Case for climate change

by Andrew Glikson

April 19, 2010

The origin and consequences of climate change

The widening gulf between scientific observations around the globe and public perceptions of the nature and origin of climate change is threatening to lead the world away from evidence-based policies despite projections by the world's major climate research bodies (NASA/Goddard Institute of Space Science, National Snow and Ice Data Centre [Colorado], Hadley-Met, Tyndall Centre for Climate Change, British Antarctic Survey, Potsdam Institute for Climate Impact Research) as summarized in references[1], including the Australian Antarctic Division, CSIRO and Bureau of Meteorology[2]. A joint statement by the world's academies of science states[3], among other:

> "*However, climate change is happening even faster than previously estimated; global CO2 emissions since 2000 have been higher than even the highest predictions, Arctic sea ice has been melting at rates much faster than predicted, and the rise in the sea level has become more rapid. Feedbacks in the climate system might lead to much more rapid climate changes*."

Below I refer to principal changes in the atmosphere/ocean/cryosphere system since the mid-20th century. I avoid terms such as '*denial', 'alarmist'* or *'skeptic'*. Skepticism is inbuilt into peer-reviewed science and is in no way an exclusive precinct of critics. As is the case with the medical profession, where evidence emerges for a danger to society raising a warning is the duty of scientists. Conspiracy theories can cut both ways and only serve to distract from the direct empirical evidence consistent with the laws of physics and chemistry. Nothing would relieve me and my colleagues more than if we were proven to be mistaken, if global warming would subside or, in the very least, could be shown to be a natural rather than a human-induced phenomenon. On the other hand I doubt if those who disagree with the evidence and the implications of climate change would wish to be mistaken. The consequences of such mistakes for humanity and nature would be severe.

Dating back to Arrhenius (1896), Calendar (1938), Keeling (1960s) and the formulation of the laws of thermodynamics (Stefan-Boltzmann and Kirchoff's laws), the infrared absorption/emission resonance effect of greenhouse molecules (water vapor, CO2, methane, ozone, nitric oxide) and recorded CO2-temperature relationships through time have become established tenets of atmospheric science. The global dispersal, cumulative nature and centuries to millennia-long residence time of atmospheric CO2 are contrasted with the more regional and transient nature of water vapor, with 9 days-long atmospheric residence time. Vapor concentrations are low over deserts and very low over the polar regions, yet it is the latter which are warming at a rate 3 to 4 times faster than the tropics (Figure 1 below).

The distinction between greenhouse, interglacial and glacial climate states (Figure 2) is related to the presence and extent of the polar ice sheets and of surrounding oceans, from where moist air vortices and cold currents emanate (Humboldt, California, West Africa). Warming of the poles

weakens cross-latitude gradients, ocean currents and the wind vortices, extending the El-Nino mode and limiting the La Nina mode of the ENSO cycle, which ensues in droughts. Recent studies by NASA and the British Antarctic Survey[4] observe reduction of some 10 meters of ice per year since 2003. The thermal expansion of water and the consequence of continental ice melt are reflected by sea level changes which, since the early 20th century to the present, rose from approximately 1 mm/year to 3.5 mm/year. Estimates of future sea level rise through the 21st century, ranging between 0.6 and 5 meters, assume linear to accelerating warming trends. If abrupt temperature and sea level changes during the last glacial termination (about 20 – 10 thousand years ago) are any indication, fast changes are possible where climate tipping points are reached [5].

Much can be learnt from warm stages in the history of the atmosphere. Studies of Greenland and Antarctic ice cores and of marine sediments, using a range of proxies (including oxygen, carbon and boron isotopes, fossil plants, organic matter) identify close relations between the greenhouse gas concentrations and climate states (Figure 2). Current climate change, superposed on the Holocene interglacial, is distinct from the glacial terminations recorded in ice cores for the last 800 thousand years. Whereas the glacial terminations were initiated by solar radiation peaks, triggering rapid ice melt amplified by the (so-called) *albedo flip* effect (due to the contrast between high reflection by ice and strong absorption by water), warming of the oceans and release of CO2 lagged behind temperature rise by about 800 years[6].

The emission of more than 370 billion ton of carbon (GtC) since about 1750, more than 50 percent the original atmospheric inventory of 590 GtC, has pushed atmospheric CO2 levels from the interglacial maximum of about 280-300 parts per million (ppm) of the last 1.8 million years to the current level of 389 ppm, or 460 ppm when combined with the effect of methane, tracking toward the upper stability limit of 500 ppm CO2 of the Antarctic ice sheet[7] (Figure 2). Just under 50 percent of CO2 stays in the atmosphere (Figure 3). The current rate of CO2 rise of 2 ppm per year is almost unprecedented in geological record, barring the effects of major volcanic activity or asteroid impacts, which led to CO2-rich atmosphere and mass extinction of species.

Lost too often in the climate debate is an appreciation of the delicate balance between the physical and chemical state of the Earth system and the evolving biosphere, which controls the emergence, survival and demise of species, including humans. Forming a thin breathable veneer only slightly more than one thousandth the diameter of Earth and evolving both gradually as well as through major perturbations, the atmosphere acts as a *lung* of the biosphere, allowing an exchange of carbon gases and oxygen with plants and animals, with feedbacks including release of methane. Species are capable of adapting to gradual environmental change, however, as testified by the geological record abrupt rises in CO_2, methane or H2S, injection of aerosol and dust, acidification of the oceans and consequent anoxia have led to the demise of species[8].

Since the mid-20th century climate patterns have been tracking toward conditions increasingly similar to those recorded for the mid-Pliocene, about 3 million years ago, a perspective which led the US Geological Survey to undertake extensive studies of Pliocene sediments. During the mid-Pliocene, with CO2 levels of 365-415 ppm and temperatures 3 to 4 degrees warmer that pre-industrial levels, large parts of the Greenland and Antarctic ice sheets melted, sea levels rose by about 25±12 meters and climate zones shifted toward the poles. Given the current rate of CO2 rise, future release of methane from permafrost, bogs and shallow sediments may reach levels similar to the Paleocene-Eocene Thermal Maximum (PETM) 55 million years-ago. At this stage release of c.2000 GtC as methane resulted in global temperature rise near-5 degrees Celsius. In this regard, the scale of global fossil fuel reserves, about 6000 GtC counsels caution.

Claims as if high CO2 concentrations are beneficial for plants pertain to glasshouse conditions, where high humidity is maintained, but not to open agriculture where rising CO2 and thereby temperatures lead to droughts. Excess CO2 reduces the ability of respiratory pigments to oxygenate tissues and causes hypercapnia. The parts-per-million scale of CO2 concentrations should not conceal the danger posed by excess amounts of the gas, as is the case with the toxic effects of minute quantities of a variety of substances (cf. mercury, cyanide, arsenic). In marine environments, acidification due to excess CO2 and declining pH to below 8.2 results in production of bicarbonate and carbonic acid, which benthic fauna and corals can not use for shell growth.

Finally I comment on recent allegations against climate scientists and the IPCC. That a CRU climate scientist discusses the significance of a proxy-based temperature from tree rings[9] hardly amounts to a '*climategate'* conspiracy" on the part of the scientific community. That the IPCC cites an uncertain projection for Himalayan glaciers melt (2035) does not indicate whether total Himalayan glaciers melt may occur earlier or later than this particular point in time. It must be stressed that, if anything, to date IPCC estimates of ice melt and sea level rise have been shown to constitute conservative underestimates which have already been exceeded[10]. No reason exists why people should trust climate scientists less than, for example, their medical doctors or air pilots.

At the roots of the climate debate is the precautionary principle. People insure their homes for small probabilities of loss. Nations build armed forces in connection with possible future contingencies. When faced with directly observed evidence of climate change, which led the premier science research bodies to warn the world of the consequences of the continuing emission of billions of tons of carbon, we better take note.

Consistent with the recent statement by Joachim Schellnhuber, Germany's chief climate advisor: "*We're simply talking about the very life support system of this planet*."

Dr Andrew Glikson, Earth and paleo-climate scientist, Australian National University

Joanne Nova's response to this essay: "No, Dr Glikson", … (see below)

The two essays are being discussed at joannenova.com.au

Join the discussion here…

Figures:

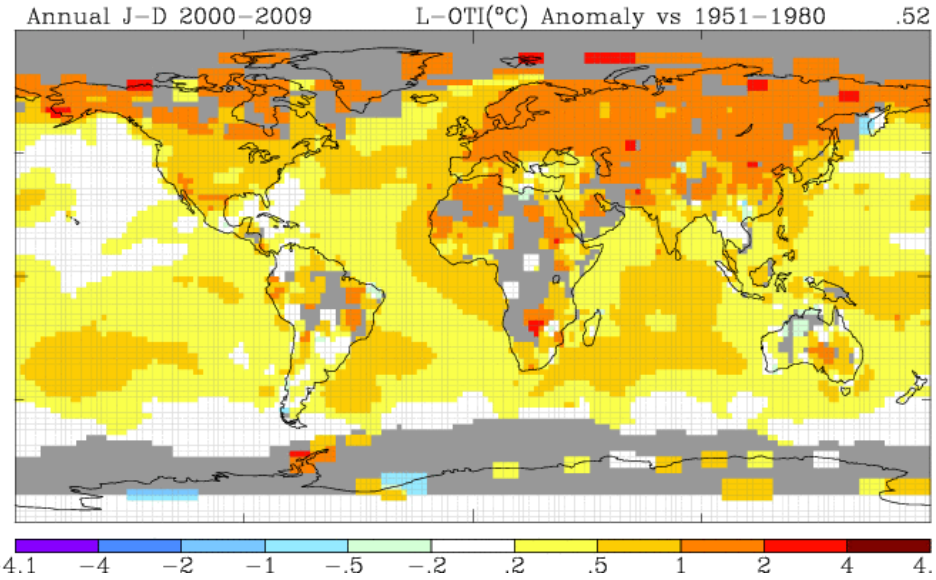

Figure 1. *Land (NASA/GISS) and ocean (NOAA) mean annual temperature anomalies for the period 2000-2009 relative to 1951-1980. Anomalies smoothed over 250 km. Note: (1) warming by up to 4 degrees Celsius over parts of the Arctic and west Antarctica; (2) warming of continental mid-latitude dry zones, including central Australia, by about 2 degrees C; (3) warming of large parts of ocean surfaces by up to 1.0 degrees C. Grey areas have no data. http://data.giss.nasa.gov/gistemp/maps/*

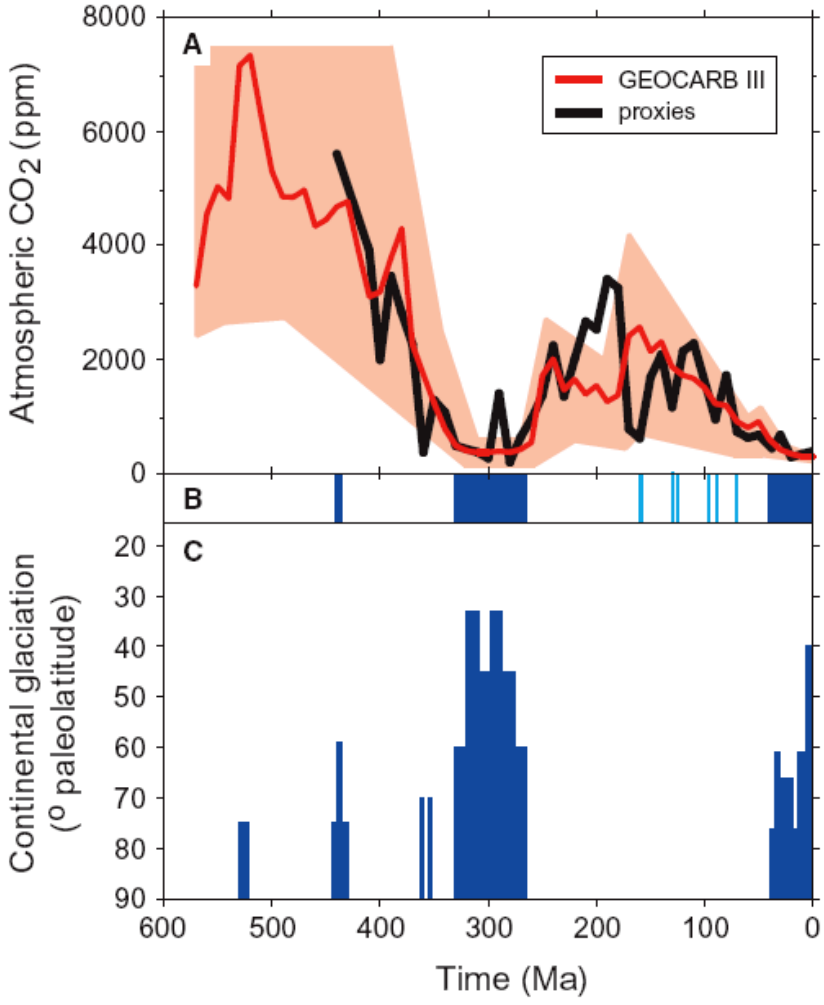

Figure 2. *Relations between atmospheric CO2 concentrations and glacial periods through time, showing the temporal distribution of ice ages and latitudinal extent of ice sheets. Note the correspondence between low CO2 levels below about 500 ppm CO2 and glaciations and between high CO2 levels and greenhouse climate states. ftp://rock.geosociety.org/pub/GSAToday/gt0403.pdf*

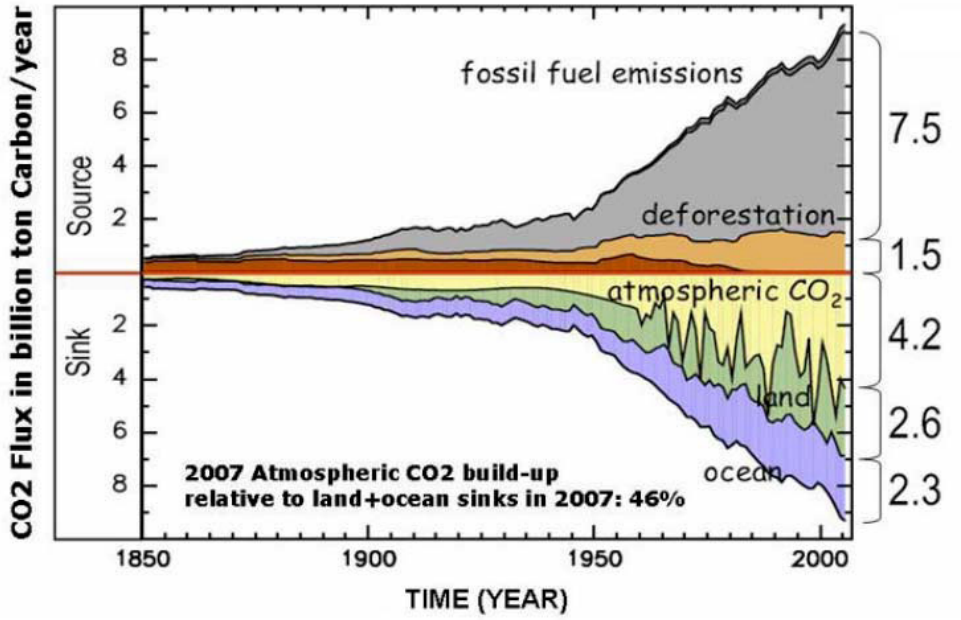

Figure 3. *Relation between the magnitude and proportions of the CO_2 cycle (in billion tons carbon per-year [GtC]) for the period 1850 – 2007, as related to fossil fuel emissions, deforestation, atmospheric accumulation and sequestration in the hydrosphere and land (vegetation and soil). Global Carbon Project http://unesdoc.unesco.org/images/0015/001500/150010e.pdf Note that, for the last decade, for emission of 7.5 GtC per-year and land clearing effects of 1.5 GtC per year, about 4.2 GtC remains in the atmosphere.*

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No, Dr Glikson

by Joanne Nova

April 19, 2010

Dr Andrew Glikson says the right motherhood lines [see: Case for Climate Change]: he talks about empirical evidence, and wants evidence based policies. All this is good, yet he sidesteps the main point — what exactly is the evidence for the theory of man-made global warming? It's the only point that matters, yet when he presents evidence it's either not empirical, not up to date, or not relevant. Why?

By hitting all the right key phrases a reader might accidentally think that Glikson is presenting key evidence and good reasoning. Take this for example: Glikson fears we're turning away from evidence-based policies. (Me too!) But to complete the sentence he lists all the committees who predict bad weather 90 years from now. It makes for good PR, but is not scientific evidence.

Committee reports count as "evidence" in a court of law, but in science, certificates, declarations, contracts, commission hearings, or 3000 page reports don't mean anything. Clouds don't give a toss about what committees predict.

