NOAA CLIMATE PROGRAM OFFICE

CLIMATE OBSERVATION DIVISION

2015-2020 STRATEGIC PLAN

June 2015

Climate Observation Division
Director's Message

On behalf of the NOAA Climate Observation Division (COD), I invite you to read our *Strategic Plan for FY 2015-2020*. This plan is meant to inform our NOAA colleagues, our partners in the U.S. and abroad, and the international climate observing community of long-term goals and strategic objectives COD will pursue over the next five years.

The plan articulates COD's vision, mission, and unique contribution to NOAA and to the nation. Our five overarching goals address key pillars of modern observing systems: developing and evolving observing and data systems to meet the stringent climate observation requirements; developing and providing value-added products and information; entraining innovation for efficiency and increased capacity; embracing partnerships to insure robustness and resiliency; and maintaining a skilled and talented work force as well as sound business practices throughout the enterprise.

The legacy of our program will be evident through the development of environmental knowledge (intelligence) founded on observations of key climate variables and processes, models, forecast systems, and other assessments. While driven primarily by climate research and operational needs, observations supported by COD address many other requirements, including weather, fisheries, energy, transportation, safety, and national defense. We will continue NOAA's leadership role in sustained *in situ* global climate observing, particularly for the global oceans and plan to build on initial observing successes in the Arctic (and in the atmospheric domain as appropriate) to address increased demand for such information. Through our strategic efforts, key worldwide consumers of this knowledge, e.g., the research community, forecasters across world, assessment communities, and those who make decisions and policy will have the critical observational information they need to assess and improve understanding of environmental changes and their impact on society, improve our predictive capabilities, and provide the foundation for knowledge-based decisions.

Regards,

David M Legler

Dr. David Legler, Director

Foreword

NOAA's observing enterprise addresses a wide range of needs for climate and environmental information to understand past and present conditions, as well as foundational information for predicting future changes. COD has led the development of *in situ* observation systems for the global/open oceans and the Arctic. Additionally, COD has sponsored research leading to value-added information and products based on a wider range of NOAA climate observing systems. This plan articulates our strategy to maintain this leadership role and embrace new opportunities to evolve, improve, and expand our activities in targeted areas.

COD-supported activities are an important foundation for a modern climate enterprise that aspires to advance *(1) scientific understanding, (2) monitoring and prediction of climate, and (3) understanding of its impacts to improve available climate information and enable effective decisions on the part of resource managers and decision/policy makers*. As such, the observations and information that COD supports provide a foundation that is critical for monitoring of changes in the climate system; predicting climate (on time scales of weeks to centuries); developing our understanding of processes in the ocean, at the ocean-atmosphere interface, and in the Arctic and how they contribute to change in the state of the climate,; and identifying impacts of such changes across the earth system – e.g., on marine ecosystems, sea level, sea-ice extent, coastal oceans, an acidifying ocean, energy and transportation (especially for the Arctic), and weather and climate extremes such as droughts, flooding, and tropical cyclones.

As one of five Divisions within the NOAA Climate Program Office (CPO) of NOAA's Office of Oceanic and Atmospheric Research (OAR), COD lays out its objectives in this Strategic Plan in direct support of CPO's and OAR's Strategic Plan objectives, namely: 1) CPO's Goal 1 objectives 2.14-2.19 (http://cpo.noaa.gov/sites/cpo/News/2014/CPO%20Strategic%20Plan.pdf) to advance the Foundational Capabilities of Observing Systems, Climate Monitoring, and Data Stewardship; 2) OAR's cross-cutting focus on Observing, Modeling, and Engaging with an emphasis on accurate and reliable data from sustained and integrated Earth observing systems (http://research.noaa.gov/sites/oar/Documents/OARStrategicPlan.pdf); and 3) NOAA's long-term goal of Climate Adaptation and Mitigation, with a focus on improving the scientific understanding of the changing climate system and its impacts (http://www.ppi.noaa.gov/wp-content/uploads/NOAA_NGSP.pdf). Specifically, this focus on making progress in the area of climate observing systems requires a robust and sustained observing system to ensure that the state of the climate system is continuously monitored. COD also contributes to NOAA's other goals focused on weather, coasts, and healthy oceans.

