### Add-on

**No extinction**

**INPCC 11**. Nongovernmental International Panel on Climate Change. Surviving the unprecedented climate change of the IPCC. 8 March 2011. <http://www.nipccreport.org/articles/2011/mar/8mar2011a5.html>

In a paper published in *Systematics and Biodiversity*, Willis *et al*. (2010) consider the IPCC (2007) "predicted climatic changes for the next century" -- i.e., their contentions that "global temperatures will increase by 2-4°C and possibly beyond, sea levels will rise (~1 m ± 0.5 m), and atmospheric CO2will increase by up to 1000 ppm" -- noting that it is "widely suggested that the magnitude and rate of these changes will result in many plants and animals going extinct," citing studies that suggest that "within the next century, over 35% of some biota will have gone extinct (Thomas *et al*., 2004; Solomon *et al*., 2007) and there will be extensive die-back of the tropical rainforest due to climate change (e.g. Huntingford *et al*., 2008)." On the other hand, they indicate that some biologists and climatologists have pointed out that "many of the predicted increases in climate have happened before, in terms of both magnitude and rate of change (e.g. Royer, 2008; Zachos *et al*., 2008), and yet biotic communities have remained remarkably resilient (Mayle and Power, 2008) and in some cases thrived (Svenning and Condit, 2008)." But they report that those who mention these things are often "placed in the 'climate-change denier' category," although the purpose for pointing out these facts is simply to present "a sound scientific basis for understanding biotic responses to the magnitudes and rates of climate change predicted for the future through using the vast data resource that we can exploit in fossil records." Going on to do just that, Willis *et al*. focus on "intervals in time in the fossil record when atmospheric CO2 concentrations increased up to 1200 ppm, temperatures in mid- to high-latitudes increased by greater than 4°C within 60 years, and sea levels rose by up to 3 m higher than present," describing studies of past biotic responses that indicate "the scale and impact of the magnitude and rate of such climate changes on biodiversity." And what emerges from those studies, as they describe it, "is evidence for rapid community turnover, migrations, development of novel ecosystems and thresholds from one stable ecosystem state to another." And, most importantly in this regard, they report "there is very little evidence for broad-scale extinctions due to a warming world." In concluding, the Norwegian, Swedish and UK researchers say that "based on such evidence we urge some caution in assuming broad-scale extinctions of species will occur due solely to climate changes of the magnitude and rate predicted for the next century," reiterating that "the fossil record indicates remarkable biotic resilience to wide amplitude fluctuations in climate.

**No extinction – empirics**

**Fettweis 11**

Christopher, Professor of Political Science @ Tulane, Dangerous Times?: The International Politics of Great Power Peace, pg. 127-128

It should go without saying that the planet's existence is not "in peril." The Earth will survive in one form or another perfectly fine, whether or not there are people able to live upon it. Moreover, there is little doubt that people will be able to continue to exist, and plenty of room for hope that we will he able to adjust peacefully over time to the warming climate. Humanity found ways to deal with prior environmental crises, from the disappearing ozone layer to acid rain, without fighting. The warming climate can he thought of as another challenge to the stability of the post-Cold War era; a corresponding increase in conflict is an empirical prediction that can he tested as the coming decades unfold. The predictions, and logic upon which they are based, are set for future evaluation. If the performance to date of the ecopessimist vision predictions is any indication of the validity of the assumptions upon which it is based, now may not be the time to begin buying property in Antarctica. The ecopessimist research program will charge ahead throughout the new century, no doubt. Evidence, or lack thereof, will matter little; we will continue to he told that resource wars are just around the corner. Recall that one of the great values of the evaluation of predictions, and what makes it such an important way to increase our understanding of international politics, is that unlike post facto explanations predictions cannot he changed to retrofit the data. The evidence is rather clear that this vision, thus far at least, was wrong, since the world has stubbornly refused to conform to the expectations ofthose who thought that environmentally induced anarchy was coming. An evaluation of the stages through which petroleum geopolitics pass suggests that even resource wars may, like all other forms, be all but obsolete

**Now there was no warrant highlighted in the 2ac impact evidence for me to read specific impact defense to, but the unhighlighted warrant in the card is climate wars**

**That will never happen**

**Tertrais 11**, Bruno, Senior Research Fellow at the Foundation for Strategic Research, and a Washington Quarterly editorial board member [“The Climate Wars Myth,” Summer, The Washington Quarterly • 34:3 pp. 1729]

So much for ‘‘climate wars.’’ But the idea according to which climate change is nevertheless a new, important factor to be taken into account in defense and security planning is itself questionable. Of course, nothing precludes us from including it in the growing list of non-military issues that may have a bearing on global security. But this has to be done in a realistic way. It is not unreasonable to state that climate change may be a ‘‘threat multiplier,’’ for instance.47 However, stating this says nothing about the probability of increased violence or instability either at the global level or for a given crisis, or about the likelihood of state failure. Such consequences depend primarily on the reaction of governments and societies, a factor which is impossible to calculate in advance. There are no data to support the vague idea that climate change can have a key role in triggering collective violence that is, be the proverbial straw that breaks the camel’s back, as argued by an alarmist study (citing once again the example of Darfur).48 Climate is ‘‘one of myriad factors in a complex causal web underlying conflict,’’ and the environment is just ‘‘one of manifold and nonessential causal factors’’ which may lead to war.49 The main causes of contemporary conflict are societal, not natural (in the broadest sense of the term, i.e., including man-made).50 Conflicts are borne out of human choices and mistakes.

**Ice age coming now – co2 key prevent end of civilization**

Marsh ‘12 (Gerald E. Marsh, 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, “The Coming of a New Ice Age,” <http://www.winningreen.com/site/epage/59549_621.htm>, 2012)

CHICAGO — 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.

**Outweighs all impacts**

**Whitehouse 12** – science adviser to the Global Warming Policy Foundation (David, 01/11, “Could rising CO2 levels help prevent the next ice age?” http://www.publicserviceeurope.com/article/1338/could-rising-co2-levels-help-prevent-the-next-ice-age)

That the trees no longer completely canopy this land is due to mankind as we cleared the forests. That the ice is no longer here is due to global warming. Without doubt, we live in an interglacial period – a warm time between ice ages. There have been many during the current great glaciation. Some have these periods have been warmer than today, many shorter than our current interglacial's duration. The return of the ice would, short of a giant meteor strike, be the biggest disaster to face humanity. Vast swathes of the northern Hemisphere would be frozen. Northern Europe, Asia, Canada and the United States would have extensive regions rendered uninhabitable. Mankind would have to move south. There would be no choice as no technology could stop the ice or allow our high populations to life amongst it. Some believe the return of the ice will not happen for thousands of years, other that the signs could be visible within decades. But could it be that the greenhouse gasses being pumped into the atmosphere, that many believe are responsible for a recent warming of the planet, might counteract the forces bringing us a new glaciation? Could it be that greenhouse gasses might actually stave off the return of the ice and save the lives of tens of millions, if not civilisation itself? A recent study by scientists at Cambridge University and published in the Journal Nature Geoscience suggests that the carbon dioxide might extend the current interglacial until carbon dioxide levels fall. They believe that the atmospheric concentration of CO2 must be about 240 parts per million before glaciation could start. Currently, it is about 390 ppm. In a 1999 essay, Sir Fred Hoyle said: "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."