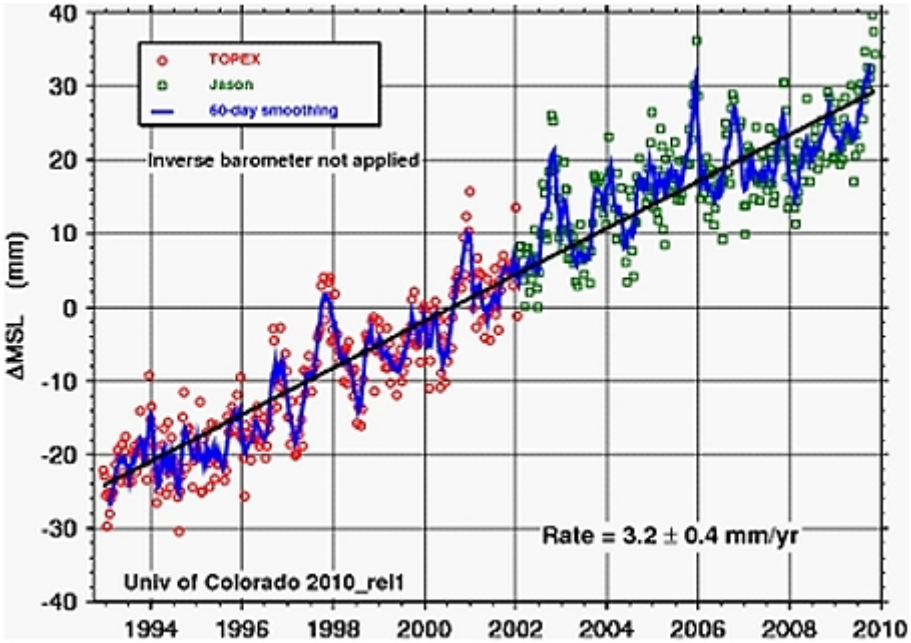
Irrelevant *and* incorrect

Arctic ice and sea levels are at least empirical evidence, but in this case, they're irrelevant.

They don't tell us anything about what *caused* the warming. Almost any cause of warming would melt sea ice. Then there's the problem that global sea ice is looking fairly robust. The Arctic has shrunk some, but the Antarctic has grown. Each year millions of square kilometres of ice melt on each half of the globe, and each year they also refreeze. Peak global sea ice is roughly the same now as it was in 1979.[1] And far from being "worse than expected," Arctic sea ice in 2010 is breaking records—still growing until the *end* of March.[2]

Rising sea-levels are similar—they're evidence of warming, but not evidence that carbon *caused* the warming. And as far as the "it's worse than we thought" theme goes: where is the scary surprising uptick? If anything, instead of an upcurve, the graph has slightly flattened off. The trend is utterly predictable, except that it might be rising *less fast* than the predictions.

Any careful scientist ought to be very qualified in using statements implying "accelerating trends". Unfounded claims about the need to rush in and sign the dotted line are like a sales pitch: *Hurry, last chance! Don't wait for more evidence…*



Note that sea levels have been rising for 200 years. Long before humans emitted significant amounts of CO_2. Half of man-made CO_2 has been emitted in the last 35 years, but the trendline remains the same before and after.

Harmful carbon?

Glikson also tries to suggest that carbon is only beneficial for plants in glasshouses "where humidity is high". Awkwardly for him, *field* studies from fifty years ago show that atmospheric carbon dioxide is the rate-limiting factor for plants — meaning they use up all the CO_2 they can between sunrise and 12 noon each day, then slow down until the carbon levels are restored in the air overnight.[3] One of the main purposes for water molecules in plant tissue is to be exchanged for CO_2 (known as evapotranspiration), so not surprisingly not only do plants prefer higher CO_2 — they grow faster — they also cope better with *drier* conditions. Overall, hundreds of studies show that plants typically grow 20-50% *more biomass* with higher CO_2 levels.[4]

Curiously Glikson mentions hypercapnia in the same paragraph and associates carbon dioxide with arsenic, mercury and cyanide. But as every toxicologist knows, any chemical will become a poison at high enough concentrations. Glikson's comparison is "true", but mindless. Pure oxygen and water can kill you too. Knowing that does not help us decide what to do with carbon. As for hypercapnia, in humans it begins to have noticeable effects at around 75,000 ppm, which at present rates of increase will become an issue sometime around the year 39,000AD. (Look out for the onset of global headaches in 37,000 years.)

But seriously, what about ocean acidification? It's worth noting that fears of ocean acidification are largely theoretical and calculated, rather than based on empirical evidence. Some corals grown in very high levels of CO_2 thrived. When one research team reconstructed ocean pH levels with boron isotopes in corals, they found no noteable trend over the last 300 years[6] or the last 6000 years.[5] Atmospheric CO_2 levels may have risen 30% recently, but at least in that marker, there's no clear relationship between ocean acidity and atmospheric CO2. Other researchers found warmer temperatures *increased* calcification along the full length of the Great Barrier Reef.[7]

Wherefore art thou reasoning?

Even the IPCC has admitted the 2035 projection for the complete melting of the Himalayas was baseless (and probably a Chinese-whispers type mistake from someone misreading "2350" as 2035). Despite this, Glikson hints that it's *possible* the Himalayas could even melt before 2035. His evidence? Not a peer reviewed paper on glaciers or a study of the Himalayas, but a study that showed the IPCC reports underestimated "other things". Really. Whether a committee makes bad projections is not remotely admissible as evidence of whether kilometre wide glaciers will disappear "unexpectedly". Why should I need to explain this to a professor? (What has happened to Australian universities?)

Endorsing low quality "science"

Glikson comments on the recent unauthorised release of emails from East Anglia, saying they hardly amount to a "ClimateGate" conspiracy by the scientific community. As usual, what he doesn't say is revealing. Since he doesn't admonish Jones and Mann for their petty, unprofessional behaviour, their attempts to hide data from other scientists, or to avoid FOIs and boasts of intimidating journal editors, does that mean he thinks these are acceptable? They talked about producing error bars that "might be wrong", they cherry picked and hid sections of graphs, and they asked groups of people to delete emails and hide files. If mass emails suggesting dishonest things is not a conspiracy, what is? Either Glikson hasn't read the emails, or he condones this. Where are the real climate scientists who stand up for transparent honest science, for verification and replication of results? If he wants us to trust them like medical doctors, we need to know that most climate scientists aim higher than "hiding declines".

Before anyone howls that the raw data is all available, note that only the *adjusted* data is available, not the raw data. The UK Met Centre admits it will take three years to reassemble the data.

Fake principles

Glikson says the root of the debate is the precautionary principle, but there is no scientific principle about "precaution". It's a catchy PR term that works just as well for skeptics (except we don't stoop to invoke it). Sensible public policy is based instead on a risk-benefit ratio. The best, most detailed information we have from hundreds of studies, thousands of boreholes, kilometres of ice cores, and hundreds of thousands of weather balloon and satellite recordings tells us that it's likely there is little risk of catastrophic warming, and little benefit in reducing carbon emissions. Therefore, we should do only the easy, cheap things to reduce emissions, while keeping watch on the data, and focus our efforts instead on real problems.

What evidence do we need?

More than anything else, we need to know how much of the recent warming has been directly due to our carbon emissions and how much has been natural. We need this predict how much warming we might get this century. The "how much" question is the 200Gt gorilla in the kitchen. Half a degree or three-and-half degrees makes all the difference. But since both natural and unnatural warming causes glaciers to melt, seas to rise, and rainfall patterns to change, how do we know how much of past warming is due to us?

The central problem with "attribution" of the cause for the warming is that dozens of major forces are working on our climate, and none of them leave a business card.

Even James Hansen and the IPCC agree that carbon dioxide, by itself, will theoretically warm us only by about 1.1 degrees if CO2 levels double (as they will have, from 1750 to the end of this century). All the papers Glikson mentions, like Arrhenius, Calendar and Keeling, agree with this calculation, as do most skeptics.

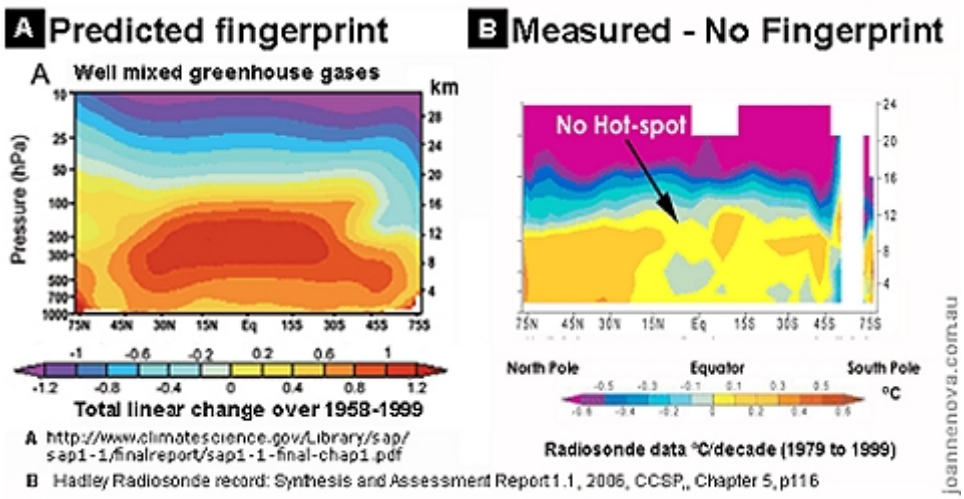
What turns this single degree into a "disaster" in their theory, worth taxing every citizen on the planet for, are the feedbacks—meaning what do clouds, humidity, ice cover, bushes, trees and plankton do in a world that's tending to be one degree warmer due to extra CO_2? Does the extra humidity form the kind of clouds that trap more heat or the kind that reflect more sunlight? The first amplifies the warming, and the other dampens it.

The models all reckon the feedbacks amplify the warming, but three independent sources of empirical evidence suggests the opposite occurs, and that the feedbacks are negative (ie. they "dampen"). In that case the headline threat reads *Half a Degree*.[8] [9] [10]

The feedbacks are crucial to the model predictions. Without feedbacks, there's no warming more than 1.1 degrees And just to make it more complicated, the major feedbacks are with water vapor—both the main greenhouse gas and what makes clouds.

All the major climate models predicted that increasing non-water-vapor "greenhouse gases" would warm the atmosphere mostly at around 10km above the tropics. Weather balloons have been measuring temperature and humidity since the 1950s, and are individually calibrated to 0.1 degrees. There are hundreds of thousands of measurements from around most of the world.

Compare the model predictions to the weather balloon measurements below. The graphs are not remotely the same. The models are wrong. The "Hot Spot" is missing. The net effect of the warming due to man-made CO_2 has been exaggerated.



Andrew Glikson doesn't mention the hot-spot.

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Credibility lies with experienced authorities

by Andrew Glikson in Response to Joanne Nova

April 29, 2010

I respond to criticisms by Joanne Nova (JN) as in her article "No, Dr Glikson" (Quadrant Online, 21.4.2010) of my article "The origin and consequences of climate change" (Quadrant Online, 21.4.2010), basing my comments on recent climate change reports, including among other the Copenhagen Synthesis Report, 2009; Four Degrees and Beyond conference, 2009; Steffen, 2010 and CSIRO-BOM[1]. I point to statements inconsistent with instrumental measurements and direct observations and to misunderstanding of atmosphere/ocean climate processes.

1. The troposphere hot spot (whose presence and intensity is related to global temperatures).

JN states: "*The models are wrong. The "Hot Spot" is missing. The net effect of the warming due to man-made CO_2 has been exaggerated*".

Response by AG: The consequences of global warming, whether from natural or anthropogenic factors, do not in themselves identify the origin of climate change, it is the identification of the external forcings which does, i.e. solar, volcanic or anthropogenic. JN's information regarding the troposphere hot spot (2006) is outdated. More recent studies (Sherwood et al., 2008) have identified the troposphere hot spot (see Figure 1), stating "*stronger warming is shown in the Northern Hemisphere where sampling is best*" [2].

2. Sea level rise.

JN states: "*If anything, instead of an up-curve, the graph has slightly flattened off. The trend is utterly predictable, except that it might be rising less fast than the predictions*."

Response by AG: JN's figure portrays only the last stage of sea level rise, from 1993 to the present (mean SL rise rate: c. 3.2 mm/year). As is shown in Figure 2[3] sea level rise rates have increased through the 20th century from below 1 mm/year early in the 20th century to near 3.5 mm/year.

3. Melting of the cryosphere.

JN states: "*Then there's the problem that global sea ice is looking fairly robust. The Arctic has shrunk some, but the Antarctic has grown".*

Response by AG: Freezing and melting of thin sea ice constitute seasonal to perennial-scale variations.[4] It is the decade-scale behaviour of the several kilometres-thick continental ice sheets which represents climate trends. Arctic sea ice has declined while Antarctic sea ice fluctuates strongly with the seasons, with only about 3 to 4 million square kilometre remaining at summer's end and with trends varying around the Antarctic continent[5].

Melting of the thick continental ice sheets includes increase in the melt extent in Greenland by about 16% from 1979 to 2002. According to Ian Allison[6] (*Division and Antarctic Climate and Ecosystems CRC): "These new estimates suggest that the total annual loss from Antarctica since 1993 is around 100 billion tonnes of ice per year, equivalent to ~0.25 mm/yr global sea level rise, but the error range is large. In Antarctica, mass loss has been greatest along coastal sectors of the Antarctic Peninsula and West Antarctica, but with thickening further inland and over most of East Antarctica partially offsetting this*."

4. Ocean acidification.

JN states: "*It's worth noting that fears of ocean acidification are largely theoretical and calculated, rather than based on empirical evidence"* and "*Atmospheric CO_2 levels may have risen 30% recently, but at least in that marker, there's no clear relationship between ocean acidity and atmospheric CO2*."

Response by AG: The relations between atmospheric CO2 and oceanic CO2 are governed by partitioning coefficients dependent mainly on temperature. The transition from the carbonate ion (CO3[-2]) which calcifying organisms use to bicarbonate and carbonic acid which organisms can not use, which occurs about 8.2-8.1, is critical for marine life, as indicated by the summary statement by the symposium on "The Ocean in High-CO2 World" 6-9 October, 2008[7].

> *"When CO2 dissolves in seawater, carbonic acid is formed. This phenomenon, called ocean acidification, is causing seawater to become corrosive to the shells and skeletons of numerous marine organisms. It also affects the reproduction and physiology of some marine organisms. These impacts have now been detected in living organisms in several regions around the world. Within decades, the chemistry of the tropical oceans will not sustain coral reef growth while large parts of the polar oceans will become corrosive to calcareous marine organisms. These far-reaching changes will impact food webs, biodiversity and fisheries."*

5. Excess CO2 - beneficial or harmful for plants?

JN states: "*Overall, hundreds of studies show that plants typically grow 20-50% more biomass with higher CO_2 levels.[iv]*"

Response by AG: According to Morgan (2002)[8]:

> "*Global climate change is expected to have ecological consequences. Field studies attempting to simulate these effects often do not investigate multiple environmental factors and may therefore miss some important feedbacks. In his Perspective, Morgan highlights the multiple-factor, 3-year field study reported by Shaw et al., who find that increasing CO_2 may inhibit plant growth. Morgan discusses possible explanations for this counterintuitive result, but cautions that short-term, transient responses may not reflect the long-term ecological response."*

And

> "*Writing in the journal Science, researchers concluded that elevated atmospheric carbon dioxide actually reduces plant growth when combined with other likely consequences of climate change -- namely, higher temperatures, increased precipitation or increased nitrogen deposits in the soil". "To understand complex ecological systems, the traditional*

approach of isolating one factor and looking at that response, then extrapolating to the whole system, is often not correct," Mooney said. "On an ecosystem scale, many interacting factors may be involved."[9]

Although JN questions an apparent absence of a troposphere Hot Spot (which would imply as if no global warming occurs) (see my Point 1 above), in other part of the article JN accepts that warming is real, as represented by ice melt and sea level rise. Elsewhere JN appears to accept humans are in part responsible, stating "*we need to know how much of the recent warming has been directly due to our carbon emissions and how much has been natural"*. JN further questions: "*what exactly is the evidence for the theory of man-made global warming*?"

Global warming constitutes the direct consequence of the emission of 370 billion tons (GtC) of carbon, namely more than 60% of the original carbon concentration of the atmosphere pre-1750 (590 GtC), as well as extensive deforestation and clearing, methane release from animals and nitric oxide release from fertilisers. Some 46% of the CO2 stays in the atmosphere (a dynamic balance which changes as the oceans warm), imparting radiative forcing of about 1.66 Watt/m2, consistent with basic physics of greenhouse gas resonance and infrared absorption/emission effects. The rise of atmospheric CO2 concentrations from the top interglacial level of 280 ppm to the current 389 ppm, the highest level recorded since 2.8 million years ago, is proceeding at a rate of c.2 ppm/year, unprecedented in the geological record (bar major volcanic periods, asteroid impacts and eruption of methane).

As indicated by the vast peer-reviewed literature, every alternative mechanism potentially underlying climate change has been examined, including solar cycles, cosmic rays, ocean current patterns, the ENSO cycle and other factors. Following a small rise in insolation during the first part of the 20th century (c. 0.2 Watt/m2), solar radiation follows the 11 years sunspot cycle of about c. +/-0.1 Watt/m2 since the mid-20th century, accompanied by corresponding oscillations of cosmic rays. The total rise in insolation since 1750 is estimated as c. 0.12 Watt/m2[10].

Advances in the study of the atmosphere-ocean-cryosphere system in the during the last 800,000 years using the ice cores, and during the last 34 million years using multiple proxies (fractionation of oxygen, carbon and boron isotopes between plankton, water and the atmosphere, fossil plant pores [stomata]), indicate high climate sensitivities (i.e. response of global temperatures to CO2 variations), above 5 degrees C per doubling of atmospheric CO2[11]. During the mid-Pliocene (2.8 – 3.0 million years ago) and mid-Miocene (14-16 million years ago) CO2 levels were about 400+/-50 ppm and mean global temperatures about 3 to 4 degrees Celsius higher than 18th century levels, suggesting that, at 389 ppm CO2, climate change is tracking toward similar conditions.