Finally, COD's activities contribute significantly towards fulfilling the requirements of key international programs including the Global Climate Observing System (GCOS) and Global Ocean Observing System (GOOS).

The COD provides essential ocean, Arctic, and climate observations and information to improve understanding, build toward better predictive capabilities, and foster a more informed and climate resilient society. To sustain and expand these critical climate observations, the CPO, OAR, NOAA, Department of Commerce, and Congress must prioritize investments in climate observations. To this end, COD seeks a sustained commitment from NOAA to support contributions towards global *in situ* observation requirements with resources for observations, ship time to service and maintain observations, monitoring and product development, and support of national and international partnerships.

Guiding Scientific Questions

The following research questions serve to guide observing and climate monitoring activities in the Climate Observation Division. For many of these questions, the Division's observing activities support partners who provide complementary capabilities, e.g. research, to address these questions.

COD Guiding Questions for Observing and Monitoring

1. What is the ocean's role in climate variability and change, including extremes (such as drought and tropical cyclones)?

2. What primary data sets and indicators best help us monitor and communicate the characteristics and effects of changes we observe in the ocean, Arctic, and climate extremes? How do we identify and evaluate tailored information products for the various audiences our climate information needs to reach (e.g., scientists, policymakers, public)?

3. What observations and monitoring are needed to improve the skill of intraseasonal to interannual climate predictions?

4. How is the ocean heat content changing? What does this imply for Earth's energy imbalance and how can this information be better used for understanding and predicting future climate?

5. What are the processes governing the global ocean's temperature, salinity, circulation, and ocean-atmosphere interactions and how are those interactions changing? What relevant processes contribute to our understanding of changes in climate, oceans, and weather, and improve their predictions?

6. How are global, regional, and local sea level changing, and why?

7. What role does the global ocean play in the uptake, storage and distribution of atmospheric carbon? What is the impact of rising atmospheric carbon on ocean biogeochemistry and marine ecosystems (e.g., ocean acidification)?

8. How is the Arctic system changing on time scales of weeks to decades, particularly the consequences that the loss of sea ice may have on both Arctic ecosystems and local and northern hemisphere severe weather events?

9. What are the links between the physical characteristics of the global oceans and marine ecosystems?

Mission

WHY WE EXIST

To provide high-quality long-term global observations,
climate information, and products
to researchers, forecasters, and other users
to inform and prepare society for environmental challenges

Vision

WHAT WE HOPE TO ACHIEVE

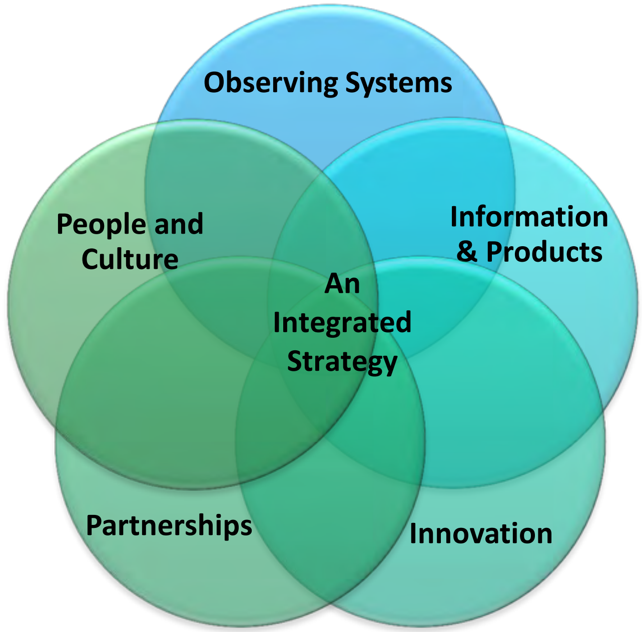
A sustained, comprehensive, and responsive global climate observing system that seamlessly delivers information and products to our partners and users within and beyond NOAA, and that provides a critical foundation for climate, weather, and environmental decision-making

