

**RESPONSES TO RECOMMENDATIONS FROM THE CLIMATE WORKING GROUP
RELATED TO COA/COM PROGRAM REVIEWS
As of October 2010**

**NOAA Climate Working Group Meeting – COM Review
April 7-8, 2010
Grand Hyatt, Washington DC**

Recommendations

COM-2010-01: The community mandates for expansion point to opportunities and the need to evolve: Develop and field deep-diving Argo floats, complete the implementation of moored ocean reference stations, and add biogeochemical sensors.

Funding to develop a profiling float for the Argo program capable of operating to 6,000 meters has been included in the FY 2011 President's Budget. If development begins in 2011, funding for the large-scale deployment of deep-diving floats is expected to be included in the 2013 budget. Two research projects have been funded under the National Oceanographic Partnership Program to develop and implement biogeochemical sensors for Argo profiling floats.

COM-2010-02: There is need for a more integrative structure and strategy amidst a portfolio of observations across ocean, land, atmosphere, and the Arctic, and against the common context of need for increased investment to sustain on-going efforts, to get back on track on planned observing system development, and to address new needs and opportunities.

This is a point well taken and one that the NOAA Climate Program Office has attempted to do by locating program managers from ocean, atmospheric, and Arctic observing programs in one office. This is particularly relevant given the publication of the recent GCOS Implementation Plan (IP-10) that is known as GCOS-138 published in August 2010 [see <http://www.wmo.int/pages/prog/gcos/Publications/gcos-138.pdf>]; unfortunately, such integration of the atmospheric, oceanic, and Arctic observing programs is difficult to do with the disparity of resources and approaches, and this could be better done under a NOAA Climate Service structure.

COM-2010-03: Attempt to establish the synergies and interrelationships among observing components that might aid prioritization.

This is done whenever possible. A prioritization of observing components is generally looked at with the following criteria:

- **Those observations needed to produce or maintain a Climate Data Record (CDR) of a GCOS Essential Climate Variable.** By CDR, it is meant that the record is to be long, calibrated, homogeneous, and with associated metadata; that is, in keeping with the Climate Monitoring Principles. It is implicit that preserving a long record would take precedence over initiating a new one. Reference observing systems, particularly those in-situ systems that could be used to bridge gaps or discontinuities that may appear in the satellite data record, are of particular interest.

- **Those observations to support a new research or service effort.** In the context of the Strategic Vision and Framework, observations to support societal challenges should receive priorities. Observing systems rarely if ever are built de novo but rather are the legacies of research or service programs.
- **Those observations supporting internationally agreed goals and plans** (of WCRP, IPCC, GCOS and GOOS), because NOAA operates many of its activities as a partner with the entire international community.
- **Those observations that provide demonstrated support for prediction.** The TAO network would be one example of such a system.
- **Those observations that provide demonstrated support for services.** Existing practitioners of climate services, for example the regional climate centers, are some of the strongest supporters of HCN-M and the regional surface networks.
- **Those observations that provide critical support for climate assessments.** The Total Solar Irradiance Sensor record does not have a strong stakeholder constituency; perhaps only a handful of investigators know how to work with the data. But there is no substitute for a consistent solar record in distinguishing a natural vs. anthropogenic climate signal.

COM-2010-04: Consider networks more holistically, (e.g., how the land-based CRN and HCN meshed with (or did not) the ocean-based tropical moored arrays and ocean reference stations) or e.g., make surface radiation products for the globe rather than for subsets of the earth's surface.

Given the holistic approach of GCOS-138 this is exactly how this is approached; while resource constraints may make it seem like subsets of the earth's surface are being addressed, this is simply not the case. NOAA can only do so much with the resources it has, but what it does accomplish is done under the auspices of GCOS and thus contributes to a full global observing component by taking care of those areas for which it has resources.

COM-2010-05 (with Climate Goal): A COSC-like advisory group should provide similar guidance to other components of the observing efforts; evolution toward guidance over the whole observing portfolio would lead to greater synthesis and holistic management.

This is not necessarily true. The atmospheric climate observing effort takes its guidance and direction from the work of the GCOS Secretariat via the Atmospheric Observations Panel for Climate (AOPC). The AOPC sets requirements for global atmospheric observing, and so a COSC-like approach would not be more effective. In fact, given the budget for atmospheric climate observations (about 10% of that for ocean climate observations), this would probably not be as worthwhile an effort. Additionally, unlike the more PI-based research approach to ocean climate observations, the atmospheric climate observing program is not PI-based, but rather is based on a systematic approach to installing and maintaining sites that does not lend itself to the need for a COSC-like approach.

COM-2010-06: A traditional SWOT (Strengths Weaknesses Opportunities Threats) analysis should being performed to determine priorities, especially in light of the fact that priorities

seem to change from year to year often with no apparent heritage or evolution from year to year.

A traditional SWOT exercise was conducted years ago to determine priorities, but is not in practice today. This is a reasonable recommendation and one that will be adopted once the Next Generation Strategic Plan is in place and a NCS is formed. With specific guidance, a SWOT analysis will be more effective.

COM-2010-07: Formally respond to the CWG with responses to reviews commissioned in the past three years.

This document constitutes a formal response to commissioned reviews from the past three years.

Climate Observations and Analysis Program Review
April 11-13, 2007
National Climatic Data Center
Ashville, NC

Recommendations

COA-2007-01: Provide a coherent integrated structure and clearer framework for Climate Observations and Analysis activities and service (i.e. a Strategic Plan), that includes aspects of implementation.

NOAA's Climate Observations and Monitoring, a core capability, will be responsive to the details of the NCS implementation strategy and NOAA's Next Generation Strategic Plan, and will articulate the Vision, Mission, and Goals.

COA-2007-02: Further the integration of the many efforts under Climate Observations and Analysis with one another and other activities under the Climate Goal.

Within the NOAA Climate Service Strategic Vision and Framework, we have identified 5 cross-cutting areas to focus on that will allow integration and coherence across programs within the Climate Service as well as across the agency. The NCS will manage the transition from individual programs in multiple parts of NOAA to an integrated program managed by the NCS, including development of internal governance bodies and an action plan

COA-2007-03: Establish prioritization process and identify new areas for investment using strategic plan.

