

## **Creating the latest IPCC report on global warming**

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The Intergovernmental Panel on Climate Change (IPCC) has spoken. “Warming of the climate system is unequivocal” and it is “very likely” due to human activities. The Summary for Policy Makers (SPM) of the Fourth Assessment Report (AR4) from Working Group I, which deals with the science of climate change and the role of humans in affecting climate, was approved by the 300 or so representatives from 113 nations in small hours of the morning on 2 February 2007 at the UNESCO building in Paris. This followed from four days of intense negotiations over wording.

The SPM runs about 17 pages including 6 figures and 3 Tables, and is available at <http://ipcc-wg1.ucar.edu/>. The full report drafted by 154 lead authors and over 450 contributing authors of *Climate Change 2007: The Physical Science Basis* of about 900 pages was also “accepted” and will be available in May after copy editing and cleanup of all the figures.

As one of about 30 Lead Author experts attending the meeting, I found the experience both exhilarating but grueling. The invited experts assembled on Saturday and Sunday before the intergovernmental meeting to go over the written comments by governments on the draft SPM. We prepared possible responses and text to update the report. The SPM approval process is very demanding as it requires unanimous consensus on the text, and is approved line by line. The rationale is that the scientists determine what can be said, but the governments help determine how it can best be said. Negotiations occur over wording to ensure accuracy, balance, clarity of message, and relevance to understanding and policy.

The meeting began in a relaxed fashion but unnecessary word-smithing and some long-winded speeches quickly meant we were running way behind the requisite pace to get through the report. Coffee breaks disappeared, and after two days we had completed only one quarter of the report. By Wednesday, lunch breaks were reduced to a minimum as sandwiches were brought in, and the dinner break disappeared as breakout groups met to negotiate text. Wednesday evening we continued until 9 p.m. when the 6-language translation was lost as the translators quit for the day. Fortunately, the delegates allowed the meeting to continue in English. The session adjourned for the day at 12:20 a.m. On Thursday, the final day, the pace picked up under more rigid control of the Chairperson, Dr. Susan Solomon of NOAA in Boulder, with word-smithing largely vanquished, but some contentious issues slowed progress. We took a very short break for sandwiches at lunch, and finally approved the text and figures in the report at 10:40 p.m. at night. The report was quickly assembled, copied and handed out, for final approval at 12:40 a.m. early Friday morning.

So what is the IPCC? Well, aside from a small Bureau, it is mostly a body of scientists from around the world convened by the United Nations jointly under the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) and initiated in 1988. Its mandate is to provide policy makers with an objective assessment of the scientific and technical information available about climate change, its environmental and socio-economic impacts, and possible response options. The IPCC reports on the science of global climate and the effects of human activities on climate in particular. Major assessments were made in 1990, 1995, 2001, and now 2007. Each new IPCC report reviews all the published literature

over the previous 5 to 7 years, and assesses the state of knowledge, while trying to reconcile disparate claims and resolve discrepancies, and document uncertainties.

The IPCC process is very open. Two major reviews were carried out in producing the latest report, and climate “skeptics” can and do participate, some as authors. There were over 30,000 comments by over 600 reviewers, all of which were responded to in writing and by changing the report. The process is overseen by two Review Editors. The strength is that it is a consensus report.

The new report is impressive in assessing a huge volume of scientific literature and it assembles a vast body of evidence from multiple lines indicating warming. The report documents the agents of change of the climate and finds that by far the dominant influence is that from human activities through increases in carbon dioxide and other greenhouse gases in the atmosphere. The main source of carbon dioxide is fossil fuel use.

The report finds that warming of the climate system is “unequivocal” as the vital signs of the planet are responding in well understood ways. These include increases in global average air temperature; atmospheric temperatures above the surface, surface and sub-surface ocean water temperature; widespread melting of snow; decreases in Arctic sea-ice extent and thickness; decreases in glacier and land ice extent and mass; and rising global mean sea level. The observed surface warming at global and continental scales is also consistent with reduced duration of freeze seasons; increased heat waves; increased atmospheric water vapor content and heavier precipitation events; changes in patterns of precipitation; increased drought; increases in intensity of hurricane activity, and changes in atmospheric winds. This wide variety of observations gives a very high degree of confidence to the overall findings. Moreover these changes are now simulated in climate models for the past 100 years to a reasonable degree, adding confidence to future projections.

From studies of long-past climate, including the famous “hockey-stick” curve of the past millennium’s temperature, the IPCC concludes that the “Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years.”

Twenty three climate models from 11 nations were applied to simulate the past century or so, and to make projections for the future using several future scenarios that cut across possible outcomes and range from low carbon dioxide emissions, to business as usual. Running the climate models with and without the human changes in atmospheric composition convincingly shows that it is humans who have very likely been responsible for the warming in the last 50 years. Changes in the sun are not responsible. Uncertainties remain, but the 2007 IPCC report definitively reaffirms in much stronger language that the climate is changing in ways that cannot be accounted for by natural variability, and global warming is happening from human activities.

The prognosis from the models is for continued warming and much larger but similar changes to those already apparent. Global mean temperature, which has increased by 1½°F in the 2001 to 2005 period compared with 1850 to 1899 is projected to increase by best estimates of from 3.2°F for a low emissions scenario to 7.2°F for a high emissions scenario in a hundred years. Sea level rise is inexorable, although uncertainty exists over risk of major ice sheet (Greenland and Antarctica) collapse that could lead to 20 feet sea level rise over many centuries. Confidence has strengthened in projections of decreases in rainfall in the subtropical land areas (which are already trending dry), including the Southwest U.S., but with increases in more northern regions.

Later on the Friday following completion of the report, news conferences were held and over 400 of the world’s press and media were there in force. A lot of us participated in television, radio, and news media interviews for many hours, in my case extending from ABC’s Good Morning America at 8:20 a.m. to the Lehrer News Hour after 10:30 p.m. at night. The recognition of the importance of the report was gratifying. My colleague, Phil Jones, from the

University of East Anglia in England, upon being asked if he was feeling a sense of history at the completion of the report was quoted in the Guardian newspaper “Mainly what I am feeling is knackered”. Seems about right.