COD's Unique Contribution

WHAT WE ARE UNIQUELY POSITIONED TO DO

COD provides leadership for sustained global *in situ* ocean climate and Arctic observing systems and is the U.S. Federal Source for sustained climate observations and information in support of research, monitoring, and prediction

STRATEGIC GOALS



1.0 Observing Systems

Sustain an evolving *in situ* global observing system adequate to monitor, understand, and support prediction of the changing Earth system in collaboration with national and international partners.

2.0 Information and Products

Provide a broad and expanding range of observation-based products and analyses that describe global and regional patterns of climate variability and change that address the needs of our broad range of customers.

3.0 Innovation

Leverage innovative practices and new technologies to improve system efficiency, timeliness, effectiveness, resilience/reliability, and catalyze new applications of observational capabilities.

4.0 Partnerships

Collaborate with interagency, federal, international, academic, and private sector partners to develop solutions for sustaining and evolving the global *in situ* observing system and leverage federal observing investments.

5.0 People and Culture

Strengthen the COD workforce to sustain leadership in global climate observing and related research.

STRATEGIC GOALS & OBJECTIVES

1.0 Observing Systems

Sustain an evolving *in situ* global observing system adequate to monitor, understand, and support prediction of the changing Earth system in collaboration with national and international partners.

Goal 1 focuses on COD's core mission and commitments. An effective observing strategy must begin with an overarching vision that articulates key imperatives and identifies opportunities to guide future efforts. Observing requirements must reflect user and stakeholder needs, some of which may evolve through long-term research and observing efforts, advances in modeling/forecast systems, and high-impact climate needs. Observing systems must address the requirements, be guided by NOAA and program priorities, and take advantage of cost-efficient measures in order to sustain itself, improving capabilities while reflecting changing capabilities of observing platforms. High-quality observational data must be accessible, especially to those who use them operationally, but also to the increasingly broad range of non-expert users. Data and metadata should be consistent, discoverable, and integrated with other like data. Moreover, it must be an end-to-end system.

FUTURE SYSTEM VISION

1.1 Articulate a vision of the future observing system that exploits new technologies.

REQUIREMENTS

Observing requirements arise from constituent needs and are designated by international efforts led by the World Meteorological Organization (WMO), Intergovernmental Oceanographic Commission (IOC), and the Arctic Council working groups. COD is developing the system in the open ocean and Arctic with other entities focusing on coasts [(e.g., the Integrated Ocean Observing System (IOOS)] and the Great Lakes, [e.g., the Great Lakes Environmental Research Laboratory (GLERL)]. COD-supported observations also address a number of non-climate needs, which are considered by the program in its prioritization of activities. Requirements change over time, particularly in response to new research findings and increasing constituent needs; COD is proactive in ensuring NOAA needs are considered in these processes. The environment is evolving over multiple decades, and because changes are often very small, and embedded within variability, requirements require high-quality observations of key variables and attributes over long periods of time.

1.2 Evolve the requirements for the current ocean, atmosphere, and Arctic observing systems in response to: the new needs of NOAA; users and decision makers in research (e.g., Ocean Acidification), forecasting, and assessments; and Societal Challenges.

1.2.1 Global Climate Observing System (GCOS)

i. Actively participate in the drafting of the new Progress Report and updated Implementation Plan of the international GCOS Program.

1.2.2 Global Ocean Observing System (GOOS)

i. Engage in developing and updating international requirements for sustained global ocean observing.

ii. Align COD practices with the GOOS Framework for Ocean Observing (FOO).

