



Last December, a very large majority of the scientific community and most politicians would have agreed that the scientific evidence of human-induced climate change was unequivocal and that the only question was whether the world's political leaders could agree in Copenhagen to meaningful legally binding greenhouse gas emission reduction targets.

But, as we now know, the negotiations only produced an aspirational target—to limit the global mean surface temperature to no more than 2 degrees C above pre-industrial levels—and an accord that does not bind any country to reduce their emissions.

Since then, the IPCC's Fourth Assessment report has been criticized for errors or imprecise wording.

- For example, the statements that the Himalayan glaciers would melt by 2035 or earlier (IPCC admitted that this was an error and not evidence-based);
- that agricultural production in some North African countries would decrease by up to 50% by 2020 (the synthesis report did not contain the nuances and more detailed discussion in the underlying chapter);
- and that over half of the Netherlands was below sea level rather than a quarter (this was largely a definitional issue – the Netherlands Dutch Ministry of transport uses the figure 60% - below high water level during storms).

These inaccuracies, coupled with the controversy surrounding illegally hacked e-mails and

temperature data from the University of East Anglia (UEA), have provided climate skeptics and some media with ammunition to undermine public confidence in the conclusions of the IPCC and climate science in general.

It is easy to see that the language in the leaked e-mails could suggest that the scientists may have inappropriately manipulated the data to support the theory of human-induced climate change and attempted to suppress other data that contradicts this theory, which is why I applaud the University of East Anglia (UEA) for rapidly establishing an independent review.

But to suggest that the hacked e-mails or the identified inaccuracies in the IPCC Working Group II report undermine the broad evidence that the Earth's climate is changing due to human activities, or that any talk of carbon emissions cuts should be suspended, is simply untenable.

Recently, the UK Royal Society, the National Environment Research Council and the UK Meteorological Office issued a joint statement not only supporting the findings of the 2007 IPCC report, but showing that recent scientific information further strengthens them. They concluded that the body of scientific evidence that underpins the call for immediate action could not be emphasized enough (<http://www.nerc.ac.uk/press/releases/2009/29-climate.asp>). The Joint sciences academies' statement (by eleven academies from developed and developing countries), also concluded that climate change is real, that we need to prepare for the consequences, and that all nations should take prompt action to reduce their greenhouse gas emissions (<http://royalsociety.org/Joint-science-academies-statement-Climate-change-adaptation-and-the-transition-to-a-low-carbon-society/>).

So let me return to the issue of the IPCC, which is one of the most rigorous scientific review bodies in existence. Many thousands of scientists have dedicated their time to preparing and reviewing the most comprehensive and authoritative assessments of climate science available. In addition, governments from around the world have also reviewed the IPCC findings and by consensus approved the key findings in the Summaries for Policymakers and Synthesis Reports. The reports undergo two rounds of peer-review, and the policymakers summaries of the Working Groups are then subjected to a word by word approval of all governments in the presence of the chapter lead authors.

In many cases the IPCC is very conservative in its statements, e.g., the projections of sea level rise reported in WG I were based on contributions from thermal expansion of the oceans and the melting of mountain glaciers, but did not contain a contribution from the melting of the Greenland ice sheet due to an inadequate understanding of the current rate of melting. Some would say: Only four mistakes or cases of imprecise wording have been found in the thousand page WG II report, and none in WGs I and III, so is there really a problem?

I see no evidence that the authors purposely overstated the potential impacts from climate change in an effort to convince the public of the seriousness of the threat – the threat is serious enough without –hyping it—and the expert and government peer-review process should have caught these inaccuracies and imprecise wordings. The vast amount of attention in the print and TV media, at least in the UK, has probably left some of the public confused if not sceptical – the challenge now is to regain any lost trust through a continuing re-examination and restatement of the evidence, clearly identifying what we know and what is still uncertain. It is critical that the public understand the issue of climate change given the need to both mitigate and adapt in a cost-effective and socially responsible manner.

So does the IPCC process need to be significantly revised? I would argue that it does not. The IPCC is more than capable of conducting rigorous and reliable assessments in an open, transparent and inclusive manner, but it also needs to take steps to regain its full and deserved credibility. The Principles and Procedures for the selection of authors and review editors, and the peer-review process and approval of reports are all sound. What is needed is to tighten up the implementation of these procedures.