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- **Those observations that provide critical support for climate assessments.** The Total Solar Irradiance Sensor record does not have a strong stakeholder constituency; perhaps only a handful of investigators know how to work with the data. But there is no substitute for a consistent solar record in distinguishing a natural vs. anthropogenic climate signal.

COA-2007-04: Adopt a system approach (the “climate information system”) that more fully involves relevant line offices and the outside community, and includes observations, a performance tracking system, data management and integration, data analysis and reanalysis, assessment and attribution, initialization of predictions, and responsiveness to users.

Such an end-to-end approach for observations is a goal of the NOAA Climate Program and we continually work towards that; the proposed structure of the NOAA Climate Service will serve to advance this end-to-end process, and is also in line with the new strategic vision for the US Global Change Research Program (USGCRP).

COA-2007-05: Ongoing efforts to sustain continuity in climate observing records are critical, and must remain a major priority; however, contingency plans for inevitable gaps in the climate record must be developed.

The inevitable gaps referred to here are primarily recognized to be a potential of the satellite climate record; as such, it is critical to have a robust in-situ observing program with more resources in order to implement key international programs such as the GCOS Reference Upper Air Network (GRUAN); and this is why reference networks are the primary objective of the US GCOS Program.

COA-2007-06: If consolidation of multiple networks (e.g., a reference radiosonde network with temperature, ozone, radiation, and water vapor) could provide savings in staff and locations and help bridge gaps, then implementing this kind of network should be a higher priority.

The GCOS Reference Upper Air Network (GRUAN) is an evolving international reference observing network that will observe a wide range of meteorological variables as suggested in this recommendation. The first priority observations include surface and reference upper-air meteorological variables and total column water vapor. The second priority includes wind profiles, surface radiation parameters (ideally as measured by the GCOS Baseline Surface Radiation Network), temperature and water vapor from a ground-based remote sensor such as a microwave or multichannel infrared radiometer, water vapor and cloud information from ground-based lidar, and total column and profile measurements of ozone, methane, and aerosols. Third and fourth priorities include carbon dioxide profiles and detailed cloud and hydrologic variables. One of the main reasons for establishing GRUAN is to ensure that potential gaps in satellite programs do not invalidate the long-term climate record.

Where consolidation efforts are possible, they will be accomplished. However, it should be realized that implementing a program such as the GRUAN at a limited number of sites (30-40 worldwide) for climate observing purposes does not necessarily allow larger networks with more

of a weather focus to be eliminated. The co-location of GRUAN sites at US DOE ARM sites is an example of taking advantage of existing infrastructure and then only having to pay for incremental GRUAN-only reference costs.

COA-2007-07: Expand the assimilation and analysis component of COA, synthesize observations and create strong links between observations and data assimilation and production of analyses and error fields, especially to enable observing system experiments which will aid in observing system design.

Ocean Climate Observation (OCO)-sponsored activities have been spun up, commencing in the FY2010 to FY2011 time frame, to produce monthly global ocean heat content anomaly fields derived from blended Argo and altimetry data (e.g., the datasets used to derive annual ocean heat content anomalies reported in the BAMS State of the Climate Report). The objective is to provide the monthly datasets to an OCO-sponsored project at the NOAA Climate Prediction Center (CPC) for comparison with data assimilation model results (e.g., GODAS and/or other DAS systems).

A second OCO-sponsored activity, begun in FY2010 at CPC, is development of an ocean observing system experiment (OSE) designed to evaluate the utility of the TAO array. Sensitivity experiments are being run to assess the impact of various ocean observation data platforms on ocean state analysis and subsequent seasonal forecasts. Data denial experiments are run to evaluate the adequacy of the TAO array under various design configuration options, and to assess their impacts on seasonal and interannual forecasts. Data loss that occurred as a consequence of ship time shortage in 2009 is being simulated by holding back data in the eastern Pacific.

A third OCO-sponsored activity has been active for several years, originally based at the University of Washington, but more recently moved to RSMAS. In this activity, an observing system simulation experiment (OSSE) is run at varying levels of resolution to simulate the extent to which ocean state can be determined from interrogation of Argo floats. Published analyses have pointed to deficiencies in the Argo array at high latitudes, thus underscoring the need for better geographic coverage, particularly in the area of the Antarctic Circumpolar Current.

NCEP and the U.S. Navy are jointly participating in both GODAE OceanView (GOV) and the JCOMM ETOOFS (Expert Team on Operational Ocean Forecasting Systems). Both NCEP and the U.S. Navy are represented on the GOV Steering Team (NCEP and NRL) and on the ETOOFS (NCEP and NAVO), which means that the Navy is representing both military and civilian operational ocean forecasting interests, and NCEP is contributing to the international coordination in R&D needs for future development of operational ocean forecasting capability.

During the past 3+ years, NCEP has developed a strategy in Global Ocean Modeling and set it into motion. Progress to date includes:

- 1) The first operational global ocean model at NCEP will be the Navy's global HYCOM. To this extent, NCEP (EMC) has successfully configured NAVO's global HYCOM and the model is now waiting for implementation by its operational division (Target: Q1FY11);

2) NAVO is now providing the initial condition for the global HYCOM to NCEP (EMC) daily. NCEP will use the NAVO initial condition to initiate daily production of the global HYCOM at NCEP (Status: completed);

3) NCEP and the Navy have jointly initiated an effort with other partners (e.g., Univ. of Maryland) to develop the next generation ocean data assimilation framework for both NAVO and NCEP that would be compatible with framework for an operational NWP data assimilation system. (Status: multi-year effort).

In terms of a long-term strategy/approach in GODAE OceanView:

1) NCEP envisions that it will not have its own global ocean model that could rival the Navy's. Instead, NCEP will be working alongside the Navy, taking advantage of the Navy's past and future investments in global ocean modeling, to have a common operational global ocean model.

2) The next generation ocean data assimilation system at NAVO and NCEP will be a common framework that will also be compatible with the operational NWP assimilation framework, and hopefully also consistent with climate models. There will not be a separate NCEP-only development on ocean data assimilation for global HYCOM.

With 1) and 2) above, the difference between NAVO and NCEP global HYCOM runs will be in the use of different atmospheric forcing that comes from different operational NWP models - FNMOC for NAVO, and GFS (NCEP) for NCEP. This would provide the application development with a multi-model ensemble when outputs are exchanged in real-time.

