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Re: Rulemaking
Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act
Docket ID No. EPA-HQ-OAR-2009-0171

The Heartland Institute submits the following comments in response to the United States Environmental Protection Agency ("EPA") Notice of Rulemaking entitled *Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act.* For the reasons discussed below, for EPA Administrator Lisa P. Jackson to make this proposed positive finding would be unreasonable, unlawful, and arbitrary and capricious.

I. About The Heartland Institute

The Heartland Institute is a national nonprofit research and education organization, tax exempt under Section 501(c)3 of the Internal Revenue Code, headquartered in Chicago, and founded in 1984. It is not affiliated with any political party, business, or foundation.

Heartland's mission is to discover, develop, and promote free-market solutions to social and economic problems. Such solutions include market-based approaches to environmental protection, privatization of public services, parental choice in education, personal responsibility

in health care, and deregulation in areas where property rights and markets do a better job than government bureaucracies.

Heartland's nearly 200 free-market policy experts—managing editors, senior fellows, policy advisors, and contributing editors—are able to provide testimony, articulate issue positions through the media, and help educate in other ways policymakers at all levels of government in the fifty states and Washington, D.C. Our policy advisors are academics and professionals including members of the faculties of Harvard University, Georgetown University Law Center, the Massachusetts Institute of Technology, The University of Chicago, The University of Chicago Law School, UCLA School of Law, Northwestern University, and scores of other respected universities. In addition, approximately 150 elected officials – Democrats as well as Republicans – serve on Heartland's Board of Legislative Advisors.

Our publications are distributed to approximately 8,300 state and national elected officials and 8,400 local government officials. Heartland also communicates with media, civic and business leaders, educators, other groups, and the general public.

The Heartland Institute seeks to bring sound science and economics to the debate on environmental issues. We believe there is too much alarmism in these debates and too little attention being paid to the real science. In the specific case of global warming, Heartland has been a major source of research and commentary in the U.S. questioning whether enough is known about climate change to justify government action. As this comment demonstrates, consideration of all relevant peer-reviewed academic articles on an array of climate change issues mandates that EPA abandon its attempts to regulation anthropogenic emissions of greenhouse because of the extreme uncertainty that these emissions cause or contribute to air pollution.

In recent years, Heartland has been providing a platform for the so-called "skeptics" in the global warming debate, among other reasons, because (a) it is apparent that the proposed assertion of federal governmental powers over human-induced greenhouse gas emissions exploits the public's scientific illiteracy to advance the government's agenda; and (b) the economic consequences of greenhouse gas emission regulatory programs on the scale proposed by EPA in this rulemaking and in the Advanced Notice of Proposed Rulemaking, EPA-HQ-OAR-2008-0318-0117 ("ANPR"), *Regulating Greenhouse Gas Emissions Under the Clean Air Act* would be devastating. Heartland has hosted three international conferences in New York and Washington in 2008 and 2009, bringing together hundreds of scientists, economists, and policy experts to explore issues ignored by the IPCC in its reports.

Heartland has published and disseminated numerous books and studies on climate change and global warming, including Heartland's monthly newspaper *Environment and Climate News;* James M. Taylor, J.D., *What Climate Scientists Think about Global Warming* (Heartland Institute, 2007); S. Fred Singer and Dennis T. Avery, *Unstoppable Global Warming: Every 1,500 Years* (Rowman & Littlefield Publishers, Inc. 2007); Joseph L. Bast, James M. Taylor, and Jay Lehr, *State Greenhouse Gas Programs*: *An Economic and Scientific Analysis* (Heartland Institute, 2003); Joseph L. Bast, *New Source Review: An Evaluation of EPA's Reform Recommendations* (Heartland Institute, 2002). In 2008, Heartland published S. Fred Singer, ed., *Nature, Not Human Activity, Rules the Climate,* a summary report for policymakers from the Nongovernmental International Panel on Climate Change.

In June 2009, Heartland published *Climate Change Reconsidered: The 2009 Report of the Nongovernmental International Panel on Climate Change* (henceforth "the NIPCC Report"), in which coauthors Dr. S. Fred Singer and Dr. Craig Idso and 35 contributors and reviewers present an authoritative and detailed rebuttal of the findings of the United Nations' Intergovernmental Panel on Climate Change (IPCC), on which EPA is relying for this proposed Endangerment Finding and its other greenhouse gas regulatory proposals. The scholarship in this book demonstrates overwhelming scientific support for the position that the warming of the twentieth century was moderate and not unprecedented, that its impact on human health and wildlife was positive, and that carbon dioxide probably is not the driving factor behind climate change.

A copy of the NIPCC Report is attached to and submitted as part of this comment. Heartland also urges EPA to review additional publications as they become available, posted at http://www.co2science.org/.

Further information about Heartland's work on climate change is available at http://www.globalwarmingheartland.org/ and http://www.nipccreport.org/

II. Introduction

The issue in this rulemaking is whether the Administrator should make a finding that six greenhouse gases "cause" or "contribute" to "air pollution" that "may reasonably be anticipated to endanger public health or welfare" under Section 202(a) of the Clean Air Act. She has proposed a positive Endangerment Finding. 74 Fed. Reg. 18886. This proposed finding has ramifications well beyond this rulemaking because it will trigger a cascade of regulation of these greenhouse gas emissions under other sections of the Act.

The Clean Air Act provides that the courts may reverse EPA regulations that are unreasonable and arbitrary and capricious. This comment proves that the science cited by EPA as supposedly supporting the proposed positive finding is wholly insufficient, and therefore a positive endangerment finding would be subject to judicial reversal on these grounds.

Furthermore, federal guidelines, including those of EPA itself, require that "influential" rulemakings like this one be based on data that is "accurate, clear, complete, and unbiased." This data must also be collected by the "best available methods." The data must also be the most recent available. EPA's data fail to meet these requirements.

As demonstrated below and in the NIPCC Report, EPA has failed to consider a vast body of peer-reviewed academic research relevant to this rulemaking. These studies demonstrate, among other things, that EPA's computer models are incapable of accurately simulating past temperatures and thus cannot be used to predict future temperatures. EPA even admits there are substantial uncertainties in these models.

EPA's contentions that the global warming of the twentieth century was caused by human activity and that human emissions will cause future warming are undermined by an extensive

body of scientific research pointing to natural forcings and feedback effects that are not taken into account by computer models. Some of these forcings and effects are sufficiently large to entirely explain the warming of the twentieth century or to entirely offset any human effect due to CO_2 emissions.

EPA relies on a piece of research – the so-called "hockystick" diagram by Mann *et al.,* to support its claim claim that the warming of the twentieth century was unprecedented. But this study is widely discredited in the academic literature. Similarly, extensive observational data contradicts EPA's contentions that there has been any human effect on the rate at which glaciers have melted since the last Ice Age, sea levels have risen, or precipitation has increased or become more extreme.

The connection between carbon dioxide levels in the atmosphere and global temperatures is much more complex, and probably much weaker, than EPA assumes. Many paleoclimatologic studies find warming temperatures preceeded rather than followed elevated carbon dioxide concentrations. EPA also fails to consider research by solar scientists who find that temperatures correlate more closely with solar cycles than anthropogenic greenhouse gas emissions.

The Heartland Institute has published a 737-page report, titled *Climate Change Reconsidered: The 2009 Rerport of the Nongovernmental International Panel on Climate Change* ("NIPCC Report") that documents the statements made in this comment and comprehensively refutes the claims contained in EPA's Endangerment Finding.

The scientific positions described in this comment and in the NIPCC Report are entirely within the mainstream of the scientific community. Besides the thousands of source citations to peer-reviewed scientific journal articles contined in the NIPCC Report is the fact that more than 31,000 scientists have signed a petition saying "there is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing, or will in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate." The complete text of that petition, an explanation of how it was circulated, and a directory of all 31,478 American scientists who signed it appears in Appendix 4 of the NIPCC Report. There is no similar summary of alarmist science that has been signed by anywhere near 31,000 scientists. In contrast, the IPCC, upon which EPA heavily relies, lists only 2,400 participants, many of whom are not scientists and many of whom disagree with the alarmist conclusions asserted by the relative handful of lead authors who composed the final documents.

The core issue in this rulemaking is, as noted above, whether man-induced greenhouse gas emissions cause or contribute to a threat to human health or welfare. A fair evaluation by EPA of the entire body of relevant, peer-reviewed academic research should lead it to conclude that they do not, and the proposed finding ought to be withdrawn.

III. EPA Has Failed to Provide Notice and a Meaningful Opportunity to be Heard During this Rulemaking in Violation of Law and the U.S. Constitution.

A. The Notice Provided for this Rulemaking Was Defective.

The official Federal Register notice for this rulemaking, dated April 24, 2009, informed the public that comments could be submitted by e-mail to GHG--Endangerment-Docket@epa.gov[.] 74 Fed. Reg. 18886. This address is incorrect; e-mails using it are not transmitted to EPA. The correct address is GHG-Endangerment-Docket@epa.gov (with one dash rather than two dashes between "GHG" and "Endangerment"). Due to this error, an unknown number of interested persons have been deprived of the opportunity to comment.

If EPA's erroreous e-mail address is not corrected and republished, if the comment period for this rulemaking is not extended, and if the Administrator finalizes her Endangerment Finding, this rulemaking will be subject to reversal because EPA and the Administrator have violated the Due Process Clause of the U.S. Constitution, the procedures required by the Clean Air Act, the Administrative Procedure Act, and Executive Order Number 12866.

The Due Process Clause of the Fifth Amendment guarantees that "no person shall . . . be deprived of life, liberty, or property, without due process of law." "A fundamental requirement of due process is 'the opportunity to be heard.' It is an opportunity which must be granted at a meaningful time and in a meaningful manner." *Armstrong v. Manzo*, 380 U.S. 545, 552 (1965). The opportunity to submit a comment by e-mail that cannot reach EPA and remains floating in the ether is the exact opposite of meaningful.

The Clean Air Act provides that "the Administrator *shall* allow any person to submit written comments, data, or documentary information…" in a rulemaking process like this one. 42 U.S.C. §7607(d)(5)(i)(emphasis supplied.) The Administrative Procedure Act, which is applicable to EPA,[1] provides that EPA "*shall* give interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments with or without opportunity for oral presentation." 5 U.S.C.S. §553(c)(emphasis supplied). This provision is mandatory by its plain terms, not discretionary. The APA further provides that Federal Register notice must be given of: "the established places at which . . . the public may. . . make submittals . . . ." 5 U.S.C.S. §552(a)(1)(A).[2] EPA and the Administrator have violated these provisions.

Furthermore, as the EPA Guidelines recognize, Executive Order Number 12866 dated October 4,1993, applies to this rulemaking. This Order requires that an agency like EPA "shall (consistent with its own rules, regulations, or procedures) provide the public with meaningful participation in the regulatory process." 58 Fed. Reg. 51735. This provision too has been

[1] Although the Clean Air Act contains its own procedural provision, 42 U.S.C.S. 7607, this section applies in addition to the Administrative Procedure Act (APA). *Small Refiner Lead Phase-Down Task Force v. U.S. EPA,* 705 F.2d 506, 522-23 (D.C. Cir. 1983)("At a minimum, failure to observe the basic APA procedures, if reversible error under the APA, is reversible error under the Clean Air Act as well").

[2] The right to comment "is not meager. The right to comment better grounds agency action in the actual values and interests of the people subject to the action and it better 'assure[s] that the agency will have before it the facts and information relevant to a particular administrative problem, as well as suggestions for alternative solutions. The courts, therefore, will not credit rulemaking as 'fully reasoned' unless the agency takes into account the data and critical analysis and identification of interests and priorities as offered by public comment." Alfred C. Aman, Jr., and William T. Mayton, *Administrative Law* at 54 (West Group 2001)(internal citations omitted).

violated.

There is a pattern here: The same thing happened during the ANPR comment period, when EPA also provided an erroneous e-mail address in the Federal Register notice. (*See* 73 Fed. Reg. 44354 (July 30, 2008) and Heartland's submittal dated November 28, 2008.) Where, as here, a vast new regulatory regime is proposed, imposing new Clean Air Act control measures that will cost many trillions of dollars, the process leading to such regulation ought not be tainted in any way. EPA ought to republish the Endangerment Finding in the Federal Register with the correct e-mail address. It should also extend the deadline for submission of comments for at least 60 days. This is an important issue to every person in this country, and EPA owes it to the American public to give every interested person the opportunity to be heard.

B. There Is No Meaningful Opportunity to Be Heard.

Pursuant to Executive Order Number 12866 dated October 4, 1993, and Sections 6.2 and 6.3 of EPA Information Quality Act Guidelines, discussed below, information disseminated by EPA in a rulemaking that has "an annual effect on the economy of $100 million or more or adversely affect[s] in a material way the economy, a sector of the economy, productivity, competition, [or] jobs" is "influential" and thus subject to particularly rigorous data quality standards. 58 Fed. Reg. 51735. Further, as just noted, Executive Order Number 12866 and Due Process require a meaningful opportunity to be heard.

EPA has proffered hundreds of thousands of pages of scientific data in support of the proposed Endangerment Finding. Tens of thousands of pages of this data – primarily from the Climate Change Science Program – has been published in the past year and was not available in the ANPR process. Yet EPA has provided merely 60 days for review of and comment on this massive quantity of information.

When regulations implicating not millions or billions but rather many trillions of dollars in economic costs are proposed, EPA owes the American public a comment period of ample length to enable the public to participate in a meaningful way. EPA ought to extend the comment period for at least another 60 days.

IV. EPA's Proposed Endangerment Finding and Its Underlying Science Documents Violate the Information Quality Act.

A. EPA's Proposed Endangerment Finding Data Violates OMB's Information Quality Act Guidelines.

These comments shall prove that the data EPA relies on for its proposed Endangerment Finding violate the Information Quality Act. (Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (P.L. 106-554).) The proposed Endangerment Finding thus is void.

The Act directs federal agencies to maximize "the quality, objectivity, utility, and integrity" of

information they prepare and disseminate and requires agencies to adopt and follow implementing guidelines. Information must be "accurate, clear, complete, and unbiased." *Id.*

As detailed in the NIPCC Report and this comment, EPA's data is biased, incomplete, and inaccurate. The scientific research on which the proposed Endangerment Finding is based was promulgated by the IPCC and dates to the year 2006 at the latest. The data is inaccurate, as the NIPCC Report demonstrates. EPA's data are incomplete because they omit the wealth of scientific research identified and discussed in the NIPCC Report casting profound doubt on whether global warming results from anthropogenic emissions of greenhouse gases. For these reasons, the OMB guidelines are violated.

In addition, when EPA engages in "analysis of risks to human health, safety and the environment," it is required by the Office of Management and Budget's guidelines to apply the principles enacted by Congress in the Safe Drinking Water Act, 42 U.S.C. §300g-1(b)(3)(A) and (B). 67 Fed. Reg. 8458-60. This section of the SDWA requires EPA to use only:

> [T]he best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and
>
> [D]ata collected by accepted methods or best available methods.

42 U.S.C. §300g-1(b)(3)(A). As discussed below, the "best available" data has not been included by EPA in the scientific documents it relies on for this proposed Endangerment Finding. Also, as discussed below, the methods used to collect data – temperature observations now known to be defective and computer models that have been widely discredited – were not the best available.

The SDWA also requires EPA to address: "each significant uncertainty" in assessing public health risks; all studies capable of assisting in resolving the uncertainties; all peer-reviewed studies that "fail to support any estimate of public health effects;" and the methodology by which inconsistent scientific data was reconciled. *Id.*

As noted below, in the TSD and the CCSP data promulgated in support of the proposed Endangerment Finding, significant uncertainties are expressed but not resolved. Also as noted below, there is a vast body of inconsistent scientific data. Again this was not resolved. For these reasons, the Information Quality Act has been violated. The proposed Endangerment Finding is therefore void.

B. EPA's Proposed Endangerment Finding Data Violates EPA's Own Information Quality Act Guidelines.

As required by the Information Quality Act, EPA has adopted *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* ("EPA Guidelines"). EPA has also violated these guidelines by disseminating flawed and incomplete scientific data.

EPA's guidelines require that the information it disseminates maximizes "quality" and

"objectivity." "Objectivity focuses on whether the disseminated information is being presented in an accurate, clear, complete, and unbiased manner, and as a matter of substance, is accurate, reliable, and unbiased." EPA Guidelines at §5.1.

