

Chapter 29. 1989: The Whitehouse Effect

America's two-party political system still functioned in the 1980s, to a degree. The United States was not yet fully immersed in echo-chamber monotony of political extremes, when global warming burst onto the global scene. The bipartisan cooperation on climate policy that emerged, however, was not designed. It just sort of happened.

Ernest Hollings, Chairman of the Senate Committee on Commerce, Science and Transportation, sent the official requests to testify. A hearing was planned for April 1989, to be conducted by Senator Al Gore, Chairman of the Subcommittee on Science, Technology and Space.

The hearing was postponed, though, because Gore's six-year-old son, Al Gore III, was injured when hit by a car as he ran onto a busy street outside Memorial Stadium after a Baltimore Orioles baseball game. Al Gore spent a month in the hospital with his son as he recovered from near-fatal injuries. The hearing was rescheduled for Monday 8 May.

The invitation letter to me requested that I testify on my "research on global climate models." Specifically, "to discuss what processes are included in the models and what are not, and to summarize the conclusions that can be drawn from the models."

That was an open license, again. I based my testimony on a paper we were just finishing.¹

We found that dry places get drier and wet places wetter with global warming. Also, warming is greater in the dry places. Summers in the Southwest United States and the Mediterranean and Middle East regions, which are in the dry subtropics, become much hotter and drier.

Most of the world is sometimes wet and sometimes dry. The timing and location of wet or dry conditions are variable and difficult for models to predict accurately. Therefore, for the sake of analyzing the physics of the climate changes, we sorted the climate model diagnostics at each location into the dry times and the wet times. A clear picture emerged: an intensification of both dry and wet conditions as global temperature increases. As far as I know, our paper was the first one to reach the conclusion wet-will-get-wetter, dry-will-get-drier conclusion, and we made clear the physical basis for that conclusion.

These results were obtained with a specific model, the GISS climate model, but we showed that results from other models, such as Manabe's at the Geophysical Fluid Dynamics Laboratory, were consistent with ours. Furthermore, intensification of dry and wet extremes was a logical result of increased surface heating and more rapid evaporation in a warmer world.

Storms become stronger in a warmer world. Most storms were not resolved by any climate model in 1989, as the finest resolution was a few hundred kilometers, and surely not by our model with its grid spacing of about 1000 km. Nevertheless, we could extract diagnostic data to investigate how storm intensity would change with increased global temperature.

Specifically, we could calculate change of the "fuel" for storms, something called "moist static energy," which is the sum of sensible heat, latent heat and geopotential energy. We found a rational result: increased evaporation from Earth's surface with global warming leads to a large increase of moist static energy near the surface. In turn, this implies that a warmer climate is prone to more powerful vertical convection that reaches greater altitude. We showed that a similar conclusion followed for the very different model of Manabe.

These changes lead to increases of deep moist convection, with associated heavy rainfall. In our model, doubled CO₂ caused the height of the convective cumulus storm cells to increase several hundred meters. Higher absolute humidity, thus greater latent heat, and deeper penetration of moist convection cause a larger portion of the rainfall to occur in intense thunderstorms, as opposed to the gentler rainfall from large-scale stratiform clouds.

Increased storm strength is not limited to thunderstorms. Kerry Emanuel of MIT, a world expert on tropical storms, used sea surface temperature changes from our doubled CO₂ experiment to estimate the effect of greenhouse warming on the maximum intensity of tropical cyclones. He found the minimum sustained surface pressure decreased from 880 millibars to 800 millibars. The corresponding maximum wind speed increased from 175 mph (miles per hour) to 220 mph.

Tropical storm surface pressure and wind speed depend on many factors, and seldom approach their maximum potential intensity. However, storm damage increases exponentially with wind speed, so the infrequent most intense storms cause the lion's share of storm damage.

The picture that emerged from the modeling was clear, and it was not pretty. Global warming causes more extreme precipitation events, greater floods, and stronger storms. Those effects alone would be important.

The picture becomes more alarming, however, when we consider these effects in combination with rising sea level. Most of the world's large cities are on coastlines. Coastal population and infrastructure continue to increase.

This qualitative picture is not dependent on model details and uncertainties. The expectation of increased precipitation extremes and stronger storms is a straightforward consequence of fundamental moist thermodynamics.