**Ice age coming now- 2022 is the solar peak. These are cycles in the atmosphere inevitably will occur- Co2 keeps up artificially alive- ice age is a question of when and not if- we are 600 years overdue**

**Boyle ‘12** (Popular Science (Rebecca, 01/08, “Human CO2 Emissions Could Avert the Next Ice Age, Study Says,” http://thegwpf.org/science-news/4714-human-co2-emissions-could-avert-the-next-ice-age-study-says.html)

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. Their 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.

**Every Co2 particle is a life**

Watts ’12 (Anthony Watts, American meteorologist, president of IntelliWeather Inc., editor of the blog, Watts Up With That?, and founder of the Surface Stations Project, “Increased CO2 Emissions Will Delay Next Ice Age”, <http://wattsupwiththat.com/2012/01/08/increased-co2-emissions-will-delay-next-ice-age/>, January 8, 2012)

Sir Fred Hoyle Vindicated (Via Dr. Benny Peiser of the GWPF) According to new research to be published in Nature Geoscience (embargoed until 1800 GMT/10AM PST, Sunday 8 January 2012), the next ice age could set in any time this millennium were it not for increases in anthropogenic CO2 emissions that are preventing such a global disaster from occurring. The new research confirms the theory developed by the late Sir Fred Hoyle and Professor Chandra Wickramasinghe in the 1990s that without increased levels of CO2 emissions into the atmosphere ‘the drift into new ice-age conditions would be inevitable.’ [...] The problem for the present swollen human species is of a drift back into an ice-age, not away from an ice-age. Manifestly, we need all the greenhouse we can get, even to the extent of the British Isles becoming good for the growing of vines…. 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. Since bolide impacts cannot be called up to order, 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.

**Newest evidence proves peatlands will cause an ice age – only continued emissions solve**

Page 11/9 (Lewis Page, Posted in Science, “An ICE AGE is coming, only CO2 can save us”, November 9, 2012)

A group of Swedish scientists at the University of Gothenburg have published a paper in which they argue that spreading peatlands are inexorably driving planet Earth into its next ice age, and the only thing holding back catastrophe is humanity's hotly debated atmospheric carbon emissions. "We are probably entering a new ice age right now. However, we're not noticing it due to the effects of carbon dioxide," says Professor of Physical Geography Lars Franzén, from the Department of Earth Sciences at Gothenburg uni. Franzén and his colleagues have examined various scenarios for the peatlands of Sweden, which are a continually expanding "dynamic landscape element". According to the scientists: Peatlands grow in height and spread across their surroundings by waterlogging woodlands. They are also one of the biggest terrestrial sinks of atmospheric carbon dioxide. Each year, around 20 grams of carbon are absorbed by every square metre of peatland. The scientists have calculated that the potential is there for Swedish peatlands to triple in extent, enormously increasing their carbon sink effect. By extrapolating to include the rest of the world's high-latitude temperate areas - the parts of the globe where peatland can expand as it does in Sweden - they project the creation of an extremely powerful carbon sink. They theorise that this is the mechanism which tends to force the Earth back into prolonged ice ages after each relatively brief "interglacial" warm period. "Carbon sequestration in peatland may be one of the main reasons why ice age conditions have occurred time after time," says Franzén. With no other factors in play, the time is about right for the present interglacial to end and the next ice age to come on. Indeed, Franzén and his crew think it has barely been staved off by human activity: The researchers believe that the Little Ice Age of the 16th to 18th centuries may have been halted as a result of human activity. Increased felling of woodlands and growing areas of agricultural land, combined with the early stages of industrialisation, resulted in increased emissions of carbon dioxide which probably slowed down, or even reversed, the cooling trend. Other scientists have attributed the Little Ice Age to a quiet period in the Sun's activity: others say it was purely a local effect in Europe, though that theory has lately been disproved by research in Antarctica. In any case, the scientists assess that if it weren't for human activity such as carbon emissions, we could expect a new ice era in short order. They write: Thus, on a global scale, carbon sequestration in peatlands may have had important climate cooling effects towards the ends of previous interglacials ... It cannot be ruled out that similar effects would be seen in a hypothetical Holocene lacking human presence. It's probably worth noting that the great physicist Freeman Dyson long ago suggested that only relatively small amounts of new peatland would be enough to sequestrate colossal amounts of CO2 from the air. Other scientists have noted in recent times that brief warming spells like that observed at the end of the 20th century appear to have occurred towards the end of previous interglacial periods - just before the glaciers returned. If Franzén and his team are right, the big chill is now under way, and is only just being held off by increasing human carbon emissions - perhaps explaining why temperatures have been merely flat for the last 15 years or so, rather than descending. The Swedish scientists' paper is published in the peer-reviewed journal Mires and Peat, and can be read here in pdf.

**Best studies go neg**

**Amos ‘12** (Jonathon Amos, Science correspondent, BBC News, “CO2 'drove end to last ice age',” <http://www.bbc.co.uk/news/science-environment-17611404>, April 4, 2012)

A new, detailed record of past climate change provides compelling evidence that the last ice age was ended by a rise in temperature driven by an increase in atmospheric carbon dioxide. The finding is based on a very broad range of data, including even the shells of ancient tiny ocean animals. A paper describing the research appears in this week's edition of Nature. The team behind the study says its work further strengthens ideas about global warming. "At the end of the last ice age, CO2 rose from about 180 parts per million (ppm) in the atmosphere to about 260; and today we're at 392," explained lead author Dr Jeremy Shakun. "So, in the last 100 years we've gone up about 100 ppm - about the same as at the end of the last ice age, which I think puts it into perspective because it's not a small amount. Rising CO2 at the end of the ice age had a huge effect on global climate." The study covers the period in Earth history from roughly 20,000 to 10,000 years ago. This was the time when the planet was emerging from its last deep chill, when the great ice sheets known to cover parts of the Northern Hemisphere were in retreat. The key result from the new study is that it shows the carbon dioxide rise during this major transition ran slightly ahead of increases in global temperature. This runs contrary to the record obtained solely from the analysis of Antarctic ice cores which had indicated the opposite - that temperature elevation in the southern polar region actually preceded (or at least ran concurrent to) the climb in CO2. This observation has frequently been used by some people who are sceptical of global warming to challenge its scientific underpinnings; to claim that the warming link between the atmospheric gas and global temperature is grossly overstated. But Dr Shakun and colleagues argue that the Antarctic temperature record is just that - a record of what was happening only on the White Continent. By contrast, their new climate history encompasses data from all around the world to provide a much fuller picture of what was happening on a global scale. This data incorporates additional information contained in ices drilled from Greenland, and in sediments drilled from the ocean floor and from continental lakes. These provide a range of indicators. Air bubbles trapped in ice, for example, will record the past CO2 concentrations in the atmosphere. Past temperatures can also be inferred from ancient planktonic marine organisms buried in the sediments. That is because the amount of magnesium they would include in their calcite skeletons and shells was dependent on the warmth of the water in which they swam. "Our global temperature looks a lot like the pattern of rising CO2 at the end of the ice age, but the interesting part in particular is that unlike with these Antarctic ice core records, the temperature lags a bit behind the CO2," said Dr Shakun, who conducted much of the research at Oregon State University but who is now affiliated to Harvard and Columbia universities. "You put these two points together - the correlation of global temperature and CO2, and the fact that temperature lags behind the CO2 - and it really leaves you thinking that CO2 was the big driver of global warming at the end of the ice age," he told BBC News.

