

NOAA's Responses to:

Climate Goal Program Reviews

and

***Climate Services External Review Report and
Options for Developing a National Climate
Service***

**Reports from the Climate Working Group of the NOAA
Science Advisory Board**

November 2010

This report serves as NOAA’s Response to the Climate Goal Program Reviews and the Climate Services External Review Report and Options for Developing a National Climate Service. The documents contained within this report include the following:

- 1. Summary responses to recommendations related to the programmatic reviews, Climate Services External Review, and Options report**
- 2. Appendices A: Full responses to recommendations related to the Climate Observations and Monitoring Program review**
- 3. Appendices B: Full responses to recommendations related to the Climate Research and Modeling Program review**
- 4. Appendices C: Full responses to recommendations related to the Climate Information Products and Applications review**
- 5. Appendices D: Full Responses to Recommendations related to Climate Services External Review and Options for Developing a National Climate Service**

Introduction

Over the past three years, the NOAA Science Advisory Board's Climate Working Group (CWG) has conducted a series of reviews of NOAA's Climate Goal Programs. These reviews included the Climate Observations and Analysis Program (COA: April 2007), the Climate Research and Modeling Program (CRM: March 2008), and the Climate Information Products and Applications (CIPA: July 2009).

Additionally, in June 2008 at a meeting held in Vail, Colorado, a 13 member external Review Team under the auspices of the Climate Working Group conducted a review of NOAA's initial climate services strategy document *Draft Strategic Plan For a National Climate Service*. Following a recommendation from the External Review team, NOAA assisted with the development of a coordinating committee and four Tiger Teams to analyze the organizational options that were presented in the *Climate Services External Review Report*.

This document provides a summary of NOAA's responses to the recommendations of the three programmatic reviews as well as to the review of the *Draft NOAA Strategic Plan for National Climate Service* and the key implementation conclusions of *Options for Developing a National Climate Service*, a report developed by the coordinating committee based upon the conclusions of the four Tiger Teams.

The Climate Goal appreciates the guidance and recommendations the Climate Working Group has provided over the past 3 years through these reviews. They have provided the Climate Goal with scientific advice and broad direction regarding the Goal's current suite of and future plans for climate capabilities, assets, and services. As the proposal for a Climate Service within NOAA has emerged, the CWG's findings and recommendations have been instrumental to inform the Climate Service Vision and Strategic Framework document and implementation plan.

Overarching Climate Goal Recommendations

The following is a summary of overarching recommendations the Climate Working Group provided to the Climate Goal Programs over the course of the three Goal program reviews. These recommendations have been instrumental in the development of a framework for a Climate Service within NOAA.

Recommendation: *Develop a comprehensive and in-depth strategic framework/plan for climate services.*

In the past year NOAA has been developing a Climate Service Vision and Strategic Framework (Framework) that outlines a mission, vision and goals for a Climate Service, as well as details on how NOAA will scale-up climate services and integrate activities both across the Climate Service elements and with other parts of NOAA. Driven by a growing demand for easy and timely

access to scientific data and information about climate, the Framework describes a new organization that will improve understanding and anticipation of changes in climate, and promote a climate-resilient society and environment.

The Framework has undergone a rigorous public comment and review period.¹ In addition, NOAA has conducted informational webinars for internal and external partners. The National Academy of Public Administration reviewed the Framework during their study and analysis of organizational options for a Climate Service within NOAA. In agreement with the CWG, NAPA also emphasized to NOAA the importance of formal strategic and implementation plans. We believe the Framework is a significant step, and has allowed us to engage in a process of internal and external dialog. NOAA will use this foundation to inform strategy and planning for climate as part of NOAA's Strategic Evaluation and Execution (SEE) planning process. Currently all NOAA goals and enterprise objectives are developing Implementation Plans and Annual Operating Plans as part of the SEE process, including climate.

Recommendation: *Establish and promote internal and external partnerships.*

NOAA concurs that the success of the Climate Service will be greatly impacted by our ability to build and nurture partnerships to improve the integration of climate science and services. These partnerships will include: other parts of NOAA; federal, state and local agencies; academic partners; private industry, and the international community. The Climate Service will employ a full range of formal and informal agreements with external partners from contracts, cooperative research and development agreements, to formal interagency and international processes. Some examples of new partnerships that will help build climate services within NOAA include the National Ocean Service Coastal Services Center, regarding coastal inundation and vulnerability, and with the National Weather Service for Regional Climate Service Directors and work with the National Centers for Environmental Prediction (NCEP). Within the Federal Government NOAA continues to demonstrate leadership with U.S. Global Climate Research Program (Tom Karl Lead), Climate Change Adaptation Task Force (Dr. Lubchenco co-lead) and the emerging Climate Services Roundtable (Dr. Lubchenco co-lead). Complimenting these inter-agency structures, NOAA has been formalizing external partnerships include an MOU with the Department of Interior on climate service activities, especially regional coordination; an MOU with the Department of Energy on High Performance Computing to enable testing of NOAA climate models on the world's fastest computers; and an MOU with the Australian Commonwealth Scientific and Industrial Research Organization.

Recommendation: *Provide meaningful methods to evaluate progress and measure performance.*

¹ NOAA has evolved the Framework based on the extensive feedback received during the public comment period, and will make the revised document publicly available pending internal review and approval. All references to the Framework in these responses to SAB recommendations refer to the revised version which reflects stakeholder feedback.

Performance evaluation is a priority for the Department of Commerce and NOAA overall. NOAA's new planning and budget process, Strategic Execution & Evaluation (SEE), was developed to link strategic formulation of NOAA's Next Generation Strategic Plan (NGSP) with improved program execution, and enhanced accountability. The NGSP also includes evidence of progress statements that list the outcomes NOAA will evaluate its performance against. Steps within SEE place particular emphasis on evaluation and results-based management. In addition, NOAA's NGSP lays out four objectives for the Climate Goal. In Fiscal Year 2011 NOAA's climate programs will be responsible for developing an Annual Operating Plan (AOP) and Implementation Plan (IP) through FY 17 that outline how the Climate Goal intends to achieve the NGSP objectives and support goals across NOAA. The AOP requires objectives and milestones be listed for FY11 that must be reported on, and will be tracked by corporate NOAA.

Recommendation: *Improve internal budget and planning processes to promote timeliness and effectiveness.*

The SEE process will permit NOAA to learn from its programs' results and achieve its objectives, while simultaneously responding to ever-changing economic, governmental, social and environmental forces. In addition to the AOP, NOAA's Climate Goal programs have established a process of quarterly planning meetings to help establish priorities for the Climate Service. The first meeting was held in early November in Charleston, SC, and the next meeting is being scheduled for January in Seattle, WA. These will help ensure that NOAA's climate assets are being used effectively to address NOAA and the Nation's most pressing priorities.

Recommendation: *Promote better integration among climate programs and activities.*

NOAA's Climate Service will evaluate the integration of the core capabilities including the science with basic services delivery to support new services, and how well the balance of the two is achieving the NGSP objectives and addressing the societal challenges. The four societal challenges are: climate impacts on water resources, changes in extremes of weather and climate, sustainability of marine ecosystems, and coasts and climate resilience. The evaluation of Climate Service integration will examine aspects such as the resourcing of basic services compared to new services to address the societal challenges; and how well the Climate Service organization is coordinating internally to optimize integration to deliver new services more efficiently. In addition, the AOP will be critical in ensuring that NOAA's climate assets are working towards a common set of priorities, and aligned to achieve NOAA's climate objectives. Going forward, the quarterly Climate Service meetings will be important to ensure that the various programs and activities are aware of each other's activities. Finally, to promote integration of Climate across all the Line Offices, NOAA's Implementation Plans require an analysis of cross-line office dependencies need to achieve its goals, including the Climate Goal. This exercise will support the coordination of all climate assets, including those that play a supporting role but whose main function is not climate related. It should be noted however, NOAA continues to believe a reorganization is needed to ensure effective integration for this critical mission area.