COA-2007-08: Advance the approach to engaging partners from the external community in Climate Observations and Analysis and Climate efforts. Broader partnerships should include:

- ***International, regional, national and local observing systems and programs;***
- ***Universities and other partners in the extramural research agencies;***
- ***Agency partners in a number of other agencies;***
- ***Regional partners including, most notably, the Regional Climate Centers, State Climatologists, RISA programs and IOOS Regional Associations among others; and***
- ***The private sector active in climate research, monitoring and services.***

Partners are engaged at all levels; a lot of work in coordinating and engaging with partners is already done and, if anything, is expanding. To date, observations support internationally agreed upon goals and plans (of WCRP, IPCC, GCOS and GOOS), because NOAA operates many of its activities as a partner with the entire international community. Also, please see COA-2007-06.

COA-2007-09: Choose a variety of sustained mechanisms for user engagement and feedback to help guide program design, priorities and implementation.

The Ocean Climate Observation (OCO) Annual System Review is conducted annually and invites users to participate in discussions about ocean observation needs and feedback. Other activities engage the user community, including an annual trip by a subset of Climate Program

Office program managers to GFDL to determine data uses and needs.

As the Climate Prediction Center (CPC) has access to the operational oceanic and atmospheric reanalysis data and the seasonal climate outlooks made by the NCEP's Climate Forecast System (CFS), CPC is well positioned to provide the user community with a timely and accurate assessment and interpretation of the evolution of the state of the global ocean, its interaction with the atmosphere, and its prediction by CFS. Information about the current state of the ocean is disseminated via the CPC's GODAS website: <http://www.cpc.ncep.noaa.gov/products/GODAS/>. Dissemination of the ocean state information via the website is augmented through an operational product referred to as the "Monthly Ocean Briefing" (MOB), which was first implemented in May 2007. These briefings enable data providers and the user community to interact, and can lead to discussions regarding data needed in order to enhance our understanding of the state of the ocean.

COA-2007-10: COA should develop a clear and consistent vision for the role of satellite data in climate services.

The vision set forth in the Climate Service Vision and Strategic Framework is in Appendix A:

- The NCS will sustain and work with partners to expand the comprehensive nature of the observing system and monitoring capability, which includes the refresh of measurement approaches using technological advances with compliance of the climate monitoring principles.
- The NCS will provide full and open access to data, information, and service for NOAA, other agencies, and both the public and private sectors for climate-related decision support and other purposes.
- The NCS will archive and steward data from operational satellites from NOAA and its partners, and assemble these data to create multi-decadal measurement records of many essential climate variables including sea-surface temperature, clouds, water vapor, and other parameters as the basis for determining the origins and impacts of climate variability and change. The NCS will partner with NESDIS and NASA to prepare for the stewardship of data from upcoming operational satellite systems.
- The NCS will continue to support the acquisition, deployment, and operation of a solar irradiance sensor and two Earth radiation budget sensors that will be deployed on future satellite systems. The data and measurements from these sensors will be integrated with the core NCS climate monitoring capabilities.
- The NCS will engage the satellite research community through a competitive grants program to capture and deliver its expertise in the construction of CDRs, archiving the data and code necessary for their production, developing the capacity to produce these products operationally and routinely within NOAA, and planning to maintain the continuity of CDRs across future observing systems.
- The launch of the Earth radiation budget sensors on satellite platforms will permit NCS to build new monitoring products for better quantifying Earth's radiation budget, which can be used to diagnose changes in Earth's climate system as well as to discover the processes at work, and thus to improve predictions of changes in precipitation and surface temperature patterns.

- Incoming solar radiation is a major driver of Earth's climate system, and the launch of the solar irradiance monitor, TSIS, will allow the NCS to detect minute spectral changes in the solar output and will enable the continuity of this important base measurement which is used in predictive climate models.
- The NCS will expand its portfolio of CDRs to include measurements that describe multi-decadal measurements of precipitation, outgoing Earth radiation, ice cover, land surface temperature, aerosols, sea-surface winds, and other key parameters that enable climate monitoring and assessments activities. CDRs are defined as time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change. The NCS will also sustain and enhance its existing collection of Climate Data Records and plan for the continuity of these records in the future.
- The NCS will employ the CLASS to meet its archive storage needs through its multi-node distributed architecture. The NCS will leverage CLASS capabilities to provide user-defined search and access to data. These data services will extend beyond the NCS and will address all of NOAA's data archive needs.

COA-2007-11: Issues of satellite data assimilation, relationships and dependencies on other parts of NOAA, and the long-term relationship between NASA and NOAA need to be addressed.

The Joint Center for Satellite Data Assimilation was formed by NOAA and NASA in 2001 and has worked to advance assimilation of satellite data, though primarily at weather time scales. The larger issue of coordination between NASA and NOAA is formally addressed by the NASA Earth Science-NOAA Joint Working Group on Transition of Research to Operations, which is quite active and represented at the highest levels of NOAA/NESDIS and NASA Earth Science. Examples of successful or promising handoffs from NASA to NOAA include the JASON series and the TSIS and CERES sensors that are to fly on JPSS.

COA-2007-12: Resolve conflict of interest over program manager of COA being Director of NCDC.

NOAA is in the process of moving away from the PPBES budgeting process and the matrix managed approach that resulted in these conflicts of interest across NOAA. NOAA is implementing a new Strategy Execution and Evaluation (SEE) process. The SEE process allows the accountability and authority over resources, as well as program management, to reside within each line office.

COA-2007-13: Concern exists over the limitations to the timeliness and effectiveness of the COA program imposed by NOAA's PPBES process, with a lack of flexibility in implementation by disconnecting planning from execution, and the inability of the Climate Program Office to control resources and ensure coordination, especially involving the outside community.

NOAA is in the process of moving away from the PPBES budgeting process and is implementing a new Strategy Execution and Evaluation (SEE) process. The SEE process allows the accountability and authority over resources, as well as program management, to reside within

each line office. The SEE process provides a detailed annual roadmap for each Line Office, Staff Office, and Council, which will allow for improved execution of programs, and, ultimately, enhanced accountability. The steps within SEE place particular emphasis on evaluation and results-based budgeting. The process will permit NOAA to learn from its programs' results and achieve its objectives, while simultaneously responding to ever-changing economic, governmental, social and environmental forces. The formation of the proposed Climate Service Line Office will allow for increased oversight and direction over formulation, execution and evaluation of climate activities.

