Conrad C. Lautenbacher, Jr.
Vice Admiral, U.S. Navy (Ret.)
Under Secretary of Commerce for
Oceans and Atmosphere

NOAA Annual Guidance Memorandum for FY 2010 – 2014

NOAA's Vision: *An informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions.*

NOAA's Mission: *To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs.*

The National Oceanic and Atmospheric Administration (NOAA) Strategic Plan articulates NOAA's long term vision and establishes the overarching goals and strategies required to realize that vision[1]. Each year, NOAA's planning processes provide an opportunity to assess our strategic direction, accommodate new trends and challenges within and outside NOAA, and adjust our corporate priorities to ensure progress toward our strategic goals. This Annual Guidance Memorandum (AGM) identifies the most urgent and compelling NOAA-wide programmatic and managerial priorities for FY 2010 – 2014, reflecting input from NOAA's stakeholders as well as our own assessment of external trends and drivers, mission requirements and program capabilities, and strategic imperatives facing each of NOAA's strategic goal teams and the organization as a whole. It recognizes that NOAA's vision and mission are global in scope and therefore require both domestic and international engagement to achieve NOAA's priorities.

By its nature, the AGM does not and cannot refer to all significant program and managerial efforts NOAA will need to pursue over the planning period to successfully execute its mission requirements. Instead, this AGM identifies a limited number of high-level programmatic and managerial priorities that are NOAA-wide in nature (e.g., interdisciplinary, inter-organizational challenges), require significant and sustained financial or managerial resources and effort, and have a singular impact on NOAA's ability to achieve its long-term strategic goals. These priorities respond to strategic trends and challenges that can be met only through the concerted efforts of NOAA's Goal Teams, Programs, Line Offices, and Councils.

[1] *New Priorities for the 21st Century – NOAA's Strategic Plan for FY 2006 – 2011*, available at: http://www.spo.noaa.gov/

Introduction

During recent planning cycles, NOAA's Goal Teams and Programs have rigorously specified their requirements drivers and have detailed the significant and generally increasing gaps between current program resources and those required to fully address all programmatic requirements. While these requirements gaps continue to grow, the overall federal fiscal and policy environment is becoming increasingly constrained.

NOAA's planning priorities, as described in this document, must balance pressures to change with the imperatives of continuously maintaining a broad array of current research, operational, and partnership commitments and responding efficiently to legislative mandates. External pressures to change are continuous, as societal demands for NOAA's capabilities evolve, as the state of science and technology changes, and as NOAA's requirements are modified by Congress and the Administration. This AGM reviews the most urgent and compelling of these external pressures, and incorporates appropriate adjustments to NOAA's programmatic and organizational priorities. This introduction briefly describes some of the more comprehensive external changes that have shaped this AGM.

Recent and emerging changes to NOAA's statutory requirements drivers for ocean and coastal[2] ecosystem management

Recent Administration and Congressional actions indicate that ocean issues will continue to remain a high priority in FY 2010 – 2014. The FY 2008 President's Budget requested substantial increases for ocean and coastal observation, science, protection, and management. The Administration is also proposing legislation to create a NOAA Organic Act and reauthorize both the Coral Reef Conservation Act and the National Marine Sanctuaries Act. Congress also has been very active on ocean issues. It recently passed the Marine Debris Research, Prevention, and Reduction Act, which directs NOAA to take action to protect ocean and coastal ecosystems from marine debris. Congressional interest is further highlighted by the introduction of the Oceans Conservation, Education, and National Strategy for the 21st Century Act and legislation on ocean exploration, the Integrated Ocean Observing System (IOOS), and Integrated Ocean and Coastal Mapping.

On January 12, 2007, the President signed the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA)[3], opening a new chapter in NOAA's stewardship of the nation's living marine resources. The Act reinforces NOAA's mandate to end overfishing, increases our use of market-based management programs, calls for improved science (especially our ability to monitor recreational fishing), requires NOAA to produce annual catch limit forecasts for all regulated species, supports our enforcement efforts, and aids our efforts to curtail illegal, unreported, and unregulated (IUU) fishing on the high seas. The MSRA reinforces a future expectation for NOAA as a leader of cooperative conservation that is embodied in Executive Order 13352 on Facilitating Cooperative Conservation[4], in the U.S. Ocean Action Plan[5], and in the proposed NOAA Organic Act. The MSRA and the Marine Debris Research, Prevention, and Reduction Act, in combination with other pending legislation, such as the National Offshore Aquaculture Act and reauthorization of the Coastal Zone Management Act and Coral Reef Conservation Act, broadens NOAA's core mission requirements for Ocean and Coastal Ecosystem Management as well as Environmental Knowledge and Expertise functions.

[2] This document follows the convention used in the Ocean Action Plan and other government documents where the phrase "ocean and coastal" includes the Great Lakes.
[3] Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (http://www.nmfs.noaa.gov/sfa/2007reauth_notsigned.pdf)
[4] E.O. 13352 (http://www.ofee.gov/eo13352.pdf)
[5] U.S. Ocean Action Plan (http://ocean.ceq.gov/actionplan.pdf)

Heightened awareness and acceptance of the scientific basis for climate change

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), released in early 2007, established with very high confidence (>90%) the anthropogenic warming influence on climate and documented the substantial progress for the past six years of research on climate change and its fundamental causal factors. This report has contributed to a heightened public awareness of climate change and acceptance of its scientific basis. The IPCC has further reported on the observed and projected impacts of climate change and vulnerability of a wide range of systems and sectors, including ocean ecosystems, emphasizing the need for adaptation and mitigation strategies. As a lead agency in the science of climate change, this evolving debate presents NOAA with important questions concerning its role and priorities in the Nation's climate enterprise. For example, the Fourth IPCC report demonstrates the emerging capabilities of earth system science and the improvement of climate change information on regional scales, which is becoming increasingly valuable for decision makers.

