

Speaking Truth to Power: Science at the Copenhagen Climate Talks

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I propose the following ground rules:

1. We will discuss science only, not policy, politics, or advocacy.

2. Hold questions until the end, except for quick clarifications.

3. No *ad hominem* arguments.

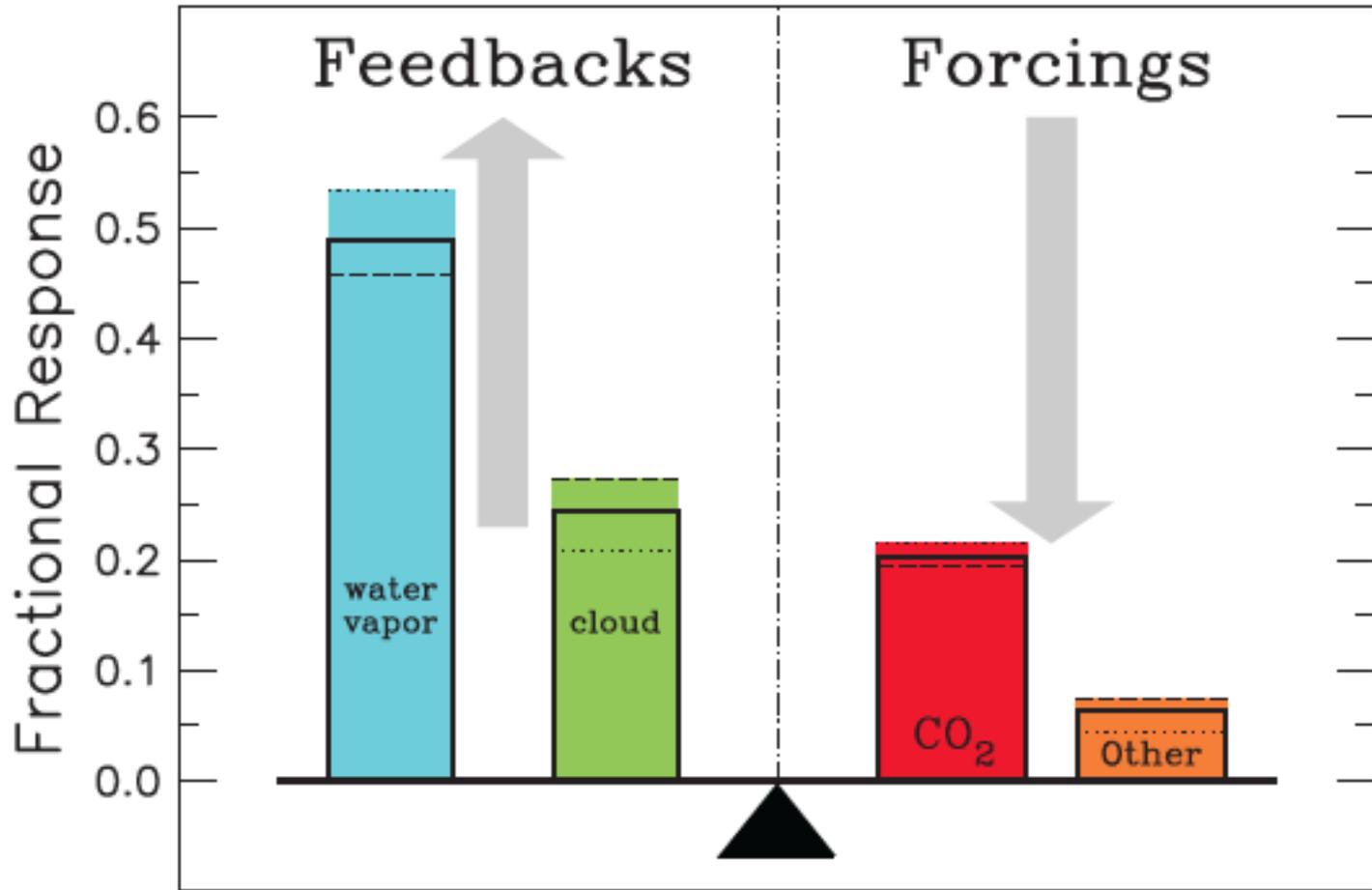
Bill Scott: You will get some skeptical questions. I'll mention two examples from past meetings. First, we've been shown that water vapor has stronger greenhouse radiation absorption than carbon dioxide. Can you explain the relative concerns between CO₂ and water vapor?

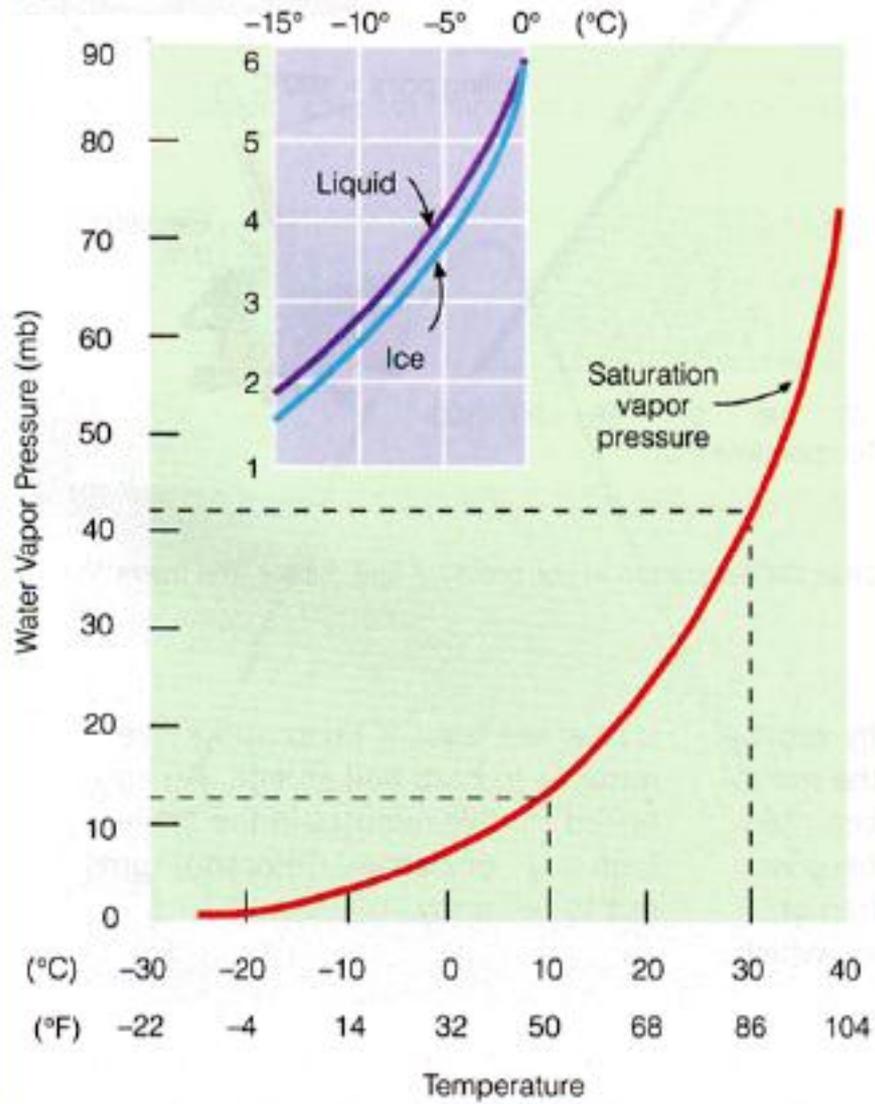
Also, we've looked at the ice core data showing a strong correlation between CO₂ and temperature over a million years. Some claim that time regression analysis shows that the temperature actually leads the CO₂ by about 700 years. Can you speak to the credibility of this time analysis?