1.2.3 Sustaining Arctic Observing Networks (SAON)

i. Engage in developing and updating the Arctic Council's endorsed pan Arctic monitoring plans and programs to include local, regional and global assessments of change.

1.2.4 NOAA

i. Ensure the global in situ climate observation system is responsive to NOAA's Climate Societal Challenge findings (within COD mission scope of sustained observing).

ii. Formulate COD criteria for prioritizing system evolution based on observing system requirements (1.2), COD's Guiding Questions (p. 4), and NOAA needs.

OBSERVATIONS

The COD supports the design and evolution of sustained observing systems that address desired requirements through long-term investment in comprehensive observing systems and technology development and testing. The program makes use of existing observing systems/platforms and programs, a cost-effective approach to expanding and enhancing the system. When expanding, the program considers existing and planned *in situ* and remotely-sensed observing capabilities, as well as the improved capabilities of numerical forecast/analysis systems to provide a more complete depiction of environmental changes. Technological capabilities have increased dramatically over the past few years. The program must evaluate these capabilities to determine whether they can support program objectives, and be incorporated into program plans. Supported observing systems need to be evaluated routinely in the context of observing needs and program objectives.

1.3 Sustain critical observing system elements according to NOAA needs, international requirements, and COD's Guiding Questions (p. 4).

1.4 Grow the ocean, atmosphere, and Arctic observing systems in response to the requirements of end users and stakeholders engaged in research, operations, and assessments.

1.5 Adapt and evolve the ocean, atmosphere, Arctic, and relevant biogeochemistry and biological observing system in accordance with COD priorities (see 1.2.4).

1.5.1 Advance observing capabilities for the global tropics, especially in the Tropical Pacific.

1.5.2 Advance observing capabilities for the deep ocean.

1.5.3 Advance observing capabilities for the Arctic and sea ice regions.

> ***Strategy**: Adapt and evolve the observing system by enhancing technology for deep ocean measurements and advancing biogeochemical capabilities.*
>
> *~ OceanObs'09 priorities*

1.5.4 Advance ocean biogeochemical observing system capabilities.

1.5.5 Advance observing capabilities for ocean boundary current regions.

1.6 Maximize synergies between sustained observing activities and planned climate process field campaigns to improve relevance of field campaigns towards improving the sustained observing system.

1.7 Align observing system performance with prioritized requirements.

1.8 Develop observing system evaluation capabilities in the context of research, analyses, monitoring, model validation, and forecast requirements.

1.9 Improve the cost effectiveness of the observing system.

1.9.1 Leverage multi-use observing platforms.

1.9.2 Consider consolidation of existing climate observing networks.

1.9.3 Optimize deployment opportunities.

DATA

Data and information from supported observing systems must be accessible, discoverable, integrated with like data from other national and international programs, and preserved. As such, COD works with its partners to:

1.10 Improve the timeliness and dissemination of observations and information.

1.10.1 Improve near-real time access to *in situ* observations to address important operational needs an ensure data return.

1.10.2 Better integrate (e.g. through U.S. IOOS efforts) global ocean data systems with coastal and other data systems.

1.10.3 Promote international integration of climate data through best practices of data acquisition, quality control, standardization, and accessibility.

1.11 Meet and exceed US Federal and NOAA environmental data management requirements, e.g. OSTP mandate on Increasing Public Access to Research Results

2.0 Information & Products

Provide a broad and expanding range of observation-based products and analyses that describe global and regional patterns of climate variability and change that address the needs of our broad range of customers.