Similarly, the conclusion that global warming tends to cause most dry areas to get drier and hotter, while wet regions tend to get wetter, is a straightforward consequence of increased heating of the surface. All realistic models obtain these results.

On Friday 5 May 1989 I received a phone call from NASA Headquarters. OMB (Office of Management and Budget) requested changes to my prepared testimony, which I had submitted to Headquarters a few days earlier. The requested changes were being sent to me by fax.

Embers of anger began to smolder as I awaited delivery of the fax. I did not understand why OMB should even have the right to review my testimony.

The first requested change was insertion of the following paragraph: "Again, I must stress that the rate and magnitude of drought, storm and temperature change are very sensitive to many physical processes mentioned above, some of which are poorly represented in the GCMs. Thus, these changes should be viewed as estimates from evolving computer models and not as reliable predictions."

The embers began to burn hotter. In my opinion, I had already included appropriate caveats. As the first paragraph of my testimony I had written "This statement is based on studies carried out with my colleagues David Rind, Andy Lacis, Tony Del Genio, Reto Ruedy, Sergej Lebedeff, Michael Prather and Peter Stone at the NASA Goddard Institute for Space Studies. The opinions expressed represent our scientific conclusions, but they do not necessarily represent NASA policy or a consensus of the scientific community."

Further, I included additional caveats within the testimony. Most important, we were careful to focus on basic physics of climate processes, not on detailed model results, so we could say “...certain fundamental conclusions emerge which we believe are very unlikely to change as knowledge of the climate system becomes more precise.”

OMB’s second change was to add the sentence: “One point that remains scientifically unknown is the relative contribution of natural processes and human activities to these forcings.”

The third and final OMB change was to replace my statement: “Although it will be more difficult to constrain CO₂ emissions than was the case for CFCs, there are many policy options which would reduce atmospheric CO₂ growth rates and make good economic and environmental sense, independent of concerns about an increasing greenhouse effect.” The OMB replacement read: “Although it will be more difficult to constrain CO₂ emissions than was the case for CFCs, any policy options which should reduce atmospheric CO₂ growth rates should make good economic and environmental sense, independent of concerns about an increasing greenhouse effect.”

Only this third change was directly relevant to the nation’s budget. However, they seemed to be saying that the nation should not even consider actions to address the greenhouse effect, per se, only actions that made sense independently of the greenhouse effect. They were expecting me to make their policy statement, as if I agreed with it and as if it were my own statement.

Late Friday afternoon OMB’s decision arrived: the only change they were willing to make was to replace “these climate forcings” in their second insertion with “non-CFC climate forcings,” because it could not be denied that CFCs were human-made.

I had already been thinking about what I would do if OMB insisted on their changes. I asked my secretary to make the one change that OMB approved, and I asked her to obtain Senator Gore’s fax number and make sure that his office was aware that I was sending him a message.

The message would not be on NASA letterhead or go through the chain of command, and there was no time to go through typing, proof reading, and corrections. It would not be finished until after business hours. I printed the message on a lined tablet, except the three OMB paragraphs, which I cut out of the testimony with scissors and taped into the message.²

The three-page message included an outline of points I wanted to make in my oral summary. I was in the middle of a disagreement with NASA Earth Sciences, as I was pressing them to spend more money on developing brainpower and less on giant hardware in space. So the bottom line of the testimony was my recommendation for a more balanced allocation of resources.³

In this note to Senator Gore I suggested that he query me during the hearing about the first OMB insertion. I would make clear that the statement was OMB’s opinion, not mine.

It was after 7 PM when I got home. Anniek greeted me, saying that Senator Gore had called.

“What did he say?”

“He wants you to call him. I only asked him about his son.” Anniek said that his son was home in a full body cast. He had suffered multiple broken bones and a concussion. More than half of his spleen was removed, but he was expected to recover.

When I called him, Gore expressed indignation about OMB's edits of my testimony. He wanted to make an issue of it, if I had no objection. Of course, I agreed – my aim was to draw attention to the practice of White House censorship, as well as to our views on the science.

Senator Gore asked if I was willing to do an interview with the New York Times over the weekend, warning me that I might get in trouble.

“It's o.k. I think I'm in trouble anyhow.”

Gore responded “there's an old Chinese proverb that covers cases like this.”

Unwittingly, I played the straight man: “Oh? What's that?”

“If they can't take a joke, fuck 'em.”

