Science Hearing Watch

Science-based analyses of America's key environmental issues

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On October 1, 2003 the U.S. Senate Committee on Commerce, Science & Transportation, chaired by The Honorable John McCain (R-AZ), held a full committee hearing on climate change. In the following brief, the Center for Science & Public Policy (CSPP) analyzes the scientific integrity of a number of statements put forth by participants of that hearing on various topics of global climate change.
(Note: Participant comments may be paraphrased due to availability of transcripts.)

Full Committee Hearing
October 1, 2003

Description: Members will hear testimony on recent scientific, governmental, and corporate activities concerning climate change. Senator McCain will preside. Following is a tentative witness list (not necessarily in order of appearance):

Opening Remarks:
The Honorable John McCain
United States Senator, (R-AZ)

Panel 1:
Mr. Jos Delbeke
Director for Air Quality, Climate Change, Chemicals, and Biotechnology, the Delegation of the European Commission of the European Union

Panel 2:
Dr. Antonio Busalacchi, Jr.
Chair of the Climate Research Committee, Board on Atmospheric Science and Climate, National Research Council

Mr. Ethan J. Podell
President, Orbis Energy, LLC

Dr. Stephen Schneider
Professor, Department of Biological Sciences, and Co-Director, Center for Environmental Science and Policy, Stanford University

Dr. Tom M.L. Wigley

Senior Scientist, Climate and Global Dynamics Divisions, Climate Analysis Section and Program Director, A Consortium for the Application of Climate Impact Assessments (ACACIA),, National Center for Atmospheric Research

Panel 3:
Mr. Paul Gorman
Executive Director, National Religious Partnership for the Environment

Mr. Christopher Walker, Esq.
Managing Director, Greenhouse Gas Risk Solutions, Swiss Re Financial Services Corporation

Mr. John B. Stephenson
Director, Natural Resources & Environment, U.S. General Accounting

Is the IPCC's Projected Range of Future Temperature (a rise of 1.4ºC to 5.8ºC by the year 2100) Even Plausible?

Senator McCain. Current models indicate a large potential range for future climates, with global mean surface temperature warming by 1.4 to 5.8ºC (2.5 to 10.4ºF) by 2100 (IPCC, 2001).

Comment. Hearing panelist Dr. Stephen Schneider, back in 1989, had this to say about how to raise attention to issue of global climate change:

> On the one hand, we are ethically bound to the scientific method, in effect promising to tell the truth, the whole truth, and nothing but…which means that we must include all the doubts, caveats, ifs, and buts.
>
> On the other hand, we are not just scientists, but human beings as well. And like most people, we'd like to see the world a better place, which in this context translates into our working to reduce the risk of potentially disastrous climate change. To do that we have to get some broad-based support, to capture the public's imagination. That, of course, entails getting loads of media coverage. So we have to offer up scary scenarios, make simplified, dramatic statements, and make little mention of any doubts we might have. This 'double ethical bind' that we frequently find ourselves in cannot be solved by any formula. Each of us has to decide what the right balance is between being effective and being honest. I hope that means being both.

This tactic of "offering up scary scenarios" is what the upper end of the IPCC's temperature range amounts to, as there is scant observational evidence to support the IPCC extreme outcomes. Instead, there is an ever-growing body of evidence that points to the low end of the IPCC temperature range as the most likely pathway for future temperatures under evolving human activities. This evidence tells such a strong story, President's Council on the Environment in a June 12, 2003 address that the time has come to abandon the IPCC scenarios as they are not scientifically defensible. Hansen stated:

There are reasons to believe that the IPCC scenarios are duly pessimistic. First, they ignore changes in emissions, some already underway, due to concerns about global warming. Second, they assume that true air pollution will continue to get worse, with O_3, CH_4, and black carbon all greater in 2050 than in 2000. Third, they give a short shrift to technology advances than can reduce emissions in the next 50 years….This 'current trends' growth rate of climate forcings [based on observations], i.e. 2 W/m^2 in 50 years, is at the low end of the IPCC range of 2-4 W/m^2. The IPCC scenario of 4 W/m^2 requires a 4% per year exponential growth rate of CO_2 emissions for 50 years and a large growth of air pollution. The 4 W/m^2 scenario yields dramatic climate change for the media to fixate upon, but it is implausible.