Recommendation: *Engage stakeholders and incorporate user feedback.*

The Climate Service requires an organizational framework that builds sustained dialog with the external stakeholder community and links diverse scientific and service communities. The Climate Service will evolve in an iterative fashion that incorporates vigorous research investigations and discovery, and considers new processes, user requirements and user feedback. The fundamental goal of a Climate Service will be to directly connect the best and most relevant climate science to user decisions. For example, the Framework document underwent a round of public comment which resulted in several key changes being incorporated into the Framework. NOAA also held several webinars, participated in speaking engagements, and held meetings in order to solicit input on the document. In addition, one function of the six new Regional Climate Services Directors is to engage with users and stakeholders, both existing and new, to help promote a two-way engagement in service development, as well as facilitate their use of service products. In addition, while developing the NGSP NOAA engaged in a year-long iterative public comment process with its stakeholders, and the input we received for the Climate Goal and the associated objectives was critical in framing the final language. In addition to these NOAA processes, NOAA believes that the National Assessment process is an important mechanism for developing sustained relationships with users. NOAA intends to leverage our participation in the National Assessment into stakeholder engagement opportunities to inform NOAA's climate science and service development and delivery.

Recommendation: *Improve understanding of existing NOAA capabilities and assets.*

NOAA will build the Climate Service on four core capabilities already existing within the agency:

- Observing Systems, Data Stewardship, and Climate Monitoring
- Understanding and Modeling
- Integrated Services Development and Decision Support
- Projections and Predictions

NOAA is developing a climate portal to provide information about its capabilities and assets within these core capabilities on the internet. NOAA will use a direct engagement method through its regional climate service enterprise lead by its new regional climate services directors to provide information to stakeholders about its capabilities and assets. Finally, the development of needs assessments with stakeholders will permit the agency to provide another means of communicating its capabilities and assets. Assessments are an important way of engaging with stakeholders, and NOAA is actively supporting the upcoming National Assessment. The National Assessment is an engagement opportunity for all federal agencies to share with users the various services available to them.

Responses of the Climate Observations and Monitoring (COM) Program to the Recommendations of the Climate Working Group (CWG) Review of NOAA's Climate Observations and Analysis (COA) Program

The April 2007 CWG review of the Climate Observations and Monitoring COM Program (referred to as COA for purposes of the review) and the CWG's Spring 2010 meeting summary provide more than 60 recommendations and other constructive comments aimed at improving NOAA's climate services. COM has formulated responses to approximately 45 recommendations.

Given the large list of recommendations from the April 2007 review, the substantive overlap among many comments, and the need to work across the Climate Goal (CG) to address others, COM offers the following responses to the CWG, organized by primary topics:

(1) General

Recommendation: *There is a need for an integrated structure and clearer framework for COA activities/service.*

NOAA agrees with the review finding that a Climate Service line office within NOAA would ease many of the perceived management challenges. A Climate Service line office has been proposed by the Department and a reorganization package has been submitted to the Office of Management and Budget for review and comment. The proposed Climate Service includes an Office of Observing Systems, Data Stewardship, and Climate Monitoring to build a more integrated program. The Agency has developed a NOAA Climate Service Vision and Strategic Framework document, which addresses basic services as well as four cross-cutting societal challenge areas that will foster integration and coherence across the proposed Climate Service as well as across the agency.

Recommendation: *Adopt a "climate information system" approach.*

An end-to-end approach, connecting science to society, is a goal of The Climate Service and this will be aligned with the strategic vision for USGCRP. The Climate Service Vision and Strategic Framework outlines a way forward for developing this end-to-end approach and also points out priority areas for development by identifying four key societal challenges.

Recommendation: *Engage external partners.*

Partners are being engaged at all levels – World Climate Research Program (WCRP), Intergovernmental Panel on Climate Change (IPCC), GCOS and GOOS, NSF, NASA, universities

(CIs). Internationally, NOAA has agreements for specific ocean observing systems, including: India, Japan, Brazil, and France on tropical moored buoy arrays.

Recommendation: *Sustain user engagement/feedback.*

The NOAA Global Ocean Observations System Annual System Review invites user input/feedback and trips to user offices to determine data uses and needs; “Monthly Ocean Briefings” enable data providers & user community to interface. The Framework outlines an approach for “Needs Assessments” to be conducted by the Climate Service, which will substantially sustain and broaden user engagement and feedback.

Recommendation: *Enhance the ocean-observing system (deep-diving Argo, Ocean Reference Stations (ORS), biogeochemical sensors).*

This will be determined based upon availability of resources. The 2011 President’s Budget initiative on sea level includes deep Argo and ORS. OceanObs’09 calls for sustaining the system, then enhancing it as resources become available.

Recommendation: *Achieve integration across observing systems.*

Restructuring of Climate Program Office (CPO) brought the atmosphere, ocean, and Arctic observing systems closer, but still with a disparity of resources and approaches. There is a need for further development under a Climate Service. The Climate Service proposal includes an Office for Observing Systems, Data Stewardship, & Climate Monitoring, that will be responsible for improving the integration of climate observing systems.

Recommendation: *Consider networks holistically.*

The observing system is implemented under the auspices of the Global Climate Observing System (GCOS), which uses a holistic approach and contributes to a full global observing system component by addressing those areas for which NOAA has resources. NOAA plays an active role in the development of GCOS and works to leverage its contributions with those of international partners.

Recommendation: *Establish synergies and interrelationships among observing components to aid in prioritization.*

Prioritization of observing components is accomplished as is possible and is generally performed using the following criteria:

- Observations needed to maintain a Climate Data Record. Reference observing systems used to bridge gaps and discontinuities in the satellite are of particular interest.
- Observations to support a new research or service effort
- Observations supporting internationally agreed upon goals and plans

- Observations that provide demonstrated support for prediction
- Observations that provide demonstrated support for services
- Observations that provide critical support for climate assessments

Recommendation: *There is a need for a Climate Observing System Council (COSC)–like advisory group for other components of the observing efforts.*

Unlike the more PI-based research approach to ocean climate observations, the atmospheric climate observing program is not PI-based and is based on a systematic approach to installing and maintaining sites that does not lend itself to the need for a COSC-like advisory group. The Carbon observing system is coordinated and discussed within the Carbon Cycle Science Steering Group and Interagency Carbon Cycle Working Group of the USGCRP. The NOAA Science Advisory Board (SAB) will be reviewing the composition of all formal working groups. Options for advisory groups are also being considered in the context of the proposed Climate Service.

Recommendation: *SWOT analysis should be performed.*

This recommendation will be adopted once the Next Generation Strategic Plan (NGSP) is in place and the Climate Service is formed.

(2) Data Ingest, Access, and Archive (and “Storage” CLASS CONOPS)

Recommendation: *Leadership of data management activities should be clearly defined to provide more appropriate levels of direction, prioritization, and integration of activities, to more systematically identify opportunities and risks, and to raise the needed funds in the budget process.*

Considerable progress has been made since 2007 and data centers are much more involved in managing the overall CLASS effort. The institution of the Climate Data Records program at NCDC fosters and empowers this leadership. Merger of all data centers and CLASS into the Climate Service will further facilitate this leadership.

Recommendation: *If GEO-IDE is the solution to integration/interoperability problems, then there needs to be top level recognition in NOAA that GEO-IDE is important and GEO-IDE should be prioritized as such; integration is required to accomplish the Climate Goal. GEO-IDE and CLASS should be linked.*

Implementation of GEO-IDE, which is in its initial stages, is under the auspices of the NOAA Environmental Data Management Committee (EDMC), which oversees data management policy across NOAA. GEO-IDE is a foundation element for NOAA’s Environmental Data Architecture.

