study lead author Jeremy Shankun of Harvard University said. "This, to me, seems like pretty powerful proof of theory of the connection between greenhouse gases and global warming."¶ There are two main sources of carbon dioxide, the chief greenhouse gas. The natural source comes mostly from dead plants and animals and that amplified the ice age thaw. In modern day, emissions from burning coal, oil and other fossil fuels add greatly to that natural carbon dioxide.¶ The ice age warming in Antarctica still appears to come before the carbon dioxide increases, which are calculated using an 800,000 year old Antarctic ice core, but there's good reason, Shankun said.¶ Temperature records and other ocean data paint a complicated picture of just how the last ice age thawed. It's almost like a Rube Goldberg machine, with one step leading to another and another. When the last ice age peaked about 25,000 years ago, the ice sheet extended to Iowa and New York City, Shankun said.¶ The ice sheet was actually so large that it was unstable, said study co-author Peter Clark of Oregon State University.¶ The initial trigger to the melt: A small and predictable wobble in Earth's orbit around the sun. That tiny wobble meant a tilt toward the sun that brought more sunlight in the Northern Hemisphere, causing ice sheets to melt and sending whopping levels of fresh water into the world's oceans.¶ That caused the global circulation of the oceans to stop, which in turn warmed the southern oceans melting southern ice sheets over areas where more of the world's carbon dioxide is trapped, Shankun said.¶ That released massive amounts of the greenhouse gas, which then amplified the global temperature spike, Shankun said.¶ By 11,000 years ago, the ice age was history and greenhouse gas and temperature levels had stabilized. That changed with the industrial age and the increased use of fossil fuels.¶ Carbon dioxide levels have jumped roughly the same amount in the last century as they did over 6,000 years to get out of the ice age, Shankun said.¶ Penn State University professor Richard Alley and others called this a significant advance in studies about past climate change and carbon dioxide, saying "this may be of help in explaining things out in the sound-bite world."

#### Human CO2 increases thwarting global cooling

Rebecca Boyle, Writer and contributor Popular Science Magazine, “Human CO2 Emissions Could Avert the Next Ice Age, Study Says”, 1/8/2012, Popular Science Magazine, <http://www.popsci.com/science/article/2012-01/human-co2-emissions-could-avert-next-ice-age-study-says>

Earth could be entering a new Ice Age within the next millennium, but it might not, the deep freeze averted by warming from increased carbon dioxide emissions. Humans could be thwarting the next glacial inception, a new study says.¶ Even in the comparatively long time scales of Earth history, we’re kind of overdue for another ice age — our current Holocene era has lasted about 11,600 years, roughly 600 years longer than the average interglacial (between-ice-age) periods of the past. If atmospheric CO2 levels were lower, the next ice age might have started sometime within the next 1,000 years, according to researchers from University College London and Cambridge University.¶ RELATED ARTICLES¶ Antarctic Collision Snaps Rhode-Island-Sized Iceberg Off Glacier¶ Global Warming Opens a Long-Sought Shipping Route Through the Arctic¶ Study: Rising Global Temperatures Spur Steepest Sea Level Rise In 2,100 Years¶ TAGS¶ Science, Rebecca Boyle, climate change, co2 emissions, global climate change, global warming, ice age, ocean currents, solar cyclesTheir conclusion is based in part on abrupt temperature changes in the overall temperature contrast between Greenland and Antarctica, according to a Cambridge news release. The North Atlantic would cool rapidly while Antarctica warms, fluctuations that would only happen if expanding ice sheets were calving icebergs huge enough to impact ocean circulation. These temperature see-saws can therefore be used to pinpoint the activation of a new ice age, a “glacial inception.”¶ Chronis Tzedakis from UC London and colleagues examined our present conditions, including temperature averages and solar radiation strength, and found a close analogue to the present, an era called Marine Isotope Stage 19, or about 780,000 years ago. The eras have a similar astronomical configuration and climate, although their CO2 trajectories are pretty different (ours is on the rise).¶ A phenomenon called insolation was a key factor here. Insolation is the seasonal and latitudinal distribution of solar radiation, which changes a tiny bit over tens of thousands of years due to tiny variations in Earth’s orbit around the sun. These little differences are one of the factors that can help trigger a cooling event, cascading toward an ice age. The insolation minimum in the MIS19 era was similar to our own, so it’s a valid analogy, the researchers say.¶ The team applied their glacial inception fingerprinting method to MIS19, looking at ice core samples, plankton remains and debris that would have floated on the encroaching ice, and determined at what point the glacial inception would have started. Then they compared that time frame to the Holocene time frame.¶ “Taking the [current era] to MIS19c analogy to its logical conclusion implies that the current interglacial would be nearing its end,” the researchers write. If, that is, atmospheric CO2 levels were comparable to the MIS19 era. Which they aren't. This shows that while insolation is an important ingredient, apparently it’s not as potent an ice age determinant as CO2.¶ “The current insolation forcing and lack of new ice growth mean that orbital-scale variability will not be moderating the effects of anthropogenically induced global warming,” the authors conclude.

#### Our warming levels are the same as the past- stopping an ice-age

Harvard Gazette, Newspaper written by Harvard students for Harvard University, “Illuminating Carbons Climate Change Researchers Demonstrate role of CO2 in Delegation”, 4/20/2012, Harvard Science, <http://news.harvard.edu/gazette/story/2012/04/illuminating-carbons-climate-effects/>

Harvard scientists are helping to paint the fullest picture yet of how a handful of factors, particularly a worldwide increase in atmospheric carbon dioxide, combined to end the last ice age 10,000-20,000 years ago.¶ As described in a paper published April 5 in Nature, researchers compiled ice and sedimentary core samples collected from dozens of locations around the world, and found evidence that while changes in the planet’s orbit may have touched off a warming trend, increases in CO2 played a far more important role in pushing it out of the ice age.¶ “Orbital changes are the pacemaker. They’re the trigger, but they don’t get you too far,” lead author Jeremy Shakun, a visiting postdoctoral fellow in earth and planetary sciences, said. “Our study shows that CO2 was a much more important factor, and was really driving worldwide warming during the last deglaciation.”¶ Though scientists have known for many years, based on studies of Antarctic ice cores, that deglaciations over the past million years and sharp increases in CO2 were connected, establishing a clear cause-and-effect relationship between CO2 and global warming from the geologic record has remained difficult, Shakun said. In fact, when studied closely, the ice-core data indicate that CO2 levels rose after temperatures were already on the increase, a finding that has often been used by global warming skeptics to bolster claims that greenhouse gases do not contribute to climate change.¶ Many climate scientists have addressed the criticism and shown that the lag between temperature and CO2 increases means that greenhouse gases were an amplifier, rather than trigger, of past climate change, but Shakun and his colleagues saw a larger problem — while CO2 measurements taken from air bubbles in the ice cores reflect levels throughout the global atmosphere, temperatures recorded in the ice only reflect local Antarctic conditions.¶ ¶ Shakun picks through 2-million-year-old seashells from the Gulf of Mexico. He will later analyze the chemistry to reconstruct the temperature of the waters.¶ To get a more accurate picture of the relationship between global temperature and CO2, the researchers synthesized dozens of core samples — 80 in all — collected from around the world.¶ “We have ice cores from Greenland; people have cored the sea floor all around the world, they’ve cored lakes on the continents, and they have worked out temperature histories for all these sites,” Shakun said. “Putting all of these records together into a reconstruction of global temperature shows a beautiful correlation with rising CO2 at the end of the ice age. Even more interesting, while CO2 trails Antarctic warming, it actually precedes global temperature change, which is what you would expect if CO2 is causing the warming.¶ “The previous science clearly said that CO2 had something to do with warming,” Shakun added. “It has gone up and down in tandem with the ice ages, so it is clearly involved. If it was an amplifier, the question was: How big of an amplifier? Does it explain a lot of climate change, or was it a small piece, and other factors were more important? I think this research really points a strong finger at the idea that CO2 was a major player.”¶ Armed with that evidence, Shakun and colleagues were able to sketch out how a series of factors aligned to eventually set off a worldwide warming trend and the end of the ice age.¶ Most scientists now believe, Shakun said, that the first domino wasn’t an increase in greenhouse gases, but a gradual change in the Earth’s orbit. That change resulted in more sunlight hitting the northern hemisphere. As the ice sheets over North America and Europe melted, millions of gallons of fresh water flooded into the North Atlantic and disrupted the cyclical flow of ocean currents.¶ “Ocean circulation works like a global conveyor belt,” Shakun said. “The reason it’s important for climate is because it’s moving heat around. If you look at it today, the northern hemisphere is, on average, a couple degrees warmer than the south, and that’s partly because the ocean is pulling heat northward as it flows across the equator in the Atlantic.¶ “But if you turn the conveyor belt off, it’s going to warm the south because you’re no longer stealing that heat away. Warming the southern hemisphere, in turn, shifts the winds and melts back sea ice that had formed a cap, trapping carbon in the deep ocean.”¶ As more and more CO2 enters the atmosphere, Shakun said, the global warming trend continues, “and pretty soon you’re headed out of an ice age.”¶ While the research strengthens the link between CO2 and the ice ages, Shakun believes it also reinforces the importance of addressing CO2-driven climate change in our own time.¶ “I don’t think this tells us anything fundamentally new about global warming,” Shakun said. “Most scientists are not in doubt about the human-enhanced greenhouse effect — there are nearly a dozen strong pieces of evidence that it is affecting global climate. This is just one more log on the fire that confirms it.”¶ Shakun’s research was supported by a National Oceanic and Atmospheric Administration Climate and Global Change Fellowship and by the National Science Foundation, and conducted using resources at the Oak Ridge National Laboratory.

#### Current greenhouse emissions delaying the ice age

Anthony Watts, Willard Anthony Watts is an American meteorologist, president of IntelliWeather Inc., editor of the blog, Watts Up With That?, and founder of the SurfaceStations.org project that documents the siting of weather stations across the United States, “ New Paper: AGW may save us from the next ice age”, 1/8/2012, <http://wattsupwiththat.com/2012/01/08/new-paper-agw-may-save-us-from-the-next-ice-age/>

New paper: AGW may save us from the next ice age¶ Posted on January 8, 2012 by Anthony Watts¶ As mentioned in our WUWT story earlier today Increased CO2 Emissions Will Delay Next Ice Age the official press release is now out at Eurekalert and published below. I can hear the wailing and gnashing of teeth already. Bottom line, you can manage a hot summer, but you can’t get out of the way of tons of ice. Unfortunately, the authors find a way to make this out to be bad news, by suggesting Antarctica is melting. So far, we’ve seen no evidence of that. In fact Antarctic Sea Ice is trending upwards in the past 30 years:¶ Graph source: Cryosphere Today¶ From the University of Florida¶ Global warming caused by greenhouse gases delays natural patterns of glaciation, researchers say¶ GAINESVILLE, Fla. — Unprecedented levels of greenhouse gases in the Earth’s atmosphere are disrupting normal patterns of glaciation, according to a study co-authored by a University of Florida researcher and published online Jan. 8 in Nature Geoscience.¶ The Earth’s current warm period that began about 11,000 years ago should give way to another ice age within about 1,500 years, according to accepted astronomical models. However, current levels of carbon dioxide are trapping too much heat in the atmosphere to allow the Earth to cool as it has in its prehistoric past in response to changes in Earth’s orbital pattern. The research team, a collaboration among University College London, University of Cambridge and UF, said their data indicate that the next ice age will likely be delayed by tens of thousands of years.¶.

#### Our Carbon Levels are stopping the ice age from occurring in the squo

Anthony Watts, Willard Anthony Watts is an American meteorologist, president of IntelliWeather Inc., editor of the blog, Watts Up With That?, and founder of the SurfaceStations.org project that documents the siting of weather stations across the United States, “ New Paper: AGW may save us from the next ice age”, 1/8/2012, <http://wattsupwiththat.com/2012/01/08/new-paper-agw-may-save-us-from-the-next-ice-age/>

The study looks at the prehistoric climate-change drivers of the past to project the onset of the next ice age. Using astronomical models that show Earth’s orbital pattern with all of its fluctuations and wobbles over the last several million years, astronomers can calculate the amount of solar heat that has reached the Earth’s atmosphere during past glacial and interglacial periods.¶ “We know from past records that Earth’s orbital characteristics during our present interglacial period are a dead ringer for orbital characteristics in an interglacial period 780,000 years ago,” said Channell. The pattern suggests that our current period of warmth should be ending within about 1,500 years.¶ However, there is a much higher concentration of greenhouse gases trapping the sun’s heat in the Earth’s atmosphere now than there was in at least the last several million years, he said. So the cooling that would naturally occur due to changes in the Earth’s orbital characteristics are unable to turn the temperature tide.¶ Over the past million years, the Earth’s carbon dioxide levels, as recorded in ice core samples, have never reached more than 280 parts per million in the atmosphere. “We are now at 390 parts per million,” Channell said. The sudden spike has occurred in the last 150 years.¶ For millions of years, carbon dioxide levels have ebbed and flowed between ice ages. Orbital patterns initiate periods of warming that cause ocean circulation to change. The changes cause carbon dioxide-rich water in the deep ocean to well up toward the surface where the carbon dioxide is released as a gas back into the atmosphere. The increase in atmospheric carbon dioxide then drives further warming and eventually the orbital pattern shifts again and decreases the amount of solar heat that reaches the Earth.¶ “The problem is that now we have added to the total amount of CO2 cycling through the system by burning fossil fuels,” said Channell. “The cooling forces can’t keep up.”¶ Channell said that the study, funded by the National Science Foundation in the U.S, and the Research Council of Norway and the Natural Environment Research Council in the United Kingdom, brings to the forefront the importance of atmospheric carbon dioxide because it shows the dramatic effect that it is having on a natural cycle that has controlled our Earth’s climate for millions of years.¶ “We haven’t seen this high concentration of greenhouse gases in the atmosphere for several million years,” Channell said. “All bets are off.”

Christine Dell'Amore, environment/writer editor for National Geographic News, “Next Ice Age Delayed by Global Warming Study says”, 9/3/2009. National Geographic News, <http://news.nationalgeographic.com/news/2009/09/090903-arctic-warming-ice-age.html>

Humans are putting the brakes on the next ice age, according to the most extensive study to date on Arctic climate change.¶ The Arctic may be warmer than it's been in the past 2,000 years—a trend that is reversing a natural cooling cycle dictated by a wobble in Earth's axis.¶ Previously, researchers had looked at Arctic temperature data that went back just 400 years. (See photos of how climate change is transforming the Arctic.) ¶ That research showed a temperature spike in the 20th century, but it was unclear whether human-caused greenhouse gas emissions or natural variability was the culprit, noted study co-author Gifford Miller of the Institute of Arctic and Alpine Research at the University of Colorado, Boulder.¶ By looking even farther back in time, Miller and colleagues' newest study reveals that the 20th century's abrupt warming may have in fact interrupted millennia of steady cooling. ¶ It's "pretty clear that the most reasonable explanation for that reversal is due to increasing greenhouse gases," Miller said.¶ The researchers' computer climate models dovetails with field data such as sediment cores and tree rings, which "really … solidifies our understanding," he said.¶ Eventually Earth will slip again into the pattern of cyclical ice ages, Miller added, but it may be thousands of years before that happens.¶ Ice Age, Interrupted¶ Earth's angle toward the sun changes due to a natural 26,000-year-long wobble, which causes the planet to spin on is axis like an unstable top, so that a line drawn from the axis would trace a cone in the sky.¶ The wobble causes Earth to make its closest pass by the sun in different months over the long term. For the past 7,000 years, Earth has passed closest to the sun in January. ¶ This means less sunlight has been hitting the Arctic during its summertime, so the region should be cooling. (See an Arctic map.)¶ To estimate past temperatures, the research team looked at Arctic lake sediments and at previously published data of glacial ice cores and tree rings.¶ The team also examined a computer model of global climate based at the National Center for Atmospheric Research in Colorado.¶ Miller and colleagues found that the wobble in Earth's tilt causes Arctic temperatures to drop by about 0.36 degree Fahrenheit (0.2 degree Celsius) every thousand years during a cooling phase.¶ But human-caused global warming overwhelmed that gradual cooling in the mid-1990s, shooting temperatures up by about 2.5 degrees Fahrenheit (1.4 degrees Celsius) over the course of a few decades.¶ In fact four of the five warmest decades in the past 2,000 years occurred after 1950, according to the study, which will be published tomorrow in the journal Science.¶ Ecologist Syndonia Bret-Harte said she has seen the effects of climate change firsthand during her research on the changing Alaskan tundra.¶ The new study "doesn't seem that surprising, but it's good to confirm what researchers were already thinking," said Bret-Harte, of the Institute of Arctic Biology at the University of Alaska, Fairbanks.

#### Our current CO2 emmissions can reduce the severity of the next Ice Age

The Hindustan Time, One of the biggest circulated newspapers in India, “ Global Warming is Stopping Lethal Ice Age”, 1/09/2012. <http://www.hindustantimes.com/world-news/Europe/Global-warming-is-stopping-lethal-ice-age/Article1-793875.aspx>

Human carbon emissions could put off a "lethal" ice age which is due to start within 1,500 years say British scientists at Cambridge University.¶ According to them levels of CO2 in the atmosphere could actually insulate against a catastrophic ice age which would see glaciers ¶ ¶ advance over Europe and north America.¶ They admit people would be "better off" in a warmer world.¶ Lead scientist Luke Skinner says even if carbon emissions stopped today, levels would remain elevated for at least 1,000 years and stored heat could actually prevent the next Ice Age from happening, the Daily Mail reported.¶ Instead things would cool down but not quite so severely. Thanks to elevated levels of carbon dioxide in the atmosphere the earth would not experience "glaciation" - periods of severe cold where glaciers advance.¶ The current level of carbon dioxide is 390 parts per million. The scientists believe that level would need to drop to 240 parts per million to allow glaciation to take place.¶ "It s an interesting philosophical discussion. Would we better off in a warm world rather than a glaciation? Probably we would. At current levels of CO2 even if emissions stopped now we'd probably have a long interglacial period," he said.¶ "Interglacial" periods are warmer periods between periods of glaciation. The last ice age ended 11,500 years ago.¶ The cycle is dictated by tiny variations in Earth's orbit around the sun. Ice ages are marked by glaciers advancing over continents. At the peak of the last ice age large areas of Europe Asia and North America were covered in ice.

#### CO2 Emissions increasing the temperature- Stops Ice Age

Ruddiman, W.F., Vavrus, S.J. and Kutzbach J.E. et al 2005, Kutzbach is a Senior Scientist  
Professor Emeritus of Atmospheric and Oceanic Sciences, and Environmental Studies, Ruddiman is a [palaeoclimatologist](http://en.wikipedia.org/wiki/Palaeoclimatologist) and Professor Emeritus at the [University of Virginia](http://en.wikipedia.org/wiki/University_of_Virginia), Vavrus a Ph.D., Atmospheric Sciences, University of Wisconsin-Madison, “ The Over-Due Glacial Hypothesis”,  <http://www.co2science.org/articles/V8/N3/C1.php>

The authors contend that "ice-core evidence from previous interglaciations indicates that forcing by orbital-scale changes in solar radiation and greenhouse-gas concentrations should have driven earth's climate significantly toward glacial conditions during the last several thousand years," and that "the hypothesized reason most of this cooling did not occur is that humans intervened in the natural operation of the climate system by adding significant amounts of CO2 and CH4 to the atmosphere, thereby offsetting most of the natural cooling [that otherwise would have occurred] and fortuitously producing the climatic stability of the last several thousand years." If true, how did humans do it? Ruddiman et al. attribute the anomalous increase in atmospheric CO2 to massive early deforestation of Eurasia, while they link the anomalous CH4 increase to the introduction of irrigation for rice farming in southeast Asia, as well as to increases in biomass burning and the development of animal husbandry. Based on the periodicities and phases of the natural cycles of CO2 and CH4 that are revealed in the 400,000-year Vostok ice core, Ruddiman et al. first determined that the air's CO2 concentration should have fallen to 240-245 ppm, whereas it gradually rose to a level of 280-285 ppm, just before the start of the Industrial Revolution, while the air's CH4 concentration rose to approximately 700 ppb when it should have fallen to about 450 ppb. Then, based on the IPCC sensitivity estimate of a 2.5°C temperature increase for a doubling of the air's CO2 content, they calculated that the supposedly anthropogenic-induced CO2 and CH4 anomalies should have produced an equilibrium warming of approximately 0.8°C on a global basis and 2°C in earth's polar regions. On the basis of these calculations, the authors conclude that "without any anthropogenic warming, earth's climate would no longer be in a full-interglacial state but well on its way toward the colder temperatures typical of glaciations," and that "an ice sheet would now be present in northeast Canada, had humans not interfered with the climate system." If correct, the overdue-glaciation hypothesis indicates that in the absence of anthropogenic contributions of CO2 and CH4, the climate today would be, in the words of Ruddiman et al., "roughly one third of the way toward full-glacial temperatures," which also suggests that the extra CO2 we are currently releasing to the atmosphere via the burning of fossil fuels may well be what's keeping us from going the rest of the way. Hence, even if the IPCC is correct in their analysis of climate sensitivity and we are wrong in suggesting the sensitivity they calculate is way too large, the bottom line for the preservation of civilization and much of the biosphere is that governments ought not interfere with the normal progression of fossil fuel usage, for without more CO2 in the atmosphere, we could shortly resume the downward spiral to full-fledged ice-age conditions. Ought we not be doubly careful, therefore, as the United States indeed is, in not rushing forward to implement the Kyoto Protocol or anything like it? We certainly think so.

#### We are in global cooling, and warming is preventing it from getting worse.

Paul Mcrae, Journalist who has been writing for the Toronto Star, Globe and Mail, Bangkok Post, and Victoria Times colonist, “ Back to the Future: Paradise Lost or Paradise Gained?”. 7/20/2012. <http://www.paulmacrae.com/?p=239>

Curiously, while alarmists warn about the horrors of returning to the climate of millions of years ago, paleoclimatologists tell a different story. They more often see our earlier planet as a “paradise,” even “paradise lost.” In fact, “paradise lost” is the subtitle of a 1994 book on our planet 33 million years ago by veteran paleo-climatologist Donald A. Prothero—The Eocene-Oligocene Transition: Paradise Lost. The Eocene (55-33 million years ago) began what is sometimes called the Golden Age of Mammals. This geological age was at least 10°C warmer than today, free of ice caps, and with CO2 levels, Prothero suggests, of up to 3,000 parts per million, which is almost eight times today’s level of about 400 ppm. Yet Prothero calls the Eocene a “lush, tropical world.”[8] At the end of the still very warm Oligocene (33-23 mya), Prothero puts CO2 levels at 1,600 ppm, or four times today’s levels.[9] Prothero’s 1994 CO2 estimates may be a high, but no one—not even Hansen—denies that CO2 levels were several times higher than today’s in the Eocene and Oligocene and, indeed, right down to the Miocene (23-5 mya). For Prothero, the boundary between the Eocene and Oligocene was “paradise lost” because it was then, about 33 million years ago, that the planet began its slide from a “lush, tropical world” into its current ice age conditions (see Figure 1), with glaciations every 85,000 years interspersed with brief, 15,000-year warm interglacials. Figure 1: Temperatures over 65 million years. Source: Global Warming Art In fact, the planet is currently its coldest in almost 300 million years. Yet, for Hansen and others in the alarmist camp, our ice-age world is in danger of getting too hot—maybe even as hot as the Pliocene, or the Miocene, or the Oligocene, or even, heaven forbid, the Eocene. Many other writers on paleoclimate also use the term “paradise” to describe climate in the distant past. For example, in a history of evolution for younger readers, science writer Sara Stein paints the Eocene of 50 million years ago as follows: The world that all the little brown furry things [mammals] inherited from the dinosaurs was paradise. [emphasis added] The climate was so mild that redwoods, unable now to live much further north than California’s pleasant coast, grew in Alaska, Greenland, Sweden, and Siberia. There was no ice in the Arctic. Palm trees grew as far north as 50 degrees latitude, roughly the boundary between the United States and Canada. Below that subtropical zone—that was similar to Florida’s landscape today—was a broad band of tropical rain forest.”[10] Sounds grim, doesn’t it? One of the most prominent climate alarmists, Tim Flannery, also uses the “p” word when he describes Eocene North America in his very readable The Eternal Frontier, on the geological and biological history of North America. Flannery writes: When Earth is warm (in greenhouse mode)—as it was around 50 million years ago—North America is a verdant and productive land. [emphasis added] Almost all of its 24 million square kilometers, from Ellesmere Island in the north to Panama in the south, is covered in luxuriant vegetation.[11] Flannery titled the section of the book that deals with the “verdant and productive” Eocene as: “In Which America Becomes a Tropical Paradise.” Yet this was a time, it should be remembered, when temperatures and CO2 levels were much higher than today’s. Unfortunately, trapped in his alarmism, Flannery doesn’t see the irony. British paleontologist Richard Fortey describes the landscape of Australia 20-35 million years ago, during the Oligocene and Miocene, as being “as rich as Amazonia, green and moist, with trees and ferns in profusion.”[12] Today much of Australia, an area the size of the continental United States, is desert and bush and supports only 22 million people compared to 300 million in the U.S. As recently as 125,000 years ago, the peak of the last interglacial, our planet was 3-5°C warmer than today at the poles according to the Intergovernmental Panel on Climate Change (IPCC) itself, with sea levels 4-6 metres (12-20 feet) higher than today’s interglacial so far.[13] Even Britain was semi-tropical, with hippopotami gamboling in the Thames, apparently untroubled by extreme weather events, extreme droughts, extreme flooding, etc. A mere 8,000 years ago, during the Holocene Optimum period that was at least 1°C warmer than today, much of the Sahara Desert was green, as were many other regions that today are desert.[14] Why? Because warmer temperatures mean less polar ice, making more water available for precipitation, and therefore promoting a greener planet. So, millions of years ago, during geological eras much warmer than today, with much higher levels of carbon dioxide, the planet faced the same environmental hazards we face today—volcanoes, earthquakes, tsunamis and the like. But it was not plagued by the extreme weather events, extreme droughts, extreme flooding, mass extinctions, or even the ocean “acidification” claimed by climate alarmists for the world of the future.

### Ice Age Impact – Extinction

#### Ice Age leads to extinction

Sterling- 7-25-12- Has B.Sc. in Pol. Sc. & History; M.A. in European Studies; B.Sc. in EducationM.T.S. (theology); LL.B. (English Law); M.S. (Criminal Justice)- <http://europebusines.blogspot.com/2010/08/special-post-life-on-this-earth-just.html>

So what does this mean? **Violent mixing of the seasons, crop failures, and increased drought and floods in diverse places is now daily news** since the April 20th 2010 BP Oil Volcano. They have killed the pacemaker of world climate in the worlds of Dr Zangari PhD. Dr Mike Coffman PhD geologist resource climatologist, and Dr Tim Ball PhD climatologist have confirmed that if this data is correct, that **an ice age and massive climate shift with famine is now imminent**. We are now seeing Russia stop all delivery of wheat crops on prior contracts, and most sources of staple food crops moving worldwide in a crisis of famine. **The Gulf Stream and related currents are effectively DEAD. This should enrage the public and bring forth scientists to challenge and support the data and analysis, for the consequences to the civilization of mankind and ecological collapse have global consequence producing famine, death and massive population migration away from zones of advancing ice age and regions unfit for human habitation**. Let us get the facts and call the corporate and government to task on these issues now or face worldwide catechisms of biblical proportions. We shall continue to report with new scientific experts on this most important disaster. ¶ The 'process' of entering a new Ice Age could begin coming upon us in full force (rather like in the movie "The Day After Tomorrow") at any time, or it could take three to five year to fully play out with early glaciation beginning in North America and Europe and Asia this winter (both models have existed in the beginnings of different Ice Ages in Earth's past**).¶ A new Ice Age, could kill 2/3 of the human race in the first year in a rapid onset; a slower onset would likely kill close to this number but simply take a handful of years.!** Thank you BP; thank you President Obama, the lies and the dispersants were just great. Now if you could just direct all that hot air to the right places maybe we can avoid a icy hell in our near future.

#### Ice age outweighs all other impacts

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

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

#### Impact is extinction.

Caltech 12 (California Institute of Technology, 4/10/2012, What Triggers a Mass Extinction? Habitat Loss and Tropical Cooling Were Once to Blame, Science Daily, <http://www.sciencedaily.com/releases/2012/04/120410145956.htm>)

The second-largest mass extinction in Earth's history coincided with a short but intense ice age during which enormous glaciers grew and sea levels dropped. Although it has long been agreed that the so-called Late Ordovician mass extinction -- which occurred about 450 million years ago -- was related to climate change, exactly how the climate change produced the extinction has not been known. Now, a team led by scientists at the California Institute of Technology (Caltech) has created a framework for weighing the factors that might have led to mass extinction and has used that framework to determine that the majority of extinctions were caused by habitat loss due to falling sea levels and cooling of the tropical oceans.¶ The work -- performed by scientists at Caltech and the University of Wisconsin, Madison -- is described in a paper currently online in the early edition of the Proceedings of the National Academy of Sciences.¶ The researchers combined information from two separate databases to overlay fossil occurrences on the sedimentary rock record of North America around the time of the extinction, an event that wiped out about 75 percent of marine species alive then. At that time, North America was an island continent geologists call Laurentia, located in the tropics.¶ Comparing the groups of species, or genera, that went extinct during the event with those that survived, the researchers were able to figure out the relative importance of several variables in dictating whether a genus went extinct during a 50-million-year interval around the mass extinction.¶ "What we did was essentially the same thing you'd do if confronted with a disease epidemic," says Seth Finnegan, postdoctoral scholar at Caltech and lead author of the study. "You ask who is affected and who is unaffected, and that can tell you a lot about what's causing the epidemic."¶ As it turns out, the strongest predictive factors of extinction on Laurentia were both the percentage of a genus's habitat that was lost when the sea level dropped and a genus's ability to tolerate broader ranges of temperatures. Groups that lost large portions of their habitat as ice sheets grew and sea levels fell, and those that had always been confined to warm tropical waters, were most likely to go extinct as a result of the rapid climate change.¶ "This is the first really attractive demonstration of how you can use multivariate approaches to try to understand extinctions, which reflect amazingly complex suites of processes," says Woodward Fischer, an assistant professor of geobiology at Caltech and principal investigator on the study. "As earth scientists, we love to debate different environmental and ecological factors in extinctions, but the truth is that all of these factors interact with one another in complicated ways, and you need a way of teasing these interactions apart. I'm sure this framework will be profitably applied to extinction events in other geologic intervals."¶ The analysis enabled the researchers to largely rule out a hypothesis, known as the record-bias hypothesis, which says that the extinction might be explained by a significant gap in the fossil record, also related to glaciation. After all, if sea levels fell and continents were no longer flooded, sedimentary rocks with fossils would not accumulate. Therefore, the last record of any species that went extinct during the gap would show up immediately before the gap, creating the appearance of a mass extinction.¶ Finnegan reasoned that this record-bias hypothesis would predict that the duration of a gap in the record should correlate with higher numbers of extinctions -- if a gap persisted longer, more groups should have gone extinct during that time, so it should appear that more species went extinct all at once than for shorter gaps. But in the case of the Late Ordovician, the researchers found that the duration of the gap did not matter, indicating that a mass extinction very likely did occur.¶ "We have found that the Late Ordovician mass extinction most likely represents a real pulse of extinction -- that many living things genuinely went extinct then," says Finnegan. "It's not that the record went bad and we just don't recover them after that."

#### Humans are prone to extinction.

Curnoe 11 (Darren Curnoe, Associate Professor, University of New South Wales 2011 – present, Senior Lecturer, University of New South Wales 2005 – 2011, Australian National University, PhD, palaeoanthropology and geochronology, 2000, 6/7/2011, Climate change, doomsday and the ‘inevitable’ extinction of humankind, Climate change, doomsday and the ‘inevitable’ extinction of humankind, the Conversation, <http://theconversation.edu.au/climate-change-doomsday-and-the-inevitable-extinction-of-humankind-1656>)

Around 500 million years ago, animal life was almost non-existent on Earth. Today, biologists recognise up to 6 million animal species.¶ Humanity – Homo sapiens – is just one among the 4,500 living mammal species; and some understanding of where we might be headed can be gleaned from where we’ve been – our evolutionary journey.¶ Our starting point as a group of two-footed, small-toothed, weakly-muscled, brainy “have-a-chat” apes is the ancestor we share with living chimpanzees some 7 million years ago.¶ (The two chimpanzee species are endangered, incidentally, because of the environmental destruction caused by us, their closest cousin).¶ Our evolutionary group – the hominins – diversified quickly after the split from the human-chimp ancestor, and through its multiple evolutionary iterations natural selection produced 25 or 30 two-footed ape species – undoubtedly with more to be found as anthropologists discover more fossils. All of these are now extinct, except us.¶ Those 7 million years represent only the last couple of minutes on a 24-hour clock of Earth’s 5 billion year history. The culling of 30 species to 1 in this short timeframe, or a more than 95% loss of hominin biodiversity, is worse than the worst mass extinction episode recorded in the fossil record: the Permian event some 250 million years ago.¶ But these mass events obscure the fact that, in the history of life, extinction has been a dominant theme, a continuous process. Evidence from the last 600 million years shows roughly one-third of existing animal species going extinct every 10 million years.¶ Seen in this context, the rate of extinction in the human evolutionary tree is striking, about three times faster than normal. This strongly suggests that we hominins are a highly extinction-prone mammal.

#### Ice Age causes extinction

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

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

#### An ice age will lead to extinction

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

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

### Ice Age Impact – Species

#### Ice age leads to species extinction—empirics prove.

Koch 11 (Wendy Koch, Reporter, moderates the Green House community, which follows green living, environmental issues, green home building and sustainable communities, 11/4/2011, Climate change linked to Ice-Age animal extinctions, USAToday, http://content.usatoday.com/communities/greenhouse/post/2011/11/climate-change-extinction-ice-age-mammals/1#.UA1lB2j3DVo)

Climate change and human activity caused the extinction of some Ice-Age animals, such as the woolly rhinoceros, woolly mammoth and wild horses, and the near extinction of others including reindeer, bison and musk ox, says an international study.¶ The scientists say their study, published in the journal Nature, is the first to combine genetic, archaeological and climatic data to track the population history of six large Ice-Age mammals and can shed light on the possible fates of today's animals as the Earth continues its current warming cycle.¶ "Although these cold-adapted animals certainly fared better during the colder, glacial periods, they still managed to find places where the climate was just right -- refugia -- so that they could survive during the warmer, interglacial periods. Then, after the peak of the last ice age around 20,000 years ago, their luck started to run out," co-author Beth Shapiro, a biology professor at Penn State University, said in announcing the findings.¶ The study adds to the scientific debate about what caused the extinction of large mammals. A 2010 study by researchers at the University of Wollongong and the University of Adelaide said humans caused them in Australia, and a 2009 study said mammoths and mastodons began dying out 1,000 years before humans arrived in North America.¶ In the case of the woolly rhinoceros, the new study found that the species never overlapped with humans in Europe, so climate change is the main reason for its extinction. "Still, we expect humans might have played a role in other regions of the world where they did overlap with woolly rhinos," Shapiro said.¶ She said the evidence is much clearer that humans did influence, and not always negatively, the population sizes of the five other species -- the woolly mammoth, wild horse, reindeer, bison and musk ox.¶ "During the period when these animals were declining, the human population was beginning its boom, and was spreading out across not only the large-bodied mammals' cold-climate habitats, but also across their warm-climate refuges, changing the landscape with agriculture and other activities," Shapiro said.¶ The study says reindeer managed to find safe habitat in high arctic regions and bison, though extinct in Asia where their populations were extensive during the ice ages, are found only in North America although a related species survives in small numbers in Europe.¶ It says cold-adapted musk oxen now live only in the arctic regions of North America and Greenland, with small populations in Norway, Siberia and Sweden. Interestingly, the scientists say that if humans had any impact on them, it may have been to help sustain them. They note that musk oxen expanded rapidly after becoming established in Greenland about 5,000 years, despite having been a major resource for the Paleo-Eskimo population.¶ In addition to Shapiro, many other scientists contributed to this study from the United States as well as Denmark, Australia, Sweden, Spain, the United Kingdom, the Netherlands, Germany, Norway, Russia, China and Canada. The research was funded, in part, by the Leverhulme Trust, the Awards Fund, the Danish National Research Foundation, the Lundbeck Foundation, the Danish Council for Independent Research and the U.S. National Science Foundation.