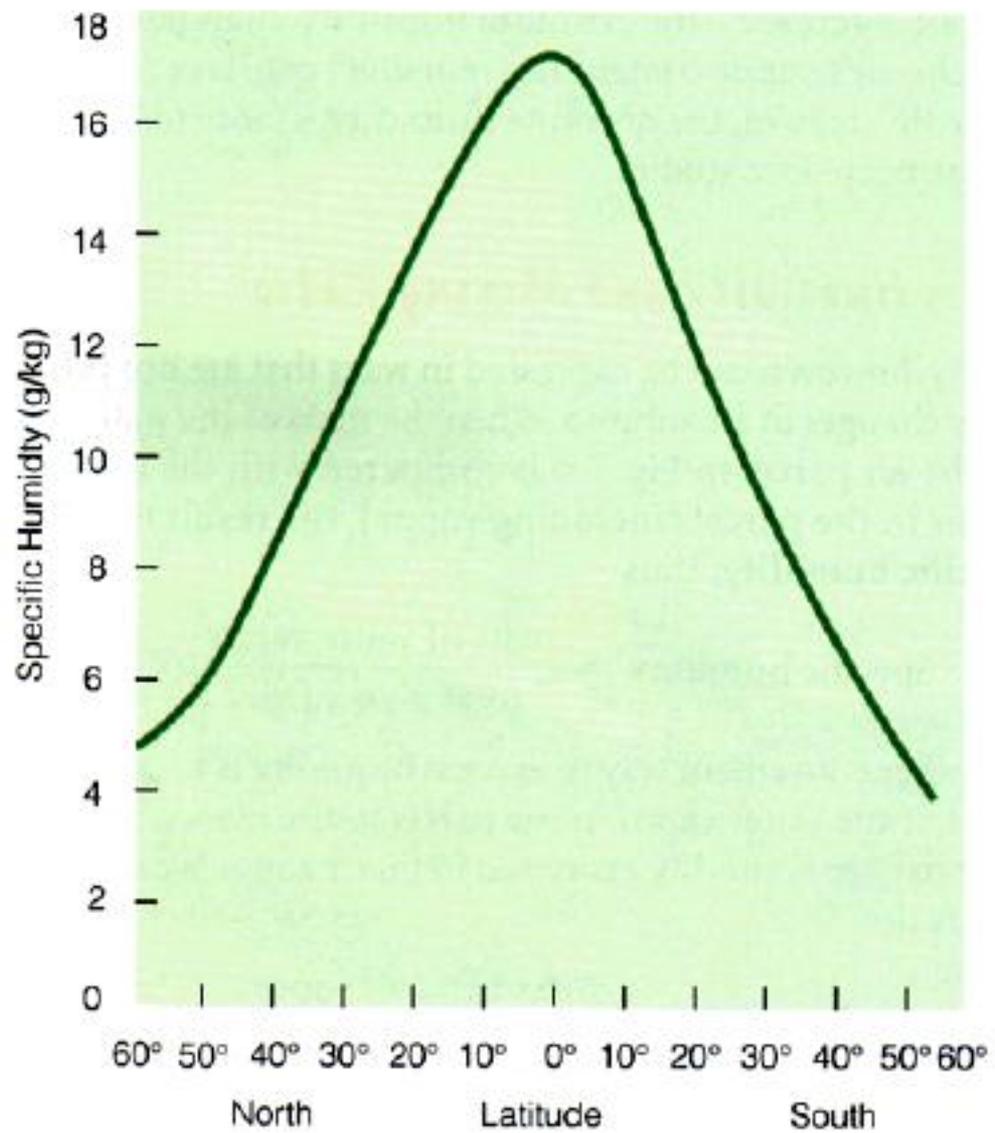
With a straightforward scheme for allocating overlaps, we find that water vapor is the dominant contributor (50% of the effect), followed by clouds (25%) and then CO₂ with 20%.

Schmidt et al. *Geophys Res Let* in press, 2010.