I chuckled. He asked me to stop by his office Monday morning before the hearing.

After I hung up, Anniek asked why I had laughed. I told her what he said. She frowned. I guess she does not appreciate Chinese proverbs.

Senator Gore saw an opportunity for a brouhaha that might affect an ongoing battle in Washington. He was prescient. The battle was over the mind of President Bush, specifically his position on climate change. Was there a need for an international global climate agreement?

The guardian of Bush's mind was his chief of staff, John Sununu. Bush relied on Sununu's political acumen. It would be difficult to affect Bush's position without first persuading Sununu. Or, perhaps, boxing Sununu in.

Bush claimed to be an activist during the hot 1988 summer. “Those who think we are powerless to do anything about the greenhouse effect forget about the ‘White House effect’; as President, I intend to do something about it,” he said in Michigan in August. He promised to convene an international environmental conference. “We will talk about global warming, and we will act.”

Not so fast. Bush was no scientist. Once elected, he needed technical advice. He found it at his right hand as soon as he chose John Sununu, ex-governor of New Hampshire, to be his chief -of-staff. Sununu had once been a scientist. He had a Ph.D. in mechanical engineering from MIT.

Sununu was also a politician, a very successful three-term Governor of New Hampshire. He was a pragmatic conservative, who turned a budget deficit into a surplus without raising taxes. His environmental record was strong. He increased spending on public-land preservation. He signed the nation's first acid-rain legislation, and he lobbied President Reagan for a national 50 percent reduction of sulfur emissions, consistent with the target advocated by the Audubon Society.

Sununu had both political and scientific perspectives on climate change. These are still relevant today, so let's examine them in simplified terms. First, the political perspective.

Core conservative values include minimal government size and minimal regulations.

Conservatives believe that economic growth will help solve global environmental problems, including over-population. Their rationale is that family size will decline as living standards rise, even to the point that fertility rates fall to or below replenishment levels. Most conservatives agree that other things are required to make this approach work, including universal women's rights and sensible regulations. Let's call this the “growth” perspective.

The “antigrowth” perspective is exemplified by *Limits to Growth*,⁴ a study commissioned by the Club of Rome to explore consequences of finite world resources. *Limits to Growth* was widely panned because it gives short shrift to the potential for technology to solve problems of resource depletion, pollution and food production. Nevertheless, it can be argued, much real-world data remain consistent with the business-as-usual scenarios in *Limits to Growth* that lead to economic and societal collapse in the latter part of the 21st century.

So the growth/antigrowth picture is still debated, with resolution uncertain – at least to a degree.

Sununu’s political perspective was simple. He saw an international global climate agreement as a threat to the conservative worldview. Such an agreement would be used by the antigrowth crowd to promote the command and control, antigrowth, policies that he feared. The United States, with its high per capita level of resource consumption, was certain to be a target.

Sununu’s scientific perspective was skepticism, to put the best face on it. President Bush’s science adviser, D. Allen Bromley, a nuclear physicist, was also a global warming skeptic. Skepticism is the soul of good science, if it induces the rigorous study of critical issues.

However, the skepticism must be unbiased. If preference or ideology affects a person’s analysis, that practitioner is likely to be exposed as a second-rate scientist or even a quack. The dominant characteristic of the biased scientist is cherry-picking, choosing data that supports, or seems to support, a preferred conclusion, while down-playing or ignoring contrary data.

Sununu zeroed in on an important climate model issue: ocean mixing and its effect on surface climate response. He thought that the huge heat capacity of the ocean would reduce human-made warming to a negligible amount. Warren Washington, leader of the National Center for Atmospheric Research (NCAR) modeling group, explained to Sununu that only the upper layers of the ocean would come into play on short time scales, but Sununu wanted to have his own climate model to play with on his Compaq 386 desktop computer⁵ and he badgered Bromley to extract a model from NCAR. Eventually they provided Sununu a simple one-dimensional model, which would allow him to mix heat into the ocean as he chose.

Ocean models used by climate scientists were primitive, but we knew something about ocean mixing. Ocean measurements revealed how deep CFCs and other human-made chemicals had penetrated into the ocean. In our GISS climate model we used mixing rates for heat anomalies inferred from these passive tracers. Heat is not a passive tracer, because ocean temperature change can alter mixing rates. However, warming the ocean surface reduces the density of the surface layer, which is likely to reduce ocean overturning and thus reduce penetration of heat anomalies into the ocean -- so, if anything, our approach probably overstated ocean heat uptake.