Emphasis on extreme scenarios may have been appropriate at one time, when the public and decision-makers were relatively unaware of the global warming issue… Now, however, the need is for demonstrably objective climate forcing scenarios consistent with what is realistic under current conditions. Scenarios that accurately fit recent and near-future observations have the best chance of bringing all of the important players into the discussion, and they are what is needed for the purpose of providing policy-makers the most effective options to stop global warming.

Dr. Hansen bases his conclusions on a careful review and consideration of a large set of actual observations of how human activities that impact the climate are evolving, as well as how the climate is responding to these activities. In a 2001 *Proceedings of the National Academy of Sciences* paper, he wrote, "A byproduct of the above analysis [a review of the observations] is the conclusion that future global warming can be predicted much more accurately then is generally realized…we predict additional warming in the next 50 years of _ºC ± _ºC, a warming rate of 0.15ºC ± 0.05ºC per decade."

That conclusion is derived from a similar line of reasoning to that of Michaels et al. (2002), who arrived at a temperature rise of 1.5ºC–2.0ºC by 2100 by a careful review of observations and modifications to IPCC emissions scenarios. Michaels demonstrated that a simple extrapolation of the average atmospheric carbon dioxide growth rate during the past 25 years yields a concentration by the year 2100 that is at or below the very lowest value the IPCC considered in their 2001 *Third Assessment Report* (TAR).

Michaels et al. conclude:

Despite the uncertainty that future results may hold, the set of climate observations continues to expand and the trends in fundamental quantities such as atmospheric CO_2 concentrations and global temperatures are becoming better established. Since these quantities serve as integrators of all processes acting on and within these systems, the only uncertainty they contain is measurement uncertainty, which is arguably small. Therefore, these trends should serve as the de facto standard for future expectations, at least in the near term and should be better incorporated into longer-term projections of future temperature changes.

From analyses such as these of Hansen and Michaels, it is clear that the set of future emissions scenarios the IPCC considered is biased to the extreme high end—undoubtedly chosen to produce lurid temperature forecasts. Of the range of temperature projections in the IPCC *Third Assessment Report* (1.4ºC to 5.8ºC), it is the high end that gets all the press attention. Associated with such a temperature change is a great deal of climate upheaval. Yet there is no observational support for such a scenario. Instead, the observational evidence is for a modest temperature rise and accompanying such a modest temperature rise is only a modest climate change—one which is easily adapted to, and one in which the potential for beneficial impacts (e.g. higher crop productivity, enhanced growing seasons) becomes large.

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Are Temperature Trends as Measured by Satellites Becoming More in Agreement with Surface Temperatures?

Participant Statements

Panelist Tom Wigley: If, however, the UAH [satellite-derived] data are found to have underestimated the warming trend in the troposphere, then this will resolve an important climatological 'problem' and provide a strong endorsement for the validity of current climate models.

CSPP Comments

According to climate models, temperatures in the lower atmosphere should warm as fast, or even faster than temperatures on the surface of the Earth in response to enhanced greenhouse gas concentrations. According to observations, however, this has not been the case during the past 25 years. Since the temperature structure of the surface and the lower atmosphere is one of the primary factors that influences daily weather events (temperature, precipitation, wind, etc.), the failure of the climate models to replicate the observed behavior of the atmosphere renders them virtually useless as tools to project climate conditions into the future. Therefore, there has been a great deal of effort to understand why the observed temperature trends in the lower atmosphere are much lower than the surface temperature trends as well as the climate model expectations.

Recently, there have been claims made that these differences have been explained away by the suggestion that faulty measurements and data handling procedures were incorporated by the scientists who have been responsible for the development of the long-standing satellite-derived reference dataset of lower atmospheric temperatures. These claims are simply false.

The attack of the satellite lower atmospheric temperature data set as compiled by University of Alabama-Huntsville (UAH) scientists John Christy and Roy Spencer was first began in 1998 when *Nature* published the findings of Frank Wentz and Matthias Schabel. These researchers reported that the orbits of the satellites that carry the microwave sounding units (MSUs) employed to determine atmospheric temperatures were slowly losing altitude. Spencer and Christy had not accounted for that orbital decay. Wentz and Schabel demonstrated that when altitude loss was factored in, the trend in satellite-measured temperatures increased, and the gap between surface and satellite trends (the root of the "satellite controversy") significantly narrowed.