COA-2007-14: Improve the functioning of the NOAA internal process that integrates program planning, budget formulation and execution, and processes used to determine priorities when requested and appropriated budgets differ.

NOAA is implementing a new Strategy Execution and Evaluation (SEE) process. The SEE process allows the accountability and authority over resources, as well as program management, to reside within each line office. As part of the SEE process, NOAA reassesses its options during the Corporate Portfolio Analysis. This step allows NOAA to analyze its implementation plans to identify key issues and corporate priorities going into the next budget formulation phase and draws attention to long-term concerns that may require Leadership attention. The subsequent review of the Corporate Portfolio allows NOAA to reassess commitments made in the Implementation Plans and priorities set in the Corporate Portfolio Analysis and reconciles the implementation plans with the enacted appropriation.

COA-2007-15: Upgrade and invigorate the extramural grants program especially to include calls related to reanalysis and attribution; NOAA should commit a fixed fraction of program funds to peer-reviewed extramural funding, and maintain this funding commitment.

The Climate Program Office has two programs with funding announcements in FY11 for reanalysis and attribution.

In their most recent (FY11) call for proposals, the Modeling, Analysis, Predictions, and Projections Program (MAPP) is soliciting competitive proposals for research in three areas including: Evaluation of Recently Developed Reanalysis Projects including, but not limited to, CFS-Reanalysis and the 100-year Historical Reanalysis Project.

In addition, the Climate Observations and Monitoring (COM) Program's FY11 solicitation for competitive proposals for research focuses on three areas including climate change detection and attribution, with a particular focus on documenting and attributing changes at continental to regional scales (in joint partnership with DoE)

The NOAA Programs performing climate research maintain a balanced portfolio of peer-reviewed extramural/intramural and non-peer-reviewed extramural/intramural. Maintaining budget flexibility to adjust the budget for each type of research is critical for NOAA to meet its strategic goals and objectives. A fixed fraction may not be the best approach to managing the climate research because it limits management flexibility. However, NOAA does have a goal of

maintaining a robust peer-reviewed extramural grant program and awards over \$100.0 million in competitive research.

COA-2007-16: Include a visitor and postdoctoral program so that connections to internal personnel are fostered.

The NOAA Climate and Global Change Postdoctoral Fellowship Program was founded in 1990 and is funded by the NOAA Climate Program Office. The program pairs recently graduated PhDs with host scientists at U.S. institutions to work in an area of mutual interest. The program aims to create the next generation of climate researchers. It endeavors to attract recent PhDs with research interests in areas relevant to the NOAA climate science and services program. The purpose of the program is to help create and train the next generation of researchers needed for climate studies. There have been 166 appointments made to the program to date.

The NOAA Climate and Global Change Postdoctoral Fellowship Program focuses on observing, understanding, modeling, and predicting climate variability and change on seasonal and longer time scales. This includes the documentation and analysis of past, current, or possible future climate variability and change and the study of the underlying physical, chemical, and biological processes.

In addition, the NOAA Climate Program Office in collaboration with the UCAR Visiting Scientist Programs (VSP), funds the PACE (Postdocs Applying Climate Expertise) Fellowship Program. This program has been developed to: Grow the pool of scientists qualified to work at the interface between climate science and its applications; transition advances in climate science and climate prediction into climate-related decision making tools and frameworks; and increase and strengthen collaborations between climate research institutions and decision making institutions across all sectors.

The program seeks recent or anticipated PhDs who have expertise in climate science and who are interested in applying their knowledge of the climate system to increase decision-making capacity in climate-sensitive sectors. They program currently has a 2011 call for applications to their Fellowship Program.

COA-2007-17: A COSC-like advisory group should provide similar guidance to other components of the observing efforts; evolution towards guidance over the whole observing portfolio would lead to greater synthesis and holistic management.

The NOAA Science Advisory Board (SAB) will be reviewing the composition of all working groups during their December 2010 meeting. As NOAA builds the structure to support and moves forward with the implementation of a NOAA Climate Service, we are reviewing options for our working groups.

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

COA-2007-18: Leadership of data management activities, which is critical to the success of COA, should be clearly defined to provide more appropriate levels of direction, prioritization,

and integration of activities, to more systematically identify opportunities and risks, and to raise the needed funds in the budget process. These activities should focus explicitly on the needs of COA as opposed to being required to address the broader needs of NOAA.

Considerable progress in this area has been made since 2007, and the data centers are now much more involved in managing the overall CLASS effort. The institution of the Climate Data Records program at NCDC has gone a long way in fostering and empowering this leadership.

COA-2007-19: If GEO-IDE is the solution to integration/interoperability problems, then there needs to be top level recognition in NOAA that GEO-IDE is important and GEO-IDE should be prioritized as such, i.e., from the COA perspective, it should be stated that integration is required to accomplish the Climate Goal.

NOAA's Global Earth Observation - Integrated Data Environment Initiative (GEO-IDE) is a set of guidelines and best practices that establish a framework for improving the interoperability of NOAA's environmental information management resources. These guidelines and best practices address long-term preservation (e.g., [NOAA Procedure for Scientific Records Appraisal and Archive Approval](#)), discovery and access, standards, data quality, etc. The implementation of GEO-IDE, which is in its initial stages, is under the auspices of the NOAA Environmental Data Management Committee, which oversees data management policy across NOAA. GEO-IDE is a foundation element for NOAA's Environmental Data Architecture.

COA-2007-20: The group of climate users needs to be clearly identified and prioritized, so that the climate data access/management requirements can be identified specifically for this group. Prioritization is critical when addressing funding shortfalls in the data management part of COA.

This is an ongoing activity that the Climate Observations and Monitoring program is attempting to conduct to identify users and determine their needs.

COA-2007-21: Given the importance of data integration: The panel endorses the notion of a NOAA group, the Data Management Integration Team (DMIT), operating as part of GEO-IDE to address access, standards and other relevant data management issues. From the COA perspective, this group should work closely with existing climate groups. The adoption of standards, at least for metadata, should be done soon so that those collecting data know what standards to follow.