EPA's guidelines define a "top Agency action" to include a rulemaking such as this one because it is involves "highly controversial" science and economic issues and will have "potentially great or widespread impacts on the private sector…." Thus, the information disseminated as part of this rulemaking is, under the definitions in the EPA Guidelines, "influential." EPA Guidelines at §6.3. Particular rigor is required for influential information:

> EPA recognizes that influential scientific, financial, or statistical information should be subject to a higher degree of quality (for example, transparency about data and methods) than information that may not have a clear and substantial impact on important public policies or private sector decisions.

Id. But, as noted, the information disseminated in support of this Endangerment Finding fails to meet this standard.

EPA also recognizes its obligations under the SDWA to use the "best available" data in making risk assessments, with the term "available" being defined "the availability at the time an assessment is made." EPA Guidelines at §6.4. EPA goes on to say it "also recognizes that scientific knowledge about risk is rapidly changing and that risk information may need to be updated over time." *Id.* As noted, the data on which the proposed Endangerment Finding is based dates to 2006, for the most recent.[3] As noted in the NIPCC Report, the state of scientific knowledge about the risk of global warming is changing rapidly. EPA's data does not meets its obligations under the SDWA. The proposed Endangerment Finding therefore is void.

V. EPA's Proposed Endangerment Finding and Its Underlying Science Documents Violate the Clean Air Act's Prohibition of Regulations That Are Unreasonable, Arbitrary, and Capricious.

A court may reverse EPA regulations that are:

> (A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;
>
> (B) contrary to constitutional right, power, privilege, or immunity;
>
> (C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right . . . .

[3] The new CCSP products were published in 2008 and 2009 but, as in the case of the EPA Technical Support Document for this proceeding, these products are based on academic research as of 2006.

42 U.S.C. §7607(d)(9). Also, as noted above, the Administrator may make a positive endangerment finding only for emissions "which may reasonably be anticipated to endanger public health or welfare. 42 U.S.C. §7521(a). For the reasons set forth in this comment, including the NIPCC Report, the proposed Endangerment Finding violates these provisions.

VI. EPA Engages in Clear Legal Error by Enabling the Administrator to Make an Endangerment Finding Based on Low Likelihood that Climate Change Is Driven by Anthropogenic Emissions of Certain Greenhouse Gases.

In proposing her Endangerment Finding, the Administrator uses the legislative history of Section 202(a) of the Clean Air Act, 42 U.S.C. §7521(a)(1) to interpret the terms "judgment" and "endanger" in that statute. Based on this legislative history, she contends she is authorized to based her Endangerment Finding on "projections,[4] assessments and estimates," to "extrapolate from limited data," and to balance the likelihood and severity of effects:

> This balance involves a sliding scale; on one end the severity of the effects may be significant, but the likelihood low, while on the other end the severity may be less significant, but the likelihood high. Under either scenario, the Administrator is permitted to find endangerment. If the harm would be catastrophic, the Administrator is permitted to find endangerment even if the likelihood is small. in making her endangerment finding.

74 Fed. Reg. 18891-92. EPA's use of legislative history is clear legal error, however.

Section 202(a) provides:

> The Administrator shall by regulation prescribe (and from time to time revise) in accordance with the provisions of this section, standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.

Id.

Under well-established principles of statutory construction, the legislative history of a statute may not be considered unless the statutory language is ambiguous. *Barnhill v. Johnson,* 503 U.S. 393, 401 (1992("[W]e note that appeals to statutory history are well taken only to resolve 'statutory ambiguity'"). *See also Ratzlaf v. United States*, 510 U.S. 135, 147-48 (1994)("[W]e do not resort to legislative history to cloud a statutory text that is clear"). There is nothing ambiguous about the terms "judgment" and "endanger" in Section 202(a). The term "judgment" is well-understood to mean a reasoned decision based on facts. The common meaning of

[4] As discussed below, the verb "project" and its derivatives are IPCC-speak for computer modeling, which, in the case of climate change, is seriously flawed.

"endanger" is also clear. It means "to expose to danger, harm, loss; imperil." (*Webster's New World College Dictionary*, 4th edition, Wiley Publishing Co., Inc. (2002).) Thus, use of legislative history here is entirely improper.

Furthermore, use of the legislative history to assert that the Administrator may make a finding based only on slight certainty of harm is plainly not what Congress authorized in enacting this provision. Rather, Congress authorized her to make a decision based on facts – a "judgment"— that harm to human health and welfare is reasonably likely. As submitted in this comment, science relied on by EPA, as well as the vast body of academic scientific peer-reviewed research that EPA ignored, cannot support such a judgment.

VII. EPA's Reliance on Computer Models is Unreasonable, Arbitrary, and Capricious.

EPA can regulate only those air pollutants the Administrator finds "in his judgment cause, or contribute to, air pollution" and only when those pollutants "may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. §7521(a)(1).

EPA's entire rationale for regulating the six specified greenhouse gases rests upon its adoption of 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) ("IPCC AR4") computer models. These models purport to show the globe has warmed in past decades due to anthropogenic emissions of these gases and will continue to do so in the future, with allegedly catastrophic impacts on human health and welfare. The computer modeling from IPCC AR4 was conducted prior to 2006. EPA conducted no modeling of its own. In light of the known deficiencies of IPCC's computer models, described below, EPA's failures to consider more recent data and to conduct its own modeling means that its proposed Endangerment Finding is legally insufficient and arbitrary and capricious.

As the D.C. Circuit has recognized in a case under a different section of the Clean Air Act, to be valid drivers of regulation, computer models must be continuously updated and verified:

> Congress intended that monitoring would impose a certain discipline on the use of modeling techniques, which would be the principal device relied upon for the projection of the impact on air quality of emissions from a regulated source. This projects that the employment of modeling techniques be held to earth by a continual process of confirmation and reassessment, a process that enhances confidence in modeling, as a means for realistic projection of air quality

Alabama Power Company v. Costle, 636 F.2d 323, 372 (D.C. Cir. 1979).

Because this computer modeling is deficient and unreliable in numerous important respects, as EPA concedes and the NIPCC Report proves, the proposed finding is unreasonable and arbitrary and capricious.

A. EPA Itself Admits the IPCC Computer Modeling upon Which the Proposed Endangerment Finding Is Based Is Flawed in Significant Ways.

EPA's discussion of the modeling used is abbreviated; EPA merely adopts the modeling used in the IPCC AR4 and adds a few comments from the Climate Change Science Program Synthesis and Assessment Products. Even this abbreviated discussion, however, demonstrates that modeling done to date is utterly and fatally flawed and that the Administrator cannot use it to reasonably support her proposed Endangerment Finding.

EPA itself admits in the Technical Support Document for this rulemaking that computer models are defective in numerous important respects, including but not limited to the 13 defects described immediately below. *Endangerment and Cause and Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act* ("TSD").

First, the models can accurately simulate future climate changes only if they can accurately simulate the current and past climate. (TSD at 39.) EPA says it has "considerable confidence" in the models' predictions of the future. (TSD at 52.) But the Climate Change Science Program assessment of computer modeling, incorporated into the TSD, doesn't share EPA's opinion on simulation accuracy. CCSP states:

> Climate modeling has been steadily improving over the past several decades, but the pace has been uneven because several important aspects of the climate system present especially severe challenges to the goal of simulation.
>
> Simulations from different state-of-the-science models have not fully converged, however, since different groups approach uncertain model aspects in distinctive ways. This absence of convergence is one useful measure of the state of climate simulation; convergence is to be expected once all climate-relevant processes are simulated in a convincing physically based manner. However, measuring the quality of climate models so the metric used is directly relevant to our confidence in the models' projections of future climate has proven difficult. The most appropriate ways to translate simulation strengths and weaknesses into confidence in climate projections remain a subject of active research.

Climate Models: An Assessment of Strengths and Limitations, U.S. Climate Change Science Program Synthesis and Assessment Product 3.1 at 1, 4 (2008). Furthermore, as noted below, EPA's models are significantly flawed in past and present climate simulations.

Second, EPA concedes computer modeling does not result in definitive projections of future climate change. Computer models use "scenarios," EPA says, which "are story lines regarding possible futures. These storylines are designed to be internally consistent in their assumptions regarding population and economic growth, implementation of policies, technology change and adoption, and other factors that will influence emissions. *Scenarios are not projections of the future, but are used to illustrate how the future might look if a given set of events occurred and policies implemented.*"(TSD at 46; emphasis supplied.) Despite this caution, the TSD uses the word "project" or its derivatives more than 285 times in discussing future climate change. (*See* TSD generally.)

Third, EPA says clouds are not well represented in the computer models, leading to "uncertainties" in predicting how much climate change will take place in the future and the timing of any climate change. (TSD at 52.)

Fourth, there are "uncertainties" about composition and distribution of past aerosol emissions in the paleoclimate records. (TSD at 15.) There are also "uncertainties" in the models of future aerosol effects on climate and the interaction of aerosols with clouds, which "potentially can change cloud radiative properties and cloud cover." This is "a major stumbling block," EPA admits. (TSD at 52.) As discussed below, clouds exert considerable cooling effects. Their underrepresentation in the models is a significant defect which disqualifies use of these models in this Endangerment Finding.

Fifth, "[t]here are still large uncertainties associated with current inventories of BC and OC, the ad hoc scaling methods used to produce future emissions, and considerable variation among estimates of the optical properties of carbonaceous aerosols. Given these uncertainties, future projections of forcing by BC and OC are quite dependent on the model and emissions assumptions (Meehl et al., 2009). Similarly, CCSP (2008d) concluded that one of the most important uncertainties in characterizing the potential climate impact of aerosols is the projection of their future emissions." (TSD at 48.)

Sixth, the models are global and are not accurate at regional levels or over time periods of less than 50 years. "Attribution at these scales, with limited exceptions, has not yet been established." (TSD at 42.)

Seventh, projections of precipitation are "problematic" in some cases. (TSD at 52-53.) This is a serious defect because, as discussed below, precipitation is a major driver of weather and climate.

Eighth, EPA notes "an important inconsistency may have been identified in the tropics." Observation shows more surface warming, rather than tropospheric warming, while models simulate the opposite—more tropospheric warming than surface warming. EPA says one possible explanation is observational errors, but adds "the issue is still under investigation." (TSD at 41.)

Ninth, current modeling does not distinguish between natural and human-induced changes in hurricane activity, so "a confident assessment of human influence on hurricanes" requires further study. (TSD at 42.)

Tenth, "[t]here is no clear evidence to date of human-induced global climate change on North American precipitation amounts." (TSD at 43.)

Eleventh, EPA notes CCSP states that models of glacial ice are "in their infancy" and that "recent evidence for rapid variations in this glacial outflow indicates that more-realistic glacial models are needed to estimate the evolution of future sea level." (TSD at 57.)

Twelfth, EPA notes sulfates and black carbon "may significantly influence 21st century climate change" and could be responsible for 40 percent of U.S. summer warming by 2100 and a decrease in precipitation. But one simulation shows this "could" cause up to 40 percent of continental U.S. summer warming by 2100 and decrease in precipitation. But there is no "consensus" due to "uncertainties about different pollution control storylines." (TSD at 60.)

Thirteenth, by its own admission, IPCC models (and thus EPA) considered only two natural forcing agents: solar activity and volcanoes. (TSD at 41.) As discussed below, there are numerous other natural forcing agents EPA should have considered.

B. EPA Ignores These Deficiencies in Adopting Wholesale the "Unequivocal" IPCC Projections that Global Warming and Its Consequences Are Occurring Due to Anthropogenic Greenhouse Gas Emissions.

Unrestrained by the defects in its computer modeling, both as to simulations of past and current climate and predictions of the future, EPA nevertheless finds warming is "very likely" to occur in the 21st century with dire consequences for this nation. In light of the broad array of errors that even EPA admits exist in modeling, EPA's certainty that this parade of horribles will occur is simply astonishing.

Among other predictions, EPA lists the following.

First, emissions of greenhouse gases at or above the current rates will "very likely" cause future warming larger than in the 20th century. All North America is "very likely to warm" more than global mean warming. (TSD at 45, 53, 57.)

Second, despite "significant limitations," including lack of cloud representation, computer models "provide credible quantitative estimates of future climate change" and "a robust and unambiguous picture of significant climate warming in response to increasing greenhouse gases." (TSD at 52.)

Third, precipitation is "very likely" to increase in all of North America except in the south and southwest portions due to global warming, according to models. Models simulate global mean precipitation increases with global warming. Global intense precipitation events will result in deaths, injuries, infectious diseases, intoxications and mental health problems (Confalonieri et al, 2007). Flooding may also lead to contamination of waters with dangerous chemicals, heavy metals, or other hazardous substances, from storage or from chemicals already in the environment (Confalonieri et al, 2007). (TSD at 56, 59, 62, 69.)

Fourth, "models suggest that human-induced climate change is expected to alter the prevalence and severity of many extreme events such as heat waves, cold waves, storms, floods, and droughts." (TSD at 61.)

Fifth, sea levels are projected to rise by between 0.18 and 0.59 meters, compared with the base period of 1980 to 1999, according to the IPCC AR4, but may "substantially exceed these levels" due to melting of the Greenland and Antarctic ice sheets. Sea levels could rise up to one meter. (TSD at 56, 61.)

Sixth, there will be a "likely increase in intense tropical cyclone activity" which is linked to increased risk of deaths, injuries, water and foodborne disease and post-traumatic stress disorders. (TSD at 72.)

Seventh, droughts are "likely to increase," though not "likely" in the United States. (TSD at 72.)

Eighth, changes in temperature and precipitation are projected as "likely to increase wild fires, leading to increased eye and respiratory illnesses and injuries, burns, smoke inhalation. (TSD at 72.)

Ninth, the spread of several food and water-borne pathogens will "likely" increase. (TSD at 73.)

As discussed above, the predictive value of computer models is only as good as their ability to reconstruct the past. Since the computer models EPA relies on do not accurately simulate the past, EPA's use of them to predict the future—for the purpose of imposing a regulatory scheme that will cost all Americans trillions of dollars—is unreasonable, arbitrary and capricious. EPA should withdraw the Endangerment Finding.

C. EPA Failed to Consider and/or Correctly Interpret Peer-Reviewed Scientific Research that Proves the IPCC's Computer Models Are Unreliable.

The IPCC computer models adopted without evaluation by EPA have been severely criticized by many respected scientists for being too unreliable to form the basis of public policy. Specifically, and as documented below, researchers have found IPCC's general circulation models (1) are not intended to produce forecasts and are inherently incable of doing do; (2) fail to replicate real-world conditions, an essential test of reliabilility; (3) fail to correctly simulate the physics of Earth's radiative energy balance; (4) fail to properly model cloud formation and cloud-radiation interactions; and (5) fail to simulate even major observed precipitation anomalies, such as the summer monsoon rainfall over the Indian region.

This peer-reviewed research is extensively summarized in Chapter 1 of the NIPCC Report (NIPCC Report at 1-27.) and is briefly summarized here.

1. Computer Models Cannot Generate Scientific Predictions.

Computer models are tools used by scientists to better understand how the climate responds to internal and external "forcings" such as changes in the amount of carbon dioxide and solar radiation. But computer models are nothing more than a statement of how the modeler believes a part of the world works and are not designed to produce scientific forecasts (Bryson, 1993). Forecasting, in contrast, is a scientific discipline (Armstrong, 2001), and one with which the authors of the IPCC reports are apparently unfamiliar. An "audit" of the IPCC AR4 Working Group I's report – on which the EPA relies heavily—by professional forecasters found no citations to "the primary sources of information on forecasting methods" and "the forecasting procedures that were described [in sufficient detail to be evaluated] violated 72 principles. Many of the violations were, by themselves, critical." (Green and Armstrong, 2007).

Armstrong, J.S. 2001. *Principles of Forecasting – A Handbook for Researchers and Practitioners.* Kluwer Academic Publishers, Norwell, MA.

Bryson, R.A. 1993. Environment, environmentalists, and global change: A skeptic's evaluation. *New Literary History:* **24**: 783-795.

Green, K.C. and Armstrong, J.S. 2007. Global warming: forecasts by scientists versus scientific forecasts. *Energy Environ.* **18**: 997–1021.

2. Failure to Replicate Reality

One way to test a computer climate model is to see if it can replicate real-world conditions. The models used by the IPCC and EPA have been severely criticized for failing to replicate real-world conditions in the articles and books cited here.

Balling, R.C. 2005. Observational surface temperature records versus model predictions. In Michaels, P.J. (Ed.) *Shattered Consensus: The True State of Global Warming.* Rowman & Littlefield. Lanham, MD. 50-71.

