Identifying Crucial Issues in Climate Science

**Drastic Change in the Earth System During Global Warming: Sapporo, Japan, 24 June 2008**

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The Nobel Peace Prize awarded to the Intergovernmental Panel on Climate Change (IPCC) and former U.S. vice president Al Gore indicates that global warming is recognized as a real phenomenon critical to human beings. However, humanity’s knowledge concerning global warming is based on an uncertainty larger than 50% in the warming rate during the past century. Therefore, scientific clarification is needed to understand important mechanisms that potentially produce positive feedbacks in the Earth system—such mechanisms must be better understood before scientists can develop more reliable predictions.

To plan for the future, a symposium was organized at Japan’s Hokkaido University in association with the G8 Summit, where the most recent updates on the five urgent issues in climate science were discussed. These issues, considered to be crucial as severe impacts on human society continue to rise, included (1) causes and magnitude of sea level rise; (2) decay of glaciers and the Greenland and Antarctic ice sheets; (3) disappearance of the summer Arctic sea ice; (4) carbon uptake or emission by the terrestrial ecosystem; and (5) marine ecosystem change resulting in carbon emissions.

The main conclusions were as follows:

1. For sea level rise, the crucial components are ocean warming below 2000 meters and melting of the Greenland and West Antarctic ice sheets. The IPCC projection of 59 centimeters in this century is the lower bound of projected sea level rise.
2. More information is needed on ice sheet melting, especially basal conditions considered to be crucial for sliding, that may contribute to significant sea level rise.
3. Summertime Arctic sea ice is disappearing faster than IPCC projections. Crucial mechanisms for this may be warm water inflow from the Pacific and Atlantic oceans.
4. The terrestrial ecosystem may change from carbon sink to carbon source in this century, responding to warming and drought.
5. Oceans may also change from sink to source under weakening of thermohaline circulation and acidification.

Despite the comprehensive review by IPCC on the past progression and future projections of global warming, skepticism among citizens persists, causing pervasive confusion. Under this delicate situation, a proposed role for the scientific community at the meeting was that scientists should try to give more information beyond the policy of taking overaction rather than regretting terrible consequences without action. Instead, scientists should endeavor to clarify crucial mechanisms within their own academic communities and the public, being careful not to be too conservative while avoiding false alarms. This is a tricky balance, as scientists could lose credibility if they are recognized to have oversold their own research areas or projects.

This report was prepared with important input by John Church and Wieslaw Maslowski.

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ABOUT AGU

Bender Receives 2008 Roger Revelle Medal

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Michael L. Bender was awarded the 2008 AGU Roger Revelle Medal at the AGU Fall Meeting Honors Ceremony, held 17 December 2008 in San Francisco, Calif. The medal is for “outstanding contributions in atmospheric sciences, atmosphere-ocean coupling, atmosphere-land coupling, biogeochemical cycles, climate, or related aspects of the Earth system.”

Citation

It gives me great pleasure to present the 2008 AGU Roger Revelle medalist, Michael Bender. Michael has tackled an amazingly broad range of problems in ocean geochemistry and biogeochemistry, in all of which he has shown deep scholarship and profound originality. He has a knack for taking on the most intractable of problems and through the development of new measurement techniques and imaginative interpretation of his observations, coming up with truly original contributions that get us all thinking in new directions.

Michael did his Ph.D. with Wally Broecker at Columbia University and was a professor of oceanography at the University of Rhode Island from 1972 to 1997 before joining the Geosciences Department at Princeton University. Most of his early research was on the cycling of metals in the ocean, including valuable insights on the role of hydrothermal circulation and atmospheric deposition. He was also an important contributor to early work on sediment diagenesis, including valuable insights by him and his graduate student Flip Froelich on the zonation of biogeochemical reactions in the sediments and its relationship to thermodynamics.

The primary contributions for which Michael is being recognized today grew out of a visit to the Centre des Faibles Radioactivities, near Paris, in 1983–1984, where he began making measurements of oxygen isotopes in trapped air bubbles in ice cores, building on some ideas he had first begun to explore in 1980 and which he then continued to investigate in his own lab with his graduate student Todd Sowers. His initial paper on this topic was published in 1985, and his contributions since then have included an impressive array of related applications based on measurements of oxygen isotopes and of O2/N2 in firn air, in the atmosphere, and in the ocean. A partial list of his major accomplishments includes the first robust and general methods for temporal correlation among ice cores and between ice cores and sediment records using the 18O/16O ratio and more recently the 17O/16O ratio; dating of ice cores by correlation of these properties with insolation changes; development of the theory of gas isotope fractionation in firn air that was carried out by Jeff Severinghaus working in his lab and that has since had many interesting applications; the use of oxygen isotopes to...