Climate Working Group

Climate Research and Modeling Program Review

Based on a Review Panel Meeting Held on March 24-26, 2008
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for
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Overarching goal is to develop, understand, and improve the capability to make intraseasonal, seasonal, decadal, and centennial-scale predictions of climate variability and projections of future climate change on global to regional scales.

An additional, emerging goal is to attribute observed climate fluctuations, such as droughts, and changes in the Arctic, to specific causes.
NOAA’s CRM Program is producing important, useful, and interesting research that represents a major contribution to the extremely important, and now highly visible, world-wide enterprise of climate research.

NOAA scientists have made many world-class contributions to the scientific investigation of the Earth’s climate and global change. NOAA’s superb contributions to recent international assessments are particularly noteworthy.

NOAA’s provision of information on climate variability and the impacts of climate variability on society are also commended.

A key challenge for the future is to improve the overall design and cooperative interactions of the many institutional components involved in the CRM Program.

Strategic Planning is obviously required to meet this challenge.
Recommendations
Panel 1a: Understanding Climate Processes

• Emphasis on understanding basic processes should be balanced with improving the models.

• Emphasize understanding changes in stratospheric water vapor and understanding how changes in stratospheric ozone relate to climate changes.

• Emphasize decreasing uncertainty in aerosol/cloud interactions and how to treat these processes within the global models.

• Emphasize better coordination between measurements and modeling and between small scale process modeling and large scale prediction.

• There is a need for better connection of the chemical and physical sciences and the role of chemical science and air quality in NOAA.

• A Strategic Plan is needed, to define how the various activities fit together into a coherent whole.
Panel 1b: Ocean Processes and Carbon Cycle

• The CRM Program needs to better integrate with NOAA observational and modeling efforts to improve the observing system, the models, and the predictions. The Panel recommends additional targeted CLIVAR CPTs to take advantage of the wealth of Earth system observations to improve operational seasonal to interannual forecasting, initialization of decadal prediction, and climate projection. NOAA should continue to fund NOAA scientist participation in CLIVAR CPTs. Regular meetings among key NOAA CRM researchers from all supported labs and related University research colleagues would facilitate such interactions.

• NOAA should continue to push the resolution envelope, at least for decadal-scale modeling.

• The state of understanding of the interactions among coastal upwelling, advection, nutrient cycling, river inputs, and estuarine biogeochemistry and sedimentation remains poor. Progress in this area will likely require experiments at very high resolution in collaboration with experimentalists and data from field campaigns.
Panel 2: Reanalysis, Data Assimilation, and Carbon Tracking

• The CFSRR should survey the community to define the product streams.

• The CFSRR should undertake a validation to demonstrate the performance of the system, and should involve external community early in the evaluation.

• NCEP/EMC and NCDC should consider a distributed and incremental archiving of the reanalysis.

• Broad consensus is needed on the proposed estimates of biases and uncertainties.

• The above recommendations also apply to the 20th Century Reanalysis.

• NOAA management should determine if, when, and how the CDA should transition to CFS, and if not, why it should continue at GFDL.
Panel 2: Reanalysis, Data Assimilation, and Carbon Tracking, contd.

• The predictability of the Atlantic Meridional Overturning Circulation should continue to be a research problem, rather than an operational problem, for the foreseeable future.

• CarbonTracker should receive rigorous scientific review, and it should be integrated more fully with other CRM projects.

• An effort should be made to include ESM component models in the Carbon Tracker. This would improve the Carbon Tracker analyses, might expose weaknesses in ESM, and would help initialize ESM components for decadal prediction.

• NOAA should take the lead to develop an ongoing national program to produce periodic reanalyses through an interagency partnership.
Panel 3a: Modeling Overview

• GFDL and NOAA management should reach a mutual agreement of the relative priorities of Climate Modeling and of ESM development. Then the various critical climate problems should be prioritized, and resources allocated accordingly.

• GFDL needs to make a strategic decision as to whether or not it wants to take a leading role, nationally and internationally, in ESM development.

• Management should determine to what extent future IPCC obligations can be supported through current and new collaborations, partnerships and linkages.

• GFDL and NCEP should collaboratively perform an evaluation of HYCOM’s overall performance as an ocean model for use by NCEP.

• NCEP should give higher priority to understanding climate, as per the draft CRM charge. In particular, it should consider whether the empirical result that the MME has improved forecast skill has a satisfactory theoretical basis.
Panel 3a: Modeling Overview, contd.

- NCEP should develop the automated metrics that are appropriate to measure the skill of climate predictions.

- NCEP should develop more formal and persistent mechanisms for scientific interactions with the outside research community.

- NOAA management should assess the success of the Climate Test Bed, and develop a strategy for it to reach its potential.

- NOAA needs to lead and develop the national strategy for intraseasonal to interannual climate prediction inclusive of MME, data assimilation, forecast metrics.

- The computing requirements for a National MME should be included in the NCEP climate computing request for 2011.
Panel 3b: Model Development

Modeling

• The high-resolution modeling activity provides a strong incentive for a major enhancement of computing resources.

• The ongoing atmospheric dynamical core development is very promising, but developments at GFDL, NCEP, and ESRL should be more formally coordinated.

• A consensus plan is needed to guide the parallel development within GOLD of MOM and HIM based capabilities at GFDL.

