Understanding Global Climate Variability and Its Effects on Marine Ecosystems

Marine Ecosystems and Climate: Modeling and Analysis of Observed Variability; Boulder, Colorado, 2–14 August 2009

Despite evidence of significant impacts from climate change, relatively few published papers in ecology, conservation biology, and biodiversity research deal with marine systems. This stark fact motivated a recent colloquium, hosted by the Advanced Study Program (ASP) at the National Center for Atmospheric Research (NCAR). The goal was to encourage graduate students to undertake research studies on understanding and predicting global climate variability and its impacts on marine ecosystems. An invited group of 18 international experts worked closely with 26 students from the climate, marine ecosystem, and impact communities.

The experts presented lectures on topics including the response of benthic, coastal, and open-ocean ecosystems to climate change; modes of tropical and extratropical climate variability; statistical analysis techniques; Earth system and regional ocean modeling; and fisheries, marine protected areas, and other socioeconomic issues. An accompanying set of computer-based tutorials was designed to give the students an in-depth understanding of the models and analysis methods available to tackle these cross-disciplinary research problems.

An important portion of the colloquium was devoted to four hands-on projects that allowed the students to put into practice the research approaches introduced in the lectures and tutorials. The first project involved the use of an individual-based model, coupled to a coastal circulation model, to explore how trajectories of simulated mesozooplankton might be altered under different upwelling and micronutrient limitation scenarios. Though the effects were not large, significantly different spatial patterns arose over a full season from the various limitation scenarios. The second project examined the inherent (unforced) variability in a coupled climate-biogeochemical model. Global teleconnections associated with the El Niño–Southern Oscillation (ENSO) phenomenon were well simulated. ENSO events had a strong impact on the biogeochemistry of the tropical Pacific Ocean, with an increase in phytoplankton and zooplankton biomass during La Niña.

The third project applied a regional ocean circulation model coupled to a 10-component lower trophic level biological model to investigate the biological consequences of deep-water pumping, which has been proposed as a hurricane deterrent in the Gulf of Mexico. Results showed that such a strategy might produce significant changes to the summer-time surface layer ecosystem, possibly comparable in importance to the ecological effects of the hurricane itself. The final project used coupled climate model projections to test how differing rates of coral adaptation to temperature affected bleaching frequency in the 21st century. The analysis found that if coral temperature tolerance is determined by the temperature history of the coral, then fast adaptation rates (e.g., a temperature tolerance set by the previous 10-year period) were not always an advantage.

Presentations, webcasts, and other materials from the colloquium are available at http://www.cgd.ucar.edu/events/marine/. A longer version of this report, including a full list of contributing authors can be found in the online supplement to this Eos issue (http://www.agu.org/eos_elec/).

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Multiagency Initiative to Provide Greenhouse Gas Information

Global Greenhouse Gas Information System Workshop; Albuquerque, New Mexico, 20–22 May 2009

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The second Greenhouse Gas Information System (GHGIS) workshop brought together 74 representatives from 28 organizations including U.S. government agencies, national laboratories, and members of the academic community to address issues related to the understanding, operational monitoring, and tracking of greenhouse gas emissions and carbon offsets. The workshop was held at Sandia National Laboratories and organized by an interagency collaboration among NASA centers, Department of Energy laboratories, and the U.S. National Oceanic and Atmospheric Administration. It was motivated by the perceived need for an integrated interagency, community-wide initiative to provide information about greenhouse gas sources and sinks at policy-relevant temporal and spatial scales. Such an initiative could significantly enhance the ability of national and regional governments, industry, and private citizens to implement and evaluate effective climate change mitigation policies.

Workshop presentations and discussions explored scientific and stakeholder requirements for a robust GHGIS capability including surveys of current inventory processes, observations and modeling capabilities, perceived longer-term information needs, and mechanisms to integrate existing and future assets into an evolving information system framework. A vision emerged for an operational greenhouse gas information system in which data from a variety of sources, including in situ and remote sensing measurements of land, ocean, and atmosphere, economic activity data, and inventories, are continuously and transparently integrated to produce information relevant for policy. The system would enable community-wide efforts to reconcile disparate estimates of greenhouse gas sources and sinks produced via different methodologies, validate and further improve existing GHG inventories, and extend scientific understanding of the carbon cycle and climate system.

Workshop participants agreed that there is significant value in continuing this interagency and community-wide dialogue with a diverse community of contributors and stakeholders. To facilitate this dialogue, participants recommended the development of a community reference guide to define common terms that are used differently between communities, document the various methods currently used to estimate greenhouse gas sources and sinks, and describe how uncertainties are quantified for the estimates.

Participants also suggested that executing a set of focused and coordinated pilot