A National Strategy for Advancing Climate Modeling

Statement of Task

Climate models are the foundation for understanding and projecting climate and climate-related changes and are thus critical tools for supporting climate-related decision making. This study will develop a strategy for improving the nation’s capability to accurately simulate climate and related Earth system changes on decadal to centennial timescales. The committee’s report is envisioned as a high level analysis, providing a strategic framework to guide progress in the nation’s climate modeling enterprise over the next 10-20 years. Specifically, the committee will:

1. Engage key stakeholders in a discussion of the status and future of climate modeling in the United States over the next decade and beyond, with an emphasis on decade to century timescales and local to global resolution. This discussion should include both the modeling and user communities, broadly defined, and should focus on the strengths and challenges of current modeling approaches, including their usefulness to decision making, the observations and research activities needed to support model development and validation, and potential new directions in all of these spheres.

2. Describe the existing landscape of domestic and international climate modeling efforts, including approaches being used in research and operational settings, new approaches being planned or discussed, and the relative strengths and challenges of the various approaches, with an emphasis on models with decade to century timescales and local to global resolution.

3. Discuss, in broad terms, the observational, basic and applied research, infrastructure, and other requirements of current and possible future climate modeling efforts, and develop a strategic approach for identifying the priority observations, research, and decision support activities that would lead to the greatest improvements in our understanding and ability to monitor, model, and respond to climate change on local to global space scales and decade to century timescales.

4. Provide conclusions and/or recommendations for developing a comprehensive and integrated national strategy for climate modeling over the next decade (i.e., 2011-2020) and beyond. This advice should include discussion of different modeling approaches (including the relationship between decadal-to-centennial scale modeling with modeling activities at other timescales); priority observations, research activities, and infrastructure for supporting model development; and how all of these efforts can be made most useful for decision making in this decade and beyond.

Examples of the types of strategic questions to be addressed include: What is the appropriate balance between improving resolution and adding complexity as computing power improves? What are the advantages and disadvantages of different approaches to projecting regional climate change (e.g., embedded regional models, statistical downscaling, etc.)? What are the benefits and tradeoffs associated with multi-model versus unified modeling frameworks? What
opportunities might exist to develop better interfaces and integration between Earth system models and models of human systems? What observations and process studies are needed to initialize climate predictions on both regional and global scales, advance our understanding of relevant physical processes and mechanisms, and validate model results? What critical infrastructure constraints, including high performance computing and personnel issues, currently limit model development and use? What steps can be taken to improve the communication of climate model results (e.g., presentation of uncertainties) and ensure that the climate modeling enterprise remains relevant to decision making? What modeling approaches and activities are likely to provide the most value for the investments required?

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