

DRAFT PROGRAM CHARTER
FOR
Climate Research and Modeling Program
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1. EXECUTIVE SUMMARY

Program Description:

An overarching goal of climate research and modeling is to develop, understand, and improve the capability to make intra-seasonal, seasonal, decadal, and centennial-scale predictions of climate variability and projections of future climate change on global to regional scales. This will enable regional and national managers to better plan for the impacts of climate variability and provide climate assessments and projections to support policy decisions with objective and accurate climate change information. The CRM Program directly supports the other Programs under the National Oceanic and Atmospheric Administration's (NOAA) Climate Mission Goal. CRM also contributes to the other four NOAA Mission Goals, Ecosystems, Weather and Water, Commerce and Transportation, and Mission Support.

A key requirement for predictions and projections is models that embody sufficient realism in terms of process understanding, sufficient spatial resolution, and improved physics. To achieve these goals, continued development of Earth system models is required, especially with regard to incorporating carbon cycle and other relevant chemical processes for making predictions on longer time-scales. The informational output of CRM will enable regional and national managers to better plan for the impacts of climate variability and provide climate assessments and projections to support policy decisions with objective and accurate climate change information.

An emerging focus of the predictions capability is on the decadal time-scales, which will influence infrastructure decisions. Decadal predictions start from the observed state of the climate system, and will be driven by more confident estimates of near-term changes in radiative forcing. To advance decadal predictions, whose acceptance is dependent on the confidence in understanding and modeling, observations of the slowly varying components of the climate system need to be assimilated, and the rapidly varying components such as the radiative forcing agents like aerosols and ozone need to be calculated and accurately represented.

To achieve its goals, this program maintains a suite of operational climate outlooks and implements the next generation operational climate outlooks and assessments by improving climate models, improving forecast generation techniques, and maintaining real-time climate monitoring data sets. This program also maintains and develops leading edge Earth System Models for the understanding of past climate change, interpretation of present climate events and trends, projection of future climate change on regional to global scales, including biogeochemical cycles, as well as developing estimates of future changes in climate radiative forcing agents. Activities under this program are spread across several line offices and NOAA laboratories, and also support, and leverage on, an extensive array of competitively reviewed research.

The Climate Research and Modeling Program maintains capabilities that include (i) understanding climate processes, (ii) Earth System modeling, prediction, and projection, leading to the understanding of climate variations and change and future climate predictions, and (iii) climate analysis and attribution. Activities within these capabilities include (i) operational forecasts and assessments, (ii) applied climate

research and development, (iii) measurements and understanding of non-CO₂ climate forcing agents, (iv) understanding the causes of climate forcing, (v) understanding and prediction of the ozone layer recovery, (vi) analysis of the climate system, (vii) characterizing observations for climate models, and (viii) climate attribution.

2. PROGRAM REQUIREMENTS

A. Legislative and Directive Documents establishing needs and requirements:

Legislation:

- *National Weather Service Organic Act* (15 U.S.C. §313): Outlines NOAA's responsibility to produce climate forecasts.
- *National Climate Program Act*, 15 U.S.C. 2901-2908, at 2904(d) (4), et seq.: This act authorizes global data collection, and monitoring and analysis activities to provide reliable, useful and readily available information on a continuing basis. In addition, the act authorizes measures for increasing international cooperation in climate research, monitoring, analysis and data dissemination.
- *Global Change Research Act* (15 U.S.C. §2921 et seq.): This act mandates the development of a research program whose goal is to understand climate variability and its predictability. It also mandates research and observation of human activities that may lead to global changes and may adversely affect society (i.e. global warming and stratospheric ozone depletion).
- *Global Climate Protection Act of 1990*, 7 U.S.C. § 6701 et seq.: Requires research in climate change needed to protect the environment. The CRM Program produces results used for the decision support for protecting the environment.
- *Coastal Zone Management Act of 1972* (16 U.S.C. §1450 et seq.): Requires understanding and prediction of long-term climate change which may have large impacts in the coastal zone such as global warming and associated sea level rise.