**Warming for Co2 overwhelms- stream shutdown false**

CS ’12 (ClimateSight, edited by Kate, scientist, presenter at the 2011 Fall AGU, American GeoPhysical Union, Fall Conference “The Day After Tomorrow: A Scientific Critique,” <http://climatesight.org/2012/04/26/the-day-after-tomorrow-a-scientific-critique/>, April 46, 2012)

Additionally, Jack’s statements regarding the plausibility of an imminent Gulf Stream shutdown due to global warming fly in the face of current scientific understanding. As the world continues to warm, and the Greenland ice sheet continues to melt, the North Atlantic circulation will probably slow down due to the added freshwater. The resulting cooling influence on parts of Europe will probably still be overwhelmed by warming due to greenhouse gases. However, a complete shutdown of the Gulf Stream is extremely unlikely within this century. It’s unclear whether an eventual shutdown is even possible, largely because there is less land ice available to melt than there was during the Younger Dryas. If such an event did occur, it would take centuries and still would not cause an ice age – instead, it would simply cancel out some of the greenhouse warming that had already occurred. Cooling influences simply decrease the global energy balance by a certain amount from its initial value; they do not shift the climate into a predetermined state regardless of where it started.

**Most qualified studies go negative**

Hoffman ’10 (Doug L. Hoffman, Worked professionally as a mathematician, a computer programmer, an engineer, a computer salesman, a scientist, and a college professor. Dr. Hoffman earned his undergraduate degree, a BS in Applied Mathematics, from the Florida Institute of Technology. There he cut his teeth on computer models of heat flow and urban traffic simulations. After graduating, he performed hydro-acoustic work for the U.S. Navy in the Virgin Islands, where he first met Allen Simmons. Later projects included engineering work on the Carrier Automatic Landing System and cockpit field of view simulations, and environmental models for the Saudi Arabian government, He returned to academia in 1990, earning a Masters degree and a PhD in Computer Science at the University of North Carolina at Chapel Hill. While there he did research in Molecular Dynamics Simulations and, as a member of the BioSCAN team, he helped develop and implement high-speed comparison methods for RNA, DNA, and protein sequences, work funded by the Human Genome Project. After joining the research faculty at UNC, he continued to pursue his thesis work, automated comparison of three dimensional protein molecules, Since 2000, he has been working in industry, serving as senior grid architect for a major information processing company, publishing several papers on modeling the performance of large scale grid computers. With a life long passion for education, he has also continued to teach as an adjunct Professor of Computer Science at Hendrix College and the University of Central Arkansas, “Ocean Conveyor Belt Dismissed”, <http://theresilientearth.com/?q=content/ocean-conveyor-belt-dismissed>, June 29, 2010)

After nearly 50 years of acceptance, the theory that a great ocean “conveyor belt” continuously circulates water around the globe in an orderly fashion has been dismissed by a leading oceanographer. According to a review article in the journal Science, a number of studies conducted over the past few years have challenged this paradigm. Oceanographers have discovered the vital role of ocean eddy currents and the wind in establishing the structure and variability of the ocean’s overturning. In light of these new discoveries, the demise of the conveyor belt model has been become the new majority opinion among the world's oceanographers. According to M. Susan Lozier, of Duke University, “the conveyor-belt model no longer serves the community well.” The idea that the ocean conveyor belt transports cold, dense water from the subpolar North Atlantic along the “lower limb” of the conveyor belt to the rest of the global ocean, where the waters are upwelled and then transported along the “upper limb” back to deepwater formation sites, has been supported by the majority of oceanographers for decades. This circulating flow was assumed to operate along western boundary currents in the deep ocean and provide a continuous supply of relatively warm surface waters to deepwater formation sites. While it was thought to be vulnerable to changes in deepwater production at high latitudes, with significant injections of fresh water capable of disrupting the smooth operation of the system, under normal conditions the conveyor belt was thought to function constantly and consistently. Now it seems that opinions within the oceanographic community have shifted, and the great ocean conveyor belt model has fallen from grace. As detailed in an eye opening article by Dr. Lozier, the conveyor belt has been found wanting and dismissed as the dominant ocean overturning paradigm. Lozier is Professor of Physical Oceanography and Chair of the Earth and Ocean Sciences Division at Duke, and is an expert in large-scale ocean circulation, water mass distribution and variability. The article, “Deconstructing the Conveyor Belt,” begins with a short history of the conveyor belt theory's development. According to Lozier, our modern idea of the ocean’s overturning, and our understanding of its importance to Earth's climate, developed as a result of the work of two prominent oceanographers: Fifty years ago, Henry Stommel theorized that recently ventilated waters of high-latitude origin must be transported equatorward at depth along western-intensified boundary currents. Assuming that water masses formed via deep convection in isolated regions in the northern North Atlantic and near Antarctica essentially fill the abyssal ocean, Stommel surmised that the deep ocean exports these waters via a distributed upwelling to the surface. Furthermore, he suggested that because such upwelling produces a stretching of the water column that induces a loss of angular momentum, the deep interior waters must compensate by flowing poleward toward regions of higher angular momentum. Thus, the equatorward transport of deep water masses was confined to the western boundaries of the basins. Stommel’s theory gave the ocean’s overturning, previously amorphous in its third dimension, a structure: Deep waters are transported equatorward in a steady, continuous deep western-intensified boundary current from their formation sites at high latitudes. The abyssal flow field, as theorized by Stommel in 1958. The second important oceanographer was the eminent Wallace S. “Wally” Broecker, Newberry Professor in the Department of Earth and Environmental Sciences at Columbia University and a scientist at Columbia's Lamont-Doherty Earth Observatory. Arguably one of the world’s greatest living geoscientists, for more than half a century, Broecker has investigated the ocean’s role in climate change. He was among the pioneers in using radiocarbon and isotope dating to track historical climate change, and the influence of climate change on polar ice and ocean sediments. It was Broecker who coined the term “ocean conveyor belt.” According to Lozier, work by Broecker and colleagues suggested that the ocean’s overturning was responsible for the rapid climate fluctuations experienced during Earth’s last glacial period. “Though the importance of the ocean’s overturning to Earth’s climate had previously been understood, Broecker’s work essentially cemented the role of the conveyor belt as an agent of climate change,” states her review. “Thus, just as Stommel’s work gave spatial structure to the overturning, Broecker’s provided a temporal context.” So what has changed oceanography's mindset enough to proclaim the conveyor belt—arguably the most important discovery in the history of oceanography—an idea whose time has past? Since its proposal, oceanographers have understood that the conveyor model is an oversimplification of the way ocean overturning actually takes place. But it was believed to be a useful simplification, capable of providing an overall model of the ocean's transportation of heat energy, if not the exact details. But now it seems that some major features of the conveyor belt have been called into question. Here is a list of recent discoveries that have shaken the foundation of the conveyor belt theory. Most of the subpolar-to-subtropical exchange in the North Atlantic occurs along interior pathways. The deep deep western boundary current (DWBC) breaks up into eddies at 11°S. There is little meridional coherence in the overturning transport from one gyre to the next . Wind forcing, rather than buoyancy forcing, can play a dominant role in changing the transport of the overturning. The southward transport of deep waters at 8°S, off the Brazilian coast, was shown to be carried entirely by migrating coherent eddies. Floats launched within the DWBC at 53°N do not follow a continuous boundary current, but instead take multiple paths to the subtropics, including interior pathways far removed from the DWBC. Two recent studies have found unexpected pathways in the upper ocean. A recent study shows that MOC transport in the subtropical North Atlantic is susceptible to variability in the "leakage" of warm and salty water into the South Atlantic. Studies showing little to no coherence across gyre boundaries have prompted interest in monitoring the overturning circulation in the South Atlantic and the subpolar North Atlantic. The connectivity of the overturning and, more importantly, of the meridional heat transport from one basin to the next can no longer be assumed on interannual time scales. When all of these observations are combined, they indicate that the conventional conceptual model of ocean overturning needs revamping. As Dr. Lozier put it: “In sum, the impact of eddies on our concept of a continuous lower limb for the ocean’s overturning has evolved from an understanding that eddies can detrain and entrain fluid along the DWBC to the recognition that the DWBC can, at certain locales and perhaps certain times, be a series of migrating eddies, to the realization that eddy-driven flow provides an alternate pathway for deep waters to spread globally.” In other words, it doesn't work as simply as we thought. Lozier is in a good position to make such a judgment, since it is partly due to her work that scientists are revisiting the conveyor belt model. As noted on this blog in “Conveyor Belt Model Broken,” work by Lozier and Amy Bower of Wood’s Hole, using RAFOS float data, showed that there was something fundamentally wrong with how the ocean's overturning flow was being modeled. By analyzing the divagating float paths, it was discovered that ocean currents did not behave as expected. Reported back in May of 2009, their discovery had the potential to affect both short term and long term climate change. This is because ocean currents not only redistribute surface warmth, the oceans themselves are a vast reservoir for heat and carbon dioxide. I concluded that this finding invalidated the IPCC's GCM climate model predictions, because the models were based on incorrect behavior of the ocean overturning currents. At the time, Dr. Lozier took exception to my supposition, stating in an email, “the climate models care first and foremost about the return of the surface waters and our research has no bearing in the slightest on those waters.” I disagreed, saying that the discovery of significant eddies changed the assumptions on how the deep sea currents flow, which must change the boundary conditions between different masses of water. This cannot help but alter the long term reaction of the ocean to the energy flowing through it. More recently, variations in continuous data measurements from cable-moored instrument arrays identified large and unexpected yearly fluctuations in conveyor flow. As additional discoveries have unfolded, it was also found that there are large reservoirs of CO2 stashed away in the deep ocean, again previously unexpected. As the evidence has piled up, Dr. Lozier has been forced to admit that there are implications for climate change and the way the Earth system is modeled. In her own words: Added impetus for revamping comes from a recent study revealing a considerable reservoir of anthropogenic CO2 in the deep North Atlantic, surmised to result from the production of high-latitude water masses and their subsequent equatorward spread. Clearly, an improved understanding of the pathways of the upper and lower limbs of the ocean’s overturning will aid assessments of the ocean’s role in the uptake, transport, and storage of heat and CO2, crucial components of Earth’s climate system. This reinforces the claim that previous climate models—which are highly dependent on the coupling between ocean and atmosphere and, hence, the ocean circulation models they contain—cannot be considered accurate reconstructions of Earth's climate system. I repeat my earlier assertion: if the conveyor belt model is wrong then none of the IPCC's model results can be taken seriously. This point is underscored by recent work that found small changes in high latitude insolation, driven by Earth's orbital cycles, can trigger significant changes in lower latitude ocean and atmospheric circulation. The circulation of Earth's oceans is now known to be much more complex and nuanced than even a decade ago, which has significant implications for climate modeling.