JN writes: "*Committee reports count as "evidence" in a court of law, but in science, certificates, declarations, contracts, commission hearings, or 3000 page reports don't mean anything. Clouds don't give a toss about what committees predict."*

Response by AG: Courts of law don't deal with scientific questions. Clouds follow the laws of atmospheric physics and chemistry, which climate science investigates. As in other fields of science and technology, credibility lies with the respective experienced authorities and is protected, as much as humanly possible, by the peer review system, which attempts to ensure publications are consistent with the data base, direct field observations, correct calculations and the basic laws of physics and chemistry.

The CRU E-mails. Play the ball not the man. That individual scientists used terms in personal E-mails, or objected to publication of what in their view are unfounded claims, as part of the peer review process, hardly reflect on the scientific discipline as a whole and in no way detract from the overwhelming reality of ice melting, sea level rise, the polar-ward shift in climate zones, the increasing frequency of droughts and extreme weather events around the globe.

It will be interesting to know what amount of direct observations and physical and chemical evidence for the past and present behaviour of the atmosphere-ocean-cryosphere system would convince societies to pause before continuing to use the atmosphere as an open channel for the emission of some 8 billion tons of carbon per year.

Dr Andrew Glikson, Earth and paleo-climate scientist, Australian National University

Figures:

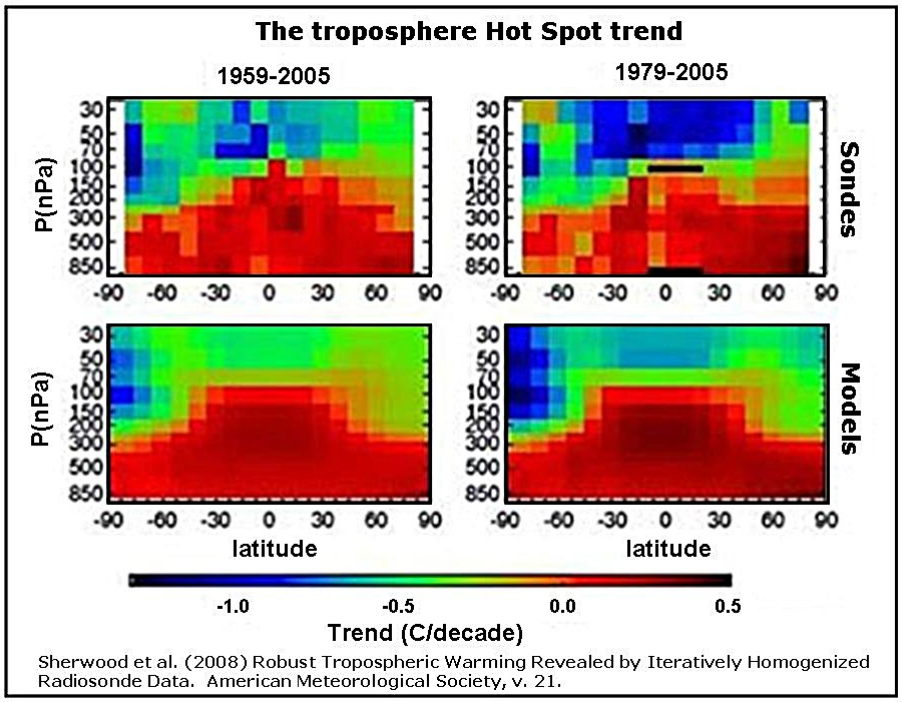

Figure 1. Radiosonde (weather balloon) measurements and models of the equatorial troposphere hot spot trend, seen to intensify from 1959-2005 to 1979-2005. Sherwood et al. 2008 AMETSOC Real climate

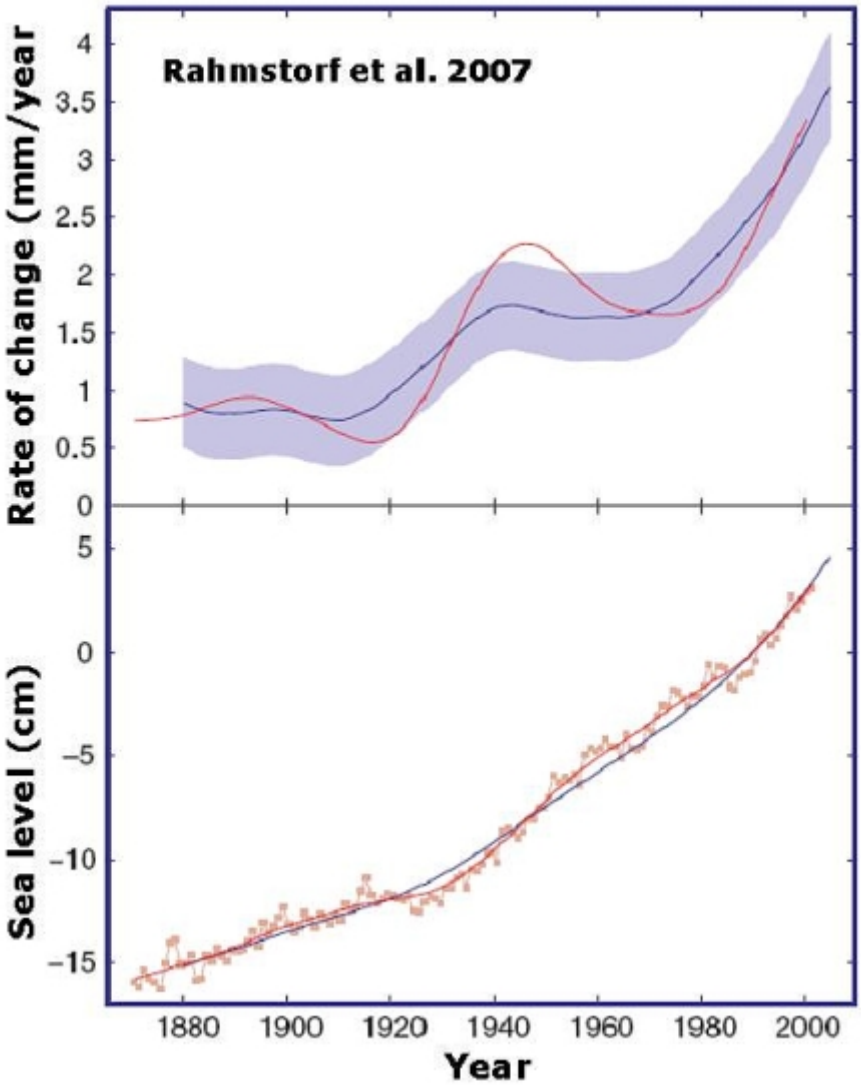

Figure 2. A. Rate of sea-level rise obtained from tide gauge. B. Sea level relative to 1990 obtained from observations. Rahmstorf et al. 2007. Science 315.

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Credibility lies on evidence

by Joanne Nova in **Reply to Andrew Glikson**

April 29, 2010

Dr Andrew Glikson still misses the point, and backs his arguments with weak evidence and logical errors. Instead of empirical evidence, often he quotes authoritative reports written by glorified committees. He sidesteps around the central issue—where is the evidence for the positive feedback assumed in the models? This feedback creates the disaster. If the "hot spot" is missing and feedback is negative, almost everything else is irrelevant. Glikson serves the Australian taxpayer, yet gives us only *half* the story.

Throw away your thermometers, we found the "hot spot" with wind-gauges!

Glikson claims Sherwood 2008[1] found the hot spot, but there are no such grand claims in that paper, and nor do the graphs he selected support it. Possibly Glikson meant to refer to another Sherwood paper (Allen and Sherwood 2008[2]) where they just threw out the temperature measurements holus bolus and used wind shear analysis. Despite the creative effort, all they achieved was to find results that fall within the wide error bars of *possibility*. This is after nine years of efforts in re-analysing the radiosonde data. Clutching at straws anyone?

The temperature sensors on weather balloons are individually calibrated to a tenth of a degree, the hot-spot is at least 0.6°C, and there have been hundreds of thousands of measurements, so why throw them all away? As I wrote in *the Skeptics Handbook*: "Thermometers ferrgoodnesssake are *designed* to measure the temperature. Why should wind-gauges *accidentally* be better at it?"

Of the four main data sets (two satellites and two weather-balloon sets), three are in good agreement with each other, and their results unequivocally say that there is no "hot spot". (See fig 1). One satellite set (RSS) got results that slightly overlap with results from some models. That's as good as it gets for the models.

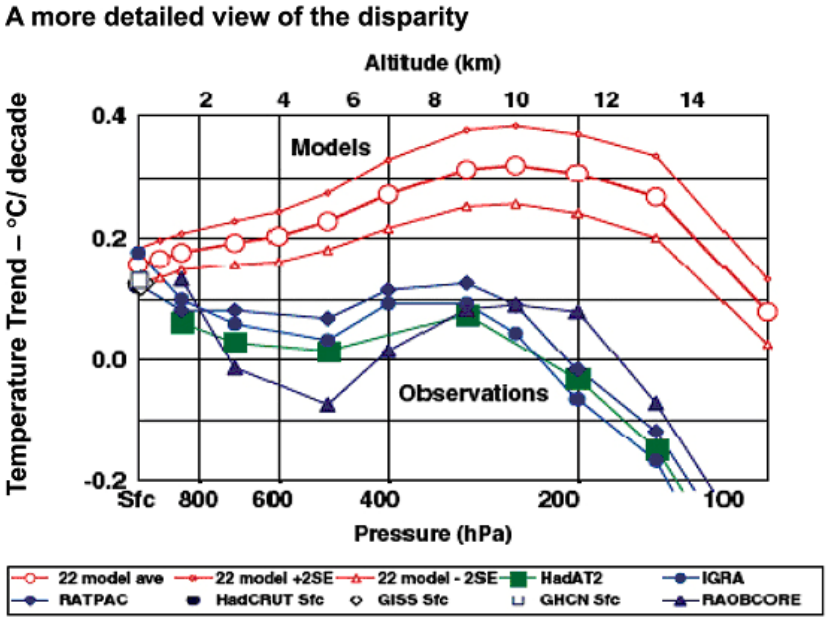

Figure 1. A more detailed view of the disparity of temperature trends is given in this plot of trends (in degrees C/decade) versus altitude in the tropics (Douglass et al. 2007-[9]). Models show an increase in the trend with altitude, but observations from balloons and satellites do not. Graph thanks to NIPCC.

Glikson apparently doesn't understand the power of the feedbacks in the climate models and the meaning of the hot spot. His response is tortuous. He mistakenly infers that if the hot spot is missing there could be no global warming. It's a strawman that tells us he doesn't understand the chart. The hot spot pattern is meant to compare *trends* between the air 10 km up and the surface, not absolute temperatures. And I'm quite consistent in saying that man-made warming is probably real but minor. I provided two references suggesting it is in the order of 0.5°C of warming *instead* of 3.5°C. Yes, CO_2 causes warming, but how much? [10] [11] If either of the papers I listed is right, you can kiss goodbye to the catastrophe.

Glikson then digs deeply into the handbag of IPCC quick-fix-glue and resorts to the ritual lines about how the IPCC has "looked at every possible cause" and ruled all the rest out. It's known as argument from ignorance: *we can't think of anything else it could be.* Never mind that they are searching for answers with the same models that can't "find" the Medieval Warm Period, the Roman Warming, the cause of the Little Ice Age, the warm period in the 1940's, or the cooling of the '50s and '60s either. Never mind that even the IPCC admits they can't model cloud cover well, and can't explain why there's been no statistically significant warming since 1995.

When you look everywhere with a blindfold on, the only thing you find is darkness.

Sea-levels that shock (80 years later)

Glikson criticises me for looking at sea level data from *only the last 20 years*, but he forgets that I did that in response to his claim that things are "worse than the *IPCC* predicted". The IPCC remember, was created in 1988 and so his idea of using a sea-level graph back to 1900 rather misses the point. Sure sea level trends increased in the 1930s, but if that trend "shocks" the researchers in 2009, that isn't a point to brag about. Obviously the claim that sea level rise is worse than the IPCC predicted was shown to be patently, obviously wrong by the graph I posted in my last piece. Sea levels *have* risen, but the trend has *not accelerated* at all since the IPCC was formed. Indeed it seems to be flattening off, something that Glikson also *did not disagree* with.

There's no reason to look back 100 years and pretend to be shocked in the last two years that things got worse than you thought–80 years ago.

Cause and Effect goes AWOL

Every other point that Glikson makes (sea levels, ice sheets, and Greenland melt extents) are all *effects* of global warming and don't tell us anything about the *cause* of the warming. But they *do* at least tell us that the warming started a century *before* our carbon emissions began to rise, which rather puts the kybosh on the recent correlation with CO_2 in any case. Sure, let's talk "long term": sea levels have been rising since 1850, and glaciers have been melting since 1800. We've been recovering from the Little Ice Age for 200 years. Fully 70% of the carbon that's "Man-Made" has been made *since* 1945 and the trend *hasn't* changed. (Fig 2)

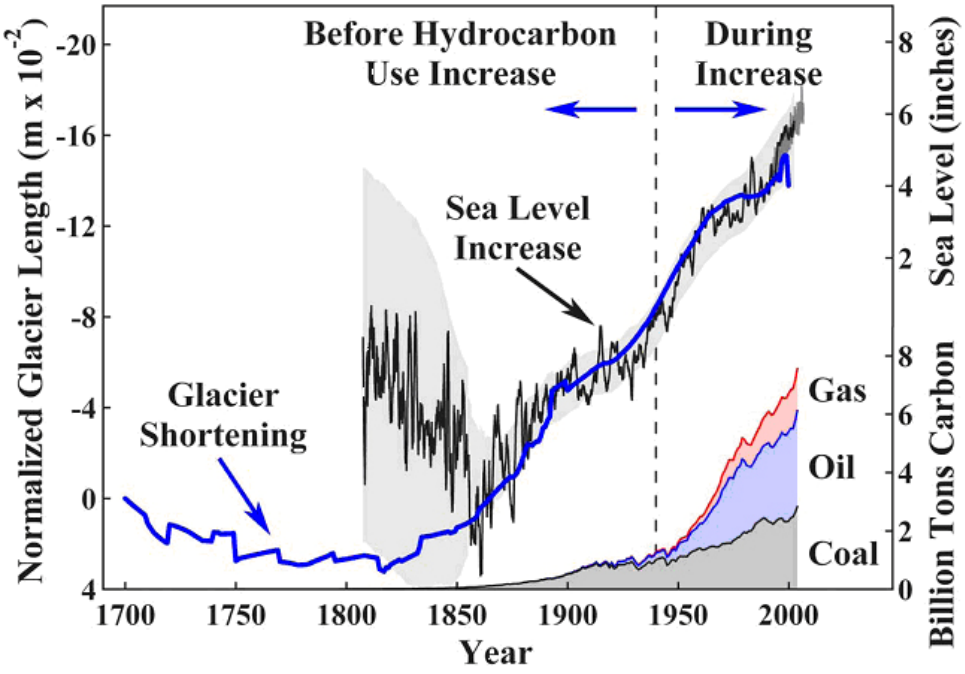

Figure 2. Glacier shortening[3] [4] and sea level rise[5]. Gray area designates simulated range of error in the sea level record. These measurements lag air temperature in creases by about 20 years. So, the trends began more than a century be fore in creases in hydrocarbon use. GRAPH from the global warming review by Robinson, Robinson and Soon.

Ocean Acidification? Don't pour hydrochloric acid into your fish tank, OK?

I claimed that fears about acidification are *theoretical* rather than *observed*, and to back up my point Glikson links to a summary statement from a symposium. It's yet another committee report, and not empirical evidence. When a researcher recently did the hard yards of actually bubbling CO_2 through corals in a tank, and also analyzing sediment cores, she and her team found that in the last 220 years as CO_2 levels increased the average cocolith mass grew by 40%.[6] Far from inhibiting coral growth, warmer temperatures and increased CO_2 has apparently helped corals.

Her results were different from others because she used CO2 to increase the acidity, rather than throwing hydrochloric acid into the tank as people had previously done.

Did the cryosphere melt?

Glikson originally talked about Arctic sea ice, which was not only irrelevant in a discussion about the cause of global warming, but was misleading because Antarctic sea ice has grown, and globally the levels peak at the roughly the same size each year. Glikson doesn't disagree with this, but oddly calls the Arctic shrinking a "decline" and the Antarctic increase a "fluctuation". He shifts topic and suggests the ice sheets on Antarctica are losing ice mass. But Wingham et al found that Antarctic ice appears to be *thickening* by around 27Gt ± 29 Gt /yr, resulting in a slight reduction in sea-levels.[7] That "partial offset" in East Antarctica that Glikson quotes looks like it's *larger* than the trend it is "offsetting".

Will the plants wither? Not likely…

I linked to hundreds of studies showing plants prefer higher CO_2 levels, and Glikson quotes a study that "expects" CO_2 "may" inhibit plant growth when combined with all the other projections that the unvalidated, flawed models project. I'm warned to consider complex whole systems, not just single variable studies. Righto. Let's do that: satellites record that the biomass of the entire planet increased 6% from 1982 – 1999[8]. (Six percent in just 18 years!) So, all that warming and a large increase in CO_2 worked out just fine for life on Earth.

Are these CO_2 levels "unprecedented"?