Observational data provided by COD's research activities (e.g. Goal 1) are foundational elements of a broader climate enterprise that address the needs of the climate research, forecasting, and assessment communities while also providing critical information to stakeholders and decision makers that need to monitor and respond to changes in earth's climate. These, and data from others within and external to NOAA, are the basis for authoritative climate data sets and contribute to various critical climate assessments (e.g., IPCC, Arctic Climate Impact Assessment). Although the focus of COD's ocean observing efforts is global, the linkages between the global ocean and regional climate variability and change are strong. Integrated oceanic, atmospheric, and biological observing products and knowledge underscore these global to regional connections as well as the key role that climate observations and products play in understanding critical regions. A range of observations, from global to regional in nature, are needed to guide answers to scientific questions, improve models, and provide knowledge to decision makers. COD will engage the scientific community in developing new and tailored information products around the diverse suite of climate-related observational data produced by NOAA and its national and international partners to address key scientific and societal challenges, such as better understanding of extreme events.

The Division will continue to focus on the development of value-added climate information, products, and indices that can enhance the use of climate data to address specific needs of a wide range of users and decision-makers. This focus strengthens the connection between foundational observation activities and their application within the climate enterprise.

These observations and products will be used to educate and communicate to others the foundational role that observations and the Division play in providing accessible, actionable information about the changing state of the climate. The observations and products will also be disseminated through NOAA websites, publications, assessments, and reports. COD education and outreach efforts will further inform federal leadership, educators, and the public.

PRODUCTS AND ANALYSES

COD is committed to providing value added information and products to diverse users and stakeholders. To meet these needs requires support for developing new and improved products, sustaining products over climate time scales, and transitioning products to "operations". Reprocessing and reanalysis of data is also essential.

2.1. Sustain existing products foundational to understanding and describing climate variability and change.

2.2. Support development of new products describing patterns of climate variability and change with a focus on oceans, Arctic, and extremes.

2.3. Develop and articulate clear strategies for identifying and prioritizing the development of new products and improving established products based on scientific and societal needs.

2.4. Establish and expand new long time-series baseline indicators of climate variability and change.

2.5. Develop improved products describing the status of the climate observing system.

2.6. Seek input and feedback from users and stakeholders to better understand and support their needs.

COMMUNICATION, DISSEMINATION, AND OUTREACH

Equally as critical as developing authoritative climate information products is ensuring that such information is available, accessible and known to a diversity of users. A sustained communication and dissemination effort is needed to highlight the value provided by observing systems themselves as well as to make certain that critical climate information is being fully utilized in the scientific and societal arenas.

2.7. Build awareness for COD capabilities at the highest levels of NOAA and DOC.

2.8. Develop a Communications Strategy to promote availability and utility of data and products the Division supports, as well as advancements in observing capabilities, through targeted climate education, communication, and outreach activities using NOAA websites, publications, assessments, reports, and representative indicators.

***Strategy**: Develop a Communications Strategy for COD to translate the science for a broad audience.*

2.9. Support data discovery and dissemination mechanisms particularly for specific products that are designed to reach key audiences (federal leadership and decision-makers, the public, educators).

3.0 Innovation

Leverage innovative practices and new technologies to improve system efficiency, timeliness, effectiveness, resilience/reliability, and catalyze new applications of observational capabilities.

The Climate Observation Division's observing system portfolio needs to meet increasing demands (e.g., deep ocean observations and observations of biogeochemical processes, as well as greater access to atmospheric observations) as well as sustaining and evolving existing long-term data sets of climate observations, all in a constrained budget environment. This will require the development and incorporation of new observing technologies such as autonomous vehicles and sensors (i.e., biogeochemical sensors) into existing platforms, and high latitude observations including under-ice observations and observations in increasingly ice-free oceans. Along with new platforms and sensors, increasing demands include higher temporal and spatial resolution (e.g., in the tropics), more accurate and precise observations, observations at higher vertical resolution, and real-time command and control of platforms to change sampling protocols and/or mission programs.