### Ice Age Impact – Super Volcanoes

#### Super volcanoes lead to ice age.

Black 12 (Richard Black, environment correspondent, 1/30/2012, Volcanic origin for Little Ice Age, BBC News, <http://www.bbc.co.uk/news/science-environment-16797075>)

An international research team studied ancient plants from Iceland and Canada, and sediments carried by glaciers.¶ They say a series of eruptions just before 1300 lowered Arctic temperatures enough for ice sheets to expand.¶ Writing in Geophysical Research Letters, they say this would have kept the Earth cool for centuries.¶ The exact definition of the Little Ice Age is disputed. While many studies suggest temperatures fell globally in the 1500s, others suggest the Arctic and sub-Arctic began cooling several centuries previously.¶ The global dip in temperatures was less than 1C, but parts of Europe cooled more, particularly in winter, with the River Thames in London iced thickly enough to be traversable on foot.¶ What caused it has been uncertain. The new study, led by Gifford Miller at the University of Colorado at Boulder, US, links back to a series of four explosive volcanic eruptions between about 1250 and 1300 in the tropics, which would have blasted huge clouds of sulphate particles into the upper atmosphere.¶ These tiny aerosol particles are known to cool the globe by reflecting solar energy back into space.¶ "This is the first time that anyone has clearly identified the specific onset of the cold times marking the start of the Little Ice Age," said Dr Miller.¶ "We have also provided an understandable climate feedback system that explains how this cold period could be sustained for a long period of time."¶ The scientists studied several sites in north-eastern Canada and in Iceland where small icecaps have expanded and contracted over the centuries.¶ When the ice spreads, plants underneath are killed and "entombed" in the ice. Carbon-dating can determine how long ago this happened.¶ So the plants provide a record of the icecaps' sizes at various times - and therefore, indirectly, of the local temperature.¶ An additional site at Hvitarvatn in Iceland yielded records of how much sediment was carried by a glacier in different decades, indicating changes in its thickness.¶ Putting these records together showed that cooling began fairly abruptly at some point between 1250 and 1300. Temperatures fell another notch between 1430 and 1455.¶ The first of these periods saw four large volcanic eruptions beginning in 1256, probably from the tropics sources, although the exact locations have not been determined.¶ The later period incorporated the major Kuwae eruption in Vanuatu.¶ Aerosols from volcanic eruptions usually cool the climate for just a few years.¶ When the researchers plugged in the sequence of eruptions into a computer model of climate, they found that the short but intense burst of cooling was enough to initiate growth of summer ice sheets around the Arctic Ocean, as well as glaciers.¶ The extra ice in turn reflected more solar radiation back into space, and weakened the Atlantic ocean circulation commonly known as the Gulf Stream.¶ "It's easy to calculate how much colder you could get with volcanoes; but that has no permanence, the skies soon clear," Dr Miller told BBC News.¶ "And it was climate modelling that showed how sea ice exports into the North Atlantic set up this self-sustaining feedback process, and that's how a perturbation of decades can result in a climate shift of centuries."

#### Super volcanoes caused the last ice age—extinction risk high.

Hamilton 10 (Andy Hamilton, columnist, 5/5/10, What would happen if: A super volcano erupted?, Wired UK, <http://www.wired.co.uk/news/archive/2010-05/05/what-would-happen-if-a-super-volcano-erupted>)

The 24-hour news channels might have made the Eyjafjallajokull volcano eruption seem like a huge disaster, but in actuality it is merely a blip; a small inconvenience. Even if it carries on erupting, it is like a fart in sea of methane.¶ The same could not be said if a super volcano erupted, and there are at least 40 of these on our planet. The super volcano over in Yellowstone National Park, USA, erupts once every 600,000 years. Worryingly, it last erupted 640,000 years ago and is thought to be the cause of the last ice age. We're overdue, and bison have been found dead around the volcano, the ground has been shaking, rising, getting warmer and gas is being emitted -- all signs that an overdue eruption is imminent.¶ When this does happen (and we are certain it will), it will cause untold "disruption". Those within the vicinity will be incinerated as temperatures from the lava flow can reach up to 500 degrees, meaning all surrounding cities will be utterly destroyed. If you somehow managed to survive the fast flowing lava, the thick ash cloud that would rain down would choke you to death. All the states surrounding Wyoming would certainly perish very quickly.¶ The UK and the rest of Earth would not escape. We would all be affected, wherever we were. Global temperatures would plummet by at least 21 degrees. This could last for many years, meaning that all plant life will slowly die off. We will have no vegetables; animals -- our meat -- will have no food, so humankind would likely starve.

#### Impact is extinction.

Wolchover 12 (Natalie Wolchover, Life's Little Mysteries Staff Writer, 6/4/2012, Yellowstone Supervolcano: Will It Erupt During Our Lives, Huffington Post, <http://www.huffingtonpost.com/2012/06/04/yellowstone-supervolcano-eruption-unlikely_n_1569214.html>)

A rough estimate based on geologic records indicates there's a 1-in-10,000 chance of a "supereruption" at Yellowstone during our lifetimes. However, given the erratic nature of volcanoes, that number doesn't mean much. The bulging pocket of magma swishing around beneath Old Faithful might never blow its lid again. Or, it might put on a surprise fireworks show next Independence Day. Scientists just don't know.¶ But if or when it blows, what will actually happen? Will it be the end of us all, or just a big knock to the tourism industry in Wyoming?¶ Each of the three past supereruptions of the Yellowstone hotspot spewed more than 1,000 cubic kilometers of magma into the environment — the benchmark of a "supervolcano." According to Jacob Lowenstern, scientist-in-charge at the Yellowstone Volcano Observatory, that's a large enough eruption to cover much of North America in an ash blanket of varying thickness.¶ "The ash is thick (more than about 30 centimeters of ash) near the eruption source and a small fraction of a millimeter once you move 2,000 miles away. It's fair to say that a trace of ash would be found over most of the United States, though it would only be thick enough to collapse roofs in the states closest to Yellowstone," Lowenstern told Life's Little Mysteries.¶ With enough warning, the states near Yellowstone could be evacuated, which would largely avoid a tremendous loss of life caused by the downpour of ash, the scientists said. But that's just in the short term; the aftermath would be the rub. For several days, ash would hang in the air, making it difficult to breathe. And that blanket of ash covering the country would smother vegetation and pollute the water supply, quickly leading to a nationwide food crisis. "A lot of people would perish," said Stephen Self, director of the Volcano Dynamics Group at the Open University in the U.K. He envisions American refugees lining up at the Mexican border. [5 Ways the World will Radically Change This Century]

#### Super volcano outweighs GNW.

Dye 12 (Lee Dye, writer, This Is the Way the World Ends? Volcanoes Could Darken World, ABC News, <http://abcnews.go.com/Technology/end-world-super-volcanoes-form-quickly-destructive-asteroid/story?id=16508702#.UBGjw2j3DVp>)

Super-volcanoes have probably caused more extinctions than asteroids. But until now it has been thought that these giant volcanoes took thousands of years to form -- and would remain trapped beneath the earth's crust for thousands more years -- before having much effect on the planet.¶ But new research indicates these catastrophic eruptions, possibly thousands of times more powerful than the 1980 eruption of Mount St. Helens, may happen only a few hundred years after the volcanoes form. In other words, they may have a very "short fuse," according to researchers at Vanderbilt University.¶ Such an event could make thermonuclear war or global warming seem trivial, spewing untold tons of ash into the atmosphere to block sunlight. The result would be many years of frigid temperatures, wiping out millions of species. A super-volcano that erupted 250 million years ago is now believed to have created the greatest mass extinction the world has ever seen, wiping out up to 95 percent of all plant and animal species. Some renegade scientists believe it was a volcano, not an asteroid, that killed off the dinosaurs 65 million years ago.

#### Multiple causes—Long Valley, Yellowstone, and more.

Dye 12 (Lee Dye, writer, This Is the Way the World Ends? Volcanoes Could Darken World, ABC News, <http://abcnews.go.com/Technology/end-world-super-volcanoes-form-quickly-destructive-asteroid/story?id=16508702#.UBGjw2j3DVp>)

Gualda's team studied deposits in the Long Valley Caldera in northeastern California, where a violent eruption blew 150 cubic miles of molten rock into the atmosphere, blanketing much of North America with hot ash and dropping the earth's surface more than a mile as it sank into the area once occupied by the magma. That was about 760,000 years ago, but all these years later the region still keeps a lot of scientists on the edge of their seats.¶ The Long Valley geology began misbehaving again in 1978 when a 5.4 earthquake struck six miles southeast of the caldera, suggesting that the volcano might be reasserting itself. In subsequent years that was followed by swarms of small quakes, which are closely associated with pending volcanic eruptions.¶ A couple of decades ago, trees began dying on nearby Mammoth Mountain from large amounts of carbon dioxide seeping from the magma, according to the U.S. Geological Survey.

#### Yellowstone super volcano on brink now.

Waugh 12 (Rob Waugh, writer, 5/31/2012, Supervolcanoes with power to 'destroy civilisation' explode far more rapidly than scientists had believed - and one could be bubbling under U.S. right now, Mail Online, <http://www.dailymail.co.uk/sciencetech/article-2152278/Supervolcanoes-power-destroy-civilisation-explode-far-rapidly-scientists-believed--bubbling-U-S-right-now.html>)

The supervolcano has erupted a total of three times in the last 2.1 million years. Scientists believe it could be due to erupt again.¶ A full scale eruption at Yellowstone would be 1,000 times more powerful than the volcanic blast that tore apart Mount St Helens in 1980.¶ There is evidence that a similar super-eruption in Indonesia 74,000 years ago came close to wiping out the entire human species.¶ The new study was based on analysis of a super-eruption that occurred in eastern California 760,000 years ago.¶ Several independent lines of evidence indicated that the magma pool erupted within a few thousand years, perhaps within a few hundred years, covering half the North American continent with smouldering ash.¶ The scientists based their estimate on quartz crystallisation rates. Previous studies have relied on the growth of zircon crystals, which is said to be a less accurate method.¶ The research is published in the online journal Public Library of Science ONE.¶ Lead scientist Dr Guilherme Gualda, from Vanderbilt University in Nashville, Tennessee, said: ‘Our study suggests that when these exceptionally large magma pools form they are ephemeral and cannot exist very long without erupting.¶ ‘The fact that the process of magma body formation occurs in historical time, instead of geological time, completely changes the nature of the problem.’¶ He said regions such as Yellowstone should be monitored regularly to provide advance warning of a catastrophic super-eruption.

### AT: Thermohaline Link Turn

#### Empirics and Antarctic prove- thermohaline collapse not going to happen

Thayer Watkins- No Date- Department of economics at San Jose University- <http://www.sjsu.edu/faculty/watkins/thermohaline.htm>

**Climatological questions should be dealt with on an empirical level** because the climate system is so complex that perfectly plausible theoretical arguments are often incorrect. What is the empirical evidence? **First consider the matter of the extent of seaice in the Arctic.¶ Although the general trend is downward over the period shown the levels were lower in the 1930's yet recovered. It is also notable that from 1994 to 1995 the area decreased by about seven hundred thousand square kilometers yet it increased the next year by about five hundred thosand square kilometers and by 2001 was back up to normal**. The melting of seven hundred thousand square kilometers of sea ice from 1994 to 1995 apparently had no effect on the Gulf Stream and the thermohaline circulation it represents.¶ **It is notable that if the fluctuations in Arctic ice are due to global warming then there should be a similiar decline in seaice in the Antarctic but instead in the Antarctic there has been an increase in sea ice such that there has been essentially no change in sea ice in the polar regions of the Earth.** For more on this see [Polar Ice](http://www.sjsu.edu/faculty/watkins/polarice.htm).¶ Although there has been warming in the Arctic region the amount is far less than what is predicted by the global climate models. Those models project temperature increases in the polar regions of three to four times the global average. **The temperature increase in the Arctic has been about 80 percent larger than the global average but temperature have been declining in the Antarctic rather that increase three to four times the global average.** For more on this matter see [Polar Warming](http://www.sjsu.edu/faculty/watkins/polarwarming.htm).¶ Even within the Arctic region there are subregions experiencing downward trending temperatures including the area of Greenland which is the most relevant region concerning effects on the thermohaline circulation.¶ The general trend has been downward. One can of course find intervals over which that trend seems to be upward but selectivity is possible with even random numbers and represents a creation of a trend by the observer rather than something that is in the data.¶

#### 4 reasons why the THC won’t shut down.

Edward Ulrich- no date- <http://www.newsofinterest.tv/global_warming/effects/sea_level/ugw_sea_level.php>

In his unfortunately popular movie, "An Inconvenient Truth," former U.S. Vice President Al Gore predicts a rise in sea level, not of the 4 to 6 inches endorsed by most experts, but of 20 feet! Where could he have come up with such an absurd number? Gore predicts another climatic event, similar to the Younger Dryas episode of 12,500 years ago, when the sudden release of of trillions of tons of melt-water from melting glaciers in North America **shut down the Atlantic Conveyor, plunging the world into a 1,000-year ice age. We can think of four reasons not to take this prediction seriously. First, consider the trillions of tons of Ice Age ice sheets we don’t have because they melted more than 10,000 years ago.** Twelve thousand years ago, the Gulf Stream did get overwhelmed--by melt-water from the huge ice sheets and glaciers of the ice age as the planet warmed into the Climate Optimum. **But the ice age had created an ice sheet up to 9,000 feet thick over the northern part of Europe and North America.** The Laurentian Ice Sheet in the center of North America extended over all the Great Lakes, west into Iowa and south into Indiana and Ohio. **We calculate there were some 40,000 trillion tons of ice in the world’s various ice sheets and glaciers at that time. Much of that ice is gone now, and the melt-water is already in the oceans. Gore’s scenario cannot happen because there’s not enough ice to trigger it. Second, the recent warming years, far from triggering a shutdown of the Atlantic Conveyor, have produced a rapid and systematic increase in the flow rate of deep Atlantic currents**. (314) Third, Dr. Gagosian of the Woods Hole Oceanographic Institute, one of the few scientists Gore is able to cite in support of his incredible thesis, is clearly engaged in the now-widespread scientific practice of "scaring up research funds." He noted in his statements that the seas are responsible for about half of the global climate factors, while virtually all of the global warming research money has gone to the atmospheric scientists. (315) His notorious alarming prediction was little more than a thinly veiled demand for more funding. **Fourth, computerized global circulation models say it won't happen. Computer modeling can be useful when the factors involved are known and the instructions to the computer can be based on real-world data**. After the publication of a report by the National Research Council's Committee on Abrupt Climate Change, (316) researchers at the Lamont-Doherty Earth Observatory ran several versions of the Gulf Stream Collapse theory on the global climate model at the Goddard Institute for Space Studies. **The team found no evidence for a "tripping point" that would push the planet from the projected warming of the 21st century to an abrupt global cooling**. Instead, they found a linear response to glacial meltwater. They say the expected increase in global melt water with the Modern Warming "is not rapid with realistic freshwater inputs." (317) In other words, without an extra 40,000 trillion tons of ice to melt, warming won't shut down the Atlantic Conveyor--as **it didn't during the warming surges of 1850-1870 or 1920-1940.**

#### THC collapse won’t happen

<http://earthsky.org/earth/rapid-collapse-of-atlantic-ocean-circulation-possible-new-study-suggests>

**Fortunately, projected amounts of freshwater input from increased precipitation, river runoff and the melting of Greenland ice sheets at the end of the 21st century are not expected to be enough to cause a complete collapse of thermohaline circulation in the Atlantic Ocean**. But, the math does come a little too close for comfort. Hence, future work that reduces uncertainties and improves the predictability of climate models will likely continue to be a priority area for research.

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

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

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

#### Thermohaline won’t collapse.

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

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

### Prodict – General Ice Age Theorists

#### Ice Age theory can no longer be dismissed – new studies prove

Solomon 11 – Lawrence Solomon is an environmental writer and executive director of Energy Probe, a Canadian non-governmental environmental organization, 2011 (“NASA Scientist Reverses Sunspot Prediction, Bolstering Global Cooling Theory,” The Global Warming Policy Foundation, June 17th 2011, <http://thegwpf.org/the-climate-record/3232-nasa-scientist-reverses-sunspot-prediction-bolstering-global-cooling-theory.html>)

Five years ago, NASA’s David Hathaway, one of the world’s leading authorities on the solar cycle, predicted that the Sun was about to enter an unusually intense period of sunspot activity. Referring to Solar Cycle 24, the 11-year period that we’re now in, Hathaway predicted that it “looks like it’s going to be one of the most intense cycles since record-keeping began almost 400 years ago.”¶ Because sunspot activity has historically predicted periods of global warming and global cooling – lots of sunspots translates into lots of warming and vice versa – Hathaway’s study – presented at a December 2006 meeting of the American Geophysical Union in San Francisco — acted to support global warming theorists and to discredit the various solar scientists who believe that Earth is about to enter a prolonged period of cooling.¶ Today, Hathaway, a solar physicist at NASA’s Marshall Space Flight Center, believes his earlier prediction was wrong. Rather than hitting a peak of 160 sunspots, and possibly 185, as he predicted in 2006, he now believes that the Sun’s activity will decline dramatically. The current prediction, to less than half that of 2006, “would make this the smallest sunspot cycle in over 100 years,” he now states.¶ All this comes amid a flurry of other reports, including from scientists at the U.S. National Solar Observatory (NSO) and U.S. Air Force Research Laboratory, indicating that global cooling, and perhaps even a new Little Ice Age, is on its way.¶ “We expected to see the start of the zonal flow for Cycle 25 by now, but we see no sign of it,” states Frank Hill of the U.S. National Solar Observatory, who recently co-authored another paper in the field. “This indicates that the start of Cycle 25 may be delayed to 2021 or 2022, or may not happen at all.”¶ The upshot is chilling: “If we are right, this could be the last solar maximum we’ll see for a few decades,” Hill states. “That would affect everything from space exploration to Earth’s climate.”¶ The notion of another Little Ice Age, as happened in the last half of the 1600s, is no longer dismissed. Asks the National Solar Observatory: “An immediate question is whether this slowdown presages a second Maunder Minimum, a 70-year period with virtually no sunspots [which occurred] during 1645-1715.”

#### Global cooling gaining momentum among scientists

Robinson 8 – E. Robinson is a writer for Delta Farm Press, 2008 (“Global cooling gains momentum among scientists,” Delta Farm Press, August 25th 2008, <http://deltafarmpress.com/global-cooling-gains-momentum-among-scientists>)

Two weeks ago, after writing about the possibility that the Earth may actually be entering a cooling phase, I braced myself for a torrent of icy missives from the global warming crowd suggesting that the heat must have fried my noggin.¶ By the way, it is very difficult to discuss global cooling in the midst of a summer when temperatures are hovering around 100 degrees and crops are wilting. As one friend and colleague from the sweltering Southwest noted after reading the column, “Please send some of that cooling this way.”¶ However, one response opened my eyes to the growing community of global warming skeptics out there, most of them merited scientists. I thought it might be worth presenting their thoughts — a little equal time if you will. Marc Marona, a global warming skeptic who works for the U.S. Senate Committee on Environmental and Public Works, sent me these excerpts from a U.S. Senate report.¶ Russian solar physicists Galina Mashnich and Vladimir Bashkirtsev are so convinced that global temperatures will cool within the next decade they have placed a $10,000 wager with a United Kingdom scientist to prove their certainty. The criteria for the $10,000 bet will be to compare global temperatures between 1998 and 2003 with those between 2012 and 2017. The loser will pay up in 2018, according to an April 16, 2007, article in Live Science.¶ Australian engineer Peter Harris says that the Earth is nearing the end of the typical interglacial cycle and is due for a sudden cooling climate change. “Based on this analysis we can say that there is a 94 percent probability of imminent global cooling and the beginning of the coming ice age.¶ “Climate is becoming unstable,” Harris went on to say. “Most of these major natural processes that we are witnessing now are interdependent and occur at the end of each interglacial period, ultimately causing sudden long-term cooling.”¶ Oleg Sorokhtin, merited scientist of Russia and fellow of the Russian Academy of Natural Sciences and staff researcher of the Oceanology Institute, says to “stock up on fur coats and felt boots! Earth is now at the peak of one of its passing warm spells. It started in the 17th century when there was no industrial influence on the climate to speak of and no such thing as the hothouse effect.¶ “Carbon dioxide is not to blame for global climate change, Sorokhtin said. “Solar activity is many times more powerful than the energy produced by the whole of humankind. Man’s influence on nature is a drop in the ocean.”¶ Canadian climatologist Timothy Ball said, “If we are facing (a crisis) at all, I think it is that we are preparing for warming when it is looking like we are cooling. We are preparing for the wrong thing.”¶ On the impact of carbon dioxide on global temperature, United Kingdom astrophysicist Piers Corbyn said, “There is no evidence that carbon dioxide has ever driven or will ever drive world temperatures and climate change. Worrying about carbon dioxide is irrelevant.”¶ So there you have it folks — solid evidence from the other side of the global warming fence and critical thinking I’m sure you won’t hear much about outside this space.¶ To be honest, I’m not sure which global weather consequence is more daunting — to be ice fishing in Florida or planting cotton in Maine. But politicians and the popular press should speak out for the resumption of genuine, open debate on climate change. Global warming is not necessarily a foregone conclusion.

#### Top climate modelers believe we are entering a global cooling phase

Pearce 9 – Fred Pearce is a science writer and has reported on the environment, popular science and development issues from 64 countries over the past 20 years. He specializes in global environmental issues, including water and climate change. He is a regular broadcaster and international speaker on environmental issues, and has given public presentations on all six continents in the past few years, 2009 (World's climate could cool first, warm later,” New Scientist, September 4th 2009, <http://www.newscientist.com/article/dn17742-worlds-climate-could-cool-first-warm-later.html?DCMP=OTC-rss&nsref=online-news>)

Forecasts of climate change are about to go seriously out of kilter. One of the world's top climate modellers said Thursday we could be about to enter one or even two decades during which temperatures cool.¶ "People will say this is global warming disappearing," he told more than 1500 of the world's top climate scientists gathering in Geneva at the UN's World Climate Conference.¶ "I am not one of the sceptics," insisted Mojib Latif of the Leibniz Institute of Marine Sciences at Kiel University, Germany. "However, we have to ask the nasty questions ourselves or other people will do it."¶ Few climate scientists go as far as Latif, an author for the Intergovernmental Panel on Climate Change. But more and more agree that the short-term prognosis for climate change is much less certain than once thought.¶ Nature vs humans¶ This is bad timing. The UN's World Meteorological Organization called the conference in order to draft a global plan for providing "climate services" to the world: that is, to deliver climate predictions useful to everyone from farmers worried about the next rainy season to doctors trying to predict malaria epidemics and builders of dams, roads and other infrastructure who need to assess the risk of floods and droughts 30 years hence.¶ But some of the climate scientists gathered in Geneva to discuss how this might be done admitted that, on such timescales, natural variability is at least as important as the long-term climate changes from global warming. "In many ways we know more about what will happen in the 2050s than next year," said Vicky Pope from the UK Met Office.¶ Cold Atlantic¶ Latif predicted that in the next few years a natural cooling trend would dominate over warming caused by humans. The cooling would be down to cyclical changes to ocean currents and temperatures in the North Atlantic, a feature known as the North Atlantic Oscillation (NAO).¶ Breaking with climate-change orthodoxy, he said NAO cycles were probably responsible for some of the strong global warming seen in the past three decades. "But how much? The jury is still out," he told the conference. The NAO is now moving into a colder phase.

#### Mathematical data supports ice age theory

Harris 7 – Dr. Peter Harris is an Australian engineer writing a report for ICECAP, the International Climate and Environmental Change Assessment Project, 2007 (“Probability of Sudden Global Cooling,” ICECAP, August 20th 2007, <http://icecap.us/images/uploads/Probability_of_Sudden_Global_Cooling.pdf>)

The attached data is well known and was derived mathematically by Quinn et al. in 1991 ¶ and it shows the effect of orbital geometry on solar forcing or insolation, and displays ¶ global climate as glaciation data on the same time scale. ¶ What seems to have been overlooked is the remarkable degree of correlation between ¶ insolation (shown in yellow) and sudden changes in global climate which are reflected in ¶ the glaciation data. For some time it was thought that the 100 thousand year climate cycle was driven by ¶ eccentricity but the above data clearly shows how insolation responds to the combined ¶ orbital parameters including Obliquity and Precession. For example the split peak in ¶ glaciation approx 230KY BP is caused when Precession and Obliquity defeat ¶ eccentricity. ¶ A closer examination of these data is one way of finding a macro measure of the ¶ probability and timing of sudden climate change. A close review of the attached data shows that over the past 400KY there have been 18 ¶ down cycles in insolation and these correlate with 17 sudden downturns in global ¶ temperature. We have a rapid decline in insolation now. ¶ In the same period there have been 17 upturns in insolation and they correlate with 16 ¶ sudden upturns in temperature. ¶ Based on this history we can say with a probability of 94% that global climate will follow ¶ these variations in insolation and this seems to be a remarkable result. We could expect ¶ the mathematics to be correct but the glaciation data is based on analysis of a proxy, ¶ however it correlates well with independent ice core data. ¶ The correlation is true in terms of direction of change ie cooling or warming, but does not ¶ extend to a measure of the degree of cooling or warming. It appears to display as a trigger ¶ or catalyst for the more complex internal process particularly involving the endothermic ¶ and exothermic reactions as water changes through three states as well as effects from the ¶ carbon cycle and ocean circulation etc. ¶ Nevertheless there is a remarkable external macro correlation which could be used to ¶ forecast major sudden changes in global climate based on a projection of the orbital ¶ geometry. ¶ The data also clearly shows the nominal 100KY cycle for glaciation and the interglacial ¶ phases and it shows that we have reached the end of the typical Interglacial cycle and are ¶ due for a sudden cooling climate change. ¶ Based on this analysis we can say that there is a probability of 94% of imminent global ¶ cooling and the beginning of the coming ice age. ¶ By observation of a number of natural internal processes we can find further support for ¶ the coming change and I have referred before to the confirmed slowdown of the Gulf ¶ Stream, the effect of major endothermic polar ice melt and forecast reduction in solar ¶ activity after 70 years of extreme activity not seen for 8000 years before. The ¶ Stratosphere is cooling and ice is building on the South Pole. Climate is becoming ¶ unstable. ¶ Most of these major natural processes that we are witnessing now are interdependent and ¶ occur at the end of each interglacial period, ultimately causing sudden long term cooling

#### Scientists and experts warn of coming ice age

Thornhill 8 – Cher Thornhill is a writer for Mail Online, 2008 (“Global warning: We are actually heading towards a new Ice Age, claim scientists,” Mail Online, November 13th 2008, <http://www.dailymail.co.uk/sciencetech/article-1085359/Global-warning-We-actually-heading-new-Ice-Age-claim-scientists.html>)

It has plagued scientists and politicians for decades, but scientists now say global warming is not the problem. ¶ We are actually heading for the next Ice Age, they claim.¶ British and Canadian experts warned the big freeze could bury the east of Britain in 6,000ft of ice.¶ Most of Scotland, Northern Ireland and England could be covered in 3,000ft-thick ice fields. ¶ The expanses could reach 6,000ft from Aberdeen to Kent – towering above Ben Nevis, Britain’s tallest mountain.¶ And what's more, the experts blame the global change on falling - rather than climbing - levels of greenhouse gases. ¶ Lead author Thomas Crowley from the University of Edinburgh and Canadian colleague William Hyde say that currently vilified greenhouse gases – such as carbon dioxide – could actually be the key to averting the chill. ¶ The warning, published in the authoritative journal Nature, is based on records of tiny marine fossils and the earth’s shifting orbit. ¶ The Earth has seen dramatic climate fluctuations – veering between cold and warm extremes - over the past three million years, the researchers say. ¶ And changes in the Earth’s orbit and slowly falling levels of carbon dioxide are the cause.¶ The team says we are approaching a turning point, in the next 10,000 to 100,000 years, which will lead to the new ice sheets smothering much of Europe, Asia and South America. ¶ The theory, which is based on computer models, suggests ice sheets will also slash sea levels by up to 300m, so Russia and Alaska will be connected by land. ¶ The North Sea will become part of a huge glacier stretching from Holland and Scandinavia to the Russian Far East.

#### Scientific consensus that even a few degrees of cooling can bring an Ice Age

Hurd 9 – Dale Hurd is a veteran reporter for CBN, 2009 (“Global Cooling Earth's Little-Known Threat,” Christian Broadcasting Network, December 16th 2009, <http://www.cbn.com/CBNnews/584180.aspx>)

But what if the Earth was no longer warming, but cooling? One image shows how the sun has looked for most of 2008 and 2009-- devoid of any sunspots. NASA says sunspot activity is now at a 100 year low.¶ "The sun is very cold right now and when there are no sunspots, the sun is cold, and that is one of the reasons we haven't seen warming for the past 12 years or so," said former Virginia state climatologist Patrick Michaels.¶ "We haven't seen any net change in temperature for about 12 years now," Michaels added. "We had a warming that began in 1977 and ended somewhere in late1997, and it hasn't been seen since."¶ Michaels is the author of the book, Climate of Extremes, about the current political and scientific environment, in which facts like the current lack of warming get trampled in the rush to "save the planet."¶ "If I tell you the world is going to end, I'll get on TV. If I tell you it's not, I probably won't," he explained.¶ "Climate of Extremes describes the rhetorical climate of extremes that has arisen on climate change," he continued. "Either you believe it's the end of the world or you say it's not happening at all, and the truth lies somewhere in between."¶ Earth's 'Little Ice Ages'¶ There was much higher sunspot activity in the 1990s, and high sunspot activity correlates with a hotter sun. The 90s is generally viewed as the hottest decade since the 1930s.¶ At the Center for Sun-Climate Research at the Danish Space Institute in Copenhagen, Jens Pedersen and his staff are investigating the link between solar activity and Earth temperature.¶ The scientific record shows that between the 1600s and 1700s, sun spot activity was very low, and the Earth was so cold that the period became known as the "little ice age."¶ "We know from the records that there were very few of these sunspots for very long periods, from about 1650 until about 1715," Pedersen said. "This particular period of low solar activity also correlates with a period where the climate at least in most of Europe and other places of the world was very cold."¶ It was also very cold in North America during the colonial period compared to today.¶ Colonial art often shows deep snows and ice filled rivers during the winters. The winter of 1780 was so cold in Virginia that the Norfolk Historical Society says the mouth of the Chesapeake Bay froze solid and men walked across it.¶ On the Virginia Beach oceanfront, ocean ice piled up 20 feet high and didn't melt completely until May. That's almost unimaginable in Virginia Beach today, where the ice on a typical winter's day is lucky to make it past noon.¶ Another little ice age appeared again in North America in the mid-1800s along with a corresponding scarcity of sunspots.¶ Connecting the Sun and 'Global Cooling'¶ At the Danish Space Institute, they are testing a theory that may explain the connection between a lack of solar activity and cooling: the Svensmark Cosmic Ray Theory.¶ The earth is constantly being bombarded with cosmic rays, high-energy particles from exploding stars. The Svensmark Cosmic Ray Theory says that when these cosmic rays enter the Earth's atmosphere, they help create clouds.¶ An active sun strengthens a magnetic shield around the earth that lets fewer cosmic rays get through. If the sun is less active, more cosmic rays get through. And the more cosmic rays, the more clouds, and the cooler global temperatures will be.¶ The theory has its scientific critics, but it is also viewed as politically incorrect in some quarters to expend resources on climate theories that might compete with the dominant view of human-induced climate change.¶ As the Obama administration and the EPA prepare to pursue expensive solutions to keep the Earth from warming, the Earth could actually be facing a cooling trend that, if severe, would be far more destructive to food supply and human health.¶ "Most scientists and economists would agree that a moderate warming would probably be beneficial, and a cooling of a couple degrees would probably be very, very bad," Michaels said. "Remember that cooling it just a few degrees brings on an ice age, and that's quite a bit different than what would happen if you warmed it a few degrees."

#### A growing number of scientists and experts support the global cooling theory

De Lima 12 – Kyle De Lima is a writer for Earthwise Limited, 2012 (“Global Warming..? Or is it Global Cooling?” Earthwise Ltd, February 6th 2012, <http://www.earthwise-trinidad.com/wp-content/uploads/2012/02/Is-The-Earth-Really-Warming-Up.pdf>)

Now, there is another theory that is gaining momentum. It is one that completely ¶ removes us human beings from the equation. The theory maintains that the planet itself goes through specific cycles and that there is nothing we can do to ¶ affect it. Either positively or negatively.¶ For those of us that wish to remain informed, read on…¶ The Theory Of Global Cooling?¶ Over the past forty years or so, there has been a growing number of scientists ¶ and various other experts that discount the Global Warming theory and instead ¶ favor the Global Cooling hypothesis. ¶ In a report published in www.ClimateDepot.com last month, over 1000 scientists ¶ have spoken out against the United Nation’s Intergovernmental Panel on Climate ¶ Change (IPCC). A number of these scientists previously championed the cause of ¶ the Global Warming theory. To Global Warming protagonists, the report no doubt will be a difficult read. But ¶ I think we should all be reading as many articles, reports and studies as we can… ¶ At least enough so that we can create our own ‘informed’ opinion.¶ There seems to be just as many hypothetical explanations to support Global ¶ Cooling as there are supporting Global Warming.¶ Members of the scientific community that support the Global Cooling hypothesis ¶ claim that the Earth is constantly undergoing changes to the climate, and that ¶ they claim that the cycle is fairly predictable.¶ One prominent historical climatologist, Dr. Tim Ball says that the data shows that ¶ the Earth cooled slightly from 1680 to 1940. He goes on to point out that from 1940 to around 1980, the data suggests that the Earth stopped cooling and began ¶ to warm up instead. ¶ Dr. Ball explains that this heat increase is explained by a phenomenon called ¶ “The Urban Heat Island.” This basically says that weather stations that were ¶ previously beyond a city’s limits, have since been absorbed by expanding urban ¶ growth, and that the data being recorded by them nowadays is distorted. He goes ¶ on to say that weather stations in rural areas prove that the planet has in fact ¶ been experiencing a cool down. He also says that satellite data confirms this ¶ slight cool down. To read Dr. Ball’s responses to questions on Global ¶ Warming/Cooling, please click: http://www.fcpp.org/publication.php/864¶ In 2008, researchers from Duke University published their findings after ¶ studying the IPCC claims that human activity, not solar activity is the major cause ¶ of changes to the average temperatures of the Earth.¶ According to Nicola Scafetta and Bruce West, the period of warming experienced ¶ up until 2002 was to be expected, as it is a well-known fact that the sun ¶ undergoes periods of decreased solar activity in which the incidence of solar ¶ flares decreases or in some cases even ceases for periods of time ranging from ¶ decades, to over one hundred years at a time.¶ Scafetta and West concluded by stating that by their calculations, the sun is in ¶ fact up to 67% responsible for global climate changes, and that as the sun enters ¶ it’s latest period of relatively low solar activity, we will see the Earth cool, ¶ dispelling fears of a continued rise in temperatures.