Glikson refers to studies from millions of years ago when CO_2 levels were equivalent to today, but temperatures were even higher. The big problem with these studies is that we *know* higher temperatures *cause* CO_2 levels to rise. There is 50 times as much CO_2 in the oceans as there is in the atmosphere, and it's simple chemistry that the oceans release CO_2 as they warm. So again, as with the ice cores, the cause and effect link is most likely the reverse of what he and Gore imply. If it was warmer back then, there *would have been* more CO_2 in the atmosphere. It's no surprise at all that the CO_2 was higher at the same time as the temperature was as well, indeed it's utterly predictable.

Evidence—What evidence?

Glikson reckons the credibility in science lies with "respected authorities" (are there any left?). It's a naked fallacy of logic. Credibility in science lies with those who have evidence and don't break laws of reason. It's judged by how well the theories predict the real world. Empirical evidence is what makes or breaks it, and the bigger predictions of man-made global warming have been busted.

Glikson mixes up cause and effect. He pays lip service to my comment that sea-level, glaciers and melting ice are effects of warming, and don't tell us what caused the warming. But having done that, in the most fitting of ironies, without even blinking, he finishes up with claims that the ClimateGate emails don't detract from the reality of ice melting and seas rising and all those nasty storms. For once he's right, those emails don't detract *at all* from all the irrelevant, distracting discussion points out there. (But why say it?)

He wonders how much evidence I need? I want evidence that sheds light on the *cause*. I need a bit more than one study where wind-gauges pretend to be thermometers, while the thermometers apply for a redundancy package. Is that too much to ask?

Thanks to Baa Humbug and DE for advice and research

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Additional information:
Avoiding Carbon Myopia, Science and Public Policy Institute, Willie Soon and David Legates

Effects of CO2 on climate

by Andrew Glikson

May 11, 2010

I respond to points raised in Joanne Nova's piece *Credibility lies with evidence*.

From JN's statement: "*And I'm quite consistent in saying that man-made warming is probably real but minor. I provided two references suggesting it is in the order of 0.5°C of warming instead of 3.5°C. Yes, CO_2 causes warming, but how much*", it appears the differences in views regarding the reality and origin of global warming are of a quantitative nature rather than qualitative nature.

However, JN also states: "*I want evidence that sheds light on the cause"* (i.e. of global warming) and *"the cause and effect link is most likely the reverse"*. If I read the last statement correctly, JN questions whether it is CO2 which drives temperatures or the other way around?

Rising CO2, rising temperatures and melting ice are intertwined processes forming feedback loops, i.e. elevated CO2 causes warming and warming drives further CO2 release. The geological record displays episodes of *Primary forcing* by carbon release of CO2 from volcanoes or from carbon-rich sediments excavated by asteroid impacts, or release of methane from heated sediments, amplified by feedbacks, leading to mass extinction of species[1]. The release of some 370 billion tons of carbon as coal, oil and gas from rocks, where the carbon was locked for millions of years, constitutes *primary radiative forcing*, triggering a carbon cycle feedback loop amplified by ice melt/warm water interaction where albedo loss by melting ice is reinforced by infrared absorption by open water[2]. A prime example is the transformation of the Arctic Sea from a high albedo ice surface to infrared-absorbing open-water ocean, with effects on the Greenland ice cap and northern hemisphere climate.

Quantitative relations between CO2 and temperature are defined by the "climate sensitivity" index (T rise per doubling of CO2 concentration)[3], estimated at about 3+/-1.5C but stronger during glacial periods. The current CO2 level at 389 ppm is the highest since 2.8 million years ago (mid-Pliocene), when temperatures rose by 3-4 degrees C and sea levels by 25+/-12 meters [4],[5]. The occurrence of thousands of billion tons of carbon as meta-stable methane deposits in permafrost, Arctic lakes and bogs poses a serious risk associated with polar warming, currently up to 4 degrees C[6]. The emission of some 370 billion tons of carbon (GtC) since 1750 constitutes near-20% of the carbon released as methane during the Paleocene-Eocene Thermal Maximum 55 Ma ago, which raised global temperatures by near 5 degrees C[7].

Paleo-climate records indicate high temperatures and high CO2 levels of several thousand ppm during much of the early Paleozoic (540–350 Ma), a period of low solar luminosity[8]. Levels of greenhouse gases and temperature display an overall but highly intermittent decline with time whereas, by contrast, solar luminosity has been rising, negating a long-term correlation between the sun and global temperatures. It is when CO2 levels declined to below c.500 ppm that the Antarctic ice sheet formed. Conversely, the rise of CO2 above this level would melt the great ice sheets. Abrupt increases in CO2 leading to sharp warming episodes were associated with mass extinction

of species [9]. The current CO2 rise rate of c.2 ppm/year, unprecedented in geological history (excepting major volcanic and impact events), is a cause for concern.

JN states: "*warming started a century before our carbon emissions began to rise".*

The study of multiple proxies, including oxygen isotopes from ice cores, lake and cave deposits, Ca/Mg ratios, 13C and alkenone (organic remnants), tree rings and sapropel (carbon-rich soil), display consistent paleo-temperature trends (Figure 1). The data indicate long-term cooling since about 4-5 thousand years ago, a rise of about c.0.5 degrees C during c.950-1050 AD (Medieval Warm Period - MWP), a decline by a similar amount to 1600-1700 AD (Little Ice Age) related to near-nil sunspot activity, then a rise by more than 1 degree C to a level which exceeds the MWP by near-0.5 degrees C. Only 0.12 Watt/m2 of warming since 1750 AD is attributed to the solar factor.[10]

JN states: "*If the "hot spot" is missing and feedback is negative, almost everything else is irrelevant".*

As indicated in Figure 2[11], 1957-2005 warming of the surface (c.0.5-0.6 degrees C), of the lower troposphere (c.0.3-0.4C) and of mid to upper troposphere, and cooling of the stratosphere, expected from the greenhouse infrared backscatter effect, are consistent with a rise in mean global temperatures, perturbed by the aerosol effects of volcanic eruptions.[12]

Figures:

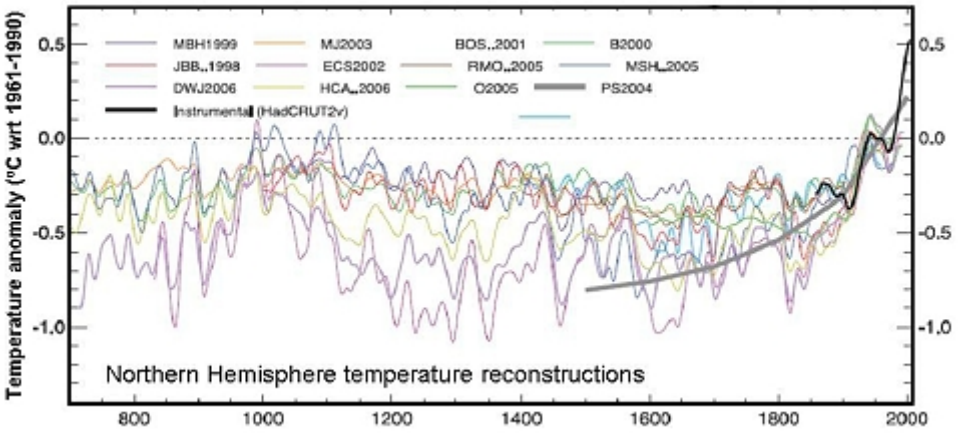

Figure 1. IPCC 2007 Chapter 6. Records of Northern Hemisphere temperature variation during the last 1.3 kyr. Reconstructions using multiple climate proxy records identified in Table 6.1, including three records (JBB.1998, MBH..1999 and BOS..2001) shown in the Third Assessment Report and the HadCRUT2v instrumental temperature record in black. All temperatures represent anomalies (°C) from the 1961 to 1990 mean.

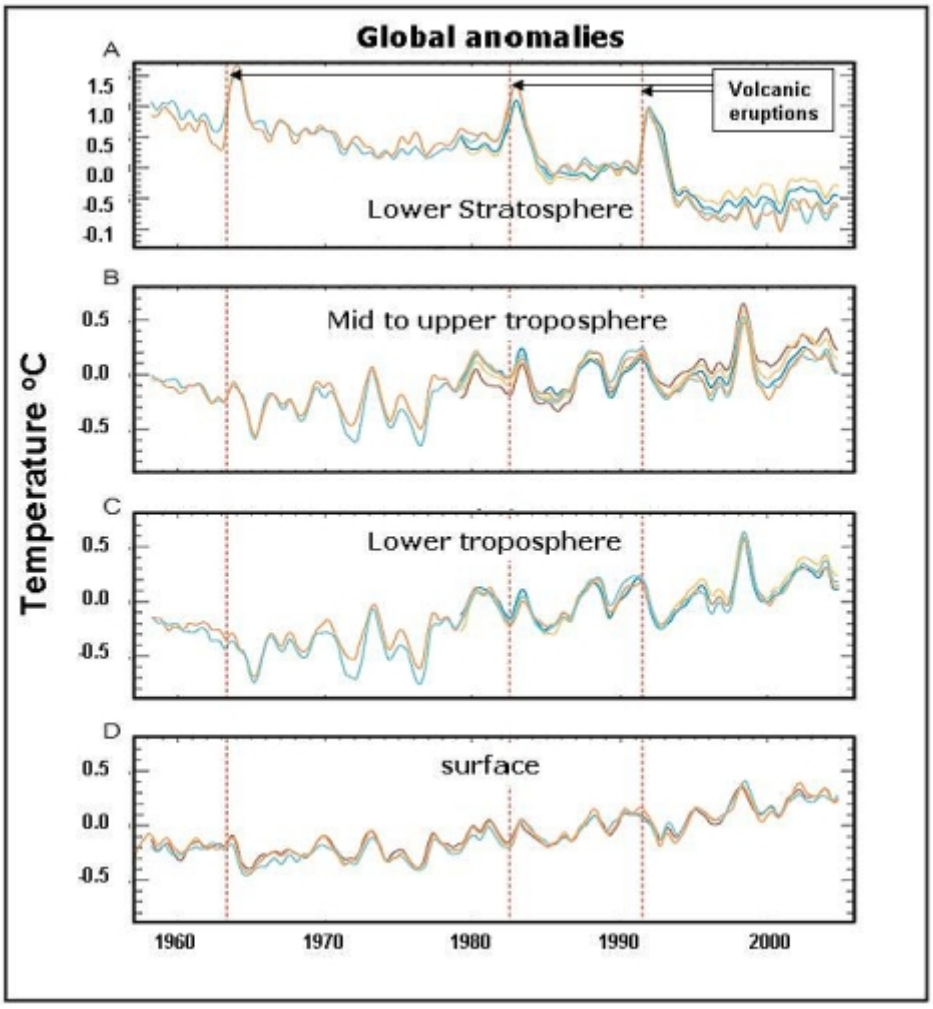

Figure 2. Observed surface and upper-air temperature anomalies (°C). (A) Lower stratosphere T4, (B) Troposphere T2, (C) Lower troposphere T2LT from UAH, RSS and VG2 MSU satellite analyses, and UKMO HadAT2 and NOAA RATPAC radiosonde records, and (D) surface records from NOAA, NASA-GISS and UKMO/CRU (HadCRUT2v). All time series are monthly mean anomalies relative to the period 1979 to 1997 smoothed with a seven month running mean filter. Major volcanic eruptions are indicated by vertical orange dashed lines.

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[10] IPCC AR4-2007
[11] Adapted from Karl *et al.,* (2006); IPCC (2007) Figure 3.17. Department of Climate Change: Science – facts and fiction. (http://www.climatechange.gov.au/en/climate-change/science.aspx)

[12]Adapted from Karl *et al.,* (2006); IPCC (2007) Figure 3.17.
(http://www.climatechange.gov.au/en/climate-change/science.aspx)

Depending on flawed models

by Joanne Nova

May 11, 2010

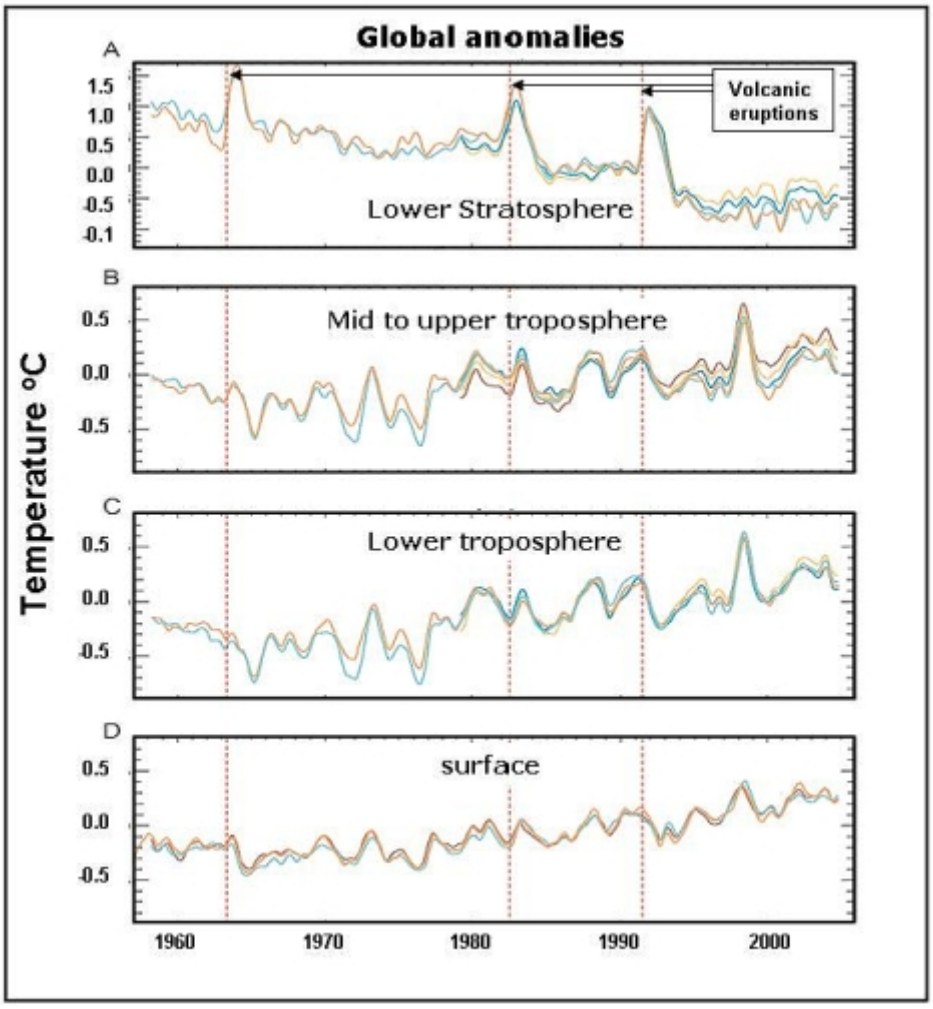
I am impressed that Glikson replied politely, rose above any ad hominem or authority based arguments, and focused on the science and the evidence. This kind of exchange is exceedingly rare, and it made it well worth continuing. Links to Part I and II are at the end. Round 4 was copied from comments up to the post.

For a sentence, I almost think Dr Glikson gets it. Yes, it's a quantitative question: *Will we warm by half a measly degree or 3.5 degrees*? It's not about the direct CO_2 effect (all of one paltry degree by itself), it's the feedbacks—the humidity, clouds, lapse rates and other factors that amplify (or not) the initial minor effect of carbon.

Decades ago, the catastrophe-crowd made guesses about the feedbacks—but they were wrong. Instead of amplifying carbon's effect two-fold (or more!) the feedbacks *dampen* it.

Dr Glikson has no reply. He makes no comment at all about Lindzen [1], Spencer[2] or Douglass[3] and their three peer reviewed, independent, empirical papers showing that the climate models are exaggerating the warming by a factor of six. (Six!) He's probably unaware that the *assumptions* about positive feedback are wrong, and all the portents of disaster were built upon those guesses. Everything else is just an error cascade flowing from a base assumption that is implicit and essential (and wrong). Don't expect the IPCC to explain it in an easy-to-read brochure though.

In Figure 2 of Glikson's piece, he actually inadvertently demonstrates the missing hot spot. There's the vindication. Glikson apparently doesn't understand that the upper tropospheric graph is supposed to show a *higher rate of warming* than the surface graph. Instead it's about the same. This is yet another way of showing there is no hotspot, no "thickening" of the global-greenhouse-gas-blanket, and thus that the surface warming is predominantly *not caused* by an increase in greenhouse gases.



Glikson's Figure 2. Observed surface and upper-air temperature anomalies (°C). (A) Lower stratosphere T4, (B) Troposphere T2, (C) Lower troposphere T2LT from UAH, RSS and VG2 MSU satellite analyses, and UKMO HadAT2 and NOAA RATPAC radiosonde records, and (D) surface records from NOAA, NASA-GISS and UKMO/CRU (HadCRUT2v). All time series are monthly mean anomalies relative to the period 1979 to 1997 smoothed with a seven month running mean filter. Major volcanic eruptions are indicated by vertical orange dashed lines.

As usual, everything else offered by Glikson depends on the flawed models, on cringe-worthy hockey sticks, or on studies from millions of years ago that don't have the resolution to tell us much about cause and effect.

Who is confused here?

Glikson tries to paint me as confused and quotes me out of context. When I ask for *evidence that sheds light on a cause*, I'm talking about all the evidence he was offering on sea ice, or ice sheets, or sea levels, which tell us nothing about what *caused* the warming. Glikson at least seems to agree with me, as this time (finally) he's stopped repeating those irrelevant points.