Christy, J. 2005. Temperature changes in the bulk atmosphere: beyond the IPCC. In Michaels, P.J. (Ed.) *Shattered Consensus: The True State of Global Warming.* Rowman & Littlefield. Lanham, MD. 72-105.

Essex, C. and McKitrick, R. 2002. *Taken by Storm. The Troubled Science, Policy and Politics of Global Warming*. Key Porter Books. Toronto, Canada.

Frauenfeld, O.W. 2005. Predictive skill of the El Niño-Southern Oscillation and related atmospheric teleconnections. In Michaels, P.J. (Ed.) *Shattered Consensus: The True State of Global Warming.* Rowman & Littlefield. Lanham, MD. 149-182.

Michaels, P.J. 2009. *Climate of Extremes: Global Warming Science They Don't Want You to Know.* Cato Institute. Washington, DC.

Michaels, P.J. 2005. *Meltdown: The Predictable Distortion of Global Warming by Scientists, Politicians and the Media.* Cato Institute, Washington, DC.

Michaels, P.J. 2000. *Satanic Gases: Clearing the Air About Global Warming.* Cato Institute. Washington, DC.

Pilkey, O.H. and Pilkey-Jarvis, L. 2007. *Useless Arithmetic*. Columbia University Press, New York.

Posmentier, E.S. and Soon, W. 2005. Limitations of computer predictions of the effects of carbon dioxide on global temperature. In Michaels, P.J. (Ed.) *Shattered Consensus: The True State of Global Warming*. Rowman & Littlefield. Lanham, MD. 241-281.

Spencer, R. 2008. *Climate Confusion: How Global Warming Hysteria Leads to Bad Science, Pandering Politicians and Misguided Policies that Hurt the Poor.* Encounter Books. New York, NY.

A specific example of the failure of models to similate real-world climate conditions is a test performed by Wielicki *et al*. (2002) , wherein four state-of-the-art climate models and one weather assimilation model failed to reproduce the observed decadal changes in top-of-the-atmosphere thermal and solar radiative energy fluxes that occurred over the past two decades. No significant decadal variability was exhibited by *any* of the models; and they *all* failed to reproduce even the cyclical seasonal change in tropical albedo. The administrators of the test concluded that "the missing variability in the models highlights the critical need to improve

cloud modeling in the tropics so that prediction of tropical climate on interannual and decadal time scales can be improved."

Wielicki, B.A., Wong, T., Allan, R.P., Slingo, A., Kiehl, J.T., Soden, B.J., Gordon, C.T., Miller, A.J., Yang, S.-K., Randall, D.A., Robertson, F., Susskind, J. and Jacobowitz, H. 2002. Evidence for large decadal variability in the tropical mean radiative energy budget. *Science* **295**: 841-844.

3. Radiative Balance

"[U]ncertainties as large as, or larger than, the doubled CO_2 forcing could easily exist in our modeling of future climate trends, due to uncertainties in the feedback processes," wrote J.E. Harries in 2000. Because of the vast complexity of the subject, Harries says,"even if [our] understanding were perfect, our ability to describe the system sufficiently well in even the largest computer models is a problem." (NIPCC at 12.)

Hartmann, writing in *Science*, says "the models are deficient" and "if the energy budget can vary substantially in the absence of obvious forcing," as it did over the past two decades, "then the climate of earth has modes of variability that are not yet fully understood and cannot yet be accurately represented in climate models." The models are particularly poor at explaining evaporation and cloud processes at the tropics, which could act as a natural "vent" or "thermostat" controlling global temperatures.

Cumulative impacts of radiative forcing must be understood and measured before the models can be reliable. Yet one extensive study by Ghan *et al.* (2001) dentified a long list of improvements needed in models before such certainty could be achieved, and concluded that "much remains to be done before the estimates are reliable enough to base energy policy decisions upon." (NIPCC at 13.)

Bellon, G., Le Treut, H. and Ghil, M. 2003. Large-scale and evaporation-wind feedbacks in a box model of the tropical climate. *Geophysical Research Letters* **30**: 10.1029/2003GL017895.

Chen, J., Carlson, B.E. and Del Genio, A.D. 2002. Evidence for strengthening of the tropical general circulation in the 1990s. *Science* **295**: 838-841.

Ghan, S.J., Easter, R.C., Chapman, E.G., Abdul-Razzak, H., Zhang, Y., Leung, L.R., Laulainen, N.S., Saylor, R.D. and Zaveri, R.A. 2001. A physically based estimate of radiative forcing by anthropogenic sulfate aerosol. *Journal of Geophysical Research* **106**: 5279-5293.

Harries, J.E. 2000. Physics of the earth's radiative energy balance. *Contemporary Physics* **41**: 309-322.

Hartmann, D.L. 2002. Tropical surprises. *Science* **295**: 811-812.

Wielicki, B.A., Wong, T., Allan, R.P., Slingo, A., Kiehl, J.T., Soden, B.J., Gordon, C.T., Miller, A.J., Yang, S.-K., Randall, D.A., Robertson, F., Susskind, J. and Jacobowitz, H. 2002. Evidence for large decadal variability in the tropical mean radiative energy budget. *Science* **295**: 841-844.

4. Cloud Impacts

A principal reason why the IPCC's computer models fail is because they cannot correctly model the creation and effects of clouds. Randall *et al*. (2003) state "the representation of cloud processes in global atmospheric models has been recognized for decades as the source of much of the uncertainty surrounding predictions of climate variability." They report that "despite the best efforts of [the climate modeling] community ... the problem remains largely unsolved. They say "the large-scale effects of microphysics, turbulence, and radiation should be parameterized as closely coupled processes acting in concert," but that only a few models have even attempted to do this because "the cloud parameterization problem is overwhelmingly complicated," and "cloud parameterization developers," as they call them, are still "struggling to identify the most important processes on the basis of woefully incomplete observations." They conclude, "a sober assessment suggests that with current approaches the cloud parameterization problem will not be 'solved' in any of our lifetimes." Many other scientists agree. (NIPCC at 16-18.)

Chou, M.-D., Lindzen, R.S. and Hou, A.Y. 2002. Reply to: "Tropical cirrus and water vapor: an effective Earth infrared iris feedback?" *Atmospheric Chemistry and Physics* **2**: 99-101.

Gordon, C.T., Rosati, A. and Gudgel, R. 2000. Tropical sensitivity of a coupled model to specified ISCCP low clouds. *Journal of Climate* **13**: 2239-2260.

Grabowski, W.W. 2000. Cloud microphysics and the tropical climate: Cloud-resolving model perspective. *Journal of Climate* **13**: 2306-2322.

Grassl, H. 2000. Status and improvements of coupled general circulation models. *Science* **288**: 1991-1997.

Groisman, P.Ya., Bradley, R.S. and Sun, B. 2000. The relationship of cloud cover to near-surface temperature and humidity: Comparison of GCM simulations with empirical data. *Journal of Climate* **13**: 1858-1878.

Lane, D.E., Somerville, R.C.J. and Iacobellis, S.F. 2000. Sensitivity of cloud and radiation parameterizations to changes in vertical resolution. *Journal of Climate* **13**: 915-922.

Lindzen, R.S., Chou, M.-D. and Hou, A.Y. 2001. Does the earth have an adaptive infrared iris? *Bulletin of the American Meteorological Society* **82**: 417-432.

Randall, D., Khairoutdinov, M., Arakawa, A. and Grabowski, W. 2003. Breaking the cloud parameterization deadlock. *Bulletin of the American Meteorological Society* **84**: 1547-1564.

The role of the flux of biologically-produced dimethyl sulfide from the oceans and other organic matter into the atmosphere and their influence on cloud formation further complicates the matter of modeling the effects of clouds. O'Dowd *et al.,* writing in 2004, say their data "completely change the picture of what influences marine cloud condensation nuclei given that water-soluble organic carbon, water-insoluble organic carbon and surface-active properties, all of which influence the cloud condensation nuclei activation potential, are typically not parameterized in current climate models." They say "an important source of organic matter from the ocean is omitted from current climate-modeling predictions and should be taken into account." (NIPCC at 18.) Other researchers have pointed to other omissions and errors.

Ayers, G.P. and Gillett, R.W. 2000. DMS and its oxidation products in the remote marine atmosphere: implications for climate and atmospheric chemistry. *Journal of Sea Research* **43**: 275-286.

Charlson, R.J., Lovelock, J.E., Andrea, M.O. and Warren, S.G. 1987. Oceanic phytoplankton, atmospheric sulfur, cloud albedo and climate. *Nature* **326**: 655-661.

L'Ecuyer, T.S. and Stephens, G.L. 2007. The tropical atmospheric energy budget from the TRMM perspective. Part II: Evaluating GCM representations of the sensitivity of regional energy and water cycles to the 1998-99 ENSO cycle. *Journal of Climate* **20**: 4548-4571.

O'Dowd, C.D., Facchini, M.C., Cavalli, F., Ceburnis, D., Mircea, M., Decesari, S., Fuzzi, S., Yoon, Y.J. and Putaud, J.-P. 2004. Biogenically driven organic contribution to marine aerosol. *Nature* **431**: 676-680.

Siebesma, A.P., Jakob, C., Lenderink, G., Neggers, R.A.J., Teixeira, J., van Meijgaard, E., Calvo, J., Chlond, A., Grenier, H., Jones, C., Kohler, M., Kitagawa, H., Marquet, P., Lock, A.P., Muller, F., Olmeda, D. and Severijns, C. 2004. Cloud representation in general-circulation models over the northern Pacific Ocean: A EUROCS intercomparison study. *Quarterly Journal of the Royal Meteorological Society* **130**: 3245-3267.

Spencer, R.W. and Braswell, W.D. 2008.Potential biases in feedback diagnosis from observational data: A simple model demonstration. *Journal of Climate **21:** 5624-5628.*

Zhang, M.H., Lin, W.Y., Klein, S.A., Bacmeister, J.T., Bony, S., Cederwall, R.T., Del Genio, A.D., Hack, J.J., Loeb, N.G., Lohmann, U., Minnis, P., Musat, I., Pincus, R., Stier, P., Suarez, M.J., Webb, M.J., Wu, J.B., Xie, S.C., Yao, M.-S. and Yang, J.H. 2005. Comparing clouds and their seasonal variations in 10 atmospheric general circulation models with satellite measurements. *Journal of Geophysical Research* **110**: D15S02, doi:10.1029/2004 JD005021.

Zhou, Y.P., Tao, W.-K., Hou, A.Y., Olson, W.S., Shie, C.-L., Lau, K.-M., Chou, M.-D., Lin, X. and Grecu, M. 2007. Use of high-resolution satellite observations to evaluate cloud and Randall, D., Khairoutdinov, M., Arakawa, A. and Grabowski, W. 2003. Breaking the cloud parameterization deadlock. *Bulletin of the American Meteorological Society* **84**: 1547-1564.

5. Models Cannot Simulate or Predict Precipitation

Computer models have been conspicuously unable to similate participation patterns, even so major an observed precipitation anomaly as the summer monsoon rainfall over the Indian region. This is a major defect of the models because precipation plays a major role in cooling the atmosphere. For example, the 2004 summer monsoon season of India experienced a 13 percent precipitation deficit that was not predicted by any of the empirical or dynamical models regularly used in making rainfall forecasts (Gadgil *et al*., 2005). Researchers who performed a historical analysis of the models' monsoon forecasting skill over the period 1932-2004 found no improvement since the very first versions of the models were applied to the task some seven decades earlier. *Id*. The models often failed to correctly predict even the *sign* of the precipitation anomaly, frequently predicting excess rainfall when drought occurred and drought when excess rainfall was received. Once again, other researchers have confirmed this finding. (NIPCC Report at 23-25.)

Allan, R.P. and Soden, B.J. 2007. Large discrepancy between observed and simulated precipitation trends in the ascending and descending branches of the tropical circulation. *Geophysical Research Letters* **34**: 10.1029/2007GL031460.

Gadgil, S., Rajeevan, M. and Nanjundiah, R. 2005. Monsoon prediction—Why yet another failure? *Current Science* **88**: 1389-1400.

Lau, K.M., Shen, S.S.P., Kim, K.-M. and Wang, H. 2006. A multimodel study of the twentieth-century simulations of Sahel drought from the 1970s to 1990s. *Journal of Geophysical Research* **111**: 10.1029/2005JD006281.

Lebel, T., Delclaux, F., Le Barbé, L. and Polcher, J. 2000. From GCM scales to hydrological scales: rainfall variability in West Africa. *Stochastic Environmental Research and Risk Assessment* **14**: 275-295.

Lin, J.-L. 2007. The double-ITCZ problem in IPCC AR4 coupled GCMs: Ocean-atmosphere feedback analysis. *Journal of Climate* **20**: 4497-4525.

Walsh, K. and Pittock, A.B. 1998. Potential changes in tropical storms, hurricanes, and extreme rainfall events as a result of climate change. *Climatic Change* **39**: 199-213.

Wentz, F.J., Ricciardulli, L., Hilburn, K. and Mears, C. 2007. How much more rain will global warming bring? *Science* **317**: 233-235.

Woodhouse, C.A. 2003. A 431-yr reconstruction of western Colorado snowpack from tree rings. *Journal of Climate* **16**: 1551-1561.

D. Summary

EPA acts in an unreasonable, arbitrary, and capricious fashion when it admits to 13 errors and shortcomings of computer models, yet bases on those very models its forecast of negative consequences on human health and welfare. Its review of the scientific literature is biased, incomplete, and unreliable because it overlooks or misinterprets the extensive body of peer-reviewed literature exposing the errors and limits of attempting to make predictions on the basis of computer models.

As the NIPCC Report concludes: "Climate models currently do not provide a reliable scientific basis for implementing programs designed to restrict anthropogenic CO_2 emissions. The cloud parameterization problem by itself is so complex that no one can validly claim that humanity's continued utilization of fossil-fuel energy will result in massive counter-productive climatic changes. There is no justification for that conclusion in reliable theoretical models." (NIPCC Report at 21.)

VIII. EPA's Proposed Endangerment Fails to Give Sufficient Weight to Natural Feedback Factors and Forcings.

EPA opines "that it is very unlikely that the global pattern of warming observed during the past half century is due" to natural forcings. The primary natural forcings considered by EPA are solar activity and volcanoes. (TSD at 41.) EPA mentions increases in aerosols (primarily sulfate, organic carbon, black carbon, nitrate and dust) as producing cooling, but calls these "the dominant uncertainty in radiative forcing" and assumes, unreasonably, that they are too small to matter. (TSD at 22.)

EPA adopts, uncritically, the IPCC's conclusion that "if CO_2 concentrations were to double, the rise in global average surface temperature "is *likely* to be in the range 2°C to 4.5°C with a best estimate of about 3°C, and is *very unlikely* to be less than 1.5°C [italics in the original]" (NIPCC Report at 27.)

But EPA failed to consider other natural feedbacks and forcings, some of which may totally offset the forcings from rising CO_2 levels. Seven such factors and forcings identified by the authors of the NIPCC Report are: (A) a natural heat vent over the tropics; (B) cooling from

increased plant emissions of sulfate aerosols; (C) increased photosynthesis from diffuse light; (D) Iodine compounds emitted from marine algae; (E) declining methane concentrations; (F) increased dimethyl sulfide emissions from oceans; and (G) natural and anthropogenic aerosol emissions.

If any of these feedbacks and forcings play a larger role than EPA and the IPCC assume, then the role played by rising CO_2 must be correspondingly smaller, and EPA's endangerment finding is based on inaccurate or incomplete data. Since EPA and IPCC unreasonably ignore or underestimate the consequences of *all* of these feedbacks and forcings, it follows that the EPA endangerment finding is not scientifically valid.

A. A natural heat vent over the tropics

Scientists have discovered a "natural heat vent" in the tropics, the eastern part of the west Pacific, and three regions in the U.S., Turkey, Canada, and Australia. When sea surface temperatures reach a certain level, evaporation and wind currents change to affect cloud cover, resulting in the release of more heat into space and a natural cooling of sea surface and the Earth's atmosphere. The exact functioning of this process is still unknown, but evidence of its existence is widely acknowledged in the peer-reviewed scientific literature. (NIPCC Report at 16, 17.)

Chou, M.-D., Lindzen, R.S. and Hou, A.Y. 2002. Reply to: "Tropical cirrus and water vapor: an effective Earth infrared iris feedback?" *Atmospheric Chemistry and Physics* **2**: 99-101.