### Extra

**Co2 fertilization key to Chinese wheat- key to global food security**

Knappenberger 12/19 (Paul C. Knappenberger, Administrator of the World Climate Report, Assistant Director of the Center for the Study of Science, Global Science Report is a weekly feature from the Center for the Study of Science, “CO2 Benefits Outweigh Climate Stressors: Chinese Wheat”, December 19, 2012)

In the vast majority of laboratory and field experiments, the benefits of higher atmospheric carbon dioxide (CO2) concentrations for plants (including food crops) generally outweigh the negative impacts from climate change. And this is even assuming the “dumb farmer scenario” that we recently blogged, in which farmers and agronomists don’t develop new production techniques, technologies, crop varietals, etc., to adapt to change, turning expected losses into gains. There is overwhelming evidence such as the remarkably robust increase that has occurred in the yield of most of the world’s major crops when grown in developing or developed nations. In other words, adding CO2 to the atmosphere may be a win-win situation for the world’s vegetation, but we digress… Here, we’ll highlight a new study showing that including the fertilization effect of higher CO2 concentrations in a crop model of wheat grown in China turns projections of future climate change-driven reductions in crop yields into CO2-driven yield increases. The study was conducted by researchers Yujie Liu and Fulu Tao of the Chinese Academy of Sciences and will soon be published in the Journal of Applied Meteorology and Climatology. Liu and Tao used a complex crop model to evaluate the changes in wheat production (which accounts from 22% China’s primary food production), in the main wheat cultivation areas in China under three climate change scenarios—global temperature increases of 1°, 2°, and 3°C. They modeled the crop response both with and without considering the fertilization impacts of additional atmospheric CO2 concentrations (which presumably produced the warming) and compared the results. Here is their summary: There is a high probability of decreasing (increasing) changes in yield and water use efficiency under higher temperature scenarios without (with) consideration of CO2 fertilization effects. Elevated CO2 concentration generally compensates for the negative effects of warming temperatures on production. Moreover, positive effects of elevated CO2 concentration on grain yield increase with warming temperatures. The findings could be critical for climate change-driven agricultural production that ensures global food security. Findings and conclusions like these are a breath of carbon dioxide-enhanced fresh air in a world of climate gloomsaying.

**Chinese political instability causes nuclear war**

Yee et al. ‘2 (Herbert Yee, Professor of Politics and International Relations at the Hong Kong Baptist University, and Ian Storey, Lecturer in Defence Studies at Deakin University, 2002, “The China Thre AT: Perceptions, Myths and Reality,” RoutledgeCurzon, 2002)

The forth factor contributing to the perception of a China threat is the fear of political and economic collapse in the PRC, resulting in territorial fragmentation, civil war and waves of refugees pouring into neighbouring countries. Naturally, any or all of these scenarios would have a profoundly negative impact on regional stability. Today the Chinese leadership faces a raft of internal problems, including the increasing political demands of its citizens, a growing population, a shortage of natural resources and a deterioration in the natural environment caused by rapid industrialization and pollution. These problems are putting a strain on the central government’s ability to govern effectively. Political disintegration or a Chinese civil war might result in millions of Chinese refugees seeking asylum in neighbouring countries. Such an unprecedented exodus of refugees from a collapsed PRC would no doubt put a severe strain on the limited resources of China’s neighbours. A fragmented China could also result in another nightmare scenario—nuclear weapons falling into the hands of irresponsible local provincial leaders or warlords. From this perspective a disintegrating China would also pose a threat to its neighbours and the world.