The DMIT, with representatives from across NOAA, operates as a team of the Environmental Data Management Committee (EDMC) and has been active in advancing the Global Earth Observation Integrated Data Environment (GEO-IDE) initiative. It has developed a set of GEO-IDE Guidelines and Best Practices that includes recommendations on data and metadata standards. It works with all of NOAA's data management programs and has strong and long-standing ties with the NOAA National Data Centers. More recently, it has been briefed to the Climate Program Office Global Interoperability Program (GIP), and continued interaction and coordination is anticipated.

COA-2007-22: There is a strong need to link GEO-IDE and CLASS. If GEO-IDE is the coordination activity for the NOAA Climate Goal cyber-infrastructure interoperability element, these two systems should, at a minimum, be linked. Alternatively, CLASS should be integrated into an organization in which GEO-IDE provides the lead.

The NOAA National Data Centers are using CLASS to provide archive services for major NOAA observing system programs and are active participants in DMIT and the GEO-IDE initiative. In addition, they are critical members of an Archive Architecture Team that has been formed under the EDMC and is charged with developing a Concept of Operations for NOAA's Data Archives. The AAT is using the ConOps to address the preservation and stewardship of all NOAA data and information resources.

COA-2007-23: Addressing the interoperability issues for climate studies is required not only with groups outside of the Climate Program within NOAA but also with groups external to NOAA. There are several options for ensuring that common standards required for interoperability are adopted. NOAA can:

- a. Take the lead and/or work with other agencies.***
- b. Work within NOAA to achieve standardization.***
- c. Build the capability into GEO-IDE to augment metadata after the fact (via the service-oriented architecture) allowing for the inclusion of important data sets developed by non-NOAA organizations into a standard-homogeneous environment.***
- d. Build metadata/standard crosswalks.***

NOAA is using the EDMC, DMIT and GEO-IDE to pursue each of these alternatives. They sponsor membership and support or coordinate participation in formal standards bodies including ISO TC 211 and the Open Geospatial Consortium (OGC) and with interagency, international and community organizations such as the GEO Architecture and Data Committee (ADC), the USGEO Architecture and Data Management (ADM), the Committee on Earth Observation Satellites Working Group on Information Systems and Services (WGISS) and the Federation of Earth Science Information Partners (ESIP). The efforts to develop the GEO-IDE Guidelines and Best Practices draw on these external interactions and the EDMC and DMIT provide the internal forum to discuss and promote them across NOAA programs. The GEO-IDE initiative is also sponsoring a pilot project to provide a Unified Access Framework to existing gridded data collections (UAF-Grid) from multiple NOAA programs and potentially non-NOAA data sets. One of the barriers to discovery and access of these collections is lack of adequate metadata and this project is addressing that gap. Finally, the GEO-IDE Standards Sub-task has developed and demonstrated crosswalks between a number of important data and information standards widely used in the community (OGC, OpenDAP, Unidata, ISO).

In-situ Observing Systems and Data Management including Stewardship

COA-2007-24: There should be a better link with, or inclusion of, the regional coastal ocean observing efforts going on under NOS and NWS.

The physical co-location of the NOAA Climate Program's observation group with the IOOS program has provided better linkage in this area. Collaboration with NOS and other line offices

on the development of the NOAA contributions to the National Ocean Policy Engagement Strategy, Policy Objective Team #9 on Ocean, Coastal, and Great Lakes Observations, Mapping and Infrastructure is increasing the awareness of the need for additional collaboration.

COA-2007-25: A systems approach to atmospheric observations was not evident and may not be easily built. The evolution of an integrative strategy for atmospheric observations is encouraged with attention paid to what makes the atmospheric observations climate quality and to adhere to the principles for climate observations.

The atmospheric observations program takes a proactive and systematic approach towards implementing systems. This has resulted in the completion of the 114-station USCRN network in the lower 48 states, and a good start towards completing the 29-station USCRN network in Alaska by 2016. Coupled with the installation of soil sensors at USCRN sites and the implementation of the Regional US Historical Climatology Network (RUSHCN) at 141 stations in the US Southwest, we believe that a good systematic approach exists.

The **GCOS Reference Upper Air Network** (GRUAN) is responsive to this recommendation in that it is being designed to directly address climate monitoring and science requirements by employing specialized instruments and adhering fully to the GCOS climate monitoring principles agreed to by the United Nations Framework Convention on Climate Change. Upper air observations within the GRUAN network will provide long-term high-quality climate records, will be used to constrain and validate data from space based remote sensors, and will provide accurate data for the study of atmospheric processes.

On a regional scale, COM and its partners support organization and operation of a small network of atmospheric observatories around the Arctic rim that will produce “climate-quality” data. These observatories strive to have a common set of instrumentation and aim to produce circum-Arctic products.

COA-2007-26: Overlapping old and new observing systems is needed.

This is true and is one of the 10 GCOS Monitoring Principles; this is how, for example, the USCRN and RUSCHN programs are managed. It is not always possible given resources, but is a basic tenet for which we strive.

Within the Argo Program, several experiments have been conducted in which Argo and CTD measurements of temperature and salinity and Argo, XBT, and CTD measurements of temperature have been compared. These will continue as part of the effort to develop drift and bias corrections for Argo and XBT observations and the products (e.g., ocean heat content) of those observations. We feel that this has been the basis for retaining many of the XBT lines during the build out of the Argo array.

COA-2007-27: Better integration of ocean and atmospheric observing system with those doing biological and chemical observations would be beneficial.

Approximately one-half of the slightly more than 200 Argo floats equipped with dissolved oxygen sensors are U.S. Argo Program Floats. These are deployed in regions where dissolved oxygen measurements are of importance to biogeochemical research and not subject to Exclusive Economic Zone considerations in their continued operation. U.S. Argo PIs are also funded under research programs to conduct near-surface salinity observations in support of remotely sensed research and to develop a nitrate sensor.

On a regional scale, the COM program supports climate-related observations in the U.S. Arctic that include physical, chemical and biological measurements. One objective is to detect physical variability and change and associated biological response.

While there is a long way to go to blanket the ocean with the full suite of chemical and biological observations desired, the CLIVAR/CO₂ repeat hydrography cruises have long stood as an example of excellent integration of physical and chemical oceanographic measurements. Expanding from current GCOS-92-based objectives, whose full implementation exceeds the budgetary reach of the program, to the yet more ambitious and comprehensive vision of integrated biological measurements, as articulated at OceanObs'09, cannot be accomplished under current funding scenarios.