Realizing that this orbital decay was indeed a concern, Spencer and Christy examined the issue in more detail than Wentz and Schabel had. In doing so, they discovered an additional orbital effect, that of orbit drift—an undocumented east-west movement of the satellites. As it turns out, the artificial cooling trend imparted by the orbital decay was nearly cancelled out by an artificial warming trend added by the orbit drift. It toto, the correction to the data only resulted in a very modest warming trend, one that didn't come close to bringing the satellite temperatures into agreement with surface temperatures.

Earlier this summer, another attempt to discredit Spencer and Christy's data set appeared in *Science* magazine. *Science* rushed to publication a paper by a research team led by Benjamin Santer and colleagues that compared climate model output with a still unpublished satellite dataset compiled by none other than Wentz and Schabel with the additional help of Carl Mears. It seems that the folks at the Remote Sensing Systems (RSS) (the workplace of the aforementioned satellite researchers) weren't happy with how Christy and Spencer compiled the satellite data, so they came up with their own version. The RSS version had more of a warming trend than the UAH version.

The Santer et al. contribution was an attempt to adjudicate between the two satellite temperature datasets. However, instead of comparing the two satellite data compilation against a third, independent set of temperature measurements of the lower atmosphere as recorded by weather balloons (launched twice daily to collect atmospheric data for use in weather forecasting), Santer et al. chose to compare the satellite observations to climate model results. They found that the warming trends in the lower atmosphere as predicted by the climate model were closer in magnitude to the faster-warming RSS satellite data compilation than the slowly warming UAH realization. This technique, however, represents science turned on its head. The scientific method requires that a hypothesis is put forth and then observations are collected to test that hypothesis. In contrast, Santer et al. used a hypothesis (i.e., a climate model) to test the observations. The way it should have worked, had the scientific method been followed, was that independent weather-balloon measurements would have been used to determine which satellite realization was closer to being correct.

As it turns out, the results of precisely this analysis was provided in two papers published at virtually the same time as the Santer paper (although neither was in *Science* or *Nature*), one by a research team led by John Lanzante, and the other by John Christy and colleagues. Both research teams showed an extremely close correspondence between weather-balloon temperature trends and the UAH satellite-measured temperature trends. These analyses mean that the RSS data compilation, as well as the climate models relied on by Santeer et al., are quite different from the standard set of observations.

A third paper attacking the Spencer and Christy satellite dataset also appeared this summer in *Science* magazine. In this paper, Konstantin Vinnikov and Norman Grody employ their own statistical scheme to recalibrate the satellite data to account for changes in the orbit drift of the satellites. They throw out the efforts and results of both the RSS and the UAH researchers and dismiss all of the weather-balloon records, and then determine that the satellite-measured temperature trends in the lower atmosphere are about 50 percent *greater* than the surface measurements. From the same analysis they also determine that the diurnal cycle of temperature in the lower atmosphere shows a double peak (at 11 a.m. and again at 9 p.m.) with a local minimum in between at about 3:30 p.m.

This latter finding represents a near physical impossibility. The temperature of the earth (and thus the lower atmosphere) warms and cools over the course of a day primarily based upon the rising and the setting of the sun. The sun rises in the morning until it reaches its peak around midday and then starts to set. Temperatures follow accordingly. They start to warm in the morning, reach their maximum near midday, and then begin to cool again. That leads to a very smooth diurnal cycle of temperatures (especially when averaged over a large number of days). The amplitude of the diurnal temperature cycle decreases as you ascend through the atmosphere (it is largest at the surface), but it is nevertheless present throughout nearly the entire atmosphere.

Christy el al. (2000) used the satellite observations to determine that the peak of the diurnal cycle (daily maximum temperature) in the lower atmosphere occurs at about 1:30 p.m. Mears et al. (2003) use a climate model to simulate the path of temperatures throughout the day in the lower atmosphere and find the peak temperature to occur at about 2:00 p.m. Vinnikov and Grody (2003), however, using a statistical method they developed themselves, find *two* peaks, one at 11 a.m. and another at 9 p.m. with cooler temperatures in between (a relative minimum at about 3:30 p.m.). It seems physically unrealistic the think that atmospheric temperatures cool from 11 a.m. to 3:30 p.m. (when the sun is primarily rising and heating the surface and the air) and then begin to warm again from 4 p.m. to 9 p.m. (as the sun is setting).