NOAA has a broad suite of capabilities for addressing current and future climate impacts related to water and drought, coastal management and planning, extreme events, ecosystem impacts, and the Arctic. In response to the National Integrated Drought Information System (NIDIS) Act of 2006, NOAA has taken the lead of an interagency approach to climate services for better drought monitoring, forecasting, and early warning. The vision for NIDIS is a dynamic and accessible drought risk information system that provides users with the ability to determine the potential impacts of drought, and with the decision support products needed to better prepare for and mitigate the effects of drought. NIDIS will become the prototype of climate services provided by NOAA. It will allow NOAA to further improve its climate forecasts, improve their scope and applicability, and to work with stakeholders to communicate climate impact information tailored to specific regional needs.

These emerging demands for climate information services suggest an expanded role for NOAA in three functions: Environmental Data and Information Systems; Ocean and Coastal Ecosystem Management; and Environmental Knowledge and Expertise.

Ocean Research Priorities Plan and Implementation Strategy

The interagency Joint Subcommittee on Ocean and Science Technology (JSOST) released the national Ocean Research Priorities Plan and Implementation Strategy[6] (ORPP) in January 2007. This plan identifies three critical elements—ocean observations, forecasting key ocean and ocean-influenced processes and phenomena, and scientific support for ecosystem based management—supported by twenty national priority areas. NOAA has important capabilities and assets related to many of these areas, spanning near- and long-term research challenges. The Implementation Strategy highlights the need for execution of the ORPP to be accomplished through extensive partnerships and interagency collaboration, coordinated through the federal ocean governance structure. No one group is expected to address the priorities alone. In the near-term, however, NOAA has been specifically tasked to contribute a significant share of the activities needed on four priorities: forecasting the response of coastal ecosystems to persistent forcing and extreme events; comparative analysis of marine ecosystem organization; sensors for marine ecosystems; and assessing Meridional Overturning Circulation (MOC) variability and its implications for rapid climate change. The ultimate success of the ORPP is tied to the successful implementation of these four projects. NOAA's continued support of the near-term priorities throughout FY 2010 – 2014 is therefore critical.

[6] '*Charting the Course for Ocean Science in the United States for the Next Decade - An Ocean Research Priorities Plan and Implementation Strategy*', NSTC JSOST, January 26, 2007 (http://ocean.ceq.gov/about/sup_jsost_prioritiesplan.html)

Among the priorities that the Plan lays out for the long-term, NOAA will need to guarantee similar continued support to: balance sustainable use and protection of the environment and marine resources while enabling marine operations to meet challenging and increasing levels of transportation, commerce, and security in the maritime domain; understand the interactions between marine operations and marine life (research on ocean sound impacts on marine mammals, development of mitigation strategies and technologies such as passive sonar); and advance understanding and technologies to enhance the benefits of various natural resources from the open ocean, coasts and Great Lakes. Pending legislation, and recent OMB support in the FY 2008 Presidential Budget, envisages NOAA as the lead agency in the United States' ocean and coastal mapping efforts, which extend from traditional hydrography to habitat characterization. Mapping activities are intended to include the areas and the resources of the outer continental shelf, beyond the Exclusive Economic Zone (EEZ).

The broad and compelling research plan set forth by JSOST calls for a renewed focus on NOAA's Ocean and Coastal Ecosystem Management, Environmental Data and Information Services, and Environmental Knowledge and Expertise functions.

Continuity of Satellite Earth Observations

Earlier this year the Space Studies Board of the National Research Council (NRC) released its first decadal survey on Earth science and applications from space, commissioned under contract with NOAA, the National Aeronautics and Space Administration (NASA), and the U.S. Geological Survey (USGS). This report calls on NOAA, NASA, and USGS to greatly expand the number of planned earth science missions, their capabilities, and interagency coordination, in the context of increasingly severe challenges to the health of the earth science enterprise in the United States. Combined with the outcome of the Nunn-McCurdy decision on the National Polar-orbiting Operational Environmental Satellite System (NPOESS), and related follow-on efforts and reconfigured capabilities of the Geostationary Operational Environmental Satellite-R Series (GOES-R), the Decadal Survey raises significant issues for NOAA's priorities in three functions: Observation, Data Management and Modeling Systems; Environmental Data and Information Services; and Organizational Support and Management.

Impacts to the U.S. economy and global market share from increasing pressures on U.S. transportation systems infrastructure

Escalating external demands continue to drive NOAA to improve the accuracy and frequency of its products and services geared toward safe and efficient movement of people and commerce on the nation's roads, rails, waterways and in the air. For example, the Administration's new emphasis on the Next Generation Air Transportation System (NextGen), echoed by strong interest in Congress, will significantly alter our National Airspace System by 2025. The expected tripling of air traffic will require dramatic improvements to the aviation weather system. Because 70% of today's air traffic delays are weather related, there are key questions for NOAA to consider as its role in NextGen and improved forecast services evolves. Similarly, the Cabinet-level Committee on the Marine Transportation System (MTS) is considering far-reaching policy changes and improvements to the MTS in anticipation of the projected doubling of demand by 2020 for space on our waterways and in our ports for commercial movement of goods and people. The April 2007 report by NOAA Hydrographic Services Review Panel federal advisory committee supports these MTS goals while highlighting NOAA service delivery shortfalls and critical changes NOAA must make to support disaster response and enhance the MTS's ability to handle more traffic efficiently while reducing risk of damage to life, property and the environment. These trends are particularly relevant to priorities within NOAA's Environmental Data and Information Services function.

