

## **An Open Letter from Scientists in the United States on the Intergovernmental Panel on Climate Change and Errors Contained in the Fourth Assessment Report: *Climate Change 2007***

Many in the popular press and other media, as well as some in the halls of Congress, are seizing on a few errors that have been found in the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) in an attempt to discredit the entire report. None of the handful of mis-statements (out of hundreds and hundreds of unchallenged statements) remotely undermines the conclusion that “warming of the climate system is unequivocal” and that most of the observed increase in global average temperatures since the mid-twentieth century is very likely due to observed increase in anthropogenic greenhouse gas concentrations. Despite its excellent performance for accurately reporting the state-of-the-science, we certainly acknowledge that the IPCC should become more forthcoming in openly acknowledging errors in a timely fashion, and continuing to improve its assessment procedures to further lower the already very low rate of error.

It is our intention in offering this open letter to bring the focus back to credible science, rather than invented hyperbole, so that it can bear on the policy debate in the United States and throughout the world. We first discuss some of the key messages from climate science and then elaborate on IPCC procedures, with particular attention to the quality-control mechanisms of the IPCC. Finally we offer some suggestions about what might be done next to improve IPCC practices and restore full trust in climate science.

### **The Climate Challenge**

Our understanding of human contributions to climate change and the associated urgency for humans to respond has improved dramatically over the past two decades. Many of the major components of the climate system are now well understood, though there are still sources of significant uncertainty (like the processes that produce the observed rapid ice-sheet melting and/or collapse in the polar regions). It is now well established, for example, that atmospheric concentrations of greenhouse gases from human sources have increased rapidly since the Industrial Revolution. Increasing concentrations of greenhouse gases in the atmosphere reduce the heat going out of the climate system, i.e., the radiation balance of the Earth – and so first principles of physics tell us to expect, with a very high likelihood, that higher temperatures should have been observed.

Indeed, measurements of global average temperatures show an increase of about 0.6 degrees C over the twentieth century and about 0.8 degrees C warming since mid-19th century. The pattern of increase has not been smooth or monotonic. There have been several 10- to 15-year periods of stable or declining temperatures over the past 150 years, but 14 of the warmest 15 years on record have been experienced between 1995 and 2009. Since 1970, observational evidence from all continents and most oceans shows that many natural systems are already being affected by these temperature increases.

Because the long-term warming trends are highly significant relative to our estimates of the magnitude of natural variability, the current decadal period of stable global mean temperature does nothing to alter a fundamental conclusion from the AR4: warming has unequivocally been observed and documented. Moreover, well-understood lags in the responsiveness of the climate system to disturbances

like greenhouse gas increases mean that the current temperature plateau will very likely not persist much longer. Global climate model projections show that present-day greenhouse gas concentrations have already committed the planet to about 0.5 degree C in warming over this century.

Increasing emissions of carbon dioxide from the consumption of coal, oil and natural gas as well as deforestation have been the major drivers of this observed warming. While we cannot predict the details of our climate future with a high degree of certainty, the majority of studies from a large number of research groups in the US and elsewhere project that unabated emissions could produce between 1 and 6 degrees C more warming through the year 2100.

Other research has identified multiple reasons to be concerned about climate change; these apply to the United States as well as globally. They include (1) risks to unique and threatened systems (including human communities), (2) risks from extreme events (like coastal storms, floods, droughts, heat waves, and wildfires), (3) economic damages (driven by, for example, pest infestations or inequities in the capacity to adapt), (4) risks from large-scale abrupt climate change (e.g., ice-sheet collapse, ocean circulation slowing, sharply increased methane emissions from permafrost) or abrupt impacts of more predictable climate change (generated by thresholds in the coping capacities of natural and human systems to climate variability), and (5) risks to national security (driven largely by extreme events across the world interacting with already-stressed situations).

These sources of risk and the potential for triggering temperature-driven impacts at lower thresholds, as well as the explicit recognition in the AR4 that risk is the product of likelihood and consequence, led the nations of the world to take note of the Copenhagen Accord last December. The Accord highlights 2 degrees C in warming as a target that might reduce the chance of “dangerous anthropogenic interference with the climate system” to more manageable levels. Research has shown that increasing the likelihood of achieving this goal over the next century is economically and technically feasible with emission reduction measures and changes in consumption patterns; but it will not be easy without major national and international actions to deviate substantially from the status quo.