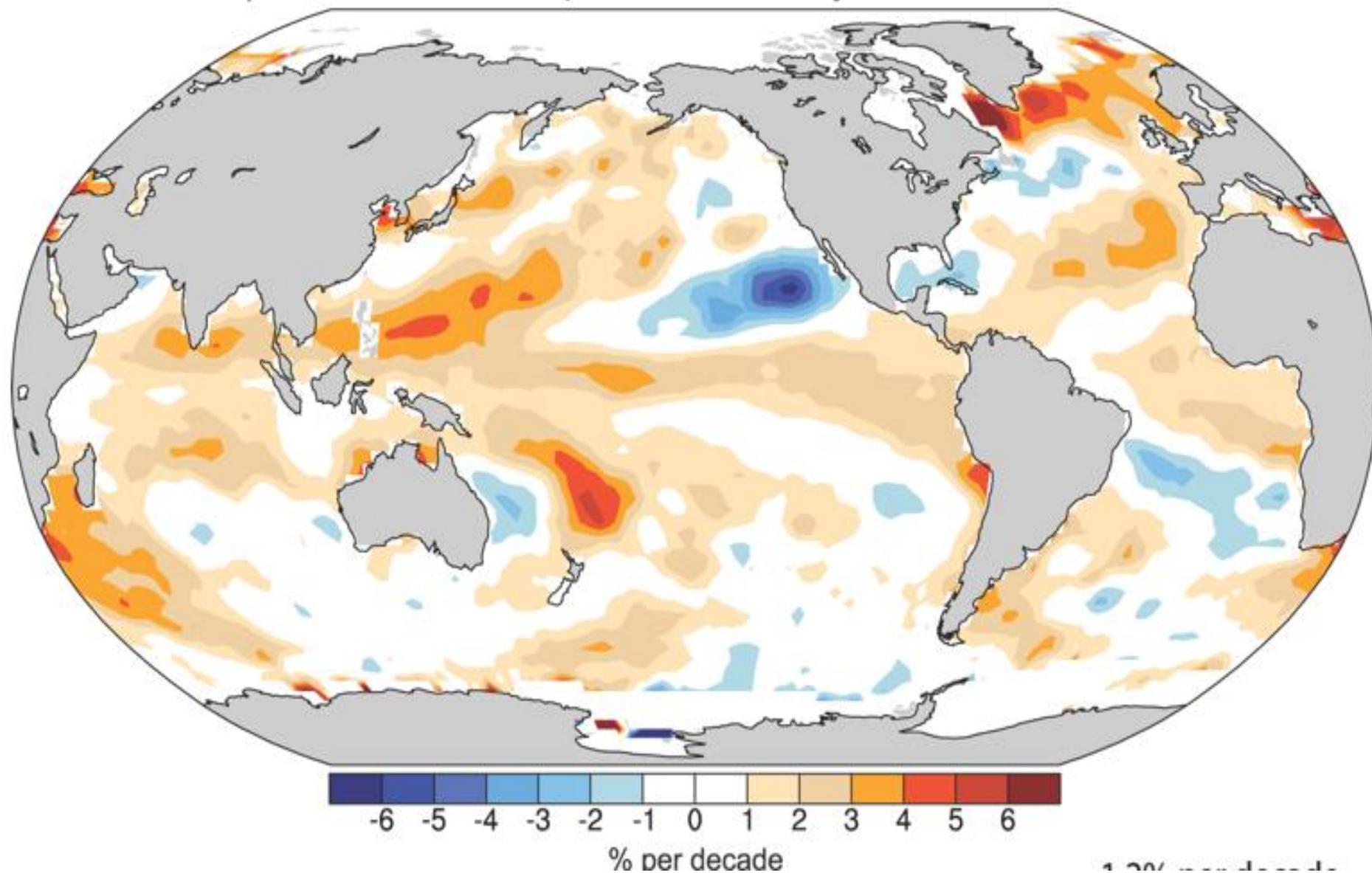
Lacis et al. *Science*, vol 330, page 356, 2010.