The DMIT (Data Management Integration Team) under the EDMC has developed a set of GEO-IDE Guidelines and Best Practices that includes recommendations on data and metadata standards, working across all of NOAA’s data management programs and data centers. Most

recently, it has been briefed to the Climate Program Office Global Interoperability Program and continued interaction and coordination is anticipated.

The NOAA National Data Centers are using CLASS to provide archive services for major NOAA observing system programs and are active participants in DMIT and the GEO-IDE initiative.

Recommendation: *Addressing the interoperability issues for climate studies is required not only with groups outside of the Climate Program within NOAA but also with groups external to NOAA.*

EDMC, DMIT, and GEO-IDE sponsor membership and support or coordinate participation in formal standards bodies including ISO TC 211 and the Open Geospatial Consortium (OGC) and with interagency, international and community organizations. The efforts to develop the GEO-IDE Guidelines and Best Practices draw on these external interactions and the EDMC and DMIT provide the internal forum to discuss and promote them across NOAA programs. The GEO-IDE initiative is also sponsoring a pilot project to provide a Unified Access Framework to existing gridded data collections (UAF-Grid) from multiple NOAA programs and potentially non-NOAA data sets. The GEO-IDE Standards Sub-task has developed and demonstrated crosswalks between a number of important data and information standards widely used in the community (OGC, OpenDAP, Unidata, ISO).

(3) In-Situ Observing Systems and Data Management Including Stewardship

Recommendation: *There should be a better link with, or inclusion of, regional coastal ocean observing efforts going on under NOS and NWS.*

Physical co-location of the NOAA Climate Program's observation group with the Integrated Ocean Observing System (IOOS) program provides better communication and linkage for ocean observations.

Collaboration on development of the NOAA contributions to the National Ocean Policy Engagement Strategy is occurring.

Recommendation: *Overlapping old and new observing systems is needed and decommissioning of elements of the observing system not performing as needed.*

Within the Argo Program, several experiments have been conducted where Argo and Conductivity Temperature Depth (CTD) measurements of temperature and salinity; and Argo, Expendable Bathythermography (XBT), and CTD measurements of temperature have been compared, and considerations are being made to phase out some systems for budget and logistical reasons.

Recommendation: *A project office for climate observations should be established to ensure integration with service development, modeling, and assessment activities. Funding increases are needed to move forward with the observing system.*

As NOAA moves forward with a Climate Service, basic services will be provided under four core capabilities, one of which is observing systems, data stewardship, and climate monitoring. The proposed Climate Service structure dedicates a budget line and office to Observing Systems, Data Stewardship, & Climate Monitoring. As the Climate Service develops, we will continue to explore options for funding increases to support observing system expansion.

(4) Analysis including Reanalysis, Observing System Simulation Experiments (OSSEs), Observing System Experiments (OSEs), and Related Research

Recommendation: *In reanalysis activities, there is insufficient attention to seeking advice, developing advisory teams, learning lessons from previous/ongoing reanalyses, upgrading input data, developing grants program to recruit users to help exploit and evaluate the products, and especially developing a detailed plan with goals and objectives that can help determine the success of the project; A strategic, systematic approach is required.*

As part of the 2011 Climate Program Office Announcement, the Modeling, Analysis, Prediction and Projection (MAPP) program has called for proposals that evaluate/intercompare recent reanalysis projects.

One aim of Global Ocean Data Assimilation Experiment (GODAE) OceanView is to formulate more specific requirements for observations on the basis of improved understanding of data utility. One of the four task teams of GODAE OceanView, joint with GCOS Ocean Observation Panel for Climate (OOPC), is the Observing System Task Team of which NOAA is a member.

NCEP has released the Climate Forecast System Reanalysis, a major upgrade over the previous generation of reanalysis products. Development of the CFSR was guided by a Science Advisory Board whose membership included experts from academia and government and international organizations, and by NCEP's many years of experience with providing and using climate reanalyses since the release of NCEP/NCAR Reanalysis. Evaluation of reanalyses was the topic of a recent workshop sponsored by NOAA, NASA, NSF and U.S. CLIVAR (November 2010).

The 20th Century Reanalysis project is an international collaborative project lead by NOAA and CIRES while profoundly connected to other reanalysis efforts and user communities nationally through U.S. CLIVAR (Climate Variability and Predictability Program) and internationally through ACRE (Atmospheric Circulation Reconstructions over the Earth).

The Climate Service will fully develop and implement interagency coordination and collaboration including defining complementary roles and responsibilities

(5) User Communities and Climate Services and Product Development

Recommendation: *A more unified and visible system might result in more support for sustained endeavors. This could include an individual or office dedicated to executing research to operations. Prioritization of products is also an ongoing reality, and one that must be better met within NOAA.*

The NOAA Climate Service Vision and Framework provides for a more cohesive and unified structure to support sustained endeavors. NOAA has proposed an Office of Service Development and Delivery to support the core capability of Integrated Service Development and Decision Support. The service development component of the Climate Service, as well as the grants programs, will reside within this office. This office will address the more systematic transfer of knowledge from research to operations.

Recommendation: *Engage partners and the external community.*

The OceanObs'09 international conference entrained the world ocean climate community in discussion of lessons learned from past ocean climate observations and of priorities for continued observations.

Climate Observations and Monitoring Program has a long-standing interest in climate variability and change in Arctic region and in the response of the marine ecosystem, in association with many national and international partners. Current efforts involve coordinated observations of defined variables in defined areas over varying times, with eventual joint analysis of data.

Colleagues at the NOAA Climate Prediction Center carry out monthly ocean climate briefings under Climate Observations Division sponsorship.

NOAA supports the NOAA Climate and Global Change Postdoctoral Fellowship Program and the Postdocs Applying Climate Expertise programs, in order to strengthen connections to internal personnel and to create the next generation of researchers needed for climate.

Recommendation: *User feedback must be better solicited; partners must better share in development and maintenance responsibilities as opportunities arise. NOAA must become more adept at entraining these partners.*

The global ocean observing system user community is invited to attend the Climate Observation Division Annual System Review to speak in a user session about their observational needs.

The Climate Service Vision and Strategic Framework document describes the process of using needs assessments to gain user feedback, especially in the four societal challenge areas. The needs assessment process will include partnering with users to understand observations and monitoring needs.

(6) Detection and Attribution

Recommendation: *Develop a strategic implementation plan for a NOAA climate attribution program with a focus on Coordination, Research, and Communication.*

Although NOAA funds attribution research, there is currently no strategic implementation plan for a NOAA climate attribution program. CPO solicits proposals that address various aspects of the detection and attribution problem in collaboration with DOE. NOAA and DOE support an ad hoc International Detection and Attribution Group (IDAG) that brings together international experts to focus on key, emerging issues in detection and attribution. Recently, NOAA has started an attribution team across the agency lead by the Physical Science Division at ESRL . This team examines the causes and implications of major weather or climate events that happen during the course of a year, such as major snow storms, droughts, floods, extreme storm systems, or changes in water levels. Reports from this group are treated as influential information and undergo independent review, consistent with the Information Quality Act.

Recommendation: *NOAA needs to speak on climate attribution issues, and must do so in a way that maintains agency credibility and reliability. The science of attribution is still not that well developed, nor likely sufficient to support an operational “attribution service.” Extreme care should be taken to stay within the science.*

NOAA is not yet ready for an attribution service, but ready for a more organized and better-funded climate attribution program. See discussion above about the new NOAA Attribution Team, which is doing this on an experimental basis. An attribution service is a worthy goal.