#### Scientific bias is not a reason to reject a theory

WSJ 12 – Wall Street Journal, 2012 (“A Global-Cooling Theory Gets a Second Chance,” Wall Street Journal, March 16th 2012, <http://online.wsj.com/article/SB10001424052702304537904577277442504539400.html>)

Scientists, it's said, behave more like lawyers than philosophers. They do not so much test their theories as prosecute their cases, seeking supportive evidence and ignoring data that do not fit—a failing known as confirmation bias. They then accuse their opponents of doing the same thing. This is what makes debates over nature and nurture, dietary fat and climate change so polarized.¶ But just because the prosecutor is biased in favor of his case does not mean the defendant is innocent. Sometimes biased advocates are right. An example of this phenomenon is now being played out in geology over the controversial idea that a meteorite or comet hit the earth 12,900 years ago and cooled the climate.¶ Enlarge Image¶ Chris Neal¶ Just because a scientist is biased in favor of his own case does not mean that his theory is wrong.¶ That the climate suddenly cooled then, plunging the Northern Hemisphere back into an ice age for 1,300 years, is not in doubt. The episode is known as the Younger Dryas, because in Scandinavia abundant pollen from a tundra flower called the mountain avens, Dryas octopetala, reappears in soil from this date, indicating that the forest had once more given way to tundra. With the sudden arrival of cooler, drier and less predictable seasons, early human attempts at agriculture in the Near East ceased, and people returned to nomadic hunting and gathering.

### Prodict – Heartland Institute

#### Heartland Institute is a leader on warming studies – prefer our ev

Peter Ferrara – Forbes – 5/31/12, Sorry Global Warming Alarmists, The Earth Is Cooling, <http://www.forbes.com/sites/peterferrara/2012/05/31/sorry-global-warming-alarmists-the-earth-is-cooling/2/>

The Heartland Institute has effectively become the international headquarters of the climate realists, an analog to the UN’s Intergovernmental Panel on Climate Change (IPCC).  It has achieved that status through these international climate conferences, and the publication of its Climate Change Reconsidered volumes, produced in conjunction with the Nongovernmental International Panel on Climate Change (NIPCC). Those Climate Change Reconsidered volumes are an equivalently thorough scientific rebuttal to the irregular Assessment Reports of the UN’s IPCC.  You can ask any advocate of human caused catastrophic global warming what their response is to Climate Change Reconsidered.  If they have none, they are not qualified to discuss the issue intelligently.

### Indict – IPCC

#### IPCC predictions are based on bad climate models – they can’t account for past changes in temperatures

Larry Bell – Forbes – 1/10/12, Global Warming? No, Natural, Predictable Climate Change, <http://www.forbes.com/sites/larrybell/2012/01/10/global-warming-no-natural-predictable-climate-change/>

An extensively peer-reviewed study published last December in the Journal of Atmospheric and Solar-Terrestrial Physics indicates that observed climate changes since 1850 are linked to cyclical, predictable, naturally occurring events in Earth’s solar system with little or no help from us. The research was conducted by Nicola Scafetta, a scientist at Duke University and at the Active Cavity Radiometer Solar Irradiance Monitor Lab (ACRIM), which is associated with the NASA Jet Propulsion Laboratory in California. It takes issue with methodologies applied by the U.N.’s Intergovernmental Panel for Climate Change (IPCC) using “general circulation climate models” (GCMs) that, by ignoring these important influences, are found to fail to reproduce the observed decadal and multi-decadal climatic cycles. As noted in the paper, the IPCC models also fail to incorporate climate modulating effects of solar changes such as cloud-forming influences of cosmic rays throughout periods of reduced sunspot activity. More clouds tend to make conditions cooler, while fewer often cause warming. At least 50-70% of observed 20th century warming might be associated with increased solar activity witnessed since the “Maunder Minimum” of the last 17th century. Dr. Scafetta’s study applies an astronomically-based model that reconstructs and correlates known warming and cooling phases with decadal and multi-decadal cycles associated with influences of planetary motions, most particularly those of Jupiter and Saturn. This “astronomical harmonics model” was used to address various cycles lasting 9.1, 10-10.5, 20-21, and 60-62 year-long periods. The 9.1-year cycle was shown to be likely related to decadal solar/lunar tidal oscillations, while those of ten years and longer duration relate to planetary movements about the Sun that may have solar influences that modulate electromagnetic properties of Earth’s upper atmosphere which can regulate the cloud system. Scafetta’s findings contradict IPCC claims that all warming observed from 1970 to 2000 has been man-made (“anthropogenically-induced”) based upon models that exclude natural quasi 20-year and 60-year climate cycle contributions. These cycles have been clearly detected in all global surface temperature records of both hemispheres since 1850, and are also evident in numerous astronomical records. The 60-year cycle is particularly easy to observe in significant surface temperature maxima that occurred in 1880-1881, 1940-1941, and 2000-2001. These momentarily warmer periods coincided with times when orbital positions of Jupiter and Saturn were relatively close to the Sun and Earth. A 60-year modulation cycle also corresponds with warming/cooling induced in the ocean surface which appears to correlate with the frequency of major Atlantic hurricanes, and is seen in the sea level rise since 1700 as well as in numerous ocean and terrestrial records dating back centuries. Further evidence of a 60-year cycle is referenced in ancient Sanskrit texts among observed monsoon rainfall cycles. Scafetta believes that a natural 60-year climate cycle associated with astronomical cycles may also explain calendars adopted in traditional Chinese, Tamil and Tibetan civilizations, since all major ancient civilizations knew about 20-year and 60-year Jupiter and Saturn cycles. Indeed, Scafetta pointed out to me that in the Hindu tradition, the 60-year cycle is known as the cycle of Brihaspati, the name of Jupiter, and that every 60 years special ceremonies are celebrated by some populations, such as the Sigui ceremony among the Dogon people of Africa. Proper reconstructions of natural 20-year and 60-year cycles, along with other independent studies, indicate that the IPCC has seriously overestimated human climate contributions. For example, according to all GCM simulations, increased CO2 concentrations should have produced an increased tropical warming trend with altitude, which is contrary to what balloon and satellites observations actually show. GCM interpretations also allege that volcano activity may have contributed an offsetting 0.1-0.2 degrees of cooling influence between from 1970 to 2000. However, that conclusion appears to significantly overestimate the volcano signal because the models predicted deep and large cooling spikes associated with eruptions which are observed to be much smaller in global surface temperature records. Accordingly, this too suggests that the 1970-2000 warming effect attributed to anthropogenic influences should be reduced. Moreover, some of the observed 0.5 degrees of warming recorded by surface stations during the 1970-2000 period which IPCC models associated with human greenhouse gases emissions, may be explained by improperly corrected urban “heat island” effects and other land use change influences. Finally, three major available global surface temperature record sources report a steady-to-cooling trend since 2001. These measurements contradict the strong warming predicted by all IPCC models during the same period that are attributed primarily to a continuing increase in CO2 emissions. Indeed, only one global surface record source shows a slight increase in the temperature since 2001. This occurred because missing temperature data needed to be adjusted or filled in to complete the records…which appears to be the case with NASA Goddard Institute for Space Studies model data resulting from poor sampling during the last decade for Antarctic and Arctic regions and the use of a 1200 km smoothing methodology. The Duke University/NASA JPL study estimates that as much as 0.3 degrees of warming from 1970 to 2000 may have been naturally induced by the 60-year modulation during the warming phase, amounting to at least 43-60% of the 0.5-0.7 degrees allegedly caused by human greenhouse emissions. Additional natural warming can be explained by increased solar activity during the last four centuries, as well as simply being part of a natural and persistent warming recovery since the end of the Little Ice Age of AD 1300-1900. Nicola Scaletta concludes that the scientific method requires that a physical model fulfill two conditions…it must be able to reconstruct as well as predict (or forecast) direct physical observations. Here, he argues that all climate models used by the IPCC can do neither. “They seriously fail to properly reconstruct even the large multi-decadal oscillations found in the global surface temperature which have climatic meaning. Consequently, the IPCC projections for the 21st century cannot be trusted.” In fact, he argues that “By not properly reconstructing the 20-year and 60-year natural cycles we found that the IPCC GCMs have seriously overestimated also the magnitude of the anthropogenic contribution to recent warming.” Unlike the current IPCC models, the astronomical harmonics model can have real climate forecasting value. By combining current trend information with natural cycle patterns Scafetta believes that the global temperature “may not significantly increase during the next 30 years mostly because of the negative phase of the 60-year cycle.” He goes on to say: “If multi-secular natural cycles (which according to some authors have significantly contributed to the observed 1700-2010 warming and may contribute to an additional natural cooling by 2100) are ignored, the same projected anthropogenic emissions would imply a global warming by about 0.3-1.2 degrees C by 2100, contrary to the IPCC 1.0-3.6 degree C projected warming.” Scafetta projects that the global climate may remain approximately steady until 2030-2040 (as was observed from the 1940s to the 1970s) because the 60-year cycle entered into its current cooling phase around 2000-2003. The climate may further cool if additional natural long and short-term cycles also enter into cooling phases. In fact the present warm period may well be at the top of a natural millennial cycle as previously occurred during Roman and Medieval times.

## Aff

### No Ice Age – General

#### Ice Age won’t occur for at least 1,500 years

**Reuters, 12** (It’s quoting Nature Geoscience, which is a popular magazine, with credible authors) “Next ice age not likely before 1,500 years, 3/9/12, <http://www.reuters.com/article/2012/01/09/us-ice-age-emissions-idUSTRE80814T20120109>

High levels of carbon dioxide emissions in the atmosphere mean the next ice age is unlikely to begin for at least 1,500 years, an article in the journal Nature Geoscience said on Monday. Concentrations of the main gases blamed for global warming reached record levels in 2010 and will linger in the atmosphere for decades even if the world stopped pumping out emissions today, according to the U.N.'s weather agency. An ice age is a period when there is a long-term reduction in the earth's surface and atmospheric temperature, which leads to the growth of ice sheets and glaciers. There have been at least five ice ages on earth. During ice ages there are cycles of glaciation with ice sheets both advancing and retreating. Officially, the earth has been in an interglacial, or warmer period, for the last 10,000 to 15,000 years, and estimates vary on how long such periods last. "(Analysis) suggests that the end of the current interglacial (period) would occur within the next 1,500 years, if atmospheric CO2 concentrations do not exceed (around) 240 parts per million by volume (ppmv)," the study said. However, the current carbon dioxide concentration is of 390 ppmv, and at that level an increase in the volume of ice sheets would not be possible, it added. The study based on variations in the earth's orbit and rock samples was conducted by academics at Cambridge University, University College London, the University of Florida and Norway's University of Bergen. The causes of ice ages are not fully understood but concentrations of methane and carbon dioxide in the atmosphere, changes in the earth's orbit around the sun, and the movement of tectonic plates are all thought to contribute. The world is forecast to grow hotter as greenhouse gases continue to rise, increasing threats such as extreme weather events and sea level rise. Scientists have warned that global temperature rise should be limited to within 2 degrees Celsius to avoid the worst effects of climate change but delays in curbing emissions growth are putting the planet at risk.

#### Little Ice Age and Maunder Minimum don’t have a connection

**Reuters, 11** (Quoting scientists from National Solar Observatory) “Scientists see sunspots, but no Ice Age" 6/16/2011, <http://www.reuters.com/article/2011/06/16/us-climate-sunspots-idUSTRE75E5L620110616>

They also wondered whether this possible slowdown, or even a long cessation of sunspot activity, indicates an upcoming return of the Maunder Minimum, a 70-year sunspot drought seen from 1645-1715.¶ They had no answer as to whether this might be true, and said nothing about whether the Maunder Minimum -- named for astronomer E.H. Maunder -- was related to a long cold period in Europe and other parts of the Northern Hemisphere known as the Little Ice Age.¶ How strong a connection is there between a Little Ice Age and a Maunder Minimum? "Not as strong a connection as people would like to believe," Hill said by phone.¶ "The Little Ice Age actually lasted for hundreds of years, of which the Maunder Minimum was only a small segment ... My personal opinion is that there is only an anecdotal connection without a whole lot of scientific background behind it."¶ Several websites and blogs have argued that the potentially cooling influence of a lower level of sunspot activity could cancel out the warming caused by human activities that generate climate-warming greenhouse gases. Hill disputed this.¶ "In my opinion, it is a huge leap ... to an abrupt global cooling, since the connections between solar activity and climate are still very poorly understood," he said in an e-mail.

### No Ice Age – AT: Solar Activity

#### Sunspots don’t mean an Ice Age

**Reuters, 11** (Quoting scientists from National Solar Observatory) “Scientists see sunspots, but no Ice Age" 6/16/2011, <http://www.reuters.com/article/2011/06/16/us-climate-sunspots-idUSTRE75E5L620110616>

Sunspot cycles -- those 11-year patterns when dark dots appear on the solar surface -- may be delayed or even go into "hibernation" for a while, a U.S. scientist said on Wednesday.¶ But contrary to some media reports, this does not mean a new Ice Age is coming, Frank Hill of the National Solar Observatory said in a telephone interview.¶ "We have not predicted a Little Ice Age," Hill said, speaking from an astronomical meeting in New Mexico. "We have predicted something going on with the Sun."¶ The appearance of sunspots helps predict solar storms that can interfere with satellite communications and power grids.¶ Hill and other scientists cited a missing jet stream, fading spots and slower activity near the Sun's poles as signs that our nearest star is heading into a rest period.¶ "This is highly unusual and unexpected," he said in a statement released on Tuesday. "But the fact that three completely different views of the Sun point in the same direction is a powerful indicator that the sunspot cycle may be going into hibernation."¶ That hibernation would not begin now, as the current sunspot cycle, the 24th, has recently passed its minimum. Hill and his colleagues pondered a slowdown in sunspot activity in the 25th cycle, expected sometime around 2019.¶

#### Impact of solar activity is minimal – GHG emissions will cause massive warming

Met Office (UK's National Weather Service) – 1/23/12, Decline in solar output unlikely to offset global warming, http://www.metoffice.gov.uk/news/releases/archive/2012/solar-output-research

23 January 2012 - New research has found that solar output is likely to reduce over the next 90 years but that will not substantially delay expected increases in global temperatures caused by greenhouse gases.¶ Carried out by the Met Office and the University of Reading, the study establishes the most likely changes in the Sun's activity and looks at how this could affect near-surface temperatures on Earth.¶ It found that the most likely outcome was that the Sun's output would decrease up to 2100, but this would only cause a reduction in global temperatures of 0.08 °C. This compares to an expected warming of about 2.5 °C over the same period due to greenhouse gases (according to the IPCC's B2 scenario for greenhouse gas emissions that does not involve efforts to mitigate emissions).¶ Gareth Jones, a climate change detection scientist with the Met Office, said: "This research shows that the most likely change in the Sun's output will not have a big impact on global temperatures or do much to slow the warming we expect from greenhouse gases.¶ "It's important to note this study is based on a single climate model, rather than multiple models which would capture more of the uncertainties in the climate system."¶ The study also showed that if solar output reduced below that seen in the Maunder Minimum - a period between 1645 and 1715 when solar activity was at its lowest observed level - the global temperature reduction would be 0.13C.¶ Peter Stott, who also worked on the research for the Met Office, said: "Our findings suggest that a reduction of solar activity to levels not seen in hundreds of years would be insufficient to offset the dominant influence of greenhouse gases on global temperatures in the 21st Century."¶ During the 20th Century solar activity increased to a 'grand maximum' and recent studies have suggested this level of activity is at or nearing its end.¶ Mike Lockwood, an expert in solar studies at the University of Reading, used this as a starting point for looking at the most probable changes in the Sun's activity over the 21st Century.¶ Met Office scientists then placed the projections into one climate model to see how they may impact temperatures.¶ Professor Lockwood said: "The 11-year solar cycle of waxing and waning sunspot numbers is perhaps the best known way the Sun changes, but longer term changes in its brightness are more important for possible influences on climate.¶ "The most likely scenario is that we'll see an overall reduction of the Sun's activity compared to the 20th Century, such that solar outputs drop to the values of the Dalton Minimum (around 1820). The probability of activity dropping as low as the Maunder Minimum - or indeed returning to the high activity of the 20th Century - is about 8%. The findings rely on the assumption that the Sun's past behaviour is a reasonable guide for future solar activity changes."

#### Decline in solar activity won’t cause cooling – current GHG offset

DAVID ROSE – Globe and Mail – 1/29/12, Forget global warming - it's Cycle 25 we need to worry about (and if NASA scientists are right the Thames will be freezing over again), <http://www.dailymail.co.uk/sciencetech/article-2093264/Forget-global-warming--Cycle-25-need-worry-NASA-scientists-right-Thames-freezing-again.html>

However, it is also possible that the new solar energy slump could be as deep as the ‘Maunder minimum’ (after astronomer Edward Maunder), between 1645 and 1715 in the coldest part of the ‘Little Ice Age’ when, as well as the Thames frost fairs, the canals of Holland froze solid.

Yet, in its paper, the Met Office claimed that the consequences now would be negligible – because the impact of the sun on climate is far less than man-made carbon dioxide. Although the sun’s output is likely to decrease until 2100, ‘This would only cause a reduction in global temperatures of 0.08C.’ Peter Stott, one of the authors, said: ‘Our findings suggest a reduction of solar activity to levels not seen in hundreds of years would be insufficient to offset the dominant influence of greenhouse gases.’

### Ice Age Inevitable

#### Ice age inevitable.

Cocks 10 (Professor Franklin Hadley Cocks '63, SM '64, ScD '65, teaches energy technology and climate-related courses at Duke University and is the author of Energy Demand and Climate Change (Wiley-VCH), which summarizes energy and climate issues of the past, present, and future, January/February 2010, Global Warming vs. the Next Ice Age, Technology review published by MIT, <http://www.technologyreview.com/mitnews/416786/global-warming-vs-the-next-ice-age/>)

Exactly why our planet occasionally cools down has taken more than a century to work out. Now we know that cyclic gravitational tugs from Jupiter and Saturn periodically elongate Earth's orbit, and this effect combines from time to time with slow changes in the direction and degree of Earth's tilt that are caused by the gravity of our large moon. Consequently, summer sunlight around the poles is reduced, and high-­latitude regions such as Alaska, northern Canada, and Siberia turn cold enough to preserve snow year-round. This constant snow cover reflects a great deal of sunlight, cooling things down even more, and a new ice age begins. Naturally, this process does not occur with anything like the speed portrayed in the movie The Day After Tomorrow, but geological and other evidence shows that it's happened at least four times.¶ With so much attention focused on global warming, this chilly prospect has been all but forgotten. Given how catastrophic another ice age could be, one might be tempted to ask whether a human-caused increase in atmospheric and ocean temperatures will actually be a boon.¶ ¶ 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.

### SQ Warming Solves Ice Age

#### Current emissions are enough to prevent Ice Age for over 1,000 years – have to act now to prevent catastrophic warming

Nina Chestney – Reuters – 1/9/12, Next Ice Age Delayed By Global Warming Gases, Study Finds, Huffington Post, <http://www.huffingtonpost.com/2012/01/09/next-ice-age-global-warming_n_1193900.html>

High levels of carbon dioxide emissions in the atmosphere mean the next ice age is unlikely to begin for at least 1,500 years, an article in the journal Nature Geoscience said on Monday.¶ Concentrations of the main gases blamed for global warming reached record levels in 2010 and will linger in the atmosphere for decades even if the world stopped pumping out emissions today, according to the U.N.'s weather agency.¶ An ice age is a period when there is a long-term reduction in the earth's surface and atmospheric temperature, which leads to the growth of ice sheets and glaciers.¶ There have been at least five ice ages on earth. During ice ages there are cycles of glaciation with ice sheets both advancing and retreating.¶ Officially, the earth has been in an interglacial, or warmer period, for the last 10,000 to 15,000 years, and estimates vary on how long such periods last.¶ "(Analysis) suggests that the end of the current interglacial (period) would occur within the next 1,500 years, if atmospheric CO2 concentrations do not exceed (around) 240 parts per million by volume (ppmv)," the study said.¶ However, the current carbon dioxide concentration is of 390 ppmv, and at that level an increase in the volume of ice sheets would not be possible, it added.¶ The study based on variations in the earth's orbit and rock samples was conducted by academics at Cambridge University, University College London, the University of Florida and Norway's University of Bergen.¶ The causes of ice ages are not fully understood but concentrations of methane and carbon dioxide in the atmosphere, changes in the earth's orbit around the sun, and the movement of tectonic plates are all thought to contribute.¶ The world is forecast to grow hotter as greenhouse gases continue to rise, increasing threats such as extreme weather events and sea level rise.¶ Scientists have warned that global temperature rise should be limited to within 2 degrees Celsius to avoid the worst effects of climate change but delays in curbing emissions growth are putting the planet at risk.

#### We have enough C02 in the atmosphere already

The Week – 1/11/12, Has climate change 'blocked' the next ice age?, http://theweek.com/article/index/223144/has-climate-change-blocked-the-next-ice-agenbsp

Earth isn't due for another ice age for 1,500 years. But by then, say researchers from Cambridge University, carbon dioxide emissions appear likely to have raised the planet's temperature so much that the ice sheets will be unable to form. Will climate change "block" the next ice age? Here, a brief guide:¶ Wait — an ice age?¶ Yup. The planet experiences regular ice ages — scientists have discovered evidence of five of them — and we're due for another one. "The period between the end of an ice age and the beginning of the next is typically about 11,000 years," says Britain's Telegraph, "due to a natural cycle related to the Earth's orbit." ¶ So when is this one supposed to hit? ¶ Around A.D. 3500, "the world will be due for another round of chilling and frozen wastelands," says the International Business Times. We're actually already overdue — it has been 11,600 years since the last ice age. But scientists determined that we're still 1,500 years out by comparing current conditions to a similar period between ice ages 780,000 years ago.¶ And this next one might not hit?¶ Probably not — at least not with current concentrations of carbon dioxide in the atmosphere. For the next ice age to hit, CO2 levels would have to fall to 250 parts per million by volume. Right now? The current carbon dioxide concentration is 390 ppmv — and at that level, the ice sheets just can't expand.¶ So that's a good thing, right?¶ Not exactly. Man-made climate change could have "huge consequences" for the planet, says study leader Dr. Luke Skinner. And the argument that CO2 emissions might be helping the planet is "missing the point."

#### Enough Warming To Prevent Ice Age for at least 1,000 years

Vegan Verve- Biochemistry Major Southampton University- 1/10/12, ”Study: Carbon Emissions Delaying Next Ice Age”, About My Planet, http://www.aboutmyplanet.com/environment/study-carbon-emissions-delaying-next-ice-age/

Ice ages on the planet are well known and often depicted in museums and even in film. The Earth has a pattern of sorts when it comes to the occurrence of ice ages, a pattern which points to another ice age being right around the corner in the scheme of Earth time (rather than human). However, a new study shows that global warming emissions will likely delay the next ice age.¶ The study was conducted by a number of scientists from London, Norway and the United States and was led by Dr. Luke Skinner from Cambridge University. The scientists determined that the next ice age should occur in approximately 1,500 years. The last ice age was approximately 11,500 years ago.¶ Changes between ice ages and what are called interglacial periods, as we are in now, require complex changes in the Earth itself. The degree of the Earth’s axis, the orbit around the sun and the rotation of the planet on its axis all factor in the changes. However, carbon dioxide concentration also play a role in the formation, higher levels of course help form interglacial while low help form ice ages.¶ The scientists determined that in order for the next ice age to occur in 1,500 years or to occur in general, carbon dioxide concentrations would have to dip to 240 parts per million. The current carbon dioxide concentration in the atmosphere is 390 parts per million. Therefore, according to the scientists, even if man stopped generating carbon dioxide today, the planet would be too warm to trigger an ice age for more than 1,000 years. In addition, the scientists also believe that glacial melting would also still likely occur.¶ Skinner stated: “At current levels of CO2, even if emissions stopped now we’d probably have a long interglacial duration determined by whatever long-term processes could kick in and bring CO2 down.”¶ Due to the topic of the study pointing to global warming emissions reducing the likelihood of an ice age in the next 1,500 years, opponents to emission control are relishing the study. Such opponents believe the increased emissions will benefit the planet’s climate overall and avoid a potentially detrimental ice age in terms of agriculture and survival.¶ But lead scientist of the study, Luke Skinner, stated that these individuals are “missing the point, because where we’re going is not maintaining our currently warm climate but heating it much further, and adding CO2 to a warm climate is very different from adding it to a cold climate. The rate of change with CO2 is basically unprecedented, and there are huge consequences if we can’t cope with that.”

#### Enough Warming to Prevent Ice Age- At rate we are going, we need to slow it down

Rob **Waugh**-UK journalist writing about trending science, web, gadgets, etc.-**1/9/2012**, “Human carbon emissions could put OFF a lethal new ice age, say scientists”, Mail Online- http://www.dailymail.co.uk/sciencetech/article-2084106/Human-carbon-emissions-lethal-Ice-Age-say-scientists.html

But due to human carbon emissions, the lethal 'big freeze' could be put off.¶ Levels of CO2 in the atmosphere could actually insulate against a catastrophic ice age which would see glaciers advance over Europe and north America.¶ The scientists admit that we would be 'better off' in a warmer world - but caution that this is 'missing the point'. ¶ In a paper published in Nature Geoscience, Cambridge University paleoclimatologist Luke Skinner says that even if carbon emissions stopped today, levels would remain elevated for at least 1,000 years, and stored heat could prevent the next Ice Age from happening. ¶ Instead, things would cool down, but not quite so severely. ¶ Thanks to elevated levels of carbon dioxide in the atmosphere, the earth would not experience 'glaciation' - periods of severe cold where glaciers advance.¶ The current level of carbon dioxide is 390 parts per million. Scientists believe that level would need to drop to 240 parts per million to allow glaciation to take place. ¶ 'It's an interesting philosophical discussion. Would we better off in a warm world rather than a glaciation? Probably we would,' says Dr Skinner. ¶ 'At current levels of CO2, even if emissions stopped now, we'd probably have a long interglacial period,' says Dr Skinner. ¶ 'Interglacial' periods are warmer periods between periods of glaciation.¶ ¶ The last ice age ended 11,500 years ago, and scientists debate over when the next one is 'due'.¶ The cycle is dictated by tiny variations in Earth's orbit around the sun.¶ Ice ages are marked by glaciers advancing over continents. At the peak of the last ice age, large areas of Europe, Asia and North America were covered in ice.¶ The effects on human civilisation would be catastrophic.¶ He says, 'This is missing the point, because where we're going is not maintaining our currently warm climate but heating it much further, and adding CO2 to a warm climate is very different from adding it to a cold climate.'¶

### Warming Impacts O/W Ice Age

#### Current C02 levels won’t maintain temperatures but drive them up - triggers the impacts

Richard Black – 1/9/12, Carbon emissions 'will defer Ice Age', BBC, <http://www.bbc.co.uk/news/science-environment-16439807>

Groups opposed to limiting greenhouse gas emissions are already citing the study as a reason for embracing humankind's CO2 emissions.¶ The UK lobby group the Global Warming Policy Foundation, for example, has flagged up a 1999 essay by astronomers Sir Fred Hoyle and Chandra Wickramasinghe, who argued that: "The renewal of ice-age conditions would render a large fraction of the world's major food-growing areas inoperable, and so would inevitably lead to the extinction of most of the present human population.¶ "We must look to a sustained greenhouse effect to maintain the present advantageous world climate. This implies the ability to inject effective greenhouse gases into the atmosphere, the opposite of what environmentalists are erroneously advocating."¶ Luke Skinner said his group had anticipated this kind of reception.¶ "It's an interesting philosophical discussion - 'would we better off in a warm [interglacial-type] world rather than a glaciation?' and probably we would," he said.¶ "But it's missing the point, because where we're going is not maintaining our currently warm climate but heating it much further, and adding CO2 to a warm climate is very different from adding it to a cold climate.¶ "The rate of change with CO2 is basically unprecedented, and there are huge consequences if we can't cope with that."

### 2AC Thermohaline Link Turn

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

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

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

### Ext – Thermohaline Link Turn

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

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

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

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

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

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

#### THC Collapse speeds up global warming; preventing it now is key.

Michael **Vellinga** and Richard A. **Wood 2001-** Both scientists that work for the Hadley Prediction

The predicted global warming over the next century due to rising greenhouse¶ gas and aerosol concentrations is estimated to lie between 1 􀀀 3:5oC (Houghton¶ et al. (1996)). The global temperature change due to the collapse of the Atlantic¶ THC varies from 􀀀1oC in the first decade to about 􀀀0:3oC in years 40-50 (Vellinga¶ and Wood (2001)). **Local temperature change after the THC collapse can¶ be much stronger than this. In a simple linear superposition the cooling due to¶ a hypothetical THC collapse** in, say 2050**, would outweigh the warming due to¶ increased greenhouse gas concentrations** around the North Atlantic in this model.¶ This study highlights the need to reduce the uncertainties in our climate models¶ regarding the stability of the THC. **An unforeseen or wrongly predicted collapse¶ of the THC would lead to significant errors in global and especially regional¶ climate predictions.** Efforts to reduce the uncertainty in modelling the stability¶ of the THC in HadCM3 are ongoing. This starts with the analysis of the dominant¶ physical processes that determine size and nature of the response by the THC¶ when it is subjected to various kinds of stress (Thorpe et al. (2001); Vellinga and¶ Wood (2001)). In the next stage one would then attempt to eliminate modelling¶ errors from these same processes.

#### Global warming leads to a collapse in the THC

Rhett A. Butler- 12-07-05- Rhett is a cofounder of multiple ecological movements and groups, somce og which include Tropical Conservation Science, Tropical Forest Network, etc. He is also an expert at examining the impact of emerging local and global trends in technology, economics, and finance on conservation and development.- <http://news.mongabay.com/2005/1207-uiuc.html>

This movement carries a tremendous amount of heat northward, and plays a vital role in maintaining the current climate," Schlesinger said. "**If the thermohaline circulation shut down, the southern hemisphere would become warmer and the northern hemisphere would become colder. The heavily populated regions of eastern North America and western Europe would experience a significant shift in climate." ¶ Higher temperatures caused by global warming could add fresh water to the northern North Atlantic by increasing the precipitation and by melting nearby sea ice, mountain glaciers and the Greenland ice sheet. This influx of fresh water could reduce the surface salinity and density, leading to a shutdown of the thermohaline circulation**.

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#### THC collapse high probability and high magnitude; empirics prove. Even with harsh climate regulations, 25% likely.

James E. Kloeppel- 12-07-05- Physical Sciences Editor at University of Illinois- <http://www.eurekalert.org/pub_releases/2005-12/uoia-gwc120705.php>

Absent any climate policy, **scientists have found a 70 percent chance of shutting down the thermohaline circulation in the North Atlantic Ocean over the next 200 years, with a 45 percent probability of this occurring in this century.** The likelihood decreases with mitigation, but even the most rigorous immediate climate policy **would still leave a 25 percent chance of a thermohaline collapse.¶** "This is a dangerous, human-induced climate change," said Michael Schlesinger, a professor of atmospheric sciences at the University of Illinois at Urbana-Champaign. "The shutdown of the thermohaline circulation has been characterized as a high-consequence, low-probability event. **Our analysis, including the uncertainties in the problem, indicates it is a high-consequence, high-probability event.**"¶ Schlesinger will present a talk "Assessing the Risk of a Collapse of the Atlantic Thermohaline Circulation" on Dec. 8 at the United Nations Climate Control Conference in Montreal. He will discuss recent work he and his colleagues performed on simulating and understanding the thermohaline circulation in the North Atlantic Ocean.¶ The thermohaline circulation is driven by differences in seawater density, caused by temperature and salinity. Like a great conveyor belt, the circulation pattern moves warm surface water from the southern hemisphere toward the North Pole. Between Greenland and Norway, the water cools, sinks into the deep ocean, and begins flowing back to the south.¶ "This movement carries a tremendous amount of heat northward, and plays a vital role in maintaining the current climate," Schlesinger said. "If the thermohaline circulation shut down, the southern hemisphere would become warmer and the northern hemisphere would become colder. The heavily populated regions of eastern North America and western Europe would experience a significant shift in climate**."¶ Higher temperatures caused by global warming could add fresh water to the northern North Atlantic by increasing the precipitation and by melting nearby sea ice, mountain glaciers and the Greenland ice sheet. This influx of fresh water could reduce the surface salinity and density, leading to a shutdown of the thermohaline circulation.¶ "We already have evidence dating back to 1965 that shows a drop in salinity around the North Atlantic,"** Schlesinger said. "The change is small, compared to what our model needs to shut down the thermohaline, but **we could be standing at the brink of an abrupt and irreversible climate change**."¶ To analyze the problem, Schlesinger and his colleagues first used an uncoupled ocean general circulation model and a coupled atmosphere-ocean general circulation model to simulate the present-day thermohaline circulation and explore how it would behave in response to the addition of fresh water.¶ They then used an extended, but simplified, model to represent the wide range of behavior of the thermohaline circulation. By combining the simple model with an economic model, they could estimate the likelihood of a shutdown between now and 2205, both with and without the policy intervention of a carbon tax on fossil fuels. The carbon tax started out at $10 per ton of carbon (about five cents per gallon of gasoline) and gradually increased.¶ "We found that there is a 70 percent likelihood of a thermohaline collapse, absent any climate policy," Schlesinger said. "Although this likelihood can be reduced by the policy intervention**, it still exceeds 25 percent even with maximal policy intervention**."¶ Because the risk of a thermohaline collapse is unacceptably large, Schlesinger said, "measures over and above the policy intervention of a carbon tax -- such as carbon capture and sequestration -- should be given serious consideration."

#### THC Collapse leads to 4K global cooling.

Climateprediction.net- The world’s largest climate forecasting experiment for the 21st century- 2012- http://climateprediction.net/content/thermohaline-experiment

**Palmer (2002) performed an experiment in which this OHFC response-pattern was scaled to correspond to a ~50% reduction in THC magnitude from HadCM3 control values and obtained a ~2K global mean cooling in response, as compared to Vellinger and Wood (2002) who induced a near-complete THC shut-down associated with a ~4K global mean cooling.** We propose initially using double Palmer (2002)’s perturbation, although the perturbed-physics ensemble set-up makes imposing a variety of OHFC perturbations very straightforward, and sensitivity of response to the imposed pattern and amplitude will be explored in the course of this project. Following Palmer (2002), the imposed OHFC perturbation is seasonally varying.

### No Extinction – Adaptation

#### Adaptation to the ice age possible – no extinction

Arizona State University News 11 (11/17/2011, Popular Archaeology, Arizona State Univeristy News, <http://www.stonepages.com/news/archives/004608.html>)

A team at Arizona State University and the University of Colorado (USA) used complex computer modelling to analyse evidence of how human hunter-gatherers responded to dramatic changes during the last Ice Age.¶ The researchers used the archaeological record to track human behavioural changes in Late Pleistocene (126,000 - 10,000 BP) Western Eurasia over a period of 100,000 years, and across the equivalent of 1,500 generations of human hunter-gatherers. They applied computer modelling to determine the evolutionary consequences of cultural and biological changes, which included how changes in the movements of modern humans and Neanderthals caused them to interact and interbreed with each other. The results showed that human mobility during the environmental changes associated with the Ice Age increased over time, likely in response to those environmental changes. The modelling suggests the last Ice Age caused the ancestors of modern humans - and Neanderthals - to widen their ranges across Western Eurasia in search of new resources as the climate shifted.¶ According to study co-author Julien Riel-Salvatore of the University of Colorado, Denver, this provides new evidence that Neanderthals were more adaptable and resourceful than previously thought, and suggests Neanderthals were gradually absorbed within the expanding modern human populations.