Demand for a strategy for improved operational forecasts of high-impact events

There is a broad concern over improving NOAA's strategy for operational forecasts of high-impact events. The Hurricane Intensity Research Working Group (HIRWG) of the NOAA Science Advisory Board (SAB) reported its findings in July 2006 on the "state of the science" and current research and development (R&D) activities in NOAA and elsewhere with respect to hurricane intensity. As a result, it recommended an agenda of R&D activities directed to improve National Weather Service skill in forecasting intensity and structure, and, in particular, rapid changes in intensity in hurricane-strength storms. The HIRWG set an overarching goal for NOAA R&D (in terms of reduction of the error in 48-hour intensity forecasts) that the group recognized as ambitious, but attainable with the engagement of the full hurricane research community and with adequate funding for a minimum of five years.

To achieve this goal, the HIRWG provided a set of recommendations to focus research on the inner core of the hurricane. These include development and validation of hurricane forecasts at a resolution (1-km) much finer than operationally feasible, without the acquisition of new, or reprioritization of existing, computing system capability. The HIRWG also identified the need for organizational changes to: (i) attain critical mass in the presently limited resources both for in-house hurricane modeling capabilities, and for interfacing with the wider research community; and (ii) accelerate the transfer of research results to operations.

The work of the NOAA SAB HIRWG, combined with the Hurricane Research assessment of the National Science Board (NSB) and the broader demand for operational forecasts of high-impact events, has a strong bearing on NOAA's Environmental Data and Information Services function.

Regional Collaboration

External demands for NOAA to improve capabilities at a regional scale continue to grow, exemplified by state-led regional initiatives such as the Great Lakes Partnership, Gulf of Mexico Alliance, West Coast Governors Agreement, and Northeast Regional Ocean Council. Demand for a regional focus to NOAA service delivery and development also is evident from the External Ecosystem Research Review, the US Commission on Ocean Policy Report, National Integrated Drought Information System (NIDIS) Legislation, and regional climate assessments. Regional implementation strategies are particularly critical to NOAA's priorities related to climate and water information services, integrated ecosystem assessments, and hazard resilient communities and businesses.

The scope and significance of these external drivers further sharpens NOAA's longstanding focus on integrating its capabilities and coordinating its services on a regional scale. Recent efforts include establishing regional teams responsible for coordinating NOAA's capabilities to meet both national and regional programmatic priorities. Through its Regional Collaboration effort, NOAA is developing more effective channels for coordinating NOAA's response to inherently regional environmental challenges.

▪ ▪ ▪

The following sections of this document convey NOAA-wide priorities for its mission goals and mission-support sub-goals over the FY 2010 – 2014 planning period. In keeping with both stakeholder and internal NOAA views, these priorities reflect NOAA's commitment to: maintaining a high degree of continuity with existing priorities and strategies; providing more focused and cohesive guidance to NOAA's goals and programs, as they develop programmatic requirements in their Program Operating Plans; and demonstrating responsiveness to critical external trends. Each section provides the priorities for FY 2010 – 2014 and a discussion of external drivers. The following table provides an overview of NOAA's entire priority set for FY 2010 – 2014.

FY 2010 – 2014 Priorities: Complete List

Priorities		Focus Areas
Ocean and Coastal Ecosystem Management	**Regional, science-based approaches to ecosystem assessments and management**	Region-specific collaborative approaches to ecosystem-based management and governance to improve ecosystem health, productivity, and sustainability
		Integrated assessments and forecasts of ecosystem health and productivity, including socioeconomic impacts and the effects of ecological factors on ocean and coastal resources
	Climate variability and ecosystem predictions	Improved monitoring and forecasting of ecosystem conditions based on climate observations and models
		Adaptation strategies for climate change, in particular as pertaining to the implications on management of trust marine living resources
	Natural resource management and stewardship	Improved effectiveness of natural resource management and stewardship supported by appropriate scientific capabilities
		International collaboration for ocean and coastal resource management and ecosystem science
		Integration of scientific and technical support for federal, state, and local officials responsible for coastal resource management
Environmental Data and Information Services	**High-impact weather and water events**	Increased accuracy for hurricane track and intensity forecasts
		Increased lead time of all high-impact weather and water events through warn-on-forecast
	Climate information services	New regional information products in response to climate extremes and abrupt climate change.
	Water information services	Regional hydrologic forecasting information services for drought and water management
	Physical ocean information services	Improved information on hydrographic services, sea level, wave, wind, current, and inundation
	Aviation weather services	Developing ensemble modeling and probabilistic forecasts for Next Generation aviation weather information services
	Building hazard-resilient communities and commerce	Developing partners' capacity to use NOAA information services to prepare for, respond to, and recover from environmental hazards
		Regionally coordinated decision support from multiple NOAA and external sources
Environmental Knowledge and Expertise	**Understanding the causes and consequences of climate change and improving climate predictions**	Understanding the drivers of decadal variability, including abrupt climate changes
		Understanding the links between climate and regional impacts, including drought, hurricanes, fires, floods, and weather extremes
		Understanding climate-ecosystem interactions, particularly ocean acidification, loss of sea ice and long-term ocean warming and their impacts on biological productivity and distribution
	Understanding ocean ecology on multiple spatial and temporal scales	Developing quantitative ecosystem models and forecasting capabilities
		Improving research tools and technologies for understanding ecosystem processes (including expanding genomic libraries) and implications for human health
	Environmental literacy and decision support	Promoting environmental literacy for improved decision-making
		Foster better decision-making through improved quantification and communication of uncertainty