Fu, Q., Baker, M. and Hartmann, D.L. 2002. Tropical cirrus and water vapor: an effective Earth infrared iris feedback? *Atmospheric Chemistry and Physics* **2**: 31-37.

Hartmann, D.L. and Michelsen, M.L. 2002. No evidence for IRIS. *Bulletin of the American Meteorological Society* **83**: 249-254.

Herman, J.R., Larko, D., Celarier, E. and Ziemke, J. 2001. Changes in the Earth's UV reflectivity from the surface, clouds, and aerosols. *Journal of Geophysical Research* **106**: 5353-5368.

Lindzen, R.S., Chou, M.-D. and Hou, A.Y. 2001. Does the earth have an adaptive infrared iris? *Bulletin of the American Meteorological Society* **82**: 417-432.

Sud, Y.C., Walker, G.K. and Lau, K.-M. 1999. Mechanisms regulating sea-surface temperatures and deep convection in the tropics. *Geophysical Research Letters* **26**: 1019-1022.

B. Sulfate Aerosols

Plants, like clouds, may act as a "biothermostat." Kuhn and Kesselmeier (20002) found lichens absorb carbonyl sulfide (OCS) from the atmosphere at a rate that gradually doubled when ambient temperatures rose from 3° to 25° C., but as temperatures increased still further, this absorption precipitously declined until it was at zero at 35° C. This suggests "the thermoregulatory function of the biosphere may well be powerful enough to define an upper limit above which the surface air temperature of the planet may be restricted from rising, even

when changes in other forcing factors, such as increases in greenhouse gas concentrations, produce an impetus for it to do so." (Kuhn and Kesselmeier, 2000)

EPA states that aerosol masses in the atmosphere are primarily sea salt and dust. (TSD at 15.) Furthermore, EPA considers in the TSD only the effect of anthropogenic emissions of aerosols and wholly ignores sources and the impacts of entirely natural aerosols (including but not limited to sea salt and dust.). (TSD at 15, 21, 41, 48, 53.) But the lichens described above, and other plants described below, demonstrate that there are natural sources of aerosols that may have much larger impacts on climate.

Atmospheric CO_2 enrichment augments plant growth, which in turn increases vegetative input of organic matter to soils. This organic matter tends to increase emissions from soils of sulfur gases such as carbonyl sulfide (OCS). This sulfur gas makes its way to the stratosphere, where it is transformed into solar reflecting sulfate aerosol particles, thus cooling the earth. (NIPCC Report at 29.)

The NIPCC Report concludes that "[T]he 'biothermostat' effect is complex and needs to be studied further, but any such processes are totally neglected in current state-of-the-art climate models." (NIPCC Report at 30.) Until these processes are understood and incorporated into models, we cannot be certain how much of the warming of the 20th century, if any, can be attributed to anthropogenic sources.

Andreae, M.O. and Ferek, R.J. 1992. Photochemical production of carbonyl sulfide in seawater and its emission to the atmosphere. *Global Biogeochemical Cycles* **6**: 175-183.

Aydin, M., De Bruyn, W.J. and Saltzman, E.S. 2002. Preindustrial atmospheric carbonyl sulfide (OCS) from an Antarctic ice core. *Geophysical Research Letters* **29**: 10.1029/2002GL014796.

Barnes, I., Becker, K.H. and Petroescu, I. 1994. The tropospheric oxidation of DMS: a new source of OCS. *Geophysical Research Letters* **21**: 2389-2392.

Erickson III, D.J. and Eaton, B.E. 1993. Global biogeochemical cycling estimates with CZCS satellite data and general circulation models. *Geophysical Research Letters* **20**: 683-686.

Idso, S.B. 1990. A role for soil microbes in moderating the carbon dioxide greenhouse effect? *Soil Science* **149**: 179-180.

Idso, S.B. 1992. The DMS-cloud albedo feedback effect: Greatly underestimated? *Climatic Change* **21**: 429-433.

Khalil, M.A.K. and Rasmussen, R.A. 1984. Global sources, lifetimes, and mass balances of carbonyl sulfide (OCS) and carbon disulfide (CS_2) in the earth's atmosphere. *Atmospheric Environment* **18**: 1805-1813.

Kuhn, U. and Kesselmeier, J. 2000. Environmental variables controlling the uptake of carbonyl sulfide by lichens. *Journal of Geophysical Research* **105**: 26,783-26,792.

C. Diffuse Light

As CO_2 enrichment of the atmosphere enhances plant productivity, a five-part negative feedback linkage takes place. As plants are increasingly able to remove more CO_2 from the air, they are

also able to emit gases to the air that are converted to "biosols." These naturally occurring aerosols then function as cloud condensation nuclei, which produce clouds which cool the earth's atmosphere. The third linkage is increases in aerosols and cloud particles enhance the diffuse radiation reaching the earth. Enhanced diffuse lighting then reduces shading under the vegetative canopy, the fourth linkage, which increases photosynthesis, the fifth linkage, extracting more CO_2 from the atmosphere. (NIPCC Report at 30-31.) Once again, EPA and the IPCC ignore this negative feedback factor and therefore overstate the role of CO_2.

Baldocchi, D., Falge, E., Gu, L.H., Olson, R., Hollinger, D., Running, S., Anthoni, P., Bernhofer, C., Davis, K., Evans, R., Fuentes, J., Goldstein, A., Katul, G., Law, B., Lee, X.H., Malhi, Y., Meyers, T., Munger, W., Oechel, W., Paw U, K.T., Pilegaard, K., Schmid, H.P., Valentini, R., Verma, S., Vesala, T., Wilson, K. and Wofsy, S. 2001. FLUXNET: A new tool to study the temporal and spatial variability of ecosystem-scale carbon dioxide, water vapor, and energy flux densities. *Bulletin of the American Meteorological Society* **82**: 2415-2434.

Fitzjarrald, D.R., Moore, K.E., Sakai, R.K. and Freedman, J.M. 1995. Assessing the impact of cloud cover on carbon uptake in the northern boreal forest. In: Proceedings of the American Geophysical Union Meeting, Spring 1995, *EOS Supplement*, p. S125.

Goulden, M.L., Daube, B.C., Fan, S.-M., Sutton, D.J., Bazzaz, A., Munger, J.W. and Wofsy, S.C. 1997. Physiological responses of a black spruce forest to weather. *Journal of Geophysical Research* **102**: 28,987-28,996.

Gu, L., Baldocchi, D.D., Wofsy, S.C., Munger, J.W., Michalsky, J.J., Urbanski, S.P. and Boden, T.A. 2003. Response of a deciduous forest to the Mount Pinatubo eruption: Enhanced photosynthesis. *Science* **299**: 2035-2038.

Law, B.E., Falge, E., Gu, L., Baldocchi, D.D., Bakwin, P., Berbigier, P., Davis, K., Dolman, A.J., Falk, M., Fuentes, J.D., Goldstein, A., Granier, A., Grelle, A., Hollinger, D., Janssens, I.A., Jarvis, P., Jensen, N.O., Katul, G., Mahli, Y., Matteucci, G., Meyers, T., Monson, R., Munger, W., Oechel, W., Olson, R., Pilegaard, K., Paw U, K.T., Thorgeirsson, H., Valentini, R., Verma, S., Vesala, T., Wilson, K. and Wofsy, S. 2002. Environmental controls over carbon dioxide and water vapor exchange of terrestrial vegetation. *Agricultural and Forest Meteorology* **113**: 97-120.

Niyogi, D., Chang, H.-I., Saxena, V.K., Holt, T., Alapaty, K., Booker, F., Chen, F., Davis, K.J., Holben, B., Matsui, T., Meyers, T., Oechel, W.C., Pielke Sr., R.A., Wells, R., Wilson, K. and Xue, Y. 2004. Direct observations of the effects of aerosol loading on net ecosystem CO_2 exchanges over different landscapes. *Geophysical Research Letters* **31**: 10.1029/2004GL020915.

Oechel, W.C. and Lawrence, W.T. 1985. Tiaga. In: Chabot, B.F. and Mooney, H.A. (Eds.) *Physiological Ecology of North American Plant Communities*. Chapman & Hall, New York, NY, pp. 66-94.

Roderick, M.L., Farquhar, G.D., Berry, S.L. and Noble, I.R. 2001. On the direct effect of clouds and atmospheric particles on the productivity and structure of vegetation. *Oecologia* **129**: 21-30.

Sakai, R.K., Fitzjarrald, D.R., Moore, K.E. and Freedman, J.M. 1996. How do forest surface fluxes depend on fluctuating light level? In: *Proceedings of the 22nd Conference on Agricultural and Forest Meteorology with Symposium on Fire and Forest Meteorology*, Vol. 22, American Meteorological Society, pp. 90-93.

Sarmiento, J.L. 1993. Atmospheric CO_2 stalled. *Nature* **365**: 697-698.

D. Iodocompounds

Another biological aerosol ignored by EPA is iodine vapor emitted from marine algae. This aerosol functions as cloud condensation nuclei reflecting incoming solar radiation and cooling the planet. Studies have linked increasing levels of iodocompounds to increasing levels of CO_2 in the atmosphere. One team of researchers, Wingenter *et al.,* concluded these compounds "may help contribute to the homeostasis of the planet." Another team, O'Dowd *et al.,* said changes in cloud albedo "associated with global change" can lead to an increase in global radiative forcing that is "similar in magnitude, but opposite in sign, to the forcing induced by greenhouse gases." (NIPCC Report at 34-35.)

Jimenez, J.L., Bahreini, R., Cocker III, D.R., Zhuang, H., Varutbangkul, V., Flagan, R.C., Seinfeld, J.H., O'Dowd, C.D. and Hoffmann, T. 2003. New particle formation from photooxidation of diiodomethane (CH_2I_2). *Journal of Geophysical Research* 108: 10.1029/2002JD002452.

Kolb, C.E. 2002. Iodine's air of importance. *Nature* **417**: 597-598.

Laturnus, F., Giese, B., Wiencke, C. and Adams, F.C. 2000. Low-molecular-weight organoiodine and organobromine compounds released by polar macroalgae—The influence of abiotic factors. *Fresenius' Journal of Analytical Chemistry* **368**: 297-302.

O'Dowd, C.D., Jimenez, J.L., Bahreini, R., Flagan, R.C., Seinfeld, J.H., Hameri, K., Pirjola, L., Kulmala, M., Jennings, S.G. and Hoffmann, T. 2002. Marine aerosol formation from biogenic iodine emissions. *Nature* **417**: 632-636.

Smythe-Wright, D., Boswell, S.M., Breithaupt, P., Davidson, R.D., Dimmer, C.H. and Eiras Diaz, L.B. 2006. Methyl iodide production in the ocean: Implications for climate change. *Global Biogeochemical Cycles* **20**: 10.1029/2005GB002642.

Wingenter, O.W., Haase, K.B., Zeigler, M., Blake, D.R., Rowland, F.S., Sive, B.C., Paulino, A., Thyrhaug, R., Larsen, A., Schulz, K., Meyerhofer, M. and Riebesell, U. 2007. Unexpected consequences of increasing CO_2 and ocean acidity on marine production of DMS and CH_2CII: Potential climate impacts. *Geophysical Research Letters* **34**: 10.1029/2006GL028139.

E. Methane

Methane is a potent greenhouse gas that is produced by natural as well as anthropogenic processes. EPA and the IPCC ignore evidence that as CO_2 concentrations and temperature increase, methane emissions and atmospheric concentrations are likely to decrease, partly offsetting the greenhouse effect. (NIPCC Report at 37-39.)

Cai, Z., Xing, G., Yan, X., Xu, H., Tsuruta, H., Yogi, K. and Minami, K. 1997. Methane and nitrous oxide emissions from rice paddy fields as affected by nitrogen fertilizers and water management. *Plant and Soil* **196**: 7-14.

Inubushi, K., Cheng, W., Aonuma, S., Hoque, M.M., Kobayashi, K., Miura, S., Kim, H.Y. and Okada, M. 2003. Effects of free-air CO_2 enrichment (FACE) on CH_4 emission from a rice paddy field. *Global Change Biology* **9**: 1458-1464.

Kruger, M. and Frenzel, P. 2003. Effects of N-fertilisation on CH_4 oxidation and production, and consequences for CH_4 emissions from microcosms and rice fields. *Global Change Biology* **9**: 773-784.

Lindau, C.W., DeLaune, R.D., Patrick Jr., W.H. *et al*. 1990. Fertilizer effects on dinitrogen, nitrous oxide, and methane emission from lowland rice. *Soil Science Society of America Journal* **54**: 1789-1794.

Schrope, M.K., Chanton, J.P., Allen, L.H. and Baker, J.T. 1999. Effect of CO_2 enrichment and elevated temperature on methane emissions from rice, *Oryza sativa*. *Global Change Biology* **5**: 587-599.

Schutz, H., Holzapfel-Pschorrn, A., Conrad, R. *et al*. 1989. A 3-year continuous record on the influence of daytime, season, and fertilizer treatment on methane emission rates from an Italian rice paddy. *Journal of Geophysical Research* **94**: 16405-16416.

Methane is naturally removed from the air by a variety of natural processes, including oxidation by methanotrophic bacteria in the aerobic zones of soil. Soil sinks are "ubiquitous" and they are "believed to be equivalent to the annual input of methane to the atmosphere." (Prinn *et al.*, 1992). There is extensive documentation in the peer reviewed literature that the natural process of methane sequestration will continue to remove this greenhouse gas from the atmosphere in a warmer or higher CO_2 world. (NIPCC Report at 40.)

Dobbie, K.E. and Smith, K.A. 1996. Comparison of CH_4 oxidation rates in woodland, arable and set aside soils. *Soil Biology & Biochemistry* **28**: 1357-1365.

Jensen, S. and Olsen, R.A. 1998. Atmospheric methane consumption in adjacent arable and forest soil systems. *Soil Biology & Biochemistry* **30**: 1187-1193.

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Pastor, J. and Post, W.M. 1988. Response of northern forests to CO_2-induced climate change. *Nature* **334**: 55-58.

Peterjohn, W.T., Melillo, J.M., Steudler, P.A. and Newkirk, K.M. 1994. Responses of trace gas fluxes and N availability to experimentally elevated soil temperatures. *Ecological Applications* **4**: 617-625.

Prieme, A. and Christensen, S. 1997. Seasonal and spatial variation of methane oxidation in a Danish spruce forest. *Soil Biology & Biochemistry* **29**: 1165-1172.

Prinn, R., Cunnold, D., Simmonds, P., Alyea, F., Boldi, R., Crawford, A., Fraser, P., Gutzler, D., Hartley, D., Rosen, R. and Rasmussen, R. 1992. Global average concentration and trend for hydroxyl radicals deduced from ALE/GAGE trichloroethane (methyl chloroform) data for 1978-1990. *Journal of Geophysical Research* **97**: 2445-2461.

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Steudler, P.A., Bowden, R.D., Meillo, J.M. and Aber, J.D. 1989. Influence of nitrogen fertilization on CH_4 uptake in temperate forest soils. *Nature* **341**: 314-316.

Striegl, R.G., McConnaughey, T.A., Thorstensen, D.C., Weeks, E.P. and Woodward, J.C. 1992. Consumption of atmospheric methane by desert soils. *Nature* **357**: 145-147.

Tamai, N., Takenaka, C., Ishizuka, S. and Tezuka, T. 2003. Methane flux and regulatory variables in soils of three equal-aged Japanese cypress (Chamaecyparis obtusa) forests in central Japan. *Soil Biology & Biochemistry* **35**: 633-641.

Watson, R.T., Meira Filho, L.G., Sanhueza, E. and Janetos, A. 1992. Sources and sinks. In: Houghton, J.T., Callander, B.A. and Varney, S.K. (Eds.), *Climate Change 1992: The Supplementary Report to The IPCC Scientific Assessment*, Cambridge University Press, Cambridge, UK, pp. 25-46.

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Whalen, S.C. and Reeburgh, W.S. 1996. Moisture and temperature sensitivity of CH_4 oxidation in boreal soils. *Soil Biology & Biochemistry* **28**: 1271-1281.

Whalen, S.C., Reeburgh, W.S. and Barber, V.A. 1992. Oxidation of methane in boreal forest soils: a comparison of seven measures. *Biogeochemistry* **16**: 181-211.

Yavitt, J.B., Downey, D.M., Lang, D.E. and Sextone, A.J. 1990. CH_4 consumption in two temperate forest soils. *Biogeochemistry* **9**: 39-52.

