Summary

NOAA's Office of Oceanic and Atmospheric Research

Roundtable: Earth System Modeling

A diverse and multi-disciplinary group of 16 constituents of NOAA's Office of Oceanic and Atmospheric Research (OAR) joined Dr. Richard W. Spinrad, OAR's Assistant Administrator, and Dr. A.E. (Sandy) MacDonald, Deputy Assistant Administrator for Laboratories and Joint Institutes, for a high-level roundtable discussion on August 2, 2007. The roundtable, held at NOAA's Cooperative Institute for Research in Environmental Sciences at the University of Colorado, centered on Earth System Modeling and OAR's role in developing and disseminating models and model technology to the scientific and operational forecasting community.

Opening Remarks

In welcoming roundtable participants, Dr. Spinrad noted that the diversity at the table was by design, so that he and Dr. MacDonald could listen to as broad a spectrum as possible of those who help develop and/or can use accurate and timely predictions of the Earth system that come from modeling. The 18 roundtables on various topics Dr. Spinrad has held around the Nation, he said, help to facilitate networking between NOAA and its key stakeholders. He noted that he uses information gleaned from constituent roundtables for longer term strategic development, as well as showing justification for particular programs and budgets that OAR advances.

Dr. Spinrad pointed to the NOAA priority to foster resilient communities, noting that agriculture and other economic sectors are affected by Earth system changes. NOAA's increased understanding and more accurate predictions of changes can help communities and individuals prepare for what's ahead.

In the category of "what keeps me up at night," Dr. Spinrad noted that changes in NOAA and all federal agencies will come with a new administration in 2009. He is keen to stay ahead of the curve, to show that NOAA research is ready to move ahead with well-considered programs that will answer key questions and help solve complex problems facing society. Foci mentioned include ongoing efforts to develop and coordinate observing systems, improvements in modeling, and regional outlook and services.

Dr. MacDonald observed that as a mission agency "in a very serious business," NOAA monitors and predicts the Earth system, and that models are a tool we use to get the answers society needs – now and in the future. Whether reducing the error in predicting hurricane landfall or discovering how the planet will react to increased greenhouse gases in the atmosphere, he said that NOAA is focused on including more aspects of the system, such as sea ice chemistry, in order to reflect the *real* Earth and improve the models that will give us more complete answers.

Constituent Observations

Participants focused on several areas relative to the topic, including the need for regional and ecosystem-level products and information; interdisciplinary science and interagency cooperation on providing services; business needs

that include the energy aspects of ever-larger, faster computing crucial to better models; and the need to maintain and improve data sets models require.

Regional Focus

Participants representing state governments and regional networks stressed the need for Earth system information that focuses on a particular region, so that those responsible for preparing for changes in weather or climate can utilize the best information available when making decisions and setting policies. An example discussed was NOAA's essential efforts to develop the National Integrated Drought Information System (NIDIS) that will bring to bear broad observing capabilities and multi-disciplinary science understanding in assessing the risk of drought for water users from farmers and business owners, to Indian tribes and wildlife managers. The value identified includes products and information and also brings together expertise and users to form an extensive program.

Another example of providing regional information invaluable to decision-makers is the newly unveiled CarbonTracker system developed by NOAA research. CarbonTracker can assists those state and local governments involved in climate initiatives that are targeting reduction of greenhouse gas emissions by tracking where CO_2 is coming from as well as determining if reduction strategies are working.

Participants said that NOAA needs to work closely with water managers to provide detailed data they need, when they need it. For example, it would be valuable if information could be provided on specific watersheds at the time that major management decisions, such as dam releases, must be made. Resource managers appreciate NOAA efforts to work locally and regionally, and to focus on specific water and river issues like volume, timing of runoff, and sentiment.

Participants underscored the need in resource management for tools to assign probability and to assess risk. They would like to see collaboration among modelers and decision makers dealing with and reducing uncertainties in models. They also expressed the need for scientists to communicate better with decision makers, to ensure that decisions that will affect natural resources and communities for years to come are infused with the best science and prediction capability available at the time.

By the same token, NOAA should take care to include stakeholders as it plans and directs its research enterprise, ensuring that NOAA is prepared to provide what the stakeholders need now and will need in the future. Participants suggested that NOAA can act as a catalyst to bring together prediction agencies and management/decision agencies.