Priorities		Focus Areas
Observation, Data Management and Modeling	**Observations integration and data management**	Integrated data assimilation and management: archived, interoperable, accessible, and readily usable observations data
		Improving capabilities to manage, calibrate, validate, and assimilate sensory data
		Developing a functional IOOS that serves internal and external user needs
	Capable and reliable observations infrastructure	Close the observing system gaps for the most critical mission needs
		Increasing the productivity of observation assets through technology development, testing, and deployment
		Ensure continuity of critical observations with NOAA and non-NOAA assets to maximize efficiency and fulfill critical mission requirements
	Ocean and Earth system modeling	Research and operational atmospheric, ocean and coastal modeling capabilities integrating physical, chemical, biological, and socioeconomic data
Organizational Support and Management	**Improve service delivery excellence and value to customers**	Accelerated transition of research and observation capabilities to new or improved operational products and services
		Regional service delivery models deployed that provide higher quality, higher value, fully integrated information services
	Strategic use of information technology	Integrated high performance computing resources and data archive/retrieve capabilities
		A single enterprise network, and IT security controls across all systems
		A comprehensive Management Information System for corporate NOAA
	Modernized, safe, high quality facilities	Modernized, consolidated, environmentally-conscious facilities portfolio, leveraged in collaboration with partners
	Strategic workforce management	Recruitment and training to guarantee the appropriate number and mixture of skills to support NOAA's strategic priorities

Ocean and Coastal Ecosystem Management: FY 2010 – 2014 Priorities

Priorities	Focus Areas
Regional, science-based approaches to ecosystem assessments and management	Region-specific collaborative approaches to ecosystem-based management and governance to improve ecosystem health, productivity, and sustainability Integrated assessments and forecasts of ecosystem health and productivity, including socioeconomic impacts and the effects of ecological factors on ocean and coastal resources
Climate variability and ecosystem predictions	Improved monitoring and forecasting of ecosystem conditions based on climate observations and models Adaptation strategies for climate change, in particular as pertaining to the implications on management of trust marine living resources
Natural resource management and stewardship	Improved effectiveness of natural resource management and stewardship supported by appropriate scientific capabilities International collaboration for ocean and coastal resource management and ecosystem science Integration of scientific and technical support for federal, state, and local officials responsible for coastal resource management

Understanding and solving complex ocean and coastal resource management problems requires approaches that are specific to regional and local conditions, and center on effective partnerships that are driven by local and state authorities but draw extensively on support from NOAA, its federal partners, and others. Over the planning period, NOAA's approach to ocean and coastal ecosystem management will continue to reflect this core principle expressed in the U.S. Ocean Action Plan. NOAA will continue to advance integrated priority setting and planning to meet the extensive, multidisciplinary challenges facing the entire U.S. ocean policy community through interagency mechanisms. NOAA also will further pursue and stimulate regional collaborations that are serving as an effective model for ecosystem-based management, emphasizing the linkages between human and natural systems.

As stated in the External Ecosystem Task Team Report to the NOAA SAB[7], the 'most rapidly changing impacts on marine ecosystems are from human activities that have direct social, cultural, and economic impacts'. The task team identified the need for NOAA to augment its existing economic and social programs, and build a social science capacity at the regional scale to close the gaps in time series data on: market and non-market uses and values of ecosystem resources; social perceptions, attitudes and values; and laws and regulations that govern the use of land and other coastal ecosystem resources. This call is consistent with the emphasis given by the JSOST ORPP to the need to integrate socioeconomic science with traditional ocean science in understanding the human impacts on marine ecosystems, and in ensuring sustainability of ecosystem goods and services. Renewed attention for the socioeconomic dimension is also reiterated in new legislative and executive mandates.

The Fourth IPCC report has significant bearing on NOAA's priorities in addressing the interactions between climate and ecosystems. To respond to increasing societal concerns about the impacts of climate change at global and regional scales, NOAA will need to investigate and inform adaptation and mitigation strategies for climate change, and, because of its statutory responsibilities,

[7] NOAA Science Advisory Board, '*Evolving an Ecosystem Approach to Science and Management Throughout NOAA and its Partners*', July 24, 2006

will also need to improve its understanding of the effects of climate on ocean and coastal resources. Continued emphasis on the interactions between climate and ecosystems will require decision-support tools to prevent, mitigate, and adapt to impacts of climate change on ocean and coastal ecosystems.

Legislative developments emphasize the need to improve NOAA's ocean and coastal resource management and stewardship function, including supporting scientific capabilities and associated requirements for protected species and habitat. The MSRA calls for increased investments in fishery management regimes, specifically for an increased capacity to monitor and enforce accountability measures to ensure domestic and international overfishing is eliminated, and regulatory requirements are enforced. With an increasing demand for seafood products, emerging legislation for aquaculture also will have a bearing on NOAA's regulatory, science and technology, and outreach activities required to support and regulate a productive and sustainable domestic marine aquaculture industry. The 2006 Papahānaumokuākea (formerly Northwestern Hawaiian Islands) Marine National Monument has brought increased attention to the use of Marine Protected Areas (MPAs) and Networks of MPAs as one tool to increase ecosystem resilience. Cooperative conservation partnerships among NOAA, other agencies, tribes, states, and local public and private entities will be an effective way to leverage NOAA's stewardship investments.