Recommendation: *A committee – made up of NOAA and non-NOAA experts in climate attribution, as well as user oriented scientists – needs to guide and provide oversight that NOAA represents the community consensus on what we can and cannot say about climate attribution.*

An experimental attribution team has begun at our Boulder ESRL Physical Sciences Division (<http://www.esrl.noaa.gov/psd/csi>). The team is comprised of members from a number of NOAA laboratories and centers. Several experimental products and analyses were provided by this team within the past year. NOAA is following the guidelines and practices provided by the Information Quality Act to oversee products produced by the attribution team.

(7) Carbon Tracker

Recommendation: *NOAA should consider Carbon Tracker as a prototype of an integrated earth system analysis that links observations, modeling, prediction, and dissemination of results.*

A NOAA Carbon Cycle Research Plan draft is available.

Recommendation: *NOAA should pursue a major expansion of its greenhouse gas observation network.*

If additional funding in FY11 becomes available, it will be devoted to an increase in atmospheric CO₂ observations in part, as well as data management efforts. The agency is also involved with a number of other federal agencies concerning the development of a more extensive Monitoring, Research and Verification system for the carbon cycle.

(8) Understanding the State of the Climate (including data assimilation) and Monitoring

Recommendation: *A team approach to external peer review for Annual State of the Climate Report may be warranted.*

Editors of the State of the Climate report partnered with the AMS to institute a peer-review of the report beginning in 2008.

Recommendation: *The State of the Climate Report should expand towards a synthesis and integration of climate observations; included DVD with data.*

The BAMS State of the Climate Report documents the state of the climate from a number of vantage points. It is intended to be a resource of what happened from a global climate perspective the previous year and resource for others to use and is not by itself an applied work integrating across sub-elements. Synthesis and integration, which blends rapidly into attribution, quickly begins to exceed the scope of the report as currently conceived, so it may be most reasonable and effective to work to launch an expanded companion (“delayed-mode”) report.

(9) Space-based Observing Systems and related Data Stewardship

Recommendation: *COA should develop a clear and consistent vision for the role of satellite data in climate services.*

A vision for the role of satellite data has been set forth in the *Climate Service Vision and Strategic Framework*, Appendix A. The role includes engaging in partnerships to expand capabilities, providing open access to data, and supporting the satellite research community to build climate data records through a competitive grants program.

Recommendation: *Address satellite data assimilation, relationships and dependencies on other parts of NOAA, and the long-term relationship between NASA and NOAA.*

The Joint Center for Satellite Data Assimilation was formed by NOAA and NASA in 2001 and has worked to advance assimilation of satellite data, though primarily at weather time scales. The larger issue of coordination between NASA and NOAA is formally addressed by the NASA Earth Science-NOAA Joint Working Group on Transition of Research to Operations, which is quite active and represented at the highest levels of NOAA/NESDIS and NASA Earth Science.

Examples of successful or promising handoffs from NASA to NOAA include the JASON series and the TSIS and CERES sensors that are to fly on JPSS.

(10) Program Management

Recommendation: *Address problems imposed by PPBES process, including: conflict of interest over program manager of COA being Director of NCDC; disconnect between planning and execution; accountability of Climate Program Office to ensure coordination with outside community.*

NOAA is transitioning from PPBES to a Strategy Execution and Evaluation (SEE) process. SEE allows the accountability and authority over resources, as well as program management, to reside within each line office. The formation of the proposed Climate Service Line Office will allow for increased oversight and direction over formulation, execution and evaluation of climate activities.

Recommendation: *NOAA should commit a fixed fraction of program funds to peer-reviewed extramural funding, and maintain this funding commitment.*

The NOAA Programs performing climate research maintain a balanced portfolio of peer-reviewed extramural/intramural and non-peer-reviewed extramural/intramural. Maintaining budget flexibility is critical for NOAA to meet its strategic goals and objectives. A fixed fraction may limit management flexibility. However, NOAA does have a goal of maintaining a robust peer-reviewed extramural grant program and awards over \$100.0 million in competitive research.

Recommendation: *Create a separate Climate Service line office within NOAA to ease many of the perceived management difficulties; an observations group under a Climate Service might be responsive to this comment.*

NOAA is establishing a Climate Service line office that will combine the United States' world-class climate monitoring and modeling capabilities with a scalable new partnership for sharing knowledge and building professional capacity at all levels of society. The basic climate services currently provided by NOAA will grow and evolve through the sustaining and strengthening of the Climate Service core capabilities.

Responses of the Climate Research and Modeling (CRM) Program to the Recommendations of the Climate Working Group (CWG) Review of NOAA's Climate Research and Modeling Program

The March 2008 CWG-sponsored programmatic review of the CRM Program and the CWG's Spring 2010 meeting summary provided 81 recommendations aimed at improving NOAA's climate research and modeling efforts. CRM has formulated detailed responses to these recommendations (complete responses, together with other relevant reviews of various CRM functionalities, such as the OAR Laboratory Reviews conducted by External Panels, are attached to this Response Report). Given the length of this list, the substantive overlap among many comments, and the need to work across the Climate Goal to address other Programs' recommendations, CRM is listing below a few of the key written responses to the CWG in the following areas.

(1) Recommendations for better coordination, integration, and strategic planning.

Recommendation: *A key challenge for the future is to improve the overall design and cooperative interactions of the institutional components involved in the CRM Program through strategic planning. There is a need to coordinate/integrate climate research and modeling across NOAA labs, cooperative institutes/centers; and competitive grants programs. A strategic plan would provide a basis for this integration.*

This recommendation is to develop a Program strategic plan that defines its vision, mission, goals, and objectives, and lays out clearly the roles and required interactions of the numerous laboratories, centers, institutes and grant programs engaged in CRM-related activities. A more unified strategy of Climate programs would improve effectiveness besides underpinning the products with scientific rigor. This plan should have sufficient specificity on how NOAA will integrate work both across a Climate Service and with other parts of NOAA (i.e., other goal teams and Line Offices), as well as with Federal, academic and other partners. CRM members will continue to contribute to the strengthening of climate research and modeling, and to the development of plans that implement priorities and activities as articulated in the Climate Service Vision and Strategic Framework and NOAA's Next Generation Strategic Plan. These will include: Roles of Labs, Centers, Institutes; Roles of Grant Programs; Intramural and Extramural Interactions; and in general better integration across NOAA on common objectives. The Climate Service Vision and Strategic Framework has been released for public review. That document identifies Understanding and Modeling as one of four core capabilities, all of which will focus initially on four societal challenges. These challenges will require concerted effort by the CRM members, working with internal NOAA and external partners. The development of integrative, strategic directions also requires addressing fundamental issues of organizational culture and structure.

Recommendation: *There is a need for better coordination of chemical and physical sciences in NOAA.*

The Climate Service's organizational approach combines chemical and physical sciences into one organizational unit for improved coordination and collaboration. The Framework describes how the interdisciplinary nature of the cross-cutting societal challenges requires a high level of collaboration. Both physical and chemical sciences have already initiated joint planning and management processes to ensure coordination. Current examples of collaborative interactions between ESRL and GFDL include CarbonTracker and research on aerosols and ozone; interactions between NCEP and GFDL include the transition of ocean models.

Recommendation: *Development of the ESM will require additional resources and strategic plans to take advantage of collaborations across the larger community.*

The ESM plan for FY11-15 incorporated in the FY11 President's budget includes resources to address biogeochemical feedbacks and biogeochemical-climate interactions, sea-level rise, and Arctic climate. The ESM strategy will also be responsive to the details of the Climate Service Vision and Strategic Framework and implementing plans. An ESM that closes the carbon cycle and using MOM4 is being used to perform simulations for the CMIP5 project and IPCC AR5. GFDL is making progress in the area of land-ice modeling, another FY11 component, through collaborations involving CICS (Princeton University) and UCAR. As the ESM efforts evolve, there is likely to be increased collaboration with NCAR particularly in the area of terrestrial biology. GFDL is part of the new data network based on the Earth System Grid, partly developed at NCAR. In addition, a collaborative effort between CarbonTracker and GFDL ESM developers has been started to include ESM component models in the CarbonTracker.