#### Co2 fertilization increases pigeon peas- key to Indian food security

Chitra et al. ’12 (Chitra N, Suhas Yelshetty, Malathi S, Jyosthna MK, Laxmi P Reddy, Singh SK, Chattopadhyay C, Deshmukh GP, Harer PN, Chavan AP, Bantewad SD, Das SB, Chandrashekara K, Parmar RD, Rao MS, Prasad YG, Prabhakar M, Sharma OP, Bhagat S, Singh Niranjan, Awasthi M, Singh Dharmendra, Sathyakumar S, Agarwal M, Singh Narendra, Ghosh Vishal, Kumari Alpana and Vennila S, National Initiative on Climate Resilient Agriculture, “MANUAL FOR PIGEONPEA PEST SURVEILLANCE”, http://www.ncipm.org.in/nicra/nicrapdfs/manuals/Manual%20for%20Pigeonpea%20Pest%20Surveillance.pdf, March 23, 2012)

Pigeonpea (Cajanus cajan (L.) Millsp.) is one of the most important legume crops of the tropics and subtropics of Asia and Africa. Pigeonpea, also known by names such as redgram, arhar and tur in India, offers nutritional security due to its richness in protein (21%) along with mineral supplements viz.,iron and iodine. India is the world’s largest producer and consumer of pulses including pigeonpea. About 90% of the global pigeonpea area (4.9 M.ha.) is in India contributing to 93% of the global production. Maharashtra, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu and Bihar are the major growing States of our country. Chhattisgarh, Rajasthan, Odisha, Punjab and Haryana also grow the crop but in lesser area. India with its area of 3.75 million hectares produces 3.1 million tonnes with its productivity ranking ninth in the world. The productivity levels range from 360 to 1145 kg/ha owing to the cultivation of the crop on a wide range of soils in different cropping systems across varied agro climatic regions. Crop’s ability to resist drought and to add large quantities of biomass to the soil in addition to nitrogen fixation makes it a good choice for rainfed as well irrigated production systems. Kharif is the growing season of pigeonpea in India. Moisture stress and sudden drop in temperature coupled with frost and foggy weather during the pod development stage, and terminal drought cause yield reduction leading to instability in production. In the context of climate change, it has been revealed that legumes, in general and pigeonpea, in particular have the potential to maximize the benefit of elevated CO2 arising out of climate change effects by matching stimulated photosynthesis with increased nitrogen fixation. Such a positive result illustrates the importance of pigeonpea as a crop of sustained supporter of food and nutritional security under the climate change scenarios. Limitation to the increasing productivity of pigeonpea is also due to biotic stresses prevalent across the pulse growing regions. Among biotic stresses diseases viz., wilt, sterility mosaic and foliar diseases and insect pests feeding on pods lead to significant yield losses. Climate change is expected to trigger changes in diversity and abundance of arthropods, geographical and temporal distribution of insect pests, insect biotypes, herbivore plant interactions, activity and abundance of natural enemies, and efficacy of crop protection technologies. We expect both the crop in terms of phenology and physiology and the pests in their occurrence and abundance likely to change. Study of impact of climate change on pigeonpea crop-pest interactions requires carefully collected data on long term basis. While already available historical data could form an approach for partial study of climate change impacts, formulation and implementation of a robust research strategy combining the present scenario of cropping patterns, cultivars, and production and protection practices across heterogeneous locations over time would yield improved and holistic understanding. Considering the importance of the pigeonpea grown across Indian cropping systems as a pulse crop and its associated role in food and nutritional security, “National Initiative on Climate Resilient Agriculture” (NICRA) provided thrust to improve the productivity level of the crop through assessment of the changing pest dynamics in relation to climate, and through development of forewarning models.

#### That’s critical to Indian power

**Robinson ‘10** (David, History lecturer at Edith Cowan University in Perth, Western Australia, PhD in History, mid-way through a Master of International Relations degree, “India’s Rise as a Great Power,” June 17, <http://lfort.wordpress.com/2010/06/17/indias-rise-as-a-great-power/>)

Despite India’s meteoric economic development, it can be said India has both the best of the First World and the worst of the Third World within its borders, and faces unprecedented human security challenges.[16] India now has 410 million people living below the U.N. poverty line – 37.2 percent of its population and actually 100 million more people than in 2004 – and millions of India’s rural poor are faced with food price inflation of up to 17 percent.[17] 60 percent of Indian labour is still agricultural, and the integration of hundreds of millions of peasants into a modern economy may be an extremely painful process.[18] And while Indian infrastructure such as roads, civil aviation, ports, and telecommunications have experienced noticeable improvements in recent years, electricity, railways, and irrigation all still need significant investment; and India continues to lag in social infrastructure, such as education and healthcare.[19] These social inequalities have fuelled the widespread ‘Naxalite’ Maoist insurgency affecting vast areas throughout eastern and central India, and whose 20,000 insurgents current Prime Minister Manmohan Singh identified as the “greatest internal security threat” facing the nation.[20] These internal issues pose the first challenge to India’s rise as a great power, as external projection must be based on a firm foundation of domestic stability. The requirements for domestic stability also shape India’s international needs. Pant asserts that, “The biggest challenge for India remains that of continuing to achieve the rates of economic growth that it has enjoyed in recent years. Everything else is of secondary importance. … Unless India can sustain this momentum, its larger foreign policy ambitions cannot be realized”.[21]

#### The impact turns and outweighs everything else—ends in extinction

Kamdar ‘7 (Mira Kamdar, World Policy Institute, 2007, Planet India: How the fastest growing democracy is transforming America and the world, p. 3-5)

No other country matters more to the future of our planet than India. There is no challenge we face, no opportunity we covet where India does not have critical relevance. From combating global terror to finding cures for dangerous pandemics, from dealing with the energy crisis to averting the worst scenarios of global warming, from rebalancing stark global inequalities to spurring the vital innovation needed to create jobs and improve lives—India is now a pivotal player. The world is undergoing a process of profound recalibration in which the rise of Asia is the most important factor. India holds the key to this new world. India is at once an ancient Asian civilization, a modern nation grounded in Enlightenment values and democratic institutions, and a rising twenty-first-century power. With a population of 1.2 billion, India is the world’s largest democracy. It is an open, vibrant society. India’s diverse population includes Hindus, Muslims, Sikhs, Christians, Buddhists, Jains, Zoroastrians, Jews, and animists. There are twenty-two official languages in India. Three hundred fifty million Indians speak English. India is the world in microcosm. Its geography encompasses every climate, from snowcapped Himalayas to palm-fringed beaches to deserts where nomads and camels roam. A developing country, India is divided among a tiny affluent minority, a rising middle class, and 800 million people who live on less than $2 per day. India faces all the critical problems of our time—extreme social inequality, employment insecurity, a growing energy crisis, severe water shortages, a degraded environment, global warming, a galloping HIV/AIDS epidemic, terrorist attacks—on a scale that defies the imagination. India’s goal is breathtaking in scope: transform a developing country of more than 1 billion people into a developed nation and global leader by 2020, and do this as a democracy in an era of resource scarcity and environmental degradation. The world has to cheer India on. If India fails, there is a real risk that our world will become hostage to political chaos, war over dwindling resources, a poisoned environment, and galloping disease. Wealthy enclaves will employ private companies to supply their needs and private militias to protect them from the poor massing at their gates. But, if India succeeds, it will demonstrate that it is possible to lift hundreds of millions of people out of poverty.  It will prove that multiethnic, multireligious democracy is not a luxury for rich societies.  It will show us how to save our environment, and how to manage in a fractious, multipolar world.  India’s gambit is truly the venture of the century.