Recognizing that many living marine resources are shared and therefore stewardship can only succeed with international coordination and collaboration, new legislative mandates are emphasizing NOAA's international role in ecosystem science and management—specifically its involvement in international collaboration for ocean and coastal resource management and scientific cooperation and exchange. Expanded resources and capabilities will be required to meet such mandates as MSRA and the Marine Debris Research, Prevention and Reduction Act. New requirements include – information sharing regarding fishing on the high seas; monitoring international compliance with fisheries regulations; monitoring of U.S. imports of fishery products to more effectively exclude products of IUU fishing from entering U.S. markets; and working to improve the effectiveness of all international fishery management organizations' stewardship practices. Through the extensive bilateral, regional, and multilateral network of engagements, NOAA will continue to play a critical role in building international partnerships and policy consensus.

Environmental Data and Information Services FY 2010 – 2014 Priorities

Priorities	Focus Areas
High-impact weather and water events	Increased accuracy for hurricane track and intensity forecasts Increased lead time of all high-impact weather and water events through warn-on-forecast
Climate information services	New regional information products in response to climate extremes and abrupt climate change
Water information services	Regional hydrologic forecasting information services for drought and water management
Physical ocean information services	Improved information on hydrographic services, sea level, wave, wind, current, and inundation
Aviation weather services	Developing ensemble modeling and probabilistic forecasts for Next Generation aviation weather information services
Building hazard-resilient communities and commerce	Developing partners' capacity to use NOAA information services to prepare for, respond to, and recover from environmental hazards Regionally coordinated decision support from multiple NOAA and external sources

The nation relies on NOAA's data and information services for public safety, a healthy environment, and a productive economy. NOAA provides both the data and assessments, analyses, and forecasts based on these data that are vital to informing partners and customers about current and future environmental conditions. Exceptional environmental data and information services require good presentation (the form) as well as good content.

Among the most visible information services that NOAA provides are forecasts, warnings and advisories for high-impact weather and water events. As Gulf Coast communities continue to rebuild from the 2005 hurricanes, including hurricanes Katrina and Rita, there is still a great deal of national attention to forecasts, warnings, and advisories for high-impact weather. In addition to their value to individuals and families in the public at large, high-impact weather forecasts, warnings and advisories are crucial inputs into the planning and response activities of state and local governments and federal agencies such as FEMA. Furthermore, NOAA recognizes that the nation's industries and air, surface, and marine transportation networks are heavily dependent on the accuracy of NOAA's weather and water forecasts to adjust strategically and minimize the ripple effect of high-impact events on costs and commerce.

External demands are particularly high for improved forecasts of hurricane intensity. The need for improved hurricane intensity forecast skills has been emphasized in many forums recently, including the NSB's "Hurricane Warning – The critical need for a national hurricane research initiative" report, the majority report of the NOAA SAB HIRWG, as well as in the NOAA-NIST Hazard Resilient Communities Plan.

NOAA also sees an evolving societal demand for accurate, reliable, and timely climate information, distinct from long-term global projections. NOAA recognizes the nation's heightened awareness and acceptance of the scientific basis for climate change and the broader demand for scientific information on the present and future state of the climate and its impacts. New

mandates at local, state, and national levels to address a changing climate include efforts to regulate greenhouse gas emissions and develop integrated climate-air quality emission management strategies.

Increased regulation will require, as a foundation, accurate and reliable operational information on climate and atmospheric composition. Following the advice of the NRC and several other bodies, NOAA's National Climatic Data Center has already initiated a program to develop, produce, and steward the world's first comprehensive suite of satellite-based climate data records (CDRs). CDRs provide a historical reference for the detection of climate change and will thus inform policy decisions at state and national levels, as well as accords and treaties at international levels.

NOAA's services to provide water information are growing in importance as water becomes a scarcer commodity in America and around the world. Water availability is internationally acknowledged as the great challenge of the 21st century. Regions in which water was once plentiful are now experiencing shortages. The NRC indicates that "in this century, the United States will be challenged to provide sufficient quantities of high-quality water to its growing population." Our freshwater supply is critically stressed by growing and migrating populations, urbanization, and climate change, especially along the coasts. According to the Council of State Governments, water wars in the United States, once limited to the semi-arid Western States, have now spread to the Midwest, East, and South.

Greater projected use of the ocean for commercial, recreational, and municipal purposes, means that NOAA must provide the public with accurate and reliable information about the ocean. An essential part of NOAA's role in an integrated, inter-agency ocean governance structure for the 21st century will be to meet the evolving need for operational ocean information services. The oceans will increasingly be a source of productive economic activity, both as a means of transit and a resource depository, and thus will face increasing environmental stress.

NOAA anticipates growing demand for sea level data for coastal planning in response to climate change; improved hydrographic, water level, weather, and wave information for safe maritime transits and efficient port traffic management with the expected increases in global commercial shipping; bathymetric data for the exploitation of resources on the outer continental shelf; near-shore current information for the environmentally responsible development of aquaculture; and ocean wind and current information for the development of renewable energy resources.

NOAA's aviation weather services must evolve with the aviation enterprise to ensure public safety and economic efficiency. As the Federal Aviation Administration begins to implement NextGen, the demand for network enabled digital weather data will increase. The NOAA sponsored Weather Integrated Product Team has developed a vision for the future NextGen Aviation Weather system that will provide four dimensional (3D plus time) weather information to automated air traffic management systems and to commercial and private aircraft operators. This system will fuse model data, automated gridded algorithms, climatology, and observational data to form a single authoritative source of aviation weather information, enabling a common weather operating picture for the users of the National Airspace System.