The Earth System to the Ecosystem

Participants also encouraged NOAA to consider the needs of habitat researchers and to help develop models that address the impacts of climate change on specific ecosystems. Whereas models run for the Intergovernmental Panel on Climate Change provide a world average for climate change, participants expressed a need for more practical, specific

information that could be used by farmers, wildlife managers, fishers, and property holders to assess their particular vulnerability to climate change.

Dr. Spinrad and Dr. MacDonald acknowledged that including data like temperature, water availability, wetlands impacts, and food web data in models can help to create Integrated Ecosystem Assessments and answer questions about future effects of climate change on particular ecosystems.

Business/Marketplace

Participants identified the need to tie technology development to energy requirements because both must be provided to build advanced computing capability.

An affordable, reliable energy source must be provided for enterprises engaged in data management and computing advancements, as these are necessary for running increasingly sophisticated models required to more accurately describe and predict the Earth system. As the need grows for increased computer power, so too, does the demand for energy explode. Participants called for NOAA to consider activities that could aid energy producers in providing stable, efficient energy supplies, activities that dovetail with NOAA's priority to create resilient communities and the charge to contribute to American competitiveness efforts.

Fostering the Modeling Community

Participants involved in Earth system modeling indicated NOAA is on the right track when it encourages the modeling community to work together. NOAA should continue efforts to develop code and software that allow diverse modeling interests to speak the same language, share advances, and improve models collaboratively. NOAA should be a leader in bringing together government agencies and academia and diverse disciplines to work on complex, entrenched environmental problems.

Modeling interests acknowledged that NOAA and the modeling community are making advances in the ability to develop more complete models that couple many aspects and dynamics of the Earth system. They called for efforts to fine tune these and reduce systematic biases in models so they can more accurately simulate mesoscale processes. Participants advised NOAA to be persistent in solving long-standing problems in Earth system science and modeling before looking for new problems to solve, and to ensure NOAA research is applicable to real predicaments society faces.

Participants said Earth system modeling efforts should continue to improve the simulation of clouds in models, a persistent wedge of uncertainty, and to include the carbon cycle (i.e., what does the Earth system do with human emissions?). Modelers also ought to emphasize better analyses of model biases, by conducting more diagnostic and reanalysis activities. Hindcasting activities like CarbonTracker are a step in the right direction.

Participants stated the need to explore new and novel approaches to improve the fidelity of models at the regional level as well as on shorter time scales – to bridge the weather-climate gap. Additionally, as major weather and climate events often are driven by world ocean anomalies, modelers must meet the

challenges of improving the data indicating the initial observed state of the system so the models can begin their runs from a more true simulated state.

Better Data, Better Models

Participants underscored the need to continue NOAA's focus on the date collection side of model improvement, and to contribute to the development of the right instruments to collect the specific data needed to correctly initialize models. NOAA should concentrate on both the precision and accuracy of data provided to modelers, but also the long-term stability of data collection and dissemination. There is a high risk-high payoff aspect to finding and developing new data streams, naturally limited by fiscal concerns, but Dr. Spinrad acknowledged that NOAA research should help to convince policy-makers and fund-providers of the need for greater risk tolerance.

In developing instruments for data collection, participants asked that NOAA emphasize getting information that users need most. In tracking carbon, for example, energy and business concerns recognize the need for reducing greenhouse gases, but don't have the monitoring and verification tools they need to do so.

They noted that data used to predict climate-warming sea level rise is not reliable and that with cuts in polar-orbiting satellite development, the melting of major ice sheets won't be accurately portrayed in climate models. Participants encouraged NOAA to push satellite climate observations and to ensure polar data is included in Google Earth data sets. They also said NOAA should pay attention to metadata and consistently provide the data upon which stakeholders are most dependent.

Conclusion

NOAA is a leader in climate-change activities throughout government and academia, participants said, and should accept the role of clearinghouse for climate assessments and mitigation activities. Participants agreed that in the rush to develop new systems of data collection and dissemination, established systems continue to be maintained and updated regularly. Dr. Spinrad concurred, saying that interoperability of systems is one of his pushes as the leader of NOAA research.

Participants iterated the challenges facing today's science endeavors, such as efforts in Earth system modeling; these include energy and power issues; encouragement of science students and recruitment of new researchers; transition of research to operations; research that is useful to the marketplace and society. They noted that leadership on these issues is difficult within the federal bureaucracy, and that NOAA might be better served if it was an independent science agency, like NASA.