Finally, there is extensive evidence in the peer-reviewed scientific literature that methane atmospheric concentrations have been declining since the mid-1980s. Growth in methane emissions has been declining between the early 1990s and the mid-2000s, according to EPA. (NIPCC Report at 42-44 and Figure 2.6.2.3.) Spikes in 1991 and 1997-98 may be attributable to El Nino effects. EPA says why this is happening is "not well-understood but are clearly related to the changes in the imbalance between CH4 sources and sinks." (TSD at 14.) But as noted above, there are several possible explanations. Regulation of methane emissions in a time of declining increases is arbitrary and capricious.

Bekki, S., Law, K.S. and Pyle, J.A. 1994. Effect of ozone depletion on atmospheric CH_4 and CO concentrations. *Nature* **371**: 595-597.

Dlugokencky, E.J., Dutton, E.G., Novelli, P.C., Tans, P.P., Masarie, K.A., Lantz, K.O. and Madronich, S. 1996. Changes in CH_4 and CO growth rates after the eruption of Mt. Pinatubo and their link with changes in tropical tropospheric UV flux. *Geophysical Research Letters* **23**: 2761-2764.

Dlugokencky, E.J., Houweling, S., Bruhwiler, L., Masarie, K.A., Lang, P.M., Miller, J.B. and Tans, P.P. 2003. Atmospheric methane levels off: Temporary pause or a new steady-state? *Geophysical Research Letters* **30**: 10.1029/2003GL018126.

Dlugokencky, E.J., Masarie, K.A., Lang, P.M. and Tans, P.P. 1998. Continuing decline in the growth rate of the atmospheric methane burden. *Nature* **393**: 447-450.

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Francey, R.J., Manning, M.R., Allison, C.E., Coram, S.A., Etheridge, D.M., Langenfelds, R.L., Lowe, D.C. and Steele, L.P. 1999. A history of $\delta^{13}C$ in atmospheric CH_4 from the Cape Grim Air Archive and Antarctic firn air. *Journal of Geophysical Research* **104**: 23,631-23,643.

Khalil, M.A.K., Butenhoff, C.L. and Rasmussen, R.A. 2007. Atmospheric methane: Trends and cycles of sources and sinks. *Environmental Science & Technology* **10.1021**/es061791t.

Lassey, K.R., Lowe, D.C. and Manning, M.R. 2000. The trend in atmospheric methane $\delta^{13}C$ and implications for constraints on the global methane budget. *Global Biogeochemical Cycles* **14**: 41-49.

Lowe, D.C., Manning, M.R., Brailsford, G.W. and Bromley, A.M. 1997. The 1991-1992 atmospheric methane anomaly: Southern hemisphere ^{13}C decrease and growth rate fluctuations. *Geophysical Research Letters* **24**: 857-860.

Rigby, M., Prinn, R.G., Fraser, P.J., Simmonds, P.G., Langenfelds, R.L., Huang, J., Cunnold, D.M., Steele, L.P., Krummel, P.B., Weiss, R.F., O'Doherty, S., Salameh, P.K., Wang, H.J., Harth, C.M., Muhle, J. and Porter, L.W. 2008. Renewed growth of atmospheric methane. *Geophysical Research Letters* **35**: 10.1029/2008GL036037.

Schnell, R.C. and Dlugokencky, E. 2008. Methane. In: Levinson, D.H. and Lawrimore, J.H. (Eds.) *State of the Climate in 2007.* Special Supplement to the *Bulletin of the American Meteorological Society* **89**: S27.

Simpson, I.J., Blake, D.R. and Rowland, F.S. 2002. Implications of the recent fluctuations in the growth rate of tropospheric methane. *Geophysical Research Letters* **29**: 10.1029/2001GL014521.

F. Dimethyl Sulfide

Warming increases the emission of dimethyl sulfide (DMS) from world oceans. DMS emissions increase formation of cloud condensation nuclei which leads to cloud droplet formation which in turn increases the albedo effect of clouds, which leads to increased cooling. (NIPCC Report at 42-45.)

Baboukas, E., Sciare, J. and Mihalopoulos, N. 2002. Interannual variability of methanesulfonate in rainwater at Amsterdam Island (Southern Indian Ocean). *Atmospheric Environment* **36**: 5131-5139.

Charlson, R.J., Lovelock, J.E., Andrea, M.O. and Warren, S.G. 1987. Oceanic phytoplankton, atmospheric sulfur, cloud albedo and climate. *Nature* **326**: 655-661.

Kouvarakis, G. and Mihalopoulos, N. 2002. Seasonal variation of dimethylsulfide in the gas phase and of methanesulfonate and non-sea-salt sulfate in the aerosols phase in the Eastern Mediterranean atmosphere. *Atmospheric Environment* **36**: 929-938.

Sciare, J., Mihalopoulos, N. and Dentener, F.J. 2000. Interannual variability of atmospheric dimethylsulfide in the southern Indian Ocean. *Journal of Geophysical Research* **105**: 26,369-26,377.

Simo, R. and Pedros-Alio, C. 1999. Role of vertical mixing in controlling the oceanic production of dimethyl sulphide. *Nature* **402**: 396-399.

Toole, D.A. and Siegel, D.A. 2004. Light-driven cycling of dimethylsulfide (DMS) in the Sargasso Sea: Closing the loop. *Geophysical Research Letters* **31**: 10.1029/2004GL019581.

G. Natural and anthropogenic aerosols

1. Net effect of aerosols

The IPCC estimates the net effect of all aerosols is to produce a cooling effect, with a total direct radiative forcing of -0.5 Wm^{-2} and an additional indirect cloud albedo forcing of -0.7 Wm^{-2} (IPCC, Fourth Assessment Report (2007), Working Group 1, p. 4). However, the scientific literature indicates these estimates are too low. Many studies suggest the net radiative forcing of aerosols may be as large as, or larger than, the radiative forcing due to atmospheric CO_2.

Anderson, T.L., Charlson, R.J., Schwartz, S.E., Knutti, R., Boucher, O., Rodhe, H. and Heintzenberg, J. 2003. Climate forcing by aerosols—a hazy picture. *Science* **300**: 1103-1104.

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IPCC. 2007-I. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and H.L. Miller. (Eds.) Cambridge University Press, Cambridge, UK.

Jacobson, M.Z. 2001. Global direct radiative forcing due to multicomponent anthropogenic and natural aerosols. *Journal of Geophysical Research* **106**: 1551-1568.

Jaenicke, R., Matthias-Maser, S. and Gruber, S. 2007. Omnipresence of biological material in the atmosphere. *Environmental Chemistry* **4**: 217-220.

National Research Council. 1979. *Carbon Dioxide and Climate: A Scientific Assessment*. National Academy of Sciences, Washington, DC, USA.

Sokolik, I.N., Toon, O.B. and Bergstrom, R.W. 1998. Modeling the radiative characteristics of airborne mineral aerosols at infrared wavelengths. *Journal of Geophysical Research* **103**: 8813-8826.

Tegen, I., Lacis, A.A. and Fung, I. 1996. The influence on climate forcing of mineral aerosols from disturbed soils. *Nature* **380**: 419-422.

Vogelmann, A.M., Flatau, P.J., Szczodrak, M., Markowicz, K.M. and Minnett, P.J. 2003. *Geophysical Research Letters* **30**: 10.1029/2002GL016829.

Wild, M. 1999. Discrepancies between model-calculated and observed shortwave atmospheric absorption in areas with high aerosol loadings. *Journal of Geophysical Research* **104**: 27,361-27,371.

2. Anthropogenic aerosols

Manmade aerosol pollution emissions, including particulate matter, may result in significant warming of the planet. For example, much of the surface warming in the U.S. between 1975 and 1994 could be the result of increases in cirrus cloud coverage from airplane contrails, meaning none would be attributable to increased CO_2 content in the atmosphere. (Minnis *et al.*, 2004). Schwartz (2004) concluded predictions in climate models of global warming "are limited at present by uncertainty in radiative forcing of climate change over the industrial period, which is dominated by uncertainty in forcing by aerosols." He adds that if this situation is not improved, "it is likely that in another 20 years it will still not be possible to specify the climate sensitivity with [an] uncertainty range appreciably narrower than it is at present." This is especially true "if the uncertainty in climate sensitivity is to be reduced to an extent where it becomes useful for formulating policy to deal with global change."

Charlson, R.J., Seinfeld, J.H., Nenes, A., Kulmala, M., Laaksonen, A. and Facchini, M.C. 2001. Reshaping the theory of cloud formation. *Science* **292**: 2025-2026.

Facchini, M.C., Mircea, M., Fuzzi, S. and Charlson, R.J. 1999. Cloud albedo enhancement by surface-active organic solutes in growing droplets. *Nature* **401**: 257-259.

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Satheesh, S.K. and Ramanathan, V. 2000. Large differences in tropical aerosol forcing at the top of the atmosphere and Earth's surface. *Nature* **405**: 60-63.

Schwartz, S.E. 2004. Uncertainty requirements in radiative forcing of climate. *Journal of the Air & Waste Management Association* **54**: 1351-1359.

Stanhill, G. and Cohen, S. 2001. Global dimming: a review of the evidence for a widespread and significant reduction in global radiation with discussion of its probable causes and possible agricultural consequences. *Agricultural and Forest Meteorology* **107**: 255-278.

Toon, O.W. 2000. How pollution suppresses rain. *Science* **287**: 1763-1765.

3. Dust

Yet another type of aerosol that affects the climate – and that is also overlooked by EPA and the IPCC – is nonbiological naturally produced aerosols -- dust. Enormous amounts of dust are transported by wind from arid areas to the oceans and to other continents, affecting cloud formation, cloud albedo, diffused light, plant growth, and other important biological processes that affect climate. (NIPCC Report at 60-61.) EPA in the TSD notes the existence of dust as an aerosol but cites no studies analyzing its impact or noting the need for additional research. (TSD at 15.) Most climate models use oversimplified parameters of some dust characteristics and ignore others, meaning whatever effect dust has on climate is mistakenly attributed to human activity. Failure to acknowledge this limitation of current scientific knowledge is another severe defect in EPA's scientific research and reason to reject the TSD.

Charney, J.G. 1975. Dynamics of desert and drought in the Sahel. *Quarterly Journal of the Royal Meteorological Society* **101**: 193-202.

Folland, C.K., Palmer, T.N. and Parker, D.E. 1986. Sahel rainfall and worldwide sea temperatures, 1901-85. *Nature* **320**: 602-607.

Giannini, A., Saravanan, R. and Chang, P. 2003. Oceanic forcing of Sahel rainfall on interannual to interdecadal time scales. *Science* **302**: 1027-1030.

Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Xiaosu, D., Maskell, K. and Johnson, C.A. (Eds.). 2001. *Climate Change 2001: The Scientific Basis*. Cambridge University Press, Cambridge, UK. (Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change.)

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Otterman, J. 1974. Baring high-albedo soils by overgrazing: a hypothesized desertification mechanism. *Science* **186**: 531-533.

Prospero, J.M. and Lamb, P.J. 2003. African droughts and dust transport to the Caribbean: climate change implications. *Science* **302**: 1024-1027.

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H. Summary

EPA, following the lead of the IPCC, assumes that all temperature trends that cannot be explained by climate models must be due to human greenhouse gas emissions. This assumption is false. We have shown that feedback factors and natural radiative forcings that are missing from the computer models either account for some or all of the warming of the second-half of the twentieth century or will have the effect of offsetting some or all future anthropogenic warming. The scientific research is replete with studies proving both statements. EPA simply ignored or overlooked this body of evidence in making its Endangerment Finding. For this reason, the finding is defective and does not supply a reliable basis for policymaking.

IX. EPA's Claims About Current and Past Temperatures and the Role of Carbon Dioxide in Causing Global Warming Are False.

EPA, citing IPCC AR4, states that "The present atmospheric concentration of CO2 (386 parts per million) exceeds by far the natural range over the last 650,000 years (180 to 300 ppm) as determined from ice cores," and that these elevated CO2 levels are responsible for warming which is "very likely to have been unprecedented in more than 10,000 years," causing "unprecedented" warming. (TSD at 13, 19.)

These assertions are contradicted by many authoritative studies that EPA (and the IPCC) disregards. For this reason, the proposed Endangerment Finding violates the Information Quality Act.

A. Paleoclimatic Data Does Not Support the Claim that CO_2 Causes Global Warming.

Reconstruction of historical atmospheric CO_2 concentrations reveals that carbon dioxide levels have been much higher in the past than the present level of 386 ppm. Rothman reports that the CO_2 level "exhibits no systematic correspondence with the geologic record of climatic variations at tectonic time scales." (Rothman, 2002) A visual examination of Rothman's plot of CO_2 and concomitant major cold and warm periods indicates the three most striking peaks in the air's CO_2 concentration occur either totally or partially within periods of time when earth's climate was relatively cool.

Studies identify periods of time when CO_2 levels were two to four times higher than the current level (Pagani *et al.,* 2005), and these carbon dioxide spikes *followed* increases in temperature by hundreds or thousands of years. This contradicts EPA's prime assertion that carbon dioxide and the other specified greenhouse gases drive warming. As the authors of the NIPCC Report conclude, "When temperature is found to lead CO_2 by thousands of years, during both glacial terminations and inceptions, it is extremely likely that CO_2 plays only a minor role in enhancing temperature changes that are induced by something else." (NIPCC Report at 65, citations removed.)

Caillon, N., Severinghaus, J.P., Jouzel, J., Barnola, J.-M., Kang, J. and Lipenkov, V.Y. 2003. Timing of atmospheric CO_2 and Antarctic temperature changes across Termination III. *Science* **299**: 1728-1731.

Cheddadi, R., Lamb, H.F., Guiot, J. and van der Kaars, S. 1998. Holocene climatic change in Morocco: a quantitative reconstruction from pollen data. *Climate Dynamics* **14**: 883-890.

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Indermuhle, A., Stocker, T.F., Joos, F., Fischer, H., Smith, H.J., Wahllen, M., Deck, B., Mastroianni, D., Tschumi, J., Blunier, T., Meyer, R. and Stauffer, B. 1999. Holocene carbon-cycle dynamics based on CO_2 trapped in ice at Taylor Dome, Antarctica. *Nature* **398**: 121-126.

Monnin, E., Indermühle, A., Dällenbach, A., Flückiger, J, Stauffer, B., Stocker, T.F., Raynaud, D. and Barnola, J.-M. 2001. Atmospheric CO_2 concentrations over the last glacial termination. *Nature* **291**: 112-114.

Mudelsee, M. 2001. The phase relations among atmospheric CO_2 content, temperature and global ice volume over the past 420 ka. *Quaternary Science Reviews* **20**: 583-589.

Pagani, M., Authur, M.A. and Freeman, K.H. 1999. Miocene evolution of atmospheric carbon dioxide. *Paleoceanography* **14**: 273-292.

Pagani, M., Zachos, J.C., Freeman, K.H., Tipple, B. and Bohaty, S. 2005. Marked decline in atmospheric carbon dioxide concentrations during the Paleogene. *Science* **309**: 600-603.

Pearson, P.N. and Palmer, M.R. 1999. Middle Eocene seawater pH and atmospheric carbon dioxide concentrations. *Science* **284**: 1824-1826.

Pearson, P.N. and Palmer, M.R. 2000. Atmospheric carbon dioxide concentrations over the past 60 million years. *Nature* **406**: 695-699.

Petit, J.R., Jouzel, J., Raynaud, D., Barkov, N.I., Barnola, J.-M., Basile, I., Bender, M., Chappellaz, J., Davis, M., Delaygue, G., Delmotte, M., Kotlyakov, V.M., Legrand, M., Lipenkov, V.Y., Lorius, C., Pepin, L., Ritz, C., Saltzman, E. and Stievenard, M. 1999. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. *Nature* **399**: 429-436.

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Royer, D.L., Wing, S.L., Beerling, D.J., Jolley, D.W., Koch, P.L., Hickey, L.J. and Berner, R.A. 2001. Paleobotanical evidence for near present-day levels of atmospheric CO_2 during part of the Tertiary. *Science* **292**: 2310-2313.

Siegenthaler, U., Stocker, T., Monnin, E., Luthi, D., Schwander, J., Stauffer, B., Raynaud, D., Barnola, J.-M., Fischer, H., Masson-Delmotte, V. and Jouzel, J. 2005. Stable carbon cycle-climate relationship during the late Pleistocene. *Science* **310**: 1313-1317.