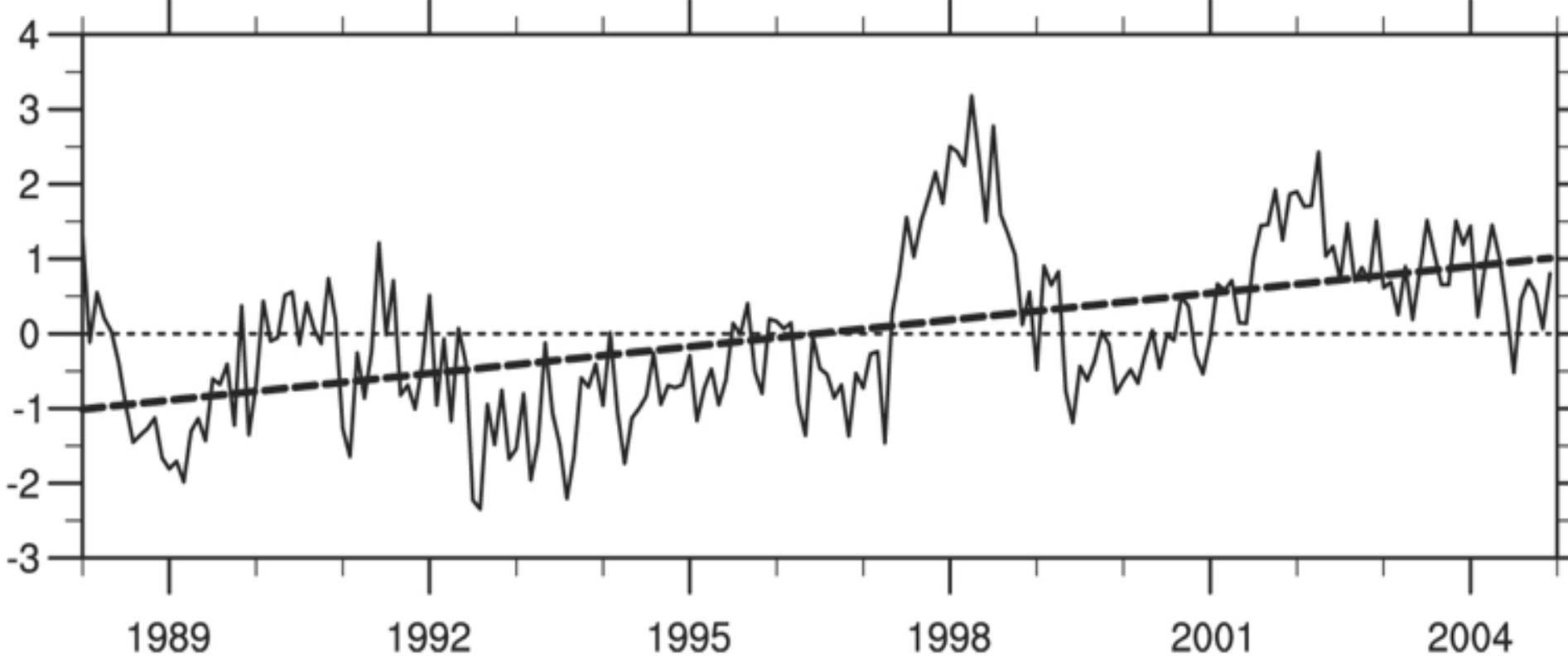


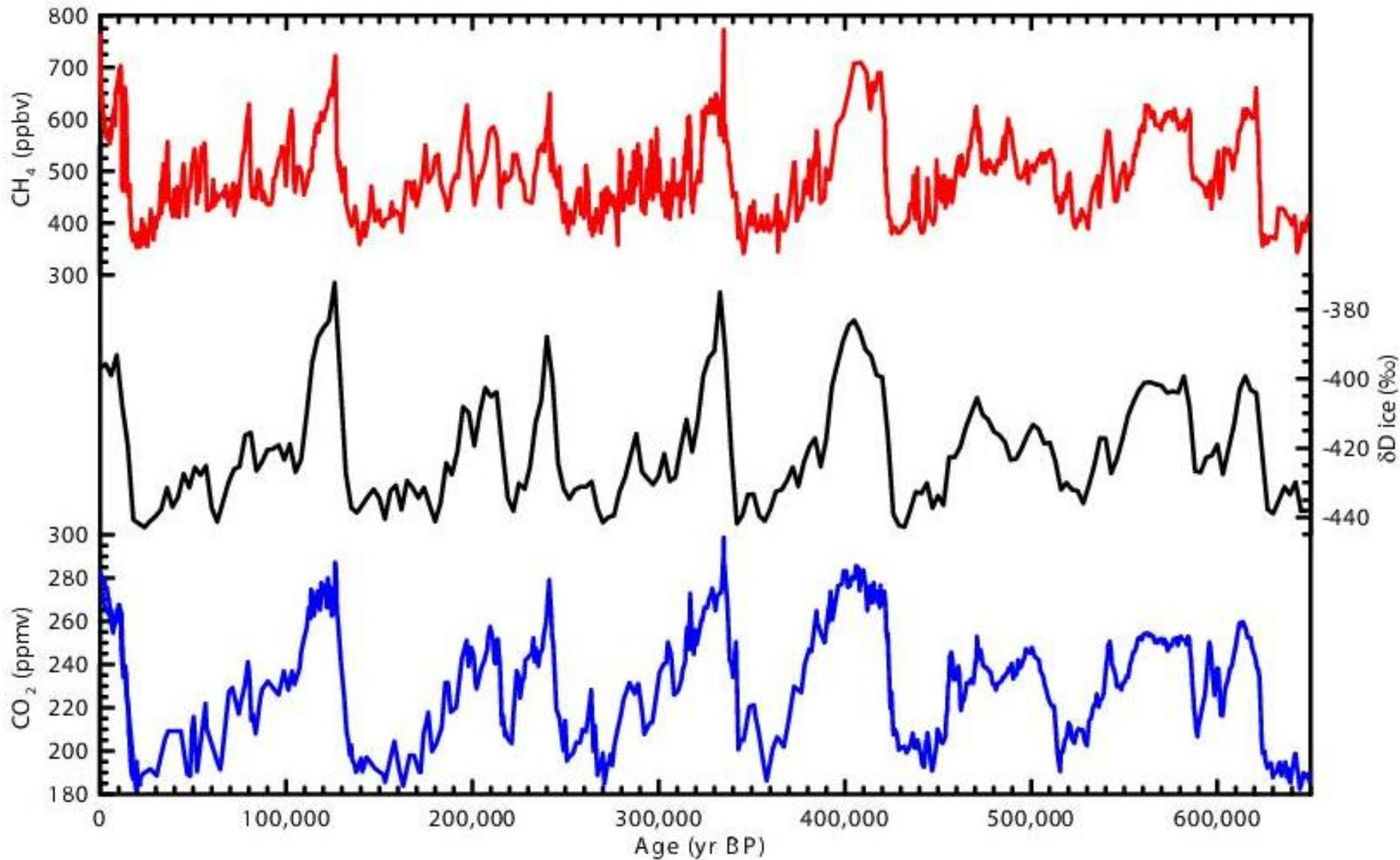


a) Column Water Vapour, Ocean only: Trend, 1988-2004



b) Global ocean mean (%) % per decade 1.2% per decade





Greenhouse gases are not the major cause of the ice ages. The driver is the distribution of sunshine over the Earth's surface as modified by orbital variations. This hypothesis was proposed by Croll in the 19th century, mathematically refined by Milankovitch in the 1940s, and continues to pass numerous critical tests even today.

Just as in the warmings, CO₂ lags the coolings by a thousand years or so. It is well known that multiple factors are involved, including the change in planetary albedo, change in nitrous oxide concentration, change in methane concentration, and change in CO₂ concentration.

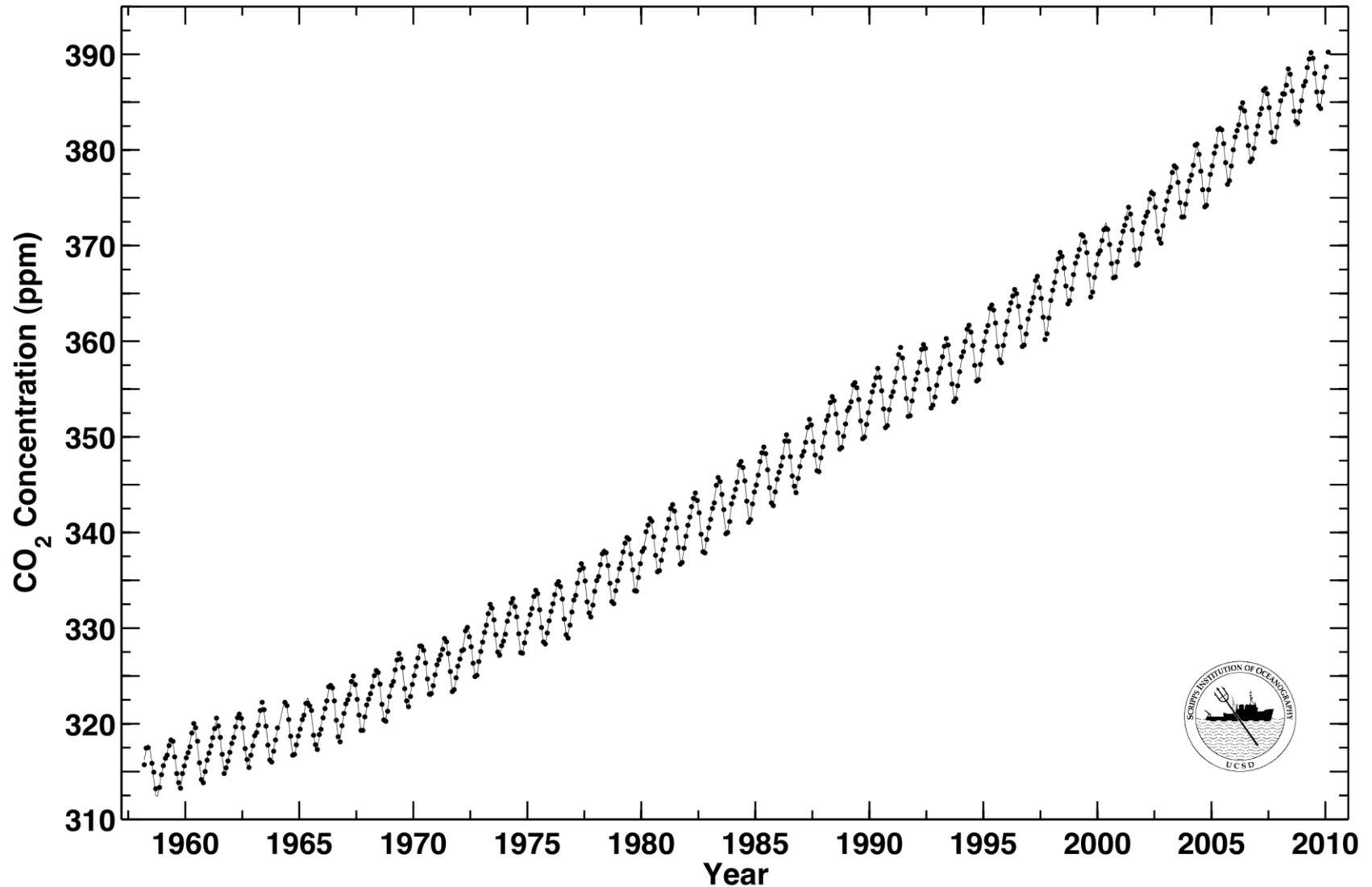
By the way, the lag of CO₂ of about 1000 years corresponds rather closely to the expected time it takes to flush excess respiration-derived CO₂ out of the deep ocean via natural ocean currents. So the lag is quite close to what would be expected, if CO₂ were acting as a feedback.