Recommendation: *NOAA should undertake a strategic planning exercise toward (possible) operational decadal predictions.*

The initial strategic aspects of a decadal prediction system are addressed in the Climate Services Vision and Strategic Framework. A key hurdle is to establish whether or not there is useful predictability at decadal scales. The evaluation of the CMIP 5 and IPCC AR5 decadal prediction experiments will be a near-term step for this evaluation. Planning for operational decadal predictions should be based on a solid foundation of fundamental research.

Recommendation: *Several comments and recommendations were made on planning, prioritizing, balancing, budgeting, engaging policy scientists, coordination, ESRL representation, integrated budget planning, and evaluating the direction of Applied Research Centers, Cooperative Institutes, for the Climate Service and customer involvement.*

Some of this is addressed in the Climate Service Vision and Strategic Framework; Interactions with the Climate Observations and Modeling Program include: climate model and data portal; Carbon Tracker; GOOS; upper tropospheric water vapor analyses; IESA; assessment processes. Besides intra-Lab interactions, CRM has also increased interactions with other OAR Labs (e.g.,

ARL, GLERL) and CPC, particularly in the form of partnerships in budget proposals with CIs e.g., CICS and CICAR.

Recommendation: *NOAA should lead 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.*

This recommendation has been endorsed by the National Academy of Public Administration study on options for a NOAA climate service. However, OSTP has identified itself as the coordinating agency for establishing the multi-agency effort for climate services and has begun the process through a multi-agency round table. NOAA does not have the authority to address the development of an entity that can receive all climate information across the federal government.

Recommendation: *Strategic planning and management is required at all levels in NOAA to allow the development of integrating activities; budget, reporting, and incentive mechanisms need to be developed to align organizations with agency goals.*

NOAA’s Next Generation Strategic Plan highlights integrating themes and was available for public comment over the summer of 2010. Accountability to strategic outcomes is critical to success. One of the purposes of the establishment of the Climate Service in NOAA is to achieve greater accountability mechanisms.

Recommendation: *NOAA cannot provide the best Climate Services without well-designed partnerships; NOAA needs a clear understanding of who its “climate customers” are.*

NOAA has outlined its strategy for coordination and facilitation with other Federal agencies within the Climate Services Vision and Strategic Framework, which includes utilization of bilateral Memoranda of Understanding, such as we have done with the Department of the Interior. Note that the Services customers are in addition to sustaining the climate science information and data exchange with stakeholders and decision makers nationally and internationally.

The strategy also articulates NOAA’s approach for Assessment Services and regional partnerships, both of which have inherent requirements to identify and engage with stakeholders in order to identify which problems to focus on, thus linking science to decision making.

Recommendation: *The Panel suggests that NOAA develop a management strategy that is consistent with modern concepts of open innovation or open communities – a generalization of the open source software culture. Success will require the development of community governance models, which include definition of process for building and modifying capabilities.*

The management strategy for the Climate Service is described in the Climate Services Vision and Strategic Framework. The Framework also describes how the Climate Service values modern management concepts such as transparency, user engagement, rapid infusion of research findings into products and services, and continuous improvement.

Recommendation: *Recognizing the successful attributes of the Climate Process Teams, the Regional Integrated Sciences and Assessment Programs, and the Applied Research Centers, the Panel recommends that NOAA develop an agency-wide strategy that incorporates these middle-sized activities as key strategic elements, utilizing integrating activities focused at the interface between organizations. NOAA should form ad hoc research teams and include non-NOAA scientists.*

Within the development of the Climate Service, there is continued support for the RISAs and Climate Process Teams. The Climate Program Office has increased the number of RISA centers to 11 and substantially increased their budget. Climate Process Teams (CPTs) selected and supported by CPO are aimed to speed development of global coupled climate models by bringing together theoreticians, field observationalists, process modelers, and the large modeling centers. CRM scientists are participating in four new CPTs. NOAA sees them as valuable mechanisms and will continue to support them. NOAA also recognizes and continues to utilize ad hoc research teams.

Recommendation: *The CPO should balance the funding of internal NOAA research groups and Cooperative Institutes with those of the external community to ensure that fresh ideas, perspectives and contributions can be brought forward for R2O transition*

The CPO views the Cooperative Institutes as one of the mechanisms for interactions with the external community. Since September 2005, NOAA's Cooperative Institute program has been governed by NOAA Administrative Order (NAO) 216-107, which provides for review and re-competition of Cooperative Institutes as well as the creation of new Cooperative Institutes to meet agency needs. The restructuring of the CPO programs is expected to provide more efficient use of funding to the external community.

(2) Recommendations for Improved Performance of Models and Predictions

Recommendation: *GFDL and NOAA management should reach a mutual agreement on the relative priorities of Climate Modeling and ESM development.*

GFDL's research priorities in Climate Modeling and ESM development are responsive to agency directives, including NOAA's Next Generation Strategic Plan, the NOAA Administrator's Annual Guidance Memorandum, the mission of NOAA's Climate Goal and the emerging requirements of NOAA's climate services. Priorities are also guided by NOAA's participation in national and international efforts including the U.S. Global Change Research Program and the Intergovernmental Panel on Climate Change and the Assessments thereof. Within GFDL, priorities are set by senior management and GFDL's new Strategic Plan (response to the GFDL

External Review conducted by OAR, report in preparation). Execution of GFDL's priorities is reviewed periodically by a panel of experts convened by NOAA's Office of Oceanic and Atmospheric Research (e.g., July 2009 Review of GFDL). GFDL is contributing two sets of Earth System Model simulations, using two different ocean models, to the Intergovernmental Panel on Climate Change 5th Assessment.

Recommendation: *Management should emphasize better coordination between measurements and modeling and between small-scale process modeling and large-scale prediction.*

Examples of existing programs that coordinate measurements and modeling include Carbon Tracker, and long- and short-lived atmospheric species; assimilation of ocean data into models; and partnerships on data assimilation, analysis and reanalysis. GFDL has selected two visiting scientists, one to address Atmospheric Radiation Measurements program observations in the context of model development and one to address large-eddy simulation-based stratiform cloud parameterization. Climate Process Teams (CPTs) selected and supported by CPO are aimed to speed development of global coupled climate models by bringing together theoreticians, field observationalists, process modelers, and the large modeling centers. CRM scientists are participating in four new CPTs.

Recommendation: *Ocean modeling science and algorithms developed in the large community filter into the GFDL ocean models more slowly than they should.*

GFDL has developed two world-class ocean models, and both will eventually be operating from one code base. Many ocean modeling science, algorithms, and parameterizations developed by, or in conjunction with, the larger community e.g., CPT process and have been incorporated into the code, evaluated, and adopted. One application resulting from an improved isopycnal ocean model has been the first NOAA model simulation study of the underwater plumes of dissolved oil in the the DeepWater Horizon disaster (Adcroft et al., *Geophysical Research Letters*, 2010)

Recommendation: *NCEP is now investing in HYCOM, so GFDL and NCEP should collaboratively perform an evaluation of HYCOM's performance as an ocean model.*

HYCOM works for NCEP for the real-time now-casting and short-term (up to 10 days) prediction problems but significant issues arise for the long-term climate simulations. A key challenge for the future is building a real-time data ingest and data assimilation system encompassing GFDL's new ocean modeling capabilities.

Recommendation: *GFDL's land-model development activity does not appear to be at the cutting edge. Land-ice modeling is a crucial area for future development.*

GFDL's land modeling effort uses the latest science. There is now a paper on the land model (Shevliakova et al., *Global Biogeochemical Cycles*, June 2009). The new scheme is included in

the GFDL climate model simulation streams for CMIP5 and AR5. The land-ice modeling is a key area requiring improvement. The FY11-15 ESM project in the FY11 President's budget includes funding to focus on ice sheet modeling.