It is likely that one of the reasons that Vinnikov and Grody have such an unusual diurnal cycle in their dataset is that they failed to account for a nonclimatic trend in the satellite data (instead mistaking it far an actual climate trend): in this case, a change in the MSU instrument temperature as the sun angle changes. The reason the diurnal temperature cycle is so important is that as the orbits of the satellites slowly drift in an east-west direction, the time of day a satellite passes over a particular place on the earth changes. Thus, a temperature trend will appear in the data not because the average temperature of the location is changing (i.e., climate change), but instead because the temperature is being taken at a different time of day. Therefore, the observed data must be adjusted for the time of day it was taken before it can be used in climate change studies.

But as the satellite orbits slowly drifts, another effect takes place—the sun shines on the actual satellite at a different angle. This results in a slight drift in the temperature of the MSU instrument, which also must be taken into account when processing the data into temperature measurements.

The UAH and the RSS researchers recognize that necessity. Vinnikov and Grody do not. Therefore, their data includes a warming trend that is not climate-related. That artificial warming is spread throughout their data and likely produces their unrealistic diurnal cycle, which is then used to correct for the orbital drift, which then ultimately leads to temperature trends that are wildly inconsistent with any others, including the independent weather balloons.

So despite recent claims that the disparity between surface temperature trends and the temperature trends in the lower atmosphere has been resolved, careful scientific scrutiny proves otherwise. The conclusion reached by the National Academy of Sciences in their 2000 report entitled “Reconciling Observations of Global Temperature Change” still stands:

> The various kinds of evidence examined by the panel led it to conclude that the observed disparity between the surface and lower to mid-tropospheric temperature trends during this particular 20-year period is probably at least partially real.

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Christy, J.R., et al., 2003. Error estimates of Version 5.0 of MSU-AMSU bulk atmospheric temperatures. *Journal of Atmospheric and Oceanic Technology*, **20**, 613-629.

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Wentz, F.J., and M. Schabel, 1998, Effects of orbital decay on satellite-derived lower-tropospheric temperature trends, *Nature*, **384**, 661–664.

Are recent temperature the warmest of the last 2,000 years?

Participant Statements

Panelist Stephen Schneider: "…What has been learned only in the past half-decade is that this unusual warmth is not just for the past 140 years, but the past 2,000…the last several decades of the 20th century exceed the range of temperatures over the past 2,000 year. Source: Mann and Jones, 2003."

CSPP Comments

The series of scientific papers to which these claims have been attached is that which has been authored by University of Virginia's Dr. Michael Mann and colleagues. Mann et al. have attempted to reconstruct the past temperature of the earth using a collection of 'temperature proxies"—things such as ice cores, tree rings, lake sediments, that respond to (and leave a record of their response) local temperature fluctuations. The Mann reconstruction has become known as the 'hockey stick' because it depicts a rather long, slow temperature decline throughout most of the past millennium (the handle of the hockey stick) and then a sudden upswing of temperature during the 20th century (the blade of the hockey stick) culminating with the last several years being the highest temperatures in the entire reconstruction. This has given rise to concerns that human activities have resulted in heretofore unprecedented global temperatures.

However, apparent fundamental defects in the primary Mann et al. papers render them unreliable for public policy decision making. A forthcoming peer-reviewed paper "audits" aspects of the Mann analysis and finds it internally flawed. The authors' document and correct mistakes and errors found in the database on which Mann relied, and recalculate the long-term temperature index using Mann's own methodology. Their results find the 20th century is not uniquely warm, contradicting the conclusions of the U.N. IPCC *Third Assessment Report* and of Mann et al. upon which it relied.