There is a rich literature on this topic. If you are interested, I urge you to read up. The contribution of CO₂ to the glacial-interglacial coolings and warmings amounts to about one-third of the full amplitude, about one-half if you include methane and nitrous oxide.

The quantitative contribution of CO₂ to the ice age cooling and warming is consistent with current understanding of CO₂'s warming properties, as in the IPCC's projections of future warming of 3 ± 1.5 deg C for a doubling of CO₂ concentration. So there is no inconsistency between Milankovitch and current global warming.

Mauna Loa Observatory, Hawaii Monthly Average Carbon Dioxide Concentration

Data from Scripps CO₂ Program. Baseline data last updated 27-Feb-2010. Archive date 06-Mar-2010 08:59:17



“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.”

- IPCC, 2007.

IPCC reports are at: www.ipcc.ch

“Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.”

- IPCC, 2007.

(‘*very likely*’ means at least 90% probable)

IPCC reports are at: www.ipcc.ch

From a climate scientist whose background is in atomic physics.

A few comments on physicists as climate skeptics.

I had an interesting experience talking to Freeman Dyson and Will Happer at a meeting last year.

I was thrilled to talk with Dyson. I have loved his writing since my first mentor in physics handed me Dyson's *Disturbing The Universe* along with the Feynman lectures when I started working in a big laser lab during high school. Later I enjoyed his papers when I got to field theory.

Dyson's comments on climate where disappointingly shallow. When I pressed him on the science, the only thing he said was that CO₂ radiative forcing was logarithmic and complained that nobody knows this or talks about it. It was disappointing to hear such a shallow commentary from such a great man.

Everyone who needs to know, knows that CO₂ forcing is (roughly) logarithmic. This science is more than half a century old; it is in any textbook. If one is going to attack the climate science this is a very odd place to start.

I also talked to Will Happer who testified in Congress slamming climate science as nonsense. When asked for a specific critique of the science, his only answer concerned saturation of the CO₂ spectral lines, yet he seemed to have little or no familiarity with the content of modern radiative transfer models which treat such line broadening with high accuracy.

All this can be well validated from both first principles and experiment. This critique is closely tied with Dyson's comment about logarithmic response to CO₂. It is likewise trivially without foundation. From Happer, a very smart and creative experimentalist, this is embarrassing and disappointing.

My hunch is that Dyson, Happer and others like them are reacting to the apocalyptic overstatements by some in the climate advocacy world such as Gore. Folks like Dyson who have thought a lot about nuclear weapons have a much higher threshold for things they call “catastrophic.”

However, I think it is a misuse of their reputations as physicists to have folks like Dyson and Happer publicly dismiss the underlying science without offering a technically substantive critique. If their concern is overhype about the risk of climate change they should critique that overhype directly.





Since the release of the IPCC report in 2007, new knowledge has emerged that furthers our understanding of climate change and the human influence on climate.

To bring this new knowledge together, 26 climate scientists from 8 countries wrote a short report, The Copenhagen Diagnosis, released in November 2009, available at:

www.copenhagendiagnosis.com

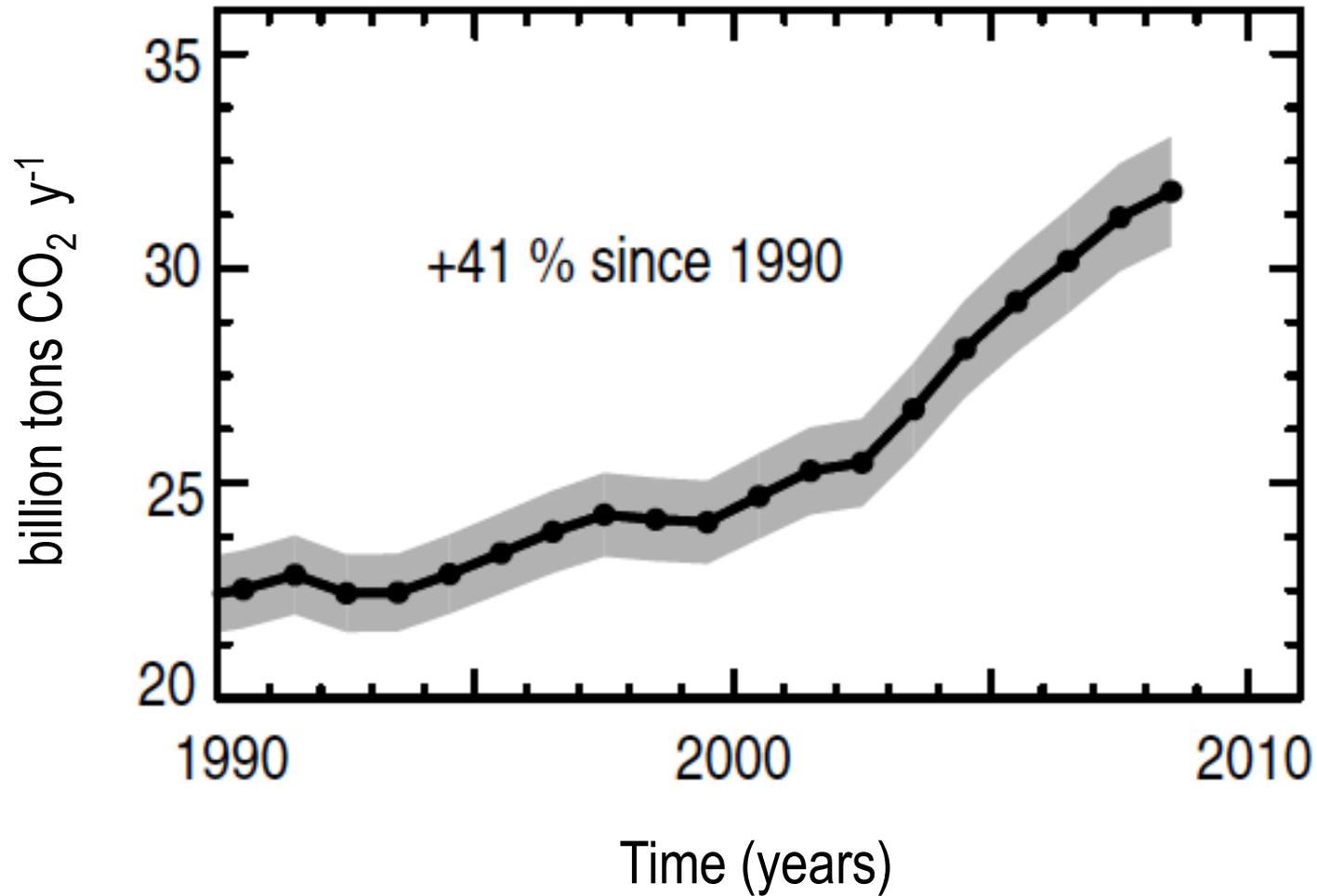
The Copenhagen Diagnosis

Updating the World on the Latest Climate Science

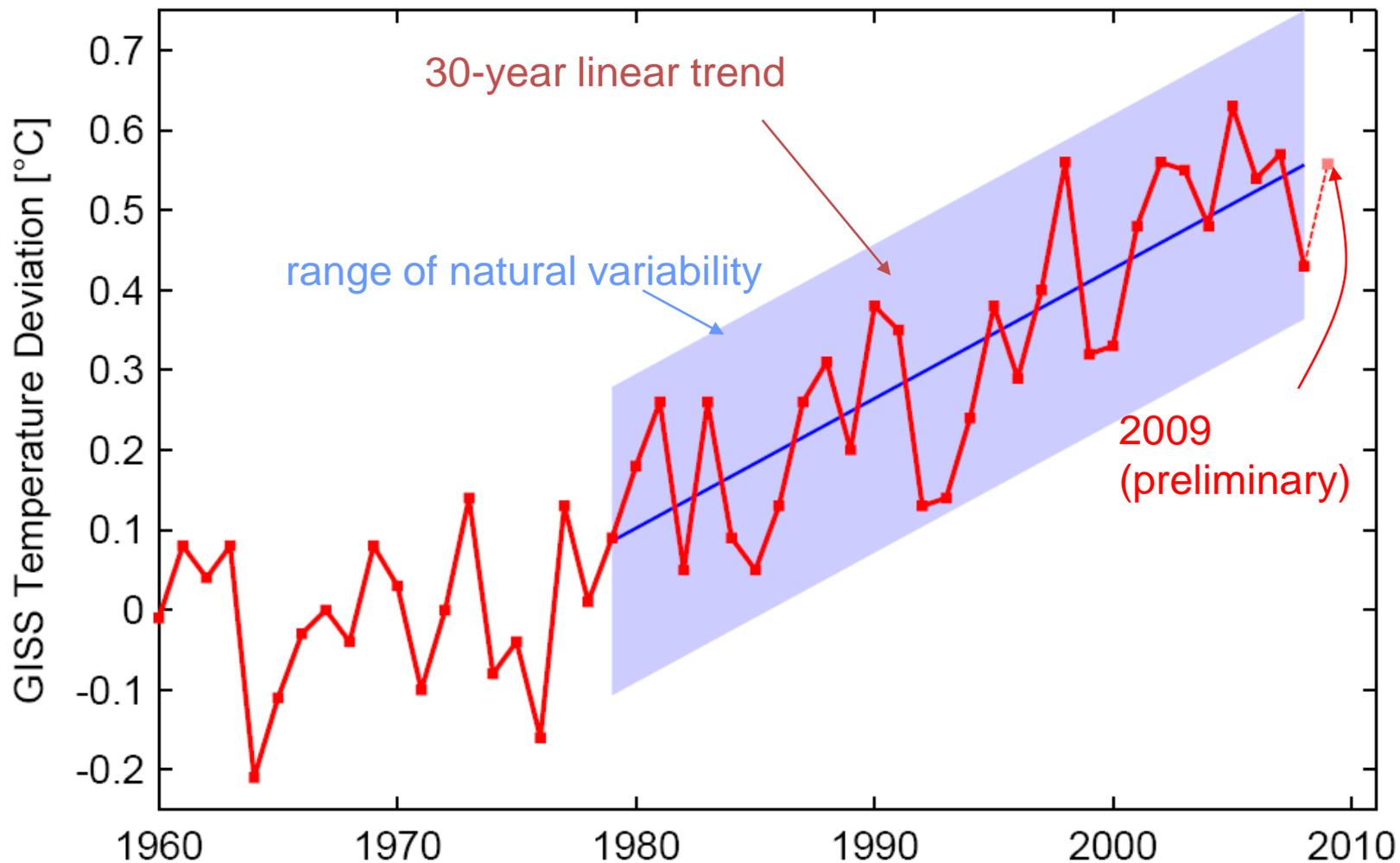


- Surging greenhouse gas emissions.
- Rising global temperatures due to human activities.
- Accelerated melting of ice sheets, glaciers, ice caps.
- Rapid Arctic sea ice decline. Sea level rapidly rising.
- Sea level rise forecast exceeding earlier estimates.
- Changing ocean temperatures, heat content, acidity.
- Delay in action risks irreversible damage.
- The turning point must come soon.