Recommendation: *The panel is concerned that the influence of water, nitrogen, and phosphorous cycles on the carbon cycle are not receiving enough attention within the ESM effort.*

Currently in the LM3 land model, the carbon and water cycles are coupled on both short-term and long-term time scales. The ESM project in the FY11 President's budget is for modeling various aspects of the terrestrial carbon cycle, including nitrogen/phosphorous soil-vegetation modules, and biogeochemistry models for wetlands, surface waters and rivers.

Recommendation: *The state of understanding of the interactions among coastal upwelling, advection, nutrient cycling, river inputs, and estuarine biogeochemistry and sedimentation remains poor.*

A key uncertainty impeding our ability to predict how these systems will change in the future is our inability to represent these coastal systems in models of global climate change. Such representation is a critical focal point of future research. An initiative addressing a portion of this problem is contained in the FY11 President's budget. However, an expansive scope is required to significantly increase the understanding.

Recommendation: *NOAA should continue to push through the resolution envelope, at least for decadal-scale modeling. For physical and biological systems, improved resolution of coastal systems is vital.*

Increasing resolution is desirable, and will be achieved to some degree using new ARRA-funded NOAA high performance computing resources at DOE/Oak Ridge National Laboratory (ORNL) when complete in FY11. An initiative to support the development of two-way nesting of regional ocean models in global ocean models is included in the Earth System Modeling: Urgent Climate Issues request within the FY11 President's Budget.

Recommendation: *There is a need for a more integrated NOAA approach to high performance computing. NOAA must recognize the importance of the information technology infrastructure necessary to support its science-based generation of products and services, including high-performance computing and communications.*

NOAA has a High Performance Computing Strategic Plan and Roadmap that identifies a new Target Architecture for NOAA HPC. The American Recovery & Reinvestment Act of 2009 provides NOAA with \$170M for high performance computing. We have installed the first phase of this at Oak Ridge National Laboratory in Tennessee. This will be augmented over the next year. The second NOAA site in Fairmont, West Virginia, will be operational in 2011. NOAA is developing an allocation process that will be applied to NOAA's entire HPC infrastructure.

(3) Recommendations for Transfer of Research to Operations

Recommendation: *Transfer of research products from labs to operations needs to be managed more effectively.*

GFDL and NCEP (EMC and CPC) have agreed to explore areas in which collaborative research in climate sciences can be pursued that will be mutually beneficial to each organization. Annual workshops and seminars are being planned to enhance communication and collaboration between GFDL and NCEP for example.

Recommendation: *Determine if, when, and how, the Coupled ensemble filter Data Assimilation (CDA) should transition to the Climate Forecast System (CFS).*

The CDA at GFDL is a crucial component of the future decadal prediction system. Season/interannual hindcasts obtained using the CDA and CM2.1 have been performed at GFDL and given to NCEP for the MME evaluation. It is cautioned that a data assimilation system designed to meet climate research needs may not be ideally suited to NCEP's need for operational prediction at shorter time scales. Transition for the CDA to the CFS would require significant additional resources.

(4) Synthesis of Research

Recommendation: *NOAA's leadership and support of policy-oriented scientific assessments should continue, including IPCC and ozone assessments. NOAA should ensure that adequate resources are allocated to key NOAA institutions. Strong efforts should be made to avoid scheduling overlap between the IPCC assessments and any national effort.*

We continue to support NOAA participation in assessments. Our participation is strengthened with the development of the NOAA Climate Services Implementation Strategy as well as the budget process. The Framework's section on the importance of assessment describes three types of assessments: 1) National and International Climate Science Assessments 2) Problem-Focused Climate Science Assessments and 3) Needs Assessments. In the FY10 budget, NOAA received \$9M for assessments. The FY11 President's budget would provide resources for a permanent capability to produce climate assessments at national and regional scales. The assessments will synthesize, evaluate and report on climate change research findings, evaluate the effects of climate variability and change for different regions, and identify climate vulnerabilities and uncertainties as part of an ongoing effort to understand what climate change means for the United States. NOAA will build permanent capacity for regional climate assessment services. This assessment services capability will serve as a cornerstone of NOAA's climate services.

The schedule for IPCC and National Assessments are outside of the purview of NOAA. Requirements for National Assessments are part of the USGCRP and are conducted every 4 years. The IPCC requirements are set by the IPCC governing body.

Recommendation: *NOAA should strive to make the assessment process as transparent and rigorous as possible, with clear articulation of the targeted “users;” all policy-influential reports like those produced by the Climate Change Science Program should be reviewed by the National Academy of Sciences. NOAA and other government agencies should not both facilitate and author assessments, there must be clear independence between these two roles.*

NOAA has helped the OSTP take a leadership role in developing the next national assessment, which will occur in 2013, and is working with collaborating agencies of the USGCRP. In addition, NOAA supports the National Assessment through an IPA for Professor Kathy Jacobs, who is on detail to OSTP, and serves as the assistant director to the National Assessment. She is developing a plan for the National Assessment, which aims to achieve broader participation and communication with users of the assessment process while separating the role of government agencies and ownership and provides independence to address the conflict of interest.

All policy-influential documents meet the criteria/demands for the Information Quality Act and Peer Review Bulletin for highly influential scientific assessments and influential scientific information. The Implementation Strategy would follow IQA proceedings, some to be reviews by NAS for the National Assessments.

Recommendation: *NOAA should explore ways to make their success in the policy-oriented scientific assessment process more of a vehicle for cross-CRM and cross-NOAA-climate-program integration and resource prioritization.*

NOAA utilizes a suite of assessment approaches in order to support a cross-cut of NOAA activities. These assessments are used to design specific services, products and/or tools for stakeholders such as policy makers, decision makers, and/or resources managers, which in turn impact local and regional decisions. We agree that assessments are a valuable tool to help identify what problems to focus on, by linking science to decision making. Nevertheless, the Climate Service Vision and Strategic Framework makes clear that not all priorities for Services are based on their applicability to the assessment process.

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

Recommendation: *The successful CPC-RISA paradigm should be expanded.*

CPO and CPC have entered into discussions on how to provide sustained support of the CPC-RISA exchanges. The recent expansion of the number of RISAs will place a practical limit on CPC's ability to sustain such an effort without an increase in staff.

Recommendation: *The Applied Research Centers (ARCs), Joint Institutes (JI) and Cooperative Institutes (CI) need to be reviewed, re-considered, and re-competed in the context of the Climate Test Bed, the more successful RISAs, and the fact that other NOAA elements and activities from other agencies should be brought together in a strategy for climate prediction products and services. Possible redefinition of these centers and institutes should be considered in context of the review and implementation of strategic planning efforts. The underutilization of these centers and institutes is a problem worth fixing.*

Response: The ARC program has been re-evaluated with a decision to retain two of the ARCs through the next cycle and to re-program the remaining resources to support MAPP and ESS goals. Since September 2005, NOAA's Cooperative Institute program (which includes Cooperative Institutes and Joint Institutes) has been governed by NOAA Administrative Order (NAO) 216-107 which provides for review and re-competition of Cooperative Institutes as well as the creation of new Cooperative Institutes to meet agency needs.