#### Climate change does not lead to extinction.

Mayell 1 (Hillary Mayell, published author, 11/12/2001, Climate Change Caused Extinction of Big Ice Age Mammals, Scientist Says, National Geographic News, <http://news.nationalgeographic.com/news/2001/11/1112_overkill.html>)

Martin, who in 1967 wrote the seminal book proposing the overkill hypothesis, disagrees that climate change could have caused the extensive extinctions.¶ "The climate had been changing over a million-year period, with swings from cold to warm, and back again—some much more severe than the one that occurred at the end of the Pleistocene," he said. "It doesn't make sense that just one more [climate shift swing] would make all the difference in the world."¶ Martin holds that the "dreadful syncopation"—humans arrive, animals disappear—seen in the islands of Oceania, Australia, New Zealand, Madagascar, and other islands fits with what happened in North America.

#### Mitigation and adaptation key.

Fischer 12 (Susanna Fischer, Grantham Research Institute on Climate Change and the Environment, LSE, and the Centre for Climate Change Economics and Policy (CCCEP) as a post-doctoral researcher in September 2011. She works in the research stream on adaptation and development. Susannah has completed a PhD at the geography department at the University of Cambridge on the politics and governance of climate change in India, 2/27/2012, What is Climate Change Adaptation, the Guardian, <http://www.guardian.co.uk/environment/2012/feb/27/climate-change-adaptation>)

There are two main policy responses to climate change: mitigation and adaptation. Mitigation addresses the root causes, by reducing greenhouse gas emissions, while adaptation seeks to lower the risks posed by the consequences of climatic changes. Both approaches will be necessary, because even if emissions are dramatically decreased in the next decade, adaptation will still be needed to deal with the global changes that have already been set in motion.¶ ¶ Humans have been adapting to their environments throughout history by developing practices, cultures and livelihoods suited to local conditions – from the Mediterranean siesta to the Vietnamese practice of building homes on stilts to protect against monsoonal rains. However, climate change raises the possibility that existing societies will experience climatic shifts (in temperature, storm frequency, flooding and other factors) that previous experience has not prepared them for.¶ ¶ Adaptation measures may be planned in advance or put in place spontaneously in response to a local pressure. They include large-scale infrastructure changes – such as building defences to protect against sea-level rise or improving the quality of road surfaces to withstand hotter temperatures – as well behavioural shifts such as individuals using less water, farmers planting different crops and more households and businesses buying flood insurance.¶ ¶ The IPCC describes vulnerability to climate change as being determined by three factors: exposure to hazards (such as reduced rainfall), sensitivity to those hazards (such as an economy dominated by rain-fed agriculture), and the capacity to adapt to those hazards (for example, whether farmers have the money or skills to grow more drought-resistant crops). Adaptation measures can help reduce vulnerability – for example by lowering sensitivity or building adaptive capacity – as well as allowing populations to benefit from opportunities of climatic changes, such as growing new crops in areas that were previously unsuitable.¶ ¶ Low-income countries tend to be more vulnerable to climate risks and some adaptation measures – such as increasing access to education and health facilities – will overlap with existing development programmes. But adaptation goes beyond just development to include measures to address additional risks specifically caused by climate change, such as raising the height of sea defences. It is still unclear how expensive these measures will be or who will pay for them, but the World Bank suggests adaptation could cost the same again as the world currently spends on development assistance.

#### Adaptation key to survival.

Danielson, no date (Stentor Danielson, Assistant Professor in the Department of Geography, Geology, and the Environment at Slippery Rock University of Pennsylvania, no date, Adaptation, <http://debitage.net/humangeography/adaptation.html>)

A classic example that illustrates the complexities of adaptation is the contrasting fates of the Norse and Inuit in Greenland (McGovern 2000). Norse settlers arrived in 986 CE, bringing with them a culture that had been developed in other North Atlantic islands like Iceland and the Shetland Islands. This culture, based around fishing, cattle herding, and farming some hardy grains, had been well adapted to these other North Atlantic environments, enabling the Norse population to succeed and grow. Greenland was a similar enough environment that the Norse could initially thrive.¶ Some time after that, the ancestors of today's Greenland Inuit moved into southern part of the island, bringing with them adaptations to the cold northern climates of Canada's Arctic Archipelago and northern Greenland. Inuit culture lacked agriculture or domestic animals besides the dog, but they had an effective package of technology such as kayaks and harpoons for hunting and fishing to supply their subsistence. After about 1300, the climate in Greenland became colder. Climatologists call the period in which the Norse settled the "Medieval Warm Period," while the cooling after 1300 is called the "Little Ice Age." This climate shift presented a challenge for both the Norse and Inuit. In particular, the cooling climate made it more difficult to procure land-based foods like cattle. The Inuit successfully shifted their subsistence strategy to emphasize more seal hunting, enabling their society to survive the Little Ice Age and continue until the present day. The Norse, on the other hand, experienced increasing food supply problems and the settlers ultimately either returned to Iceland or died, leading to the demise of the colony sometime before 1500.¶ The explanation of the difference between the Norse and Inuit fates comes down to how their cultures mediated the constraints and opportunities provided by the shared environment of 14th and 15th century Greenland. The precise course of the collapse of Norse society is a complex problem, but we can examine two features of Norse culture that inhibited it from following the successful Inuit path: xenophobia and hierarchy.¶ Archaeological evidence shows that the Inuit were quite willing to adopt ideas and technology from the Norse. Metal goods manufactured in Europe and imported by the Norse found their way along Inuit trade routes deep into the Arctic. On the other hand, the Norse were resistant to learning from the Inuit, and they never adopted technologies like kayaks and harpoons that would have enabled more effective exploitation of food resources during the Little Ice Age. Norse culture was xenophobic (literally stranger-fearing). Because the Inuit were heathens, it was believed that they had nothing of value to teach representatives of Christian European civilization. Indeed, the Norse name for all the native people of the Americas was "skrælingjar," which means "wretches" -- implying that their way of life was nasty and poor, and not worthy of emulation.¶ Norse society was also very hierarchical. Though the Norse were relatively democratic by medieval European standards (the Icelandic Alþingi is one of the world's oldest parliaments), Norse society still had a clear hierarchy between nobles and commoners. In Greenland, the chieftains had cemented their power by claiming control of the best pastureland. During the Medieval Warm Period, this was an effective source of power, as the climate was suitable for cattle-raising as an adaptation. But as the climate cooled, the chieftains were reluctant to allow Norse society to re-focus on seal hunting and other sea foods, because that would mean giving up their power base. Clinging to cattle-based subsistence served the medium-term interests of the chieftains at the expense of the short-term interests of the commoners and the long-term interests of Norse society as a whole.¶ Because environmental conditions are prone to change, it is often useful to talk about societies as having some level of adaptive capacity (Adger et al. 2006). Adaptive capacity is the ability of a society to adapt if conditions change. It is possible for some society to be very well adapted to the current environmental conditions, but to have very low adaptive capacity, so that a change in the environment will lead to severe maladaptation.

### AT: Super Volcanoes

#### Eruption would not cause extinction—minimal impacts.

Wolchover 12 (Natalie Wolchover, Life's Little Mysteries Staff Writer, 6/4/2012, Yellowstone Supervolcano: Will It Erupt During Our Lives, Huffington Post, <http://www.huffingtonpost.com/2012/06/04/yellowstone-supervolcano-eruption-unlikely_n_1569214.html>)

Perhaps foreign governments would come to our aid and embark on a major ash cleanup operation, but without such an effort, inhospitable conditions would persist in the midwestern U.S. for about a decade. "The records show that [new] vegetation starts to take hold about 10 years after supereruptions. It depends on how much rainfall the area receives, as rainfall is the main way you clear ash off the land," Self said.¶ As for the rest of the world, it would face a few years of mild climate change caused by the supereruption's ash cloud, which would wrap around the globe, casting Earth in shadow for several days and altering the chemical composition of the atmosphere for a decade or so. However, recent research shows the global impacts of supervolcanoes are less severe than scientists once thought, and a Yellowstone supereruption might be especially unimposing because its magma contains minimal sulfur. Sulfur gas produces particles called aerosols, which can cool the climate by blocking sunlight.¶ "The huge volume of magma means there would still be some sulfur injected into the atmosphere, but work has shown that you reach a sort of limit in the amount of aerosols you can produce with sulfur gas. It means that our earlier suggestions that there would be a severe temperature change is not right," Self said. [What If Earth's Magnetic Poles Flip?]¶ Based on the new models, the scientists now think the vast majority of Earth's species would weather a Yellowstone supereruption just fine (except, of course, for those knocked out due to proximity of the initial blast). They don't see any evidence in the geologic record of mass extinctions coinciding with supereruptions, and they don't predict extinctions to result from such geologic events in the future.¶ "The last time Yellowstone erupted, no extinctions took place," said Michael Rampino, a biologist and geologist at New York University. "Supereruptions are not extinction-level events," he said, but added that they can obviously cause problems for civilization.

#### Probability outweighs—eruption not likely.

McGuire 9 (Bil McGuire of University College London, also considered one of the U.K.'s top volcanologists, 1/5/2009, Yellowstone Supervolcano Earthquakes: Scientists React, US News, http://money.usnews.com/money/blogs/capital-commerce/2009/01/05/yellowstone-supervolcano-earthquakes-scientists-react)

I have indeed been paying attention to the Yellowstone situation and there have now been more than 500 small quakes since December 26th. This is certainly somewhat unusual activity, compared to recent decades, but not particularly unusual for so-called 'restless' volcanic calderas such as Yellowstone. The Campi Flegrei caldera in the Bay of Naples, for example, experienced many thousands of earthquakes in the 70s and 80s, along with surface swelling of 1 - 2 metres, all without eruption.¶ At Yellowstone, the quakes may have a number of causes, including movements along an active fault or the fracturing of rock in response to the migration of hot water or magma. Even if the latter, however, the chances are that the magma will stay beneath the surface, cool and solidify. The last eruptive activity here was a good 70,000 years ago, so the annual probability of an eruption is very small, although a steam blast left a 5 km wide crater just 13,000 years ago. So-called super-eruptions have return periods of 600 - 800,000 years or so (the last was 640,000 years ago), so the probability of another super-eruption in any single year is extremely small.

### Indict – General Ice Age Theorists

#### Scientists reject notion of coming Ice Age—time frame for Ice Age too far off

Lazar and Vogel 10 – Brian Lazar is a senior scientist at Stratus Consulting Inc. specializing in the characterization and mechanics of integrated hydrologic systems, using analytical techniques from engineering, physics, and hydrology, and Jason Vogel is a senior associate specializing in policy analysis at Stratus Consulting Inc. Dr. Vogel has investigated climate change, chemical regulation, high-level radioactive waste disposition, and natural resource management, 2010 (“Global Cooling: Science and Myth,” Weatherwise Magazine, July-August 2010, <http://www.weatherwise.org/Archives/Back%20Issues/2010/July-August%202010/global-cooling-full.html>)

Between the 1940s and the 1970s, global average temperatures cooled, constituting a period of global cooling and sparking concerns in the 1970s among some scientists, members of the press, and decision-makers that the earth could be headed into a new ice age. Many of these early climate researchers were geologists who had spent their careers puzzling over the mysteries of ice ages: Why did they happen, what triggered them, and how long did they last?¶ While some people jumped to the conclusion that the earth was headed into another ice age, most were extremely careful to nuance their claims and observations, acknowledging that climate is hard to understand and predict. The theory of global cooling received brief prominence in the early 1970s due to media reports, two record cold winters, consequent political attention, and observed cooling over the previous few decades. Most scientists, however, rejected the idea that global cooling would continue and perhaps lead to another ice age in the immediate future, as scientific understanding of atmospheric chemistry and physics improved and because temperatures started warming as many scientists had projected.¶ The difference between global cooling and greenhouse gas warming can be thought of in many ways, each containing important insights into the climate system. Global cooling and the descent into a new ice age are highly likely on the scale of hundreds to thousands of years. Climate warming due to human activities is highly likely in the immediate future—indeed numerous scientific assessments have concluded that it is already happening. Global cooling, as popularly discussed, is largely the result of natural cycles, such as the intensity of solar radiation and decadal climate oscillations. Climate warming, as popularly discussed, is largely the result of the accumulation of greenhouse gases in the atmosphere due to human industrial activity and land use. Most importantly, the causes behind global cooling and climate warming are not mutually exclusive.

#### Be wary of their authors’ claims—warming skeptics provide irrelevant and false information

Lazar and Vogel 10 – Brian Lazar is a senior scientist at Stratus Consulting Inc. specializing in the characterization and mechanics of integrated hydrologic systems, using analytical techniques from engineering, physics, and hydrology, and Jason Vogel is a senior associate specializing in policy analysis at Stratus Consulting Inc. Dr. Vogel has investigated climate change, chemical regulation, high-level radioactive waste disposition, and natural resource management, 2010 (“Global Cooling: Science and Myth,” Weatherwise Magazine, July-August 2010, <http://www.weatherwise.org/Archives/Back%20Issues/2010/July-August%202010/global-cooling-full.html>)

The story of global cooling provides insight into the world of scientific research on a high-profile topic of global importance. While pundits, advocates, and the media often present a dichotomy between either global cooling on the one hand or global warming on the other, the physical reality is much more complex. Nevertheless, climate change skeptics continue to point to the 1970s global cooling theory, the spike of global average temperature in 1998, and even to individual cold weather events, as alleged proof that climate change is a hoax. The main claims of climate change skeptics regarding global cooling, however, are irrelevant, oversimplified, or patently false.

#### No global cooling—ice age claims are dishonest

Fischer 10 – Douglas Fischer is the editor of Daily Climate, a source of record on climate change news, published by Environmental Health Sciences, 2010 (“Temperatures have risen steadily since the 1970s, Jim Hansen and fellow scientists conclude,” TDC, March 22nd 2010, <http://wwwp.dailyclimate.org/tdc-newsroom/2010/03/global-cooling-is-bunk-draft-nasa-study-finds>)

Global warming has neither stopped nor slowed in the past decade, according to a draft analysis of temperature data by NASA's Goddard Institute for Space Studies.¶ The analysis, led by Goddard director Jim Hansen, attempts to debunk popular belief that the planet is cooling. It finds that global temperatures over the past decade have "continued to rise rapidly," despite large year-to-year fluctuations associated with the tropical El Niño-La Niña cycles.¶ The analysis also predicts, assuming current El Niño conditions hold, that 2010 will go down in history as the hottest year on record despite an unusually snowy winter in the Northern Hemisphere.¶ "Communicating the reality of climate change to the public is hampered by the large natural variability of weather and climate," the Goddard scientists wrote in the draft, which was circulated by Hansen Friday evening and posted on the ClimateProgress.org blog shortly after.¶ "We conclude there has been no reduction in the global warming trend of 0.15 (to) 0.20ºC (per) decade that began in the late 1970s."¶ The new analysis combines sea-surface temperature records with meteorological station measurements and tests alternative choices for ocean records, urban warming and tropical and Arctic oscillations. It concludes the urban "heat island" impacts are small compared to the warming attributed to greenhouse gas emissions.¶ And it finds that, while this winter's unusually strong Arctic Oscillation - which funnels cold northern air to the East Coast and pulls warm mid-latitude air up to the Arctic - is predicted as atmospheric carbon dioxide levels rise, seasonal temperature anomalies associated with it aren't enough to blunt long-term warming trends.¶ "In the United States only one of the past 10 winters and two of the past 10 summers were cooler than the 1951-1980 climatology, a frequency consistent with the expected 'loading of the climate dice,' " the scientists wrote.¶ Hansen and other co-authors could not be reached for comment Saturday. The 34-page analysis has not been subjected to a peer review, though Hansen, in an email sent discussing the paper, said he intended to revise it for submission to a journal "within a month or so."¶ Michael Mann, director of the Earth System Science Center at Pennsylvania State University, called the analysis solid.¶ "Essentially he's just pointing out that we've come out of this short-term, relatively cool period," Mann said. "The globe clearly continues to warm."¶ Joe Romm, editor of ClimateProgress.org and a senior fellow at the liberal Center for American Progress, said in a phone interview that the study is "important for those who care about the science."¶ Whether it would quell the debate over global cooling - fueled in part by the East Coast's hard winter and the revelation of errors in the United Nation's Intergovernmental Panel on Climate Change synthesis report - is less certain.¶ Mann said many claims of global cooling are spurious and "intellectually dishonest."

#### Global cooling scare of the 70s proves that ice age theories are based on media manipulation, not science

Peterson et al 8 — Thomas C. Peterson is a research meteorologist at NOAA's National Climatic Data Center, the lead author on the IPCC Fourth Assessment Report, and a member of the GCOS Atmospheric Observation Panel for Climate, and William M. Connolley is the Senior Scientific Officer in the Physical Sciences Division in the Antarctic Climate and the Earth System project at the British Antarctic Survey, and John Fleck is a journalist for the Albuquerque Journal writing for the American Meteorological Society, 2008 (“The Myth of the 1970s Global Cooling Scientific Consensus,” American Meteorological Society, September 2008, <http://journals.ametsoc.org/doi/pdf/10.1175/2008BAMS2370.1>)

When the myth of the ¶ 1970s global cooling scare arises in contemporary ¶ discussion over climate change, it is most often in the ¶ form of citations not to the scientific literature, but ¶ to news media coverage. That is where U.S. Senator ¶ James Inhofe turned for much of the evidence to ¶ support his argument in a U.S. Senate floor speech in ¶ 2003 (Inhofe 2003). Chief among his evidence was a ¶ frequently cited Newsweek story: “The cooling world” ¶ (Gwynne 1975). The story drew from the latest global ¶ temperature records, and suggested that cooling “may ¶ portend a drastic decline for food production.” Citing ¶ the Kuklas’work on increasing Northern Hemisphere ¶ snow and ice, and Reid Bryson’s concerns about a ¶ long-term cooling trend, the Newsweek story juxtaposes the possibility of cooling temperatures and ¶ decreasing food production with rising global populations. Other articles of the time featured similar ¶ themes (see “Popular literature of the era” sidebar).¶ Even cursory review of the news media coverage of ¶ the issue reveals that, just as there was no consensus ¶ at the time among scientists, so was there also no ¶ consensus among journalists. For example, these are ¶ titles from two New York Times articles: “Scientists ¶ ask why world climate is changing; major cooling may ¶ be ahead” (Sullivan 1975a) and “Warming trend seen ¶ in climate; two articles counter view that cold period ¶ is due” (Sullivan 1975b). Equally juxtaposed were The ¶ Cooling (Ponte 1976), which was published the year ¶ after Hothouse Earth (Wilcox 1975).¶ However, the news coverage of the time does ¶ reflect what New York Times science writer Andrew ¶ Revkin calls “the tyranny of the news peg,” based on ¶ the idea that reporters need a “peg” on which to hang ¶ a story. Developments that are dramatic or new tend ¶ to draw the news media’s attention, Revkin argues, ¶ rather than the complexity of a nuanced discussion ¶ within the scientific community (Revkin 2005). A ¶ handy peg for climate stories during the 1970s was ¶ the cold weather.

#### Experts reject global cooling—warming skeptics base their claims on faulty observations

Borenstein 9 – Seth Borenstein writes for the Associated Press, 2009 (“Statistics experts reject global cooling claims,” USA Today, October 26th 2009, <http://www.usatoday.com/tech/science/environment/2009-10-26-global-cooling-rejected_N.htm>)

WASHINGTON — The Earth is still warming, not cooling as some global warming skeptics are claiming, according to an analysis of global temperatures by independent statistics experts.¶ The review of years of temperature data was conducted at the request of the Associated Press. Talk of a cooling trend has been spreading on the Internet, fueled by some news reports, a new book and temperatures that have been cooler in a few recent years.¶ The statisticians, reviewing two sets of temperature data, found no trend of falling temperatures over time. And U.S. government figures show that the decade that ends in December will be the warmest in 130 years of record-keeping.¶ Global warming skeptics are basing their claims on an unusually hot year in 1998. They say that since then, temperatures have fallen — thus, a cooling trend. But it's not that simple.¶ Since 1998, temperatures have dipped, soared, dropped again and are now rising once more. Records kept by the British meteorological office and satellite data used by climate skeptics still show 1998 as the hottest year. However, data from the U.S. National Oceanic and Atmospheric Administration and NASA show 2005 has topped 1998.¶ "The last 10 years are the warmest 10-year period of the modern record," said NOAA climate monitoring chief Deke Arndt. "Even if you analyze the trend during that 10 years, the trend is actually positive, which means warming."¶ Statisticians said the ups and downs during the last decade repeat random variability in data as far back as 1880.

#### Media claims of global cooling based on scientific misrepresentation—WMO proves

Parker 9 –Dianna Parker writers for Media Matters, a Web-based, non-profit progressive research and information center dedicated to comprehensively monitoring, analyzing, and correcting conservative misinformation in the U.S. media, 2009 (“Media promote claims of global cooling despite overwhelming consensus to the contrary,” Media Matters For America, March 30th 2009, <http://mediamatters.org/research/2009/03/30/media-promote-claims-of-global-cooling-despite/148737>)

Despite the scientific consensus that human-caused global warming is real and is negatively affecting our planet, those who disagree continue to receive a significant amount of attention from the media. A recent example was the March 29 New York Times Magazine cover story about physicist Freeman Dyson, who argues that global warming is not a significant problem. More broadly, throughout the past year, the media have repeatedly provided a platform for critics who argue that the globe is in a period of "cooling," while often failing to challenge their suggestion that this shows that global warming is a myth. These critics often misleadingly cite the fact that the average global temperature in 2007 and 2008 was cooler than it was in 1998, echoing an April 4, 2008, BBC article, which reported that "temperatures have not risen globally since 1998 when El Nino warmed the world." Other times, the claim is made by media figures themselves; for instance, syndicated columnist George Will wrote in his widely criticized February 15 Washington Post column that "according to the U.N. World Meteorological Organization [WMO], there has been no recorded global warming for more than a decade" -- despite repeated statements by the WMO and its representatives the Earth remains in a warming trend.¶ In fact, climate experts reject the idea that the relatively cooler global average temperatures in several of the last 10 years are any indication that global warming is slowing or does not exist. Scientists have identified a long-term warming trend spanning several decades that is independent from the normal climate variability -- which includes relatively short-term changes in climate due to events like El Niño and La Niña -- to which they attribute the recent cooler temperatures.¶ In a February 11 Guardian op-ed, Vicky Pope, the head of climate change advice at the U.K. Met Office Hadley Centre, explained that claims about the pace of global warming require more than 10 years of data, "since natural variations always occur on this timescale." She continued, "1998 was a record-breaking warm year as long-term man-made warming combined with a naturally occurring strong El Niño. In contrast, 2008 was slightly cooler than previous years partly because of a La Niña. Despite this, it was still the 10th warmest on record."¶ According to the Met Office website, the WMO "requires the calculation of averages for consecutive periods of 30 years," which was chosen "as a period long enough to eliminate year-to-year variations."¶ In a letter to the editor of The Washington Post published on March 21, WMO secretary-general Michel Jarraud responded to Will's column, writing that "[i]t is a misinterpretation of the data and of scientific knowledge to point to one year as the warmest on record ... and then to extrapolate that cooler subsequent years invalidate the reality of global warming and its effects." Jarraud wrote.

# CO2 Ag

## Neg

### 1NC CO2 Ag DA

#### CO2 emissions are key to preventing billions of deaths from global food shortages Idso 11 (Sherwood Idso, former research physicist for the Department of Agriculture, 7/6/11, “Meeting the Food Needs of a Growing World Population,” <http://www.co2science.org/articles/V14/N27/EDIT.php>).

Parry and Hawkesford (2010) introduce their study of the global problem by noting that "food production needs to increase 50% by 2030 and double by 2050 to meet projected demands," and they note that at the same time the demand for food is increasing, production is progressively being limited by "non-food uses of crops and cropland," such as the production of biofuels, stating that in their homeland of the UK, "by 2015 more than a quarter of wheat grain may be destined for bioenergy production," which surely must strike one as both sad and strange, when they also note that "currently, at least one billion people are chronically malnourished and the situation is deteriorating," with more people "hungrier now than at the start of the millennium." So what to do about it: that is the question the two researchers broach in their review of the sad situation. They begin by describing the all-important process of photosynthesis, by which the earth's plants "convert light energy into chemical energy, which is used in the assimilation of atmospheric CO2 and the formation of sugars that fuel growth and yield," which phenomena make this natural and life-sustaining process, in their words, "a major target for improving crop productivity both via conventional breeding and biotechnology." Next to a plant's need for carbon dioxide comes its need for water, the availability of which, in the words of Parry and Hawkesford, "is the major constraint on world crop productivity." And they state that "since more than 80% of the [world's] available water is used for agricultural production, there is little opportunity to use additional water for crop production, especially because as populations increase, the demand to use water for other activities also increases." Hence, they rightly conclude that "a real and immediate challenge for agriculture is to increase crop production with less available water." Enlarging upon this challenge, they give an example of a success story: the Australian wheat variety 'Drysdale', which gained its fame "because it uses water more efficiently." This valued characteristic is achieved "by slightly restricting stomatal aperture and thereby the loss of water from the leaves." They note, however, that this ability "reduces photosynthetic performance slightly under ideal conditions," but they say it enables plants to "have access to water later in the growing season thereby increasing total photosynthesis over the life of the crop." Of course, Drysdale is but one variety of one crop; and the ideal goal would be to get nearly all varieties of all crops to use water more efficiently. And that goal can actually be reached by doing nothing, by merely halting the efforts of radical environmentalists to deny earth's carbon-based life forms -- that's all of us and the rest of the earth's plants and animals -- the extra carbon we and they need to live our lives to the fullest. This is because allowing the air's CO2content to rise in response to the burning of fossil fuels naturally causes the vast majority of earth's plants to progressively reduce the apertures of their stomata and thereby lower the rate at which water escapes through them to the air. And the result is even better than that produced by the breeding of Drysdale, because the extra CO2 in the airmore than overcomes the photosynthetic reduction that results from the partial closure of plant stomatal apertures, allowing even more yield to be produced per unit of water transpired in the process. Yet man can make the situation better still, by breeding and selecting crop varieties that perform better under higher atmospheric CO2 concentrations than the varieties we currently rely upon, or he can employ various technological means of altering them to do so. Truly, we can succeed, even where "the United Nations Millennium Development Goal of substantially reducing the world's hungry by 2015 will not be met," as Parry and Hawkesford accurately inform us. And this truly seems to us the moral thing to do, when "at least one billion people are chronically malnourished and the situation is deteriorating," with more people "hungrier now than at the start of the millennium.”

### CO2 Good – Food Production

#### CO2 helps global food production – increases rainfall and lengthens the growing season

Zubrin 12

(Robert Zubrin, B.A. in mathematics and masters degree in aeronautics from the University of Rochester, 4/3/12, “Carbon Emissions are Good,” <http://www.nationalreview.com/articles/295098/carbon-emissions-are-good-robert-zubrin>)

This has left the EPA’s second premise — that global warming would be a harmful development — largely unchallenged. This is unfortunate, because while it is entirely possible that the earth may be warming — as it has done so many times in the past — there is no rational basis whatsoever to support the contention that carbon-dioxide-driven global warming would be on the whole harmful to life and civilization. Quite the contrary: All available evidence supports the contention that human CO2 emissions offer great benefits to the earth’s community of life.¶ Putting aside for the moment the question of whether human industrial CO2 emissions are having an effect on climate, it is quite clear that they are raising atmospheric CO2 levels. As a result, they are having a strong and markedly positive effect on plant growth worldwide. There is no doubt about this. NASA satellite observations taken from orbit since 1958 show that, concurrent with the 19 percent increase in atmospheric CO2 over the past half century, the rate of plant growth in the continental United States has increased by 14 percent. Studies done at Oak Ridge National Lab on forest trees have shown that increasing the carbon dioxide level 50 percent, to the 550 parts per million level projected to prevail at the end of the 21 century, will likely increase photosynthetic productivity by a further 24 percent. This is readily reproducible laboratory science. If CO2 levels are increased, the rate of plant growth will accelerate.¶ ¶ Now let us consider the question of warming: If it is occurring — and I believe it is, based not on disputable temperature measurements but on sea levels, which have risen two inches in two decades — is it a good thing or a bad thing? Answer: It is a very good thing. Global warming would increase the rate of evaporation from the oceans. This would increase rainfall worldwide. In addition, global warming would lengthen the growing season, thereby increasing still further the bounty of both agriculture and nature.

#### CO2 is key to expanded agricultural yields

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

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

#### CO2 increases all plant growth by at least 10%

Hatfield, 11 (J.L. Hatfield, laboratory director and supervisory plant physiologist for the Department of Agriculture, 3/2011, “Climate Impacts on Agriculture: Implications for Crop Production”, <http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=243239>).

The effects of increasing CO2 concentrations on various crops are summarized in Table 1 Increases in plant growth vary among species. As expected the crops with the so-called C4 photosynthetic pathway, maize, and sorghum [Sorghum bicolor (L.) Moench], have smaller responses than the C3 crops. Cotton (Gossypium hirsutum L.) may be higher because it is a woody species. However, all show a positive response to CO2 increases. In general, doubling CO2 caused approximately a 30% increase in reproductive yield of C3 species and <10% increase for C4 species. Many C3 weed species also show substantial growth benefits and resistance to herbicides at elevated CO2 (Ziska, 2003b; Ziska et al., 1999), a topic which is further expanded in a later section on Projection for Weeds.

#### CO2 allows crops to retain water – increases efficiency to 110% by 2040

Hatfield, 11 (J.L. Hatfield, laboratory director and supervisory plant physiologist for the Department of Agriculture, 3/2011, “Climate Impacts on Agriculture: Implications for Crop Production”, <http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=243239>).

In the early stages of crop development, increases in leaf area are proportional to growth rate and transpiration increases as leaf area increases (Ritchie, 1972). As plants develop, there is an increase in mutual shading and interference among leaves within a plant canopy which causes plant transpiration to increase at a diminishing rate with increasing leaf area index (LAI) and asymptotically leveling at LAIs > 4 m2 m−2, progressively uncoupling transpiration from changes in LAI (Ritchie, 1972; Villalobos and Fereres, 1990; Sau et al., 2004). Doubling of atmospheric CO2 from present-day levels will increase average C3 species growth on the order of 30% under optimum conditions (e.g., Kimball, 1983, 2007, 2010; Kimball et al., 2002) with the expectation that an increase to 440 μmol mol−1 would increase C3 plant growth on the order of 10%. Since T is most tightly coupled to changes in growth when plants are small and less after canopy closure, the overall impact of changes in CO2 via LAI effect are expected to be small. Of greater importance is the duration of leaf area which will directly affect total seasonal crop water requirements. In determinate cereal crops that are adapted to today's temperature and growing-season length, increasing temperature will hasten plant maturity reducing leaf area duration with an overall reduction in total season water requirement. However, if alternative crops or perennial crops or varieties adapted to the higher temperatures and longer growing season are used, crop water requirements would likely increase. However, a direct effect of increasing atmospheric CO2 is to cause partial stomatal closure. The result decreases conductance for water vapor loss from leaves to the atmosphere. A summary of the information available from chamber-based studies on the effects of elevated CO2 on stomatal conductance have shown, on average, that doubling CO2 reduces stomatal conductance by nearly 34% (e.g., Kimball and Idso, 1983). Morison (1987) found an average reduction of about 40% for both C3 and C4 species. Wand et al. (1999), after a meta-analysis on wild C3 and C4 grass species, grown with no stresses, concluded that elevated CO2 reduced stomatal conductance by 39% in C3 and 29% in C4 species. In soybean, the reduction in conductance was about 40% for a doubling of CO2 (Ainsworth et al., 2002; Ainsworth and Rogers, 2007). Ainsworth and Long (2005) did not observe significant differences in stomatal conductance of two C3 and C4 species when they summarized results from free-air CO2 enrichment experiments where daytime CO2 concentrations were increased from present to 550 to 600 μmol mol−1 They found an average reduction in stomatal conductance of 20%. Thus, increases in atmospheric CO2 concentration to nearly 450 μmol mol−1 as estimated (IPCC, 2007) by 2040 likely will cause reductions of approximately 10% in stomatal conductance. Such a reduction in leaf-level stomatal conductance, when considered with energy balance in the whole canopy, should lead to decreases in transpiration and potential positive impacts on crop WUE.

#### Scientific consensus proves

Idso 11 (Craig Idso, former founder, president, and current chairman of Center for the Study of Carbon Dioxide and Global Change, 6/15/11, “Estimates of Global Food Production in the Year 2050: Will We Produce Enough to Adequately Feed the World?” <http://www.co2science.org/education/reports/foodsecurity/GlobalFoodProductionEstimates2050.pd,f>, page 8).

In a test of this hypothesis, Cunniff et al. ¶ designed “a controlled environment experiment using five modern-day representatives of wild ¶ C4 crop progenitors, all ‘founder crops’ from a variety of independent centers,” which were ¶ grown individually in growth chambers maintained at atmospheric CO2 concentrations of 180, ¶ 280 and 380 ppm, characteristic of glacial, post-glacial and modern times, respectively. The ¶ results revealed that the 100-ppm increase in CO2 from glacial to postglacial levels (180 to 280 ¶ ppm) “caused a significant gain in vegetative biomass of up to 40%,” together with “a reduction ¶ in the transpiration rate via decreases in stomatal conductance of ~35%,” which led to “a 70% ¶ increase in water use efficiency, and a much greater productivity potential in water-limited ¶ conditions.” ¶ In discussing their results, the five ¶ researchers concluded that “these key ¶ physiological changes could have ¶ greatly enhanced the productivity of ¶ wild crop progenitors after ¶ deglaciation ... improving the ¶ productivity and survival of these wild ¶ C4 crop progenitors in early ¶ agricultural systems.” And in this ¶ regard, they note that “the lowered ¶ water requirements of C4 crop ¶ progenitors under increased CO2¶ would have been particularly ¶ beneficial in the arid climatic regions ¶ where these plants were ¶ domesticated.” For comparative purposes, they also included one C3 species in their study –¶ Hordeum spontaneum K. Koch – and they report that it “showed a near-doubling in biomass ¶ This body of research demonstrated ¶ that increased levels of atmospheric ¶ CO2 generally produce increases in ¶ plant photosynthesis, decreases in ¶ plant water loss by transpiration, ¶ increases in leaf area, and increases ¶ in plant branch and fruit numbers compared with [the] 40% increase in the C4 species under growth treatments equivalent to the ¶ postglacial CO2 rise.”¶ In light of these and other similar findings¶ (Mayeux et al., 1997), it can be appreciated ¶ that the civilizations of the past, which ¶ could not have existed without agriculture, ¶ were largely made possible by the increase ¶ in the air’s CO2 content that accompanied ¶ deglaciation, and that the peoples of the ¶ Earth today are likewise indebted to this ¶ phenomenon, as well as the additional 100 ¶ ppm of CO2 the atmosphere has ¶ subsequently acquired. But what about the ¶ future, will such benefits continue to¶ accrue?

#### Warming good-plant growth

Moore ’08 Senior Fellow at the Hoover Institution at Stanford University, Stanford, (Thomas Gale 7/9/12 “Global warming; the good, the bad and the ugly and the efficient” EMBO reports http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3317379/?tool=pmcentrez)

A warmer climate, especially during the winter months, would mean a longer growing season in all parts of the world that now experience frost and snow during the winter. Any part of the world above 40º North will probably enjoy less ice and freezing weather, and a greater number of warmer days in the future. The longer periods of temperate weather coupled with an increased level of CO2 in the atmosphere will cause more plant growth—in other words, create a greener planet. There is already evidence of increased plant growth: measurements by the Scripps Institution of Oceanography (La Jolla, CA, USA), at Mauna Loa in Hawaii, have documented both a rise in atmospheric CO2—from 316 parts per million in 1959 to 377 ppm in 2004—and a more pronounced seasonal pattern (http://cdiac.ornl.gov). In general, levels of CO2 in the atmosphere decrease in the spring because growing plants absorb the gas, finally reaching a low by early autumn. As plant growth ceases in autumn, CO2 levels rebound to a mid-winter high. Importantly, the amplitude of this pattern has more than doubled since 1958, which suggests that plant growth worldwide has been increasing.