Then he wonders about my statement about *the cause and effect link being reversed* in the ice cores, and asks if I question whether it is CO_2 that *drives* temperatures. Absolutely! Hasn't he heard of Le Chateliers Principle? It's basic chemistry. The vast oceans have 50 times as much CO_2 as the sky does, and the oceans release carbon as they warm and suck it back as they cool. This explains the tight correlation in the famous ice-core graph, and the 800 year lag (which is how long the deepest

oceans currents take to circulate). The Vostok Ice cores definitively confirm that *temperatures drive carbon*. Carbon probably amplifies this warming somewhat, but there is no clear evidence in the ice cores that carbon does much at all. If there was, why would the Big Scare Campaign keep it a secret?

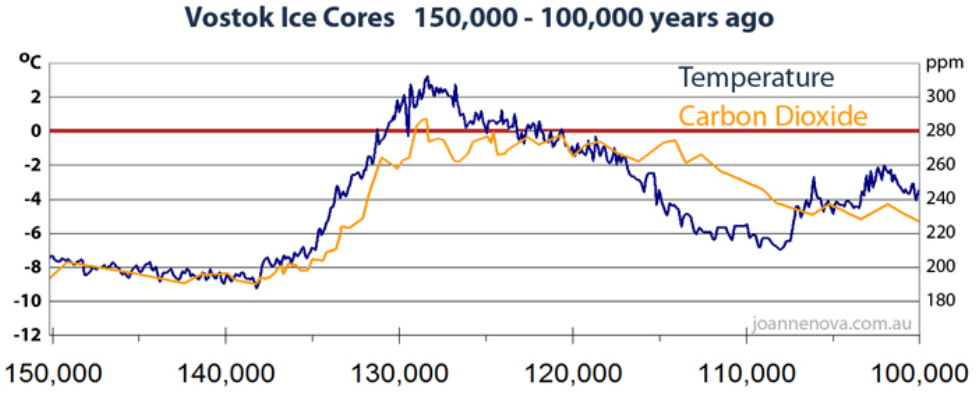


Figure 1. Vostok Ice Cores

Carbon clearly follows temperature in ice cores. There is an 800 year lag[10] on the rise, and several thousand years of lag on the fall. Temperatures drive carbon. Carbon probably amplifies this, but the effect is minor, and the amount can't be calculated with any certainty from the Vostok data. See all the other Vostok Graphs.

Digging up ancient evidence

This is Dr Glikson's bread and butter topic. He claims the geologic record displays episodes of primary forcing from carbon, but where is the evidence? All Keller[4] shows is that big volcanoes seem to cause big extinctions. Is he serious? Volcanoes pump out massive CO_2 (which warms the planet a bit) but they also pour out volumes of ash (think "nuclear winter"). Super volcano Toba was only 70,000 years ago, but if the effect was net warming, it doesn't show in the ice core records. Indeed researchers argue about how *cold* it got and how long it lasted. Was it just a 3 °C fall over 1000 years or was it a 15 °C drop over just a few decades?

Zachos 2008[5] talks about the PETM 55 million years ago. Glikson claims this shows methane warmed the planet, but Zacho's hardly refers to methane. It's a paper about CO_2. Awkwardly, other researchers find that the carbon spike appears to have *followed* the temperature spike with a lag of around 3000 years[6].

With Ward 2005,[7] the problem is that we can't tell whether the carbon rose *before* the extinctions or *after*. The odd 1000-year lag gets rather lost in the 250,000,000 year record. With this and the Geocarb graph,[8] Glikson *assumes* carbon causes the glaciation during the last 500 million years. But golly, we *know* that when temperatures are low, glaciers form and the oceans suck up all the CO_2 they can find. It is no coincidence that low temperatures and low CO2 go together. It's entirely expected and it tells us nothing about whether CO_2 amplifies the temperature. At least one study suggests it was solar insolation that forced the ice sheets to melt, not CO_2.[9] This is not just a his-vs-hers assumption tit for tat. There's a big difference: we *know* temperature definitely affects CO_2 (as I mentioned previously), and we're pretty sure (thanks to empirical evidence, see above) that CO_2 only amplifies that warming by a minor amount. When in doubt, go with the known evidence, rather than the flawed models.

The big question is that if CO_2 *drives* the climate, how come the only papers that supposedly support a major forcing come from eras so long ago that no one can say which factor rose first? Since temperature drives carbon we know there will be a correlation in the past (it'd be shocking if there weren't). But, why-o-why is there no concrete evidence from the last million years?

Hokey hockey sticks

Dr Glikson still thinks the hockey sticks are worth mentioning—but they'll go down in history as a rank embarrassment to climate science, and to *Nature and GRL* (for publishing them). MBH 1999, as I mentioned in my last reply to Glikson, is so poor analytically that his technique generates hockey sticks even with random data. It's a joke.

The IPCC graph Glikson provides "appears" to have independent studies, but 7 of the 10 studies include Mann, Briffa or Jones (each name is listed four times across these papers). Its not what the rest of the world calls "independent."

"this is a tree that *might* have grown extra fast because, say, a bear died and rotted on its roots"

Three studies depend on Bristlecones (which grow faster when CO_2 is higher, making them totally unsuitable). Two rely on the Yamal series (which boils down to one tree in northern Russia being a freak 8-standard deviation tree in the 1990's to give it a hockey stick—this is a tree that *might* have grown extra fast because, say, a bear died and rotted on its roots). Two other studies use *both* Bristlecones and Yamal. Eight of the studies are so flawed they are worthless.

The remaining two studies use different series with their own flaws: One old Briffa series is out of date, another has a large manual adjustment; Moberg et al, hides data, making it hard to replicate, and also depends on uncalibrated data. The Moberg graph is nothing like a hockey stick, in any case.

When I say "warming started a century before our carbon emission rose" and point out that the warming trend hasn't changed with all that extra CO_2, Gliksons only response is debunked Hockey Sticks, and guesstimates from faulty climate models. Is that it?

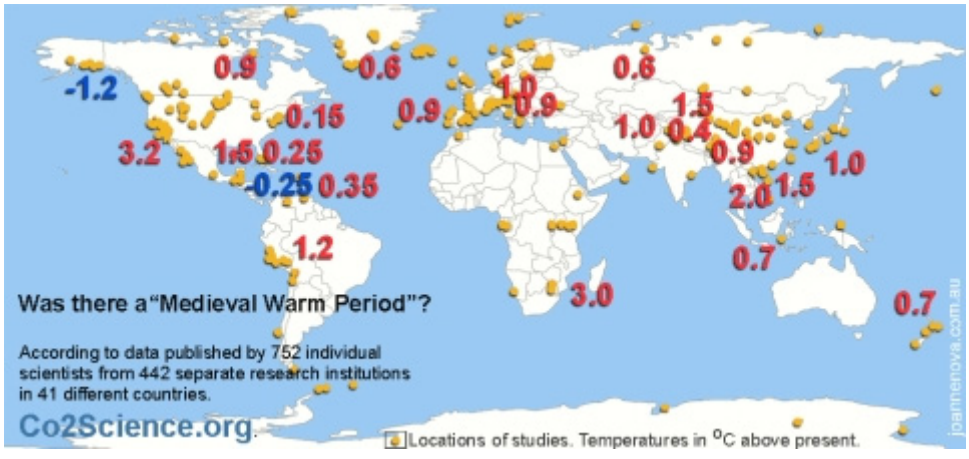


Figure 2a. Evidence for the Medieval Warm Period (Originally from this post on Hockey Sticks) Adapted from the Medieval Warming Period Project at CO2science.org

Hundreds of peer reviewed studies show it was warmer over most of the globe during medieval times. Over 6,000 boreholes from all over the world agree[11]. Craig Loehle[12] also combined 18 different proxies to arrive at a similar curve. The Hockey Stick is wrong.

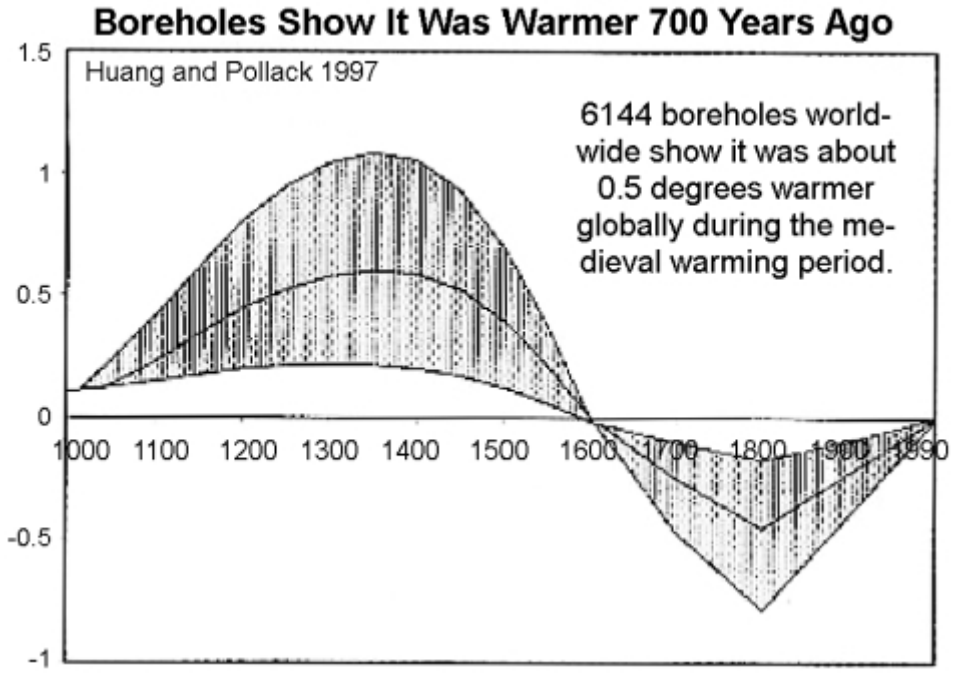


Figure 2b. Boreholes show it was warmer 700 years ago From Huang and Pollack 1997.

Where's the evidence?

The totality of "evidence" comes down to climate models that don't agree with the observations and ever more ancient geological studies that may or may not show an effect, but are simply unable to resolve details that we need. This is why the Michael Manns, Gavin Schmidts and Al Gores of the world won't debate publicly. They know they'd get caned.

If Andrew Glikson thinks he serves the taxpayer by promoting the unproved hypothesis of AGW, he must first examine the models he refers too, and give the public a balanced view of the uncertainties. It's time for the propaganda of half-truths to stop. It's time for universities to be called to order, and shamed for their pathetic standards of logic and reason.

Thanks again to Baa Humbug and DE for advice and research

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UPDATE Part IV: Andrew Glikson replied in comment #64 (copied here)

Andrew Glikson: May 14th, 2010 at 12:24 pm

Dear Joanne Nova,

Thank you for acknowedging the sincerity of climate scientists. As I wrote, I believe I can state on behalf of my colleagues – nothing would delight us more than if direct evidence existed global warming is not occurring or, at the very least, warming is not anthropogenic in origin.

I restrict my response here to the troposphere hot spot, as below. In case you are interested in further detailed response to your article "Depending on flawed models" (11.5.10) I will be pleased to contribute such reply to your website in the form of an 800-1000 words-long article.

Regarding the troposphere hot spot, I refer to the paper: "Consistency of modelled and observed temperature trends in the tropical troposphere" by 17 climate scientists (B.D. Santer, P.W. Thorne, L. Haimberger, K.E. Taylor, T.M. L. Wigley, J.R. Lanzante, S. Solomon, M. Free, P.J. Gleckler, P.D. Jones, T.R. Karl, S.A. Klein, C. Mears, D. Nychka, G.A. Schmidt, S.C. Sherwood, and F.J. Wentz), Int. J. Climatol. (2008).

Where the summary reads:

> "A recent report of the U.S. Climate Change Science Program (CCSP) identified a 'potentially serious inconsistency' between modelled and observed trends in tropical lapse rates (Karl et al., 2006). Early versions of satellite and radiosonde datasets suggested that the tropical surface had warmed more than the troposphere, while climate models consistently showed tropospheric amplification of surface warming in response to human-caused increases in well-mixed greenhouse gases (GHGs). We revisit such comparisons here using new observational estimates of surface and tropospheric temperature changes. We find that there is no longer a serious discrepancy between modelled and observed trends in tropical lapse rates. This emerging reconciliation of models and observations has two primary explanations. First, because of changes in the treatment of buoy and satellite information, new surface temperature datasets yield slightly reduced tropical warming relative to earlier versions. Second, recently developed satellite and radiosonde datasets show larger warming of the tropical lower troposphere. In the case of a new satellite dataset from Remote Sensing Systems (RSS), enhanced warming is due to an improved procedure of adjusting for inter-satellite biases. When the RSS-derived tropospheric temperature trend is compared with four different observed estimates of surface temperature change, the surface warming is invariably amplified in the tropical troposphere, consistent with model results. Even if we use data from a second satellite dataset with smaller tropospheric warming than in RSS, observed tropical lapse rate trends are not significantly different from those in all other model simulations. Our results contradict a recent claim that all simulated temperature trends in the tropical troposphere and in tropical lapse rates are inconsistent with observations. This claim was based on use of older radiosonde and satellite datasets, and on two methodological errors: the neglect of observational trend uncertainties introduced by interannual climate variability, and application of an inappropriate statistical 'consistency test'.

The observation of climate change is not model-dependent but is based on direct observations and measurements, from ground stations, weather baloons and satellites, of basic physical and chemical parameters. The role of models is to help resolve the various climate drivers (forcings) and processes, as well as project future trends.

I will add at this point that disproving the reality of anthropogenic climate change requires:

A. Negation of basic laws related to infrared resonance/greenhouse gas modulation of atmospheric temperature (Stefan-Boltzmann law, Kirchhoff's law of thermal radiation, Planck's law etc.) (For a review of the relations between CO2 and climate refer to http://www.aip.org/history/climate/co2.htm).

B. In terms of these laws, accounting for the effect of some 370 billion ton of carbon emitted by human industry since 1750 (plus land clearing) on the atmosphere, less than half of which was absorbed by the oceans, where it results in decreased pH.

Yours Respectfully
(Dr) Andrew Glikson
Earth and paleo-climate science

My Reply Part IV

Thank you Andrew,

I am happy to discuss this further, and would most welcome a contribution from you. Feel free to include graphs, there is no word restriction, though more people will read a 1000 word post than a very long one.

Anything that furthers our understanding of the climate is useful. If someone can produce convincing evidence or reasoning I would, of course, change my mind (again). Having said that, I have briefly discussed Santer et al 2008 earlier. Nine years after all the data was collected a team of scientists found some "uncertainties" in both models and radiosondes that expanded the error bars, after which they overlap. There was no new evidence, just a reanalysis, and while technically, they reconciled things, they did so without finding the hot spot, instead they found "noise".

There are responses from quite a few people in comments below #64.

Sincerely,

Joanne

Kudos to Dr Glikson for being willing to follow this up.

Please commentors note: good manners *from both sides* will be enforced more so than usual. I want polite discussion of how the climate works, and it's rare in any forum to get a quality exchange.

Guest Post by Andrew Glikson

Earth and Paleoclimate scientist
Australian National University, 18 May, 2010

Dr Andrew Glikson ANU

Unique among the terrestrial planets, occupying an intermediate position between Venus, with its thick blanket of greenhouse gases (93 bar; 96.5%CO_2, 3.5%N_2, 0.015%SO_2, 0.002%H_2O) and Mars with its thin atmosphere (<0.01 bar; 95.3%CO_2, 2.7%N, 1.6%Ar, 0.13%O, 0.08%CO, 210 ppm H2O), the Earth's atmosphere (78.08%N2, 20.95%O, 0.93%Ar, 398 ppm CO_2) allows presence of liquid water at the surface and thereby existence of life. Modulation of the atmosphere by trace greenhouse gases (H_2O, CO_2, CH_4, N_2O, Ozone), exchanged with the hydrosphere and the biosphere, constrains surface temperatures in the approximate range of -89.4°C to +58°C.

Due to long atmospheric residence time on the scale of centuries to many millennia (Eby et al. 2009) [8], CO_2 is capable of accumulation and modulating terrestrial climate, as contrasted with a shorter atmospheric residence time of methane (~8.5 years) and a short residence time of H_2O vapour in the troposphere (~9-10 days). As identified by a range of CO_2 proxy methods, listed in Table 1 and elaborated by Royer (2001, 2010) [21][22], the build-up and decline of atmospheric concentrations of CO_2 has played a profound role in the evolution of climate through geological time (Figure 1), corroborated by observation of glacial deposits and the environmental classification of fossil plants and organisms. Abrupt rises in levels of CO_2 associated with volcanic eruptions and asteroid impacts constituted an essential factor underlying extinction of species (Ward, 1994, 2007 [29] [30]; Veron, 2008 [27]).