Sununu was correct to point to ocean mixing as an issue, but this was no surprise to the climate research community. Indeed, a good ocean dynamics model was the Holy Grail. Decades later, thanks to the ocean model developed by Gary Russell and others, we could explore the deepest mysteries of sudden climate changes during Earth’s paleoclimate history, including effects on ocean circulation and global climate caused by increasing meltwater from Greenland and Antarctica. We could also use this global model to investigate options that humanity can consider for the purpose of stabilizing global shorelines.

However, Sununu had no such model. He did not need it. His main interest was not science. He had become a politician. He aimed to thwart antigrowth environmentalists. There is no evidence

that he used his little model for any meaningful studies, but he did use his knowledge of scientific terminology to cast doubt on credible science and on the climate change issue.

Sununu was aided and abetted by Bromley. To give Bromley his due, he was an effective Science Adviser. He pushed for increases in research funding to keep American manufacturing competitive and he supported expansion of the high-speed network that became the internet.

Bromley dutifully went along with Sununu's belief that global warming concerns were largely "poppycock," making no apparent attempt to alter Sununu's line. Bromley's responses to questions during congressional hearings illustrated his position well.

At one hearing Senator Gore asked, "Do you believe that the doubling of carbon dioxide in the atmosphere, which will occur in the next 40 years or so, is likely to result in global warming?" Bromley replied, "It's certainly possible, and probable to some degree, but that's as far as I can say on the basis of the evidence." Citing recent results⁶ of British climate modeler John Mitchell, Bromley concluded "my answer is that I simply don't know."⁷

Mitchell showed that the doubled CO₂ climate sensitivity of his model fell from 5.2°C to 1.9°C when he altered assumptions in his cloud calculations. Scientists like to publish results that stir things up, and such papers are useful if they identify informative observations. Unfortunately, media often aggrandize such papers for the sake of "news." Albert Einstein was disgusted with such media reports that "give the lay public misleading ideas about the character of research. The reader gets the impression that every five minutes there is a revolution in science, somewhat like the *coup d'etat* in some of the smaller unstable republics."⁸

Bromley's job, as lead scientist for the nation, was to clarify such misimpressions. It was known that a climate model's sensitivity can be altered almost arbitrarily by altering cloud calculations. As a result, models, by themselves, do not practically constrain climate sensitivity. However, real world climate sensitivity is constrained, and shown to be high, by paleoclimate data.

Bromley should have tossed water on the little fire started by the media. Instead, he threw gasoline on it. Bromley served Sununu well.

Sununu understood the big picture. The issue was whether the United States would support an international framework convention on climate change. That would require agreement that the world must avoid dangerous human-made climate change. A framework convention would be the crucial first step toward effective climate policies. Treaties would be expected to follow.

Sununu was dead set against a framework convention. His main opponent in the Administration was EPA Administrator Bill Reilly. Secretary of State James Baker III also favored a framework convention. Ongoing international diplomatic meetings on climate were merely skirmishes, important mainly for their effect on the outcome of this larger war over a framework convention.

Sununu had the upper hand, as the trusted chief of staff for President Bush. Cartoons depicted Sununu as so huge as to blot out the Sun. In practice, Sununu controlled the U.S. position at the international meetings. He gave the orders. He discouraged the idea of following through on the Bush campaign promise to host an international environmental conference.

Reilly lobbied for the United States to get involved in climate treaty making, but Sununu was in charge. Sununu ordered American delegates who would attend a climate meeting in Geneva in late May 1989 to make no commitment. That was the setting for Albert Gore's Senate hearing.



Hansen and Jerry Mahlman at 8 May 1989 Senate Hearing

I had to get up early in Ridgewood, New Jersey to catch the 6 AM Shuttle from LaGuardia on Monday morning. As I boarded the plane I failed to grab a free copy of the New York Times, because I was tired and still had to read and edit my oral testimony. So I was blissfully unaware of a headline on the front page: “Scientist Says Budget Office Altered His Testimony.”⁹

Senator Gore showed me the article as I entered his office. I had expected it to appear the next day, after my testimony. Gore had an effective strategy though – there could be a second article the next day. Shabecoff’s Monday article was substantial, laying out some of the climate science, my assertions of censorship, and the internal battle between Sununu, Bromley and Richard Darman, the head of OMB, on one hand, and Reilly and Baker, on the other.