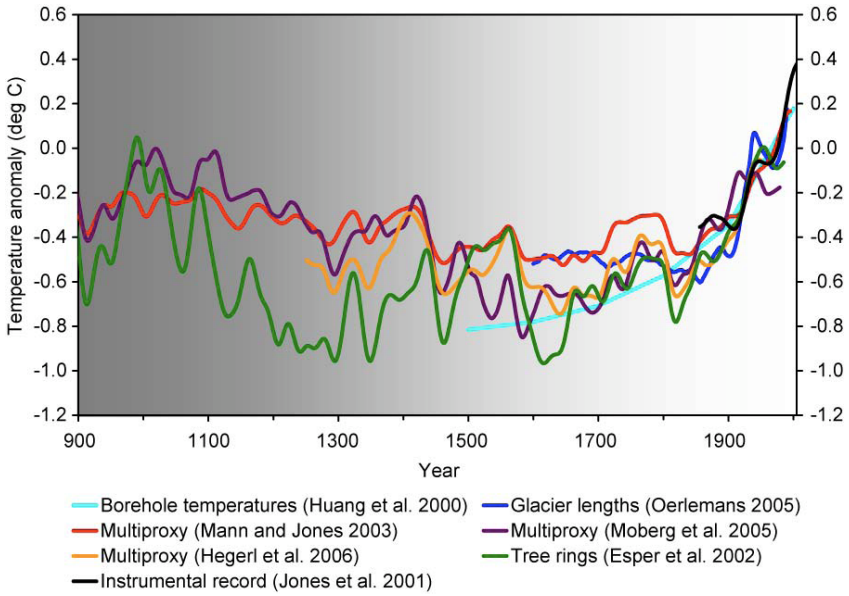
Staufer, B., Blunier, T., Dallenbach, A., Indermuhle, A., Schwander, J., Stocker, T.F., Tschumi, J., Chappellaz, J., Raynaud, D., Hammer, C.U. and Clausen, H.B. 1998. Atmospheric CO_2 concentration and millennial-scale climate change during the last glacial period. *Nature* **392**: 59-62.

Steig, E.J. 1999. Mid-Holocene climate change. *Science* **286**: 1485-1487.

B. Temperatures at the End of the Twentieth Century Were Not "Exceptional."

EPA says with a "high level of confidence" that the last several decades of the 20th century have been warmer "than any comparable period during preceding four centuries." With "[l]ess confidence," EPA states temperatures were warmer "during the past 25 years than during any period of comparable length since A.D. 900." (TSD at 26.) In support, EPA cites the National Research Council report *Surface Temperature Reconstructions For the Last 2,000 Years*.

National Academy Press, Washington, DC. (2006). EPA incorporates the following graph from the NRC Report to illustrate its claim that the warming in the twentieth century was "exceptional."



In fact, there is considerable evidence that temperatures today and at the end of the twentieth century were not exceptional and were well within the range of natural variability. EPA's own graph shows the warming trend began in the eighteenth century, *before* human emissions could have played a role. The warmer "Medieval Warm Period," from about 700 – 1300 A.D., was also obviously due to natural causes.

The graph used by EPA appears to show the highest temperatures of the Medieval Warm Period to be less than temperatures at the end of the twentieth century. If true, this could allow EPA to claim the twentieth century was "exceptional." But this graph is fraudulent, created by "tacking on" twentieth-century data obtained from surface stations to earlier data obtained from ice cores, tree rings, and other proxies. This technique is the same one used to create the "hockey stick" graph of Michael Mann *et al.*, which in fact is one of the seven lines in the graph (Mann, M.E. and Jones, P.D. 2003. Global surface temperatures over the past two millennia. *Geophysical Research Letters* **30** 10.1029/2003GL017814)

The hockeystick appears in the IPCC reports, but it has been severely criticized and largely discredited by other researchers. McIntyre and McKitrick attempted to use Mann *et al.*'s data to replicate their results and found they could not do so "due to collation errors, unjustifiable truncation or extrapolation of source data, obsolete data, geographical location errors, incorrect calculation of principal components and other quality control defects." (McIntyre and McKitrick, 2003, 2005) These criticisms were subsequently confirmed by Wegman *et al.* (2006). Mann *et al.* were forced to publish a correction admitting errors in their data, but claimed these errors did not affect their prior results. This claim, too, was quickly debunked. (NIPCC Report at 68-69.)

McIntyre, S. and McKitrick, R. 2003. Corrections to Mann *et al.* (1998) proxy data base and northern hemisphere average temperature series. *Energy & Environment* **14**: 751-777.

Graybill, D.A. and Idso, S.B. 1993. Detecting the aerial fertilization effect of atmospheric CO2 enrichment in tree ring chronologies. *Global Biogeochemical Cycles* **7**:81–95.

Mann, M.E., Bradley, R.S. and 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. and Hughes, M.K. 1999. Northern Hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations. *Geophysical Research Letters* **26**: 759-762.

Mann, M.E. and Jones, P.D. 2003. Global surface temperatures over the past two millennia. *Geophysical Research Letters* **30**: 10.1029/2003GL017814.

Mann *et al.* 2004. Corrigendum: Global-scale temperature patterns and climate forcing over the past six centuries. *Nature* **430**: 105.

NAS 2006. *Surface Temperature Reconstructions for the Last 2,000 Years*. National Academy Press, Washington, DC.

McIntyre, S. and McKitrick, R. 2005. Hockey sticks, principal components and spurious significance. *Geophysical Research Letters* 32 L03710.

NAS 2006. *Surface Temperature Reconstructions for the Last 2,000 Years*. National Academy Press, Washington, DC.

Soon, W. and Baliunas, S. 2003. Proxy climatic and environmental changes of the past 1000 years. *Climate Research* **23** (2): 89-110.

Wahl, E.R. and Ammann, C.M. 2007. Robustness of the Mann, Bradley, Hughes reconstruction of Northern Hemisphere surface temperatures: Examination of criticisms based on the nature and processing of proxy climate evidence. *Climate Change* **85**: 33-69.

Wegman, E., Scott, D.W. and Said, Y. 2006. Ad Hoc Committee Report to Chairman of the House Committee on Energy & Commerce and to the Chairman of the House sub-committee on Oversight & Investigations on the Hockey-stick Global Climate Reconstructions. US House of Representatives, Washington, DC. Available at http://energycommerce.house.gov/108/home/07142006 Wegman Report.pdf

We know Mann *et al.* are wrong because more than 660 scientists in 385 countries have produced 200 papers establishing that the MWP exists. Some of the papers are listed below. The vast majority of them agree it was warmer then than it is now. (NIPCC Report at 69-71.) The IPCC and now EPA continue to cite and rely on Mann's deceptively flawed data despite evidence that it is false. (NIPCC Report at 63-73.) This error is grounds for rejecting EPA's endangerment finding.

Bao, Y., Brauning, A. and Yafeng, S. 2003. Late Holocene temperature fluctuations on the Tibetan Plateau. *Quaternary Science Reviews* **22**: 2335-2344.

Buntgen, U., Frank, D.C., Nievergelt, D. and Esper, J. 2006. Summer temperature variations in the European Alps, A.D. 755-2004. *Journal of Climate* **19**: 5606-5623.

Chu, G., Liu, J., Sun, Q., Lu, H., Gu, Z., Wang, W. and Liu, T. 2002. The 'Mediaeval Warm Period' drought recorded in Lake Huguangyan, tropical South China. *The Holocene* **12**: 511-516.

De'er, Z. 1994. Evidence for the existence of the medieval warm period in China. *Climatic Change* **26**: 289-297.

Delegue, A.M., Fuhr, M., Schwartz, D., Mariotti, A. and Nasi, R. 2001. Recent origin of large part of the forest cover in the Gabon coastal area based on stable carbon isotope data. *Oecologia* **129**: 106-113.

Demezhko, D.Yu. and Shchapov, V.A. 2001. 80,000 years ground surface temperature history inferred from the temperature-depth log measured in the superdeep hole SG-4 (the Urals, Russia). *Global and Planetary Change* **29**: 167-178.

Elenga, H., Maley, J., Vincens, A. and Farrera, I. 2004. Palaeoenvironments, palaeoclimates and landscape development in Central Equatorial Africa: A review of major terrestrial key sites covering the last 25 kyrs. In: Battarbee, R.W., Gasse, F. and Stickley, C.E. (Eds.) *Past Climate Variability through Europe and Africa*. Springer, pp. 181-196.

Elenga, H., Schwartz, D. and Vincens, A. 1994. Pollen evidence of Late Quaternary vegetation and inferred climate changes in Congo. *Palaeogeography, Palaeoclimatology, Palaeoecology* **109**: 345-356.

Elenga, H., Schwartz, D., Vincens, A., Bertraux, J., de Namur, C., Martin, L., Wirrmann, D. and Servant, M. 1996. Diagramme pollinique holocene du Lac Kitina (Congo): mise en evidence de changements paleobotaniques et paleoclimatiques dans le massif forestier du Mayombe. *Compte-Rendu de l'Academie des Sciences, Paris, serie* **2a**: 345-356.

Esper, J., Cook, E.R. and Schweingruber, F.H. 2002. Low-frequency signals in long tree-ring chronologies for reconstructing past temperature variability. *Science* **295**: 2250-2253.

Esper, J., Frank, D., Buntgen, U., Verstege, A., Luterbacher, J. and Xoplaki, E. 2007. Long-term drought severity variations in Morocco. *Geophysical Research Letters* **34**: 10.1029/2007GL030844.

Giresse, P., Maley, J. and Brenac, P. 1994. Late Quaternary palaeoenvironments in Lake Barombi Mbo (West Cameroon) deduced from pollen and carbon isotopes of organic matter. *Palaeogeography, Palaeoclimatology, Palaeoecology* **107**: 65-78.

Giresse, P., Maley, J. and Kossoni, A. 2005. Sedimentary environmental changes and millennial climatic variability in a tropical shallow lake (Lake Ossa, Cameroon) during the Holocene. *Palaeogeography, Palaeoclimatology, Palaeoecology* **218**: 257-285.

Holmgren, K., Lee-Thorp, J.A., Cooper, G.R.J., Lundblad, K., Partridge, T.C., Scott, L., Sithaldeen, R., Talma, A.S. and Tyson, P.D. 2003. Persistent millennial-scale climatic variability over the past 25,000 years in Southern Africa. *Quaternary Science Reviews* **22**: 2311-2326.

Holmgren, K., Tyson, P.D., Moberg, A. and Svanered, O. 2001. A preliminary 3000-year regional temperature reconstruction for South Africa. *South African Journal of Science* **97**: 49-51.

Hong, Y.T., Jiang, H.B., Liu, T.S., Zhou, L.P., Beer, J., Li, H.D., Leng, X.T., Hong, B. and Qin, X.G. 2000. Response of climate to solar forcing recorded in a 6000-year $\delta^{18}O$ time-series of Chinese peat cellulose. *The Holocene* **10**: 1-7.

Huffman, T.N. 1996. Archaeological evidence for climatic change during the last 2000 years in southern Africa. *Quaternary International* **33**: 55-60.

Kondrashov, D., Feliks, Y. and Ghil, M. 2005. Oscillatory modes of extended Nile River records (A.D. 622-1922). *Geophysical Research Letters* **32**: doi:10.1029/2004 GL022156.

Lamb, H., Darbyshire, I. and Verschuren, D. 2003. Vegetation response to rainfall variation and human impact in central Kenya during the past 1100 years. *The Holocene* **13**: 285-292.

Loehle, C. 2004. Climate change: detection and attribution of trends from long-term geologic data. *Ecological Modelling* **171**: 433-450.

Maley, J. and Brenac, P. 1998. Vegetation dynamics, paleoenvironments and climatic changes in the forests of western Cameroon during the last 28,000 years B.P. *Review of Palaeobotany and Palynology* **99**: 157-187.

Naurzbaev, M.M. and Vaganov, E.A. 2000. Variation of early summer and annual temperature in east Taymir and Putoran (Siberia) over the last two millennia inferred from tree rings. *Journal of Geophysical Research* **105**: 7317-7326.

Ngomanda, A., Jolly, D., Bentaleb, I., Chepstow-Lusty, A., Makaya, M., Maley, J., Fontugne, M., Oslisly, R. and Rabenkogo, N. 2007. Lowland rainforest response to hydrological changes during the last 1500 years in Gabon, Western Equatorial Africa. *Quaternary Research* **67**: 411-425.

Nguetsop, V.F., Servant-Vildary, S. and Servant, M. 2004. Late Holocene climatic changes in west Africa, a high resolution diatom record from equatorial Cameroon. *Quaternary Science Reviews* **23**: 591-609.

Reynaud-Farrera, I., Maley, J. and Wirrmann, D. 1996. Vegetation et climat dans les forets du Sud-Ouest Cameroun depuis 4770 ans B.P.: analyse pollinique des sediments du Lac Ossa. *Compte-Rendu de l'Academie des Sciences, Paris, serie* 2a **322**: 749-755.

Tyson, P.D., Karlén, W., Holmgren, K. and Heiss, G.A. 2000. The Little Ice Age and medieval warming in South Africa. *South African Journal of Science* **96**: 121-126.

Verschuren, D., Laird, K.R. and Cumming, B.F. 2000. Rainfall and drought in equatorial east Africa during the past 1,100 years. *Nature* **403**: 410-414.

Vincens, A., Schwartz, D., Bertaux, J., Elenga, H. and de Namur, C. 1998. Late Holocene climatic changes in Western Equatorial Africa inferred from pollen from Lake Sinnda, Southern Congo. *Quaternary Research* **50**: 34-45.

Vincens, A., Schwartz, D., Elenga, H., Reynaud-Farrera, I., Alexandre, A., Bertauz, J., Mariotti, A., Martin, L., Meunier, J.-D., Nguetsop, F., Servant, M., Servant-Vildary, S. and Wirrmann, D. 1999. Forest response to climate changes in Atlantic Equatorial Africa during the last 4000 years BP and inheritance on the modern landscapes. *Journal of Biogeography* **26**: 879-885.

Wang, S.W. and Gong, D.Y. 2000. The temperature of several typical periods during the Holocene in China. *The Advance in Nature Science* **10**: 325-332.

Wirrmann, D., Bertaux, J. and Kossoni, A. 2001. Late Holocene paleoclimatic changes in Western Central Africa inferred from mineral abundance in dated sediments from Lake Ossa (Southwest Cameroon). *Quaternary Research* **56**: 275-287.

Wu, H.Q. and Dang, A.R. 1998. Fluctuation and characteristics of climate change in temperature of Sui-Tang times in China. *Quaternary Sciences* **1**: 31-38.

Xu, H., Hong, Y., Lin, Q., Hong, B., Jiang, H. and Zhu, Y. 2002. Temperature variations in the past 6000 years inferred from $\delta^{18}O$ of peat cellulose from Hongyuan, China. *Chinese Science Bulletin* **47**: 1578-1584.

Yafeng, S., Tandong, Y. and Bao, Y. 1999. Decadal climatic variations recorded in Guliya ice core and comparison with the historical documentary data from East China during the last 2000 years. *Science in China Series D-Earth Sciences* **42** Supp.: 91-100.

Yang, B., Braeuning, A., Johnson, K.R. and Yafeng, S. 2002. General characteristics of temperature variation in China during the last two millennia. *Geophysical Research Letters* **29**: 10.1029/2001GL014485.

Zhang, D.E. 1994. Evidence for the existence of the Medieval Warm Period in China. *Climatic Change* **26**: 287-297.

Kar, R., Ranhotra, P.S., Bhattacharyya, A. and Sekar B. 2002. Vegetation *vis-à-vis* climate and glacial fluctuations of the Gangotri Glacier since the last 2000 years. *Current Science* **82**: 347-351.

C. The Twentieth Century Surface Station Record is Unreliable.

EPA states that surface temperatures have increased globally over the past 100 years by about 0.74°C. "The rate of warming in the past 50 years is almost double that over the last 100 years," EPA states. (TSD at 23.) EPA says it knows this is so because of surface station temperature records kept during this period of time:

> Surface temperature is calculated by processing data from thousands of world-wide observation sites on land and sea. Parts of the globe have no data, although data coverage has improved with time. The long-term mean temperatures are calculated by interpolating within areas with no measurements using the collected data available. Biases may exist in surface temperatures due to changes in station exposure and instrumentation over land, or changes in measurement techniques by ships and buoys in the ocean. *It is likely that these biases are largely random and therefore cancel out over large regions such as the globe or tropics. Likewise, urban heat island effects are real but local, and have not biased the large-scale trends.* (TSD at 22; citations omitted; emphasis supplied.)