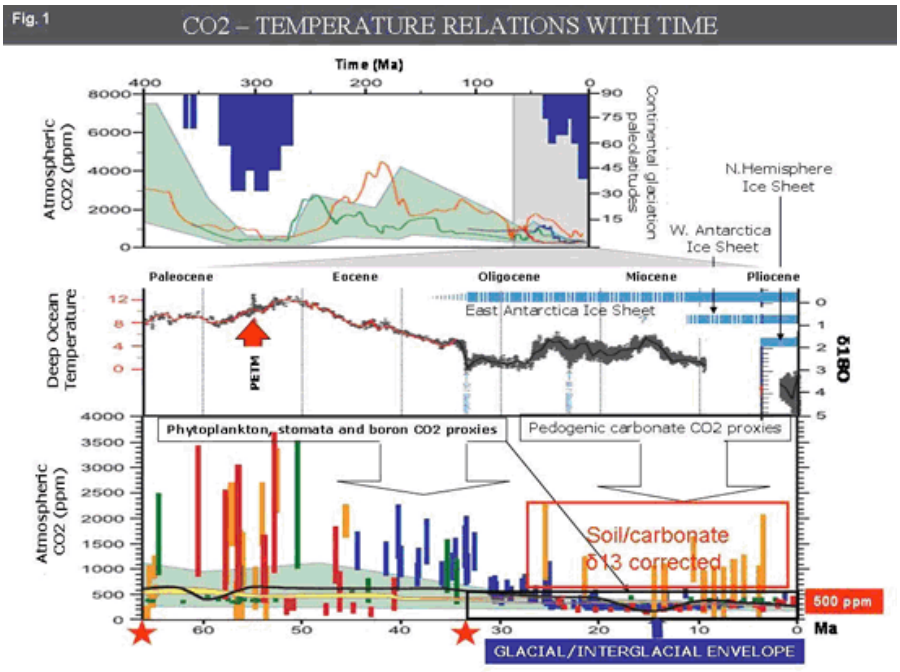

Figure 1: *Atmospheric CO_2 and continental glaciation 400 Ma to present. Note the upper limit of glacial periods under atmospheric radiative forcing levels of ~500 ppm CO_2.* ***Top****. Vertical blue bars mark the timing and palaeolatitudinal extent of ice sheets. Plotted CO_2 records represent five-point running averages from each of the four major proxies. Also plotted are the plausible ranges of CO_2 from the geochemical carbon cycle model GEOCARB III. All data have been adjusted to the Gradstein time scale.* ***Middle****. Global compilation of deep-sea benthic foraminifera 18O isotope records from 40 Deep Sea Drilling Program and Ocean Drilling Program sites updated with high-resolution records for the Eocene through Miocene interval. Most data were derived from analyses of two common and long-lived benthic taxa, Cibicidoides and Nuttallides.* ***Bottom.*** *Detailed record of CO2 for the last 65 Myr. Individual records of CO_2 and associated errors are colour-coded by proxy method; when possible, records are based on replicate samples. Dating errors are typically less than ±1 Myr. The range of error for each CO_2 proxy varies considerably, with estimates based on soil nodules yielding the greatest uncertainty. However, re-calibration of the soil-carbon proxy method (Breecker et al. 2010, Royer, 2010)* See also IPCC AR4 Ch 6)

…

Table 1. Principal proxies applied for reconstruction of Cainozoic climate conditions. Principal reference: Royer et al. 2001.

	Stomata pores in fossil plants
	Carbon d13C proxy – paleo-soil carbonate
	Carbon d13C proxy – phytoplankton
	Alkenone paleo-CO2
	Boron/Calcium
	Foraminifera d11B
CO2 proxies	d44C and d11B as pH and CO2 proxies
	Organic component of sediments (Sapropel) / N-alkane plant leaf wax / tropical vegetation.
	Detrital component of sediments / dust / indicator of mechanical glacial erosion / wind
	Boron / salinity / alkalinity
	Carbon-sulphur-oxygen mass balance calculations
	Benthic and plankton d18O; 13C-18O bonds in carbonate
	Ice cores air bubbles: d18O / deuterium
Temperature	Mg/Ca ratios in carbonate; pollen
proxies	TEX86 paleothermometer based on the relation between number of rings in the membrane lipids of the marine pico-plankton.
	ALKENONE (KETONE)– Paleo-T and CO2 proxy.

Water vapour, which exert peak radiative forcing effects in the tropics, have minor control of temperature in dry desert regions and almost none over polar regions where the atmosphere is of very low to nil water vapour concentrations, yet during glacial terminations and at present, Arctic and Antarctic latitudes have warmed up to 4 times faster than low to mid-latitudes (Figure 2).

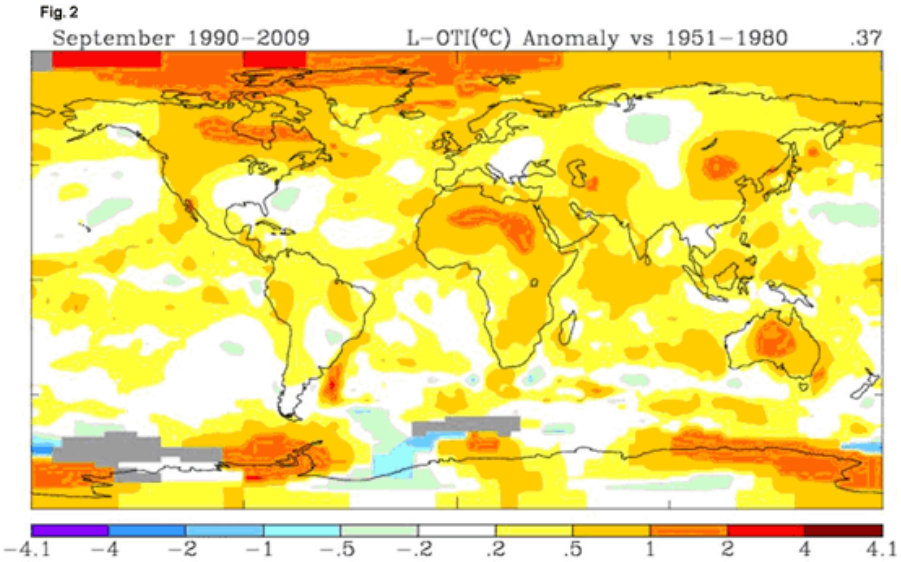

Figure 2: *Global temperature projections for mean September 1990-2009 relative to NASA's baseline of 1951-1980, displaying concentration of warming in H2O vapour-low polar and desert regions.* [NASA GISS]

Lost all too often in the climate debate is an appreciation of the delicate balance between the physical and chemical parameters of the atmosphere/ocean/land system and the evolving biosphere, which controls the emergence, survival and death of species, including humans. Forming a thin breathable veneer only slightly more than one thousandth of the Earth's diameter, the troposphere acts as the "lungs" of the biosphere, exchanging carbon gases and oxygen with plants and animals, which in turn affect the atmosphere, for example through release of methane and photosynthetic oxygen.

Prior to about 635 million years (Ma) ago, when complex multicellular Ediacra fauna appeared, the atmosphere had a greenhouse gas-rich oxygen-poor composition, arising from accumulation of CO_2 from volcanic eruptions and hydrothermal emanations, activity of methane-synthesizing bacteria and excavation of carbon from sediments through asteroid impacts. Excepting glacial periods (~2400-2200 Ma; 850-635 Ma – the "Snowball Earth period"), the dominance of high-temperature oceans on the early Earth placed constraints on CO_2 sequestration, which led to atmospheric build-up of CO_2 to thousands and tens of thousands ppm. Intermittently through the Phanerozoic (540 Ma to the present) rising atmospheric oxygen levels, proliferation of protein-synthesizing animals and emergence of vegetation (in the Silurian ~420 Ma) enhanced the biological carbon cycle, including burial and maturation of carbon as coal and oil.

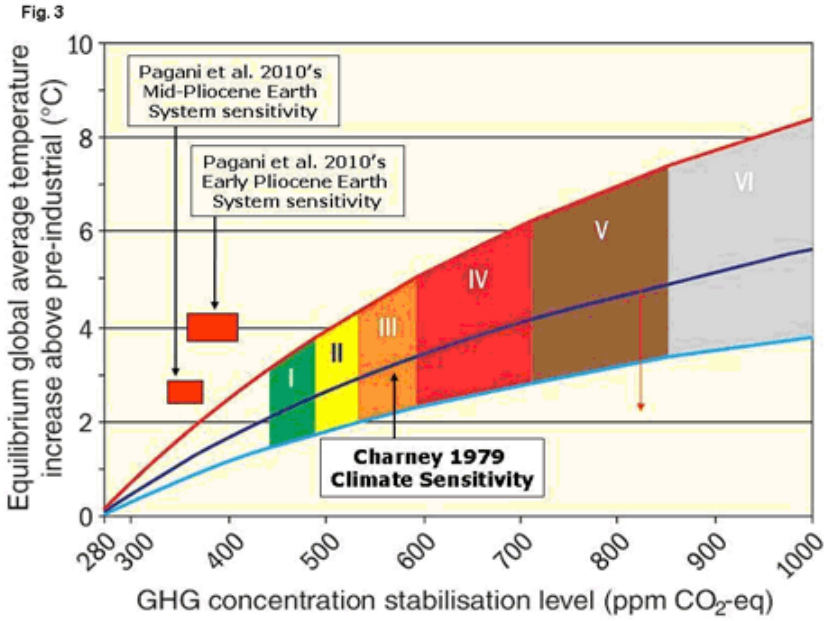

Figure 3: *Equilibrium global average temperature increase above pre-industrial (°C) vs greenhouse gas concentration stabilization level (ppm CO_2-eq). Plot represents Charney's (1979) climate sensitivity relation of 3±1.5°C and red squares regions of Pagani et al.'s (2010) early and mid-Pliocene climate sensitivity relations. Colored zones I to VI represent various CO_2 stabilization targets*
IPCC-2007-AR4.

Resolution of the effects of CO_2 on the atmosphere is defined by the *climate sensitivity* (CS) parameter, formulated as the rise in atmospheric temperature induced by doubling of CO_2 concentration. Charney (1979) [5] defines CS at 3±1.5°C (Figure 3). Recent projections from basic physical laws of the infrared absorption/emission resonance effect (Stefan-Bolzmann law, Krischhoff law), validated by laboratory experiments, are complicated by natural amplification of feedbacks from the carbon cycle and from the ice melt/albedo change amplification effect (replacement of high-reflectance ice by thermal radiation-absorbing water). These processes are classified in terms of *fast feedbacks* and of *slow feedbacks* (Hansen et al., 2007, 2008 [11][12]), defined as:

Fast feedbacks: changes of the hydrological cycle, water vapour, clouds, climate-driven aerosols, sea ice and snow cover.

Slow Feedbacks: changes in continental ice sheets, regional vegetation cover, accumulation of greenhouse gases, long term ocean current and wind patterns, position of high pressure ridges, migration of climate zones and frequency and amplitude of the ENSO cycle, consequent on changes in cross-latitude thermal gradients.

Estimates of climate sensitivity for Slow feedback processes are near double Charney's CS value (Hansen et al., 2008 [12]) (Figure 3). Paleoclimate studies by Pagani et al. (2010) define early and mid-Pliocene (5.2 – 3.0 Ma) climate sensitivities at values in the range of 7.1–9.6, classified by Schneider and Schneider (2010) as "Earth system sensitivity", with implications for 21st century climate projections (Figure 3). As continent-ocean patterns in the Pliocene were similar to the present, projections of such high CS values to the 21st century imply that, at CO_2 levels of 389 ppm,

atmospheric energy level is consistent with Pliocene levels, when temperatures were about 3 to 4°C higher than at present.

The significance of the Pliocene analogy to current climate change trends is recognized by the US Geological Survey, which has instigated a major research program (PRISM: Pliocene Research, Interpretation, and Synoptic Mapping). Results to date indicate extensive melting of the polar ice caps, sea level 25±12 meters higher than at present, a strong hydrological cycle and a shift of tropical and subtropical climate zones toward the poles (Haywood and Valdes, 2004 [13]; Haywood and Williams, 2005 [13]; Robinson et al., 2008 [20]; Chandler, 1997) [5](Figure 4).

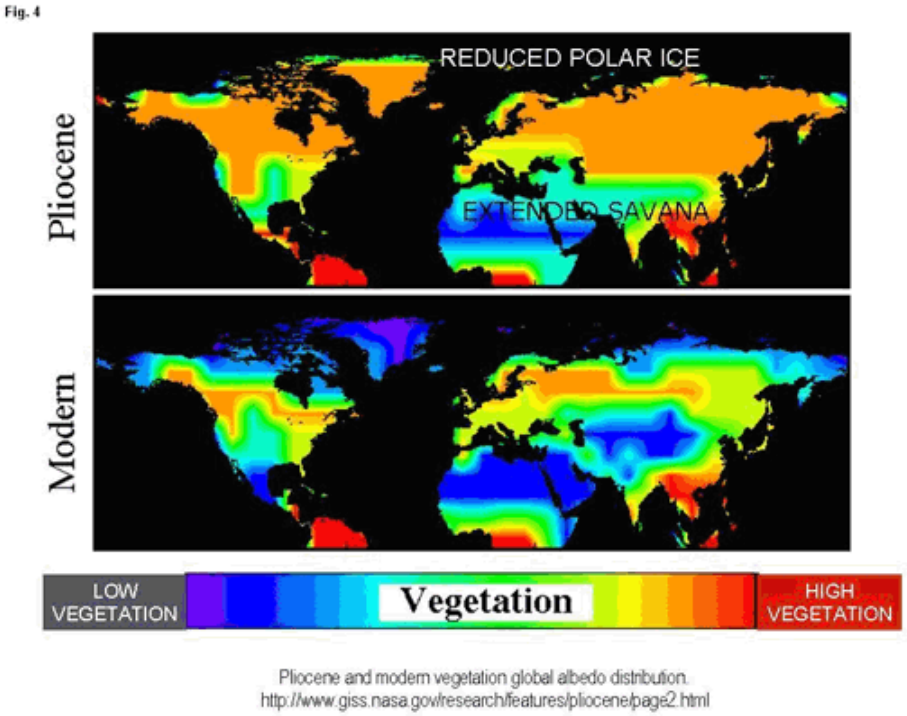

Figure 4: *Albedo changes model for the mid-Pliocene (Chandler, 1997) NASA. Note the larger extent of the deserts (Sahara, Gobbi and Mexico) in the Holocene and of vegetated savanna and of boreal forest in the sub-Arctic and Greenland in the Pliocene.*

During the early Pliocene, as rainforests contracted, hominoids bipeds descended from the trees, subsequently migrating through the savanna. Fast track transition of current climate towards similar conditions will increase evaporation and precipitation in some desert areas (cf. the Kimberley-Pilbara-Officer Basin-Nullabor corridor), whereas polar-ward migration of climate zones would result in droughts in the southeast and southwest Australian wheat belts, consistent with current developments. Calibration of Pliocene sea level rise to temperatures indicates 6-8 meters per 1 degree C, commensurate with reduction of the Greenland and west Antarctic ice sheets by approximately 50±25%.

Current climate trends are consistent with lessons from paleo-climate studies, including:

1. Enhancement of the frequency and amplitude of the El-Nino phase, and decline of the La Nina phase, of the ENSO cycle (Figure 5), i.e. tracking in the opposite direction to the overall cooling trend recorded from the Pliocene to present (Figure 6).
2. Increase melting of the large continental ice sheets and the rate of sea level rise (Figure 7)
3. Polar-ward migration of climate zones, expressed by droughts (Figure 8).

4. Increase in frequency or/and magnitude of extreme weather events (hurricanes, fires, floods) arising from higher atmospheric energy levels and affecting global insurance costs (Figure 9).

Fig. 5

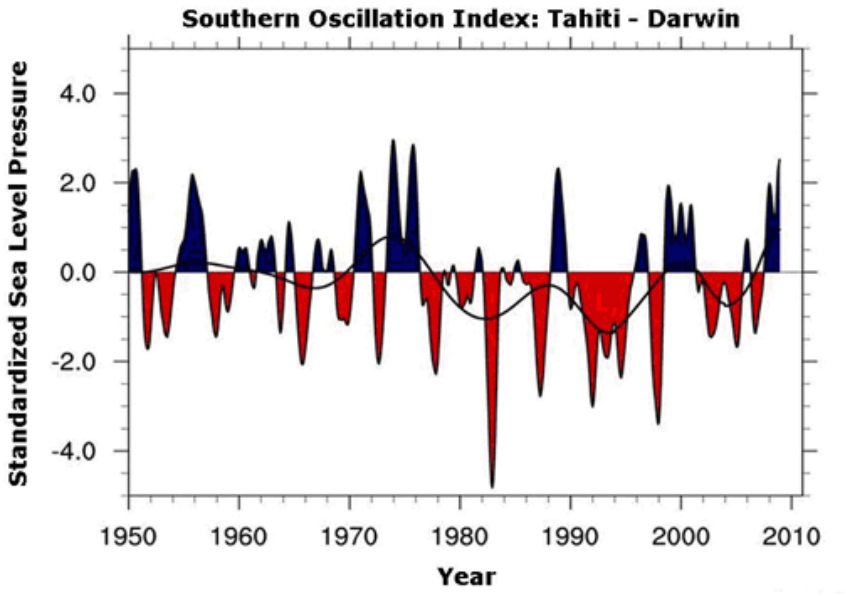

Figure 5. *Monthly Southern Oscillation Index (SOI) based on standardized sea level pressure (SLP) difference data measured between Tahiti and Darwin, Australia from 1950 to the present. Note the increase in intensity and frequency El-Nino states from about 1983. NOAA SOI*

Fig. 6

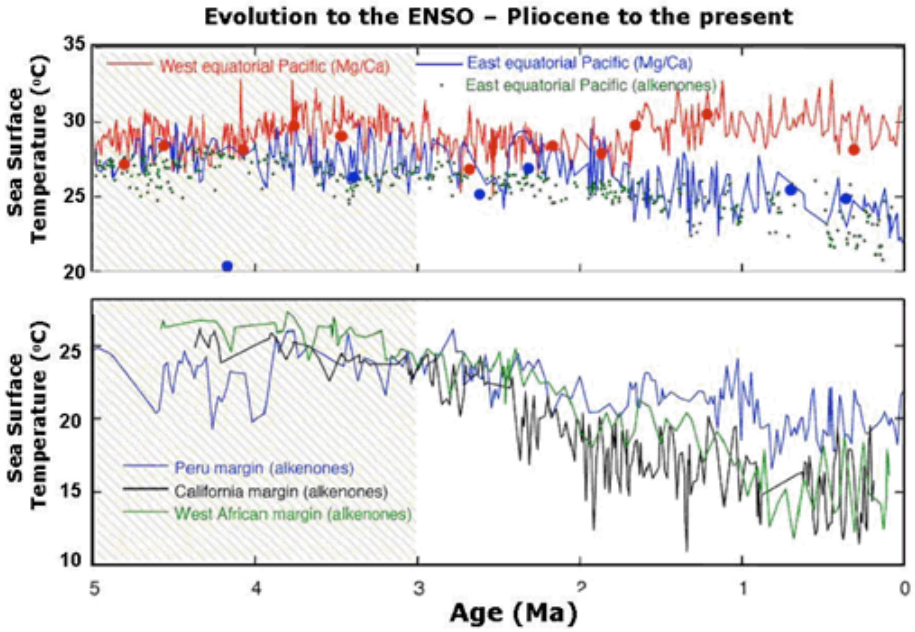

Figure 6: *Pliocene to present sea surface temperature (0C) records in the western equatorial Pacific (red line, ODP site 806) and in the eastern equatorial Pacific (blue line, site 847), both based on Mg/Ca, and for the eastern Pacific based on alkenones (green dots). Pink shading denotes the early Pliocene. Fedorov et al. 2006. [Science]*
Note the temporal divergence of west and east Pacific temperatures, indicating increased role of the La Nina – El Nino polarity.