• A formal pathway should be defined for model components to move from the ESM to the coupled climate model. Coordination between GFDL’s ESM and NCAR’s CCSM should be reconsidered. NCEP’s data assimilation and reanalysis activities are critically important for the study of the climate system and the evaluation of climate models.

• Care should be taken to maintain and enhance ties between GFDL and NCEP as the latter moves to the University of Maryland campus.
Computing Needs

• The Panel concurs in spirit and principle with the comments and recommendations in the letter of April 4, 2007 from David Fluharty to VADM Lautenbacher focused on HPC.
  ➢ NOAA should consider a centralized computing facility. (Note: a centralized facility is not the same as a single computational environment.)
  ➢ NOAA should develop a “core team of HPC expertise.”
  ➢ NOAA should establish stronger relationships with the other Federal agencies, as well as the vendor community.

• “System diagrams” are needed to define the computational environment and facilitate management and acquisition of computational systems.

• A work flow model should be built to define the requirements for the research computing.

• Sustained relations with vendors are important for keeping software execution efficient.

• The Panel encourages continued development of software frameworks.
Panel 3c: Operational Predictions and Applications

Operational climate monitoring and prediction products and services, and the climate test bed

• NCEP should provide leadership in developing a national MME.

• The CTB computer requests should include support for a national MME.

• The CTB advisory panel needs to look at how the CTB is being implemented and should report to the CWG.

• NCEP should consider a strategy for supporting visitors who come to NCEP to work directly with the scientists there.

• NOAA needs an implementation plan that closes the loop between research to operations to applications.
Panel 3c: Operational Predictions and Applications

Role of Climate Prediction Program

• A more unified CPO strategy for identifying gaps in near-term priorities, and balances between program elements would improve effectiveness for coordination across programs. Input from the operational elements of NOAA should influence the priorities.

Roles of the IRI, Applied Research Centers, Joint Institutes, and Cooperative Institutes

• The CPO ought to take care to balance the funding of internal NOAA research groups and Cooperative Institutes with those of the external community.

• The successful CPC-RISA paradigm should be expanded.

• The ARCs, Joint Institutes (JI) and Cooperative Institutes (CI) need to be reviewed, re-considered, and recompeted in the context of the review and implementation of a NOAA and CRM strategic plan.

• CWG should create a review plan for the ARCs/JI/CI and a strategic plan for better directing their research activities and integrating the results into CRM program priorities.
Panel 4: Integration and Synthesis

Synthesis of Research

• NOAA should continue its leadership of policy-oriented scientific assessments, including the IPCC.

• The implementation process used in the ozone assessment and IPCC AR4 should serve as a model for future assessments. NOAA should support the model development and analysis at GFDL.

• The CCSP assessment process is almost complete, and will continue to be impacted by political agendas. NOAA and other government agencies should not both facilitate and author assessments.

• All policy-influential reports like those produced by the CCSP should be reviewed by the National Academy of Sciences in order to remove any possible taint of political bias.

• Strong efforts should be made to avoid scheduling overlap between the IPCC assessments and any national effort.

• NOAA should explore ways to make their success in the assessment process more of a vehicle for cross-CRM and cross-NOAA-climate-program integration.
Panel 4: Integration and Synthesis, contd.

Integration Between and Across Programs

• NOAA should lead a an integrated multi-agency effort to provide climate services.

• The federal government needs to develop an entity that serves as the “recipient” of climate information that is developed, in part, by NOAA.

• Strategic planning and management is required at all levels of NOAA to would allow the development of integrating activities both internal and external to NOAA, and to help fix the current, fragmenting budget process.

• Budget, reporting and incentive mechanisms need to be developed to orient performing organization with Laboratory and Agency Goals.

• NOAA cannot provide the best Climate Services without well designed partnerships with other Federal Agencies, the academic community, the resource management community, and commercial interests.
Integration Between and Across Programs (Contd.)

• NOAA needs a clear understanding of who its “climate customers” or “climate stakeholders” are. NOAA alone cannot define the stakeholders.

• NOAA should develop a management strategy that is consistent with modern concepts of open innovation or open communities – a generalization of the open source software culture.

• In view of the successful attributes of the Climate Process Teams, the Regional Integrated Science and Assessment Programs, and the Applied Research Centers, NOAA should develop an agency-wide strategy which incorporates these middle-sized activities as key strategic elements.

• NOAA should form ad hoc research teams. Funds should be set aside in advance of any team building to ensure non-NOAA scientists will be part of any given team.

• NOAA must recognize the importance of the information technology infrastructure necessary to support high-performance computing and communications.
Panel 5: Decadal Variability and Predictability

• While the recent progress has been impressive, NOAA should form a more consistent perspective and undertake a strategic planning exercise towards (possible) operational decadal predictions.

• While the Atlantic Meridional Overturning Circulation is one of the most important foci for decadal variability and abrupt change studies, aspects of decadal variability and predictability in areas other than Atlantic, Pacific, polar regions (including recent trends in Arctic and Antarctic ice), and southern oceans, for example, should be given equal emphasis.

• Continental hydrological processes and considerations on cryospheric components of climate should also be focused. Especially, process modeling of the cryosphere should be of considerable importance in advancing the understanding of abrupt climate change.

• Coordination is needed between GFDL, NCEP, and other research sectors on initialization and prediction systems development for decadal prediction.
CWG Request of the SAB

• Consider the full range of recommendations in the CRM Review

• Endorse the CWG CRM Review Report

• Advise NOAA to proceed with developing a strategic plan for its Climate Research and Modeling Program