

William Happer

Data or Dogma? Promoting Open Inquiry in the Debate over the Magnitude of Human
Impact on Earth's Climate

Subcommittee on Space, Science, and Competitiveness

United States Senate

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My Experience

- 50 years as research physicist, on faculties of Columbia and Princeton Universities, at Department of Energy and in JASON Group.
- Pioneering work in atmospheric physics. Inventor of “sodium guide star” used on all modern telescopes to correct for atmospheric turbulence.
- Over 200 peer-reviewed papers.
- VP for research at Princeton University.
- Funder of early climate models as Director of Office of Energy Research at U.S. DOE from 1990 to 1993.

I would like to express my thanks to Senator Cruz, Senator Thune, Senator Nelson and other members of this committee for inviting me to express my views at this hearing on climate science.

My name is William Happer. I recently retired from a career of over fifty years teaching physics at Princeton and Columbia Universities. I also served as the Director of the Office of Energy Research, now the Office of Science, in the US Department of energy from the years 1990 to 1993, where I was responsible for all the non-weapons basic research of the Department of Energy. In addition to areas like high energy physics, materials science, the human genome and others, I had responsibility for DOE’s work on climate science. During my time at DOE, my office established the Atmospheric Radiation Measurement (ARM) Climate Research Facility, with remote sensing observatories all around the world. The facility is still going strong and providing high quality observational data on atmospheric physics.

After leaving DOE, I served as Princeton University’s equivalent of Vice President for Research from 1995 to 2005. I have published over 200 peer-reviewed scientific papers. Scientifically, I am probably best known for having invented the sodium guide star, used by modern ground based telescopes to remove much of the blurring of stellar images by atmospheric turbulence.

Carbon Dioxide Benefits the World

- Establishment climate models give much more warming than has been observed over the past 20 years.
- The climate sensitivity, that is, the warming from doubling CO₂ is probably in the range of 0.5° to 1.5°C.
- The sensitivity value makes all the difference. A low sensitivity value means modest warming, that will be beneficial. Warming will occur more at night than during the day and more during winter than summer.
- Increasing CO₂ levels will make plants grow faster and be less susceptible to drought. This will be a huge benefit to agriculture.

Along with other witnesses at this hearing, I hope to correct some misconceptions about the trace atmospheric gas, carbon dioxide or CO₂. In spite of the drumbeat of propaganda, CO₂ is not “carbon pollution.” As part of my written testimony, I have submitted the document, *Carbon Dioxide Benefits the World: See for Yourself*. This document summarizes the view of the CO₂ Coalition, a distinguished group of scientists, engineers, economists and others. The benefits that more CO₂ brings from increased agricultural yields and modest warming far outweigh any harm.

The key issue here is the equilibrium climate sensitivity: how much will the earth’s surface eventually warm if the atmospheric concentration of CO₂ is doubled? This number has been drifting steadily downward from a youthful Arrhenius’s first estimate of about 6 C to the estimate of the International Panel on Climate change (IPCC) of 1.5 C to 4.5 C. Observations of very small warming over the past 20 years suggest that the sensitivity is unlikely to be larger than 2 C. There are credible estimates that the sensitivity could be as small as 0.5 C.

Climate Models Don't Work; Red is Observed; Bars are Models

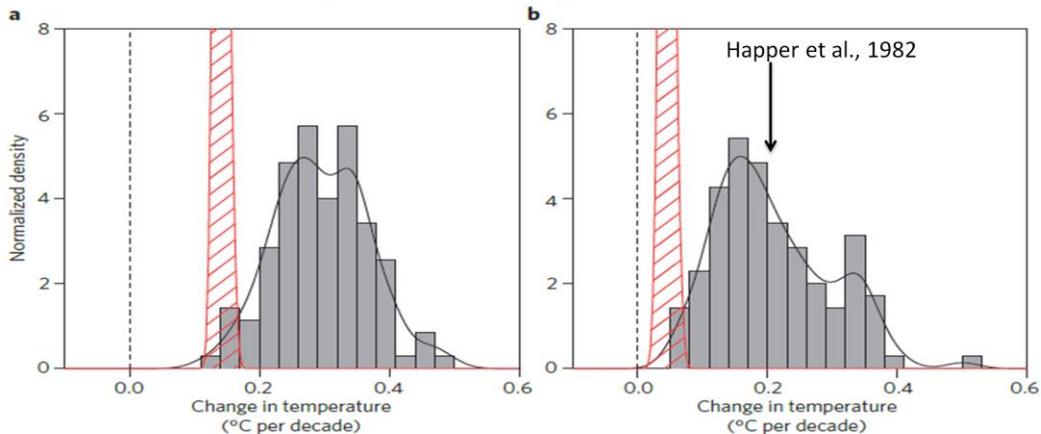


Figure 1 | Trends in global mean surface temperature. **a**, 1993–2012. **b**, 1998–2012. Histograms of observed trends (red hatching) are from 100 reconstructions of the HadCRUT4 dataset¹. Histograms of model trends (grey bars) are based on 117 simulations of the models, and black curves are smoothed versions of the model trends. The ranges of observed trends reflect observational uncertainty, whereas the ranges of model trends reflect forcing uncertainty, as well as differences in individual model responses to external forcings and uncertainty arising from internal climate variability.

Fyfe et al., *Nature Climate Change*, Vol 3, p. 767, September 2013.