Advanced telecommunications capabilities and data management processes will be required to implement the enhanced capabilities and provide augmented data to users. Ships will still be required in the foreseeable future for complex, multi-mission operations and moorings for long time-series. Due to the vastness of the global ocean compared with the number of ships available, the cost of ship operations and moorings is increasing dramatically thereby reducing overall US fleet operations. Coupled with limitations of ship deployments constrained by weather; ship-based datasets are biased to the northern hemisphere and summertime observations, particularly in high latitudes. Autonomous platforms reduce or eliminate the biases of ship operations in terms of both spatial and temporal distributions of data and also provide high-frequency observations. Often they can provide data with less latency and delays introduced by the need to retrieve underwater instruments. The reduced cost per observation from autonomous instruments will enable the deployment of more platforms with additional sensors into regions with data gaps, thereby improving data assimilation and model performance. Models themselves must be modified to accept various new data sensors and data from new types of platforms. Autonomous vehicles are also expected to be more cost efficient per observation.

Delivering the best possible climate, weather, and environmental observations requires a strategic approach to applying innovation and leveraging the latest in technologies. COD will enhance system efficiencies and effectiveness and catalyze new applications by exploring new technologies and developing strategic relationships within, and external to, NOAA.

3.1 Develop and begin implementation of a technology roadmap to align with the future vision of the observing system.

3.2 Optimize the use of all available ship resources and investigate reduced reliance on NOAA ship resources.

3.3 Improve data transmission timeliness by leveraging new and emerging technologies.

3.4 Dedicate a portion of COD's budget annually to test and implement new technologies.

3.5 Target strategic relationships and partnerships to develop and test new technologies (including those developed outside of COD, e.g. in other agencies).

3.6 Transition new technologies to established and new observing systems.

4.0 Partnerships

Collaborate with interagency, federal, international, academic, and private sector partners to develop solutions for sustaining and evolving the global *in situ* observing system and leverage federal observing investments.

PARTNERS

- OAR Programs and Labs
- NOAA Line Offices
- Interagency
- Federal
- International
- Academia
- State and Local Governments
- Private Sector

COD recognizes the importance of partnerships to sustain and evolve an effective global *in situ* observing system. COD will continue to build on its long-standing partnerships and forge new ones with other parts of NOAA, other federal agencies, international organizations, academia and the private sector to sustain and expand the current global *in situ* observing system, to address key research questions, and undertake joint work and advocacy.

NOAA

NOAA sponsors nearly half of the observational platforms currently deployed throughout the global ocean, with over 70 other countries supporting the remainder. COD manages and supports the implementation of NOAA's *in situ* contribution to the global ocean observing system for climate. COD works collaboratively both within OAR and across line offices through various working groups and other mechanisms to coordinate efforts, share information, and address observing requirements. COD also recognizes that our cooperation and collaboration with offices managing NOAA ships, aircraft, other observing systems, data archival, and satellite platforms is extremely important for advancing scientific knowledge into the future.

4.1 Coordinate with NOAA partners to efficiently identify and address observing system requirements, which help meet individual Line Office and NOAA missions.

4.1.1 Seek increased access to ship and aircraft resources and platforms, and human resources, to align with validated and prioritized user and stakeholder requirements.

INTERAGENCY

The Climate Observation Division works in close partnership with U.S. Federal Agencies focused on ocean research and observations through such programs and committees as the Interagency Ocean Observation Committee (IOOC), US Global Change Research Program (USGCRP), the Arctic Policy Group (APG), the Interagency Arctic Research Policy Committee (IARPC), the U.S. Climate Variability and Predictability Program (US CLIVAR), and the Ocean Carbon and Biogeochemistry Program (OCB). These help develop and encourage interagency synergies and efficiencies through collaboration on future plans, and integration and exchange of expertise.

4.3 Develop synergies between *in situ* and remote sensing communities for critical satellite calibration/validation work, product and information development, and updating requirements of the *in situ* observing system.

4.4 Build on existing collaborations with NSF, NASA, ONR, DOI, DOE, BOEM, EPA, and others to enhance atmospheric, sea ice, ocean, and ecosystem observations in the Arctic.