Fig. 7

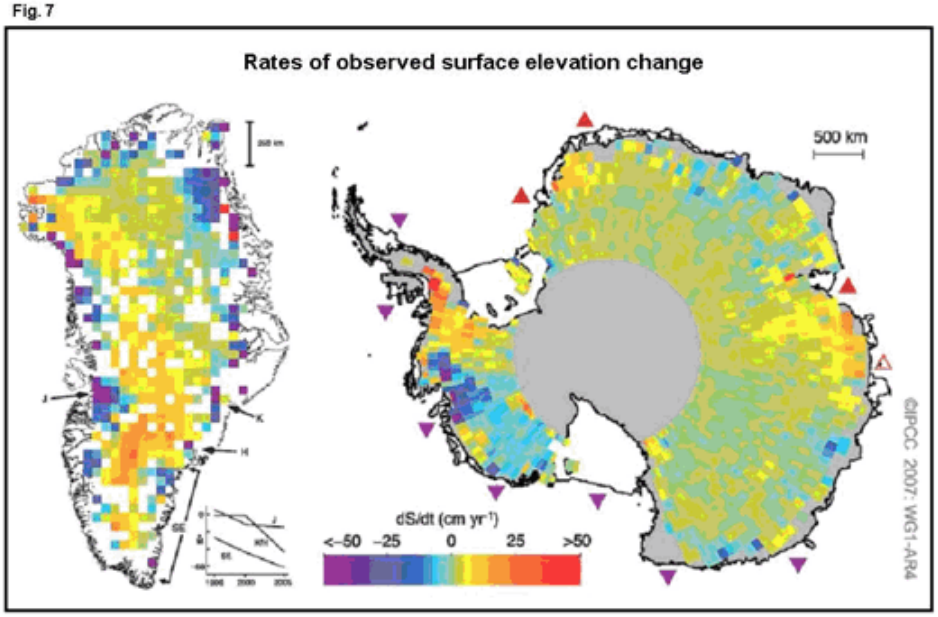

Figure 7: *Rates of observed recent surface elevation change for Greenland (left: 1989–2005) and Antarctica (right: 1992–2005). Red hues indicate a rising surface and blue hues a falling surface, which typically indicate an increase or loss in ice mass at a site, although changes over time in bedrock elevation and in near-surface density can be important.*
IPCC AR4 WG1.

Fig. 8

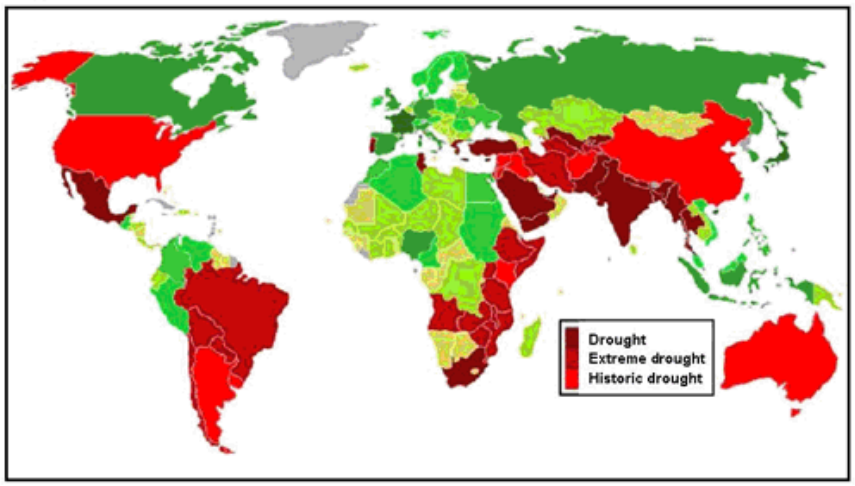

Figure 8: *Catastrophic declined in global food production: 2008–09 droughts. Source: Market Skeptics*

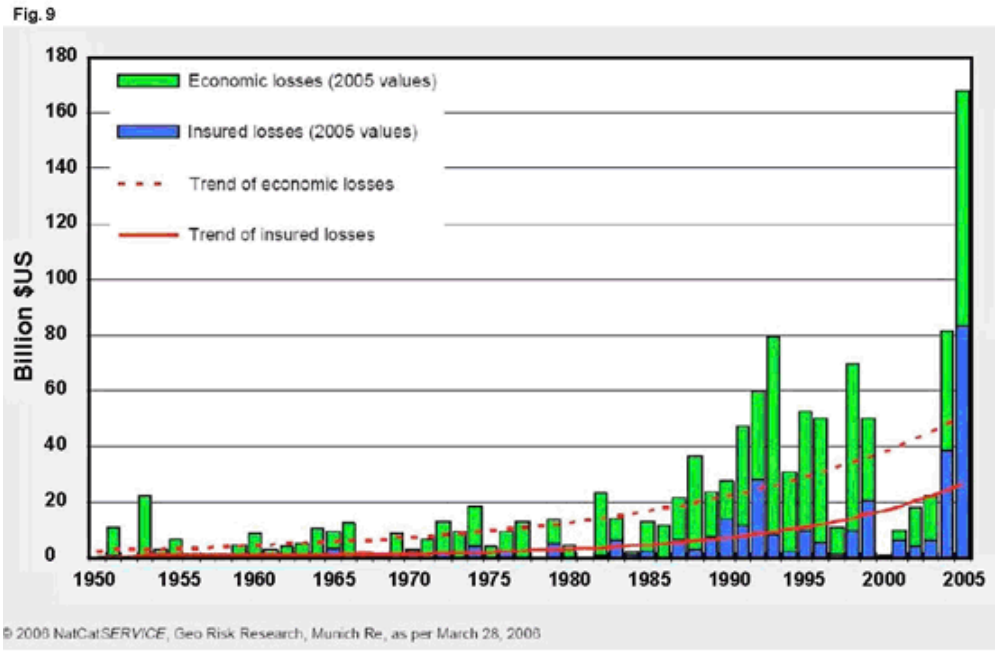

Figure 9: *Rising disasters and insurance costs between 1950 and 2006: Values in $billion. Source: Draeger-Stiftung.de*

Current climate change is distinct from and originates due to different factors which drove Pleistocene glacial terminations (420, 320, 230, 125, 14 thousand years-ago), when Milankovic cycle insolation peaks at mid-northern latitudes induced extensive melting of the Greenland and Fennoscandian ice sheets. This was followed by warming of the oceans, reduced CO_2 solubility and a rise from 180 to 280 ppm CO_2 at a lag of about 800 years behind temperature rise. By distinction, the solar factor since 18th century has risen only by 0.12 Watt/m^2, while global warming induced by carbon emissions rose by c.2,48 Watt/m^2 (CO_2+CH_4+Halocarbons; Figure 10)

As distinct from insolation-induced warming, the greenhouse effect displays the following fingerprints:

Warming in the lower atmosphere (troposphere) and cooling in the stratosphere (due to the downward component of backscatter).

1. Greater degree of warming near the poles relative to the tropics, including relatively high winter temperatures, due to elevated atmospheric greenhouse gas all-year round.
2. More hot days and nights, fewer cold days and nights, i.e. due to lesser loss of heat into the stratosphere overnight. Consequently, a reduction in the difference between daytime and night-time temperatures

Prior to about 1975-1976 the effects of greenhouse gases, solar forcing, ocean currents, the El-Nino Southern Oscillation (ENSO) cycle and aerosol albedo on mean global temperature were difficult to separate (Solanki, 2002 [23]). Since 1975-76, while solar radiation continues to oscillate according to the 11-year-long sunspot cycle, rapid warming at a rate of 0.018 degrees C/year exceeds the rate of the last glacial termination (14,700 – 11,700 years ago) by an order magnitude. Climate change trends since the 1990s continue the sharp accentuation of temperature rise rates from the mid-1970s, with strong fluctuations related to the El-Nino (e.g. 1998) and La Nina effects (e.g. 2007-2009). Principal climate change developments include:

1. Late 20th century and early 21st century CO_2 rise rate average 1.45 ppm/yr, rising to 2.2 ppm/yr in 2007, exceeds 1850-1970 rates by factors of ~4 to 5 and is two orders of magnitudehigher than mean CO_2 rise rates of the last glacial termination (~0.014 ppm/yr) (Rahmstorf et al., 2007 [17]; Global Carbon Project, (2008) [9].
2. Methane (CH_4), which after ~20 years has 23 times the greenhouse warming effect of CO_2, has been rising during 1850-1970 at a rate of ~ 5.4 ppb/yr, and has risen by 10 ppb during 2007 (http://web.mit.edu/newsoffice /2008/techtalk53-7.pdf). Methane deposits potentially vulnerable to climate change reside in permafrost (~ 900 Billion ton Carbon – GtC), high latitude peat lands (~ 400 GtC), tropical peat lands (~ 100 GtC), vulnerable vegetation (~ 650 GtC) and methane hydrates and clathrates in the ocean and ocean floor sediments (> 16,000 GtC). These deposits exceed the levels of atmospheric carbon (~750 GtC), carbon emissions to date (~ 370 GtC) and known economic carbon reserves (~6000 GtC). Recently elevated methane release was recorded from Arctic Sea sediments and sub-Arctic permafrost (Walter et al., 2006 [28]; Rigby, 2008 [18]).
3. A rise of mean Arctic and sub-Arctic temperatures in 2005-2008 by near +2.4C since 1970, underlining the critical role the poles have in global warming.
4. Arctic Sea ice melt rates of ~ 5.4% per-decade since 1980, increasing to >10% per year during 2006-2007 (National Snow and Ice Data Centre [NSIDC], 2008).
5. Greenland and WestAntarctica warming and ice melting (Figure 7) at rates of >10% per decade culminating in mid-winter ice shelf breakdown (Wilkinsice shelf; June, 2008, NSIDC, 2008).
6. Slow-down of the North Atlantic thermohaline conveyor belt and down-welling water columns (NASA, 2004; Bryden et al., 2005) [4], with attendant danger of its cessation analogous to conditions ~8.2 kyr ago (Alley et al., 2000, 2003 [1] [2][1,2]).
7. Temperature projections for the North Atlantic Ocean (Keenlyside et al., 2008 [15]) may be consistent with slowdown of the Gulf Stream, due to potential effects of Greenland ice melt waters.
8. Increased frequency and intensification of categories 4 and 5 hurricanes (Webster et al., 2005 [31]).

The polar ice sheets serve as the "*thermostat*" of glacial conditions which commenced at 34 Ma when CO_2 levels declined to below 500 ppm (Figure 1), enhancing the flourishing of large mammals, rendering the decline of Greenland and Antarctic ice sheets of particular concern. NASA satellite gravity and microwave measurements indicate a doubling of Greenland ice melt areas per-decade (NASA 2006). Rates of ice loss of the Greenland ice sheet have increased from 0.05±0.12 mm/yr during 1961–2003 to 0.21±0.07 mm/yr during 1993-2004. The measurements indicate an increase in ice sheet melt area by 16% from 1979 to 2002 (Steffen and Huff, 2002 [24]; Steffen et al., 2004 [25]; NASA, 2006; Hanna et al., 2005 [10]; IPCC-2007; Hansen et al., 2007 [11]). Time-variable gravity measurements from the GRACE (Gravity Recovery and Climate Experiment) satellites of mass variations of the Antarctic ice sheet during April 2002–August 2005 detected a decrease in the mass of the ice sheet at a rate of 152±80 cubic kilometres of ice per year. Most of this mass loss came from the west Antarctic Ice Sheet, including a water equivalent decrease in ice thickness of -1 to -4 cm/year for the Antarctic peninsula and the Ross Sea-Amundsen shelf area (Rignot and Thomas, 2002 [18]; Chen et al., 2006 [6]; Velicogna and Wahr, 2006 [19]). GRACE-based estimates by Chen et al. (2006) [7] identify ice loss of 77±14 km^3/year in West Antarctica and gain of +80±16 km^3/year in Enderby Land of East Antarctica.

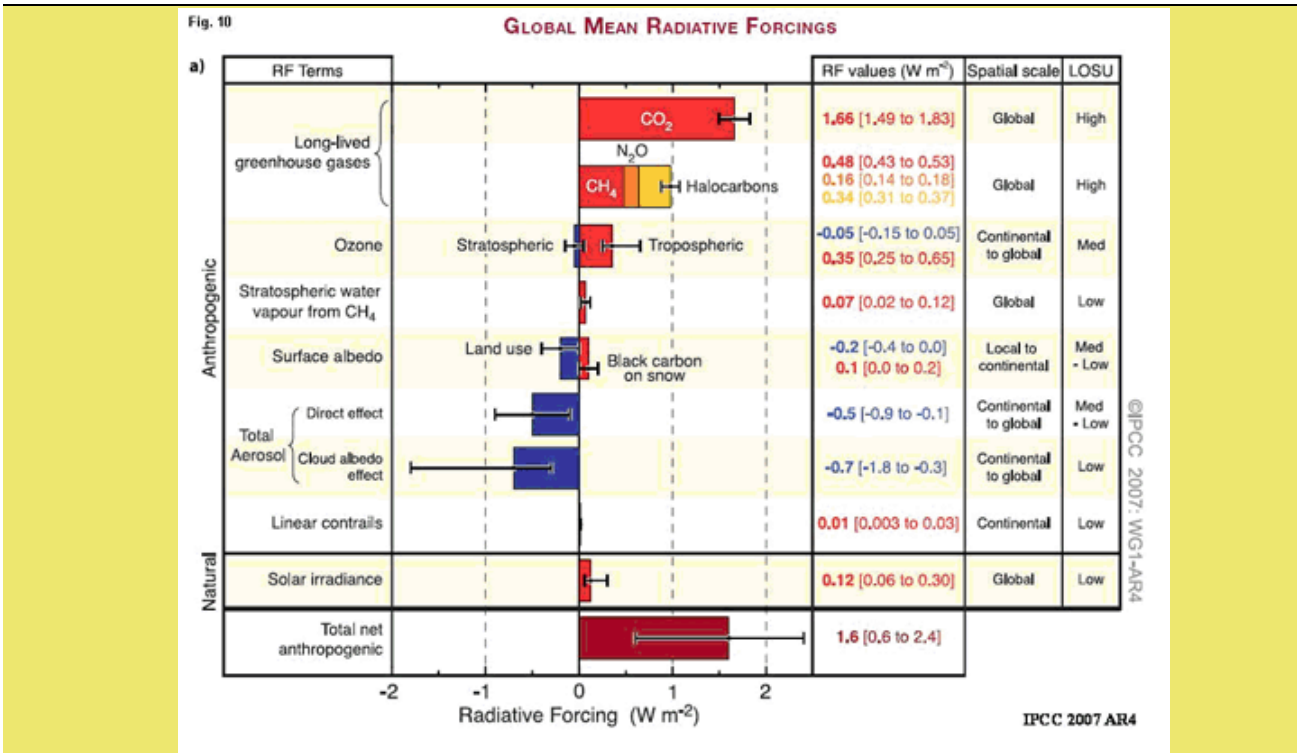

Figure 10: *Global mean radiative forcings and their 90% confidence intervals in 2005 for various agents and mechanisms. Columns on the right-hand side specify best estimates and confidence intervals; typical geographical extent of the forcing (Spatial scale); and level of scientific understanding (LOSU) indicating the scientific confidence level. The net anthropogenic radiative forcing and its range are also shown.*
IPCC AR4 WG1

Figure 10 summarizes the various global mean radiative forcings operating on the terrestrial atmosphere from 1750AD. Temperature rise due to total positive forcing of +3.16 Watt/m^2 (CO_2, CH_4, N_2O, Halocarbons, ozone, stratospheric vapour due to methane, black carbon) is partly masked by negative feedbacks of -1.45 Watt/m^2 (depletion in stratospheric ozone, increase in surface albedo due to land use, albedo effects of aerosols and aerosol effects on clouds). The balance of +1.71 Watt/m^2 translates to a potential temperature rise of about 1.3^{o}C. Once the masking effects of aerosols are removed, potential temperature rise would approach near 2^{o}C.

