July 29, 2003

UCAR response to request for input on McCain-Lieberman Climate Stewardship Act

In July 2003, Rick Anthes responded to a request from Senator John McCain (R-Arizona) for information relevant to the McCain-Lieberman Climate Stewardship Act (S. 139). Below is the full text of Dr. Anthes' response.

Rick Anthes is president of the University Corporation for Atmospheric Research (UCAR).

Science-based comments from the Center for Science and Public Policy examine the scientific accuracy of the statements made.

The primary issues include whether the late 20th century is the warmest in 2,000 years as claimed by the IPCC Third Assessment Report, and the nature of the IPCC science peer review standards.

July 29, 2003
The Honorable John McCain
United States Senate
241 Senate Russell Office Building
Washington, D.C. 20510

Dear Senator McCain:

In response to your letter of July 28, 2003, I would like to offer the following responses to your questions regarding the science of climate change. Your original questions are included in italics: Question 1 -- First, is there a scientific consensus in your atmospheric research community that the earth has been experiencing a warming trend in the last century and that this global climate change would not be expected from the study of climate changes that have occurred in past millennia? What modeling or other evidence supports your conclusion?

There is strong agreement among the vast majority of climate scientists that Earth has been experiencing a warming trend in the last century and that this global climate change would not be expected from the natural variability such as that experienced in past millennia. By climate scientists, I mean scientists who

are actually doing climate science, either modeling or observations, and publishing their work in peer-reviewed professional scientific journals. The enclosed article, On Past Temperatures and Anomalous Late 20th Century Warmth, appeared very recently in the scientific publication, Eos, of the American Geophysical Union. The authors are thirteen highly respected scientists from diverse institutions who answer your question unequivocally in the following statement: "…the conclusion that late-20th century hemispheric-scale warmth is anomalous in the long-term (at least millennial) context, and that anthropogenic factors likely play an important role in explaining the anomalous recent warmth, is a robust consensus view." The article also provides references to independently developed global climate models from different institutions (e.g. the National Center for Atmospheric Research, the Geophysical Fluid Dynamics Laboratory, the Hadley Centre in the U.K.) that all demonstrate, "that it is not possible to explain the anomalous late-20th century warmth without the contribution of anthropogenic factors." It is noteworthy that the very recent document, The U.S. Climate Change Science Program-A Vision for the Program and Highlights of the Scientific Strategic Plan, which was transmitted to Congress by the highest levels of the Administration, prominently features a quote from the June 2001 NRC report, Climate Change Science: An Analysis of Some Key Questions: "Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise." The main observations of the IPCC Report lead, correctly in my view, to the conclusion that the global average surface temperature has increased over the 20th century by about 0.6 degree Centigrade (1.1 degree Fahrenheit), that the increase in temperature in the late 20th century over the Northern Hemisphere is the largest of any century in the past 1,000 years, and that human activity has caused a major percentage of that late century warming. The warming of the planet has caused snow cover to decrease, glaciers to retreat, global average sea level to rise, and ocean heat content to increase. We are entering a climate regime never before experienced by human civilization.

Comment. It is notable that since the publication of the aforementioned Eos article, there have been two new research articles published in the peer-reviewed scientific literature that have cast doubt on the findings reported in Eos. The first describes a longer extension of the temperature proxy data back in time to the about the year 200 A.D. This analysis, done by Dr. Michael Mann and Dr. Phil Jones, not only attempts to create a proxy reconstruction for the Northern Hemisphere (the region examined by earlier Mann works) but also for the Southern Hemisphere and the globe (through averaging the two hemispheres). What they found was remarkable in light of previous works. For both the globe, and the Southern Hemisphere, the late 20th-century, according the proxy reconstructed temperature history was not the warmest in the record. In fact, in

the Southern Hemisphere, the late 20th century temperatures were at or below the long-term average. This fact was certainly not described by Dr. Anthes. The only way to make the late-20th century seem unusual is to tack a completely different dataset onto the end of the record, not a proxy reconstruction, but one of actual measured temperatures. Since the overlap between the two datasets is extremely poor as is evidenced in figures below, a direct comparison between these two datasets is not justified—in fact, it represents an apples and oranges comparison.