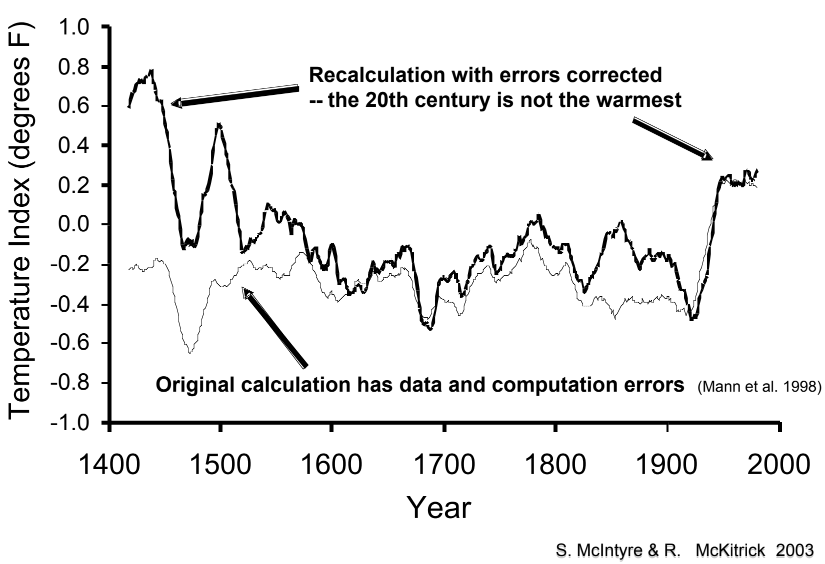
The authors conclude (*emphasis added*):

The MBH98 [Mann et al., 1998] **hockey stick-shaped** NH [Northern Hemisphere] temperature index discussed here has been extremely influential in discussions of 20th century global warming. Together with a pre-1400 extension derived in Mann et al. (1999) and a spliced instrumental temperature series, this index figured prominently in the IPCC Third Assessment Report (IPCC 2001) and numerous other publications. However, the dataset used to make this construction contained **collation errors, unjustified truncation or extrapolation of source data, obsolete data, incorrect principal component calculations, geographical mislocations and other serious defects**. These errors and defects substantially affect the temperature index.

Although not all of the dataset could be audited, it was possible to prepare a data base with substantially improved quality control, by using the most recent data and collating it correctly, by avoiding arbitrary filling in or truncation of data and by computing principal components using standard algorithms. Without endorsing the MBH98 methodology or choice of source data, we were able to apply the MBH98 methodology to a database with improved quality control and found that their own method, carefully applied to their own intended source data, yielded a Northern Hemisphere temperature index in which the ***late 20th century is unexceptional compared to the preceding centuries*****,** displaying neither unusually high mean values nor variability. More generally, the extent of errors and defects in the MBH98 data means that the indexes computed from it are **unreliable** and cannot be used for comparisons between the current climate and that of past centuries, such as "temperatures in the latter half of the 20th century were unprecedented," or that "even the warmer intervals in the reconstruction pale in comparison with mid-to-late 20th-century temperatures" (Mann et. al. 1999) or those by the IPCC (2001) that the 1990s was the "warmest decade" and 1998 the "warmest year" of the millennium.

Given the fundamental defects in the Mann paper, it should not be relied upon for making public policy decisions.

Northern Hemisphere -- 20th century not the warmest



This figure shows the original Mann et al.(1998) global temperature reconstruction for the past 600 years (thin black line), and the recomputation of this record that corrected for some data handling errors in the original analysis (thick black line).

References:

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Are storms like Hurricane Isabel a Harbinger of things to come as a result of global warming?

Participant Statements

Panelist Antonio Busalacchi, Jr.: While Isabel cannot be linked to global warming, it is a harbinger of things to come.

CSPP Comments

An aspect of climate to which the coastal regions of the eastern and southern United States is particularly vulnerable is tropical storms and hurricanes. A single severe hurricane that hits a densely built up coastal area can cause billions of dollars in damage. Several months ago we were witness to the far-reaching destruction that Hurricane Isabel wreaked along her path from landfall along the North Carolina Outer Banks though central Virginia. The massive tree damage, associated widespread power outages, and high storm surge will long be remembered by all those who were impacted by the storm. If hurricane activity in the Atlantic Ocean were to increase because of human-induced global warming, a substantial portion of the U.S. population would be especially at risk.

But the evidence simply isn't there to link worsening hurricanes and global warming. A recent review of the Atlantic Basin hurricane activity was conducted by a research team led by National Oceanic and Atmospheric Administration hurricane specialist Dr. Christopher Landsea (Landsea et al., 1999). The Landsea team found that the Atlantic hurricane history is characterized by large variations in numbers and strength of storms over decadal time periods and a lack of strong long-term linear trends. Intense hurricanes were relatively common during the middle part of 20th century (1940s through the 1960s) and relatively rare from the 1970s through the early 1990s. In fact, they note that "Inhabitants of the Caribbean and the U.S. East Coast, in particular, were quite fortunate during the last few decades as these regions experienced many fewer damaging hurricanes than in earlier decades. Consequently, normalized hurricane damages in the United States were substantially lower during the 1970s and 1980s than in previous decades."

