

Humanity Has A Significant Effect on Climate – The AGU Community Has The Responsibility To Accurately Communicate The Current Understanding Of What is Certain And What Remains Uncertain [May 10 2013]

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I served on the AGU Panel to draft the updated Position Statement on “Human Impacts on Climate”. We were charged by the AGU to provide

“.....an up-to-date statement [that] will assure that AGU members, the public, and policy makers have a more current point of reference for discussion of climate change science that is intrinsically relevant to national and international policy.”

In my view, this means we were tasked to report on the most important aspects of climate change. This was incompletely done in the Statement, where they inaccurately, in my view, discuss a view of climate change that is dominated by the emission of CO₂ and a few other greenhouse gases. Indeed, the Committee, under the direction of Jerry North, with the report writing subgroup led by Susan Hassol, was clearly motivated to produce a Statement of this one particular view. Under his leadership, other views were never given an adequate opportunity to be discussed.

The Committee, instead of presenting the actual state of scientific understanding on the issue of climate change, used the following approach, as summarized in my son’s book “The Honest Broker”

Scientific activity is diverse enough to provide information that can be used to support different perspectives on any topic ... [to] decide the course of action and then find information to back it up is a common practice across the political spectrum. ”

The Committee leadership already had a course of action in mind even when we were appointed.

I presented to the Committee what I have concluded is a more scientifically robust Statement. I started from their Statement, and accepted what I could, as well as sought to remain close to their length.

I sought to answer the following questions, which the Statement accepted by the Committee incompletely does and/or does not address at all.

1. What is the definition of climate and climate change?
2. What are the societally and environmentally important climate metrics (e.g. a global average surface temperature trend; changes in ocean and atmospheric circulation patterns over multi-year time periods; sea level rise, trends in extreme weather etc)?
3. What are the main human and natural climate forcings?

4. What is the observational evidence for climate change?
5. What is the skill of the global and regional climate model projections (predictions) of changes in these metrics on multi-decadal time scales?
6. What are recommended pathways forward to reduce the risk from climate, including changes in climate over time?

My proposed text of a more balanced Statement on “Human Impacts on Climate” is

Humanity Has A Significant Effect on Climate – The Scientific Community Has The Responsibility To Communicate The Current Understanding Of What is Certain And What Remains Uncertain

Climate is defined here as the statistical description of all the elements in the climate system (including the atmosphere, ocean, land surface and cryosphere), including both the mean state and any variations over time. Climate change is defined as a shift in the statistical description of climate. Climate change includes radiative, biophysical, biogeochemical and biogeographic effects. “Human-caused climate change” is a change resulting from one or more of the human climate forcings.

The natural Earth’s climate system, even in the absence of humans, is nonlinear in which forcings and response are not necessarily proportional; thus change is often episodic and abrupt, rather than slow and gradual. Climate has always changed over time. As Earth’s population has grown, however, human climate forcings have become significant on the local, regional and global scales. These human forcings include greenhouse gas emissions (e.g. CO₂, methane, CFCs), aerosol emissions and deposition [e.g., black carbon (soot), sulfates, and reactive nitrogen], and changes in land use and land cover. A number of these forcings are spatially heterogeneous and include the effect of aerosols on clouds and associated precipitation. Most, if not all, of these human radiative, biophysical, biogeochemical and biogeographic influences on regional and global climate will continue to be of concern during the coming decades. Natural climate forcings and feedbacks will also continue to be major effects on this time period.

With respect to human climate forcings, among their effects is their role in altering atmospheric and ocean circulation features away from what they would be in the natural climate system. While the greenhouse and aerosol emissions, in particular, have resulted in changes to the global average radiative forcings, the use of a global averaged radiative forcing or a global average surface temperature are grossly inadequate metrics to diagnose such effects as circulation changes on multi-decadal time scales. It is these regional scale atmospheric and ocean circulations that have the dominant effect on societally and environmentally important weather events such as droughts, floods, tropical cyclones, etc and any possible alteration by human climate forcings is a major concern.

It is also important to recognize that changes in the global radiative forcings (global warming or cooling) represent only a subset of climate change. The ocean is the component of the climate system that is best suited for quantifying climate system heat change. There are major unresolved issues concerning the ability of a global average surface temperature trend to accurately measure climate system heat changes. “Global Warming” can be much more accurately monitored in terms of an increase in the global annual average heat content measured in Joules.

Scientific confidence of the occurrence of climate change include, for example, that over at least the last 50 years there have been increases in the atmospheric concentration of CO₂; increased nitrogen and soot (black carbon) deposition; changes in the surface heat and moisture fluxes over land; increases in lower tropospheric and upper ocean temperatures and ocean heat content; the elevation of sea level; and a large decrease in summer Arctic sea ice coverage and a modest increase in Antarctic sea ice coverage. Over the last ten years, lower tropospheric and upper ocean temperatures increases, however, have been less than in the preceding years, for reasons that are actively being debated.

These climate changes are a result of human and natural climate forcings and feedbacks - the relative role of each in altering atmospheric and ocean circulation features, and even the global annual average radiative forcing, however, is still uncertain. We do know that added carbon dioxide is the largest human-caused, and black carbon the second largest positive annual, global-averaged radiative forcing, while sulfates are among the largest human-caused negative annual, global-averaged radiative forcing. The importance of decadal and longer variations in natural annual, global-averaged radiative forcing (e.g. due to solar, and from internal natural climate feedbacks, such as from cloudiness), however, remains uncertain.

Climate models, unfortunately, are still unable to provide skillful predictions of *changes* in regional climate statistics on multi-decadal time scales at the detail desired by the impacts communities. Even on the global scale, the annual, global-averaged radiative forcing predicted by the models is significantly greater than has been observed based on the accumulation of Joules in the climate system. The summer arctic sea ice extent, in contrast, has been significantly under predicted by the models, while the summer Antarctic sea ice extent increase has been missed by the models. Also attribution of specific extreme weather events to multi-decadal changes in climate has not yet been shown, and is likely not even possible.

We recommend a way forward that promotes effective policy decisions even with these uncertainties. The Statement on Climate Change that was adopted by the majority on the Committee, unfortunately, does not provide an accurate summary of our understanding of climate change issues, and, thus, is not an effective policy framework to reduce risks from the climate system.

The effective use of mitigation and adaption to reduce the risk to water resources, food, energy, human health and well-being, and ecosystem function from climate (including changes in the climate system) requires a multi-disciplinary, multi-faceted approach. Attempts to significantly influence climate impacts based on just controlling CO₂ and a few other greenhouse gases emissions is an inadequate and incomplete policy for this purpose. The goal should be to seek politically and technologically practical ways (with minimal cost and maximum benefit) to

reduce the vulnerability of the environment and society to the entire spectrum of human-caused and natural risks including those from climate, but also from all other environmental and social threats.