Gore wanted to start the hearing with the censorship issue, just as Wirth had rearranged the 1988 hearing. I preferred to do the hearing as scheduled, because I wanted to describe the science as I had prepared it. I did not trust my ability to extemporize. Gore consented, although it meant the heavy media presence, even greater than at the 1988 hearing, would have a long wait.

Senator Gore was considerate. He asked if I was all right. “You like this stuff, right?”

“No, but it’s not a problem.”

As we left his office, he said “Let’s take separate stairs. If we go together they can get us both with one hand-grenade.” I assumed that he did not want the media to think we were conspiring.

The hearing was disappointing to me. Unlike the 1988 hearing, there was no focus on climate science – only on censorship. I failed to get Senator Gore or the media to pay attention to the other half of the global warming science – the fact that increased global warming would lead to greater extremes at the wet end of the hydrologic cycle, more heavy rainfall events, extreme floods and more powerful storms, as well as more extreme heat waves and drought.

A photo that appeared in some newspapers had me holding up a tiny Christmas tree bulb, with Senator Gore squinting down as if to say “what the devil are you trying to show?” This small bulb had a power output of 1.1 watts. I had brought one bulb in my suit pocket and one in my pants pocket, to be sure that I could find one when I wanted to show it.

My point was that the measured increase of greenhouse gases in the 30 years since Keeling began to measure CO₂ caused a climate forcing of 1.1 watts per square meter. This, to me, was a very large force. It is more than four times larger than the variation between solar minimum and solar maximum of the energy Earth absorbs from the Sun. Also, it is more than a quarter of the climate forcing that would occur with doubled atmospheric CO₂.



Impromptu news conference outside Senate hearing room

Later I was told that the demonstration probably has the opposite effect. The lay person thinks “the human effect amounts to a tiny light bulb? All the fuss is about that?”

A reporter crawled along the floor and handed me a note, while Jerry Mahlman, Director of the Geophysical Fluid Dynamics Laboratory at Princeton, gave his testimony. The note said that there would be a press conference with Senator Gore after the hearing – could I come?

“No, I must catch a plane,” I wrote on the note. Erik, a sophomore at Ridgewood High School, would be the starting pitcher in a JV game that afternoon. I had just enough time to get there. However, they set up microphones just outside the hearing room door – so it was unavoidable.

If I had been media-savvy I would have prepared a few lines while Jerry was talking. I could have noted that global warming was pumping up both ends of the hydrologic cycle. I kicked myself later – I missed an opportunity to focus on the science in my testimony.

The important point, however, was that the climate policy issue got elevated above Sununu. President Bush could not miss the story and its implications for him. Senator Gore made certain of that by ridiculing President Bush’s prior claim to be the environmental President.

It was the lead story on the evening news. I was told that I appeared in cameo and that Gore castigated Bush. An Administration spokesman said that I was entitled to my opinion, and there would be no retaliation against me. Hmm. More on that topic later.

I escaped the news conference, with just time to stop at home and then get to Erik’s game.

My car needed an oil change before a long trip that evening, so, from our barn, I took an oil filter, cans of oil, and a pan to catch the old oil, and parked beside the ball field. I watched the game when Erik was pitching, and got under the car when his team was batting. Changing the oil was strangely pleasurable. I was out of Washington, politics and the media – back in Ridgewood, on the ground in jeans and a T-shirt. It was a beautiful day. Erik pitched well, as a sign of things to come. The next two years he was the number one pitcher on the varsity team, pitching a complete game in almost every game he started, and making the league all-star team.

When I got back home, Anniek gave me a message to call my supervisor, Jim Trainor, the successor to Frank Martin as director of the Goddard Space and Earth Sciences division. Trainor warned me that Gore was talking to the media about having more hearings over the next week or two, bringing in the OMB censor, using me and other scientists to confront OMB.

That was a bad idea. Other scientists were unlikely to support me. Scientists are skeptical by nature. A workshop in Washington after my 1988 testimony included a “get Jim Hansen” session, an observer told Richard Kerr.¹⁰ I accepted that as normal scientific skepticism. As I told Kerr “When we’re at this level of signal to noise, anyone can disagree with me.”