### **The IPCC and the Fourth Assessment Report**

The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the IPCC in 1988 to provide policy makers regularly with balanced assessments of the state of knowledge on climate change. In so doing, they created an open intergovernmental organization in which scientists, policy analysts, engineers, and resource managers from all over the world were asked to collaborate. At present, more than 150 countries including the United States participate in the IPCC. IPCC publishes an assessment report approximately every six years. The most recent Fourth Assessment, approved by member countries and released in 2007, contained three volumes: *The Physical Science Basis* (Working Group I); *Impacts, Adaptation and Vulnerability* (Working Group II) and *Mitigation of Climate Change* (Working Group III) and a Synthesis Report. More than 44 writing teams and 450 lead authors contributed to the Fourth Assessment – authors who have been selected on the basis of their expertise in consultation with all member countries and who were assisted by another 800 scientists and analysts who served as contributing authors on specific topics. Authors donated their time gratis, and the entire process was supported by four Technical Support Units (TSUs) that employ 5 to 10 people each.

## **Errors in the Fourth Assessment Report**

It was hard not to notice the extraordinary commotion that erupted around errors that were eventually found in the AR4. The wrong year for the projected disappearance of the Himalayan glaciers and the wrong percentage of ‘land below sea level’ in the Netherlands are examples of errors that need to be acknowledged frankly and rectified promptly. In a few other cases, like the discussion of the correlations between crop yields, climate change, and climate variability in North Africa, caveats that were carefully crafted within the chapters were not included when language was shortened for the Synthesis Report. While striving to simplify technical details and summarize major points, some important qualifications were left behind. These errors of omission in the summary process should also be recognized and corrected. Other claims, like the one reported at the end of February suggesting that the AR4 did not mention the millions of more people who will see increases in water availability that were reported in the cited literature along with the millions of more people who will be at risk of water shortage, are simply not true. In any case, it is essential to emphasize that none of these interventions alter the key finding from the AR4 that human beings are very likely changing the climate, with far-reaching impacts in the long run.

The heated debates that have emerged around these instances have even led some to question the quality and integrity of the IPCC. Recent events have made it clear that the quality control procedures of the IPCC are not watertight, but claims of widespread and deliberate manipulation of scientific data and fundamental conclusions in the AR4 are not supported by the facts. We also strongly contest the impression that the main conclusions of the report are based on dubious sources. The reference list of the AR4 contains about 18,000 citations, the vast majority of which were published in peer-reviewed scientific journals. The IPCC also has transparent procedures for using published but not peer-reviewed sources in their reports. These procedures were not properly followed in the isolated Himalaya case, but that statement was never elevated into the Summary for Policymakers of either Working Group II or the Synthesis Report – documents that were approved unanimously and word for word by all member nations.

Nonetheless, failsafe compliance with these procedures requires extra attention in the writing of the next round of assessments. We propose implementing a topic-based cross-chapter review process by which experts in an impact area of climate change, such as changes in water resources, scrutinize the assessment of related vulnerability, risk analyses, and adaptation strategies that work downstream from such changes. Here we mean, to continue the example, assessments of possible increases in flooding damage in river basins and the potential for wetlands to provide buffers in the sectoral and regional chapters. This would be most productively implemented just before the first-order draft, so that chapter authors can be alerted to potential problems before the major review step.

## **Quality Control within the IPCC and US Review**

The impression that the IPCC does not have a proper quality-control procedure is deeply mistaken. The procedure for compiling reports and assuring its quality control is governed by well-documented principles that are reviewed regularly and amended as appropriate. Even now, every step in the preparation of every chapter can be traced on a website: *First Order Drafts* (with comments by many scientists as well as author responses to those comments), *Second Order Drafts* in which those comments are incorporated (and comments by experts and country representatives on revised versions as well as another round of author responses), and so on, up through the final, plenary-approved versions.

To be clear, 2,500 reviewers together provided about 90,000 comments on the 44 chapters for the AR4. Each comment is documented on a website that also describes how and why the comment was or was not incorporated in the next revision. Review editors for each chapter worked with the authors to guarantee that each comment was treated properly and honestly in the revision; in fact, no chapter can ever move forward for publication without the approval of its set of two or three review editors.