COA-2007-28: COA should consider moving toward producing global surface radiation and surface energy balance fields, taking over some new Arctic observations, and possibly collaborating with other line offices (e.g., use of DART buoys for climate observations).

With the new structure of the Climate Observations and Monitoring (COM) Program, including Ocean, CCDD, Arctic, Argo, Atmosphere, and Carbon Monitoring, more integration with the Arctic Program Office has taken place.

COA-2007-29: We suggest that the BAMS State of the Climate Report should, with time, move toward increasing integration across sub-elements and across the air-sea interface possibly requiring more effort and time, which could delay publication of the report.

The BAMS State of the Climate Report does as a good job of documenting the state of the climate from a number of vantage points; its intent is to be a resource of what happened from a global climate perspective in the previous year and to be a resource for others to use. It is not in and of itself an applied assessment that looks to integrate across sub-elements as the IPCC does. As noted, to do this would not only change its character, but would lead to long delays in its production. As it is the work and publication schedule delays publication of BAMS until the July issue. Further delay of the publication is not an option for the BAMS State of the Climate Report editorial staff, since the publication deadline is set by a high agency authority with the goal of releasing the report while its findings are still relevant to the broad public. The goal is to inform the public about observed climate change within six months after the completion of the reporting period (i.e., the prior calendar year). However, working under very tight time constraints, increasing efforts have been made in the 2008 and 2009 reports to enhance author-to-author feedback loops during an expanded period of “internal review.”

COA-2007-30: Procedures, consistent with climate observing principles, should be in place to

decommission elements of the observing system not performing as needed (e.g., phasing out of broadcast mode XBTs).

During the OceanObs 99 meeting, it was recommended that Low Density (commonly called “broadcast mode”) XBT deployments be terminated once it is demonstrated that Argo floats could reproduce the same type of signals that the XBTs in LD mode are providing. Such analyses have not been conducted, however, broadcast mode XBTs are being phased out for budget and logistical reasons in order to focus on transport and supplementing Argo in boundary current regions (see COM-2010-03). Recent work indicates that there is value in continuing some of the long LD records (~40 years) because they are useful for model validation, hypothesis testing and/or monitoring upper layer temperature structure and, at some point, some LD records may be reinstated.

COA-2007-31: Sparse reference networks may not address needs for higher spatial resolution, but without analysis and efforts on modeling and attribution, the need for high spatial resolution in climate observations is unclear.

For this we look to the GCOS requirements produced by the GCOS Science Panels coupled with the work of hundreds of scientists who produced the latest GCOS IP-10 report (GCOS-138 and formerly GCOS-92) as a guide in the determining the spatial resolution of reference systems.

One application that has grappled with spatial and temporal constraints on in situ sampling is the attempt to evaluate seasonal uptake of CO₂ by the ocean. Clearly, a dozen or even two-dozen volunteer observing ships carrying pCO₂ instruments, plus a dozen or so (or even the ultimately desired 50) moorings equipped with pCO₂ instruments can hardly provide the high spatial resolution required for global coverage of this phenomenon. The outcome of a series of projects sponsored jointly by OCO and our sister Global Carbon Cycle program have resulted in development of analyses that utilize remotely sensed proxies to fill in the gaps. A robust (low resolution) network of surface pCO₂ measurements is required to maintain and upgrade calibrations (and to support improved analytical methodologies), but the approach has allowed us to realistically move away from the impractically expensive high spatial resolution surface deployments that would otherwise have been required.

COA-2007-32: Partnering with other agencies and observing networks may fill in some gaps and is important given financial constraints on climate observations.

This is true, and that is why this is exactly what we do. The ocean observations program could not in and of itself field a global ocean observing network without cooperating with both domestic and international partners. The Ocean Obs '09 conference is an example of how that leveraging works to further the ocean observing system. The implementation of the GRUAN system is another such example, where NOAA pays the incremental costs of GRUAN observations while the DOE ARM sites where GRUAN exists pays for the existing upper air observing infrastructure.

COM is a partner with NSF in supporting ocean and atmospheric observations in the Arctic region. There is an interagency “Arctic Observing Network” group, co-chaired by NSF and

NOAA, which works to catalog the full U.S. effort in the Arctic and strive for sharing and coordination.

COA-2007-33: Funding increases are needed to move forward with the observing system.

As NOAA moves forward with a Climate Service, basic services will be provided under four core capabilities, one of which is observing systems, data stewardship, and climate monitoring. As the NOAA Climate Service develops, we will continue to explore options for funding increases to support observing systems.

COA-2007-34: Uncertainty exists about the extent of data management efforts as well as partnering with producers of products, with modeling, and with assessment activities. These efforts, along with development of a clear process for evolution, integration, and assessment of efficacy are needed, and should be aided by the establishment of a Project Office for Climate Observations.

Under the proposed structure for NOAA's Climate Service (NCS), there are three key core capability areas that will provide the foundation for all the services the NCS and its partners will deliver. One of these three areas is Observing Systems, Data Stewardship, & Climate Modeling. The NCS structure dedicates an office to Observing Systems, Data Stewardship, & Climate Monitoring. This office will be responsible for the tracking of broadly accessible results such as data and information and new and applicable measurement techniques as well as making measurable progress towards achieving robust climate observing systems and accurate climate data. In addition, as part of the NCS, this office will also work to partner with producers of data products, as well as modeling and assessment activities.

Analysis including Reanalysis, OSSEs, OSEs, and related Research

COA-2007-35: In reanalysis activities, insufficient attention has been given to seeking advice and developing an advisory team, learning lessons from previous and ongoing reanalyses, upgrading the input data, developing a grants program component to recruit users to help exploit and evaluate the products, and especially developing a detailed plan with goals and objectives that can help determine the success of the project.

As part of the CPO Announcement for 2011, the Modeling, Analysis, Prediction and Projection (MAPP) program has called for proposals that evaluate and compare recent reanalysis projects, specifically:

“i) investigate general aspects of the general circulation, and the global water and energy cycles (such as temporal and spatial structure of biases and uncertainties) comparing CFS-R with other Reanalyses products and independent observations; ii) investigate the impacts of non-stationarities in the observational system on the reanalysis products.”

