To: ***GHG–Endangerment-Docket@epa.gov***

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From: Center for Science and Public Policy

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Written testimony of Dr. Roger A. Pielke, Sr.
House Subcommittee on Energy and Air Quality
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Please find the following comments related to EPA's April 24, 2009 **Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act (EF)**.

These comments also address issues in the April 17, 2009 **Technical Support Document (TSD)** that includes many of the detailed references to science, data, and models used to justify comments in the Endangerment Finding.

Issue Summary

There are fatal flaws in the Administrator's Endangerment Finding:

1. The global climate models do not have all of the first-order human climate forcings and they cannot skillfully predict regional and local impacts.
2. Regional scale climate cannot be predicted decades into the future.
3. Climate model predicted multi-decadal regional scale climate variations and change cannot be attributed to specific human climate forcings.
4. Climate model predicted multi-decadal regional scale climate variations and change cannot be used for impacts assessments, including for the proposed Endangerment Finding

Specific Errors in the EF/TSD

EF.18896.2-3

In addition to attributing recent global warming to anthropogenic greenhouse gas influence at the global scale, both the IPCC and CCSP reports attributed recent North American warming to elevated greenhouse gas concentrations. A 2008 CCSP report [22] found that for North America, ''more than half of this warming [for the period 1951–2006] is likely 23 the result of human-caused greenhouse gas forcing of climate change.''

[22] CCSP (2008) Reanalysis of Historical Climate Data for Key Atmospheric Features: Implications for Attribution of Causes of Observed Change. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Randall Dole, Martin Hoerling, and Siegfried Schubert (eds.)]. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC, 156 pp.

EF.18898.2

The global indicators of change go beyond the well-established surface air temperature rise discussed above. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. Observations show that changes are occurring in the amount, intensity, frequency, and type of precipitation. There is strong evidence that global sea level gradually rose in the 20th century and is currently rising at an increased rate. Widespread changes in extreme temperatures have been observed in the last 50 years.

Regarding observed changes in extreme events, another 2008 CCSP report [26] stated the following: ''Many extremes and their associated impacts are now changing. For example, in recent decades most of North America has been experiencing more unusually hot days and nights, fewer unusually cold days and nights, and fewer frost days. Heavy downpours have become more frequent and intense. Droughts are becoming more severe in some regions, though there are no clear trends for North America as a whole. The power and frequency of Atlantic hurricanes have increased substantially in recent decades, though North American mainland land-falling hurricanes do not appear to have increased over the past century. Outside the tropics, storm

tracks are shifting northward and the strongest storms are becoming even stronger.''

[26] Karl, T.R., G.A. Meehl, T.C. Peterson, K.E. Kunkel, W.J. Gutowski, Jr., D.R. Easterling (2008) Executive Summary in Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

Comments

Weather and Agricultural, Hydrologic and Other Impacts Respond to Regional Climate Forcings and Feedbacks Not a Global Average Temperature Trend

1. **Can regional scale climate be predicted decades into the future?**

The CCSP Report 2008e "The effects of climate change on agriculture, land resources, water resources, and biodiversity in the United States" accepts model predictions and presents them as skillful predictions by the agricultural, land resources, water resources, and biodiversity impacts communities. The main focus of this assessment is the next 25-50 years. The report claims that

> "*the climate change that will occur during this period is relatively well understood. Much of this change will be caused by greenhouse gas emissions that have already happened."*

The 2005 National Research Council Report concluded that the

> "*global mean surface temperature response [offers] little information on regional climate change or precipitation"*

"Regional variations in radiative forcing may have important regional and global climatic implications that are not resolved by the concept of global mean radiative forcing. Tropospheric aerosols and landscape changes have particularly heterogeneous forcings"

and

> *Regional diabatic heating [from tropospheric aerosols and landscape*

changes] can… cause atmospheric teleconnections that influence regional climate thousands of kilometers away from the point of forcing"

Humans, therefore, have a more diverse influence on the climate system than is represented by a focus on anthropogenic inputs of CO2 into the atmosphere. Other investigators agree on the significance of regional heating on weather patterns. For example, as written in Palmer et al. (2008):

> *"As is well known, systematic changes in diabatic heating fields will perturb the planetary-wave structure of the atmosphere, in both the tropics and the extratropics*"

and

> *"It will be decades before climate change projections can be fully verified."*

There is substantial research that supports the conclusions from the 2005 National Research Council report (NRC 2005) that the human role in the climate system is more diverse than focusing only on the global warming effect of CO2.

As shown in NRC 2005, the regional climate is influenced by a variety of human climate forcings besides CO2. The global models must include all of the first-order human climate forcings as a necessary condition for skillful predictions.