Proxy reconstruction of global temperatures (blue line) and instrument records (red line) from Mann and Jones (2003). If one is interested in the story told by the proxy reconstruction, the red line must be ignored, for the correspondence between it and the blue line, during the period of overlap, is poor.

This figure is the Southern Hemispheric proxy reconstructed temperature history since 200 AD from Mann and Jones (2003). Again, the blue line represents the proxy reconstructed temperatures and the red line represents the observed temperatures. At the end of the record, the blue line is below the long-term average while the red line zooms nearly off the chart—this indicates the poor correspondence between the two records and thus they should not be compared.

The second paper to cast doubt on the findings reported in the Eos article is even more disturbing in that it suggests that many of the results presented in the Eos article are seriously flawed as a result of data and data mishandling errors and that these apparent fundamental defects in the primary Mann et al. papers render them unreliable for public policy decision making. This paper, published by researchers Steve McIntyre and Ross McKitrick serves as an “audit” to certain aspects of the Mann analysis and finds them to be 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 (http://www.uoguelph.ca/~rmckitri/research/trc.html). Their results, presented in the figure below, 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.

Figure 1 – Temperature INDEX estimated from thermometer records and PROXY indicators of environmental change, SMOOTHED WITH 20-YEAR MOVING AVERAGES. The IPCC-related work (drawn with a light line) has errors that have recently been corrected (heavy line). The corrected results show that the 20th century is not unusually warm compared to periods in the last 600 years (see S. McIntyre and R. McKitrick, Energy & Environment, in press, Nov. 15, 2003).

References:

Mann, M.E., Bradley, R.S., Hughes, M.K., 1998. Global-scale temperature patterns and climate forcing over the past six centuries, Nature, 392, 779-787.

Mann, M.E., Bradley, R.S., Hughes, M.K., 1999. Northern Hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations, Geophys. Res. Lett., 26, 759-762.

Mann, M.E., et al., 2003. On past temperatures and anomalous late-20th century warmth. EOS, Trans. Amer. Geophys. Union, 84, 256-258.

Mann, M.E., Jones, P.D., 2003. Global surface temperatures over the past two millennia. Geophys. Res. Lett, doi:10.1029/2003Gl017814.

S. McIntyre and R. McKitrick, Energy & Environment, in press, Nov. 15, 2003).

Anthes. The best evidence for a scientific consensus is the Intergovernmental Panel on Climate Change (IPCC) process, which is open to all, and all comments are dealt with and addressed with a written record. Skeptics are involved both as authors and reviewers. I know that you are familiar with the IPCC Third Assessment Report. I want to endorse the conclusions of the report as representing the best, most accurate science that the resources of countries around the world are able to produce. Approximately 700 scientists worldwide contribute to the IPCC reports, and another 700 review them. The fact that this number of scientists, working directly in the field of climate and climate change, produce a consensus, policy-neutral document like the IPCC Third Assessment Report of Working Group 1 is an extraordinary achievement in itself and is likely without parallel in any other field of research.

Comment. Immediately after the IPCC Third Assessment Report (TAR) came out, many leading climate scientists, most of which are also the authors of the IPCC TAR, raised doubts concerning the scientific confidence of statements in the report (emphasis added).

(1) From Allen, Raper and Mitchell (Science, vol. 293, 430-433, 2001) [all three are lead authors of IPCC TAR report].

We should recall that the IPCC was under considerable pressure in 1990 to make a statement attributing observed climate changes to human influence because if they didn't, someone else would. "It was the unanimous view of the TAR lead authors that no method of assigning probabilities to a 100-year climate forecast is sufficiently widely accepted and documented in the refereed literature to pass the extensive IPCC review process. Three reasons stand out: the

difficulty of assigning reliable probabilities to socioeconomic trends (and hence emissions) in the latter half of the 21st century, the difficulty of obtaining consensus ranges for quantities like climate sensitivity, and the possibility of a nonlinear response in the carbon cycle or ocean circulation to very high late-21st-century greenhouse gas concentrations."