One of the aims of GODAE OceanView is to formulate more specific requirements for observations on the basis of improved understanding of data utility. One of the four task teams of GODAE OceanView, operating jointly with the OOPC, is the Observing System Task Team,

of which NOAA is a member.

NCEP released the Climate Forecast System Reanalysis (CFSR: see Saha et al., The NCEP Climate Forecast System Reanalysis, Bull. Amer. Meteor. Soc. 2010, e-View doi: 10.1175/2010BAMS3001.1), a major upgrade over the previous generation of reanalysis products. Development of the CFSR was guided by a Science Advisory Board whose membership included experts from academia and government and international organizations, and by NCEP's many years of experience with providing and using climate reanalyses since the release of NCEP/NCAR Reanalysis 1 (described in Kalnay et al., The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470, 1996). A major advancement in the development of the CFSR, compared to earlier NCEP reanalyses, was the real-time monitoring that took place during the execution of the CFSR. Thousands of graphical plots were generated automatically at the end of each reanalyzed month, and displayed on the CFSR website in real time. Scientists from both CPC and EMC monitored different aspects of the reanalysis during this 2-year process. This extremely large "atlas" of plots depicting nearly all aspects of the CFSR is open to the public at: <http://cfs.ncep.noaa.gov/cfsr>. The release of the CFSR dataset enables users to compare the resulting fields with earlier reanalyses (e.g. R1 and R2) with observations in order to perform an objective assessment of biases and uncertainties (see, for example, Higgins et al., Intercomparison of Daily Precipitation Statistics over the United States in Observations and in NCEP Reanalysis Products, accepted in Journal of Climate: doi/abs/10.1175/2010JCLI363.) Evaluation of reanalyses was the topic of a recent workshop sponsored by NOAA, NASA, NSF and U.S. CLIVAR (November 2010). Workshop objectives include: assessing strengths and limitations of the new recent U.S. reanalyses (including the CFSR) and suggesting where improvements of reanalysis products can be made; identifying additional studies necessary to further elucidate the fidelity and usefulness of recent U.S. reanalyses; and developing diagnostics to quantitatively assess needed improvements in Integrated Earth System Analysis (IESA) products.

The 20th Century Reanalysis project is an international collaborative project lead by NOAA and CIRES while profoundly connected to other reanalysis efforts and user communities nationally through U.S. CLIVAR (Climate Variability and Predictability Program) and internationally through ACRE (Atmospheric Circulation Reconstructions over the Earth). ACRE was established in 2008 with five core partners: the Queensland Climate Change Centre of Excellence (QCCCE) in Australia; the Met Office Hadley Centre (MOHC) in the UK; NOAA/ESRL, CIRES, the University of Giessen in Germany and the University of Bern in Switzerland. Validation of the 20th Century Reanalysis is addressed by an ACRE working group on Verification and Validation, chaired by Gil Compo, University of Colorado/NOAA ESRL.

COA-2007-36: The needs of some communities should be sought or recognized (such as the chemical and aerosol communities, the polar [especially Arctic] community, and the climate change community).

Arctic needs are recognized and addressed through the Arctic Program Office and their participation in national and international organizations and committees with the Arctic community.

COA-2007-37: There is no clear sense of broader reanalysis issues or of an overall strategic vision and approach. An implementation plan that identifies critical paths and activities and permits priority-setting is greatly needed.

Responsibility for planning NOAA's reanalysis activities was transferred to the Climate Research and Modeling (CRM) Program as part of the Climate Goal restructuring in 2008. NOAA's reanalysis activities were reviewed as part of the March 2008 CRM review by the Climate Working Group, and detailed responses to review recommendations are provided in Appendix B: Responses to Recommendations Related to CRM Program Review

Climate Services and Product Development

COA-2007-38: A clear and consistent vision of the multitude of user communities must be better understood and subsequently maintained. Users must be engaged with all facets of product development and delivery. Means of obtaining user feedback are a must in order to ensure the success of product and service programs.

During the Ocean Climate Observation Annual System Review, users are engaged in discussion and presentation highlighting their data use and data needs. To date, it has been challenging to receive specific data requirements from many data users (e.g., some climate modelers), since many of them often prefer the "give us everything" data approach.

COA-2007-39: Currently lacking is a well-developed means of soliciting new products and retiring those not deemed useful. Adaptation strategies must be incorporated in recognition of eventual changes in user demands or priorities.

With potential budget cuts in the future, products not deemed useful will have to be retired in order to sustain other elements of the observing system and data analysis program. A method for doing this is currently being developed.

COA-2007-40: User feedback must be better solicited, and partners must better share in development and maintenance responsibilities as opportunities arise. NOAA must become more adept at entraining these partners.

The global ocean observing system user community is invited to attend the OCO Annual System Review to speak in a user session about their observational needs. Funded ocean observing PIs identify the users and describe the uses of their data in their annual progress reports.

COA-2007-41: NOAA must continually aim toward meeting the needs of the vast array of user communities that increasingly rely upon high-quality climate products and services.

Better connections between observations and monitoring and the climate service division must be established in order to identify how data are enabling services like sea level change forecasts and ecosystem impacts.

COA-2007-42: NOAA badly needs some sort of overall planning and coordination of

analysis/reanalysis and allied activities, and that coordination and planning must incorporate other national efforts and the relevant international community.

The Climate Program Office has funding announcements in FY11 for reanalysis. In their most recent (FY11) call for proposals, the Modeling, Analysis, Predictions, and Projections Program (MAPP) is soliciting competitive proposals for research in three areas including: Evaluation of Recently Developed Reanalysis Projects including, but not limited to, CFS-Reanalysis and the 100-year Historical Reanalysis Project.

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

COA-2007-43: Reanalysis and allied activities are vital to COA and the Climate Goal, and there is insufficient effective coordination and planning across the topic within NOAA. A strategic, systematic approach is required. Develop plans and coordinating infrastructure necessary, and specify whose job it is to make that happen.

The Climate Program Office has funding announcements in FY11 for reanalysis. In their most recent (FY11) call for proposals, the Modeling, Analysis, Predictions, and Projections Program (MAPP) is soliciting competitive proposals for research in three areas including: Evaluation of Recently Developed Reanalysis Projects including, but not limited to, CFS-Reanalysis and the 100-year Historical Reanalysis Project.