4.5 Collaborate with NSF and other agencies to address key guiding questions and monitoring of essential variables.

4.6 Explore ways to improve interagency coordination of ship resources to meet mission needs.

INTERNATIONAL

While NOAA is recognized as a world leader in global in-situ observations for the Ocean and Arctic, it does this in partnership with many other nations and organizations. NOAA's contributions to global ocean observing are coordinated internationally in cooperation with the Joint WMO - IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) with infrastructure in place to coordinate deployments and provide system monitoring and data throughflow enabling completeness of key observing networks (e.g. buoys/moorings, ships of opportunity, sub-surface profiling floats, tide gauges). NOAA and its partners also support infrastructure (see Goal 1) for requirements and evaluation processes. COD-supported observations are implemented in accordance with and under the auspices of both the international GCOS and GOOS at the WMO, IOC, and Arctic Council Working Groups.

COD has significant experience in partnering with other countries to achieve common data collection goals. NOAA's ship capacity is limited and cannot meet all the needs by itself. Because of the remote nature of some observing requirements, using conveniently located foreign assets can be more efficient and cost effective. Many of these partnerships have been accomplished under Memoranda of Understanding, Joint Project Agreements, and Science and Technology Agreements, which detail comparable contributions of resources and effort from all partners (e.g., Tropical Atmosphere Ocean/ Triangle Trans-Ocean Buoy Network (TAO/TRITON), Argo, Russian-American Long-term Census of the Arctic (RUSALCA), the International Arctic System for Observing the Atmosphere (IASOA)), have accrued significant advantages and cost savings in meeting the associated observing requirements. Joint Project and other Agreements help meet our observing requirements, as these arrangements equitably bring resources from all partners to the joint effort and thereby reduce the total demand on NOAA resources. Increasing the capacity of other nations with interest in climate observing is a worthwhile strategic investment towards increasing international contributions towards climate observing.

4.7 Enhance the sustainability of the global climate observing system by diversifying, supporting, and leveraging international partnerships (e.g. seeking additional partners to support global in-situ climate observations), frameworks, and assessments.

4.8 Lead the international coordination of global ocean *in situ* observing system implementation; increase leadership in sustained observing of the Arctic; and where appropriate in the atmospheric domain.

4.9 Sustain engagement and sponsorship of international observational management and coordination activities.

4.10 Increase the number of capacity-building activities with potential global in-situ climate observing partners (e.g., with South Korea, Indonesia).

4.11 Seek shared resourcing of projects with other countries to equitably meet multiple observing requirements with partners, thereby reducing the total demand on NOAA resources.

ACADEMIA

COD supports researchers at academic institutions to advance the *in situ* observing activities. NOAA's Cooperative Institutes are academic and non-profit research institutions that conduct research in support of NOAA's Missions, Goals and Strategic Plan. Currently, the Division supports 7 Cooperative Institutes across 23 states and the District of Columbia. Additionally, the Division utilizes competitions in select areas to identify and support outstanding research proposals from academia that advance its objectives.

4.12 Enhance NOAA-academic collaboration and research to advance Division research and advocacy for enhanced global *in situ* observing.

PRIVATE SECTOR

COD will pursue private-public partnerships [e.g. manufacturers of observing instruments and sensors, private ship owners] to sustain and enhance the *in situ* global observing system for climate.

4.13 Pursue public-private partnerships to improve observational capabilities for and enhanced advocacy for enhanced global *in situ* observing.

5.0 People and Culture

Strengthen the COD workforce to sustain leadership in global climate observing and related research.