This slide shows that various mainstream climate models (the gray bars) have predicted much more warming than observed (the red bars). For full disclosure I add the warming predicted by me and my JASON colleagues in our book, *The Long-Term Impacts of Increasing Atmospheric Carbon Dioxide Levels*, edited by Gordon McDonald, Ballinger Publishing Company, Cambridge, MA (1982). My colleagues and I also predicted far too much warming. The models don't work. The most natural reason for this is that they have assumed climate sensitivities that are much too large. Most of the models in the figure use climate sensitivities of 3 C to 3.5 C.

Basic Facts Of CO₂ Fertilization Are Undisputed

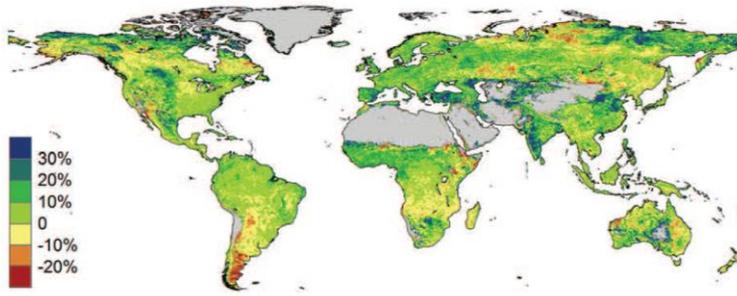
- Plants need CO₂ for photosynthesis. Plant growth rates and drought resistance would benefit significantly from additional CO₂.
- We can tell photosynthesis evolved during periods of much higher CO₂ concentrations, because the great majority of photosynthetic organisms (e. g., plants, algae) use the protein rubisco, which functions best when CO₂ concentrations are higher and O₂ concentrations are lower than those today.
- All trees, and many other plants, wheat, rice, soybeans, cotton, etc. are handicapped because, by historical standards, there currently is too little, not too much, CO₂ in the atmosphere.

Few realize that the world has been in a CO₂ famine for millions of years, a long time for us, but a passing moment in geological history. Over the past 550 million years since the Cambrian , when abundant fossils first appeared in the sedimentary record, CO₂ levels have averaged many thousands of parts per million (ppm) not today's few hundred ppm [R. A. Berner and C. Kothavala, *Geocarb: III, a revised model of atmospheric CO₂ over the Phanerozoic time*, American Journal of Science, **301**, 182 (2001). Pre-industrial levels of 280 ppm (parts per million), are not that far above the minimum level, around 150 ppm, when many plants die from CO starvation [J. K. Dippery, D. T. Tissue, R. B. Thomas and B. R. Strain, *Effects of low and elevated CO₂ levels on C3 and C4 annuals* , Oecologia, **101**, 13 (1995)].

Thousands of peer reviewed studies show that almost all plants grow better (and land plants are more drought resistant) at atmospheric CO₂ that are two or three times larger than those today.

Global Greening From CO₂ Fertilization: 1982-2010

R. J. Donohue, M. L. Roderick, T. R. McVicar, and G. D. Farquhar, *Impact of CO₂ fertilization on maximum foliage cover across the globe's warm, arid environments*, *Geophysical Research Letters*, 40, 3031-3035 (2013). [Graphic courtesy of R. J. Donohue]



This slide summarizes satellite measurements of vegetation changes over the 28-year period from 1982 to 2010. The authors of the study have tried to eliminate any influences rainfall changes or other confounding factors during the measurement period. The earth is really getting greener, and an important part of the reason is more atmospheric CO₂.

Since more CO₂ is beneficial, current US policies to limit CO₂ emissions are harmful. The United States needs a “Team B” to tell the whole story of CO₂

- There is only a “Team A,” the Intergovernmental Panel on Climate Change (IPCC) that produces “science” that supports government policies to limit CO₂ emissions. IPCC reports to the United Nations, not to the American people. Groupthink is inevitable in the IPCC.
- The USA needs a “Team B,” charged with producing an unbiased assessment of the effects, favorable as well as unfavorable, of more CO₂. A few analogous situations are:
 - Team B assessment of the Soviet threat in 1976.
 - Los Alamos vs. Livermore Nuclear Weapons Laboratories.
 - National Defense Panel (NDP) versus Quadrennial Defense Review (QDR).
 - Senate vs. House (as envisaged by the framers of the US Constitution).

For many decades the citizens of the USA and of much of the world have been flooded with the message that CO₂ is “carbon pollution.” We are supposed to trust our government and selfless NGO’s for instructions on how to save the planet. Much of the message is false, but its purveyors control key positions in the media, in the government, in scientific societies, in charitable foundations etc. This makes it difficult to get out the truth that climate science is far from “settled.” To the extent it is settled, it indicates no cause for alarm or for extreme measures. Indeed, a dispassionate analysis of the science indicates that more CO₂ will bring benefits, not harm to the world.

The Congress could help by establishing a “Team B” to make a dispassionate review of climate science, with sponsorship by the federal government.

Team B must be sponsored by the US Government

- Much of the US public has a touching faith in science sponsored by the US government. Any sponsor other than the government would expose Team B to charges of conflicts of interest.
- Team B must report directly to the government, and not be managed by the scientific societies, NAS, AAAS, APS, ACS, etc. The leaderships of nearly all these organizations have uncritically endorsed the IPCC, to the disgust of much of their membership.
- The Congress must be involved in the selection of the leadership of Team B to avoid co-option by the climate establishment.

For credibility, it is essential that Team B be sponsored by the federal government. Otherwise there would be vigorous attempts to ignore any findings not considered politically correct, because the team members would be said to be working directly or indirectly for fossil fuel interests.