My concern was how the public would perceive debate. I could claim that paleoclimate data, climate modeling, modern data, and basic physics together make a strong case for a human role in ongoing climate change, but others would disagree. It would be an argument among experts. OMB and Sununu would find justification for turning my testimony into wishy-washy mush.

I had no time to call Senator Gore. I barely had time to eat and pack a travel bag before Kiki’s softball game. I was co-coach of her team. Coaching softball was easy. Games were more social activity than sport. I worked with Kiki on windmill pitching, but she was not very interested. She was well coordinated, though, and could throw the ball over the plate.

After the game I had to drive to Amherst, Massachusetts, for a workshop that had already begun. I knew from the agenda, focused squarely on my 1988 testimony, that I would be under continual fire. It was a 200-mile trip at night in the pre-GPS era, so it was after 2 AM when I sank into bed.

Probably intentionally, I was a few minutes late to the morning meeting. I always felt awkward in small talk over coffee. A copy of the Tuesday *Science Times* of the New York Times, with headline “White House Admits Censoring Testimony,” lay glaring but silent on the table where I picked up my coffee. I could only wonder about the conversations that morning.

My talk was low key. I addressed the two criticisms of my 1988 testimony that had emerged. First, a New York Times front-page story in January 1989 trumpeted “U.S. Data since 1895 Fail to Show Warming Trend” based on a paper¹¹ that found no discernable warming in the contiguous 48 United States. This result seemed to contradict my testimony. Had “global” warming somehow failed to find its way to the United States?

The second issue was urban warming. Cities are heated by our energy use and by human-made structures with large thermal inertia that do not cool off at night as much as the countryside. Weather stations in urban areas thus record a spurious local warming not caused by the greenhouse effect. Was our global analysis spoiled by inclusion of urban weather stations?

A persuasive way to deal with these issues, I decided, was to work with Tom Karl, NOAA’s top expert on data records and data quality. Tom always began his presentations by describing the data problems, including urban warming, but also other effects such as station moves and change of the time of day at which the meteorological data are recorded. The care with which he addressed these issues gave him great credence with scientific colleagues.

Tom Karl and I compared several analyses of U.S. and global temperature change. Our study benefited from the fact that Karl had just completed the laborious construction of the Historical Climatology Network (HCN) data set for the United States. The HCN data were adjusted, station-by-station, as well as possible for all known biases.

In this joint study we concluded that there was in fact a warming trend in the U.S. for the period 1900-1987, but the rate of warming (0.26°C per century) was only half as large as the global warming rate. The contiguous 48 United States cover only 1.5 percent of the globe, so high temporal and regional variability could account for the smaller warming in the U.S. The warming rate for the 50 states, including Alaska and Hawaii, was 0.33°C per century.

These comparisons were the heart of my talk at Amherst. The paper describing this work was attached to my 1989 testimony and included in the Congressional Record.

Richard Kerr, the top writer for *Science Magazine*, attended the Amherst workshop. In an interview, I described the three conclusions in my 1988 testimony: (1) the world is in a real warming trend (99 percent confidence), (2) the warming is due to increasing greenhouse gases (high degree of confidence), and (3) global warming will cause an increase of hydrologic extremes (more extreme heat waves, droughts, and wildfires as well as heavier rainfall and floods).

Andy Lacis, laughing, showed me Kerr's article "Hansen vs. the World on the Greenhouse Threat" and said "they have you shouting angrily into a microphone." No doubt the editors, not Kerr, picked a photo from hundreds taken during my testimony. In reality, I had schooled myself to be more relaxed in 1989 than I had been in 1988.

Although Kerr reported unanimous criticism of my testimony, he made it easy to read between the lines. He quoted one scientist: "if there were a secret ballot at this meeting on the question, most people would say the greenhouse warming is probably there." Another: "What bothers a lot of us is that we have a scientist telling Congress things that we are reluctant to say ourselves."

The phenomenon of scientific reticence was apparent. A primary reason for reticence is that the penalty for "crying wolf" is clear and immediate, administered via peer review of papers and funding proposals. In contrast, there is no penalty for "fiddling while Rome burns." On the contrary, one is praised for extensive caveats and calls for more research.

Kerr also exposed a misplaced focus on climate models: "What really bothers them is not that they believe Hansen is demonstrably wrong, but that he fails to hedge his conclusions with the appropriate qualifiers that reflect the imprecise science of climate modeling," Kerr wrote.