COD will maintain its leadership role in global *in situ* observations and monitoring with a commitment to establish and continue a high level of the scientific, technical, and managerial expertise within its workforce. COD will maintain and improve the recruitment of superb and diverse scientific talent. It will encourage and enable continued engagement with, and leadership of, the scientific and observing communities, and focus on succession planning to ensure a sustained pool of capabilities. This requires encouraging participation in professional growth opportunities, sustaining management competencies, establishing efficient business practices, and offering attractive high quality work life options such as telework and e-learning. Finally, COD will emphasize cooperation, collaboration, and transparency in a manner that benefits the program workforce, all program participants, and stakeholders.

PEOPLE

5.1 Develop and implement a multi-year staffing plan to address COD strategic staffing needs.

5.2 Sustain continuity of scientific and technical expertise by filling capability or capacity gaps with strategic recruitment of personnel and development activities aligned with system requirements.

5.3 Advance program management capabilities and technical expertise.

5.3.1 Encourage employee professional development through participation in interagency, national, and international panels, committees, and other leadership opportunities.

5.3.2 Increase COD training in the grants management process.

5.3.3 Promote use of an electronic grant awards management system.

CULTURE

5.4 Foster a culture that encourages interdisciplinary efforts and teamwork.

5.4.1 Target areas for cross program coordination and collaboration within CPO.

5.4.2 Create new opportunities for professional contribution and growth, which align with Program goals and share these new understandings with colleagues.

5.5 Convene an annual offsite COD retreat/training.

5.6 Facilitate transparent and ongoing communication at all levels within COD.

Appendix A. GCOS Climate Monitoring Principles

The Climate Observation Division seeks to uphold these principles.

Effective sustained and robust observing systems for climate should adhere to the following principles*:*

1. The impact of new systems or changes to existing systems should be assessed prior to implementation.
2. A suitable period of overlap for new and old observing systems is required.
3. The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves.
4. The quality and homogeneity of data should be regularly assessed as a part of routine operations.
5. Consideration of the needs for environmental and climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.
6. Operation of historically-uninterrupted stations and observing systems should be maintained.
7. High priority for additional observations should be focused on data-poor regions, poorly observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution.
8. Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation.
9. The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted.
10. Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.

Appendix B. Acronyms

AMAP – Arctic Monitoring and Assessment Programme
AOML – Atlantic Oceanographic and Meteorological Laboratory
BOEM – Bureau of Ocean Energy Management
CAFF – Conservation of Arctic Flora and Fauna
CLIVAR – Climate Variability and Predictability Program
COD – Climate Observation Division
COSC – Climate Observing System Council
DOE – Department of Energy
DOI – Department of the Interior
ESRL – Earth System Research Laboratory
EPA – Environmental Protection Agency
GCOS – Global Climate Observing System
GFDL – Geophysical Fluid Dynamics Laboratory
GLERL – Great Lakes Environmental Research Laboratory
GOOS – Global Ocean Observing System
IABP – International Arctic Buoy Programme
IARPC – Interagency Arctic Research Policy Committee
IASOA – International Arctic System for Observing the Atmosphere
IOC – Intergovernmental Oceanographic Commission
IOOS – Integrated Ocean Observing System
NASA – National Aeronautics and Space Administration
NCEP – National Centers for Environmental Prediction
NDBC – National Data Buoy Center
NOAWG – NOAA Ocean Acidification Working Group
NSF – National Science Foundation
NWS – National Weather Service
OAP – Ocean Acidification Program
OCB – Ocean Carbon and Biogeochemistry Program
OMAO – Office of Marine and Aviation Operations
ONR – Office of Naval Research
PIRATA – Pilot Research Moored Array in the Tropical Atlantic
RAMA – Research moored Array for African-Asian-Australian Monsoon Analysis and prediction
RUSALCA – Russian-American Long-term Census of the Arctic
SAON – Sustaining Arctic Observing Network
TAO/TRITON – Tropical Atmosphere Ocean/ Triangle Trans-Ocean Buoy Network
TWG – Tropical Pacific Observing System Working Group
USDA – U.S. Department of Agriculture
USGCRP – U.S. Global Change Research Program
WMO – World Meteorological Organization