#### Loss of arable land means Co2 fertilization is the only way to increase food production fast enough to solve for coming resource shortages- short timeframe for food crisis instability- our impacts turns theirs

Carter et.al ‘11(Carter Robert, PhD, Adjuct Research Fellow, James Cook University, Fred Singer, PhD, President of the Science and Environmental Policy Project, Susan Crockford, evolutionary biologist with a specialty in skeletal taxonomy , paleozoology and vertebrate evolution, Joseph D’Aleo, 30 years of experience in professional meteorology, former college professor of Meteorology at Lyndon State College, Indur Goklany, independent scholar, author, and co-editor of the Electronic Journal of Sustainable Development, Sherwood Idso, President of the Center for the Study of Carbon Dioxide and Global Change, Research Physicist with the US Department of Agriculture, Adjunct Professor in the Departments of Geology, Botany, and Microbiology at Arizona State University, Bachelor of Physics, Master of Science, and Doctor of Philosophy, all from the University of Minnesota, Madhav Khandekar, former research scientist from Environment Canada and is an expert reviewer for the IPCC 2007 Climate Change Panel, Anthony Lupo, Department Chair and Professor of Atmospheric Science at the University of Missouri, Willie Soon, astrophysicist at the Solar and Stellar Physics Division of the Harvard-Smithsonian Center for Astrophysics, Mitch Taylor (Canada) [“Climate Change Reconsidered 2011 Interim Report,” September, Science and Environmental Policy Project, Center for the Study of Carbon Dioxide and Global Change)

Many other researchers have broached this subject. In a paper recently published in the Annual Review of Plant Biology, three scientists associated with the Institute of Genomic Biology at the University of Illinois at Urbana-Champaign (USA) write that meeting the global increase in agricultural demand during this century ―is predicted to require a doubling of global production,‖ but ―the world has limited capacity to sustainably expand cropland,‖ and this capacity is actually ―shrinking in many developed countries.‖ Thus, Zhu et al. (2010) state, ―meeting future increases in demand will have to come from a near doubling of productivity on a land area basis,‖ and they conclude ―a large contribution will have to come from improved photosynthetic conversion efficiency,‖ estimating ―at least a 50% improvement will be required to double global production.‖ The researchers‘ reason for focusing on photosynthetic conversion efficiency derives from the experimentally observed facts that increases in the atmosphere‘s CO2 concentration increase the photosynthetic rates of nearly all plants, and those rate increases generally lead to equivalent—or only slightly smaller—increases in plant productivity on a land area basis. That provides a solid foundation for their enthusiasm in this regard. In their review of the matter, however, they examine the prospects for boosting photosynthetic conversion efficiency in an entirely different way: genetically, without increasing the air‘s CO2 content. ―Improving photosynthetic conversion efficiency will require,‖ the three scientists state, ―a full suite of tools including breeding, gene transfer, and synthetic biology in bringing about the designed alteration to photosynthesis.‖ For some of these ―near-term‖ endeavors, they indicate ―implementation is limited by technical issues that can be overcome by sufficient investment,‖ meaning they can ―be bought.‖ But several ―mid-term‖ goals could take 20 years or more to achieve; and they state ―even when these improvements are achieved, it may take an additional 10–20 years to bring such innovations to farms in commercial cultivars at adequate scale.‖ And if that is not bad enough, they say of still longer-term goals that ―too little of the science has been undertaken to identify what needs to be altered to effect an increase in yield,‖ while in some cases they acknowledge that what they envision may not even be possible, as in developing a form of RuBisCO that exhibits a significant decrease in oxygenation activity, or in designing C3 crops to utilize the C4 form of photosynthetic metabolism. Clearly, we do not have the time to gamble on our ability to accomplish what needs to be done in order to forestall massive human starvation of global dimensions within the current century. Therefore—in addition to trying what Zhu et al. suggest—we must rely on the ―tested and true‖: the CO2-induced stimulation of plant photosynthesis and crop yield production. And all we need to do in this regard is to refrain from interfering with the natural evolution of the Industrial Revolution, which is destined to be carried for some time yet on the backs of fossil-fuel-driven enterprises that can provide the atmosphere with the extra carbon dioxide that will be needed to provide the extra increase in crop growth that may mean the difference between global food sufficiency and human starvation on a massive scale a mere few decades from now. What, then, can we do to defuse the ticking time-bomb of this looming food and water crisis? One option is to do nothing: don‘t mess with the normal, unforced evolution of civilization‘s means of acquiring energy. This is because on top of everything else we may try to do to conserve both land and freshwater resources, we will still fall short of what is needed to be achieved unless the air‘s CO2 content rises significantly and thereby boosts the water use efficiency of Earth‘s crop plants and that of the plants that provide food and habitat for what could be called ―wild nature,‖ enabling both sets of plants to produce more biomass per unit of water used. To ensure this happens, we will need all of the CO2 that will be produced by the burning of fossil fuels, until other forms of energy truly become more cost-efficient than coal, gas, and oil. In fact, these other energy sources will have to become much more cost-efficient before fossil fuels are phased out, because the positive externality of the CO2-induced increase in plant water use efficiency provided by the steady rise in the atmosphere‘s CO2 concentration due to the burning of fossil fuels will be providing a most important service in helping us feed and sustain our own species without totally decimating what yet remains of wild nature.

#### Global food insecurity causes global war

Vidal ’12 (John Vidal, UN University, Guardian's Environment Editor, “Food scarcity: the timebomb setting nation against nation”, <http://ourworld.unu.edu/en/food-scarcity-the-timebomb-setting-nation-against-nation/>, October 15, 2012)

Brandon Hunnicutt has had a year to remember. The young Nebraskan from Hamilton County farms 2,600 acres of the High Plains with his father and brother. What looked certain in an almost perfect May to be a “phenomenal” harvest of maize and soy beans has turned into a near disaster. A three-month heatwave and drought with temperatures often well over 38°C burned up his crops. He lost a third and was saved only by pumping irrigation water from the aquifer below his farm. “From 1 July to 1 October we had 4 inches of rain (10 centimeters) and long stretches when we didn’t have any. Folk in the east had nothing at all. They’ve been significantly hurt. We are left wondering whether the same will happen again,” he says. On the other side of the world, Mary Banda, who lives in Mphaka village near Nambuma in Malawi, has had a year during which she has barely been able to feed her children, one of whom has just gone to hospital with malnutrition. Government health worker Patrick Kamzitu says: “We are seeing more hunger among children. The price of maize has doubled in the last year. Families used to have one or two meals a day; now they are finding it hard to have one.” Hunnicutt and Banda are linked by food. What she must pay for her maize is determined largely by how much farmers such as Brandon grow and export. This year the US maize harvest is down 15% and nearly 40% of what is left has gone to make vehicle fuel. The result is less food than usual on to the international market, high prices and people around the world suffering. “This situation is not going to go away,” says Lester Brown, an environmental analyst and president of the Earth Policy Institute in Washington. In a new book, Full Planet, Empty Plates, he predicts ever increasing food prices, leading to political instability, spreading hunger and, unless governments act, a catastrophic breakdown in food. “Food is the new oil and land is the new gold,” he says. “ We saw early signs of the food system unravelling in 2008 following an abrupt doubling of world grain prices. As they climbed, exporting countries [such as Russia] began restricting exports to keep their domestic prices down. In response, importing countries panicked and turned to buying or leasing land in other countries to produce food for themselves.” “The result is that a new geopolitics of food has emerged, where the competition for land and water is intensifying and each country is fending for itself.” Brown has been backed by an Oxfam report released last week. It calculated that the land sold or leased to richer countries and speculators in the last decade could have grown enough food to feed a billion people — almost exactly the number of malnourished people in the world today. Nearly 60% of global land deals in the last decade have been to grow crops that can be used for biofuels, says Oxfam. The next danger signal, says Brown, is in rising food prices. In the last 10 years prices have doubled as demand for food has increased with a rapidly growing world population and millions have switched to animal-based diets, which require more grain and land. Most grain prices have risen between 10% and 25% this year after droughts and heatwaves in Ukraine and Australia as well as the US and other food growing centres. The UN says prices are now close to the crisis levels of 2008. Meat and dairy prices are likely to surge in the new year as farmers find it expensive to feed cattle and poultry. Brown says: “Those who live in the United States, where 9% of income goes for food, are insulated from these price shifts. “But how do those who live on the lower rungs of the global economic ladder cope? They were already spending 50% to 70% of their income on food. Many were down to one meal a day already before the recent price rises. What happens with the next price surge?” Oxfam said last week it expected the price of key food staples, including wheat and rice, to double again in the next 20 years, threatening disastrous consequences for the poor. But the surest sign, says Brown, that food supplies are precarious is seen in the amount of surplus food that countries hold in reserve, or “carry over” from one year to the next. “Ever since agriculture began, carry-over stocks of grain have been the most basic indicator of food security. From 1986 to 2001 the annual world carry-over stocks of grain averaged 107 days of consumption. After that, world consumption exceeded production and from 2002 to 2011 they averaged just 74 days of consumption,” says Brown. Last week the UN estimated US maize reserves to be at a historic low, only 6.3% below estimated consumption and the equivalent of a three-week supply. Global carry-over reserves last week stood at 20%, compared to long term averages of well above 30%. Although there is still — theoretically — enough food for everyone to eat, global supplies have fallen this year by 2.6% with grains such as wheat declining 5.2% and only rice holding level, says the UN. There is no guarantee, says Brown, that the world can continue to increase production as it has done for many years. “Yields are plateauing in many countries and new better seeds have failed to increase yields very much for some years,” he said. Evan Fraser, author of Empires of Food and a geography lecturer at Guelph University in Ontario, Canada, says: “For six of the last 11 years the world has consumed more food than it has grown. We do not have any buffer and are running down reserves. Our stocks are very low and if we have a dry winter and a poor rice harvest we could see a major food crisis across the board.” “Even if things do not boil over this year, by next summer we’ll have used up this buffer and consumers in the poorer parts of the world will once again be exposed to the effects of anything that hurts production.” Brown says: “An unprecedented period of world food security has come to an end. The world has lost its safety cushions and is living from year to year. This is the new politics of food scarcity. We are moving into a new food era, one in which it is every country for itself.”