Fossil Fuel CO₂ Emissions



Global Temperature Change Since 1980



Observed and Modeled Arctic Sea-ice Extent

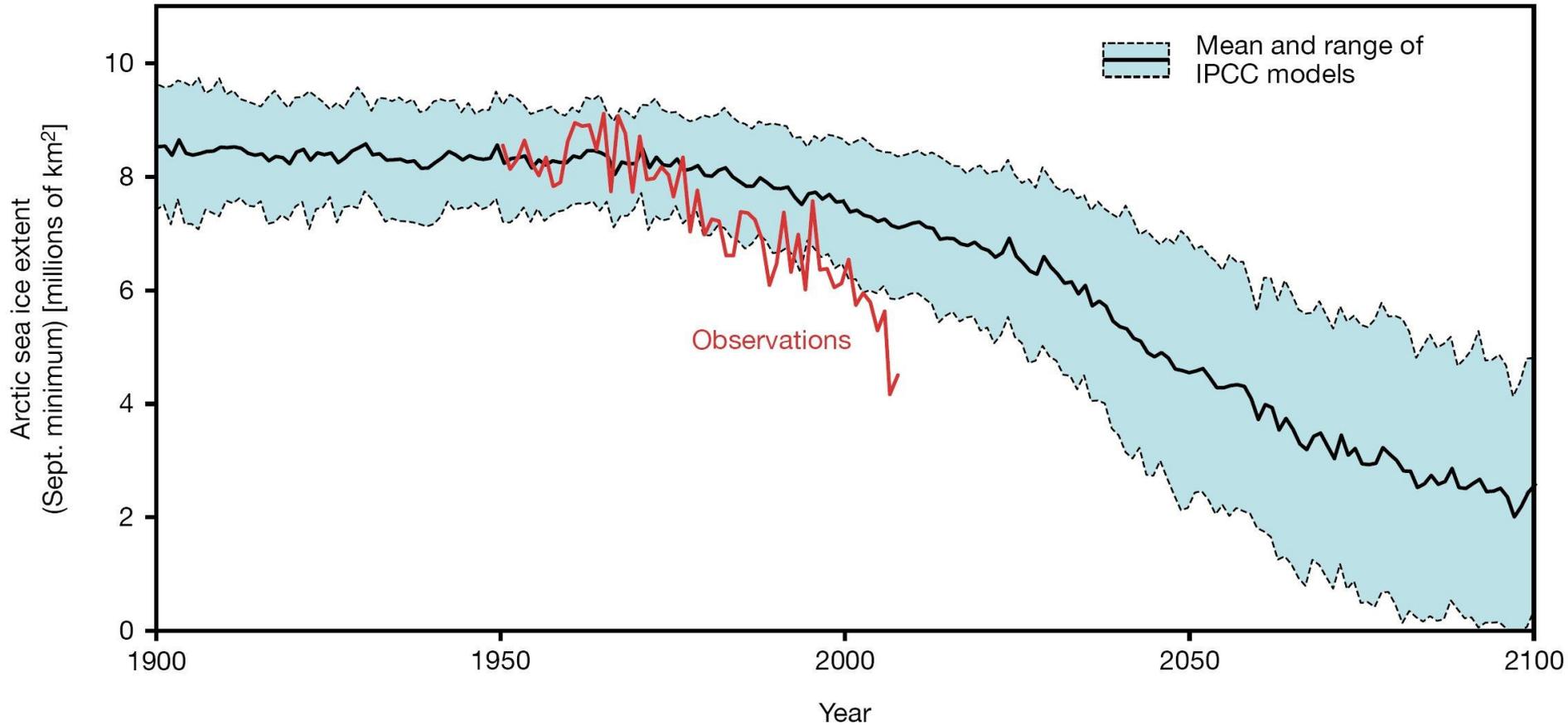
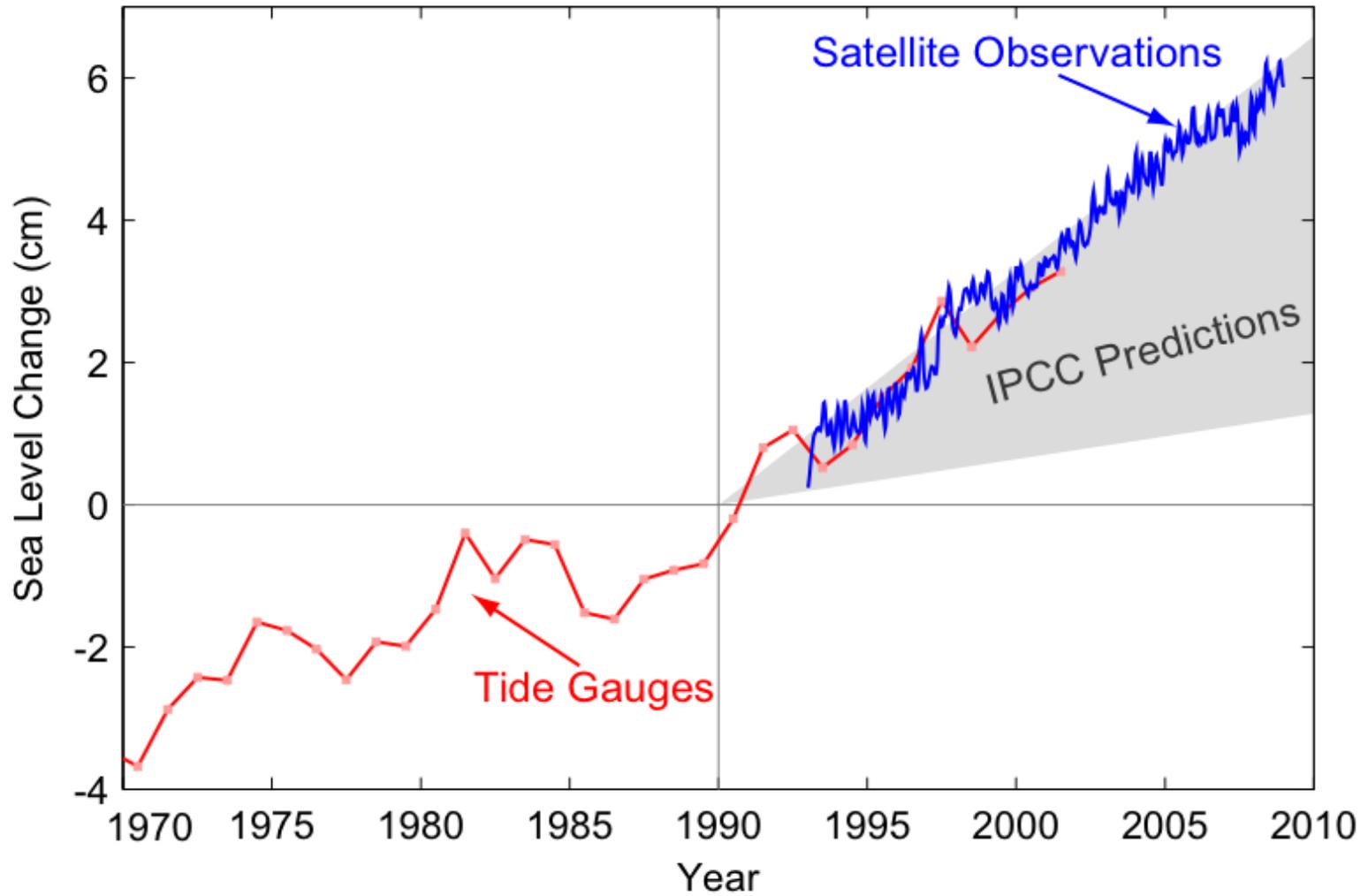