#### Warming good-greenland proves

Moore ’08 Senior Fellow at the Hoover Institution at Stanford University, Stanford, (Thomas Gale 7/9/12 “Global warming; the good, the bad and the ugly and the efficient” EMBO reports http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3317379/?tool=pmcentrez)

A recent report in The New York Times (New York, NY, USA) about the effect that warmer weather is having in Greenland indicated significant gains for the island: “Winter is coming later and leaving earlier. That means there is more time to leave sheep in the mountains, more time to grow crops, more time to work outdoors, more opportunity to travel by boat, since the fjords freeze later and less frequently. […] Cod, which prefer warmer waters, have started appearing off the coast again. Ewes are having fatter lambs, and more of them every season. The growing season, such as it is, now lasts roughly from mid-May through mid-September, about three weeks longer than a decade ago” (Lyall, 2007). The article also reported that a Greenland supermarket was stocking locally grown cauliflower, broccoli and cabbage for the first time. The current climatic conditions in Greenland are similar to those during the Medieval Warm Period when Norwegian settlers brought farming to that country.

#### Warming is essential to agriculture – 600 years of African trends prove

Taylor, 11 James Taylor, managing editor of Environment & Climate News, a national monthly publication devoted to sound science and free-market environmentalism with a circulation of approximately 75,000 readers. He is also senior fellow for The Heartland Institute focusing on environmental issues. “ Climate Change Weekly: Global Warming Benefiting Africa’s Sahel Region” <http://news.heartland.org/newspaper-article/2011/12/15/climate-change-weekly-global-warming-benefiting-africas-sahel-region>

Global warming activists are sounding four-alarm fire bells over a new study claiming global warming is causing drought and killing trees in the Sahel region of sub-Saharan Africa. Much like previous claims that have fallen by the wayside, the notion that global warming is devastating the Sahel is unlikely to stand the dual tests of time and scientific scrutiny. According to the new study, a rise in temperatures and a decline in precipitation during the 20th century reduced tree densities in the Sahel by approximately 18 percent from 1954 through 2002. Lead author Patrick Gonzalez says in a press release accompanying the study, “Rainfall in the Sahel has dropped 20-30 percent in the 20th century…” At first glance, the study and accompanying press release might present a persuasive argument for Western democracies to reduce carbon dioxide emissions. Then again, the argument that Western democracies should reduce carbon dioxide emissions may have been driving the study, rather than the other way around. Lead author Gonzalez is also a lead author for the United Nations Intergovernmental Panel on Climate Change (IPCC), whose funding and very existence are dependent on the assertion that humans are causing a global warming crisis. Moreover, IPCC is on record claiming global warming is causing an increase in drought, so having a new study claiming global warming is causing drought and related problems in Africa’s Sahel region bolsters the shared interests of Gonzalez and IPCC. Gonzalez also spent half of the past decade as a staffer for the Nature Conservancy environmental activist group. The Nature Conservancy is one of the most vocal proponents of global warming alarmism and has also long asserted Western democracies must dramatically reduce carbon dioxide emissions. Further, NASA and the U.S. Geological Survey funded the study. If such funded studies find little about which to be concerned, NASA and U.S. Geological Survey funds dry up, as do funds for Gonzalez and his National Park Service employers. This is not to say that readers should dismiss out of hand a study published by a Nature Conservancy staffer and United Nations representative with clear incentives to conclude global warming is causing drought and tree deaths. Such a background and incentives should, however, cause readers to look a little more deeply at the facts before accepting the study’s conclusions at face value. Turning to the science, assertions that global warming is causing drought and tree deaths in the Sahel is surprising news to many scientists and Sahel observers. The Sahel is a relatively narrow band of land stretching east-west across the African continent at the southern edge of the Sahara Desert. Contrary to what Gonzalez reports in his new study, many studies have documented improving conditions in the Sahel as the earth has warmed. “The southern Saharan desert is in retreat, making farming viable again in what were some of the most arid parts of Africa,” New Scientist reported in 2002 (http://www.newscientist.com/article/dn2811-africas-deserts-are-in-spectacular-retreat.html). “Burkina Faso, one of the West African countries devastated by drought and advancing deserts 20 years ago, is growing so much greener that families who fled to wetter coastal regions are starting to go home.” An “analysis of satellite images completed this summer reveals that dunes are retreating right across the Sahel region on the southern edge of the Sahara desert,” New Scientist explained. “Vegetation is ousting sand across a swathe of land stretching from Mauritania on the shores of the Atlantic to Eritrea 6000 kilometres away on the Red Sea coast. Nor is it just a short-term trend. Analysts say the gradual greening has been happening since the mid-1980s.” “There are more trees for firewood and more grassland for livestock. And a survey among farmers shows a 70 per cent increase in yields of local cereals such as sorghum and millet in one province in recent years,” New Scientist added. These trends have continued throughout the past decade. In 2009 scientists at Boston University used satellite data to study African vegetation patterns since the mid-1990s. As reported by BBC News, “satellite images from the last 15 years do seem to show a recovery of vegetation in the Southern Sahara.” “The broader picture is reinforced by studies carried out in the Namib Desert in Namibia,” BBC News added. “This is a region with an average rainfall of just 12 millimetres per year – what scientists call ‘hyper-arid’. Scientists have been measuring rainfall here for the last 60 years. Last year the local research centre, called Gobabeb, measured 80mm of rain.” Scientists at Brown University and the University of Minnesota-Duluth confirmed a longer term improvement in African soil moisture. After studying African drought patterns since the 1400s, the scientists reported in January 2007 in the peer-reviewed science journal Geology that Africa is “experiencing an unusually prolonged period of stable, wet conditions in comparison to previous centuries of the past millennium.” Moreover, “the patterns and variability of twentieth-century rainfall in central Africa have been unusually conducive to human welfare in the context of the past 1400 yr,” the scientists explained. The same patterns are occurring globally. Analyzing satellite imagery that has been available since 1982, scientists reported in a 2003 peer-reviewed study in Science, “We present a global investigation of vegetation responses to climatic changes by analyzing 18 years (1982 to 1999) of both climatic data and satellite observations of vegetation activity. Our results indicate that global changes in climate have eased several critical climatic constraints to plant growth, such that net primary production increased 6% (3.4 petagrams of carbon over 18 years) globally.” With so many studies and data indicating global warming is benefiting soil moisture, plant growth and forest expansion in the Sahel region, Africa as a whole and globally, the new assertion that global warming is causing a climate crisis in the Sahel is speculative and controversial at best. Perhaps Gonzalez inadvertently revealed the true purpose of his new study when he concluded his press release by saying, “We in the U.S. and other industrialized nations have it in our power, with current technologies and practices, to avert more drastic impacts around the world by reducing our greenhouse gas emissions.” This is certainly something we would expect a Nature Conservancy staffer and United Nations representative to say.

#### Elevated CO2 Levels is Key to better Forests

Idso et Al, 2011 (Craig D. Idso, founder and chairman of the board of the Center for the Study of Carbon Dioxide and Global Change, Robert M. Carter, emeritus fellow and science policy advisor at the free market think-tank the Institute of Public Affairs and an adjunct professorial research fellow in earth sciences at James Cook University, S. Fred Singer, American physicist and emeritus professor of environmental science at the University of Virginia, Contributors: Susan Crockford (Canada) Joseph D‘Aleo (USA) Indur Goklany (USA) Sherwood Idso (USA) Madhav Khandekar (Canada) Anthony Lupo (USA) Willie Soon (USA) Mitch Taylor (Canada) Editors: Joseph L. Bast (USA), S.T. Karnick (USA), Diane Carol Bast (USA), “Climate Change Reconsidered” 2011 Interim Report Chapter 7, Online @ <http://nipccreport.org/reports/2011/2011report.html>)

Moving up from individual species and small groups of plants to the ecosystem scale, we consider the case of natural and plantation-type forests, beginning with studies of the latter type, where the air around groups of trees has been experimentally enriched with CO2, starting with the study of McCarthy et al. (2010). Conducted at the Duke Forest Free-Air CO2Enrichment (FACE) facility, this study is a long-term experiment designed to investigate the effects of an extra 200 ppm of atmospheric CO2 on the growth and development of a plantation of loblolly pine (Pinus taeda) trees with an understory of various broadleaf species, including Liriodendron tulipifera, Liquidambar styraciflua, Acer rubrum, Ulmus alata, and Cornus florida, plus various other trees, shrubs, and vines. All of these were grown on a soil that Finzi and Schlesinger (2003) describe as being in ―a state of acute nutrient deficiency that can only be reversed with fertilization. Many researchers had long thought such fertility deficiency would stifle the ability of the extra aerial supply of CO2 to significantly stimulate the forest‘s growth on a continuing basis. Working with data for the years 1996–2004, the team of nine researchers writes, ―net primary productivity [NPP] for pines, hardwoods and the entire stand was calculated as the sum of the production of coarse wood (stems, branches, coarse roots), leaf litter (lagged for pines), fine roots and reproductive structures. The results of this protocol indicated ―elevated CO2 increased pine biomass production, starting in 1997 and continuing every year thereafter, and ―the CO2-induced enhancement remained fairly consistent as the stand developed. In addition, they found ―elevated CO2 increased stand (pine plus all other species) biomass production every year from 1997 onwards with no trend over time, while the average yearly increase in NPP caused by the approximate 54 percent increase in the air‘s CO2 content was 28 percent. Thus, and in spite of the original belief of many scientists that low levels of soil nitrogen—especially an acute deficiency—would preclude any initial growth stimulation provided by atmospheric CO2 enrichment from long persisting, the suite of trees, bushes, and shrubs that constitute the Duke Forest has continued to maintain the extra CO2enabled vitality it exhibited right from the start of the study, with no sign of it even beginning to taper off. Further extending the results of the Duke Forest FACE study were Jackson et al. (2009), who describe new belowground data they obtained there, after which they present a synthesis of these and other results obtained from 1996 through 2008, seeking to determine ―which, if any, variables show evidence for a decrease in their response to atmospheric CO2 during that time frame. Among many other things, Jackson et al. report ―on average, in elevated CO2, fine-root biomass in the top 15 cm of soil increased by 24%, and in recent years the fine-root biomass increase ―grew stronger, averaging ~30% at high CO2. Regarding coarse roots having diameters greater than 2 mm and extending to a soil depth of 32 cm, they report, ―biomass sampled in 2008 was twice as great in elevated CO2. We calculate from the graphical representation of their results that the coarse-root biomass was fully 130 percent greater, which is astounding, particularly given that the extra 200 ppm of CO2 supplied to the air surrounding the CO2-enriched trees represented only about a 55 percent increase over ambient conditions. In the concluding sentence of their paper‘s abstract, Jackson et al. state, ―overall, the effect of elevated CO2 belowground shows no sign of diminishing. In expanding on this statement, the four researchers note ―if progressive nitrogen limitation were occurring in this system, we would expect differences in productivity to diminish for trees in the elevated vs. ambient CO2 plots, but they state, ―in fact there is little evidence from estimates of aboveground or total net primary productivity in the replicated Duke experiment that progressive nitrogen limitation is occurring there or at other forest FACE experiments, even ―after more than a decade of manipulation of the air‘s CO2 content, citing in this regard—with respect to the latter portion of their statement—the report of Finzi et al. (2007). Consequently, there is very good reason to believe the ―aerial fertilization effect of atmospheric CO2 enrichment will continue to benefit Earth‘s forests significantly as long as the atmosphere‘s CO2 concentration continues to rise.

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

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

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

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

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

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

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

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

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

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

### CO2 Good – Soil Erosion

#### Warming Prevents Topsoil Erosion

M. A. Nearing- Soil scientist for National Soil Erosion Research Laboratory, Argricultural Research Service, U.S. Department of Agriculture- 2004, “Expected Climate Change Impacts on Soil Erosion Rates: A Review, Journal of Soil and Water Conservation, http://www.tucson.ars.ag.gov/unit/publications/PDFfiles/1542.pdf

Soil erosion rates may be expected to change in response to changes in climate for a variety of reasons, the most direct of which in the change in the erosive power of rainfall. A second predominant pathway of influence by climate change on erosion rates is through plant biomass. The mechanisms by which climate change affects biomass, and by which biomass changes impact runoff and erosion and erosion, are complex. For example, anthropogenic increases in atmospheric carbon dioxide concentration causes increases in plant production rates and changes in plant transpiration rates, which translate to an increase in soil surface canopy cover and, more importantly, biological ground cover.

#### Soil Erosion Causes Extinction

Stephen Leahy- the science and environment correspondent for Inter Press Service News Agency-3/22/8,“Peak soil: the silent global crisis,” Earth Island Journal, <http://www.earthisland.org/journal/index.php/eij/article/peak_soil/>

A harsh winter wind blew last night, and this morning the thin snow cover has turned into a rich chocolate brown. The dirt covering the snow comes from cornfields near my home that were ploughed following the harvest, a common practice in southern Ontario and in the corn-growing regions of the US Midwest.¶ A handful of this dirty snow melts quickly, leaving a thin, fine-grained wet mess. It doesn’t look like much, but the mucky sludge in my hand is the prerequisite for life on the planet. ¶ “We are overlooking soil as the foundation of all life on Earth,” says Andres Arnalds, assistant director of the Icelandic Soil Conservation Service. Arnalds is an eloquent spokesperson for the unheralded emergency of soil erosion, a problem that is reducing global food production and water availability, and is responsible for an estimated 30 percent of the greenhouse gases emissions. “Land degradation and desertification may be regarded as the silent crisis of the world, a genuine threat to the future of humankind.” ¶ Arnalds is dead serious when he calls soil erosion a crisis. Each year, some 38,000 square miles of land become severely degraded or turn into desert. About five billion acres of arable land have been stripped of their precious layer of topsoil and been abandoned since the first wheat and barley fields were planted 10,000 years ago. In the past 40 years alone, 30 percent of the planet’s arable land has become unproductive due to erosion, mainly in Asia and Africa. At current erosion rates, soils are being depleted faster than they are replenished, and nearly all of the remaining 11 billion acres of cropland and grazing land suffer from some degree of erosion.¶ Most of this erosion is simply due to plowing, removal of crop residues after harvest, and overgrazing, which leaves soil naked and vulnerable to wind and rain. It is akin to tire wear on your car — a gradual, unobserved process that has potentially catastrophic consequences if ignored for too long.¶ Arnalds has seen our perilous future crisis by looking into the past. Eleven hundred years ago, the first Icelandic settlers came to a cold island mostly covered by forests and lush meadows, and blessed with deep volcanic soils. In a pattern repeated around the world, settlers cleared the forests and put too many animals on the meadows, until 96 percent of the forest was gone and half the grasslands destroyed. By the 1800s, Iceland had become Europe’s largest desert; the people starved, and the once prosperous country became one of the world’s poorest. “Once soil is gone, you can’t get it back,” Arnalds says. “It’s a non-renewable resource.”

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No one knows how much food-producing land will be left by 2050, when another three billion people are expected to join the current global population of 6.5 billion. What we do know is that right now, 99 percent of human food calories come from the land. Global food production has kept pace with population growth thus far thanks chiefly to the extensive use of chemical fertilizers. But food production per acre of land is starting to decline, primarily due to loss of productive land and water shortages. The latter is often the result of soil erosion because soil and vegetation act as a sponge that holds and gradually releases water. And that soil erosion, in turn, is exacerbated by chemical farming practices that over time break down soil structure.¶ Add to these challenges climate change’s impact on soil erosion and the competition between growing food and producing biofuels, and it’s frightening to consider the challenge of feeding nine billion people when nearly one billion go hungry right now. Arnalds summarizes the challenge: More food will have to be produced within the next 50 years than during the last 10,000 years combined. “Securing food in many places will become a crisis of rapidly growing proportions.”¶ Erosion largely goes unnoticed by farmers as it “nickels and dimes you to death,” says David Pimentel, an ecologist at Cornell University who has conducted extensive research on the subject. Even if there were no humans on the planet, soils would still erode. The soil formation from the weathering of rock and the breakdown of plants, however, would be faster than the erosion rate; it takes roughly 500 years to create one inch of soil. Once humans remove natural vegetation, soil is exposed to raindrops that easily dislodge it, washing soil particles into creeks, streams, rivers, and eventually into the ocean. One rainstorm will wash away .04 inches of soil. This may not seem like much, but over one acre of land that fraction of an inch adds up to tons of topsoil.¶ Wind also disrupts soil, and can transport dust huge distances. Dry and windy conditions blew nearly two inches of topsoil off Kansas farmlands during the winter of 1995–96. Contrary to common belief, the topsoil loss in Kansas didn’t end up being neatly deposited on farms in neighboring states. More than 60 percent ended up clogging ditches, streams, rivers, and lakes. That makes waterways more prone to flooding (further exacerbating erosion) and contaminates them with fertilizer and pesticide residues, Pimentel says.¶ Every rainy day or windy night steals a thin layer of soil from any exposed piece of ground until there is little left but sand and rock. “Iowa has some of the best and deepest soils in the world,” Pimentel says, “and they’ve lost nearly 50 percent in the last hundred years.” ¶ Erosion’s potential threat to humanity remains largely ignored by the world community. When soil experts from around the world met in Selfoss, Iceland in August 2007, they concluded that an international treaty is needed to spur countries into taking action to protect their soils. The soil scientists proposed that, at the very least, soil ought to have its own year — “The International Year of Land Care” — to focus the world’s attention on soil stewardship.

### CO2 Good – Photosynthesis

#### Increases in CO2 content increase plant photosynthesis, decrease water loss, and increase fruit number

Idso 11 (Craig Idso, former founder, president, and current chairman of Center for the Study of Carbon Dioxide and Global Change, 6/15/11, “Estimates of Global Food Production in the Year 2050: Will We Produce Enough to Adequately Feed the World?” <http://www.co2science.org/education/reports/foodsecurity/GlobalFoodProductionEstimates2050.pd,f>, page 7).

The idea that an increase in the air’s CO2¶ content may be of benefit to the biosphere ¶ can be traced back in time over 200 years. ¶ As early as 1804, for example, de Saussure ¶ showed that peas exposed to high CO2¶ concentrations grew better than control ¶ plants in ambient air; and work conducted ¶ in the early 1900s significantly increased ¶ the number of species in which this ¶ growth-enhancing effect of atmospheric ¶ CO2 enrichment was observed to occur (Demoussy, 1902-1904; Cummings and Jones, 1918). In ¶ fact, by the time a group of scientists convened at Duke University in 1977 for a workshop on ¶ Anticipated Plant Responses to Global Carbon Dioxide Enrichment, an annotated bibliography ¶ of 590 scientific studies dealing with CO2 effects on vegetation had been prepared (Strain, ¶ 1978). This body of research demonstrated that increased levels of atmospheric CO2 generally ¶ produce increases in plant photosynthesis, decreases in plant water loss by transpiration, ¶ increases in leaf area, and increases in plant branch and fruit numbers, to name but a few of ¶ the most commonly reported benefits. And five years later, at the International Conference on ¶ Rising Atmospheric Carbon Dioxide and Plant ¶ Productivity, it was concluded that a doubling of the air’s ¶ CO2 concentration would likely lead to a 50% increase in ¶ photosynthesis in C3 plants, a doubling of water use ¶ efficiency in both C3 and C4 plants, significant increases ¶ in biological nitrogen fixation in almost all biological ¶ systems, and an increase in the ability of plants to adapt ¶ to a variety of environmental stresses (Lemon, 1983).

### CO2 Good – Fruits/Flowers

#### CO2 increases are key to flowers and fruits Idso 12 (Sherwood Idso, former research physicist for the Department of Agriculture, 4/25/12, “Growth Response to CO2 (Flowers),” <http://www.co2science.org/subject/f/summaries/flowers.php>)

By 2002, so many authors had weighed in on the subject that Jablonski et al. (2002) conducted a meta-analysis of 159 peer-reviewed scientific journal articles published between 1983 and 2000, dealing with the effects of atmospheric CO2 enrichment on the reproductive growth characteristics of several domesticated and wild plants. In calculating the mean responses reported in those papers, Jablonski et al. found that for increases in the air's CO2 concentration ranging from approximately 150 to 450 ppm (rough average of 300 ppm), across all species studied, the extra CO2 supplied to the plants resulted in 19% more flowers, 18% more fruits, 16% more seeds, 4% greater individual seed mass, 25% greater total seed mass (equivalent to yield), and 31% greater total mass.

CO2 key to plants –fruits and flowers Idso 12(Sherwood Idso, former research physicist for the Department of Agriculture, 4/25/12, “Growth Response to CO2 (Flowers),” <http://www.co2science.org/subject/f/summaries/flowers.php>)

Nearly all of Earth's plant life responds favorably to increases in the air's CO2 content by exhibiting enhanced rates of photosynthesis and biomass production. But what about other plant characteristics? How do they respond to rising atmospheric CO2? The present review investigates what scientists have learned with respect to plant floral features. In one of the earliest papers to address this subject, Idso et al. (1990) grew water lilies in sunken metal stock tanks located out-of-doors and enclosed within clear-plastic-wall open-top chambers through which air of either 350 or 650 ppm CO2 was continuously circulated. Over the course of two growing seasons, he and his colleagues measured a number of plant responses to these two environmental treatments. Their results indicated that the water lilies in the CO2-enriched enclosures grew better than the water lilies in the ambient CO2 enclosures, as the leaves in the CO2-enriched tanks were larger and more substantial, and 75% more of them were produced over the course of the initial five-month growing season. Each of the plants in the CO2-enriched tanks also produced twice as many flowers as the plants growing in normal air; and the flowers that blossomed in the CO2-enriched air were more substantial than those that bloomed in the air of normal CO2 concentration: they had more petals, the petals were longer, they had a greater percent dry matter content, and each flower consequently weighed about 50% more. In addition, the stems that supported the flowers were slightly longer in the CO2-enriched tanks; and the percent dry matter contents of both the flower and leaf stems were greater, so that the total dry matter in the flower and leaf stems in the CO2-enriched tanks exceeded that of the flower and leaf stems in the ambient-air tanks by approximately 60%. Several years later, Deng and Woodward (1998) studied the direct and interactive effects of elevated CO2 and nitrogen supply by growing strawberries in controlled glasshouses exposed to atmospheric CO2concentrations of 390 and 560 ppm at three levels of nitrogen for nearly three months. The two authors found that strawberries growing at the elevated CO2 concentration contained additional sugar and physical mass to support significantly greater numbers of flowers and fruits than in strawberry plants growing at 390 ppm CO2. This effect consequently led to total fresh fruit weights that were 42 and 17% greater in CO2-enriched plants that received the highest and lowest nitrogen levels, respectively.

### CO2 Good – C3/C4 Plants

#### CO2 benefits both C3 and C4 plants –increases efficiency of growth and photosynthesis

Stack Exchange 12 (Stack Exchange, 1/31/12, “How will rising carbon dioxide levels in the troposphere affect photosynthetic producers,” <http://biology.stackexchange.com/questions/681/how-will-rising-carbon-dioxide-levels-in-the-troposphere-affect-photosynthetic-p>).

Photosynthesis evolved in a high-CO2 atmosphere, before the oxygen-enrichment of the atmosphere (which actually happened as a result of photosynthesis). Most plant species operate C3 photosynthesis. In these plants, carbon dioxide diffuses into the cell where it is fixed by Ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) into a 3-carbon molecule (hence C3), which is then polymerised to make sugars. A crucial fact about RuBisCO is that it has both carboxylase (carbon-fixing) activity and oxygenase (oxygen-fixing) activity. This means that oxygen and carbon dioxide compete for the active site on the enzyme complex, leading to RuBisCO being quite inefficient and slow at fixing carbon in higher oxygen concentrations. That didn't matter in the high-CO2 atmosphere of the early Earth, but in todays atmosphere O2 concentrations are high enough that they severely limit the productivity of C3 plants. However, plants haven't just been growing slowly all that time - several mechanisms for increasing photosynthetic efficiency have evolved. The most influential systems involve concentrating carbon dioxide in a particular area, excluding oxygen, and concentrating RuBisCO in that same area. This avoids the oxygen competition for the active site and allows RuBisCO to operate more efficiently. The key adaptation here is C4 photosynthesis - the system which is present in most grasses and many of the most productive plants on Earth (e.g. maize, sugarcane, Miscanthus). It has evolved at least 62 times independently. It works by having RuBisCO concentrated within 'bundle sheath' cells which are surrounded by a layer of suberin wax. This layer prevents CO2 escaping and O2 from getting in. CO2 from the atmosphere is then fixed in different cells - 'mesophyll cells' - by another enzyme - Phosphoenolpyruvate carboxylase (PEPC), resulting in a four-carbon molecule (hence C4). This 4-carbon acid, (malate or oxaloacetate depending on the system) is then shuttled into the bundle sheath cells. There, the CO2 is released again by a variety of enzymes depending on the system, creating a high CO2 concentration in the cell where RuBisCO can then work efficiently.¶ In general, C4 plants are much (about 50%) more efficient than their C3 counterparts, and they are particularly well adapted to high temperatures and moist environments. So, as atmospheric CO2 levels continue to rise, C3 plants will gradually be able to photosynthesize more efficiently. Interestingly though, C4 plants are predicted to also benefit from increased atmospheric CO2. If global temperatures rise as predicted, both C3 and C4 plants will be able to operate more efficiently than they currently do, up to a maximum temperature beyond which enzymes will begin to denature faster and efficiency will drop. One consideration is that the difference in efficiency between C3 and C4 systems will decrease, which may significantly alter the makeup of plant communities around the world.

#### CO2 increases C3 plant yields

Idso et Al, 2011 (Craig D. Idso, founder and chairman of the board of the Center for the Study of Carbon Dioxide and Global Change, Robert M. Carter, emeritus fellow and science policy advisor at the free market think-tank the Institute of Public Affairs and an adjunct professorial research fellow in earth sciences at James Cook University, S. Fred Singer, American physicist and emeritus professor of environmental science at the University of Virginia, Contributors: Susan Crockford (Canada) Joseph D‘Aleo (USA) Indur Goklany (USA) Sherwood Idso (USA) Madhav Khandekar (Canada) Anthony Lupo (USA) Willie Soon (USA) Mitch Taylor (Canada) Editors: Joseph L. Bast (USA), S.T. Karnick (USA), Diane Carol Bast (USA), “Climate Change Reconsidered” 2011 Interim Report Chapter 7, Online @ <http://nipccreport.org/reports/2011/2011report.html>)

We begin our review of atmospheric CO2 enrichment effects on Earth‘s vegetation with a consideration of C3 plants—those in which the enzyme RuBisCO is involved in the uptake of CO2 and the subsequent photosynthetic process, which results in its incorporation into a 3-carbon compound—starting with the study of Norikane et al. (2010). They focused on the genus Cymbidium, which comprises about 50 species distributed throughout tropical and subtropical Asia and Oceania. The four researchers worked with shoots of Music Hour ‗Maria,‘ a type of orchid, possessing two to three leaves, which they obtained from a mass of protocorm-like bodies they derived from shoot-tip culture. They grew them in vitro on a modified Vacin and Went medium in air augmented with either 0, 3,000, or 10,000 ppm CO2 under two photosynthetic photon flux densities (either 45 or 75 µmol m -1 s -1 ) provided by cold cathode fluorescent lamps for a period of 90 days. They then transferred the plants to ex vitro culture for 30 more days. Relative to plants grown in vitro in ambient air, the percent increases in shoot and root dry weight due to enriching the air in which the plants grew by 3,000 ppm CO2 were, respectively, 216 percent and 1,956 percent under the low-light regime and 249 percent and 1,591 percent under the high-light regime, while corresponding increases for the plants grown in air enriched with an extra 10,000 ppm CO2 were 244 percent and 2,578 percent under the low-light regime and 310 percent and 1,879 percent under the high-light regime. Similarly, in the ex vitro experiment, the percent increases in shoot and root dry weight due to enriching the air in which the plants grew by 3,000 ppm CO2 were 223 percent and 436 percent under the low-light regime and 279 percent and 469 percent under the high-light regime, while corresponding increases for the plants grown in air enriched with an extra 10,000 ppm CO2 were 271 percent and 537 percent under the low-light regime and 332 percent and 631 percent under the high-light regime. Consequently, the Japanese scientists concluded, ―super-elevated CO2 enrichment of in vitro-cultured Cymbidium could positively affect the efficiency and quality of commercial production of clonal orchid plantlets. Turning from ornamental plants to food crops, Vanaja et al. (2010) note grain legumes ―provide much needed nutritional security in the form of proteins to the predominant vegetarian populations of India and also the world. They further state that legumes—of which pigeon peas are an important example—―have the potential to maximize the benefit of elevated CO2 by matching stimulated photosynthesis with increased N2 fixation**,** citing Rogers et al. (2009). Therefore, they grew pigeon peas (Cajanus cajan L. Millsp.) from seed to maturity outdoors at Hyderabad, India within open-top chambers maintained at atmospheric CO2 concentrations of either 370 or 700 ppm. They then harvested the plants and measured pertinent productivity parameters. This work revealed, according to the team of nine Indian scientists, that in the higher of the two CO2 concentrations, ―total biomass recorded an improvement of 91.3%, grain yield 150.1% and fodder yield 67.1%. They also found ―the major contributing components for improved grain yield under elevated CO2 were number of pods, number of seeds and test weight, with these items exhibiting increases of 97.9 percent, 119.5 percent, and 7.2 percent, respectively. In addition, they found there was ―a significant positive increase of harvest index at elevated CO2 with an increment of 30.7% over ambient values, which they say was due to the crop‘s ―improved pod set and seed yield under enhanced CO2 concentration. These multiple positive findings, according to the scientists from India‘s Central Research Institute for Dryland Agriculture, illustrate the importance of pigeon peas for ―sustained food with nutritional security under a climate change scenario. In much the same vein, Yang et al. (2009) declared, ―rice is unequivocally one of the most important food crops that feed the largest proportion of the world**‘s** population, that ―the demand for rice production will continue to increase in the coming decades, especially in the major rice-consuming countries of Asia, Africa and Latin America, and that ―accurate predictions of rice yield and of the ability of rice crops to adapt to high CO2 environments are therefore crucial for understanding the impact of climate change on the future food supply. In fact, they forcefully state—and rightly— that ―there is a pressing need to identify genotypes which could optimize harvestable yield as atmospheric CO2 increases.

#### CO2 increases C4 output

Idso 2011 (Craig D. Idso, founder and chairman of the board of the Center for the Study of Carbon Dioxide and Global Change, Robert M. Carter, emeritus fellow and science policy advisor at the free market think-tank the Institute of Public Affairs and an adjunct professorial research fellow in earth sciences at James Cook University, S. Fred Singer, American physicist and emeritus professor of environmental science at the University of Virginia, Contributors: Susan Crockford (Canada) Joseph D‘Aleo (USA) Indur Goklany (USA) Sherwood Idso (USA) Madhav Khandekar (Canada) Anthony Lupo (USA) Willie Soon (USA) Mitch Taylor (Canada) Editors: Joseph L. Bast (USA), S.T. Karnick (USA), Diane Carol Bast (USA), “Climate Change Reconsidered” 2011 Interim Report Chapter 7, Online @ <http://nipccreport.org/reports/2011/2011report.html>)

Moving on to C4 plants—where the enzyme PEP carboxylase allows CO2 to be taken in very quickly and delivered directly to RuBisCO for photosynthetic incorporation into a 4-carbon compound—Vu and Allen (2009) note such vegetation represents ―fewer than 4% of all angiosperm species, yet ―their ecological and economic significance is substantial. On a global basis, for example, they write, ―up to onethird of terrestrial productivity is provided by C4 plants, citing Cerling et al. (1997), Ghannoum et al. (1997), and Brown et al. (2005), and they note ―in many tropical regions, the food source is primarily based on C4 crops, among [which] maize, millet, sorghum and sugarcane are the most agriculturally important monocots in terms of production (Brown, 1999), with ―up to 75% of the world sugar production provided by sugarcane (De Souza et al., 2008). In addition, they indicate the emerging ―use of sugarcane as a source for biofuel production has been highly recognized, citing Goldenberg (2007). So what will happen to the productivity of this important crop as the air‘s CO2 content continues its upward climb, especially if global air temperatures rise along with it? Historically, C4 crops have been thought to be relatively unresponsive to atmospheric CO2 enrichment, as they possess a CO2-concentrating mechanism that allows them to achieve a greater photosynthetic capacity than C3 plants at the current atmospheric CO2 concentration, particularly at high growth temperatures (Matsuoka et al., 2001). Thus, simple reasoning might suggest C4 plants may be little benefited, if at all, in a CO2-enriched and warmer world of the future. However, in the case of sugarcane, as the research of Vu and Allen demonstrates, simple reasoning would be incorrect, especially with respect to the most important measure of sugarcane‘s economic value: stem juice production. The two researchers with the USDA‘s Agricultural Research Service, who hold joint appointments in the Agronomy Department of the University of Florida (USA), grew two cultivars of sugarcane (Saccharum officinarum) for a period of three months in paired-companion, temperaturegradient, sunlit greenhouses under daytime CO2 concentrations of 360 and 720 ppm and air temperatures of 1.5°C (near ambient) and 6.0°C higher than outside ambient temperature, after which they measured several different plant properties. ―On a main stem basis, Vu and Allen write, ―leaf area, leaf dry weight, stem dry weight and stem juice volume were increased by growth at doubled CO2 [as well as at] high temperature, and they state these increases were even greater under the combination of doubled CO2 and high temperature, with plants grown under these conditions averaging ―50%, 26%, 84% and 124% greater leaf area, leaf dry weight, stem dry weight and stem juice volume, respectively, compared with plants grown at [the] ambient CO2/near-ambient temperature combination. In addition, they write, ―plants grown at [the] doubled CO2/high temperature combination were 2- to 3-fold higher in stem soluble solids than those at [the] ambient CO2/near-ambient temperature combination. Consequently, as Vu and Allen conclude, ―sugarcane grown under predicted rising atmospheric CO2 and temperature in the future may use less water, utilize water more efficiently, and would perform better in sucrose production. This bodes well for tropical-region agriculture, especially, as they note, ―with the worldwide continued increase in demand for sugarcane as a source of food and biofuel. Last, they add that significant ―improvements in stem sucrose and biomass through classical breeding and/or new biotechnology may also be achieved; and, hence, they state, ―studies to identify the cultivars with high efficiency in water use and stem sucrose production under future changes in CO2 and climate are of great importance and should be initiated and explored. Working hand-in-hand with the benefits provided by the ongoing rise in the air‘s CO2 content, therefore, as well as those provided by the possibility of still higher air temperatures to come, we may yet be able to meet the increasing food needs of our expanding numbers without taking vast amounts of land and freshwater resources from Earth‘s natural ecosystems. Also studying sugarcane, Gouvea et al. (2009) used the agrometeorological model of Doorenbos and Kassam (1994) ―to estimate sugarcane yield in tropical southern Brazil, based on future A1B climatic scenarios presented in the fourth Intergovernmental Panel on Climate Change report. They first calculated potential productivity, which considers ―the possible impacts caused by changes in temperature, precipitation, sunshine hours and CO2 concentration in the atmosphere, as well as technological advances, and then actual productivity, which additionally accounts for the yield-reducing effects of water stress. Based on their calculations, Gouvea et al. determined ―potential productivity will increase by 15% in relation to the present condition in 2020, by 33% in 2050 and by 47% in 2080, and ―actual productivity will increase by 12% in relation to the present condition in 2020, by 32% in 2050 and by 47% in 2080. They further indicate expected technological advances, including the development of new varieties and best-management practices, will account for 35 percent of the yield gains in 2020, 51 percent in 2050, and 61 percent in 2080. Consequently, and in spite of the gloomy prognostications of the IPCC and its followers, this modeling exercise suggests there will be, in the words of the four researchers, ―a beneficial effect of forecasted climate changes on sugarcane productivity, due to the expected increases in temperature and CO2 concentration.