This is demonstrably untrue. Almost all near-surface temperature records taken in the past 100 years are from sensors in high-growth urban areas. Global studies find significant warming effects in urbanized areas. One study noted "surface and lower tropospheric warming trends of all industrial regions are greater than the mean warming trend of the earth's non-industrial regions, and that the difference in warming rate between the two types of land use grows ever larger as the degree of industrialization increases." (McKitrick and Michaels, 2004) Even in small towns, UHI effects dwarf the contributions of greenhouse gases. (NIPCC Report at 95-97.)

Studies in North America find UHI impacts ranging from 0.82°C to 2.2°C over short periods of time. Since IPCC finds a 100-year temperature rise of only 0.74°C to be due to anthropogenic emissions of greenhouse gases, this is highly significant. "These results indicate just how difficult it is to measure a background global temperature increase that is believed to have been less than 1°C over the past century (representing a warming of less than 0.1°C per decade), when the presence of a mere 4,500 people can create a winter heat island that may be two orders of magnitude greater than the signal being sought." (NIPCC Report at 97-102.)

Meteorologist Anthony Watts, in a study published this year, enlisted more than 650 volunteers to inspect NOAA and NASA temperature stations throughout the U.S. They found 89 percent of temperature stations failed to meet NOAA's own siting requirements. Many were located near heat sources such as air conditioner exhaust fans, asphalt parking lots, roads, and buildings. Watts found 68 near sewage treatment plants that emit heat in digesting waste. (NIPCC Report at 102.)

Balling Jr., R.C., Cerveny, R.S. and Idso, C.D. 2002. Does the urban CO_2 dome of Phoenix, Arizona contribute to its heat island? *Geophysical Research Letters* **28**: 4599-4601.

Changnon, S.A. 1999. A rare long record of deep soil temperatures defines temporal temperature changes and an urban heat island. *Climatic Change* **42**: 531-538.

DeGaetano, A.T. and Allen, R.J. 2002. Trends in twentieth-century temperature extremes across the United States. *Journal of Climate* **15**: 3188-3205.

De Laat, A.T.J. and Maurellis, A.N. 2004. Industrial CO_2 emissions as a proxy for anthropogenic influence on lower tropospheric temperature trends. *Geophysical Research Letters* **31**: 10.1029/2003GL019024.

Dow, C.L. and DeWalle, D.R. 2000. Trends in evaporation and Bowen ratio on urbanizing watersheds in eastern United States. *Water Resources Research* **36**: 1835-1843.

Gallo, K.P., Easterling, D.R. and Peterson, T.C. 1996. The influence of land use/land cover on climatological values of the diurnal temperature range. *Journal of Climate* **9**: 2941-2944.

Gallo, K.P., Owen, T.W., Easterling, D.R. and Jameson, P.F. 1999. Temperature trends of the historical climatologic network based on satellite-designated land use/land cover. *Journal of Climate* **12**: 1344-1348.

George, K., Ziska, L.H., Bunce, J.A. and Quebedeaux, B. 2007. Elevated atmospheric CO_2 concentration and temperature across an urban-rural transect. *Atmospheric Environment* **41**: 7654-7665.

Gonzalez, J.E., Luvall, J.C., Rickman, D., Comarazamy, D., Picon, A., Harmsen, E., Parsiani, H., Vasquez, R.E., Ramirez, N., Williams, R. and Waide, R.W. 2005. Urban heat islands developing in coastal tropical cities. *EOS: Transactions, American Geophysical Union* **86**: 397,403.

Hansen, J., Sato, M., Glascoe, J. and Ruedy, R. 1998. A commonsense climatic index: Is climate change noticeable? *Proceedings of the National Academy of Sciences USA* **95**: 4113-4120.

Hayhoe, K., Cayan, D., Field, C.B., Frumhoff, P.C. *et al*. 2004. Emissions, pathways, climate change, and impacts on California. *Proceedings of the National Academy of Sciences USA* **101**: 12,422-12,427.

Hinkel, K.M. and Nelson, F.E. 2007. Anthropogenic heat island at Barrow, Alaska, during winter: 2001-2005. *Journal of Geophysical Research* **112**: 10.1029/2006JD007837.

Hinkel, K.M., Nelson, F.E., Klene, A.E. and Bell, J.H. 2003. The urban heat island in winter at Barrow, Alaska. *International Journal of Climatology* **23**: 1889-1905.

Jáuregui, E. 2005. Possible impact of urbanization on the thermal climate of some large cities in Mexico. *Atmosfera* **18**: 249-252.

Kalnay, E. and Cai, M. 2003. Impact of urbanization and land use change on climate. *Nature* **423**: 528-531.

LaDochy, S., Medina, R. and Patzert, W. 2007. Recent California climate variability: spatial and temporal patterns in temperature trends. *Climate Research* **33**: 159-169.

Leung, L.R., Qian, Y., Bian, X., Washington, W.M., Han, J. and Roads, J.O. 2004. Mid-century ensemble regional climate change scenarios for the western United States. *Climatic Change* **62**: 75-113.

Maul, G.A. and Davis, A.M. 2001. Seawater temperature trends at USA tide gauge sites. *Geophysical Research Letters* **28**: 3935-3937.

McKitrick, R. and Michaels, P.J. 2004. A test of corrections for extraneous signals in gridded surface temperature data. *Climate Research* **26**: 159-173.

Oke, T.R. 1973. City size and the urban heat island. *Atmospheric Environment* **7**: 769-779.

Streutker, D.R. 2003. Satellite-measured growth of the urban heat island of Houston, Texas. *Remote Sensing of Environment* **85**: 282-289.

Van Aardenne, J.A., Dentener, F.J., Olivier, J.G.J., Klein Goldewijk, C.G.M. and Lelieveld, J. 2001. A 1° x 1° resolution dataset of historical anthropogenic trace gas emissions for the period 1890-1990. *Global Biogeochemical Cycles* **15**: 909-928.

Velazquez-Lozada, A., Gonzalez, J.E. and Winter, A. 2006. Urban heat island effect analysis for San Juan, Puerto Rico. *Atmospheric Environment* **40**: 1731-1741.

Watts, A. 2009. *Is the U.S. Temperature Record Reliable?* Chicago, IL: The Heartland Institute.

Ziska, L.H., Bunce, J.A. and Goins, E.W. 2004. Characterization of an urban-rural CO_2/temperature gradient and associated changes in initial plant productivity during secondary succession. *Oecologia* **139**: 454-458.

D. EPA Ignores "Fingerprinting" Data from the CCSP and Others

EPA states that "fingerprinting"—the process of matching computer modeling projections with observed realities—determines the accuracy of the models in predicting the warming impacts of future emissions from anthropogenic forces. This is working, EPA says, and there is "clear evidence of human influences on the climate system. EPA notes, however, that:

> [A]n important inconsistency may have been identified in the tropics. In the tropics, most observational data sets show more warming at the surface than in the troposphere, while almost all model simulations have larger warming aloft than at the surface. A possible explanation for this inconsistency is error in the observations, but the issue is still under investigation. 39-41

This not merely an "inconsistency," but a significant piece of evidence that cannot be reconciled with the greenhouse theory of global warming that EPA assumes to be correct. *It only takes one fact to disprove a theory.* The suggestion that observational data may be in error (which EPA references) appears in the executive summary of the Karl *et al.* CCSP Report but not in the body of that report, meaning the peer-reviewed report does not support the idea that the data, rather than the theory, might be wrong.

All climate models predict that if anthropogenic greenhouse gases are driving climate change, a unique fingerprint must be detected in the tropics through a warming trend that increases with altitude in the troposphere (the vertical area up to about 15 kilometers). Natural forcing will not yield this fingerprint. Comparing models with data observed by balloons establishes no warming, but rather a slight cooling with altitude, as IPCC and CCSP concede.

The failure of the atmosphere in the tropics to show the warming signature that virtually all global warming models predict should occur is a reason to question the validity of both the theory and the models upon which it is built. The authors of the NIPCC Report conclude, "This mismatch of observed and calculated fingerprints clearly falsifies the hypothesis of anthropogenic global warming (AGW). We must conclude therefore that anthropogenic greenhouse gases can contribute only in a minor way to the current warming, which is mainly of natural origin." (NIPCC Report at 107-08.)

Douglass, D.H., Pearson, B. and Singer, S.F. 2004. Altitude dependence of atmospheric temperature trends: Climate models versus observations. *Geophysical Research Letters* **31**.

Douglass, D.H., Christy, J.R. , Pearson, B.D. and Singer, S.F. 2007. A comparison of tropical temperature trends with model predictions. *International Journal of Climatology* (Royal Meteorol Soc). DOI:10.1002/joc.1651.

Karl, T.R., Hassol, S.J. , Miller, C.D. and Murray, W.L. (Eds.) 2006. *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences.* A report by the Climate Change Science Program and Subcommittee on Global Change Research, http://www.climatescience.gov/Library/sap/sap1-1/final report/default.htm.

Michaels, P.J. and Knappenberger, P.C. 1996. Human effect on global climate? *Nature* **384**: 522-523.

NAS 2000. *Reconciling Observations of Global Temperature Change.* National Academy of Sciences. National Academy Press, Washington, DC.

Santer, B.D., *et al.* 1996. Towards the detection and attribution of an anthropogenic effect on climate. *Climate Dynamics* **12**: 79-100.

Singer, S.F. 1999. Human contribution to climate change remains questionable. Also, Reply. *EOS: Transactions, American Geophysical Union* **80**: 33, 186-187 and 372-373.

Singer, S.F. 2000. Climate policy—From Rio to Kyoto a political issue for 2000 and beyond. *Essays in Public Policy* **102**. Hoover Institution, Stanford University, Stanford, CA.

Singer, S.F. 2001. Disparity of temperature trends of atmosphere and surface. Paper presented at 12th Symposium on Global Climate Change, American Meteorological Society, Albuquerque, NM.

E. EPA's Claims Regarding Arctic Temperature Trends are False.

EPA states that "[a]verage Arctic temperatures increased at almost twice the global average rate in the past 100 years." (TSD at 24.) This is contradicted by a vast amount of data demonstrating the Arctic have fluctuated in the past, both warming and cooling, and recently is once again cooling. (NIPCC Report at 115-131.)

1. Greenland

Greenland was colonized around 1000 AD in the Medieval Warm Period by the Norse. They disappeared in the extreme cooling of the Little Ice Age about 400 years later. The climate then warmed from 1925 to 1945 (as EPA concedes (TSD at 24), when carbon dioxide emissions were lower than they currently are. But the climate there is now cooling, when carbon dioxide emissions are higher. (NIPCC Report at 115-18):

Bard, E. 2002. Climate shock: Abrupt changes over millennial time scales. *Physics Today* **55(12)**: 32-38.

Broecker, W.S. 2001. Was the Medieval Warm Period global? *Science* **291**: 1497-1499.

Christiansen, H.H. 1998. 'Little Ice Age' navigation activity in northeast Greenland. *The Holocene* **8**: 719-728.

Chylek, P., Box, J.E. and Lesins, G. 2004. Global warming and the Greenland ice sheet. *Climatic Change* **63**: 201-221.

Comiso, J.C., Wadhams, P., Pedersen, L.T. and Gersten, R.A. 2001. Seasonal and interannual variability of the Odden ice tongue and a study of environmental effects. *Journal of Geophysical Research* **106**: 9093-9116.

Dahl-Jensen, D., Mosegaard, K., Gundestrup, N., Clow, G.D., Johnsen, S.J., Hansen, A.W. and Balling, N. 1998. Past temperatures directly from the Greenland Ice Sheet. *Science* **282**: 268-271.

Dansgaard, W., Johnsen, S.J., Gundestrup, N., Clausen, H.B. and Hammer, C.U. 1975. Climatic changes, Norsemen and modern man. *Nature* **255**: 24-28.

Esper, J., Cook, E.R. and Schweingruber, F.H. 2002. Low-frequency signals in long tree-ring chronologies for reconstructing past temperature variability. *Science* **295**: 2250-2253.

Hanna, E. and Cappelen, J. 2002. Recent climate of Southern Greenland. *Weather* **57**: 320-328.

Hanna, E. and Cappelen, J. 2003. Recent cooling in coastal southern Greenland and relation with the North Atlantic Oscillation. *Geophysical Research Letters* **30**: 10.1029/2002GL015797.

Humlum, O. 1999. Late-Holocene climate in central West Greenland: meteorological data and rock-glacier isotope evidence. *The Holocene* **9**: 581-594.

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X. EPA's Contentions that Observations of Glacier Loss, Sea Ice Loss, Precipitation Increases, and Sea-Level Rise Support Anthropogenic Warming Are Contradicted by Extensive Scientific Research.

EPA states that the direct effects of elevated CO_2 concentrations include "loss of sea ice," "melting glaciers," and "very large" rises in ocean levels in the U.S. from melting ice sheets in Greenland and West Antarctica, and significantly increased precipitation in North America. (TSD at 32, 103, 114.) There is extensive scientific literature contradicting these claims, meaning there is once again no scientific basis for regulating greenhouse gas emissions. (NIPCC Report at 135-206.)

A. Glaciers

Globally, sparse data exists about glaciers. There are 160,000 glaciers known to exist in the world, but only 42 percent have been inventoried to any degree. There is mass balance data (positive for growth, negative for shrinkage) for only 200 of them for a single year. There is mass balance data for only 42 of them for ten years. This causes an "important problem" which means we know little about glaciers. In the Little Ice Age, glaciers generally gained mass, while during warming periods they lost mass. One study found no trend during the period 1946-1995 when CO_2 levels were rising. (NIPCC Report at 136-37.)

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1. Africa

Studies show glaciers in Africa have indeed retreated, but not due to any unusual warming that human activities might have caused during the twentieth century. Modern glacier recession on Kilimanjaro began around 1880, approximately the same time the planet began to recover from the several-hundred-year cold spell of the Little Ice Age. Two recent studies concluded that "the reasons for the rapid decline in Kilimanjaro's glaciers are not primarily due to increased air temperatures, but a lack of precipitation" (Duane *et al*. (2008)) and "warming fails spectacularly to explain the behavior of the glaciers and plateau ice on Africa's Kilimanjaro massif ... and to a lesser extent other tropical glaciers." (Mote and Kaser (2007)) (NIPCC Report at 137-40.)

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2. Antarctica

In West Antarctica, if glaciers continue to melt at the current rate, sea levels will rise by one millimeter per century (about the size of a paper clip), one study suggests. But many other studies suggest glaciers there operate on time scales of hundreds of thousands of years and have had melted in the Medieval Warm Period and gained mass in the Little Ice Age. (NIPCC Report at 140-42.)

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Stenoien, M.D. and Bentley, C.R. 2000. Pine Island Glacier, Antarctica: A study of the catchment using interferometric synthetic aperture radar measurements and radar altimetry. *Journal of Geophysical Research* **105**: 21,761-21,779.

Wardle, P. 1973. Variations of the glaciers of Westland National Park and the Hooker Range, New Zealand. *New Zealand Journal of Botany* **11**: 349-388.

3. The Arctic

Computer models predict the first signs of anthropogenic carbon dioxide-induced global warming will be in the polar regions. If true, studies should show the second half of the twentieth century featured unprecedented warming at the poles of the earth. They do not. Rather, they show cycles of retreat and advance over decadal and millennial time periods. "This thermal behavior is about as different as one could imagine from the claim that the warming of the globe over the last two decades of the twentieth century was unprecedented over the past two millennia. Especially is this so for a high-northern-latitude region, where the IPCC claims CO_2-induced global warming should be earliest and most strongly expressed." (NIPCC Report at 144.)

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4. Europe

In Europe, some glaciers are melting while others are not. So there is definitely no strong correlation between CO_2 emissions and glacier melting. (NIPCC Report at 145-147.)

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5. North America

Studies show no trend in North America, where some glaciers have added mass while others have lost mass. The glacial retreat in Glacier National Park mostly occurred from 1830 to 1942, a period during which CO_2 emissions rose only slightly. (NIPCC Report at 147-49.)

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Briffa, K.R. and Osborn, T.J. 2002. Blowing hot and cold. *Science* **295**: 2227-2228.

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Moore, G.W.K., Holdsworth, G. and Alverson, K. 2002. Climate change in the North Pacific region over the past three centuries. *Nature* **420**: 401-403.

Pederson, G.T., Fagre, D.B., Gray, S.T. and Graumlich, L.J. 2004. Decadal-scale climate drivers for glacial dynamics in Glacier National Park, Montana, USA. *Geophysical Research Letters* **31**: 10.1029/2004GL019770.