- The selected authors need to represent the full range of credible views, including those of the sceptics.
- The IPCC should consider shorter reports focussed on the key issues rather than the all-encompassing reports that have become the norm.
- Authors, peer-reviewers and the Working Group secretariats need to be absolutely rigorous in ensuring that all conclusions are backed up by evidence, with an accurate assessment of how good the evidence is, and that all of the citations are valid.
- Grey literature, i.e., that which has not been peer-reviewed—can and should be used, as long as it is evidence-based and available to peer-reviewers for evaluation.

The co-sponsors of the IPCC, i.e., the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), in response to a request by Environment Ministers at the UNEP Governing Council meeting in Bali, announced that they would initiate an

independent review of IPCC management and procedures by an eminent panel of scientists.

One criticism often aimed at the IPCC is that it is not flexible and unable to conduct rapid response assessments of new evidence due to the requirements of two rounds of peer-review involving experts and governments. One solution to this weakness is to complement, not replace, the IPCC by developing a “peer-reviewed” wiki that can continually update the evidence base and synthesize the findings, noting where the new evidence strengthens, modifies or undermines previous conclusions.

In my opinion, there is no doubt that the evidence for human-induced climate change is irrefutable. The world's leading scientists, many of whom have participated in the IPCC, overwhelmingly agree on two things:

- 1. What we're experiencing cannot be attributed to natural variation in the climate over time, but is due to human activities.
- 2. If we do not act, climate change will continue apace with increasing droughts, floods and rising seas, leading to major damaging impacts to the natural world (loss of species and critical ecosystem services) and society (displaced human populations).

There is no doubt that the atmospheric concentration of greenhouse gases has increased significantly over the past 150 years primarily due to human activities. These gases are radiatively active and absorb and trap outgoing infra-red radiation from the Earth's surface. Based on simple physics, the Earth's atmosphere must respond by warming – the only issue is by how much and when.

The IPCC concluded that the global temperature data and analyses are robust, with increasing variable and extreme temperatures, coupled with increasing severe weather events, heat-waves, floods and droughts. While a number of scientists argue that some of the land temperature data is contaminated and unreliable because of the urban heat island effect and movement of observational sites (the scientists who have reported these trends in the peer-review literature and IPCC argue that these effects are taken into account), ocean data, and balloon and satellite data also show an increasingly warmer world (these data sets are clearly free from any potential contamination from an urban heat island effect).

In addition, the evidence for a changing climate over the past 100 years also comes from

observed changes in retreating mountain glaciers throughout most of the world, a decline in the extent and thickness of arctic sea ice, melting of the Greenland ice sheet, changes in precipitation patterns, and changes in vegetation and the behaviour of wildlife. However, the challenges of the sceptics must be fully addressed.

The key question is the cause of the observed changes in temperature. The IPCC concluded that it is very likely (>90% certain) that most of the observed changes over the past 50-60 years are due to human activities, and that the observed changes cannot be explained by known natural phenomena.

Future increases in greenhouse gas concentrations are projected to be accompanied by increased climate variability and more extreme climatic events, leading in general to adverse impacts on agriculture, water quantity and quality, coastal erosion, loss of biodiversity and degradation of ecosystem services. Developing countries will be the most vulnerable and poor people within them. Therefore, it is clear that climate change is not only an environmental issue, but a development and security issue.

All major emitters of carbon dioxide and other greenhouse gases need to rapidly and cost-effectively transition to a low-carbon economy in both the production and use of energy and the management of forests and agricultural lands. In order to ensure food, water, and human security, and protect the world's biodiversity, between now and the end of the century, the goal should be to limit the global average temperature rise to 2 degrees C above pre-industrial levels. This will require global emissions of all greenhouse gases to peak by around 2015 and reduce by at least 50% by 2050 (relative to 1990). Without concerted action now, the world will be faced with temperature increases far in excess of 2 degrees C, with unthinkable impacts.

An equitable and substantive post-Kyoto agreement is essential if the aspirational target of 2 degrees C is to be realized. Industrialized countries must demonstrate leadership, and provide developing countries with technical and financial assistance to reduce their greenhouse gas emissions, while they address the critical issues of poverty and hunger.

Given the limited success at Copenhagen, 2010 is a critical year for the world's political leaders to unite in the fight against climate change. Strong and visionary political leadership will be essential. We must not allow the sceptics to use the incident at UEA or the mistakes in the IPCC report to distract us or derail the political will to safeguard the planet.

Robert Watson

<http://blogs.worldbank.org/climatechange/scientific-evidence-human-induced-climate-change-unequivocal>