The relationship of global temperatures to the number of intense landfalling hurricanes and the amount of damage they cause is either not present, or is very weak. In fact, Landsea comments that as atmospheric carbon dioxide levels have increased in recent decades, "there is currently no evidence that there have been systematic changes in the observed tropical cyclones around the globe" (Landsea, 1998).

But these observations indicate there have been periods in the past when there has been greater hurricane activity than during the past several decades. It is therefore likely that, global warming aside, a trend toward more hurricanes is possible. This perfectly natural shift toward more devastating storms could, nevertheless, lead to a sustained period with the potential for a great deal of damage and hardship to residents of the U.S. Atlantic and Gulf coasts. As for the observed increase in hurricane activity since the mid-1990s, the feeling among most hurricane researchers is that this is a sign that conditions are once again returning to the patterns that were responsible for the enhanced storm activity that characterized the 1940s, 1950s, and 1960s (Landsea et al., 1999). From 1940 to 1960, the Eastern Seaboard saw an average of almost one severe hurricane a year for that 20-year span. Research is currently under way to evaluate whether we are heading into a multidecadal period of enhanced hurricane activity. If this proves to be so, the rapid growth of North Carolina's coastal communities during the past several decades means that there will be a greater threat than ever before from damaging storms.

Indeed, the relatively benign period of hurricane activity during the past several decades is likely among the reasons for the explosive rise in the development, population, and overall wealth of coastal communities (Pielke and Landsea, 1998). With billions of dollars of property now at risk, the potential for hurricane damage and loss is greater than ever before, and is continuing to increase. Hurricanes will continue to hit the U.S. Atlantic coast in the future, and they likely will cause more monetary damage than similar events in the past—not as a result of anthropogenic climate change, but from natural climate cycles and their effect on the increasingly expensive properties along the coast.

There is nothing to indicate that global warming is affecting the strength or frequency of Atlantic hurricanes. In fact, during the last period that hurricane activity was high (1940–1960), global temperatures were much lower than they are now. In their review of Atlantic hurricane history, the Landsea research team, which includes some of the world's top hurricane researchers, asked and then answered a series of questions pertaining to whether climate change policy would be an appropriate method for controlling future hurricanes. A summary of their discussion follows (Landsea et al., 1999):

> • Can the scientific community reliably differentiate future hurricane frequencies and magnitudes based on the various scenarios of greenhouse gas emissions and concentrations?
>
> The analysis of climatological information suggests that for many decades to come, detection of a human-forced signal in the tropical cyclone record will be extremely difficult to detect because of both the relatively modest size of the predicted changes…and the rather large apparently natural multidecadal variability. Therefore it is unrealistic for policy makers to expect in the near term (i.e., in the next few years) that the scientific community will be able to reliably predict future hurricane incidences differentiated by various emissions scenarios. Henderson-Sellers et al. (1998) noted that "global and mesoscale model-based predictions for tropical cyclones in greenhouse conditions have not yet demonstrated prediction skill.
>
> • Is there reason to believe that policymakers should expect the policy actions now being contemplated will reduce the number of and intensity of future hurricanes that will impact society?
>
> There is no evidence to suggest that society can intentionally modulate tropical cyclone frequencies and magnitudes through energy policies. Therefore, policy responses to hurricanes ought to focus on the reduction of society's vulnerability to hurricanes, rather

> than on prevention of the storms themselves. For instance, in the context of insurance, Henderson-Sellers et al. (1998) recommend a focus on "appropriate reserves and restrictive underwriting" rather than on accurate predictions, or by extension, on controlling future hurricane incidences.
>
> Answers to these questions do not exclude the possibility that an anthropogenic forcing might lead to changes. They do strongly suggest that reliable prediction of future hurricane indices (much less social impacts) differentiated by various emission scenarios is beyond the capabilities of the scientific community. Further, if a policy objective is to reduce society's vulnerability to hurricane impacts, then decision makers would be wiser to consider better adapting to documented variability, rather than preventing storms from occurring.

In other words, the reduction of carbon dioxide emissions is not the answer to lessening the future impact of hurricanes; instead, local adaptation and preparedness measures would have a far greater impact in protecting America's coastal population from landfalling tropical storms and hurricanes.

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