Much of NOAA's environmental data and information improves the resilience of communities and commerce to environmental hazards. NOAA's services allow partners and customers to reduce or avoid the costs that may arise from high-impact events and hazards such as hurricanes, tornadoes, tsunamis, storm surge, drought, climate change, pollution, and the mismanagement of natural resources. The 2006 Congress enacted the Tsunami Warning and Education Act, providing NOAA with the responsibility to ensure reliable tsunami forecasts and warnings and help communities in their preparation and mitigation of these natural hazards. Prioritizing "resilience" puts the focus of NOAA's efforts directly on the interface between the provision of services and their applications in the contexts of our partners and customers.

Improving the nation's resilience to hazards means improving research, observations, and models to develop the content of its information and management services. However, included in these functions should be a focus on improving partner and customer use of NOAA's services. The question of how and where to develop the core capabilities that enable better hazard resilience will be answered by healthy feedback from users of NOAA's decision support services.

Environmental Knowledge and Expertise: FY 2010 – 2014 Priorities

Priorities	Focus Areas
Understanding the causes and consequences of climate change and improving climate predictions	Understanding the drivers of decadal variability, including abrupt climate changes Understanding the links between climate and regional impacts, including drought, hurricanes, fires, floods, and weather extremes Understanding climate-ecosystem interactions, particularly ocean acidification, loss of sea ice and long-term ocean warming and their impacts on biological productivity and distribution
Understanding ocean ecology on multiple spatial and temporal scales	Developing quantitative ecosystem models and forecasting capabilities Improving research tools and technologies for understanding ecosystem processes (including expanding genomic libraries) and implications for human health
Environmental literacy and decision support	Promoting environmental literacy for improved decision-making and use of NOAA's environmental data, information services, and expertise. Foster better decision-making through improved quantification and communication of uncertainty

In addition to providing data and information, NOAA also provides a less tangible but no less important product: knowledge of the environment, and of techniques for environmental monitoring, forecasting, and management. NOAA's intangible "know-how" is distinct from its data and information because it draws largely and directly from NOAA research and operational processes. But just as with data and information, knowledge and expertise cannot exist independent of form. NOAA provides knowledge to the public via outputs such as professional journal articles, conference presentations, technical reference manuals, educational materials, official testimonies, participation in inter-agency and international decision processes, technical assistance and training, websites, and blogs, as well as media consultations.

Emerging as some of the most powerful and valuable knowledge that NOAA experts produce are the causes and consequences of climate change, as well as how to improve climate predictions. With the release of the IPCC report, the climate debate is shifting from understanding the problem to devising solutions; but there is still critical research to be conducted and scientific findings to be disseminated. There is a growing academic and public interest in Arctic climate change, drought, ocean and atmospheric circulation and chemistry changes, sea level rise, changes in greenhouse gas forcing, and climate and air quality.

We must gain a better understanding of the drivers of decadal climate variability, including abrupt climate changes. Research into the mechanisms behind fluctuations of the MOC, and its potential implications for rapid climate change, will address uncertainties the IPCC report leaves unresolved. The ORPP, a product of the National Science and Technology Council's JSOST, specifically tasked NOAA with: (i) conducting "modeling experiments on the origins of MOC variability leading to

improved understanding of the relative roles of wind and thermohaline forcing"; (ii) testing "models and theories against climate data sets"; and (iii) implementing "improved models for MOC-related studies."

Our nation has an extremely large and diverse geography, spanning a multitude of regions with unique geophysical and socioeconomic attributes. Climate change affects different regions in different ways, and it is incumbent upon NOAA to help the communities and businesses within each region to develop a thorough understanding of the impacts they are likely to face, such as drought, hurricanes, fires, floods, weather extremes, and the evaluation of adaptation options.

There is also the need to research and communicate interactions between climate and ecosystems, such as ocean acidification. While the process by which ocean acidification increases in response to the increase in atmospheric carbon dioxide emissions is well understood, little is known about the response of genetically diverse populations, synergistic effects, physiological and micro-evolutionary adaptations, and, more broadly, about the transfer of effects through the ecosystem.

Research into climate-ecosystem interactions will inform NOAA activities mandated by the Coral Reef Conservation Act, Magnuson-Stevens Act, and Endangered Species Act, as well as activities undertaken within such programs as the Global Earth Observation System of Systems (GEOSS), Arctic Climate Impact Assessment, the Climate Change Science Program, and the U.S. Global Change Research Program's Carbon Cycle Science Program. The 2006 reauthorization of the Magnuson-Stevens Act specifically calls for a NRC review of how ocean acidification may potentially affect fisheries.

NOAA also observes a growing national need for a more detailed and comprehensive understanding of ocean ecology on multiple spatial and temporal scales. A strong scientific base for ecosystem-based management is among the central themes of the ORPP. The ORPP recommends better quantification of ecosystem dynamics in relation to human activities, and tasks NOAA to "develop quantitative ecosystem models in partnership with academic and agency partners, apply appropriate data from multiple in-house monitoring databases, and interpret results." It also tasks NOAA to "analyze the MPA role in relation to conventional fisheries management tools, in addition to other ecosystem variables." This will require expanding NOAA's capacity in ecosystem forecasting and modeling, in synergy with IOOS.

To improve understanding of ocean ecology on multiple spatial and temporal scales, by improving sensor capabilities, NOAA is tasked to: (i) develop genomic libraries to advance understanding of ecosystem processes, as well as species abundance and distribution; (ii) develop in situ sensors for rapid detection of pathogens, harmful algae, and toxins, and methods to integrate biosensor data with other ocean observations; (iii) develop genomic and proteomic tools and supporting bioinformatics infrastructure to elucidate effects of multiple environmental stressors on marine organisms; and (iv) improve video plankton recorders for fish recruitment process studies.