#### Peak farmland – fastest timeframe impact

Leschin-Hoar 12/18 (Clare Leschin-Hoar covers seafood, sustainability and food politics. Her work has appeared in Scientific American, The Wall Street Journal, Grist, Eating Well, “Are We Already Farming Enough Land to Feed 9 Billion People?”, <http://news.yahoo.com/already-farming-enough-land-feed-9-billion-people-204625010.html>, December 18, 2012)

Humanity has reached peak farmland. It’s a chilling phrase, isn’t it? Not like peak oil, which we’re long-used to hearing by now. And much more poignant than recent reports of peak fertilizer. (Which is really about peak phosphorous, and certainly is critical, but it doesn’t conjure up quite the same pastoral image.) No, peak farmland is something you can actually envision, and the pronouncement comes at a time when we’re closing in on a global population of 9 billion hungry mouths.

#### We control all offense uniqueness- yields are increasing now

Carter et.al ’11 (Carter Robert, PhD, Adjuct Research Fellow, James Cook University, Fred Singer, PhD, President of the Science and Environmental Policy Project, Susan Crockford, evolutionary biologist with a specialty in skeletal taxonomy , paleozoology and vertebrate evolution, Joseph D’Aleo, 30 years of experience in professional meteorology, former college professor of Meteorology at Lyndon State College, Indur Goklany, independent scholar, author, and co-editor of the Electronic Journal of Sustainable Development, Sherwood Idso, President of the Center for the Study of Carbon Dioxide and Global Change, Research Physicist with the US Department of Agriculture, Adjunct Professor in the Departments of Geology, Botany, and Microbiology at Arizona State University, Bachelor of Physics, Master of Science, and Doctor of Philosophy, all from the University of Minnesota, Madhav Khandekar, former research scientist from Environment Canada and is an expert reviewer for the IPCC 2007 Climate Change Panel, Anthony Lupo, Department Chair and Professor of Atmospheric Science at the University of Missouri, Willie Soon, astrophysicist at the Solar and Stellar Physics Division of the Harvard-Smithsonian Center for Astrophysics, Mitch Taylor (Canada) [“Climate Change Reconsidered 2011 Interim Report,” September, Science and Environmental Policy Project, Center for the Study of Carbon Dioxide and Global Change)

Turning to the effect of warming on cultivation, Dong et al. (2009) state ―the annual mean surface air temperature in China has increased 1.1°C over the past 50 years,‖ adding that ―striking warming has occurred since the mid-1980s, particularly in northern China.‖ Noting annual accumulated temperatures greater than 10°C (AAT10) represent ―an important indicator of thermal conditions in crop ecology (Qiu and Lu, 1980; Bai et al., 2008),‖ which ―affects the choice of crop varieties, the crop calendar, cropping systems and crop patterns (Zheng et al., 2008),‖ the five Chinese scientists decided to ―assess the relationship between accumulated temperature change and cultivated land use in China from the late 1980s to 2000,‖ in order to determine the impact of the dramatic warming on the nation‘s agriculture. They found ―since the late 1980s, AAT10 has noticeably risen in most of China.‖ More specifically, Dong et al. indicate 1.22 x 1015 km2 of land moved from the potato accumulated temperature zone (ATZ) to the spring wheat ATZ, that 3.16 x 1015 km2 of land moved from the spring wheat ATZ to the winter wheat ATZ, and that 1.64 x 1015 km2 of land moved from the winter wheat ATZ to the rice ATZ. In addition, they determined ―because of improved thermal conditions since the late 1980s,‖ farmers changed from a single crop per year to three crops in two years in many regions, while ―the growth boundary of winter wheat moved northward.‖ With respect to the cropping index, which they define as the number of crops grown per year on a given area of land, the researchers from the Chinese Academy of Sciences state, ―as a result of climate warming on a national scale, it is feasible for the cropping index to improve.‖ They report that, indeed, ―cropping indices have improved in many regions since the 1980s,‖ citing the studies of Yan et al. (2005) and Li et al. (2008). Hence, they indicate ―to acquire higher yields of food and income, people have improved the cropping index in regions that had previously been difficult to crop and also in some areas where the index was low.‖ The past century‘s increasing temperature and atmospheric CO2 concentration have not in any way hurt the people of China. Quite to the contrary, they have improved the country‘s capacity to provide the quantities of food needed to support its population. Much the same can be said of Canada. Working with a homogenized temperature dataset consisting of daily maximum and minimum air temperatures for the period 1895–2007 obtained from 210 meteorological stations distributed across the country, plus an adjusted precipitation dataset developed at the Climate Research Division of Environment Canada, Qian et al. (2010) derived a set of agroclimatic indices that are sure to prove useful for agricultural production planning purposes for many years to come. They report, for example, that their results indicate ―a significant lengthening of the growing season due to a significantly earlier start and a significantly later end of the growing season,‖ and they state ―significant positive trends are also observed for effective growing degree-days and crop heat units at most locations across the country.‖ They also report ―the occurrence of extremely low temperatures has become less frequent during the non-growing season, implying a more favorable climate for overwinter survival,‖ and ―the total numbers of cool days, frost days, and killing-frost days within a growing season have a decreasing trend,‖ so ―crops may also be less vulnerable to cold stress and injury during the growing season.‖ They also found ―extreme daily precipitation amounts and 10-day precipitation totals during the growing season have been increasing,‖ and ―significant trends associated with increased availability of water during the growing season are identified.‖ These desirable results clearly indicate the global warming that brought an end to the debilitating cold of the Little Ice Age and ushered the planet into the Current Warm Period is proving to be a real boon to Canada, as well as to the rest of the world, which may have to depend upon North America‘s northernmost country to supply a significant portion of the food that will be required to support Earth‘s burgeoning human population in the decades to come.