A perspective on current carbon emissions arises from factors underlying the big mass extinction of species, including the end-Devonian (359 Ma; 450 – 1275 ppm CO_2; 40% extinction of Genera), Permian-Triassic (251 Ma; 3550 ppm CO_2; 80% extinction of Genera), end-Triassic (216.5 Ma and 199.6 Ma; 1300-2200 ppm CO_2; 18 – 34% extinction of Genera) and Cretaceous-Tertiary boundary (65.5 Ma; 2300 ppm CO_2; 46% extinction of Genera) (Keller, 2005 [16]). Consistent lines of evidence, including basic physical laws, multiproxy-based paleo-climate studies and direct measurements from ground stations, balloons and satellites, suggest societies need to pause before proceeding with open-ended emission of carbon gases into the terrestrial atmosphere.

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Round Five: Ignore the main point, repeat the irrelevant

The debate with Paleoclimatologist Dr Andrew Glikson about the evidence for Climate change has reached a telling point. There is a gaping hole.

Through four rounds of **to** and **fro**, I've been asking for evidence that the predicted (critical) "hot spot" was there above the equator, and we were drilling down to this point. It's the weak link in the chain of evidence, and if the climate models are wrong on this element, you can kiss goodbye to the catastrophe. Everything else might be right, but there's no major warming if there's no strong amplifying (positive) feedback, and and there is no amplifying feedback from water vapor if there is no hot spot. Indeed, I quoted evidence from three peer reviewed studies that show that we're headed for a half a measly degree of warming rather than a baking 3 – 6 degrees.

In **Round 2** Glikson didn't mention Lindzen, Spencer or Douglass (the three independent papers which suggest that predicted feedbacks are missing or negative). Instead he suggested "Sherwood 2008" found the hot-spot. I pointed out that Sherwood used wind-gauges instead of thermometers. To believe he is right we need to throw out thousands of thermometer readings and calculate the temperature indirectly from the wind-speed instead.

In **Round 3**, Glikson didn't mention Sherwood. But he posted graphs showing the troposphere had warmed. I pointed out that his graphs demonstrated what I had been saying — the upper troposphere had warmed at *the same rate* as the surface. If the hot spot was there it would have warmed nearly twice as fast.

In **Round 4** (in comments after round 3), Glikson didn't mention the graph. But he pointed to Santer 2008. I replied that Santer didn't find the hot spot, he just found fog in the data and fog in the models and stretched the error bars so wide that finally the models just overlapped with one set of observations. Santer had no new data. Nine years after the data came in, all he did was to increase the error bars and suggest that maybe our equipment wasn't good enough to find the hot-spot. It's rather devastating: if we can't build weather balloons that get a useful temperature reading, how the heck can we create models that estimate the temperature from 10,000 m below based on dozens of factors that are even harder to measure? The hot-spot should have been at least 0.6°C and radiosondes are individually calibrated to 0.1°C. Somehow we're supposed to believe that hundreds of radiosondes had missed it?

In **round 5**, Glikson didn't mention Santer. It's as if this devastating point didn't exist. Andrew Glikson is genuinely trying to come up with other evidence, and he's not just ducking out

completely (as many would), but he is ducking the point that matters, the weak link in the AGW chain. Really, seriously, everything about the Tower of Global Warming was built on the foundation of an increasing column of water vapor. Does he realize that all the other circumstantial evidence is predicated on a *guess* that the Earth's climate had net positive feedbacks, when almost all other long-lived natural systems have net negative feedbacks?

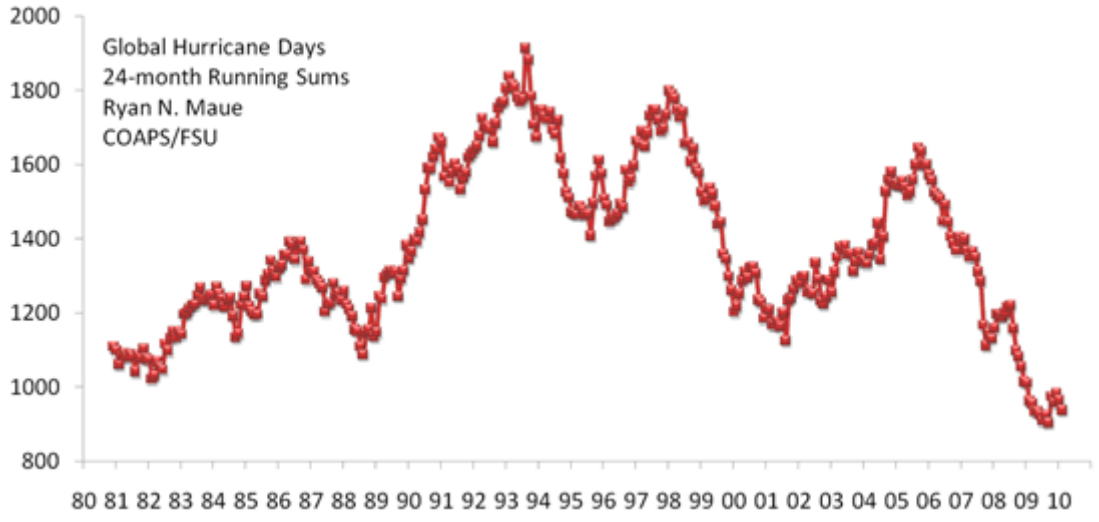
All of the other points I'll briefly sum up here below. I've had helpful responses from Michael Hammer with some very original work, and also from William Kinninmonth. I will post these both soon (separately).

In brief:

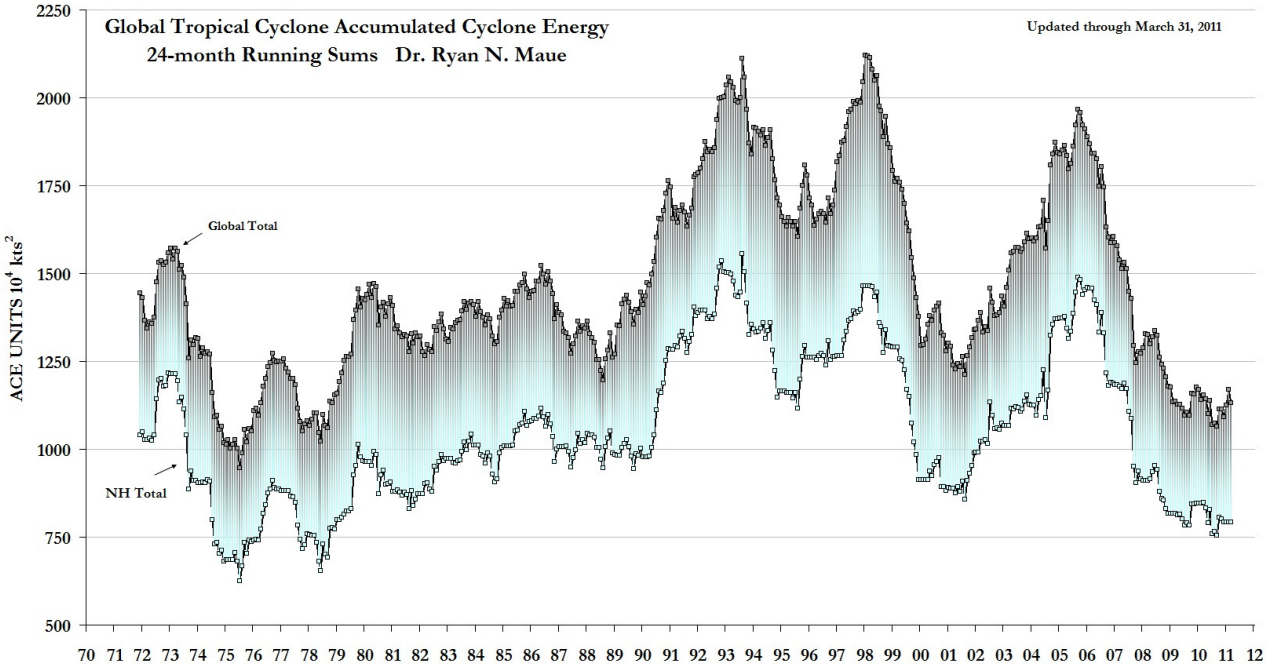
1. **Water vapor has the biggest effect in the tropics (yes) but the poles heat up the most**. (I guess the implication is that the poles are heating due to CO_2). Wait til you see Hammer's reply. I'll just say that no matter what the cause of heating, the poles will *always* probably warm more than the equator, so the fact that they have warmed more tells us nothing whether CO_2 caused it. The equator has an in built "thermostat". Cubic kilometers of water evaporate, dump that heat in the atmosphere, rain back down, and keep the equator a fairly constant temperature. At the poles though, it takes a lot of extra heat energy to "evaporate" the near zero degree water. Thus the temperatures vary much more. There is a big evaporative air conditioner working in the tropics. It's barely there at the poles.
2. **CO_2 supposedly hangs about for centuries.** This is one of the more outlandish weirdo ideas being repeated in many circles. Even though IPCC charts themselves show that a quarter of all atmospheric CO_2 churns in and out of the atmosphere *every year*. How the human contribution is supposed to behave differently, and not just become a tiny extra part of this continuous exchange defies common sense. We add 8GT per year to an atmosphere with 800GT. About 200 GT is taken up by the oceans and plants, and about that much is released. It's all in a kind of equilibrium. There's no reason to suppose that a quarter of all human emissions don't turn over each year just like all the rest. Radio carbon dating of C14 from atomic explosions decades ago confirms that there is little trace left today, and that CO_2 hangs around for about 8 -10 years. [2][3]
3. **Studies from 3 million to 500 million years ago show that when volcanoes blow up or asteroids hit, CO_2 levels rise and animals die**. Yep. That'd be because both those events are god-awful, destructive things that dump mountains of ash in the atmosphere. The ash cools the planet. Cold times are yukky for life on earth. Animals die en masse. Tsunami's, dust and lava are probably not too friendly either. The CO_2 effect is a mere rider of correlation. All these studies that are referred to are just stabs at correlation, and correlation is not causation. We know (as I've said before) that colder oceans suck CO_2 out of the atmosphere. We would be shocked (shocked, I tell you) if the geological record *didn't* show a correlation between temperature and CO_2. Temperature *drives* CO_2. Read the caption on Figure 1. "*Dating errors are typically less than ±1 Myr."* We're hunting for an effect that ought to happen in days, weeks and months, with some effect within decades, and the graph we're looking at resolves things to plus or minus *one million years*. We're searching for Nanotubes in a hay stack, and we've only got our bifocals.
4. **Fast feedbacks versus slow feedbacks.** The models obviously get the *fast* feedbacks totally wrong. So there's not much upward pressure pushing on the *slow* processes. Convince me that effects that may take hundreds of years, which depend on fast feedbacks and are calculated by faulty models are something I should pay taxes on in 2010? If there is hardly any fast feedback in the first place, doesn't that kind of suck most of the scary part out of the slow feedbacks? What are the slow feedbacks responding too? Since they're *slow*, we might

have, you know, a few years (or 100) to wait before setting up a global trading scheme and redeveloping the worlds energy supply.

5. **The world is a lot like the Pliocene a few million years ago.** Back then it was 3-4 degrees hotter and CO_2 levels were "about the same" as today. We don't know what caused that warming back then. We don't have the resolution to figure it out. Which came first, CO_2 or the heat? Perhaps it's something else entirely that came first. We can't tell. Why *assume* it was CO_2?
6. **Yes ENSO's are cycling.** We don't know exactly why, but they appear to switch every 30 years roughly. Figure 5 is only a *50 year* SOI graph. How are we supposed to see long term trends in a 30 year cycle within just 50 years? Things were due to swing towards El Nino's anyway, and now they are due to swing back to la Nina's now. So? Figure 6 has the opposite problem. It's a 5 million year graph, but we're supposed to see an effect on the SOI from the last 50 years of human CO_2 emissions? Sure maybe there is some anomalous ENSO signal lying waiting for us to find in 2050, but we can't use this as an indicator unless we feel like waiting decades (and even then it's not the answer). It's the wrong tool to use for attribution.
7. **Increased ice sheet melting.** We've already done this. Back in Round 2 I quoted Wingham 2006[1] showing that there is more ice in Antarctica. Glikson's Figure 7 graphs show that there has been significant thickening in some places on the ice sheets, and thinning in others. This is a non-point about something that can't be used for attributing climate change to CO_2 in any case. There's no cause and effect link. All forms of warming would cause ice sheets to change. (Do I need to keep repeating this?)
8. **Yes, there have been *some* droughts lately.** Any cause of warming would change rainfall patterns. There is no information here about the effect of CO_2 or the cause of the droughts
9. **Disasters cost more today than they did in 1950! Yeup.** That happens when you inflate the money supply and is a dang useless "indicator" for anything to do with climate. Can I put a fine point on it? The M3 (that's a broad monetary aggregate) in the US grew *thirty fold* from 1959 to 2005. Basically, there is 30 times as much money floating around the economy now as there was back in the fifties. How could prices of nearly everything *not* rise under that kind of money supply growth? The growth in the cost of disasters is not the graph to use. It's just a poor proxy for inflation. There are better graphs of hurricanes to use[4] and other references[5] deal with hurricanes specifically and find little trend. Right now the global accumulated cyclone energy index is at one of the lowest points in thirty years.



Global Hurricane Days, Ryan Maue



Source: Ryan Maue

(Thanks to Baa humbug and Paul M and Roger Pielke.)

What about the fingerprint of "greenhouse gases"?

There's the usual argument that greenhouse gases should 1/ warm the troposphere, 2/ cool the stratosphere, and 3/ rising minimum temperatures and less difference between minimum and maximum in daytime and night-time temperatures.

This leaves out the major effect of the fingerprint of greenhouse gases (the missing hot spot). The warming troposphere and cooling stratosphere *have* happened, which confirms that there is probably more CO_2 in the atmosphere. But as I said already (repeatedly)… *Yes* doubling CO_2 heats the planet *directly* by maybe as one (1!) degree. This is what Hansen et al suggest and possibly that is correct. But without the amplifying feedback of the water vapor and warming due to changes in clouds, there is no disaster. At most it's only one measly degree over 300 years, and worse (for the scare campaign), if Spencer and/or Lindzen are right then it's only a half a trivial, inconsequential-cancel-the-IPCC degree thanks to the negative feedback.

Other factors like extra cloud cover also cause increasing minimums by keeping in the heat. The only definitive fingerprint that would suggest impending disaster (if only it were there) is the one that isn't mentioned: the hot-spot.

Glikson's answer is polite and well referenced, but overall, it's not that well organized; it wanders around, repeating points I've already debunked or that I've already pointed out are irrelevant and avoids discussing the most important point. It is a rehash of the same old, and does nothing to convince me of a threat from man-made global warming.

I'm feeling a bit sorry for him. The Schmidts, Jones, Mann's, Hansens, Gores et al almost never "debate" — The big-name-brands in the climate-science industry know that they don't have the goods. Instead, they let the other scientists do the front line work. There are undoubtedly a lot of

expert researchers in climate related fields (but not in modelling) who have no idea that the models were based on such a flimsy assumption.

There is no evidence to support the idea that carbon's warming is amplified by humidity and clouds and this pulls the rug out from under every other point. Will any scientist from the Pro AGW side admit they can't provide evidence that there will be any warming above 1 degree for a doubling of carbon? It would take a big man.

Glikson is an expert in that fascinating area of major asteroid impacts from millions of years ago. He just announced a massive crater find in the Timor sea (possibly one of the largest ever). This is important research, but not the kind of information we need to know to generate models that actually work. Behind the scenes, why have people like ANU colleague Will Steffan left it up to poor Glikson to defend the climate models? Glikson has been dumped with the impossible task.

But having realized that there is no good answer (or Steffan and Pitman and others would be debating it instead), the honest but hard thing for Glikson to do would be to stand up and admit that he is unable to give any evidence that supports the catastrophic warming that the models suggest. It would also earn him kudos scientifically if he was one of the few climate scientists brave enough to say that the behaviours of people like Jones and Mann in emails from ClimateGate were not acceptable and did not reflect well on the industry.

Thanks to Dr Glikson for being dedicated enough to follow through, and making a serious effort to line up the evidence. Thanks also to the people who contributed to the comments below Dr Gliksons points. I wish I had time to summarize all the pertinent points here. Dr Glikson is most welcome to contribute more.

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17677 words.

The Full Debate:

Part I: Glikson "The Case for Climate Change"
Jo Nova "No Dr Glikson";

Part II: Glikson "Credibility lies with experienced authorities"
Jo Nova "Credibility lies on Evidence";

Part III: Glikson "The Effects of CO_2 on Climate"
Jo Nova "Glikson accidentally vindicates the skeptics".

Part IV: Glikson suggests evidence for the hot spot.
I point out how weak it is. (See the UPDATE below Part III).

Part V: Glikson The planetary atmosphere and climate change
Jo Nova Ignore the main point, repeat the irrelevant.

Part VI: **Dr Glikson asked to respond again. I said "please do". So far, he has no reply.**