(2) From Reilly et al. (Science, vol. 293, 430-433, 2001)

Expert judgment was widely used in preparing the TAR, but the organizers were not able to impose a consistent procedure across the various components. The likelihood terms above were variously assigned on the basis of "judgmental estimates" in the discussion of the science of climate and on using "collective judgment" when discussing the effects of climate change. However, little or no documentation is provided for how judgments were reached or whose estimates were reflected. In discussion of mitigation measures, the TAR did not report any analysis using these concepts. The TAR states that many hundreds of scientists contributed to the report. In the absence of documentation, readers could easily conclude that reported likelihoods represent a consensus among them. This is not necessarily the case. Many of the scientists listed as contributors were never consulted about these probability judgments. One of the difficulties facing the IPCC is its emphasis on consensus coupled with the range of disciplinary backgrounds and world views among its contributors. Where there are widely divergent views and a consensus cannot be reached, the alternative is to present the judgments of each expert independently. Whereas a reader may choose to adopt one view or another from those given, this result is almost always preferable to an interpretation that corresponds to no particular expert's view.

Another feature of the TAR is that many less-important conclusions have attached likelihoods, whereas some crucial ones do not. Policy-makers need guidance on a small but important set of questions: how large will the climate change be; how damaging are its effects; and how expensive might it be to meet emissions goals? Likelihood statements about these important matters are too often poorly supported in the TAR or are missing altogether.

(3) Other various leading US Climate Experts have noted in the article by R. Kerr (Science, vol. 292, 192-194, 2001)

"The major [climate prediction] uncertainties have not been reduced at all." A confident attribution to humans "may be right," but "I just know of no objective scientific basis for that." (Peter Stone of the Massachusetts Institute of Technology)

"To make it sound like we understand climate is not right." (cloud physicist

Robert Charlson, professor emeritus at the University of Washington, Seattle.)

"I don't know that they reproduce climate any better" than they did 5 years ago. (Tim P. Barnett of the Scripps Institution of Oceanography in La Jolla, California

"We have made progress, but sometimes progress means you learn you need to know more." "The more we learn [about aerosols], the less we know." (Jeffrey Kiehl, National Center for Atmospheric Research (NCAR) in Boulder, Colorado) That's evident in the body of the IPCC report. It says that the uncertainties are so large that a best estimate with error bars of the indirect cloud effect of aerosols is still impossible. In fact, the report increases the range of possible aerosol cloud effects over 1995 estimates. Now they span from no effect to a cooling large enough to almost compensate for the total warming from all current greenhouse gases

"It's extremely hard to tell whether the models have improved" in the past 5 years, "the uncertainties are large."(Gerald North, Texas A&M University.) North sees the "huge range of climate uncertainty among the models" as a sign of fundamental problems. "There are so many adjustables in the models," he says, "and there is a limited amount of observational data, so we can always bring the models into agreement with the data." Models with sensitivities to CO2 inputs at either extreme of the range can still simulate the warming of the 20th century, he notes, suggesting that adjustables like aerosols and clouds are compensating for the sensitivity differences.

Anthes Question 2 -- Second, is the scientific community in agreement that this climate change is due to the accumulation of enormous quantities of greenhouse gases in the atmosphere due to human activities, primarily the burning of fossil fuels? Yes, as answered above. This is now very widely believed to be so, even among many skeptics, some of who now argue that the warming will be benign. As noted above, it is not possible to explain the anomalous late-20th century warmth without the contribution of anthropogenic factors.

Comment: See comment above.

Anthes Question 3 -- Third, does the scientific evidence point to the need to take measures to reduce greenhouse gas emissions now and the potential consequences of inaction? This question is a lot tougher because it brings into play non-scientific issues and issues that I am not an expert in such as economic and other social factors. However, my personal opinion is that we should not wait to act until everything is known about all of these complex issues. The risk of climate change is very real and the peoples of the world, including those in the United States, should adopt a "no-regrets" strategy and

take a number of actions to reduce the threat. This would include stabilizing the global population, reducing fossil fuel emissions, emphasizing conservation much more than we do now, developing alternative and renewable energy sources, and many other actions. In my opinion, these actions would be beneficial even without climate change. I believe we can do all of these things without reducing our standard of living. In fact, I believe that we can do these things and actually increase the quality of life in this and other countries.