#### Co2 solves:

#### Nitrogen

#### Increases nitrogen cycling – solves the nitrogen turn – we cite the only study in existence on this

Carter et.al ‘11(Carter Robert, PhD, Adjuct Research Fellow, James Cook University, Fred Singer, PhD, President of the Science and Environmental Policy Project, Susan Crockford, evolutionary biologist with a specialty in skeletal taxonomy , paleozoology and vertebrate evolution, Joseph D’Aleo, 30 years of experience in professional meteorology, former college professor of Meteorology at Lyndon State College, Indur Goklany, independent scholar, author, and co-editor of the Electronic Journal of Sustainable Development, Sherwood Idso, President of the Center for the Study of Carbon Dioxide and Global Change, Research Physicist with the US Department of Agriculture, Adjunct Professor in the Departments of Geology, Botany, and Microbiology at Arizona State University, Bachelor of Physics, Master of Science, and Doctor of Philosophy, all from the University of Minnesota, Madhav Khandekar, former research scientist from Environment Canada and is an expert reviewer for the IPCC 2007 Climate Change Panel, Anthony Lupo, Department Chair and Professor of Atmospheric Science at the University of Missouri, Willie Soon, astrophysicist at the Solar and Stellar Physics Division of the Harvard-Smithsonian Center for Astrophysics, Mitch Taylor (Canada) [“Climate Change Reconsidered 2011 Interim Report,” September, Science and Environmental Policy Project, Center for the Study of Carbon Dioxide and Global Change)

Jin and Evans (2010) write, ―resource limitations, such as the availability of soil nitrogen (N), are expected to constrain continued increases in plant productivity under elevated atmospheric carbon dioxide.‖ This is a common belief. Providing a glimmer of hope, however, they state, ―one potential but under-studied N source for supporting increased plant growth under elevated CO2 is soil organic N.‖ They report, ―in arid ecosystems, there have been no studies examining plant organic N uptake to date.‖ To help remedy this situation, Jin and Evans grew seedlings of the desert shrub Larrea tridentata in environmentally controlled chambers in ambient or CO2-enriched air (380 or 600 ppm) in pots filled with Mojave Desert (Nevada, USA) soils injected with isotopically labeled 15N obtained from one of three different organic and inorganic sources—(1) organic 15N glycine, (2) inorganic 15NH4+, or (3) inorganic 15NO3-. They then destructively harvested the plants following zero, two, ten, 24, and 49 additional days of growth and determined the amounts of soil N they had taken up from each of the three N sources. The scientists found ―elevated CO2 positively affected root uptake of N derived from all three N forms by day 10, with NO3--derived N taken up at the highest rates,‖ and ―added glycine was taken up as intact amino acid within one hour of treatment application, indicating that L. tridentata can directly utilize soil organic sources.‖ They note, ―to date, this study is the first to report organic N uptake by a plant species from a hot, arid ecosystem.‖ In further discussing their findings, Jin and Evans state ―there is increasing consensus that organic N uptake could be a major plant N acquisition pathway (Lipson and Nasholm, 2001; Schimel and Bennett, 2004), with 10–90% of the total annual plant N requirement potentially met by the uptake of external soil organic N (Chapin et al., 1993; Kielland, 1994; Jones and Darrah, 1994).‖ In addition, they note ―long-term exposure to elevated CO2 has altered the quality and quantity of plant-derived carbon inputs into Mojave Desert soils, leading to higher extracellular enzyme activities indicative of a greater or more active soil fungal component (Jin and Evans, 2007),‖ such that ―increased soil fungi may lead to the greater release of monomeric organic N under elevated CO2, enhancing substrate availability for soil microbes as well as for plant uptake.‖ Hence, they found several encouraging indications that the ongoing rise in the air‘s CO2 content will significantly increase the vitality of arid-land ecosystems, just as it does for other ecosystems.

#### Roots

#### peer reviewed studies prove roots just go deeper

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Concentrating on plant roots, Wang and Taub (2010) conducted a series of meta-analyses that reveal how differences in the availability of soil fertility and water, as well as the stress of ozone pollution, affect biomass allocation in plants—as expressed by the change in the fraction of root mass to total biomass (root mass fraction, or RMF)—that occurs when plants are exposed to air enriched with CO2 to levels ranging anywhere from 500 to 1,000 ppm. They used data extracted from 541 peer-reviewed scientific journal articles, which yielded a total of 1,349 RMF observations. Their analysis determined that lower soil fertility increased RMF, and the magnitude of the increase ―was similar for ambient and elevated CO2-grown plants.‖ They also found that lower soil water content increased RMF, but it did so ―to a greater extent at elevated than at ambient CO2.‖ Finally, they discovered ―CO2 enrichment had little effect on the magnitude of O3-caused reduction in RMF in herbaceous species,‖ but ―it alleviated the adverse effect of higher O3 on root production in woody species.‖ Given these findings, the two researchers concluded, ―under abiotic stresses, e.g., drought and higher O3, elevated CO2-grown plants will likely increase biomass allocation below-ground,‖ where it can be used to construct more roots that can be used to acquire more water and nutrients. However, ―because of the non-uniform changes in drought and O3 projected for different parts of the world,‖ they conclude ―elevated CO2 will have regional, but not global, effects on biomass allocation under various global change scenarios.‖ These responses should make plants—some regionally and some globally—better able to acquire more of the nutrients and water they will need to sustain the increased growth that can be expected in a high-CO2 world of the future, even in the face of significant ozone pollution.

#### That internal outweighs

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Reviewing potential remedies, the four researchers state, ―in the past, improvement of crops and agricultural techniques has mainly focused on increasing shoot biomass and seed yield,‖ but ―the relevance of the root system for food production has often been overlooked.‖ This myopic view was unfortunate, for many aspects of root system development are essential for enabling optimal plant growth in the face of numerous belowground environmental stresses such as drought, salinity, and soil-borne pathogenic attacks. They state that achieving improvements in this ―hidden half‖ of a crop‘s environment represents ―an underestimated and not fully exploited area for strategies to enhance yield.‖ Herder et al.‘s analysis indicates crop plants of the future will need ―an increased and more efficient root system‖ that includes ―more lateral branches and/or higher number of root hairs,‖ in order to ―take up water and nutrients, to fix fertile soil and to prevent soil degradation.‖ These are things that enriching the air with CO2 helps to bring about. The scientists also note ―80% of land plants obtain important mineral nutrition through the ancient arbuscular endomycorrhizal symbiosis with Glomeromycota fungi species,‖ which, according to Parniske (2008), are ubiquitous in soils. This, too, is something elevated CO2 helps to promote. In addition, they note the need for sufficient nitrogen availability to plants, which is provided to legumes by nitrogen-fixing soil bacteria located within nodules on their roots. This need is also met by increasing atmospheric CO2 concentrations.