### CO2 Good – Economy

#### CO2 key to plant growth and economic stability

Wall Street Journal 1/19/12 (“No Need to Panic About Global Warming” <http://online.wsj.com/article/SB10001424052970204301404577171531838421366.html>)

The fact is that CO2 is not a pollutant. CO2 is a colorless and odorless gas, exhaled at high concentrations by each of us, and a key component of the biosphere's life cycle. Plants do so much better with more CO2 that greenhouse operators often increase the CO2 concentrations by factors of three or four to get better growth. This is no surprise since plants and animals evolved when CO2 concentrations were about 10 times larger than they are today. Better plant varieties, chemical fertilizers and agricultural management contributed to the great increase in agricultural yields of the past century, but part of the increase almost certainly came from additional CO2 in the atmosphere. Princeton physics professor William Happer on why a large number of scientists don't believe that carbon dioxide is causing global warming. A recent study of a wide variety of policy options by Yale economist William Nordhaus showed that nearly the highest benefit-to-cost ratio is achieved for a policy that allows 50 more years of economic growth unimpeded by greenhouse gas controls. This would be especially beneficial to the less-developed parts of the world that would like to share some of the same advantages of material well-being, health and life expectancy that the fully developed parts of the world enjoy now. Many other policy responses would have a negative return on investment. And it is likely that more CO2 and the modest warming that may come with it will be an overall benefit to the planet.

#### Reducing CO2 emissions prevents economic growth

Zhao 2011- (Xiaobing “The Impact of CO2 Emission Cuts on Income” July 24th-26th,

<http://ageconsearch.umn.edu/bitstream/103412/2/Zhao-1-the%20impact%20of%20The%20cost%20of%20CO2%20emission%20cuts%20on%20income.pdf>)

Empirical Results We estimate Equation (5) year by year from 1980 to 2004. The coefficient estimates and the adjusted R are reported in Table 2. To save space, we do not report the White (1980) heteroscedasticity-consistent t-ratios. The significant coefficient estimates at the 5% level for two-sided tests are in bold. As we can see, the impact of CO2 emissions on income is statistically significant in each year. In fact, the coefficient estimate increases from 0.28 in 1980 to 0.35 in 2004, with an average of 0.31. That is, holding constant other relevant variables, a one percent cut in CO2 emissions will on average reduce income per capita by 0.31%. There are several popular proposals regarding CO2 emission cuts. However, a deep linear cut of 50% below 1990 emissions by 2050 may be more relevant to policy discussions. This proposal means at least a 1% cut in CO2 emissions per year. If a 1% cut in CO2 emissions will on average reduce income per capita by 0.31% as we show in Table 2, the cost of emission cuts is not only statistically but also economically significant. Since the average economic growth rate for the 23 OECD countries from 1980 to 2004 is only about 2% per year based on our data, a 0.31% reduction in GDP per capita per year represents a 15% slowdown in economic growth. This is the central finding of our paper. 4. Conclusion We study how CO2 emission cuts affect income in this paper. First we derive an income-CO2 relationship based on a structural production function, which is a natural way to model the relationship between income and CO2 emissions. We then use a similar methodology as Tucker (1995) to estimate the income-CO2 relationship. Such an 11 approach not only allows us to focus on the long-run relationship but also enables us to project the relationship between income and CO2 emissions for future years. Our main findings are as follows. Over the 1980-2004 period, for 23 OECD countries, the reverse EKC relationship between CO2 emissions and income is statistically and economically significant. To reduce emissions 50% below 1990 levels by 2050, the economic cost per year for developed countries is about 0.3% reduction in GDP per capita which represents a 15% slowdown in economic growth.

### CO2 Good – AT: Superweeds

#### Superweed genomes can be used to create disease resistant food crops – past research proves **Christopher 8** (Tom Christopher, reporter for gardening and environmental issues for the New York Times, 6/29/08, “Can Weeds Help Solve the Climate Crisis?”, <http://www.nytimes.com/2008/06/29/magazine/29weeds-t.html?pagewanted=7&_r=1>)

Ziska says that he worries about mankind’s ability to feed itself in a fast-changing future. Paradoxically, it is weeds, he says, that can provide solutions. They have helped us deal with lesser crises in the past. When diseases and pests overwhelmed our domesticated food crops, it was to their wild relatives — plants that mankind has been battling for millennia — that plant breeders turned. Because weeds have more diverse genomes, it is easier to find one with the proper genetic resistance to a given threat — and then to create a new hybrid by breeding it with existing crops. An answer to the Irish potato blight of 1845-6 was eventually found among the potato’s wild and weedy relatives; a wild oat found in Israel in the 1960s helped spawn a more robust, disease-resistant strain of domesticated oats.¶ Weedy ancestors of our food crops, Ziska predicts, will cope far better with coming climatic changes than their domesticated descendants. Coping, after all, is what weeds have always done best. As last year’s climate- change panel report, Climate Change 2007, made clear, we have already set in motion far-reaching and unstoppable changes in regional temperatures and precipitation and in the composition of our atmosphere. No matter what actions we take, these changes will continue for decades. If we are to avoid disaster, experts agree, we will need to be tenacious but flexible, ready to identify and exploit any opportunity in what will be a challenging, even hostile situation. In this new world that we have made, weeds, our old adversaries, could be not only tools but mentors. At which point, if Ralph Waldo Emerson is to be believed, weeds by definition will cease to exist.

### CO2 Good – Wheat

#### Increased wheat production due to CO2

Xiao et all 12, For Wheat and Rice, CO2 is Nice, <http://www.worldclimatereport.com/index.php/2012/04/20/for-wheat-and-rice-co2-is-nice/>

We have written about the biological benefits of elevated temperatures and atmospheric CO2 levels hundreds of times, and we will never run out of new material! Evidence the results of two recent article showing how CO2 improves the yield of wheat and the competitiveness of rice.¶ A team of seven scientists from various agencies in China began their article noting “In the past 100 years, the mean surface temperature in China has increased by 0.4–0.6ºC, and it is expected that the average surface temperature in western China will rise by 1.7ºC in the next 30 years and by 2.2ºC over the next 50 years.” Furthermore, Xiao et al. report “The annual mean rainfall decreased by about 60 mm [~2.4 in.] from the 1950s to the 1990s in semiarid regions of China, and a loss of soil moisture through evaporation increased 35–45 mm [~1.5 in.] due to the temperature increase. The rainfall and available soil moisture throughout the entire growing stage of the crops was about 100 mm [~4 in.] lower in the 1990s than in the 1950s. As a result, concerns about the vulnerability of agricultural production to climate change are increasing. For example, it is likely that evaporation will increase and soil moisture will decline in many regions as the temperature increases.” If that is not enough bad news, they state “There is now strong evidence that overall crop yields will decrease by 5–10% in China by 2030 as a result of climatic changes, and that the yields of wheat, rice and maize will be greatly reduced.”¶ But, then, quite importantly, they add “The impact of future climate change on crop production has been widely predicted by modeling the interaction between crops and climate change; however, few observations of the impacts of climate change on crop production have been reported.” [emphasis added]¶ Xiao and colleagues from the Institute of Arid Meteorology of the China Meteorological Administration set out to help remedy this deficiency.¶ And were they ever in for a surprise.¶ Xiao et al. grew wheat in China at several different relatively high elevation sites (1,798 m at Tongwei and 2,351 m at LuLu Mountain), and the artificially increased the temperature up to 2.2ºC. At the Tonwei site, the elevated temperatures increased grain output by over 3% and by up to 6% at LuLu Mountain. Not surprisingly, they write “These findings indicate that an increase in temperature will improve the winter wheat yield at two different altitudes.”¶ That finding certainly runs counter to the pre-existing model-based expectations!¶ And that’s not all. Xiao and team note “The results of this study revealed that a 0.6–2.2°C increase in temperature improved the water use efficiency (WUE) of winter wheat plants at both elevations evaluated.” More good news!¶ And when they consider the effect of CO2, things get even better.¶ They summarize their thoughts on CO2 with “Model projections have suggested that, although increased temperature and decreased soil moisture will reduce global crop yields by 2050, the direct fertilization effect of rising CO2 will offset these losses.”¶ And, echoing something that we must have said a thousand times, Xiao et al. go on to conclude “In general, a higher atmospheric CO2 concentration increases plant production as a result of higher rates of photosynthesis and increased water use efficiency.”¶ In the end, Xiao et al. have this to say “It is expected that by 2030 warming temperatures and changes in rainfall will have led to the increase of 3.1% in wheat yields at a low altitudes and of 4.0% in wheat yields at high altitude in semiarid northwestern China, and that by 2050, there will have been the additional increase of 2.6% and 6.0%, respectively, at these altitudes”. Further, “In addition, the results of this study revealed that a 0.6–2.2ºC increase in temperature will improve the water use efficiency of winter wheat plants at both altitudes evaluated here.”¶ So while they went into their experiment expecting bad news for winter wheat, they come out of it extoling the virtues of CO2 and a warmer climate on winter wheat yields.¶ Add the Xiao et al. study to the huge amount of research showing that crops, forests, and/or grasslands will benefit from the effects of elevated atmospheric CO2 concentrations with or without changes to temperature. Our critics just cannot accept the good news and insist that something will surely spoil the benefits.¶ For example, one thing we hear over and over is that weeds will out-compete more desirable plants and create an ecological disaster sometime down the road (after we pass another tipping-point?).¶ A recent article hits this issue head-on, and our critics will not be happy. A team of scientists from China and Norway supported financially by the National Natural Science Foundation of China and the Chinese Academy of Sciences grew rice and a weed (barnyard grass) in a paddy in eastern China at ambient (374 ppm) and ambient plus 200 ppm concentrations of atmospheric CO2. Zeng et al. conducted this experiment “in order to evaluate the impact of rising atmospheric carbon dioxide on nutrient competition between rice crop and weed. Results showed that elevated CO2 significantly enhanced the biomass, tillers, leaf area index and net assimilation rate of rice, but reduced those of barnyard grass after elongation.” They report “As a result, significant increase of the ratios of rice/barnyard grass of biomass and absolute nutrient uptake were observed under elevated CO2. The results suggest that rising atmospheric CO2 concentration could alter the competition between rice and barnyard grass in paddy fields in favor of rice.”¶ You come to World Climate Report to get the facts, and as these two studies continue to show, the evidence is overwhelming that the biosphere will be enhanced in the future, despite the claims to the contrary espoused by the more alarmist types out there.

#### CO2 Increases Chinese Winter Wheat

Xiao et al. (2010) The Effects of Warming on Winter Wheat Yields in Semi-Arid China, <http://nipccreport.org/articles/2010/nov/10nov2010a6.html>

Write that "the impact of future climate change on crop production has been widely predicted by modeling the interaction between crops and climate change," and that it is currently believed that "overall crop yields will decrease by 5-10% in China by 2030 as a result of climatic changes, and that the yields of wheat, rice and maize will be greatly reduced." However, they report that "the direct fertilization effect of rising CO2 will offset these losses," citing Ewert et al. (2002) and Long et al. (2006). In addition, they report that few real-world observations of the impacts of climate change on crop production have been reported; and they thus decided to address this deficiency.¶ Xiao et al. conducted two sets of field experiments to evaluate the effects of different degrees of warming on the productivity of winter wheat (Triticum aestivum L.) from 2006 to 2008 in the semiarid northwestern part of China: one set at the Tongwei County experiment station located at the foot of Lulu Mountain (35°13'N, 105°14'E) at an altitude of 1798 meters above sea level, and another set at the mountain's summit at an altitude of 2351 meters. At each of these locations, the seven scientists established four different air temperature treatments (ambient and ambient plus 0.6, 1.4 and 2.2°C), which they created by placing electric heating wires on the surface of the soil between the rows of wheat, which induced the 0.6-2.2°C air temperature increases they measured continuously at a height of 20 cm above the tops of the wheat canopies.¶ Citing Gao et al. (2002), the Chinese researchers say it has been predicted that "the average temperature in the semiarid northwest portion of China in 2050 will be 2.2°C higher than it was in 2002," and they report that based on the observed results of their study, this increase in temperature "will lead to a significant change in the growth stages and water use of winter wheat," such that "crop yields at both high and low altitudes will likely increase," by 2.6% at low altitudes and 6.0% at high altitudes.¶ Even without the benefits of the aerial fertilization effect and the anti-transpiration effect of the ongoing rise in the air's CO2 content, the increase in temperature that is predicted by climate models for the year 2050, if it ever comes to pass, will likely lead to increases in winter wheat production in the northwestern part of China, not the decreases that climate alarmists routinely predict.

#### Winter Wheat is at an all Time High

USDA 12, World wheat production down but still fourth largest on record, http://www.agprofessional.com/resource-centers/wheat/key-reports/World-wheat-production-down-but-still-fourth-largest-on-record-151376635.html

The USDA's Wheat outlook showed that world wheat production in 2012/13 is projected to fall to 677.6 million tons, down 17.1 million, or 2.5 percent from last year’s record of 694.6 million tons. Foreign wheat production is projected to decrease even more, down 23.8 million tons, or 3.7 percent compared to 2011/12. ¶ If realized, this year’s wheat output would be the fourth largest in history, behind the record harvests of 2008, 2009, and 2011. Though total world grain area is projected to increase, wheat area declines slightly, by 0.2 percent, as wheat has become comparatively less attractive to producers in a number of countries (Argentina, Australia), and as winterkill and dryness take its toll in a number of others (EU-27, Ukraine). ¶ The declines are partly offset by the weatherinduced recovery in planted area in Canada and Russia. Foreign yields are projected to be marginally lower (by 2.9 percent) than last year’s record, though at the high levels of 2008 and 2009. World wheat yields are projected to decline about 2.2 percent, though yields will still be at the second-highest level in history.¶ Wheat production in the EU-27, which is by far the largest world wheat producer, is projected to decline 5.4 million tons to a 5-year low of 132.0 million tons in 2012/13. Wheat yields are projected at a level of the last 5-year average, with lower yields in Spain, Poland, Hungary, Romania and higher yields in France and the United Kingdom. The winter wheat crop in the EU experienced adverse fall and winter weather conditions that are projected to reduce wheat harvested area, and have an impact on yields. Fall dryness persisted in the eastern part of the EU- 27—Romania, Hungary, Slovakia, and southern Poland. ¶ As winter unfolded, dryness subsided in the east while extremely dry conditions started to develop in Spain and in Italy’s Po valley, affecting water reserves for irrigation. Winter had normal average temperatures, though with severe cold snaps at the end of January and beginning of February. The frosts are likely to have affected some snow-free areas in northeastern France, Germany, Hungary, Slovakia, and areas with patchy snow cover in western Poland. However, primary EU wheat areas were spared the extreme cold or had appropriate snow cover. ¶ In late March, wet weather returned to major countries and wheat areas ending prolonged drought, dramatically improving crop conditions in France and Italy, and partly alleviating crop damage in northern Spain, while dryness still persisted in southern Spain where much of European durum wheat is grown. Despite improved precipitation, Germany, Poland, Czech, Slovakia, and Hungary are still drier than normal, with the Vegetation Health Index (VHI) confirming winterkill of crops.¶ China is expected to be the second largest wheat producer in 2012/13, reaching a record 120.0 million tons, an increase of 2.1 million tons from the previous year. Area planted is reported up slightly. Planting conditions for winter wheat (the major part of China’s wheat crop) were quite favorable, and current crop-growing conditions are reported to be generally good in the major wheat areas in north China. ¶ Wheat yields are projected slightly up, as in general wheat yields in China are pretty stable, rising slowly but steadily with improved irrigation since 2000. In the former Soviet Union (FSU-12), wheat production is forecast at 97.8 million tons in 2012/13, down 16.7 million from the previous year, with lower expected yields and slightly lower area (down less than 1 million hectares). The main decrease in wheat area and production is for Ukraine, where area is projected down 1.4 million hectares and production is down 9.1 million tons on the year to 13.0 million tons, the lowest since the disastrous harvest of 2003/04.¶ Area that was planted for winter wheat in Ukraine in the fall was almost the same as last year, and according to some estimates, even higher. However, dry conditions in the fall, with about only 10 percent of normal precipitation in some areas, and poor establishment of winter wheat (winter wheat occupies on average 95 percent of wheat area) is expected to result in about 1.5 million hectare losses in wheat area. ¶ Precipitation improved in December–January, but spring has been increasingly dry in southern and eastern Ukraine, which threatens to impact wheat yields even further. In European Russia, winter wheat planting is expected to be up this year, reflecting abundant moisture during the planting season. ¶ The Volga valley and part of the Central District are the main beneficiaries, after planting area was reduced because of soil moisture deficiency a year ago in a number of drought-affected regions. Average winterkill is expected this year, at around 6 percent of planted area. Some damage is anticipated in the South District, where VHI indicates areas that could be interpreted as winterkill, but conditions improve substantially further east. Spring wheat planting has just started in European Russia. ¶ In Siberia, the country’s mainspringwheat producing area, planting starts in mid-May. ¶ Wheat yield for Russia is forecast at a level slightly higher than the 5-year average, but lower than last year, and 2012/13 production is projected almost at last year’s level at 56.0 million tons. In Kazakhstan, the third main FSU wheat producer, area for 2012/13 is projected slightly down, reflecting a government program to diversify crop production away from wheat. While the spring wheat crops are just being planted, Kazakhstan is expected to have an average yield, resulting in a substantial projected decrease in wheat production, down 7.7 million tons to 15.0 million, following last year historical record yields.¶ India in 2012/13 is projected to produce another record wheat crop, up 4.1 million tons to 91 million, or almost 5 percent from a year earlier. Growing conditions and irrigation supplies have been good, and a record yield is expected. The wheat harvest is almost complete, and official reports are in line with the projection. ¶ In Pakistan, wheat area has been declining for several years, and is projected down 2.7 percent on the year, as wheat planting in November was delayed and some area was left fallow for future cotton planting. Wheat yields are also projected down, slightly below trend, reflecting lower water availability for irrigation and the higher cost of inputs. Good precipitation in both autumn and spring of 2012/13 in the major wheat-producing rain-fed areas in the northern part of Afghanistan allowed farmers to plant above-average areas for winter wheat, and is expected to support high yields, wheat production is forecast up 1.3 million tons to 3.8 million.¶ In the Middle East, wheat production is projected down 2.4 percent to 39.3 million tons, with higher area planted in Turkey, Iran, Syria, and Jordan more than offset by a reduction in Iraq. In Iran, growing conditions have been mostly favorable, and with good fall rainfall and decent snow coverage, another large wheat crop is expected. ¶ In the rest of the region, growing conditions were mixed, and most areas received good rains at some time. In Turkey, however, unusually low temperatures and slowly melting snow cover delayed crop development. While wheat plantings along the Turkish Mediterranean coast are doing very well, only 50 percent of plants emerged in Anatolia Plateau in the central-western part of the country where winterkill is expected to be fairly high. ¶ Wheat production is projected below the bumper crop last year and near the 5-year average at 17.5 million tons. In Iraq, wheat area is projected down more than 20 percent compared to a year ago. Dryness persisted in the northern part of the country, where the wheat crop is purely rainfed, and planted area is strongly correlated with precipitation. At the same time, the southern and central areas of the country are doing well, with higher projected area partly offsetting a drop in the north. With trend yields, wheat production for 2012/13 in Iraq is projected down 18 percent. ¶ In Syria, beneficial rainfall in April-May, after March dryness, is expected to enhance area planted for wheat, with production up 9 percent on the year. Rains were generally favorable across North Africa, with above-normal precipitation in the fall. However, starting in December, dryness began to develop in Morocco, which received only 20 percent of normal rainfall in the three winter months, and even good rain in March missed the main growing areas as it fell in the mountains. Rains started in earnest in April, quickly countering existing dryness, but perhaps too late to alleviate damage. ¶ Consequently, the wheat yield is projected to be down about 45 percent on the year. Morocco’s wheat production is expected to drop by 2.6 million tons to 3.2 million. Algeria and Tunisia fared quite well this winter, and wheat production is projected higher in both countries by 0.7 and 0.2 million tons (or by 25 and 12 percent), respectively. Total 2012/13 wheat output in North Africa is down 1.7 million tons. Surveys of Canadian planting intentions indicate about a 10-percent increase in total wheat sowings, a rebound from the last year’s planting. The wheat area upswing is a response to high wheat price expectations and to good weather prospects for spring grains with expected early planting as drier and warmer weather motivates producers to return land to production after last year’s floods. ¶ The intended planting of Canadian western red spring wheat is up 9 percent, planned area for durum wheat is up 27 percent (mainly in Saskatchewan, but also in Alberta), and winter wheat seeding is up almost 25 percent in eastern Canada (mainly in Ontario), due to improved planting conditions last fall. Assuming a 10-year trend yield, wheat production in 2012/13 is forecast up 7 percent to 27.0 million tons.¶ South America is expected to produce 22 million tons of wheat, down 12 percent from the previous year. In Argentina and Brazil, wheat planting has just started. In Argentina, wheat area is projected sharply down 1.0 million hectares to 4.0 million, as there are early strong indications that those farmers who have alternatives to wheat intend to decrease wheat planting. ¶ The government’s restrictive export policies are turning farmers away from wheat in favor of barley (also a winter grain in Argentina), and among summer crops, away from corn in favor of soybeans, cotton, and sunflowers. In Brazil, wheat area slips slightly, with lower area in Parana mostly being offset by an increase in Rio Grande de Sul. With expected trend yields, wheat production in Argentina and Brazil is projected down 2.5 and 0.8 million tons (17 and 14 percent) to 12.0 and 5.0 million, respectively.¶ In Australia, early indications suggest a decline in wheat area by 0.6 million hectares to 13.5 million. Production is projected to decline from last year’s all-time record by 3.5 million tons to 26.0 million. ¶ There are signs that local producers reacted to lower domestic prices by planning to shift part of their wheat area to canola, which is priced very favorably. Winter wheat planting is about to start in May, and overall moisture and weather conditions look favorable.

### CO2 Good – Generic

#### Warming means more Productivity, Empirically Proven

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

Senator Mitchell's forecast and his history are both wrong. Warmer periods bring benign rather than more violent weather. Milder temperatures will induce more evaporation from oceans and thus more rainfall -- where it will fall we cannot be sure but the earth as a whole should receive greater precipitation. Meteorologists now believe that any rise in sea levels over the next century will be at most a foot or more, not twenty.[2] In addition, Mitchell flunks history: around 6,000 years ago the earth sustained temperatures that were probably more than four degrees Fahrenheit hotter than those of the twentieth century, yet mankind flourished. The Sahara desert bloomed with plants, and water loving animals such as hippopotamuses wallowed in rivers and lakes. Dense forests carpeted Europe from the Alps to Scandinavia. The Midwest of the United States was somewhat drier than it is today, similar to contemporary western Kansas or eastern Colorado; but Canada enjoyed a warmer climate and more rainfall.

#### Humankind prospers with Warming

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

An examination of the record of the last twelve millennia reveals that mankind prospered during the warm periods and suffered during the cold ones. Transitions from a warm to a cold period or vice-versa were difficult for people who lived in climates that were adversely affected yet benefited others who inhabited regions in which the weather improved. On average, however, humans gained during the centuries in which the earth enjoyed higher temperatures. In writing about the effect of climate change on human development, Senator and now Vice-President Al Gore admits:¶ The archaeological and anthropological records indicate that each time the ice retreated [during the ice ages], the primitive peoples of the Eurasian landmass grew more populous and their culture more advanced. ... Then, 40,000 years ago, the so-called cultural explosion of tools and jewelry may have coincided with an unusually warm millennium in Europe.[9]

#### Warming is Good, Increases productivity of Industries

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

Although most of the forecasts of global warming's repercussions have been dire, an examination of the likely effects suggests little basis for that gloomy view. Climate affects principally agriculture, forestry, and fishing. Manufacturing, most service industries, and nearly all extractive industries are immune to climate shifts. Factories can be built in northern Sweden or Canada or in Texas, Central America, or Mexico. Banking, insurance, medical services, retailing, education and a wide variety of other services can prosper as well in warm climates (with air-conditioning) as in cold (with central heating). A few services, such as transportation and tourism, may be more susceptible to weather. A warmer climate will lower transportation costs: less snow and ice will torment truckers and automobile drivers; fewer winter storms -- bad weather in the summer has less disruptive effects and is over quickly -- will disrupt air travel; a lower incidence of storms and less fog will make water transport less risky. Hotter temperatures will leave mining and the extractive industries largely unaffected; they might even benefit oil drilling in the northern seas and mining in the mountains. A warmer climate could, however, change the nature and location of tourism. Many ski resorts, for example, might face less reliably cold weather and shorter seasons. Warmer conditions would mean that fewer northerners would feel the need to vacation in Florida or the Caribbean. On the other hand, new tourist opportunities might develop in Alaska, northern Canada and other locales at higher latitudes or in upper elevations.¶ A rise in world-wide temperatures will go virtually unnoticed by inhabitants of the advanced industrial countries. In his 1991 address to its members, the President of the American Economic Association asserted: "I conclude that in the United States, and probably Japan, Western Europe and other developed countries, the impact on economic output [of global warming] will be negligible and unlikely to be noticed."[10] As modern societies have developed a larger industrial base and become more service oriented, they have grown less dependent on farming, thus boosting their immunity to temperature variations. Warmer weather means, if anything, fewer power outages and less frequent interruptions of wired communications.

#### Agriculture would Flourish, Empirically Proven

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

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

#### Warming increases growth of Plants

Moore 95**,** Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

The overall effect on the world and domestic economies would be small as reduced production in some areas would be balanced by gains in others, according to an economic model of the effects of climate change on world agricultural markets. The model ... estimates a slight increase in world output and a decline in commodity prices under moderate climate change conditions.[14] [Emphasis added.]¶ Economists Robert Mendelsohn, William D. Nordhous, and Daigee Shaw researched the relationship of climate to land values in the United States.[15] After holding land quality, the proximity to urban areas and the nearest coast, and income per capita constant, they found that climate explained over two-thirds of the value of crop lands. They concluded that for the lower-48 states, a rise in average temperature of about 5deg.F and an 8 percent increase in rainfall stemming from global warming would, depending on their model, reduce the value of output between 4 and 6 percent or boost the value of output slightly. This result ignored the effect of increased CO2 on farm output. It is also consistent with the Department of Agriculture study that suggests the U.S. might see a slight fall in output while the rest of the world increased production.¶ Forestry is another sector that is potentially subject to change due to an increase in world temperatures. Canadian agricultural economists have examined the effect of a doubling of CO2 on forestry production. They concluded that increased carbon dioxide would boost productivity by 20 percent and that overall the harvest of timber in Canada would climb by about 7.5 percent.[16]

#### Empirics show rises in temps would be beneficial

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

History provides the best evidence for the effect of climate change on humans, plants and animals, but a few researchers have challenged its relevance. David Rind, a climate modeler and NASA scientist, has questioned the applicability of past warming episodes to the modern issue of climatic alteration caused by increased CO2 concentrations.[17] He attributes the origin of past periods of warmth and cold to shifts over time in the orbital position of the earth which impose more or less energy on the poles, as contrasted to a general world-wide warming that might result from the addition of man-made greenhouse gases. [See Appendix A on factors determining climate]. He also argues that the swiftness in warming that would occur following increased levels of CO2 is unprecedented in history. On the latter point, he ignores other research, such as that by a German academic, Burkhard Frenzel, who writes, "During the Holocene, very rapid changes of climate occurred. According to dendroclimatology [tree ring analysis applied to climatology], they often lasted about 20 to 30 years, or [were] even as brief as 2 to 3 years."[18] Other climate historians have found that a rapid cooling in the late glacial period -- about 11,000 years ago --took about 100 to 150 years to complete and realized about 5deg.F variation in temperature within 100 years, more than is being forecast for the next century.[1]¶ Although changes in the earth's orbital position may easily have played a role in warming the earth after the last Ice Age, the effect was world-wide rather than concentrated in northern latitudes. Ice retreated in the Southern as well as in the Northern Hemisphere. Moreover, in the subsequent warming, from around 7,000 to 4,000 years ago, the climate around the world appears to have improved. Although the evidence for warming in the Southern Hemisphere is weaker, even if higher temperatures had been localized in one hemisphere or one continent, the effect on human beings would still tell us about the benefits or costs of climatic change. Dr. Rind argues that greenhouse warming would raise winter as well as summer temperatures while past warmings, driven by orbital mechanics, have raised summer temperatures alone. Even though his models suggest that these past warmings should have boosted temperatures solely in June, July, and August, the evidence, albeit a little tenuous for the three thousand year period of Climatic Optimum, supports warmer winters. For the Little Climate Optimum that coincided with the High Middle Ages, researchers have found strong support for mild winters.¶ Moreover, at a recent conference the Russians have put forward the hypothesis that past climate changes support the proposition that the cause of the warming or cooling is irrelevant; the pattern has been the same.[20] This conclusion, disputed by some, is based on a large number of past shifts in average weather conditions dating back millions of years. The Russians contend that the climate models overstate the amount of temperature change at the equator and understate it at the poles.

#### Warming improves humankind

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

Since statistics on the human condition are unavailable except for the most recent centuries, I shall use indirect methods to demonstrate the influence of climate on man's well-being. A growth in the population, major construction projects, a significant expansion in arts and culture, all indicate that society is prosperous. If the population is expanding, food must be plentiful, disease cannot be overwhelming, and living standards must be satisfactory. In addition, if building, art, science, and literature are vigorous, the civilization must be producing enough goods and services to provide a surplus available for such activities. Renaissance Florence was rich; Shakespeare flourished in prosperous London; wealthy Vienna provided a welcome venue for Haydn, Schubert, Mozart, and Beethoven.¶ Clearly climate is far from the only influence on man's well-being. Governments that extort too much from their people impoverish their countries. A free open economy stimulates growth and prosperity. War and diseases can prove catastrophic. On the other hand, a change in climate has frequently been a cause of war or aided the spread of disease. A shift to more arid conditions, for example, impelled the Mongols to desert their traditional lands to invade richer areas. A cold wet climate can also confine people to close quarters, which can abet contagion. Moreover, a shift towards a poorer climate can lead to hunger and famine, which make disease more virulent.¶ Throughout history climatic changes probably forced technological innovations and adaptations. The shift from warm periods into Ice Ages and back again likely accelerated the evolution of modern man. Each shift would have left small groups of hominoids isolated and subject to pressures to adapt to new weather conditions. These shifts, especially to the more adverse conditions created by the spread of extreme cold, would put strong selection pressure on the human forebears that ultimately led to modern man. Even after Homo Sapiens started spreading across the earth, climate shifts fostered new technologies to deal with changed circumstances.¶ The influence of climate on human activities has declined with the growth in wealth and resources. Primitive man and hunter-gatherer tribes were at the mercy of the weather, as are societies which are still almost totally bound to the soil. A series of bad years can be devastating. If, as was the usual case until very recently, transportation is costly and slow, even a regionalized drought or an excess of rain can lead to disaster, although crops may be plentiful a short distance away. Thus variation in the weather for early man had a more profound influence on his life and death than do fluctuations in temperature or rainfall in modern times when economies are more developed. Since the time of the Industrial Revolution, climate has basically been confined to a minor role in human activity.¶

Climate History¶ Since its origins, the earth has experienced periods significantly warmer than the modern world -- some epochs have been even hotter than the most extreme predictions of global warming -- and times much colder than today. Today's cool temperatures are well below average for the globe in its more than four billion year history.[21] During one of the warmest such eras the dinosaurs roamed the earth and a rich ecological world flourished.

#### Warming is beneficial and any impacts would be mild

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

Studies of climate history show as was mentioned above that sharp changes in temperatures over brief periods of time have occurred frequently without setting into motion any disastrous feedback systems that would lead either to a runaway heating that would cook the earth or a freezing that would eliminate all life. In addition, carbon dioxide levels have varied greatly. Ice core data exhibit fluctuating levels of CO2 that do not correspond to temperature changes.[22] Most past periods display a positive relationship between CO2 and temperature, however, with a relationship roughly corresponding to that of the Global Climate Models.[23] During interglacial periods high latitudes enjoyed temperatures that were about 5deg. to 11deg.F warmer than today.[24] Middle latitudes experienced temperatures only about 4deg. to 5deg.F warmer. These warmer periods brought more moisture to the Northern Hemisphere with the exception during the Holocene of central North America. At the time of the medieval warm period, temperatures in Europe, except for the area around the Caspian Sea basin, were 1deg. to 3deg.F higher and rainfall more plentiful than today.[25]¶ This historical evidence is consistent with only some of the forecasts of the computer climate models. Most climate estimates indicate that a doubling of CO2 would generate greater rainfall in middle latitudes, and history shows that warm climates do produce more wet weather.[26] As has been found in the historical record, land temperatures should increase more than water thus strengthening monsoons. The models also predict that sea-surface temperatures in the tropics would be higher with increased CO2 but evidence from the past evinces no such relationship.[27]¶ Carbon dioxide concentrations may have been up to sixteen times higher about 60 million years ago without producing runaway greenhouse effects.[28] Other periods experienced two to four times current levels of CO2 with some warming. Scientists have been unable to determine whether the warming preceded or followed the rises in carbon dioxide. For virtually all of the period from around 125 million to about 75,000 years ago, CO2 levels were markedly higher than now.¶ The prevailing view among climatologists is that the Climatic Optimum -- 9,000 to 4,000 years ago -- resulted from orbital mechanics which increased summer radiation in the Northern Hemisphere, although winters received less heat than they do in the modern world.[29] The warmer summers melted the northern glaciers over several millennia. Warmer lands in the interior of northern continents and cooler oceans expanded the monsoons further north to bring greater rainfall to the Sahara, Arabia and southern and eastern Asia.[30] North of the monsoon area, the climate was drier than today. Anatolia, Northwestern Africa, parts of China and northern Japan experienced less rainfall.[31] By 4000 B.C., however, a slackening of the trade winds had produced warmer Atlantic ocean water off northwestern Africa, and as a consequence the Middle East, including Greece and modern Turkey, were enjoying more reliable rain.