In my judgment we should, as a nation, show leadership in this area and act not only to reduce the risk, but also to prepare for the unprecedented changes that are already likely to occur because of humanity's previous actions. This is the responsible course of action. Major disruptions to the U.S. agriculture, economy, and quality of life due to imminent climate change are definitely possible, if not likely. And the threat is not just short term; there are very long time scales involved. For example, concentrations of greenhouse gases take 50 or more years to change perceptibly because they depend on accumulated emissions. The oceans respond to atmospheric heating sluggishly and add a delay of 20 years or more, and ice sheets respond on a much longer timescale. Sea level will take centuries to reach a new equilibrium.

Hence, if we wait for proof beyond a shadow of a doubt that the climate has changed for the worse, it will be much too late to do anything about it.

One of the main risks for the United States is that of a massive, persistent drought. As we know from paleoclimate records, such droughts have occurred in the past. Imagine the Dust Bowl in the 1930s, but lasting for many decades, perhaps centuries, and covering most of the nation, from the West Coast to the Mississippi. This is a real risk, especially because of the likelihood of summer continental drought, which is exacerbated by diminished snow pack in spring. Such a change could occur abruptly and would be devastating for the U.S. As you know from the situation in your own state, such drought has been persistent in the Southwest during the past two years, with consequences for water supplies, heat waves and wild fires.

In summary, prudence (the precautionary principle) argues that we should make an honest and good faith effort to slow the rate of change as well as prepare for changes that are likely to occur even if we start acting now. We are entering into the unknown; we have good guesses as to what may occur, but our knowledge is not enough to make really good predictions. I cannot say with certainty that any of the catastrophic changes suggested by many climate models and the paleoclimate record will occur, but likewise nobody can say with any certainty whatsoever that they will not occur. Again, prudence and risk reduction are called for given the scientific evidence that we now have.

Comment: There is a growing body of evidence that suggests that 1) future global warming will be modest, and 2) the impacts of such a warming will be minimal, and even include positive changes. According to NASA's Dr. Jim Hansen, "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." Hansen arrived at this conclusion after taking into account how the temperature of the earth has responded to the sum total of all human activities during the past 20 or 30 years—the period during which anthropogenic emissions of greenhouse gases have been their greatest.

This warming rate is just barely above the lowest rate of warming for the possible temperature rise during the 21st century projected by the Intergovernmental Panel on Climate Change (IPCC) in their 2001 report. The IPCC gave the range of future global temperature increase as 1.4ºC to 5.8ºC by the year 2100. The IPCC range for the accompanying sea level rise was given as 0.09 to 0.88 meters (3.5 to 34.7 inches). Suffice it to say that the low end of the sea level rise range is closely associated with the low end of the temperature change range, and 3.5 inches is an amount that few will notice, given the fact that many areas along the U.S. East Coast didn't notice a sea level rise of a foot in the last 100 years, as our coastline continues to rebound from the ice age.

Furthermore, Dr. Hansen thinks that the IPCC emissions scenarios used to produce their temperature changes (and sea level rise) are likely "implausible." In making such claims, Hansen is joining the ranks of other climate scientists who, relying on observations of the actual behavior of the climate rather than computer models of how it should behave, think that the climate response to past, current, and future human activities will be modest. A modest climate response means that the likelihood that the impacts of climate changes on the earth and its ecosystems (including humans) will include beneficial ones grows larger.

Such positive responses are already being witnessed as evidenced by the remarkable enhancement of the global vegetation during the past 20 years recently reported by Ramakrishna Nemani and colleagues. Nemani reports that this growth enhancement results from a combination of two major influences—the increased fertilization effect from growing concentrations of atmospheric carbon dioxide, AND, the patterns of change in the earth's climate during the study period.

References:

Hansen, J.E., 2003. Can We Defuse the Global Warming Time Bomb? Edited

from a presentation made to the Council on Environmental Quality, June 12, 2003, http://www.giss.nasa.gov/research/forcings/ceq_presentation.pdf

Hansen, J.E., and M. Sato, 2001. Trends of measured climate forcing agents. Proceedings of the National Academy of Sciences, 98, 14778-14783.

Nemani, R.R., et al., 2003. Climate-driven increases in global terrestrial net primary production from 1982 to 1999. Science, 300, 1560-1563.

I hope the research information and the personal opinions I have offered are of some relevance and assistance as you and Senator Lieberman offer your amendment to the Senate energy bill.

Sincerely,

Rick Anthes