Figure 12: Minimum arctic sea-ice extent from 1979 to 2007

Sea-level change 1970-2010



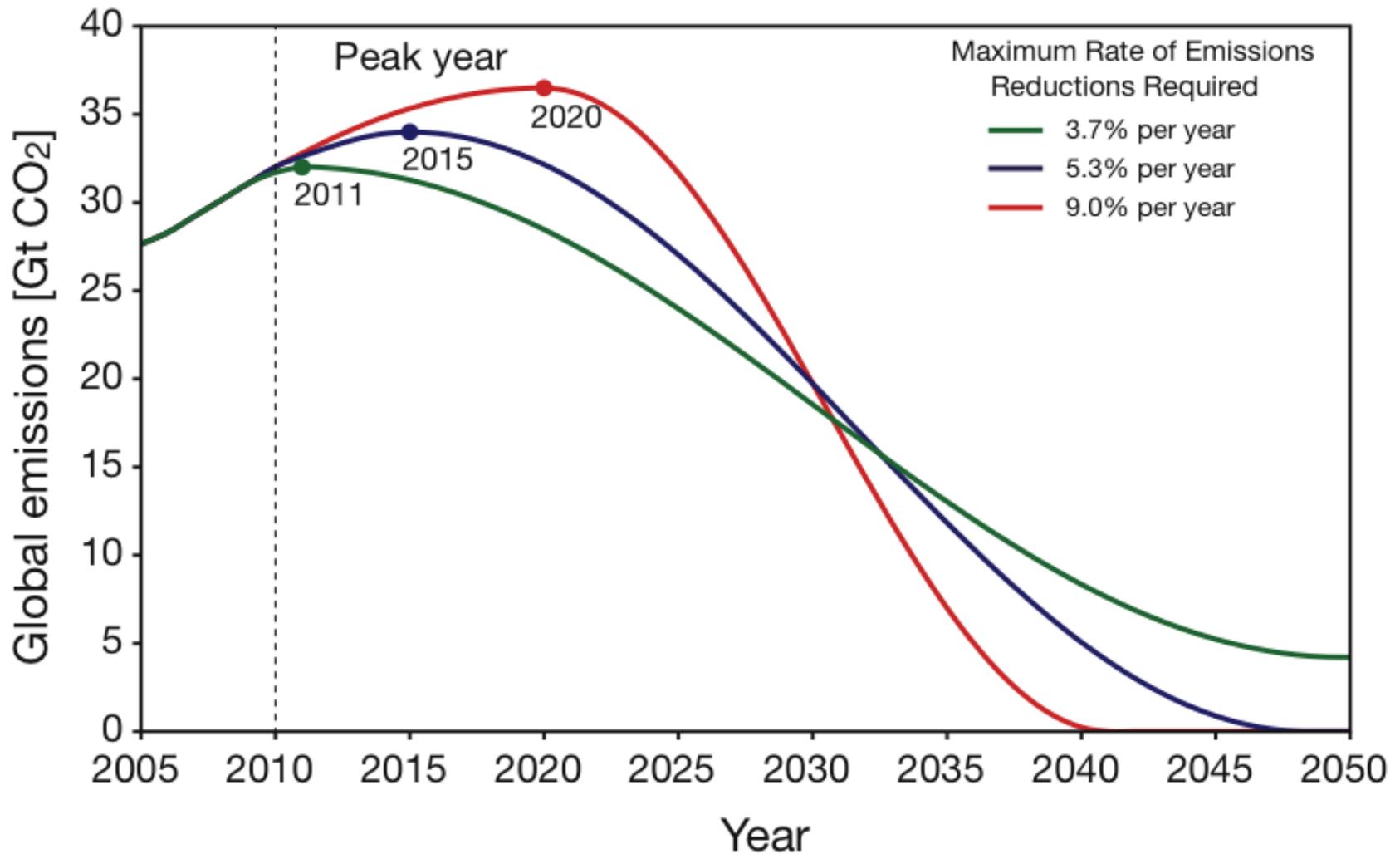


Figure 22: Emissions pathways to give 67% chance of limiting global warming to 2°C

1. The essential findings of mainstream climate change science are firm. The world is warming. There are many kinds of evidence: air temperatures, ocean temperatures, melting ice, rising sea levels, and much more. Human activities are the main cause. The warming is not natural. It is not due to the sun, for example. We know this because we can measure the effect of man-made carbon dioxide and it is much stronger than that of changes in the sun, which we also measure.

2. The greenhouse effect is well understood. It is as real as gravity. The foundations of the science are more than 150 years old. Carbon dioxide in the atmosphere traps heat. We know carbon dioxide is increasing because we measure it. We know the increase is due to human activities like burning fossil fuels because we can analyze the chemical evidence for that.

3. Our climate predictions are coming true. Many observed climate changes, like rising sea level, are occurring at the high end of the predicted range. Some observed changes, like melting Arctic sea ice, are happening faster than the anticipated worst case. Urgent action is needed if global warming is to be limited to less than 2 deg C.

4. The standard skeptical arguments have been refuted many times over. For example, the Milankovitch mechanism causing ice age transitions is irrelevant to the current warming. The warming that is occurring now, over just a few decades, cannot possibly be caused by such slow-acting processes.

5. Science has its own high standards. It does not work by unqualified people making claims on television or the Internet. It works by scientists doing research and publishing in reviewed journals. Other scientists examine, repeat and extend it. Valid results are confirmed, and wrong results are exposed. People who are not trained and experienced in this field, who do not do research and publish it following standard scientific practice, are not doing science.

6. The leading scientific organizations of the world have carefully examined the main results of climate science and endorsed them. It is silly to imagine that thousands of climate scientists worldwide are engaged in a massive conspiracy to fool everybody. It is also silly to think that a few minor errors in the IPCC reports can invalidate them. Sound science should inform wise policy. The IPCC Fourth Assessment Report at www.ipcc.ch is a good place to start.