As the 2007 IPCC report admitted, however, even in the context of the global average top of the atmosphere radiative forcing, they do not have all of the first-order climate forcings. They write in the caption to Figure SPM.2 with respect to the global average radiative forcings that.

> *Additional forcing factors not included here are considered to have a very low LOSU……"* [LOSU means "level of scientific understanding"]

There is no way that a skillful forecast of global and regional decades into the future can be made if all of the first-order climate forcings are not included.

2. **Can climate model predicted multi-decadal regional scale climate variations and change be attributed to specific human climate forcings?**

Since all first-order human climate forcings are not included, as presented in NRC 2005, the attribution of specific climate forcings to a regional response is not yet scientifically robust. This is a fatal flaw in the Administrator's Endangerment Finding.

With respect to assessing climate model skill, there have been recent studies on this issue. For example, as reported in Gleckler et al. (2008),

> *"Unlike numerical weather prediction, there is currently no widely accepted suite of metrics for evaluating climate model performance."*

One of the lead authors of the 2007 IPCC report, Kevin Trenberth, although otherwise a strong proponent of the global model predictions, stated in a candid admission [Trenberth 2007] that

> ***"In fact there are no predictions by IPCC at all. And there never have been…*** *None of the models used by IPCC are initialized to the observed state and none of the climate states in the models correspond even remotely to the current observed climate.… I postulate that regional climate change is impossible to deal with properly unless the models are initialized……..the science is not done because we do not have reliable or regional predictions of climate."*

There are even serious issues with the data that is used to validate the model predictions as well as to monitor long-term climate. For example, there are uncertainties and biases in the temperature data used to validate the model results and to assess multi-decadal temperature trends.

The land surface temperature data record is an integral component of the CCSP reports (e.g., CCSP 2006; 2008a,b***). However, as one example of a data issue, the global average surface temperature trends that have been used to validate the global climate model multi-decadal predictions have been shown to have unresolved issues as discussed in a range of peer-reviewed papers*** [e.g. Pielke et al. 2007a,b; Walters et al. 2007; Mahmood et al. 2006b; Hale et al. 2006; Pielke and Matsui 2005; Davey and Pielke 2005].

Based on this research, for example, we found a conservative estimate of the warm bias resulting from measuring the temperature near the ground

of around 0.21°C per decade (with the nighttime minimum temperature contributing a large part of this bias). ***Since land covers about 29% of the Earth's surface, the warm bias due to this influence explains about 30% of the IPCC estimate of global warming.*** In other words, consideration of the bias in temperature would reduce the IPCC trend to about 0.14°C per decade; still a warming, but not as large as indicated by the IPCC.

The message from such research is that the use of this data in the CCSP assessments will provide an erroneous overstatement of warming in the United States. ***Since the model predictions in the CCSP reports require this data for their impact assessments, the confidence that is placed on their use for such assessments is misplaced. This is another fatal flaw in the Administrator's Endangerment Finding.***

The stations used to collect temperature data are also often inappropriately located, as documented for many of the US historical climate reference network sites by Anthony Watts
[See http://gallery.surfacestations.org/main.php?g2_itemId=20 Also see http://surfacestations.org]

The immediate environment around these sites is also changing over time as vegetation grows or is removed, air conditioners are added, buildings are relocated, etc. This poor siting introduce a substantial uncertainty in assessing extreme temperatures and temperature trends.

3. Can climate model predicted multi-decadal regional scale climate variations and change be used for impacts assessments?

In order to use multi-decadal climate model predictions for accurate impacts assessments, they must have regional and local skill. However, as presented in Section 2, the models do not have this level of skill.

The spatial patterns of drought and of sea surface temperature anomalies illustrate that regional scale information is needed. However, the global models do not yet have skill at downscaling to regional and local scales, and thus are unable to provide robust information on this spatial scale to the impacts communities. This limitation has been documented in several papers; e.g. Castro et al, 2005; 2007; Lo et al. 2008; Rockel et al. 2008)

In the Castro et al. (2007) paper it was concluded that

> *"In order for RCMs [regional climate model using information from a global climate model [GCM] to be successful in a seasonal weather prediction mode for the summer season, it is required that the GCM provide a reasonable representation of the teleconnections and have a climatology that is comparable to a global atmospheric reanalysis."*

Accurate seasonal regional prediction is a necessary requirement for multi-decadal climate predictions. The multi-decadal global models have not demonstrated skill at predicting on the seasonal scale.

As written in Lo et al. (2008)

> *"Regional climate simulations that rely on those predictions for LBCs and nudging are thus dominated by the global model information."*

Therefore, if the global models do not have all of the first-order human climate forcings, they cannot skillfully predict regional and local impacts.

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