Responses of the Climate Services Development (CSD) Program to the Recommendations of the Climate Working Group (CWG) Review of NOAA's Climate Information Products and Applications (CIPA)

The July 2009 CWG-sponsored programmatic review of the CSD Program (called CIPA for purposes of the review) and the CWG's Spring 2010 meeting summary provide more than 50 recommendations and other constructive comments aimed at improving NOAA's climate services CSD has formulated responses to approximately 45 recommendations. Given the length of this list, the substantive overlap among many comments, and the need to work across the Climate Goal (CG) to address others, NOAA offers the following responses to the CWG, organized by primary topics:

(1) Strategic Framework / Strategic Plan for Climate Services

Recommendations: *Develop program and goal-wide strategic plans with sufficient specificity on how NOAA will scale up climate services and integrate work both across the NCS' elements and with other parts of NOAA (i.e., other goal teams) (CIPA Program Review, July 2009. Executive Summary: High Level Findings and Recommendations. Recommendation 1, Page 7)*

A Vision and Strategic Framework for a Climate Service in NOAA has been released for public review. That document identifies Integrated Services Development and Decision Support (ISDDS) as one of four core capabilities, all of which will focus initially on four societal challenges. These challenges require concerted effort by the ISDDS working with internal NOAA organizations and external partners. Already, six new Regional Climate Services Directors have been selected and have begun the tasks of coordinated and mutually supportive functions. An important effort for the RCSD will be to develop Regional Action Plans that lay out clear efforts in State, local, and tribal engagement, regional climate science, assessment services, and integrated climate products and services for decision support.

Recommendation: *Embrace as an urgent priority the task of developing its current array of climate information products and applications into a much more robust set of climate services, able to meet our nation's current and future needs (CIPA Program Review, July 2009. Executive Summary: High Level Findings and Recommendations. Recommendation 3, Page 10)*

Response: The Climate Service in NOAA seeks to combine the agency's world-class existing service development, delivery, and communication capabilities, to create a service-oriented organization that advances scientific understanding, engages users collaboratively and delivers service. A first step will be to integrate existing capabilities and experience with climate-relevant science and services.

Recommendation: *The CWG and the SAB, as they revisit NOAA programs in COM, CRM, and [CSD], should recognize the transitional nature of [CSD] and conduct, perhaps within a year, a*

true climate services review. This should comprehend the whole of NOAA's climate service activities across the agency (explicitly including, for example, CPC, and NCDC), not just those aspects considered in the CIPA 2009 review. It should also focus not just on process but also on substance (explicitly addressing, for example, aspects such as the incorporation of probabilistic information and uncertainty into products and services). (CIPA Program Review, July 2009. Executive Summary: High Level Findings and Recommendations. Recommendation 5, Page 11)

Response: The National Academy of Public Administration (NAPA) recently conducted a study and analysis of organizational options for a Climate Service within NOAA, emphasizing maximum effectiveness and efficiency. NOAA requested that the review panel provide an independent assessment of how NOAA should organize its climate capabilities; assess NOAA's proposed organizational structure; and make recommendations for a Climate Service line office structure that will integrate NOAA's climate science and research with service delivery. NOAA recommends delaying a full Climate Services Review until there is resolution on the Climate Service Reorganization package that is being submitted for approval.

Recommendation: *The absence of a comprehensive plan for dealing with the ecosystem dimension of climate change and climate adaptation is not surprising; however, the Climate Goal needs a very clear idea of how it is going to proceed to provide the best and most appropriate products and services where they will do the most good and serve the broadest range of clients possible. There needs to be close and effective linkages between the Climate Goal and the Healthy Oceans and Coastal Goals. (CIPA Program Review, July 2009. Panel 4.5: LMR/ecosystems, Page 22)*

Response: NOAA recognizes that the ecosystem dimension of climate change and climate adaptation is particularly necessary to a climate service. The Climate Service will focus on four societal challenges with broad economic range including the sustainability of marine ecosystems. Ecosystems are a priority to NOAA's mission and it is NOAA's priority to identify a comprehensive approach to address this societal challenge. In the new Climate Service structure, we will work across NOAA to address specific problems and will support development of new climate services necessary to meet these societal challenges.

(2) Methods to Evaluate Progress and Measure Performance

Recommendations: *The CIPA Review included numerous recommendations concerning performance measurement, which is an item for consideration and response by all of Climate Goal and the Climate Service. (CIPA Program Review, July 2009. Panel 4.7: Measuring Success/Performance Measures. Recommendations 1-5, Pages 27-28)*

Outcome-based performance measures are already under development. These in turn will necessitate using some social science methods for measuring the effectiveness of the activities undertaken by the ISDDS. Please see the table of responses in the appendix for more details.

(3) Improve Understanding of Existing NOAA Capabilities and Assets

Recommendations: *The recommendations in this area echo a long-standing issue: the need for NOAA to have a better inventory and understanding of its activities and assets, including external partnerships. The CIPA Review Panel, in particular, called for this inventory to extend beyond those activities funded or conducted through Climate Goal. (CIPA Program Review, July 2009. Panel 4.2: Regional/Place-Based Efforts, Pages 16-18)*

A “Needs Assessment” will be part of the Climate Assessment Program. To begin, ISDDS will conduct a thorough inventory of the existing assessments within each Region. With this basis, the place-based efforts can be better constructed to respond to the needs of the region based on the climate capabilities and assets already in existence.

(4) Partner/Customer Engagement, with two primary subthemes:

(A) Understanding of Customer Needs/Capabilities and Building Their Capacity

Recommendations: *An array of recommendations pointed to the need for NOAA to be externally focused and to be far more systematic in its work in order to better understand its customers and their needs and to prioritize its services. (CIPA Program Review, July 2009. Executive Summary: High Level Recommendations. Recommendation 3, Pages 10-11)*

With this in mind, the ISDDS has laid out an enterprise composed of core partners, boundary organizations and intermediary groups. Several partners familiar to the CWG include RCCs, RISAs, Sea Grant, and State Climate Offices, although it will also extend to groups such as the Climate Adaptation Knowledge Exchange (CAKE) and the National Science Teachers Association (NSTA). Leveraging existing networks and resources of partners is key to the organization of ISDDS.

Recommendation: *There is little sense of how the [Regional Services] philosophy translates to implementation and practice, relationships with partner agencies, or priorities, or any criteria for establishing priorities of regional climate services. It would be helpful, for either the CS as envisioned or an Interim/Transition Plan, to use a very specific case to “build out” climate services, with a realistic time schedule, to demonstrate that NOAA understands what it means to integrate science and regional services in practice. (Climate Working Group Meeting Report, Spring 2010. Climate Service FY2010-2020 Priorities-Regional Services, Pages 5-7)*

The Climate Service will foster the development of an innovative, integrated Regional Climate Services Partnership that brings together internal NOAA and extramural partner regional services activities and provides the institutional foundation for the Climate Service regional program. The NOAA Regional Climate Services Partnership comprises four

coordinated and mutually-supportive functional elements: state, local, and tribal engagement; regional climate science; assessment services; and integrated climate products and services for decision support. Six new regional climate service directors were recently hired to begin coordination and integration of partners within each region. One of their short-term deliverables is the development of an action plan fostering the expansion of current and future regional partnerships.

(B) Communication/Coordination (NOAA-Partner and Partner-Partner)

Recommendations: *Numerous recommendations focused on how to foster and sustain more robust, meaningful partnerships with and among NOAA's partners and stakeholders, and ways to improve flow of information and coordinate activities across the climate enterprise. A cross-agency effort is needed so that best practices can be shared and leveraged. (Climate Working Group Meeting Report, Spring 2010. Agency Partnerships, Page 5)*

Besides the installation of Regional Climate Service Directors, ISDDS is also coordinating through the USGCRP Task Force for Interagency Climate Change Communications, Education, and Engagement. Climate.gov virtual teams have begun building collaborative means to communicate on climate science and services. As the NCS Vision document states, ISDDS will work with a variety of partners inside and outside of NOAA, building mechanisms for sustained user dialogue, and collaborating with place-based experts to build on existing programs that are designed to improve that flow of information.