However, my conclusion that the world was warming was based on observations, not on models. Inference of the role of the greenhouse effect was based on knowledge of the climate forcing by greenhouse gases and its dominance over natural forcings. My conclusion about increasing climate extremes was based primarily on fundamental physics, not on climate models.

The workshop would continue all week, but I decided to leave following the Tuesday afternoon session. Mother nature would judge whether our interpretation of the data was correct. I had other work to do. I had got into another problem by criticizing NASA's proposed large satellite, "battlestar galactica," approach to Earth observations. I wanted to make the case for relatively inexpensive small satellites, especially a satellite to measure the aerosol climate forcing, which was and is very uncertain.

The political hullabaloo in Washington lasted a week. I drove back to Ridgewood Tuesday evening, still concerned that Senator Gore may want more hearings to hammer the White House. However, the situation was changing, as revealed by the Wednesday morning New York Times.

"White House Says Bush Will Call Meeting About Global Warming" read a headline. Then another article in the Friday New York Times: "U.S., in a shift, seeks treaty on global warming." President Bush had become involved – it seemed that he would honor his campaign pledge.

Indeed, the Framework Convention – in which all nations agreed to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic

interference with the climate system" – was signed by President Bush at the 1992 Earth Summit in Rio de Janeiro. Thus, three years after scientists could not even agree that Earth was warming, the crucial first step toward climate stabilization was taken. It was a remarkable achievement.

Let's not give Bush too much credit. His administration fought to make any agreement as weak as possible in practical terms. Also, the Earth Summit was not his doing – it was in preparation before he took office. The person deserving most credit is Gro Brundtland of Norway.

However, there was a real danger that the United States would not participate in a Framework Convention – as with the League of Nations – thus spoiling the realistic possibility of later agreements to phase down fossil fuel emissions. That was Sununu's intent.

In "Losing Earth" Nathaniel Rich suggests that the decision to reverse course and work toward a framework convention was the product of a dialogue between Sununu and Reilly. I disagree. Certainly President Bush encouraged the interactions among Sununu, Reilly, Darman, Baker and others that Rich describes, but he did not grant them the right to make his decision.

President George H.W. Bush made the decision to live up to his campaign promise, to go to Rio, and to agree to and sign the Framework Convention on Climate Change. Bush was an honorable person, and when he was pushed he made the decision. However, Senator Gore deserves much of the credit for deftly using the censorship hullabaloo to pressure Bush.

That accomplishment was significant. Not only did Bush sign the Convention for the United at Rio in June 1992, the United States Senate ratified the agreement unanimously on 7 October in a division vote.¹² The stage was set for political action to address climate change – if and when the most powerful nations decided that it was time to cooperate on a common threat.

John Sununu was recognized not only as being a successful Governor and an astute politician, but also as a model chief-of-staff. He was not shy about making his opinion clear, but he did not make critical decisions for the President – if he had, it would have been against a Framework Convention. Sununu remained an ardent global warming denier throughout the Bush Presidency.

Senator John Heinz, Republican of Pennsylvania, provided a glimpse into the politics behind the scenes. Two weeks after Gore's Senate hearing I received a phone call at home from Senator Heinz. First, he told me that he defended me and my testimony in discussion with Sununu and in a two-page letter to Sununu with a point-by-point criticism of OMB's changes to my testimony. He sent me a copy of that letter, dated 17 May 1989, which I still have.

Then, he asked me to reconsider his invitation to give a talk at what he described as his "town hall meeting with his constituents." The invitation letter described it as the "Heinz Senate Seminar on 'The Environment: Challenges and Priorities' at the Port of History Museum in Philadelphia." I had declined initially because it seemed to be a set-up for a fruitless debate with Andrew Solow – I anticipated disagreement about mathematical "confidence" in assessment of global warming¹³ – I had decided to let nature demonstrate the physics of what was happening.

Senator Heinz assured me that was not his intent, and, of course, I "reconsidered." At his town hall meeting, Senator Heinz made clear that he supported the environment and the economy, saw no conflict between them, and his aim was a bipartisan approach to climate and energy policy. He had spoken with the President, and Bush agreed that the U.S. should take a leadership role.