#### Warming increases agriculture and humankind’s innovation, empirically proven

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

If orbital variations produced the Climatic Optimum, the Southern Hemisphere should have been cooler. Between 10,000 B.C. and 7000 B.C., however, winter temperatures (June, July, August) below the equator warmed to higher levels than now while summer temperatures (December, January, February) were cooler than the modern world.[32] Rainfall over South America, Australia and New Zealand apparently was lighter than the present. Although the Southern Hemisphere moved out of the Ice Age with the Northern Hemisphere, its climate since then has not tracked well weather patterns north of the equator.[33] Data based on vegetation suggest that annual temperatures in New Zealand were coldest between 20,000 and 15,000 years ago, warmed subsequently and peaked between 10,000 and 8,000 years before the present -- somewhat earlier than they did in the Northern Hemisphere.[34] Temperatures appear to have been falling over the last 7,500 years. By 1500 B.C., the climate was quite similar to today's.[35]¶ Whether the whole globe warmed or not during the period 7,000 to 4,000 years ago is really irrelevant to the question of how hotter temperatures affect humans. If the Northern Hemisphere warmed, and there is good evidence that it did, then comparing how people survived in that portion of the globe provides information about how higher global temperatures would influence mankind.¶ Modern man apparently evolved into his current genotype between 40,000 and 200,000 years ago, probably in Africa during an Ice Age.[36] Around 150,000 years ago the extent of ice coverage reached a maximum, followed around 130,000 years before the present (YBP) by a rapid deglaciation.[37] The warm interglacial era, during which temperatures may have exceeded those forecast under a doubling of greenhouse gases, lasted about 15,000 years until the onset of renewed glaciation at 115,000 YBP. Over the next 100,000 years the glaciers fluctuated with the climate, but at no time did the average temperature equal the level of the previous interglacial epoch or reach the warmth of the last 10,000 years.[38]¶ In the thousands of years of the last Ice Age preceding the current warm epoch, man existed as a hunter-gatherer in a world that looked quite different from today's. Herds of large animals such as bison, mammoths, and elk roamed a largely treeless savanna in Europe. These beasts made easy prey for human hunters that enjoyed as a consequence a rich diet of wild animal meat plus, in season, local fruits and vegetables. It was during the Ice Age that the level of the ocean fell sufficiently that Asian peoples were able to migrate across what is now the Bering Strait but then was dry land. Most archaeologists date the first arrivals of humans in the Americas from around 15,000 years ago, although some have claimed evidence for an earlier arrival. No doubt the lower sea levels during the Ice Age also facilitated the arrival of the aborigines in Australia some 35,000 years ago.¶ Climatologists consider that the last Ice Age ended about 12,000 to 10,000 years ago when the glaciers covering much of North America, Scandinavia and northern Asia began to retreat to approximately their current positions. In North America the glacial covering lasted longer than in Eurasia because of topographic features that delayed the warming. Throughout history warming and cooling in different regions of the world have not been exactly correlated because of the influence of oceans, mountains, prevailing winds, and numerous other factors. Nevertheless, across the Northern Hemisphere large temperature shifts have occurred roughly together -- perhaps in some areas they have lagged other zones by a century or more. The correspondence between warming and cooling in the Northern Hemisphere and that in the Southern is less well known and may be less well correlated because of the predominance of water south of the equator and the existence of Antarctica.¶ Human progress, a few improvements in hunting tools and some cave art, was incredibly slow during the Ice Age -- a period whose length dwarfs the centuries since. Over the last 12 millennia of interglacial warmth, however, modern man has advanced rapidly. The growth in technology and living standards required a climate that was more hospitable than existed throughout that frozen period.¶ During the last Ice Age humans survived through hunting and gathering. Initially archeologists believed that these tribes, which typically consisted of 15 to 40 people, eked out a precarious existence.[39] Many modern archeologists, however, feel, based on studies of the few bands of hunter-gatherers that survived into the twentieth century, that they normally found plentiful foods in their forays and would rarely have been hungry. Modern primitive people, however, may not have been typical of earlier groups. The ones that did face food pressures would have adopted farming while those that found plentiful supplies in their environment would be less concerned with new ways of acquiring sustenance.[40] Food pressures could have arisen from either a change in climate that made previous ways-of-life untenable or an expansion of population in the region that began to overwhelm the natural supply.¶ As the earth warmed with the waning of the Ice Age, the sea level rose as much as 300 feet; hunters in Europe roamed through modern Norway; agriculture developed in the Middle East. For about 3,000 to 4,000 years the globe enjoyed what historians of climate call the Climatic Optimum period -- a time when average world temperatures -- at least in the Northern Hemisphere -- were significantly hotter than today. At its height between 4000 B.C. and 2000 B.C., H.H. Lamb, a leading climate historian, judges that the world was 4deg. to 5deg. Fahrenheit warmer than the twentieth century.[41] During the relatively short period since the end of glaciation the climate has experienced periods of stability separated by "abrupt transition."[42] Lamb calculates that at its coldest, during the Mini Ice Age, the temperature in central England for January was about 4.5deg.F colder than today.[43] He also concludes that in the central and northern latitudes of Europe during the warmest periods, rainfall may have been 10 to 15 percent greater than now and during the coldest periods of the Mini Ice Ages, 5 to 15 percent less.[44] On the other hand, cooler periods usually suffered from more swampy conditions because of less evaporation.¶ If modern humans originated 200,000 years ago, why did they not develop agriculture for the first 190,000 years? Even if Homo Sapiens Sapiens originated only 40,000 years ago, people waited 30,000 years to grow their first crops -- an innovation which yielded a more reliable and ample food supply. Farming developed first in the Middle East, right after the end of the last Ice Age -- a coincidence? The evidence suggests that from 11,000 to 9,000 years ago the climate became warmer and wetter in the Middle East shifting the ecology from steppe to open woodland.[45] This led to the domestication of plants and animals, probably because the warmer, wetter weather made farming possible. From its origins around 8000 B.C., agriculture spread northward, appearing in Greece about 6000 B.C., Hungary 5000 B.C., France 4500 B.C. and Poland 4250 B.C.46 Is it chance that this northward spread followed a gradual warming of the climate that made agriculture more feasible at higher latitudes?

#### Warming increases population and agriculture

Moore 95, Hoover Institution, GLOBAL WARMING: A Boon to Humans and Other Animals, http://www.stanford.edu/~moore/Boon\_To\_Man.html

As Anthropologist Mark Cohen writes, "If, as the archaeological record indicates, hunting and gathering was such a successful mode of adaptation over such a long period of time, and if most human populations are as conservative as anthropologists have observed them to be, we are faced with answering the question why this form of adaptation was ever abandoned."[47] He gives estimates of the efficiency of hunting and gathering that indicate that the latter was more efficient than farming -- at least for large game. He reports that when large animals are available, hunting brings 10,000 to 15,000 kilocalories per hour of hunting. However, if large animals are unavailable -- because the environment is poor or because they have all been killed -- hunting of small game will return only a few hundred to 1,500 kilocalories per hour devoted to the effort. Collecting and processing small seeds from such plants as wild wheat may produce only 700 to 1,300 kilocalories for each hour. Shellfish collection can produce 1,000 to 2,000 kilocalories per hour of work. On the other hand subsistence farming produces 3,000 to 5,000 kilocalories per hour devoted to agriculture.[48] This connotes that hunting large animals, when and if they are available, is the most economical method of subsistence, but if these beasts are exterminated or if the humans move to areas without such species, domestication of plants and animals can produce more food for the effort than any other strategy.¶ Moreover hunter-gatherers can only survive if the density of their population is low. Too many mouths would strain the environment and preclude survival. Once, humans developed farming which could support larger families and a denser population, however, the number of people did explode. Primitive tribes, dependent on hunting, scavenging, and collecting edibles to survive, had to hold their populations below what they would individually have preferred or nature kept them in check through periodic food shortages. A number of twentieth century hunter-gatherers have practiced infanticide and induced abortions to restrict the number and spacing of their children.[49] Constant travel by nomads may increase infant mortality, maternal mortality and produce more miscarriages than a sedentary life and thus have kept the numbers in check. In any case farming solved a major problem for primitive peoples. Once people settled down into fixed abodes, the population apparently ballooned.¶ Although many people view the current world's huge population with alarm, most ecologists take the size of the population of a species as an indicator of its fitness. By this criterion, the domestication of plants and animals improved greatly Homo Sapiens fitness. This essay is not the place to discuss the capacity of the globe to sustain the number of people expected to populate the world in the next century, but certainly anything that produced greater numbers of people thousands of years ago must have been beneficial for mankind.¶ Over history the number of humans has been expanding at ever more rapid rates. Around 25,000 years ago, the world's population may have measured only about 3 million.[50] Fifteen thousand years later, around 10,000 B.C., the total had grown by one-third to 4 million. It took 5,000 more years to jump one more million, but in the 1,000 years after 5000 B.C. it added another million. Except for a few disastrous periods, the number of men, women and children has mounted with increasing rapidity. Only in the last few decades of the twentieth century has the escalation slowed. Certainly there have been good times when man did better and poor times when people suffered -- although in most cases these were regional problems. However, as the following chart shows, in propitious periods, that is, when the climate was warm, the population swelled faster than during less clement eras.

### Food Shortages Impacts

#### Billions will die without expanded agricultural output

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

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

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

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

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

#### **Rapid increase in population lead to lack of food production by 2030-leads to poverty**

Chestney, Nina Jan 30, 2012, Senior Environmental Markets Correspondent, London-World lacks enough food, fuel as population soars: U.N.- http://www.reuters.com/article/2012/01/30/us-un-development-idUSTRE80T10520120130

The world is running out of time to make sure there is enough food, water and energy to meet the needs of a rapidly growing population and to avoid sending up to 3 billion people into poverty, a U.N. report warned on Monday.¶ As the world's population looks set to grow to nearly 9 billion by 2040 from 7 billion now, and the number of middle-class consumers increases by 3 billion over the next 20 years, the demand for resources will rise exponentially.¶ Even by 2030, the world will need at least 50 percent more food, 45 percent more energy and 30 percent more water, according to U.N. estimates, at a time when a changing environment is creating new limits to supply.¶ And if the world fails to tackle these problems, it risks condemning up to 3 billion people into poverty, the report said.¶ Efforts towards sustainable development are neither fast enough nor deep enough, as well as suffering from a lack of political will, the United Nations' high-level panel on global sustainability said.¶

#### Population growth leads to lack of resources-impact is poverty and famine-empirics prove

Ahmed, Nizam- 2012-02-24- Country's food production likely to face setback in coming years

http://www.thefinancialexpressbd.com/more.php?news\_id=121150&date=2012-02-24

Population boom, global warming, urbanisation and rising prices of agricultural inputs are likely to impede food production in Bangladesh, like elsewhere in the world, in the coming years, experts said Thursday.¶ If the nation fails to increase food production in proportion to the population growth millions of people will suffer from extreme poverty, the experts feared. ¶ According to aid workers, despite sufficient food production, even now, one third of Bangladesh's population cannot afford three meals a day.¶ Bangladesh produced more than 34 million tonnes of staple rice along with 0.1 million tonnes of wheat in 2011, sufficient to feed its some 160 million people, according to the department of agricultural extension (DAE).¶ The country which faced a deadly famine in 1974, when the population was about 80 million, succeeded in increasing food production gradually since late 1990s, despite rising of population.¶ However, the farmers and agriculture experts will have to work hard with higher investment from relevant authorities to stop the country from sliding back to a food deficit country, the experts said.¶ Bangladesh had high rates of population growth in the 1960s and 1970s. Since then, however, it has seen a marked reduction in its total fertility rate. Over a period of three decades it dropped from almost 7.0 to 2.4 in 2005-2010, according to the demographics of Bangladesh.¶ Following recent record harvest in 2011, the authorities concerned suspended import of rice and continued to buy wheat through imports. ¶ The growth in food production is likely to be impeded by climatic and demographic changes and price volatility in the coming years, experts said.¶ "Use of modern technology and sowing of hybrid seeds still can help us produce food as required," Zaid Bakth, a researcher at the Bangladesh Institute of Development Studies, told the FE.¶ Urbanisation, which erodes some 1.0 per cent of the country's arable land annually, is another impediment to food production, Bakth, a leading economist of the country, said.¶ Bangladesh has 8.44 million hectares of arable land as of 2010, according to the DAE.¶ According to climate experts, 17 per cent of Bangladesh will be inundated displacing some 20 million people if sea rises by one metre by 2050, shrinking cultivable lands.¶ "With use of technology we should also try to stabilise our population growth through effective programmes which are now in tatters since early 1990s," Prof Ainun Nishat, vice chancellor of Brac University, told the FE. ¶ According to the United Nations, the world population is expected to be around 9.0 billion in 2040. In 2011 it reached 7.0 billion from 3.0 billion in 1960. ¶ "An exponentially increasing human population is a rapidly growing problem," the UN said in a recent report.¶ The report said that the world was running out of time to ensure enough water, energy and food for the rising population, as each year there would be more mouths to be fed.¶ And the U.N. report warns that if the world is unsuccessful in tackling these problems, it could send three billion people into poverty.¶

#### Over population leads to resource wars and genocide-Rwanda prove

The Mad Hedge Fund Trader, JANUARY 23, 2012- The Population Boom- http://www.madhedgefundtrader.com/the-population-boom/

Long time readers of this letter know that demographic issues will be one of the most important drivers of all asset prices for the rest of our lives. The magazine expects that population will reach 9 billion by 2045, the earliest date that I have seen so far. Can the planet take the strain? Early religious leaders often cast Armageddon and Revelations in terms of an exploding population exhausting all resources, leaving the living to envy the dead. They may not be far wrong.¶ A number of developments have postponed the final day of reckoning, including the development of antibiotics, the green revolution, DDT, and birth control pills. Since 1952, life expectancy in India has expanded from 38 years to 64. In China, it has ratcheted up from 41 years to 73. These miracles of modern science explain how our population has soared from 3 billion in a mere 40 years.¶ The education of the masses may be our only salvation. Leave a married woman at home, and she has eight kids, as our great grandparents did, half of which died. Educate her, and she goes out and gets a job to raise her family’s standard of living, limiting her child bearing to one or two. This is known as the “demographic transition.”¶ While it occurred over four generations in the developed world, it is happening today in a single generation in much of Asia and Latin America. As a result, fertility around the world is crashing. The US is hovering at just below the replacement rate of 2.1 children per family, thanks to immigration. But China has plummeted to 1.5, Europe is at 1.4, and South Korea has plunged as low as 1.15.¶ Population pressures are expected to lead to increasing civil strife and resource wars. Some attribute the genocide in Rwanda in 1999, which killed 800,000, as the bloody result of overpopulation.

#### Food shortage leads to global economic recession

McKillop, Andrew- Aug 04, 2011- Writer of The Market Oracle-The Food Crisis War Endgame- http://www.marketoracle.co.uk/Article29666.html-

Food shortage is driven by population growth: anybody who wants to deny that by calling it fascistminded can take a look at how agribusiness operates, from Monsanto, Dow, Bayer and McDonalds to the Bill Gates Foundation. Their game is trashing the environment for decades or centuries ahead and making profits right now - - while just about being able to feed 6.1 billion persons on Earth. The other 900 million suffer permanent food shortage. That is one-in-seven of world population. The number of underfed is growing by around 4% to 6% per year - far ahead of the population growth rate, and the average rate of global economic growth. And one thing is sure: in global economic recession the underfed will grow even faster, unless food prices behave like "other commodities" and tank in recession - which is no longer certain.¶ This is the danger: recession will come. Oil prices will drop, even gold edges down a little - maybe - but food prices stay high and dangerous. They can, could or might even continue rising in global economic recession, drastically multiplying the social stress and damage from recession.¶

## Aff

### Warming Bad – O/W CO2 Ag

#### Warming outweighs gains from Co2 – droughts, flooding, and high temperatures devastate ag and livestock

Cheryl L Pellerin – Science Writer, Dept of State - 25 June 2010, Adaptation Critical to Agriculture in Already Changing Climate, http://iipdigital.usembassy.gov/st/english/article/2010/06/20100625122522lcnirellep0.8219416.html#axzz21vjOHv6G

Meanwhile, according to the International Food and Policy Research Institute (IFPRI), the changing climate will have dramatic consequences for agriculture. Water sources will become more variable, droughts and floods will stress crops, some coastal food-producing areas will be inundated by salty seas and food-production rates will fall in some inland areas.¶ “These changes have already begun to have documented effects on agriculture production,” Rosenzweig said, “in yields, growth stages of crops, management practices, pests and diseases, and livestock production and productivity.”¶ APPLIED EVOLUTION¶ CO2 is essential for photosynthesis — the process green plants use to turn water and sunlight into food and oxygen. Rising concentrations of CO2 in the atmosphere will increase rates of photosynthesis, speeding up growth and development for many plants. Yields for most crops have risen dramatically over the past 40 years thanks to improvements in cultivation (planting, fertilization) and genetics.¶ But as CO2 rises so does temperature, César Izaurralde of the Joint Global Change Research Institute at the University of Maryland, said June 16, and temperature increases over the next 50 to 100 years are likely to reduce yields of corn, wheat, sorghum, cotton and peanuts.¶ Paul Gepts, a geneticist and professor of agronomy at the University of California, Davis, detailed strategies for adapting agriculture to a changing climate. These include switching crops or crop mixtures to match new temperatures, increasing crop biodiversity to strengthen agricultural systems and breeding plants to produce varieties that tolerate drought, heat and other stresses.¶ Another strategy is to grow crops as usual and let climate change sort them out.¶ “This is an exercise in applied evolution,” he said. “If you provide biodiversity, the climate will automatically start selecting the crops and the varieties within those crops that are better adapted to the changed conditions.”¶ Farmers will also have to test alternative crops, Gepts said, develop ways to transition from one climate state to another, conserve genetic diversity and make sure there is support for plant breeding and breeding research.¶ Livestock, traditionally raised on open ranges, may have to be sheltered from rising temperatures and extreme weather, and Izaurralde said more research is needed to understand how environmental stresses like heat will affect animals.

#### Prefer our ev – Their argument excludes other cause-effect chains created by warming

Mariana Ashley – 7/1/10, Skeptical Science, CO2 is Good for Plants: Another Red Herring in the Climate Change Debate, http://www.skepticalscience.com/co2-is-good-for-plants-another-red-herring-in-the-climate-change-debate.html

CO2 feeds plants. And so, too, does ignorance and a little bit of politicking feed inane misconceptions. Rep. John Shimkus of Illinois made famous the CO2 as plant food argument during a U.S. House Subcommittee on Energy and Environment hearing in 2009. The basic plant food argument is that since plants need CO2 to grow, more CO2 means, by proxy, more sustained and robust plant growth globally.¶ A quick look at the science behind this argument demonstrates its inherent weaknesses. In closed, controlled environments, like greenhouses and plant nurseries, an increase in CO2 does indeed spur plant growth. However, the globe is not a controlled environment, and it’s incredible sensitivity to a variety of factors is something that is often taken for granted when such narrow arguments are proffered. A rise in CO2 levels is not the only consequence of climate change, and it is these other effects that have had and will have more abiding adverse effects on plant growth around the world.¶ While CO2 is an important element that stimulates plant growth, the planet's flora requires a cocktail of elements to maintain its health. Arguably the most important of these elements is water. With the global increase in temperature caused by the various factors affecting our climate's balance, increased evaporation means decreased soil moisture. Another effect of global climate change is erratic precipitation patterns. This causes extreme weather in certain geographic locations only sporadically, with overall, balanced rainfall drastically reduced.¶ Suppose, however, that CO2 does prime plant growth in the world at large. To what extent will this happen? For one, the increased density of forest vegetation could increase the risk of wildfires, which have reared their ugly heads in California all too often in the past few years, wreaking devastating damage. Presumably the CO2 as plant food enthusiasts offer their argument in an effort to demonstrate the resulting agricultural advantages. But even if "CO2 fertilization" occurs, weeds proliferate in tandem with crops, which would only increase the global cost of agriculture.¶ We could discuss the scientific finer points of global climate change and the unlimited effects it could have on global plant growth all day. A Climate Denial Crock of the Week video does just that in debunking the CO2 plant food argument. However, at its most basic level, the CO2 plant food argument rests on a simple logical fallacy--the fallacy of exclusion, which focuses on one cause-and-effect (in this case, more CO2 means more plants) to the exclusion of all other cause-and-effect chains.¶ When CO2 is framed as an element good for plants in order to dismiss the other existing pieces of evidences that suggest the dangers of global climate change, we are left with an idea that only distracts us from the more pressing issues of our planet's increased loss of balance.

#### Empirics prove – warming causes a 5% yield loss for every degree – outweighs c02 benefits

Nicola Jones - online news editor for Nature – 5/5/11, Climate change curbs crops, <http://www.nature.com/news/2011/110505/full/news.2011.268.html>

Farmers have produced less food during the past three decades than they would have done were climate change not happening, according to a study published today1. Global maize (corn) production, for example, is estimated to be about 3.8% lower than it would have been in a non-warmed world — the equivalent of Mexico not contributing to the maize market.¶ "These things are happening now," emphasizes David Lobell, an Earth system scientist at Stanford University in California and a co-author on the study.¶ The results come as a surprise to many. "I've been operating under the assumption we wouldn't be able to detect changes until the 20s or 30s of this century," says Gerald Nelson, an agricultural economist with the International Food Policy Research Institute in Washington DC, who was not involved with the work.¶ National crop yields are still rising as a general trend. But the fact that they are lower than a theoretical maximum is important when considering the huge challenge of feeding the world's booming population, the authors say.¶ Bigger changes may lie ahead. The study notes that the United States — which produces about 40% of the world's soya and maize — has so far been shielded from yield declines because its crop-growing regions haven't warmed in summer over the past 30 years, perhaps because of natural variability or the cooling counter-effect of aerosols. "There has been a perception that a perfect storm of conditions led to higher food prices in recent years. But that wasn't the case at all, because this major producer wasn't being detrimentally affected," says Lobell. "The US may have been lulled into a sense of complacency."¶ The study also shows that temperature has so far had a much greater effect on crop yields than precipitation. So it might be more important to breed heat tolerance into future generations of crops than to make them capable of surviving with less water.¶ Unpicking a trend¶ Crop yields depend on many things, from the vagaries of the market to the price of fertilizer and the availability of new technologies. However, the authors assumed that most of these factors are not linked to the weather, making it possible to extract a model of how temperature and precipitation is linked to national yields. Although warm temperatures can extend growing seasons, excessive heat generally restricts crop growth, and promotes pests and water loss. Additional rainfall, meanwhile, is beneficial up to a point.¶ The authors used their modelling results to estimate the effect that temperature and rainfall trends had on each nation's food production from 1980 to 2008.¶ They estimate that, despite the fertilizing effect of increased carbon dioxide in the atmosphere, the negative effect of climate change on plant growth has cut wheat production by 2.5%, but boosted that of rice by 2.9% and soya beans by 1.3%. It has also, they calculate, bumped up food commodity prices worldwide by about 6.4% over 30 years.¶ The authors admit that their results are packed full of assumptions. They could be overestimating climate's effects, because the model doesn't account for the fact that farmers might switch to different crop varieties or change their planting dates as conditions change. Conversely, the results could be an underestimate, given that the model doesn't look specifically at extreme weather events such as droughts, floods and heatwaves. "It's the best we can do with the data available," says Lobell.¶ Sooner than expected¶ The general result of about a 5% yield loss per degree Celsius of warming is consistent with previous studies, says Lobell. But the authors' conclusions differ from previous work in a few important ways.¶ A study published by Nature in 1994 concluded that the fertilizing effect of carbon dioxide would probably counteract the negative effects of warming at low latitudes for a few decades to come. "We don't see that," says Lobell.¶ That same study also concluded that warming would hit food production in developing countries harder than in the developed world, because many richer nations are in colder climates that might benefit from warming, and are probably more adaptable to changing conditions. But Lobell et al. don't see this happening either. Instead, Lobell guesses, the relatively high production per unit area in the developed world means that developed countries are actually more susceptible to the vagaries of the weather. Poorer nations, on the other hand, have a low production rate and are as much affected by other factors, such as the availability of fertilizer.¶ The results should add impetus for developed nations to take the effects of climate change on food production seriously, Lobell says. "Adaptation isn't something for down the line, it's something we need right now." The United States may already have made a start: in February, the US Department of Agriculture invested $60 million in three studies on the effects of climate change on crops and forests.

#### Even if CO2 boosts production, it decreases nutritional value – it’s a net loss for global food production

Ohio State citing Peter Curtis – ecology prof – 10/2/02, INCREASED CO2 LEVELS ARE MIXED BLESSING FOR AGRICULTURE, <http://researchnews.osu.edu/archive/co2plant.htm>

A new study suggests that rising levels of carbon dioxide in the atmosphere could be a boon for agricultural crops, as this greenhouse gas helps crop plants grow and reproduce more.¶ But that boon comes with a price, said Peter Curtis, a professor of evolution, ecology and organismal biology at Ohio State University. Greater growth and reproduction may hurt the nutritional value of crops.¶ “If you’re looking for a positive spin on rising CO2 levels, it’s that agricultural production in some areas is bound to increase,” Curtis said. “Crops have higher yields when more CO2 is available, even if growing conditions aren’t perfect.¶ “But there’s a tradeoff between quantity and quality. While crops may be more productive, the resulting produce will be of lower nutritional quality.”¶ Nutritional quality declines because while the plants produce more seeds under higher CO2 levels, the seeds contain less nitrogen.¶ “The quality of the food produced by the plant decreases, so you’ve got to eat more of it to get the same benefits,” Curtis said. “Nitrogen is a critical component for building protein in animals, and much of the grain grown in the United States is fed to livestock.¶ “Under the rising CO2 scenario, livestock – and humans – would have to increase their intake of plants to compensate for the loss.”¶ The research appears in the current issue of the journal New Phytologist.¶ To understand the role that rising CO2 levels may play on plant growth, Curtis and his colleagues conducted a meta-analysis – a technique in which researchers pull together data from a large number of similar studies (159, in this case) and summarize the results. Curtis said that this is the first time that researchers have used the meta-analysis technique to determine the effects of climate change on plant reproduction.¶ The studies were published between 1983 and 2000. The results included data on crop and wild plant species’ reproductive responses to estimated CO2 levels at the end of this century. Scientists expect CO2 levels to nearly double by 2100.¶ The researchers analyzed eight different ways plants respond to higher CO2 levels: number of flowers; number of fruits; fruit weight; number of seeds; total seed weight; individual seed weight; the amount of nitrogen contained in seeds; and a plant’s reproductive allocation, a measurement of a plant’s capacity to reproduce.¶ Plants grown at higher CO2 levels had more flowers (an average of 19 percent more in the species studied); more seeds (16 percent more); greater individual seed weight (four percent more); greater total seed weight (25 percent more) and lower concentration of nitrogen in the seeds (a decrease of 14 percent) than those grown at current levels of atmospheric CO2.¶ Under higher CO2 levels, crop plants showed a notable increase in reproduction while wild plants did not. On average, crops produced more fruits than did wild species (28 percent higher in crops vs. 4 percent higher in wild plants) as well as seeds (21 percent higher vs. 4 percent higher, respectively).¶ Individual crops varied in their response to increased CO2 levels. Rice seemed to be the most responsive, as its seed production increased an average of 42 percent. Soybean followed with a 20 percent increase in seed, then wheat (15 percent increase) and, finally, corn (5 percent increase).¶ While crop plants and wild plants had similar increases in total growth (a 31 percent increase), crops allocated the additional weight to reproduction, while wild plants seem to funnel much of it to tasks other than reproduction, Curtis said.¶ “Wild plants are constrained by what they can do with increased CO2,” he said. “They may use it for survival and defense rather than to boost reproduction. Agricultural crops, on the other hand, are protected from pests and diseases, so they have the luxury of using extra CO2 to enhance reproduction.”¶ Even though seed size increased, the amount of nitrogen in the seeds didn’t. Nitrogen levels decreased by an average of 14 percent across all plants except cultivated legumes, such as peas and soybeans.¶ For example, the total number of seeds in wheat and barley plants increased by 15 percent, but the amount of nitrogen in the seeds declined by 20 percent.¶ “That’s bad news,” Curtis said. “Nitrogen is important for building protein in humans and animals. If anything, plant biologists want to boost the levels of nitrogen in crops.¶ “A growing global population demands more food, but humans would have to eat more of the food to get the same nutritional benefits.”

#### Rising C02 levels boost weed growth more than crops

Lewis H. Ziska – Crop Systems and Global Change Laboratory, USDA – 2007, Weeds and Carbon Dioxide, In: Encyclopedia of Pest Management, Volume II, Edited by David Pimentel, <http://www.crcnetbase.com/doi/abs/10.1201/9781420068467.ch186> (and googlebooks)

As global population continues to rise, demand for energy and food will increase concurrently. As a consequence, fossil fuel burning and deforestation will continue to be human-derived sources of atmospheric carbon dioxide. Since the 1950s, direct measurements of carbon dioxide concentration [CO2] have shown an increase of approximately 20%, from 311 parts per million (ppm) to 380 ppm.1'1 The observed increase in [CO;J (~-0.5% per year) is ongoing and global (CO;] is expected to cxeecd 600 ppm by the end of the current century.121¶ Although the association between rising [CO2] and global warming has been emphasized, carbon dioxide is also the sole source of carbon for photosynthesis, and the continuing increase in atmospheric [CO2] should result in a stimulation of plant growth. However, there are over 250.000 plant species, and it seems unlikely that rising carbon dioxide levels will stimulate photosynthesis and promote growth in exactly the same manner by species with no net effect on plant competition or success. For example, based on known biochemical subtypes, plants with C3 photosynthesis (about 95% of all plant species, e.g.. all trees) are more likely than plants with C4 photosynthesis (about 4% of all plain species, e.g.. corn) to respond to increasing [CO2]"¶ But is not more plant growth beneficial to human systems in any case? Critics of global warming point to the likely stimulation of plants by [CO2] as a "wonderful and unexpected gift from the industrial revolution.'1'4' Yet, while there are obvious benefits to agronomically important crops, all plants are not equally desirable. What likely impacts can we anticipate regarding the growth and success of undesirable, or weedy species as [CO2] increases?¶ WEED-CROP INTERACTIONS IN AGROECOSYSTEMS¶ Historically, weeds have always been associated with interference in crop production. Cultivation of agronomically desirable plants has led to inadvertent selection¶ for weedy species that mimic crop phenology. Early global classification of weeds by Holm et al. indicated that a majority of the world's "worst" weeds had C4 photosynthesis, whereas of the 86 crop species that make up 95% of the world's food supply, only five arc C4. Given what is known regarding the response of these different photosynthetic subtypes to rising [CO2], this initially suggested that crop loss owing to weedy competition should decline in response to carbon dioxide.¶ Such an initial perspective now appears overly simplistic. Crop-weed competition varies by region; and C3 and C4 crops will interact with C3 and C4 weeds. Furthermore, a C3 crop vs. a C4 weed interpretation does not address weeds and crops with the same photo-synthetic pathway; yet, many of the worst/troublesome weeds for a given crop are genetically similar with the same photosynthetic type [e.g.. sorghum and Johnson grass (C4); oat and wild oat (C3)]. Although data regarding interactive outcomes between crops and weeds are scarce, as [CO2] increases, crops appear to be only favored where the weed is C4 and the crop C3. All other data suggest a greater competitive ability on the part of the weed as [CO2] increases (Fig. I).¶ INVASIVE WEEDS¶ Clearly, agriculture necessitates an economic cost associated with weed-crop competition. However, human activities have also increased the number of new plant species introduced into unknown areas. While most are beneficial, a few result in widespread environmental damage and have been deemed invasive or noxious weeds. Clearly, it is crucial to recognize those factors that contribute to their biological success.¶ Is the rise in [CO2] one such factor? A recent review suggested that on average, the growth response of individual invasive species to recent [CO2] changes (those since the mtd-l9th century vs. current levels) and projected [CO2] increases (current levels vs. the end of the 2lsl century) are about three and two times that of the published average, respectively, for all individual plants. While this suggests a "stronger than expected" response of individual invasive species, it¶ is their aggregate response within a community that provides the best estimate of whether rising [CO2] is increasing the success of weedy invaders. To date, four of five studies have indicated that [CO2] can preferentially increase the growth of invasive plants within a community. [7]

### Warming Bad – Agriculture

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Warming Bad – Pests Outweigh

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

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

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

### Warming Bad – Superweeds

#### Increased Carbon dioxide results in increased superweeds; killing off crops and spreading quickly.

The Grower- 3-28-08-<http://www.thegrower.com/news/global_warming_may_create_superweeds_117890664.html>

Global warming may be fueling a new generation of more aggressive weeds, according to recent research by the Weed Society of America.¶ **One of the major characteristics of a warming planet is an increase in the amount of carbon dioxide in the atmosphere**. Rising carbon dioxide has been shown to help vegetable and grain crops grow more quickly, become more drought resistant and produce potentially higher yields.¶ **Unfortunately, though, the impact of rising carbon dioxide seems to be far more pronounced in the weeds that compete with crops than in the crops themselves**, says Lee Van Wychen, director of science policy for the Lenexa, Kan.-based society.¶ "Weeds are survivors," he says. "They can fill various niches and thrive under a wide range of conditions**. While we have about 45 major crops in the U.S., there are more than 400 species of different weeds associated with those crops**. ¶ "**There is always another weed species ready to become a major competitor with a crop if growing conditions change, such as an increase in carbon dioxide levels."**¶ The effects of rising carbon dioxide levels on weeds can be striking. In a study conducted by Lewis Ziska, a plant physiologist with U.S. Department of Agriculture's Agricultural Research Service in Beltsville, Md., **weeds grown under urban conditions of warmer temperatures and more carbon dioxide—conditions anticipated for the rest of the world in 50 years—grew to the height of those in a country plot 40 miles outside the city, where carbon dioxide and temperature reflected background conditions.**¶ **His research shows that common ragweed plants exposed to higher levels of carbon dioxide dramatically increased the amount of pollen they produced. A doubling in carbon dioxide led to a quadrupling of pollen.** ¶ **Some people are allergic to ragweed pollen, resulting in the hay fever response, including sneezing and watery eyes. Additional work by Ziska also suggests that even recent increases in carbon dioxide during the past 50 years may have led to bigger poison ivy plants with a more virulent form of the oil that causes people to break out in a rash.**¶ "As the climate and carbon dioxide levels change, we can no longer assume the weed control strategies we used in the past will continue to work," Ziska says. "Not only are some of the nation?s most invasive weeds spreading, but they are becoming more difficult and costly to control. Understanding the impact of increasing carbon dioxide on weed control is still in its infancy. While researchers explore new approaches, we will need to mix and match the strategies currently available."