The US Government opened its reviews of the draft IPCC report to any US expert who wanted to review it. In order to protect against having this preliminary pre-reviewed draft leaked before its ultimate approval by the IPCC Plenary, the US Government asked all potential reviewers to agree not to disclose the contents of the draft. For each report, the US Government assembled its own independent panel of government experts to vet the comments before submission to the IPCC. Anything with scientific merit was forwarded. There were multiple rounds for each of the Working Group reports and the Synthesis Report, and opportunities for US experts to review the drafts were posted as Federal Register notices.

IPCC principles also govern how authors treat published but non-peer reviewed sources. These procedures acknowledge that peer-reviewed scientific journals contain little information about on-the-ground implementation of adaptation or mitigation – matters such as the emission reduction potential in a given industrial sector or country, for example, or catalogues of the specific vulnerabilities and adaptation strategies of sectors and regions with regard to climate change. This information is frequently only available in reports from research institutes, reports of workshops and conferences, or in publications from industries or other non-governmental organizations. This is the so-called *gray* literature. The IPCC procedure prescribes that authors are obliged to assess critically any *gray* source that they wish to include. The quality and validity of a finding from a non-peer reviewed source needs to be verified before its finding may be included in a chapter text. Each source needs to be completely traceable; and in cases where gray sources are used, a copy must be deposited at the IPCC Secretariat to guarantee that it is available upon request for third parties.

We conclude that the IPCC procedures are transparent and thorough, even though they are not infallible. Nonetheless, we are confident that no single scholar or small group of scholars can manipulate the process to include or to exclude a specific line of research; authors of that research can (and are fully encouraged to) participate in the review process. Moreover, the work of every scientist, regardless of whether it supports or rejects the premise of human-induced climate change, is subject to inclusion in the reports. The work is included or rejected for consideration based on its scientific merit.

It is important to note that we are not addressing here the criteria and procedures by which the IPCC selects chairs and authors. These are handled exclusively by the IPCC and its members according to terms of reference that were initially defined in the authorizing language of 1988. That is to say, governments or their appointees frame and implement these policies; and they create, approve and staff Technical Support Units for each working group. We do not make suggestions on these topics since they lie beyond our purview.

### **What comes next?**

We expect that the robust findings of the AR4 will continue to be supported by new information gleaned from literature published since 2006 – i.e., that the climate change issue is serious and real. Given these findings, we believe that the climate change issue deserves the urgent and non-partisan consideration of the country's legislative and administrative leaders. We feel strongly that exaggerated focus on a few errors from 2007 cannot be allowed to detract from open and honest deliberations about how to respond to climate risk by reducing emissions and promoting adaptation at home and abroad.

As the process of producing the IPCC Fifth Assessment Report (AR5) begins, the IPCC should become more responsive in acknowledging errors rapidly and openly as they become known. To this end, we urge the IPCC to put an erratum on its website that rectifies all errors that have been discovered in the text after publication. In doing so, a clear distinction needs to be made between errors and progressing knowledge. IPCC assessments are detailed snapshots of the state of scientific knowledge at a given time, while knowledge evolves continuously through ongoing research and experience; it is the errors in the assessments that need immediate attention. In contrast, progressing knowledge is published in new scientific journal articles and reports; this information should be used as a basis for the AR5, but it cannot be listed as errata for the AR4 because it was not available when that assessment was conducted. The website should, as well, respond rapidly and openly when reports of errors in past assessments are themselves in error. We cannot let misperceptions fester anymore than errors go uncorrected.

Climate research and the IPCC reports on the state of knowledge provide a scientific foundation for climate policy making, whose agenda is defined by the governments of the IPCC and not the lead authors per se. The quality of and the balance in the knowledge delivered by any assessment is certainly essential, as is clear and explicit communication of associated uncertainties. Given the recent political and media commotion surrounding a few clear errors, it is now equally essential that we find ways to restore full trust in the integrity of the overwhelming majority of the climate change research and policy communities. To that end, we are pleased that an independent critical evaluation of IPCC procedures will be conducted; we hope that the process will solicit participation by the National Academies of the member nations.

The significance of IPCC errors has been greatly exaggerated by many sensationalist accounts, but that is no reason to avoid implementing procedures to make the assessment process even better. The public has a right to know the risks of climate change as scientists currently understand them. We are dedicated to working with our colleagues and government in furthering that task.

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