I do not know exactly what happened behind the scenes, but I suspect that Senator Heinz influenced President Bush. Nevertheless, given the sudden change of the Administration's position following Gore's hearing, it is likely that Gore's front-page, top-of-the-evening-news pressure forced President Bush to make a decision about the Framework Convention.

Tragically, less than two years later, Senator Heinz was killed in an airplane accident.¹⁴ Senator Heinz was viewed as a possible Republican candidate for President. A Heinz Presidency in say 2000 is imaginable, but we can only dream about how history would have been altered.

The anomalous pleasure of lying under the car changing the oil was not only because it was a beautiful spring day and Erik pitched so well. It was because I had resolved to get out of the public and political side of climate change. Steve Schneider, Michael Oppenheimer and others could deal with that. I would get back to the pleasure of finding out how things work.

Finding things out – that's what science is about, right? Science and the scientific method are remarkable. We had learned a lot in one decade. That was the important thing, I thought.

It seemed that we had made the right decision in 1978. That was when I resigned as Principal Investigator for our polarimeter on Pioneer Venus, which was launched from Earth that year. Planetary research was left to the Iowa mafia, Larry Travis and Andy Lacis. I was able to hire Gary Russell onto the government staff in 1978 and David Rind in 1979. During the 5-year hiring drought that followed, which was related to the uncertain future of GISS, Inez Fung and Tony Del Genio stuck with us, until the brief but fruitful "Space Science spring" under Frank Martin in 1984-1987, when I could hire six scientists, including Inez and Tony, on civil service.

The result was a notable team of relatively young scientists that stood behind the testimonies that I delivered in 1988 and 1989, as acknowledged in the first paragraph of my 1989 testimony. Our principal product was a set of global climate simulations for three scenarios for the period 1958-2019. It took a few years to squeeze those out of our old Amdahl 470/V6 computer, but we did.

One merit of publishing predictions based on alternative scenarios for the future is that, when the future arrives, we can learn something from comparison with the real world. Science is objective and clear. The comparison would not depend upon communication ability. So we thought.

¹ Hansen, J., D. Rind, A. Del Genio, A. Lacis, S. Lebedeff, M. Prather, R. Ruedy, and T. Karl, [Regional greenhouse climate effects](#), in *Preparing for Climate Change*, Climate Institute, Washington, D.C. 1989.

² Hansen, J., Memo to Senator Al Gore, 05 May 1989, 3 pages, available [here](#).

³ The testimony, including OMB's alterations, is available [here](#).

⁴ Meadows, D.H., D.L. Meadows, J. Randers and W.W. Behrens III, *The Limits to Growth*, Potomac Associates, 205 pp., 1972.

⁵ Warren Washington, private (e-mail) communication to the author, 2019.

⁶ Mitchell, J.F.B., C.A. Senior and W.J. Ingram, [CO₂ and climate: a missing feedback?](#) *Nature* 341, 132-134, 1989.

⁷ Sun, M., [Global warming becomes hot issue for Bromley](#), *Science*, 246, 569, 1989.

⁸ Bernstein, J. *The New Yorker*, 5 November 1990, p. 154.

⁹ Four articles and a lead editorial that appeared that week in the New York Times are available [here](#).

¹⁰ Kerr, R.A., [Hansen vs. the World on the Greenhouse Threat](#), *Science* 244, 1041-1043, 1989.

¹¹ Hanson, K., G.A. Maul and T.R. Karl, [Are atmospheric "greenhouse" effects apparent in the climatic record of the contiguous U.S. \(1895-1987\)?](#) *Geophys. Res. Lett.*, 16, 49-52, 1989.

¹² A, rather uncommon, division (or standing) vote occurs when a Senator requests the Presiding Officer to count the "yea" and "no" votes, usually after a voice vote. In a voice vote the names and the exact tally are not recorded.

¹³ As an example of an arbitrary assumption in formal confidence calculations, Solow removed the trend in global temperature before looking for a human fingerprint (Kerr, R.A., *Science* 244, 1041-1043, 1989).

¹⁴ Heinz was in a small plane that collided with a helicopter attempting to observe the plane's landing gear. Two pilots on each aircraft also died. Falling debris killed two children in a school-yard and injured several more. The National Transportation Safety Board cited "appallingly poor judgment" by the pilots, noting that their visual inspection was pointless as it was impossible to see into the plane's wheel well to see if the nose gear was locked.