Interagency or International Agreements:

- *Strategic Plan for the Climate Change Science Program (CCSP)*: Requires reduced uncertainty in projections of how the Earth's climate and related systems may change in the future. Requires the federal agencies to carry out research to quantify climate forcing by various agents, reduce the uncertainties in their evaluated forcings, produce timely prediction as well as generate synthesis and assessment products (SAPs) on various aspects of climate change.
- *U.S. Ocean Action Plan / Ocean Research Priorities Plan (ORPP)*: Presents research priorities that focus on the most compelling issues in key areas of interaction between society and the ocean. Provides guidance on how the various ocean science sectors (government, academia, industry, and non-government entities) can and should be engaged, individually or through partnerships, to address the areas of greatest research priority and opportunity.
- *U. N. Framework Convention on Climate Change (UNFCCC)*: Requires better quantification of the agents that force climate change by contributing research results and providing expertise to the assessments.
- *Montreal Protocol on Substances that Deplete the Ozone Layer (and subsequent amendments)*: Requires an assessment every four years of the state of the ozone layer, its recovery, and the amounts and origins of ozone depleting substances that drive the ozone layer changes. The influence of climate change on the future of the ozone layer and the consequences of ozone layer changes to the climate also need to be addressed through research and assessments.

B. Mission Requirements

- Understand and predict climate variability on timescales ranging from intraseasonal through seasonal to decadal and beyond (*Global Change Research Act*).
- Monitor, assess, and forecast climate (*National Weather Service Organic Act*).
- Understand and predict long-term climate change and evaluate its impacts on the coastal zone (*Coastal Zone Management Act*).
- Improve climate models to reduce uncertainty in the projections of Earth's climate (*Strategic plan for the Climate Change Science Program*).
- Improve knowledge of observed variability and change of the Earth's past and present climate and environment (*Strategic plan for the Climate Change Science Program*).
- Improve quantification of the forces bringing about changes in the Earth's climate system (*Strategic plan for the Climate Change Science Program*).
- Monitor and understand changes in the ozone layer and ozone depleting gases and assess the consequences of changes (*Global Change Research Act*).
- Provide monitoring, assessment, and analysis of the climate system through adequate quality observations and measurements of atmospheric, oceanic, and select terrestrial variables, as well as modeling capabilities (*Global Change Research Act, National Weather Service Organic Act, Coastal Zone Management Act, US Ocean Action Plan*).

3. LINKS TO THE NOAA STRATEGIC PLAN

A. Goal Outcomes:

A predictive understanding of the global climate system on times scales of weeks to decades to a century with quantified uncertainties sufficient for making informed and reasoned decisions.

B. Goal Performance Objectives

Understand and predict climate variability and change from weeks to decades to a century.

Reduce uncertainty in climate projections through timely information on the forcing and feedbacks contributing to changes in the Earth's climate.

C. Goal Strategies

- Provide the research needed to understand climate processes including information products for an atmospheric composition service. (This includes coordination with the NOAA 5-Year Research Plan.)
- Provide the resolution and accuracy for prediction and projection services on future states of the climate to a scale required to meet user demand.
- Develop Earth system models with advanced assimilation systems to facilitate attribution studies and increase the range of predictability.
- Improve the quantification and understanding of the forces bringing about climate change by examining relevant human-induced increases in atmospheric constituents.
- Develop and contribute to routine state-of-the-science assessments of the climate system for informed decision-making.

- Work with customers in order to deliver climate services and information products involved in health, safety, environmental, economic, and community planning that increase the effective application of this information.

4. PROGRAM OUTCOMES

- Improved understanding of atmospheric carbon dioxide trends for policy support involving quantified estimates of carbon sinks/sources and feedbacks.
- Produce climate change projections in support of making informed policy decisions to mitigate societal impacts of climate trends.
- Produce operational climate outlooks and applications with defined uncertainties on intraseasonal, seasonal, and decadal time-scales to enable national managers to take proactive actions in response to the impacts of climate variability and change.
- Produce information on the climate roles of the radiatively important fine-particle aerosols, with an emphasis on aerosol-cloud interaction (the most uncertain of the climate forcing agents), and non-carbon dioxide greenhouse gases to provide decision support associated with options for potential near-term changes in radiative forcing of climate change.
- Produce information for the verification of the recovery of the ozone layer and the decline of ozone-depleting chemicals in the atmosphere, thereby facilitating compliance with the Montreal Protocol and its safeguarding the Earth's ultraviolet shield.