The Climate Service requires an organizational framework that brings together diverse scientific and service communities, including other parts of NOAA, federal, state, tribal and local agencies, cooperative institutes and other academic partners, the private sector, and the international community. The Climate Service will work closely with other bureaus to ensure that emerging scientific insights are transformed into high-quality products responsive to user needs. Formal, bilateral agreements will clarify roles and responsibilities and reduce unnecessary duplication.

Recommendation: *An important role of a climate service is to serve as the authoritative voice on the status of climate science questions, a function now performed on an ad hoc basis to a very limited extent by some RISAs (CIPA Program Review, July 2009. Panel 4.1 Interagency and private-sector partnerships. Recommendation 3, Pages 12-15)*

The Climate Service will build on existing programs designed to improve access to useful and usable NOAA climate data products and services, enhance overall climate literacy among the nation's citizens, provide technical training on Climate Service products and services, and expand the cadre of individuals skilled in understanding the societal

consequences of changing climate conditions and the scientific and technical capabilities that they have at their disposal.

(5) Other Aspects of NOAA's Climate Products/Services

Both the CIPA Review Panel and CWG identified other specific changes to NOAA's services, principally concerning timeliness, scope, scale, and subject matter content. An overarching means of service development is the push/pull model. The needs of the customers, within their decision-making environment, will drive the development and prioritization of climate services. In some cases, it will likely be several years before the related CIPA or CWG recommendations could be considered fully addressed. But, through the processes of stakeholder involvement in the development of the CS, four societal challenges have already been identified as the foci of attention for climate product and services development. *(CIPA Program Review, July 2009. Executive Summary: High Level Findings and Recommendations. Section 1B: NOAA's Collaboration with others, Pages 8-10)*

Responses to the NOAA Climate Working Group Recommendations from the *Review of the Draft NOAA Strategic Plan for National Climate Service and Options for Developing a National Climate Service (Barron Report)*

In June 2008, a review of NOAA's initial climate services strategy document, *Draft Strategic Plan for a National Climate Service*, was held in Vail, CO. The review was conducted by a 13 member external Review Team under the auspices of the Climate Working Group (CWG) of the NOAA Scientific Advisory Board (SAB).

The Review Team Report, *Climate Services External Review Report*² (July 15, 2008), recommended "that NOAA lead an effort, with its partners, to compare and contrast specific national options for the development of climate services." The report called for the creation of a Coordinating Committee and four Tiger Teams to explore the pros and cons of four National Climate Service organizational options:

1. Create a national climate service federation that would determine how to deliver climate services to the nation;
2. Create a non-profit corporation with federal sponsorship;
3. Create a national climate service with NOAA as the lead agency with specifically defined partners; and
4. A weather and climate service within NOAA developed from an expanded and improved weather services.

In response to the recommendation from the June 2008 review, NOAA supported the CWG's effort to convene panels of experts to discuss the development of climate services. This effort included the creation of the Climate Services Coordinating Committee, chaired by Eric Barron, and four Tiger Teams. Based on the results of the Tiger Teams' analysis and reports, the Coordinating Committee developed a final report, *Options for Developing a National Climate Service (Barron Report)*, which provides NOAA with recommendations related to the Vision, Mission, and Key Attributes of a successful National Climate Service. While the Coordinating Committee was not charged with making specific recommendations about implementation of any one of the four organizational options, it did provide five key implementation conclusions.

Five Key Implementation Conclusions:

(1) Internal Organization

Key Implementation Conclusion: *Internal reorganization of NOAA that enables greater connectivity of weather and climate functions is a necessary step for success.*

² The full Review Team report can be found on the NOAA SAB report website.

NOAA agrees and has planned for a climate service that supports this by:

- Incorporating existing climate science, research, and observation centers, as well as key data and service delivery infrastructure, into a new Climate Service Line Office
- Maintaining a close working relationship with the Climate Prediction Center of the National Weather Service
- Developing a regional climate services partnership, which began with the hiring of the six regional directors
- Working to develop the necessary business practices that will ensure that the proposed Climate Service will meet both the internal NOAA requirements for climate, the connectivity with the Weather Service, and meet the needs of external stakeholders

(2) Agency Roles and a Lead Federal Entity

Key Implementation Conclusion: *Each federal agency needs to collaboratively define its role and level of commitment in an NCS and there needs to be a lead federal entity.*

NOAA is uniquely positioned to provide critical science information, data and service delivery infrastructure.

NOAA has made efforts to take a leading role in the development of a federal climate service enterprise and continues to engage with its federal partners. Examples are, NOAA's:

- Participation in the US Global Change Research Program (USGCRP)
- Support of major reports such as the Global Change Impacts in the United States (GCCl) report and the America's Climate Choices reports
- Leadership roles that it has held in the past: the White House continues to turn to NOAA to fill leadership appointments on interagency climate committees and working groups
- Continued work with OTSP on interagency climate service activities and NOAA has begun working more closely with other agencies, e.g., the MOU with the Department of Interior

(3) Leadership within the Federal System

Key Implementation Conclusion: *Success of an NCS requires recognized, clear, authoritative, responsible leadership within the Federal System at the highest level possible.*

NOAA agrees and has been asked by the White House to assume critical leadership roles:

- Dr. Jane Lubchenco, NOAA Administrator, serving as co-chair of the Interagency Climate Change Adaptation Task Force and the National Science and Technology Council (NSTC) Climate Services Roundtable
- Dr. Thomas Karl, transitional director of NOAA's Climate Service, serving as USGCRP Chair of the Subcommittee on Global Change Research

Although clearly defined Federal leadership roles are essential, the authority to make these designations will come from outside NOAA. NOAA will continue to work closely with OSTP to inform development of a future governance structure for a national climate service enterprise.

(4) Defined Independent Budget

Key Implementation Conclusion: *A national climate service enterprise requires a defined, independent budget large enough to influence the direction of the service and achieve its mission.*

NOAA must rely upon and work with OMB and OSTP to formulate the national policy and budget decisions that will ensure this requirement is met.

NOAA's proposed climate service reorganizes existing assets to coordinate and integrate NOAA's existing climate capabilities. This will help promote greater effectiveness, cohesiveness, and to improve service relevance and delivery. NOAA recognizes that additional funds are needed to increase the core capabilities to fully meet the rapidly growing demands for climate science and service and is prepared to work with Congress, the Department of Commerce, and OMB to properly assess the budgetary needs of the Climate Service.

(5) Federated Structure

Key Implementation Conclusion: *A national climate service enterprise requires an interface best described by a federated structure (i.e., non-profit or federation) because it has a stronger connection to users and the research community.*

The Federal government is working on the development of a governance structure that will best meet the needs of a national climate service enterprise.

NSTC has formed the National Climate Services Roundtable, co-chaired by NOAA Administrator, Dr. Jane Lubchenco. The Roundtable includes federal climate service providers such as DOI, the Interagency National Climate Assessment partnership, and EPA.

The America's Climate Choices study cites the crucial importance of a network that links multiple agencies with regional expertise. The report suggests increased support for agencies with regional centers, including NOAA, and encourages new partnerships between federal agencies.

Since the completion of the Barron Report, NOAA has made progress on a number of items related to the report's findings and implementation conclusions. This includes: the sponsorship of the America's Climate Choices Study performed by the National Research Council of the National Academies; the February 8, 2010 announcement by the Department of Commerce (DOC) and NOAA of the intent to create a Climate Service line office; and the participation in the external review by the National Academy of Public Administration (NAPA) of NOAA's

proposed organizational changes for structuring a climate service within NOAA, which was completed on September 13, 2010.

NOAA Leadership, working closely with a NOAA Climate Service Implementation team continues to work out the details for a proposed reorganization. This document describes in greater detail the progress NOAA has made in addressing the findings of the external Review Team Report, key implementation conclusions of the Barron Report, and the plans and next steps in this process.