#### Superweeds spread quickly and kill crops around them

Saikat- May 17,2011- Indian Environmentalist Writer- <http://www.aboutmyplanet.com/environment/superweeds-winning-ground-over-crops-in-the-u-s/>

**Just like human immunity might lose the battle one day against antibiotic resistant germs, so will the same fate befall agricultural crops**. In an alarming development**, the superweeds have risen from the ground and are suffocating crops all around them.** Weeds versus crops have been a battle since the beginning of agriculture. But the modern day fight has moved on to a different battleground where weeds are increasingly resistant to modern day herbicides. In the crosshairs is the widely used herbicide called glyphosate, commonly known as Roundup.¶ An approximated 10 million of the 178 million acres of U.S. farmland growing corn, cotton, and soybeans are now overrun with weeds that are unassailable to the chemical. Herbicide use could cost the industry $1 Billion a year and may force farmers to review older practices that modern chemicals were supposed to replace. In the 1990s, agrotech giant Monsanto introduced genetically modified crops that could withstand glyphosate, so many farmers turned to Roundup as their sole herbicide. **Here started the problem as accidental propagation of a single species introduces genetic invariability – naturally bred resistances as the few weeds that survive pass their robustness to the next generation. 12 U.S. weed species no longer react to glyphosate, and since some seeds are windborne, resistance carries easily from one farm to another.**¶

#### Superweeds result in increased use of toxic weedicides.

Brane Space- 6-23-10- <http://brane-space.blogspot.com/2010/06/super-weeds-highlight-another-co2.html>

**The emergence of these super weeds, especially as threats to farm productivity have convinced many farmers they must resort to much more toxic weedicides to get the job done.** That includes using such infamous carcinogenic agents as: 2, 4- D, dicamba and paraquat. But critics have warned given the uncontrolled factors afoot, such as ever increasing CO2 concentrations (now tipping at nearly 400 ppm) **all that will happen is that even more super weeds will emerge, resistant to even those arch-herbicides.**

### AT: Chinese Winter Wheat

#### Changing precipitation patters destroy Chinese ag – low-end estimates predict a 5% yield loss

Chris Buckley, Reuters – 1/18/12, China report spells out "grim" climate change risks, Ag Professional, http://www.agprofessional.com/news/China-report-spells-out-grim-climate-change-risks-137577948.html?view=all

Global warming threatens China's march to prosperity by cutting crops, shrinking rivers and unleashing more droughts and floods, says the government's latest assessment of climate change, projecting big shifts in how the nation feeds itself.¶ The warnings are carried in the government's "Second National Assessment Report on Climate Change," which sums up advancing scientific knowledge about the consequences and costs of global warming for China -- the world's second biggest economy and the biggest emitter of greenhouse gas pollution.¶ Global warming fed by greenhouse gases from industry, transport and shifting land-use poses a long-term threat to China's prosperity, health and food output, says the report. With China's economy likely to rival the United States' in size in coming decades, that will trigger wider consequences.¶ "China faces extremely grim ecological and environmental conditions under the impact of continued global warming and changes to China's regional environment," says the 710-page report, officially published late last year but released for public sale only recently.¶ Even so, China's rising emissions of carbon dioxide, the main greenhouse gas from burning fossil fuels, will begin to fall off only after about 2030, with big falls only after mid-century, says the report.¶ Assuming no measures to counter global warming, grain output in the world's most populous nation could fall from 5 to 20 percent by 2050**,** depending on whether a "fertilisation effect" from more carbon dioxide in the air offsets losses, says the report.¶ But that possible fall can be held in check by improved crop choice and farming practices, as well as increased irrigation and fertiliser use.¶ China is the world's biggest consumer of cereals and has increasingly turned to foreign suppliers of corn and soy beans.¶ The report was written by teams of scientists supervised by government officials, and follows up on a first assessment released in 2007. It does not set policy, but offers a basis of evidence and forecasts that will shape policy.¶ RISING COSTS OF GROWING FOOD¶ "Generally, the observed impacts of climate change on agriculture have been both positive and negative, but mainly negative," Lin Erda, one of the chief authors of the report, told Reuters.¶ "But steadily, as the temperatures continue to rise, the negative consequences will be increasingly serious," said Lin, an expert on climate change and farming at the Chinese Academy of Agricultural Sciences.¶ "For a certain length of time, people will be able to adapt, but costs of adaptation will rise, including for agriculture."¶ Under different scenarios of greenhouse gas levels and their effects, by the end of this century China's average atmospheric temperature will have risen by between 2.5 degrees and 4.6 degrees Celsius above the average for 1961-1990.¶ Water, either too much or too little, lies at the heart of how that warming could trip up China's budding prosperity.¶ "Climate change will lead to severe imbalances in China's water resources within each year and across the years. In most areas, precipitation will be increasingly concentrated in the summer and autumn rainy seasons, and floods and droughts will become increasingly frequent," says the report.¶ "Without effective measures in response, by the latter part of the 21st century, climate change could still constitute a threat to our country's food security," it says.¶ Under one scenario of how global warming will affect water availability, by 2050 eight of mainland China's 31 provinces and provincial-status cities could face severe water shortages -- meaning less than 500 cubic metres per resident -- and another 10 could face less dire chronic shortages.¶ "Since the 1950s, over 82 percent of glaciers have been in a state of retreat, and the pace has accelerated since the 1990s," the report says of China's glaciers in Tibet and nearby areas that feed major rivers.¶ RISING SEA LEVELS¶ In low-lying coastal regions, rising seas will press up against big cities and export zones that have stood at the forefront of China's industrialisation.¶ In the 30 years up to 2009, the sea level off Shanghai rose 11.5 centimetres (4.5 inches); in the next 30 years, it will probably rise another 10 to 15 centimetres.¶ China's efforts to protect vulnerable coastal areas with embankments are inadequate, says the report, noting their vulnerability to typhoons and flood tides that global warming could intensify.¶ There are sure to be shifts in Chinese crop patterns as well, says the report. More rice and other crops will probably grow in the northeast, thanks to warmer weather and possibly more rain. In the northwest cotton-growing region of Xinjiang, shrinking water availability could lead to a "marked decline in agricultural crop productivity".¶ In northern and southwest areas, winter wheat harvests could shrink due to shifting seasons and less rain when it is needed. Corn-growing regions will need more irrigation and fertiliser.¶ "Future climate warming will therefore increase the costs of agriculture," says the report.¶ China, with 1.34 billion people, already emits a quarter of the world's CO2, with the United States the world's second largest greenhouse gas emitter.¶ The report forecasts China's CO2 emissions could reach between 9 and 9.5 billion tonnes in 2020, given the government's goal of cutting the carbon pollution emitted for each unit of growth by 40-45 percent compared to 2005 levels.¶ China's emissions totalled 8.3 billion tonnes in 2010, according to BP Statistics, representing annual growth of 10.4 percent.¶ The report says China's emissions reduction efforts up to 2020 will cost 10 trillion yuan ($1.6 trillion), including 5 trillion yuan for energy-saving technology and new and renewable energy.¶ "Many cost-effective and mature technologies for energy saving and new and renewable energy have already been widely applied," it says. "In the future, controlling greenhouse gas emissions will require more costly and less mature technologies."

#### Warming changes sowing times and rainfall – devastates Chinese wheat

Li et al - Henan Institute of Meteorological Sciences, Zhengzhou / State University of Colorado – 2008, (Li Shuyan∗a, Cheng Lina, Liu Ronghuaa , Wang Xinlib), Simulations of IPCC SRES Effect upon Winter Wheat Growing in the Chinese Huang - Huai Valley, Remote Sensing and Modeling of Ecosystems for Sustainability V, edited by Wei Gao, Hao Wang Proc. of SPIE Vol. 7083, 70831H, (2008), http://144.206.159.178/ft/CONF/16420412/16420448.pdf

3.2 Global Warming Effect on Wheat Growth/Development An appropriate wheat sowing stage is responsible for its sturdy stands, safely wintering and high-yield formation and the GD depends mainly on effective cumulative temperature in different spans. When climate is changed, the sowing time should be altered, or otherwise the on-going warm winter plus higher cumulative temperature before spring would affect the crop in its GD in winter and spring. Table 3 presents the change in days for the GD under a proper moisture condition, indicating that the development stage of main kinds of winter wheat are influenced differently by warm temperature from both the scenarios in the 2050s, with the growth accelerated and sowing – maturity period shortened. A2 (B2) shows the shortening, on average, of 18.00 (17.50) days and crop varieties of winter character have a little longer interval of shortening (days) compared to those of semi-winter or weak vernal nature. Table 3 also shows that the flowering time is earlier in the scenarios than in the control run, with 20.33 (19.00) days, on average, earlier in A2 (B2). A 2 is for a higher temperature environment so that the flowering day is earlier compared to B2. Simulation yields that the stage between flowering and maturity is prolonged by 2.33 (1.50) days for A2 (B2). The GD phases are under the control of effective cumulative temperature. The higher the mean air temperature, the faster the cumulative temperature increases such that the GD length is shortened and v.v.( Li Yan et al., 2006). The prolonged duration from flowering to maturity probably reflects the slowing down of temperature accumulation during this stage (in days). 3.3 Effect of Climate Change on Wheat Yield and Water Demand Factors influencing the wheat yield include climatic and geographic conditions in addition to its own genetic parameters (Wang et al., 1996). Under the joint impacts of higher temperature and increased rainfall in the 2050s the wheat yields will reduce all over the Huang-Huai valley, with the yield dropping, on average, by 11.53% and 9.66%, respectively for A2 and B2. Although some researchers asserted that warm winter favors wheat wintering, warmer weather contributes to the increase of the number of seeds per spike and to acceleration of milking (see, for example, Gao et al., 1993), spring and autumnal higher temperature elongates the frost-free period, speeds up the GD phase, shortens photosynthesis time and GD stage and decreases the accumulation of dry matter, thereby producing an offsetting effect on the above positive factors. On the other hand, rainfall increase is unable to alleviate effectively the effect on yield drop of warmer temperature. The field evapotranspiration exhibits a reducing trend both in A2 and B2. Because CO2 concentration is on the increase in the external environment, the wheat stoma conductance of leaf reduces to some extent, thus suppressing moisture transpiration in conjunction with the shortened GD stage, increased rainfall, decreased soil evaporation and thus reduced evapotranspiration in the full GD stage, with the evapotranspiration decline by 3.56% (2.96%) for A2 (B2). Table 4 shows that the rate of change in the guarantee irrigation water volume free from moisture stress on winter wheat differs only slightly from the volume needed at present. The full irrigation set in the CERES –Wheat model means that when field water capacity is smaller than its maximum of 90%, the system has to increase water supply via irrigation to reach the maximum, which is an ideal state. The irrigation volume increases a little except individual sites that reduce irrigation by ~4%. For the regional average, the increase is 2.49% and 0.91% for A2 and B2, respectively. Consequently, the irrigation volume has to be kept at the present level or even increase marginally to prevent winter wheat from drought stress as the overall reduction of yields occurs in the study valley. This suggests that climate warming causes the lowered productivity per unit water volume and the ever-increasing shortage of water would make it absolutely impossible to perform a region-scale full irrigation in the 2050s and even for the zones in the central and northeastern plain where irrigation level is better it is difficult to maintain the present yield levels. It is an urgent issue as to realizing higher yields of the food crops. IV. DISCUSSION The validation against data collected in the past decade and more from the representative stations shows that the DSSAT-supported CERES-Wheat model is basically applicable to winter wheat over the Huang-Huai plain. Simulation indicates that A2 scenario has greater effect upon wheat production than B2. If the sowing period were kept unchanged, warming climate would accelerate the GD in the valley. The mean over A2 and that over B2 show that the flowering phase occurs 20 days in advance and the full GD stage is shortened by ~18 days, with the number of days from the flowering to maturity increasing by ~2 days. In association with the shortening of the GD phase due to warming climate, the accumulated dry matter will reduce, reaching ~10% averaged over A2 and B2, separately, for the entire region as well as evapotranspiration drop by ~3% for irrigated wheat. However, the irrigation water volume has to be maintained at the current level or slightly increased to prevent the wheat from dryness stress so that how to warrant high field yields in the future warming climate is a pressing problem. In dealing with negative effects produced by the future climate regime it is necessary to alter the sowing stage, breed high-yield, warmth-resistant crops, improve irrigation techniques as well as management in order to minimize the detrimental factors for yield. It is noteworthy that due to constraints available in the present research, simplifications are made in the simulation, such as the water and nutrient, pest and diseases to the crop as well as anomalous weather, etc. Climate effect on the agricultural system is complex enough so that related researches are to be performed.

#### Co2 can’t offset losses from changes in temperature, radiation, and rainfall – wheat yields will drop by 25%

Anwar et al - Department of Primary Industries (Australia), Washington State Univ – 2007, (Muhuddin Rajin Anwar a,\*, Garry O’Leary a, David McNeil a, Hemayet Hossain b, Roger Nelson), Climate change impact on rainfed wheat in south-eastern Australia, Field Crops Research 104 (2007) 139–147

Low, mid and high daily climate scenarios (2000–2070), as per the International Panel on Climate Change (IPCC) were generated using the Australian Commonwealth Scientific and Industrial Research Organisation’s (CSIRO’s) global atmosphere models. These scenarios based on IPCC’s 21st century emission scenarios that combine a variety of assumptions about demographic, economic and technological driving forces likely to influence such emissions in the future, were used as input to a crop model to predict the impact of climate change on wheat yield at a location in south-eastern Australia. At this locality there are important likely changes in the primary climatic variables of temperature, rainfall and solar radiation. Generally, we found a strong and consistent positive trend in mean diurnal temperature range, followed by a significant negative trend in wheat yield under three climate scenarios with and without elevated CO2 concentration. It is possible that negative trends identified over the future decades may be artefacts of the method of substituting historical variance for future variance. We observed that from present climate to projected low, mid and high global warming scenarios, median wheat yield may decrease by about 29%. Under these scenarios, but with an elevated atmospheric CO2 climate, median wheat yield may decrease by about 25%. The effect of elevated CO2 reduces the severity of the warmer air temperatures and lower rainfall but the effect is small (4%). Advances in agronomy and breeding must boost crop yields by around 25% over the coming decades, to keep in step with predicted climate change. 1. Introduction The Australian wheat industry is highly sensitive to climatic influences. The Australian Bureau of Meteorology and others (e.g., International Panel on Climate Change, IPCC) have released detailed reports on the evidence of climate change in primary climatological data, such as rainfall and temperature (Pittock, 2003). Rainfall has increased over the last 50 years over north-western Australia, but decreased in the southwest of Western Australia, and in much of south-eastern Australia, especially in winter (AGO, 2006). The changes are consistent with an observed increase in mean sea level pressure over much of southern Australia in winter. Atmospheric carbon dioxide (CO2) concentration may rise from the current levels (374 ppm) to between 520 and 720 ppm by the year 2070 (IPCC, 2001). Such changes in climate and CO2 levels would have potentially significant impacts on wheat yields in Australia as well as areas suitable for cropping wheat (Howden and Jones, 2001; Van Ittersum et al., 2003). Australia’s average temperatures have increased by 0.8 8C since 1900 (DSE, 2004). This evidence leads to the question; what effect will climate change have on crop production? To partially answer this question, this study focuses on an assessment of the impact of climate change on wheat crops from a representative rainfed cropping area of Victoria, Australia, at Birchip (Fig. 1). The outputs of Australian Commonwealth Scientific and Industrial Research Organisation’s (CSIRO’s) global atmosphere model (Hennessy et al., 2006) with projected low, mid and high level of climate change scenarios were used as inputs for a crop model to predict the impact of climate change on wheat yield. The projected low, mid and high level of climate change scenarios are based on IPCC (SRES, 2000) greenhouse gas and sulfate aerosol emissions. These IPCC (SRES, 2000) emission scenarios for the 21st century combine a variety of assumptions about demographic, economic and technological driving forces likely to influence such emissions in the future. We highlight how the weather perturbations simulated by the climate model would be reflected in crop performance. We also outline possible adaptations strategies to combat an expected climate change. 2. Methods 2.1. Future climate scenarios The IPCC (2001) attributes most of the global warming observed over the last 50 years to greenhouse gases released by human activities. To estimate future climate change, the IPCC (SRES, 2000) prepared 40 greenhouse gas and sulfate aerosol emission scenarios for the 21st century that combine a variety of assumptions about demographic, economic and technologic driving forces likely to influence such emissions in the future. In this paper, three-climate scenarios (low, mid and high) inline with B2, A2 and A1F1 scenarios, respectively, of the IPCC (SRES, 2000) were generated using CSIRO’s global atmosphere models (McGregor and Dix, 2001; Hennessy et al., 2006) integrated with annual global warming values (8C) (Fig. 2). The CSIRO’s global atmosphere model (CCAM) simulation is driven by CSIRO’s Mark2 and Mark3 climate models, henceforth called CCAM (Mark2) andCCAM(Mark3). Both perform well over south-east Australia, although CCAM (Mark2) has a better simulation of average temperature. Hence, slightly more confidence can be placed in results fromCCAM(Mark2). Climate projections from each model are considered independent since the Mark2 and Mark3 models have different parameterisations of physical processes. Regional climate change patterns from each model were expressed as a change per degree of global warming. This allows the results to be linearly scaled for any future year using the IPCC (2001) global warming estimates (Mitchell, 2003), which include the full range of IPCC SRES (2000) scenarios of greenhouse gas and aerosol emissions, and the full range of IPCC (2001) uncertainty in climate sensitivity to these emissions (Whetton, 2001). In this study, we considered Birchip (35.988S, 142.928E) (Fig. 1), as a representative rainfed wheat growing location in the southern Mallee region of Victoria, Australia. This is a semi-arid region with an average annual rainfall of 368 mm, the long-term (1889–2005) average growing season (April–October) rainfall is 253 mm, the average minimumtemperature in July is 3.6 8C and the average maximum temperature in January is 30.7 8C. The soils in the region are dominantly red-coloured Calcarosols (Nuttall et al., 2003) with about 94 mm plant available water capacity (PAWC).We determined patterns of climate change per degree of global warming on a monthly basis for four climate variables (rainfall, maximum and minimum temperature, and solar radiation) across Victoria (Hennessy et al., 2006). The pattern applied to 71 years (1935–2005) of daily data for Birchip (obtained from SILO patch-point, http://plum.nre.vic.gov.au/ silo/) which was then used to create a 71-year future scenario from 2000 to 2070 by the method described by Suppiah et al. (2001). Thismethod assumes that the identical variance of the detrended historical data (1935–2005) is applied to future climate but the monthly means are amended to reflect the future climate scenarios. We also tested the assumption of substituting the historical variance for future variance by reversing the climatic sequence from 2005 to 1935. Table 1 shows by example the procedure applied to generate daily future climate scenarios for maximum temperature for Birchip, Victoria. A similar procedure was performed for minimum temperature, rainfall and solar radiation applying the relevant monthly pattern of change and global warming value to each observed daily matrix. We observed changes in the monthly maximum and minimum temperatures, rainfall and solar radiation (percent per degree of global warming) and these changes (positive or negative) have been applied in the methodology to create daily future climate (2000–2070) scenarios (Table 1). As an example for 1 month, Fig. 3 shows the solar radiation, rainfall, minimum and maximum temperature patterns of change per degree of global warming for the months of August, January and December, respectively, from CSIRO’s global atmosphere models (CCAM-Mark2 and CCAM-Mark3) for the state of Victoria, Australia (Fig. 1). Minimum and maximum temperature patterns have units of 8C/8C and base climatology (average temperature for 1961–1990) units are 8C. Rainfall patterns have units in %/8C and base climatology (average rainfall for 1961–1990) units are mm. Solar radiation patterns have units of %/8C and base climatology (average radiation for 1961–1990) units are MJ/m2. 2.2. Yield simulation Wheat (Triticum aestivum L. cv. Frame) yield simulation was undertaken using CropSyst version 4 (Sto¨ckle andNelson, 2001), including a new module of response to elevated atmospheric CO2.We generated an additional three input variables needed for CropSyst, i.e., relative humidity (%), dew point (8C) and wind speed (m/s) using CLIMGEN weather generator (Sto¨ckle et al., 1997). CLIMGEN is based on historical data and is designed to preserve interdependence between variables as well as persistence and seasonal characteristics of each variable. CropSyst calculates dry matter accumulation as a function of daily intercepted solar radiation and daily crop transpiration, using constant coefficients of radiation-use efficiency (RUE) (Monteith, 1981), and transpiration efficiency, K (Tanner and Sinclair, 1983). Crop parameters used in CropSyst were 3 g/MJ for aboveground RUE and 5 kPa/kg/m3 for above-ground biomasstranspiration coefficient. Starting conditions (soil water, soil N and residues) for each simulation (long-term 1904–2005, and low, med and high scenarios from 2000 to 2070) were set on the 1st of January of each simulated year based on typical crop practices at Birchip so that the response in the yield over time was due solely to climate and not adaptive management or technological innovation. Initial conditions for model simulations were reset to 10% of plant-available water, 50 kg N/ha, and 1000 kg/ha of canola residues from previous crop. Every year, 50 kg N/ha were applied at sowing (i.e., 20 May). The CropSyst model has been previously satisfactorily tested against field studies in the Mallee region of south-eastern Australia (Diaz-Ambrona et al., 2005). 2.3. Simulation under elevated CO2 Modifications were introduced to CropSyst in order to account for the effects of atmospheric CO2 concentration on plant growth and water use. These modifications are similar to those presented by Sto¨ckle et al. (1992), and are summarised in Table 2. For selecting values of Gratio, a coefficient used to increase daily crop RUE (Table 2), one differentiated between C3 (wheat, barley, sunflower and soybean) and C4 crops (maize and sorghum), but assumes the same response for crops within each of the two classes. For a doubling of atmospheric CO2 from 350 to 700 ppm, potential crop growth was specified to increase by 25%for C3 crops and by 10% for C4 crops. The transpiration efficiency coefficient (k) was also amended to be consistent with RUE adjustments after Tanner and Sinclair (1983) and increased transpiration efficiency due to lower transpiration. This involved amended transpiration as functions of canopy and air resistances and the fraction of intercepted radiation under a modified CO2 environment compared to the base line environment (Table 2). The performance of the model (CropSyst with elevated CO2) has successfully been evaluated for diverse environments (e.g., Tubiello et al., 2000; Sto¨ckle et al., 1992). 3. Results The projected climatic scenarios provide important observations. The most critical is the pattern of change seen in all variables (temperature, rainfall and solar radiation) where large gradients extend across the region of study (Fig. 3). There were differences in absolute changes between models (CCAMMark2 and CCAM-Mark3), but the direction of change was generally consistent. Consequently, we used the mean of both models for our future synthetic climate. At our study site (Birchip) in the month of August the CCAM-Mark2 model showed a 3% increase in solar radiation while the CCAMMark3 model showed no changes. In other months there were large predicted changes in temperature, rainfall and radiation (Fig. 3). The historical annual rainfall at Birchip showed high variability with a negative trend toward the latter decades (Fig. 4). The drier periods are associated with El Nin˜o Southern Oscillation (ENSO) (Power et al., 1998). In our projected climate for the three scenarios, we see a downward shift in the median annual rainfall. For the low global warming scenarios (low-GW) the annual rainfall is projected to be 351 mm compared to the historical value of 372 mm (Fig. 4). For the high global warming scenarios (high-GW) annual rainfall is project to fall to 346 mm. Whilst the decline in annual rainfall seems small (7%) the distribution of rainfall in association with the shift in other variables is expected to have a large effect on crop production. There are some quality concerns about the temperature data at Birchip prior to 1957, so our analysis excluded earlier data. We observed a significant positive (slope = + 0.024 8C/year, P = 0.004) historical trend of mean diurnal temperature range at Birchip (Fig. 5A). Similarly, this trend was evident in all the future climate scenarios with the slope varying from +0.0075 to +0.0206 8C/year (Fig. 5B–D). An increase in the mean diurnal temperature range potentially can reduce the risk of frost risk for winter crops, but the rise in temperature will accelerate phenological development and shift the sensitive flowering stage to a higher frost risk window (Stone et al., 1996). We observed significant decadal variability in simulated wheat yield in the historical data (Fig. 6A). The trend was negative with slopes ranging from 6.01 kg/ha/year from 1904 to 1970 and 11.5 kg/ha/year from 1970 to 2005 (Fig. 6A). The absolute yields are consistent with farm yield from the region (Rodriguez et al., 2006). Median wheat yield were highest (1651 kg/ha) in the historical long-term scenario (1904–2005) with a coefficient of variation (CV) of 42% and lowest (1151 kg/ha) in the high-GWscenario (Fig. 6F) with high yield variability (CV = 50%). Future wheat yield was highest (1436 kg/ha) under the low-GW scenario with enhanced CO2 concentration (Fig. 6C). Our analyses show that wheat yield would decrease by about 29% from the present climate in the projected low, mid and high scenarios and by about 25% in the projected climates with enhanced CO2. The effect of elevated CO2 is to minimise the negative effects of rising temperature and decreasing rainfall but it is unable to fully compensate (by 4%) for these more negative factors. It is tempting to view the negative yield trends of the future scenarios as likely real trends because of the expected rising temperature and radiation changes and declining rainfall (see negative slopes 5.86 kg/ha/year to 15.25 kg/ha/year in Fig. 6). However, when we regenerated the future climate data using the reverse variance from 2005 to 1935 the trends were all positive (+7.25 kg/ha/year to +21.71 kg/ha/year), but the median negative changes were nearly identical to the analyses using the historical variance from 1935 to 2005 (Fig. 7). Despite experiencing the historical or reverse historical variance in the future climate scenarios we conclude similar median crop yield declines (about 25–29% from current level) to occur at Birchip over the next 70 years without any genetic or agronomic improvement. 4. Discussion This paper suggests that the projected climate change at Birchip in north-western Victoria will reduce wheat yields. There are a number of reasons why climate change may influence yields both positively and negatively. Firstly, an increase in temperature will shorten the phenological phases. This will reduce the time for light and water capture and will reduce water and light use. A simultaneous anticipated decrease in rainfall will reduce water availability (e.g., Whetton et al., 1993). Accelerated crop development and a short grain filling period will reduce wheat grain yield. While Mitchell et al. (1993) observed significant increases in winter wheat yields from a CO2 doubling at optimum temperature, high CO2 did not make up for yield losses when plants were grown at high temperatures that caused stress and a shortening of the grain filling period. A second likely response is the C-fertiliser effect that is expected under an elevated CO2 climate. While additional available carbon will create an initial yield increase, because of increased efficiency of use of light, water, nitrogen and other minerals, such as phosphorous (Gifford et al., 2000; Drake et al., 1997; Barrett and Gifford, 1999), in dry environments reduced water-use and water-use efficiency because of lower soil water availability and the shortened growth periods due to accelerated phenology will reduce yields. In dry environments with nutrient limitations the C-fertiliser effect has been considered small (Amthor, 2001). In general, our analyses concur with Luo and Mooney (1999) and Wolfe (1994) that the CO2 fertilisation effect cannot compensate for negative effects from other environmental stresses. Climate variability is the consequence of an intrinsically non-linear and deterministically chaotic system (Ghil et al., 2002) and there are limits to what can be predicted about our future climate. We have attempted to analyse what might be achievable given such uncertain knowledge. Our analysis considers changes in temperature, solar radiation and rainfall unlike many other climate change studies. In many climate change impact studies (e.g., Tubiello, 1997; Tubiello et al., 1999; Howden and Jones, 2001; Ludwig and Asseng, 2006) the growth simulations only consider the predicted changes in mean temperature, elevated CO2 levels and precipitation ignoring future changes in solar radiation, and daily and interannual variability of all the climate variables. Had a larger variability of temperature and precipitation, and future solar radiation changes been included under climate change scenarios, as current studies indicate, the study might have resulted in more negative effects of climate change on simulated crop yields (Mearns et al., 1992). It is also possible that the equations used in present crop models (e.g., APSIM, CropSyst, CERES-wheat) to predict the effects of elevated CO2 on crop yield, based on the concept of radiation-use efficiency and transpiration efficiency and performed in daily time steps, are too simplistic to provide realistic predictions of yield. Some authors have argued that mechanistic feedbacks between photosynthetic rates and leaf stomatal conductance must be resolved, and that to this end smaller computing time-steps are necessary (Connor and Fereres, 1999; Grant et al., 1999). One of the problems of climate change research is that the mean response is predicted but not the variance. But daily timestep models like CropSyst or APSIM need daily data that has some variance. The problem is what variance should be applied. Of course it is thought that the future climate will, become more varied so this is even more problematic. But to be conservative, Suppiah et al. (2001) and Watterson (2005) used the historical variance but applied in a way to preserve the historical autocorrelation. That is, a 10-year historical drought will be also present in the new climate but with different means following to the CGM predictions. It is this mirror image of the autocorrelation that is misleading with respect to trend, as demonstrated by our reverse analysis. But the mean response over the period is identical with either approach and it is therefore valid to rely on this analysis. An important finding from our study is the problem of what variance to apply to future scenarios. We have assumed that the current variability we see in the historical data is indicative of future climate variability, but it is possible that there might be increased variability making the management of dryland cropping systems even more problematic. However, our reverse historical variance method highlights the uncertainty posed by this assumption and only the mean trends are likely to be indicative of the future crop performance in north-western Victoria. Factors limiting crop responses to climate may include plant adaptation to CO2, source-sink relationships, pest-crop interactions, and site-specific characteristics, such as soil structure, stoniness, salinity, etc. (e.g., Patterson and Flint, 1990). If these factors were incorporated in the simulation study, model predictions of crop response to elevated CO2 and climate change might have predicted even more negative effects of climate change on crop yields (Mearns et al., 1992; Amthor, 2001; Van Ittersum et al., 2003). However, recently, Howden and Jones (2001) argue that enhanced production is possible if growers respond with appropriate adaptation strategies (up to 8% increase in mean production). Strategies to adapt to climate change should concentrate on the greatest impact of higher temperatures and reduced rainfall and its effect on lowering crop yields. Such strategies include breeding more drought-tolerant cultivars, increasing water-use efficiency and better matching phenology to the new environmental conditions. It is important to consider what constitutes climate change as either ‘beneficial’ or ‘disastrous’. In regions like southern Australia under a beneficial climate change, adaptations can extend the positive effects of increased CO2 and temperature (up to 3 8C) but only in scenarios where rainfall increases (Howden and Jones, 2001). In contrast, a drier climate may be considered as a disastrous scenario where wheat yield is reduced, especially on soils with low water storage capacity increasing the risk of crop failure (Wessolek and Asseng, 2006). Monocultures may also be more vulnerable to climate change, and changing to diversify agricultural production systems should allow farmers to cope better with climate variation from year to year (Bindi and Howden, 2004). In terms of management options available to farmers, strategies that increase water supply, such as stubble retention and reduced tillage should also become more important. Use of seasonal climate forecasts could also play an important part in reducing risk in climate variability (Bindi and Howden, 2004). Despite large yield declines predicted due to climate change, we do not see cause for alarm because it is possible, and indeed probable, that productivity advances in genetics and agronomy could overcome the negative trends, and indeed reverse the trend to higher crop yields by 2070. For this to occur, investment in plant breeding and agronomy should be maintained at present or increased levels (Howden and Jones, 2001).

### AT: Soil Erosion

#### Warming increases soil erosion – climactic changes

RATTAN LAL – Env and Nat Resources Prof Ohio State – 2005, Climate Change, Soil Carbon Dynamics,

and Global Food Security, Climate Change and Global Food Security, http://www.crcnetbase.com/doi/pdfplus/10.1201/9781420028614.ch5

Projected change in climate may influence several soil processes with a consequent adverse impact on soil quality (Brinkman and Sombroek, 1996). Important among these processes with an attendant adverse impact on soil quality are: • Hydrolysis: the leaching of silica and basic cations • Cheluviation: removal of Al and Fe by chelating organic acids • Ferrolysis: transformation of clay by alternating oxidation and reduction processes, and reduction in cation exchange capacity • Dissolution: of clay minerals by strong acids producing acid aluminum salts and amorphous silica • Clay formation: reverse weathering leading to clay formation and transformation Hydrolysis and cheluviation may accelerate with temperature increases, and ferrolysis may occur in soils subject to reduction and oxidation in high latitudes and monsoonal climates. These processes increase soil erodibility and decrease water-and nutrient-retention capacity. Two schools of thought exist with regard to the effects of projected climate change on soil quality. The first school argues that climate change is likely to exacerbate global food insecurity, with increased risks of soil degradation. Accelerated soil erosion and other degrading processes already affect soil quality, especially in developing countries of the tropics and subtropics (Table 5.8). The land area affected by water erosion is estimated at 227 million ha in Africa, 441 million ha in Asia, 123 million ha in South America, and 46 million ha in Central America. Soil degradation by other processes is also a problem in developing areas. In South Asia, 25% of agricultural land is estimated to be affected by water erosion, 18% by wind erosion, 13% by fertility decline, 9% by salinization, 6% by lowering of the water table, and 2% by waterlogging (FAO, 1994). It sounds strange to say that fortunately these are overlapping categories. Soil degradation is likely to be accelerated by projected climate change, especially in ecologically sensitive regions. Global hot spots of soil erosion include the Himalayan– Tibetan ecosystem, the unterraced slopes of China and Southeast Asia, tropical areas of Southeast Nigeria, the semiarid Sahelian region of West Africa, sloping lands of Central America, and the Andean valleys and cerrado region of South America (Scherr and Yadav, 1996). Soil erosion rates are likely to change due to the erosive power of rainfall produced by more extreme precipitation events (IPCC, 1995). Since 1910 there has been a steady increase in the area of the United States affected by extreme events (>2" or >50.8 mm of rain in a 24-hour period) (Karl et al., 1996). Areas susceptible to wind erosion usually become drier and become more severely affected (Williams et al., 2002). In the U.S. Corn Belt, Lee et al. (1996) predicted that although a 2°C increase in temperature would decrease water erosion by 3% to 5%, wind erosion would increase by 15% to 18%. Thus, total erosion was predicted to increase as a consequence of increased temperature. Regions prone to salinization include the Indus, Nile, Tigris, and Euphrates river valleys; northeast Thailand; northern China; northern Mexico; and the Andean highlands (Scherr and Yadav, 1996; Norse et al., 2001). It is estimated that 20% of total irrigated area is already affected by salinization, and 12 million ha of irrigated land may have already gone out of production for this reason (Nelson and Mareida, 2001). Higher temperatures due to projected climate change, especially in arid and semi-arid regions, may produce higher evaporative demand for water and exacerbate the drought that often follows the plow (Glantz, 1994). If the soil and water are adequate, as with irrigation, it turns out that an increase in evaporative demand may heighten the risks of salinization (Brinkman and Sombroek, 1996). However, under high atmospheric CO2 conditions, there may be increased salt tolerance of crops (Bowman and Strain, 1987). Revegetation by overgrazing and other factors could exacerbate the problem of desertification (U.N. Environmental Programme, 1997), especially in Sub-Saharan Africa. Risks of overextraction of groundwater for irrigation in South Asia and also in the Near East/North Africa region are already recognized as serious (FAO, 1990). Soil degradation is thus a major threat to global food security (Oldeman, 1998), and this threat may be increased with anticipated climate change. Soil degradation, especially that caused by accelerated erosion, characteristically involves depletion of soil organic matter. Most degraded soils contain an SOC pool that is below their potential set by ecological factors. Lee et al. (1996) observed that when the SOC pool decreased by 4.8 MT/ha in the U.S. Corn Belt, about 50% of this loss was due to accelerated soil erosion. Further, increased temperature and precipitation accelerate losses of SOC. These can exacerbate nutrient depletion in low-input agricultural systems that are already vulnerable to severe nutrient depletion, as is the case in Ghana (Rhodes, 1995) and elsewhere in Sub-Saharan Africa (Stoorvogel and Smaling, 1990). Sustainability of agriculture in the Sahel is already problematic (Reardon, 1995). It becomes even more difficult to attain with increased risks of soil degradation.

#### Their models are bad- human induced soil erosion is highly unlikely

Johnson 1 (D. Gale, Eliakim Hastings Moore Distinguished Service Professor of Economics Emeritus at the University of Chicago., August 1, pg. http://www.heartland.org/Article.cfm?artId=1058)

That erosion exists cannot be questioned. After all, the Yellow River didn't get its name by accident. But in much of the discussion of erosion, as well as other aspects of soil degradation, it is seldom asked whether the erosion is human induced--it tends to be merely assumed that it is. In addition, when and where there is erosion, little or no evidence is provided as to whether it occurs on farmland. Lindert directly addresses the issue of whether the erosion has taken a serious toll on the farmlands of two countries. As noted below, he finds no evidence that the depth of the topsoil has declined over a period of half a century in these two countries. One can hope that future estimates of soil degradation, including the extent of soil erosion, will utilize the real evidence that is available rather than speculating of the basis of models not grounded in historical data.

#### Soil erosion is exaggerated – there’s no threat.

Julian Simon, Senior Fellow @ CATO Institute, 1997, “Digging Deeper into the Soil Erosion Scam,” CATO Institute, https://www.cato.org/pub\_display.php?pub\_id=6139

The soil erosion claims were equally ridiculous. According to the USDA, only a tiny proportion of cropland--3 percent--is so erosive that no management practices can help much. Seventy-seven percent of cropland erodes at rates below 5 tons per acre each year, the equilibrium rate at which new soil is formed below the surface; that is, most cropland erodes less than the "no net loss rate." Just 15 percent of U.S. cropland "is moderately erosive and eroding about a 5-ton tolerance. Erosion on the land could be reduced with improved management practices," though this does not necessarily mean the land is in danger or is being managed uneconomically. In short, the aggregate data on the condition of farm and the rate of erosion do not support the concern about soil erosion. What's more, the data suggest that the condition of cropland has been improving rather than worsening. Theodore W. Schultz, the only agricultural economist to win a Nobel Prize, and Leo V. Mayer of the USDA, both wrote very forcefully that the danger warnings were false. Mr. Schultz cited not only research but also his own lifetime recollections starting as a farm boy in the Dakotas in the 1930s.