Underlying a great deal of NOAA's ultimate mission goals is the development of an environmentally literate public and the direct support of public and private sector decisions. NOAA seeks to improve societal knowledge of environmental issues to support its strategic goals. The agency could not achieve its mission if it did not provide the consultation, advice, education and training that accompany its more tangible outputs. Information only has value if can change behavior. By supporting the immediate decisions of our partners and customers and by educating them for future decisions, NOAA makes real the potential value of its information.

Reports from the IPCC call for a climate literate public that understands the issues of concern and is capable of making informed decisions. The NIDIS Act of 2006 calls for a system that effectively communicates forecasts, conditions, and drought impacts to decision makers, the private sector, and

the public. The success of this system depends on the ability of our constituents to understand, utilize, and act upon the information provided. As hurricane Katrina demonstrated, an accurate forecast or warning is only effective if the recipients of the information understand them and take appropriate action.

One of the greatest difficulties that NOAA has in "getting the message out" is in the communication of probabilistic information and uncertainties. This is a problem that cuts across the entire agency. Addressing this problem will involve understanding how individuals and communities perceive and respond to risk. It will also involve raising the level of scientific sophistication of its partners and customers. The expertise required here is less the rigorous science of earth and environment and more the craftsmanship of communication and education.

Observation, Data Management and Modeling Systems FY 2010 – 2014 Priorities

Priorities	Focus Areas
Capable and reliable observations infrastructure	Close the observing system gaps for the most critical mission needs Increasing the productivity of observation assets through technology development, testing, and deployment Ensure continuity of critical observations with NOAA and non-NOAA assets to maximize efficiency and fulfill critical mission requirements
Observations integration and data management	Improving capabilities to manage, calibrate, validate, and assimilate sensory data Integrated data assimilation and management: archived, interoperable, accessible, and readily usable observations data Developing a functional IOOS that serves internal and external user needs
Ocean and Earth system modeling	Research and operational atmospheric, ocean and coastal modeling capabilities integrating physical, chemical, biological, and socioeconomic data

High-quality data are at the foundation of NOAA's responsibilities to inform and advise the public and to manage national trust resources. They can take the form of "raw" observations of the state of the environment in real time, they can be assimilated data that are formulated as input into specific models or other external applications, or they can be the data that emerge from models as predictions of future environmental states. All of these vital data types rely on highly specialized, high-performance systems for sensing, processing, coding, transmitting, receiving, and storing data. Further, they rely upon collaborative interagency and intergovernmental exchanges as well as planning for capitalization, maintenance, and disposal.

To conduct almost every facet of its operations, NOAA requires a capable and reliable observations infrastructure. Satellite systems provide the bulk of NOAA's sensory data. However, the rapidly rising costs of satellites, due to delays and complications in manufacturing, have forced NOAA to demanifest sensors from planned satellite systems. Rising satellite costs are a further incentive for NOAA to consider, where possible, alternative platforms (radar systems, ships and underwater vehicles, buoys, and aircraft) to collect the needed observations data. Other alternatives include obtaining data from international partners and the private sector. Countries such as Japan, China, and India all operate satellite observation systems, the data from which may be a cost-effective substitute for ensuring that NOAA-operated sensors are on orbit and on schedule. NOAA's use of data from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) is an example of current partnership with the private firm Orbimage.

Sea-going vessels are another primary source of observation data, providing in situ measurements of physical and biological oceanography and supporting both NOAA's information services and its ecosystems management services. NOAA's fleet faces a similar problem to its satellites: expanding mission requirements and finite resources for infrastructure. The above focus area, "close the observing system gaps for the most critical mission needs," must include the evaluation of options to close the requirements gap for at-sea data collection with respect to NOAA mission requirements.

Observing System Experiments (OSE) and Observing System Simulation Experiments (OSSEs) are powerful and relatively inexpensive ways of assessing the impact of potential new observations, for determining the impact of removal of current observing systems, and for refining and redirecting current observing practices. NOAA should carry out an OSSE as part of the preparation for certain deployments, and also as a way of redefining the overall observing strategy to fill critical mission needs. Further, with the advent of new forecast techniques, including high-resolution models, OSSEs would provide an excellent way of fine-tuning the observing system to the forecast needs.

Just as essential as the observations infrastructure is the management and integration of the resultant observations data. Once a datum is created by sensing device, there is still a long chain of processes that must occur before it is available for use by a NOAA modeler or an external consumer. These processes of data transmission, storage, validation, assimilation, as well as sensor calibration, are often under-estimated in the cost of the observing system and thus tend to be under-funded. Efficiencies in the system as a whole can be increased by attending to this bottleneck.

NOAA's mission increasingly demands integrated data assimilation and management for archived, interoperable, accessible, and readily usable observations data. Better data management will result in better quality data.

IOOS is a nationally important infrastructure that will enable users to characterize, understand, predict, and monitor changes in coastal and ocean environments and ecosystems. The Administration requested substantial funding for IOOS in its FY 2008 request, and Congress introduced IOOS legislation. IOOS is critical to understanding, responding, and adapting to the effects of high-impact weather, global-to-regional climate variability, and natural hazards.

Ocean and Earth system modeling are fundamental to producing environmental predictions, projections, forecasts, hindcasts, and nowcasts. NOAA's modeling capabilities are being driven by demands for its own evolving information services, particularly for improvements in hurricane and climate information. Furthermore, NOAA and environmental agencies around the world are working to design the algorithms for earth system models and to couple existing models together. NOAA is contributing to and gaining from international cooperation in modeling through projects such as the North American Ensemble Forecast System and The Observing system Research and Predictability Experiment (THORPEX).