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Vincent, C. 2002. Influence of climate change over the 20th century on four French glacier mass balances. *Journal of Geophysical Research* **107**: 4-12.

Vincent, C. and Vallon, M. 1997. Meteorological controls on glacier mass-balance: empirical relations suggested by Sarennes glaciers measurements (France). *Journal of Glaciology* **43**: 131-137.

Wiles, G.C., D'Arrigo, R.D., Villalba, R., Calkin, P.E. and Barclay, D.J. 2004. Century-scale solar variability and Alaskan temperature change over the past millennium. *Geophysical Research Letters* **31**: 10.1029/2004GL020050.

Yoo, J.C. and D'Odorico, P. 2002. Trends and fluctuations in the dates of ice break-up of lakes and rivers in Northern Europe: the effect of the North Atlantic Oscillation. *Journal of Hydrology* **268**: 100-112.

B. Sea Ice

EPA cites IPCC computer models that predict more rapid melting of sea ice in the Arctic and Antarctic. (TSD at 30-32.) EPA concedes, however, these models are crude. EPA claims observations show ice in the Antarctic is increasing slightly and decreasing rapidly in the Arctic. (TSD at 30-32) Data reported in the NIPCC Report, however, supports the former observation but contradicts the latter. The NIPCC Report agrees the models are crude.

1. Antarctic

The following studies confirm that Antarctic sea ice is growing either in extent or thickness, meaning there are no grounds in data from that part of the world for restricting greenhouse gas emissions.

Cavalieri, D.J. and Parkinson, C.L. 2008. Antarctic sea ice variability and trends, 1979-2006. Journal of Geophysical Research **113**: 10.1029/2007JC004564.

Cavalieri, D.J., Parkinson, C.L. and Vinnikov, K.Y. 2003. 30-Year satellite record reveals contrasting Arctic and Antarctic decadal sea ice variability. *Geophysical Research Letters* **30**: 10.1029/2003GL018031.

Comiso, J.C. 2000. Variability and trends in Antarctic surface temperatures from in situ and satellite infrared measurements. *Journal of Climate* **13**: 1674-1696.

Comiso, J.C. and Nishio, F. 2008. Trends in the sea ice cover using enhanced and compatible AMSR-E, SSM/I, and SMMR data. *Journal of Geophysical Research* **113**: 10.1029/2007JC004257.

Elderfield, H. and Rickaby, R.E.M. 2000. Oceanic Cd/P ratio and nutrient utilization in the glacial Southern Ocean. *Nature* **405**: 305-310.

Hanna, E. 2001. Anomalous peak in Antarctic sea-ice area, winter 1998, coincident with ENSO. *Geophysical Research Letters* **28**: 1595-1598.

Laine, V. 2008. Antarctic ice sheet and sea ice regional albedo and temperature change, 1981-2000, from AVHRR Polar Pathfinder data. *Remote Sensing of Environment* **112**: 646-667.

Liu, J., Curry, J.A. and Martinson, D.G. 2004. Interpretation of recent Antarctic sea ice variability. *Geophysical Research Letters* **31**: 10.1029/2003GL018732.

Parkinson, C.L. 2002. Trends in the length of the Southern Ocean sea-ice season, 1979-99. *Annals of Glaciology* **34**: 435-440.

Parkinson, C.L. 2004. Southern Ocean sea ice and its wider linkages: insights revealed from models and observations. *Antarctic Science* **16**: 387-400.

Vyas, N.K., Dash, M.K., Bhandari, S.M., Khare, N., Mitra, A. and Pandey, P.C. 2003. On the secular trends in sea ice extent over the antarctic region based on OCEANSAT-1 MSMR observations. *International Journal of Remote Sensing* **24**: 2277-2287.

Watkins, A.B. and Simmonds, I. 2000. Current trends in Antarctic sea ice: The 1990s impact on a short climatology. *Journal of Climate* 13: 4441-4451.

Yuan, X. and Martinson, D.G. 2000. Antarctic sea ice extent variability and its global connectivity. *Journal of Climate* **13**: 1697-1717.

Zwally, H.J., Comiso, J.C., Parkinson, C.L. Cavalieri, D.J. and Gloersen, P. 2002. Variability of Antarctic sea ice 1979-1998. *Journal of Geophysical Research* **107**: 10.1029/2000JC000733.

2. Arctic

"Arctic climate is incredibly complex" and thorough data are not available. No clear long-term trends are detectable because the extent and thickness of Arctic ice varies by location and simultaneously over differing timescales. Describing data previously cited (NIPCC Report at 154-57), the NIPCC Report states:

> In light of this litany of findings, it is difficult to accept the claim that Northern Hemispheric sea ice is rapidly disintegrating in response to CO_2-induced global warming. Rather, the oscillatory behavior observed in so many of the sea ice studies suggests, in the words of Parkinson (2000b), "the possibility of close connections between the sea ice cover and major oscillatory patterns in the atmosphere and oceans," including connections with: "(1) the North Atlantic Oscillation (e.g., Hurrell and van Loon, 1997; Johannessen *et al*., 1999; Kwok and Rothrock, 1999; Deser *et al*., 2000; Kwok, 2000, Vinje, 2001) and the spatially broader Arctic Oscillation (e.g., Deser *et al*., 2000; Wang and Ikeda, 2000); (2) the Arctic Ocean Oscillation (Polyakov *et al*., 1999; Proshutinsky *et al*., 1999); (3) a 'see-saw' in winter temperatures between Greenland and northern Europe (Rogers and van Loon, 1979); and (4) an interdecadal Arctic climate cycle (Mysak *et al*., 1990; Mysak and Power, 1992)." The likelihood that Arctic sea ice trends are the product of such natural oscillations, Parkinson continues, "provides a strong rationale for considerable caution when extrapolating into the future the

> widely reported decreases in the Arctic ice cover over the past few decades or when attributing the decreases primarily to global warming," a caution with which we heartily agree.

Moreover, it is possible some thinning of Arctic ice took place in the 1990s, but location-specific observational data is contradictory, with some showing thickening. The models came in for criticism (NIPCC Report at 159-61):

> Laxon *et al*. concluded that "errors are present in current simulations of Arctic sea ice," stating in their closing sentence that "until models properly reproduce the observed high-frequency, and thermodynamically driven, variability in sea ice thickness, simulations of both recent, and future, changes in Arctic ice cover will be open to question."

Consequently, it is factually incorrect to allege that greenhouse gases must be limited in order to slow or reduce the amount of Arctic sea ice melting that might be occurring.

The NIPCC Report presents sources separately for sea ice extent and sea ice thickness. The following sources are for the extent of Arctic sea ice:

Bamber, J., Krabill, W., Raper, V. and Dowdeswell, J. 2004. Anomalous recent growth of part of a large Arctic ice cap: Austfonna, Svalbard. *Geophysical Research Letters* **31**: 10.1029/2004GL019667.

Belchansky, G.I., Douglas, D.C., Alpatsky, I.V. and Platonov, N.G. 2004. Spatial and temporal multiyear sea ice distributions in the Arctic: A neural network analysis of SSM/I data, 1988-2001. *Journal of Geophysical Research* **109**: 10.1029/2004JC002388.

Cavalieri, D.J., Parkinson, C.L. and Vinnikov, K.Y. 2003. 30-Year satellite record reveals contrasting Arctic and Antarctic decadal sea ice variability. *Geophysical Research Letters* **30**: 10.1029/2003GL018031.

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Deser, C., Walsh, J. and Timlin, M.S. 2000. Arctic sea ice variability in the context of recent atmospheric circulation trends. *Journal of Climate* **13**: 617-633.

Divine, D.V. and Dick, C. 2006. Historical variability of sea ice edge position in the Nordic Seas. *Journal of Geophysical Research* **111**: 10.1029/2004JC002851.

Grumet, N.S., Wake, C.P., Mayewski, P.A., Zielinski, G.A., Whitlow, S.L., Koerner, R.M., Fisher, D.A. and Woollett, J.M. 2001. Variability of sea-ice extent in Baffin Bay over the last millennium. *Climatic Change* **49**: 129-145.

Heide-Jorgensen, M.P. and Laidre, K.L. 2004. Declining extent of open-water refugia for top predators in Baffin Bay and adjacent waters. *Ambio* **33**: 487-494.

Hurrell, J.W. and van Loon, H. 1997. Decadal variations in climate associated with the North Atlantic Oscillation. *Climatic Change* **36**: 301-326.

Jevrejeva, S. 2001. Severity of winter seasons in the northern Baltic Sea between 1529 and 1990: reconstruction and analysis. *Climate Research* **17**: 55-62.

Johannessen, O.M., Shalina, E.V. and Miles, M.W. 1999. Satellite evidence for an Arctic sea ice cover in transformation. *Science* **286**: 1937-1939.

Krabill, W., Abdalati, W., Frederick, E., Manizade, S., Martin, C., Sonntag, J., Swift, R., Thomas, R., Wright, W. and Yungel, J. 2000. Greenland ice sheet: High-elevation balance and peripheral thinning. *Science* **289**: 428-430.

Kwok, R. 2000. Recent changes in Arctic Ocean sea ice motion associated with the North Atlantic Oscillation. *Geophysical Research Letters* **27**: 775-778.

Kwok, R. 2004. Annual cycles of multiyear sea ice coverage of the Arctic Ocean: 1999-2003. *Journal of Geophysical Research* **109**: 10.1029/2003JC002238.

Kwok, R. and Rothrock, D.A. 1999. Variability of Fram Strait ice flux and North Atlantic Oscillation. *Journal of Geophysical Research* **104**: 5177-5189.

Mysak, L.A., Manak, D.K. and Marsden, R.F. 1990. Sea-ice anomalies observed in the Greenland and Labrador Seas during 1901-1984 and their relation to an interdecadal Arctic climate cycle. *Climate Dynamics* **5**: 111-133.

Mysak, L.A. and Power, S.B. 1992. Sea-ice anomalies in the western Arctic and Greenland-Iceland Sea and their relation to an interdecadal climate cycle. *Climatological Bulletin/Bulletin Climatologique* **26**: 147-176.

Omstedt, A. and Chen, D. 2001. Influence of atmospheric circulation on the maximum ice extent in the Baltic Sea. *Journal of Geophysical Research* **106**: 4493-4500.

Parkinson, C.L. 2000a. Variability of Arctic sea ice: the view from space, and 18-year record. *Arctic* **53**: 341-358.

Parkinson, C.L. 2000b. Recent trend reversals in Arctic sea ice extents: possible connections to the North Atlantic Oscillation. *Polar Geography* **24**: 1-12.

Parkinson, C.L. and Cavalieri, D.J. 2002. A 21-year record of Arctic sea-ice extents and their regional, seasonal and monthly variability and trends. *Annals of Glaciology* **34**: 441-446.

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Proshutinsky, A.Y., Polyakov, I.V. and Johnson, M.A. 1999. Climate states and variability of Arctic ice and water dynamics during 1946-1997. *Polar Research* **18**: 135-142.

Rogers, J.C. and van Loon, H. 1979. The seesaw in winter temperatures between Greenland and Northern Europe. Part II: Some oceanic and atmospheric effects in middle and high latitudes. *Monthly Weather Review* **107**: 509-519.

Serreze, M.C., Maslanik, J.A., Scambos, T.A., Fetterer, F., Stroeve, J., Knowles, K., Fowler, C., Drobot, S., Barry, R.G. and Haran, T.M. 2003. A record minimum arctic sea ice extent and area in 2002. *Geophysical Research Letters* **30**: 10.1029/2002GL016406.

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Venegas, S.A. and Mysak, L.A. 2000. Is there a dominant timescale of natural climate variability in the Arctic? *Journal of Climate* **13**: 3412-3434.

Vinje, T. 2001. Anomalies and trends of sea ice extent and atmospheric circulation in the Nordic Seas during the period 1864-1998. *Journal of Climate* **14**: 255-267.

Vinnikov, K.Y., Robock, A., Stouffer, R.J., Walsh, J.E., Parkinson, C.L., Cavalieri, D.J., Mitchell, J.F.B., Garrett, D. and Zakharov, V.R. 1999. Global warming and Northern Hemisphere sea ice extent. *Science* **286**: 1934-1937.

Wang, J. and Ikeda, M. 2000. Arctic Oscillation and Arctic Sea-Ice Oscillation. *Geophysical Research Letters* **27**: 1287-1290.

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Gagnon, A.S. and Gough, W.A. 2006. East-west asymmetry in long-term trends of landfast ice thickness in the Hudson Bay region, Canada. *Climate Research* **32**: 177-186.

Holloway, G. and Sou, T. 2002. Has Arctic Sea Ice Rapidly Thinned? *Journal of Climate* **15**: 1691-1701.

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Proshutinsky, A.Y. and Johnson, M.A. 1997. Two circulation regimes of the wind driven Arctic Ocean. *Journal of Geophysical Research* **102**: 12,493-12,514.

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C. Sea Level Rise

EPA states "with high confidence" that there is "strong evidence" of gradual global sea level rise in mid-19th and 20th century, after "little change" between 0 AD and 1900 AD. The seas are currently rising at an increased rate, with about 50 percent of the rise due to glacier/ice melting. (TSD at 31-32.) However, once again, peer-reviewed studies contradict EPA's claims. Most experts in the field report a slow and steady increase in sea level since the end of the last Ice Age, with no sign of a human impact on the trend. There is no evidence that regulating human greenhouse gas emissions would have any effect on sea level.

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D. Precipitation

EPA adopts the IPCC forecast of "[s]ignificantly increased precipitation" in eastern North and South America, northern Europe and north and central Asia. The IPCC states there is drying in the Sahel, the Mediterranean, southern Africa and parts of southern Asia that is attributable to global warming. "Precipitation is highly variable spatially and temporally, and data are limited in some regions," EPA concludes. (TSD at 29.)

The truth is that global data shows slight increases in precipitation with some decreases in some areas in more recent years. Precipitation in the twentieth century was not unusual: droughts and floods were more frequent and more severe in the centuries *before* human activity could have played an effect. There is no scientific evidence that restricting human greenhouse gas emissions would produce a more favorable pattern of precipition anywhere in the world. (NIPCC Report at 162-64.)

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Precipitation in the United States shows no discernable impact from greenhouse gas emission increases in the late twentieth century. Precipitation has decreased in the Pacific Northwest, one study found, and there is an ambiguous trend in the Rockies. Other long term studies concluded the United States was "extremely wet" during the Medieval Warm Period. Studies find variability in this country's precipitation history, including several droughts, one in the 1950s. (NIPCC Report at 162-74.)

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II. EPA's Dismissal of Solar Activity as the Primary Driver of Warming/Cooling Cycles Is Unwarranted and Unwise.

EPA pays insufficient attention to the most important issue before it in the proposed endangerment finding: whether manmade emissions of the six greenhouse gases are the cause of or contribute to global warming (if there is any). EPA is content merely to quote the IPCC AR4 that "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations." Why is this "very likely? Because IPCC computer models say so, according to EPA. This is not enough science to support a positive Endangerment Finding. As discussed in this submittal, these models are "notoriously unreliable." (NIPCC Report at 207.) And, as discussed above, it's far from certain the climate is warming.

What if the climate is influenced more by solar variability than by anthropogenic greenhouse gas emissions? EPA dismisses this possibility, saying only this:

> Changes in solar irradiance since 1750 are estimated to cause a radiative forcing of +0.12 (+0.06 to +0.30) W/m^2. This is less than half of the estimate given in IPCC's Third Assessment Report (2001), with a low level of scientific understanding (Solomon et al., 2007). Uncertainties remain large because of the lack of direct observations and incomplete understanding of solar variability mechanisms over long time scales. Empirical associations have been reported between solar-modulated cosmic ray ionization of the atmosphere and global average low-level clouds cover but evidence for a systematic indirect solar effect remains ambiguous. The lack of a proven physical mechanism and the plausibility of other causal factors make the association between galactic cosmic ray-induced changes in aerosol and cloud formation controversial (Solomon et al., 2007).

(TSD at 22.)

The NIPCC Report cites scores of recent studies that EPA and the IPCC have ignored. These studies "suggest the IPCC has got it backwards, that it is the sun's influence that is responsible for most climate change during the past century and beyond." (NIPCC Report at 207.)

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XII. Conclusion

For the foregoing reasons, the Administrator's proposed positive Endangerment Finding is legally insufficient because it is unsupported by sound, accurate, relevant, and recent peer-reviewed scientific data. It would be unreasonable, arbitrary and capricious, and entirely unlawful for her to issue it. The proposed Endangerment Finding should be withdrawn.

Respectfully submitted,

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