5. PROGRAM ROLES AND RESPONSIBILITIES

This program is established and managed with the procedures established in the NOAA Business Operations Manual (BOM). Responsibilities of the Program Manager are described in the BOM. Responsibilities of other major participants are summarized below:

A. Participating Line Offices, Staff Office, and Council Responsibilities

- NOAA Office of Oceanic and Atmospheric Research (OAR) is responsible for providing capabilities for climate diagnostics, climate modeling, and climate projections through the Geophysical Fluid Dynamics Laboratory (GFDL). It is also responsible for conducting research and climate observation through its offices, laboratories, and cooperative institutes, including but not limited to the Climate Program Office and Earth System Research Laboratory (ESRL).
- NOAA Weather and Water Goal Air Quality Program is responsible for joint studies on radiation balance and air-quality-health.
- The National Weather Service (NWS) through the Climate Prediction Center (CPC) and Environmental Modeling Center (EMC) is responsible for providing an infrastructure to maintain operational climate predictions on intraseasonal, seasonal, and interannual time scales, and to provide a vehicle for transitioning products developed under the NOAA research to operations.
- NESDIS STAR is responsible for developing algorithms to retrieve carbon gas data from infrared satellite data and for satellite-based ozone-layer and aerosol-radiation monitoring.
- The Aircraft Operations Center provides the fully outfitted WP-3, G-IV, and Twin Otter aircraft platforms, certain key meteorological and navigation data instrumentation, aircrew, and Aviation Project Management for the Climate Forcing Program that produces some of the data required for this

performance measure. Specialized air chemistry instruments are provided by NOAA and PIs supported via extramural grants.

- The NOAA Office of General Counsel (GC) is responsible for providing legal services necessary to enable the program to discharge its duties.
- The NOAA Research Council provides guidance on research priorities with different time horizons.
- The NOAA Office of Public and Intergovernmental Affairs communicates findings and results to a variety of audiences via the media.

B. External Agency/Organization Responsibilities

- Intergovernmental Panel on Climate Change (IPCC) established by the World Meteorological Organization (WMO) and United National Environmental Programme (UNEP) coordinates international assessment of scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation.
- Numerous national and international working groups provide community-based science and implementation planning to guide NOAA's funding of climate variability and change research. These include but are not limited to: Climate Research Committee of the National Academy of Sciences/National Research Council; US Interagency Working Groups for the various Research Element Activities of the US Climate Change Science Program; US Interagency Groups for Climate Variability and Predictability (CLIVAR) and Global Energy and Water Cycle Experiment (GEWEX); World Climate Research Programme, sponsored by the WMO, Intergovernmental Oceanographic Commission (IOC) and the International Council of Scientific Unions (ICSC); US Scientific Steering Committees for CLIVAR, SPARC, and GEWEX.
- Academic and research communities external to NOAA support increased understanding of climate variability and change and development of improved climate prediction techniques via competitive research grants.

6. END USERS OR BENEFICIARIES OF PROGRAM

Products generated by the Climate Research and Modeling Program will benefit the following end users:

- General Public – The program contributes to improved understanding of climate variability and change, including extreme events, enabling the public to plan, anticipate, mitigate, and adjust appropriately. It informs and educates public about climate.
- Businesses – The program provides data, model simulation results, and analyses beneficial to businesses developing and modifying business plans sensitive to weather and climate on timescales from intraseasonal to multiple decades. It provides operational forecasts and outlooks of intraseasonal to interannual variations and intradecadal trends.
- Government – The program supports decision-makers with policy formulation to mitigate climate impacts and reduce costs. It provides information needed to manage natural resources and ecosystems, enhance studies on the spread of climate sensitive diseases, and contribute to mitigating natural hazards along the coast and the interior of the Nation.
- Academia – The program awards funding for extramural research and observation to support these research programs.
- International – The program provides objective information about climate change projections in support of making informed policy decisions for mitigation and adaptation strategies related to global change.