NOAA must maintain state-of-the-art computing facilities with sufficient capability for world-class models. Expanded focus on modeling also arises from external factors, such as a projected drop in Department of Defence funding for operational modeling under the tri-agency (NOAA, Air Force, Navy) National Unified Operational Prediction Capability. NOAA's modeling can also benefit from transferring developments in computing technology from other agencies. The High-End Computing Revitalization Act of 2004, for example, created "leadership class" supercomputers at the Department of Energy and a "High-End Software Development Center."

Organizational Support & Management: FY 2010 – 2014 Priorities

Priorities	Focus Areas
Improve service delivery excellence and value to customers	Accelerated transition of research and observation capabilities to new or improved operational products and services Regional service delivery models deployed that provide higher quality, higher value, integrated information services
Strategic use of information technology	Integrated high performance computing resources and data archive/retrieve capabilities A single enterprise network, and IT security controls across all systems A comprehensive Management Information System for corporate NOAA
Modernized, safe, high quality facilities	Modernized, consolidated, environmentally-conscious facilities portfolio, leveraged in collaboration with partners
Strategic workforce management	Recruitment and training to guarantee the appropriate number and mixture of skills to support NOAA's strategic priorities

NOAA's organizational support and management functions support all functions in the agency by providing the appropriate human, capital, and financial capabilities. In the context of anticipated financial and other resource constraints, as well as anticipated growth in demand for NOAA's products and services, the agency's ability to pursue its mission priorities will depend heavily upon improving the efficiency and effectiveness with which it manages these resources.

As demands continually grow for scientific expertise, data, and information services, NOAA must develop new organizational approaches and technology-driven service delivery improvements to maximize the value of the public's investment in NOAA. At the same time, a wide range of external drivers will place a premium on the strategic use of information technology, including increasingly dense and information-intensive weather and climate models, massive increases in the volume of satellite data under NPOESS and GOES-R, geographically dispersed use of NOAA's high-performance computers, and broad-based needs for greater integration and interoperability of observational data and information to support GEOSS and NOAA's own mission needs.

NOAA must continually improve service delivery excellence and value to customers. An essential component of improving services is bringing the most innovative science and technology to bear on challenges and opportunities we face. Thus, NOAA must foster the transition of mature research capabilities, through their development and deployment phases, to new or improved operational services. Transitioning research results to operations means that NOAA can maximize its efficiency and effectiveness: the products of NOAA R&D will not languish and the operational services that NOAA provides to the public can progress along what should be a continuous path of innovation. NOAA must implement strategies to bridge the so-called "valley of death" between R&D and operations (and often between NOAA and its partners, such as NASA).

Also, as external demands for NOAA to improve capabilities at a regional scale continue to grow, NOAA must begin to deploy regional service delivery models that provide higher quality, higher value, integrated information services. Such delivery models will depend greatly on engaging our partners and customers, combining NOAA's in-house, service-specific expertise with the external decision maker's application-specific expertise. In this way, NOAA can create value for the nation more efficiently and achieve its strategic outcomes more readily. To facilitate this bilateral, mutually beneficial exchange, NOAA should also utilize social and economic analyses to more fully understand

the requirements of its partners and customers and to gauge the agency's performance in meeting those requirements.

As an information provider in the 21st century, NOAA must make strategic use of information technology. NOAA must optimize information technologies and systems to improve product and service quality, enhance access to a wider range of integrated observational data and information services, and to lower internal operational costs. This means balancing the needs to have adequate information security with the needs to provide our partners and customers with a service-oriented architecture. For NOAA to fulfill its mission requires integrated high-performance computing resources with the capability to easily and reliably archive and retrieve data, a single enterprise network and IT security controls across all systems, and a comprehensive Management Information System for corporate NOAA.

The home of NOAA operations should be modernized, safe, high-quality facilities. Therefore, NOAA must integrate its facility planning and management with agency-wide program needs through a stable, long-term, NOAA-wide facilities modernization strategy. As a federal environmental agency, NOAA should set an example for the rest of the nation by being environmentally conscious in the development of its facilities modernization strategy.

Fundamental to NOAA's work is a strategic approach to managing its workforce. The aging of the federal workforce is one major driver for an emphasis on workforce management. In the coming years NOAA will have to accommodate the retirement of a significant number of employees and maintain a level of expertise sufficient to carry out the agency's mission. This will present particular challenges to NOAA as a science and technology agency. Recent declines in the number of math, science, and engineering graduates will likely result in a supply shortage in the market for the kind of analytically focused labor that NOAA depends upon.

Similarly, NOAA sees a need for greater expertise in environmental policy and relationship building. Given the growing gap between NOAA's resources and requirements, as well as growing need to establish governance structures in marine and coastal management, there will be an increased need to partner with other organizations (public, commercial, non-profit) and other governments (international, tribal, state, local). Solid relationship building requires additional time and effort to support the necessary face-to-face meetings, putting additional demands on the current workforce. Hiring and training to managing NOAA's alliances and networks of expertise is instrumental to developing a workforce effective in building partnerships domestically and internationally.

Conclusion

The priorities identified in this Annual Guidance Memorandum embody NOAA's vision of the future and incorporate near-term adjustments needed for NOAA to achieve its long-term strategic goals, in light of external developments and the needs and expectations of NOAA's stakeholders. In so doing, this document establishes a solid framework for Goal Team and Program-level planning, Council deliberations, and ultimately the Programming phase of NOAA's Planning, Programming, Budgeting, and Execution System. For more information on this or other planning documents send an email to strategic.planning@noaa.gov.