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

User Communities and Climate Services and Product Development

COA-2007-44: Find and engage partners through a problem/issue-focused approach (e.g., water resource management, disaster management, coastal planning) – as opposed to a broad, “shotgun” approach to search for and engage users.

We have been realigning our approach to observations by making connections between data and applications. An example of a new connection involves identifying coastal partners who can benefit from a clearer understanding and analysis of coastal tide gauge station data and ocean heat content data from Argo profiling floats in order to assist with predictions of sea level change.

COA-2007-45: Make more effort to engage with professional and scientific organizations (e.g., AMS, ASCE) to determine needs of large groups of users.

We call attention here to the OceanObs’09 international conference held in September 2009, which entrained a large percentage of the world ocean climate community in a week long discussion of the lessons learned from the past decade of ocean climate observations and consideration of priorities for continued observations.

COA-2007-46: Have more systematic engagement with partners, who can provide connections to, and feedback from, the broad spectrum of users of climate products and services.

As one step in this direction, we point here to the monthly ocean climate briefings carried out under OCO-sponsorship by our colleagues at the NOAA Climate Prediction Center.

COA-2007-47: COA could do a much better job in encouraging and guiding collaboration across its many elements within the NOAA Climate Program. COA needs to leverage its limited resources by working with its partners, who are engaged in many of the same primary activities. COA/NOAA needs to identify what only it can do and do that well with its limited resources, particularly where its partners/users are critically dependent on it. COA also needs to recognize that its partners/users can particularly provide regional and sector-specific products and services, so that COA does not need to replicate those capabilities.

The NOAA Ocean Climate Observation office funds nearly 49% of the global ocean observing system and supports global projects to sustain and enhance the system. OCO partners with nations across the globe to advance the 10-year implementation plan. In light of a changing structure within NOAA, a Climate Planning meeting identified additional ways to partner within NOAA to leverage resources within the agency to enhance products and services.

COA-2007-48: If COA has identified an interest or need in some regional or sector specific problem, it should engage its partners to do the research and develop the services, primarily at their expense, while COA provides the high-quality CDRs.

COM has a long-standing interest in climate variability and change in the Arctic region and in the response of the marine ecosystem. This work is done in association with many partners, nationally and internationally. Costs are shared and each partner does what it can. A current effort involves coordinated observations of defined variables in defined areas over varying times, with eventual joint analysis of data. Each partner covers its own costs, and the integrated data set will be analyzed collaboratively.

COA-2007-49: A more unified and visible system might result in more support for sustained endeavors. This could include an individual or office dedicated to executing research to operations. Prioritization of products is also an ongoing reality, and one that must be better met within NOAA.

The NOAA Climate Service Vision and Framework provides for a more cohesive and unified structure to support sustained endeavors. One of the NCS core capabilities is an office dedicated to Integrated Service Development and Decision Support. The service development component of the NCS as well as the grants program will reside within this office. This office will address the more systematic transfer of knowledge from research to operations.

Detection & Attribution

COA-2007-50: The Panel suggests the development of a strategic implementation plan for a NOAA climate attribution program, and is urged to develop this plan as quickly as possible, with a focus on Coordination, Research, and Communication.

While attribution research is funded by NOAA, there is currently no strategic implementation plan for a NOAA climate attribution program. CPO solicits proposals that address various aspects of the detection and attribution problem (i.e., data sets that support detection/attribution, development of advanced statistical techniques, attribution at global and regional scales, development of event attribution approaches) in collaboration with DOE. NOAA and DOE also support an ad hoc International Detection and Attribution Group (IDAG) that brings together international experts (e.g., contributors to the IPCC assessments) to focus on key, emerging issues in detection/attribution.

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

COA-2007-51: To avoid idiosyncrasies of individual authors on the Annual State of the Climate Report, a team approach and more extensive external peer review may be warranted.

Agreed; that is why the editors of the State of the Climate report have partnered with the AMS to institute a peer-review of the report beginning in 2008. This has added a month to the publication time, but it has been quite worthwhile and was a direct result of this CWG recommendation.

In each of the past two years (State of the Climate in 2008 and in 2009) enhancements have been made to the peer review process for the report. Three rounds of peer review (at least for the Global Oceans Chapter) are now built into the extraordinarily tight time constraints associated with producing the report (Data are analyzed through the prior calendar year with publication of the report in July): (1) intra-author review, in which all section authors are asked to review all other chapter sections; this is intended, also, to stimulate “cross-talk” among sections authors, ranging from citing findings elsewhere in the chapter to developing joint figures and minor analyses; (2) “informal” review by selected readers, and (3) formal peer review conducted by the American Meteorological Society.

COA-2007-52: The State of the Climate Report should expand towards a synthesis and integration of climate observations. In this regard, calculation of derived variables (such as upper ocean heat content) would be a valuable supplement to the Report; future editions of the Report would benefit from the consideration of data assimilation/ reanalysis products. Each Report might be accompanied by a DVD containing the data depicted in the report.

We disagree with changing the nature of the report to a synthesis report. The BAMS State of the Climate Report does a good job of documenting the state of the climate from a number of vantage points; the intent is for it to be a resource that describes what happened from a global climate perspective during the previous year and to be a resource for others to use. It is not in and of itself an applied assessment that looks to integrate across sub-elements as the IPCC does. There are direct links in the report to the locations of its supporting data. Given the easy

availability of the data referenced in the report, we do not believe that the extra effort and expense of producing a DVD is warranted.

We do not reject the validity and value of these ideas, in particular that of distributing data with the report. However, the synthesis and integration, which blends rapidly into attribution, quickly begins to exceed the scope of the report as currently conceived. We agree, however, that given so many “maps” of ocean variables, one perceives enormous value in overlaying and integrating them. However, because expanding the scope of the report is not commensurate with the mandated publication deadline, it may be most reasonable and effective to launch a companion (“delayed-mode”) report that fully embraces the suggestions made above.

COA-2007-53: A list of 42 Essential Climate Variables may not be affordable or attainable. NOAA needs a process for prioritizing their investments in the climate observing system and its evolution. There is a strong need for data assimilation in this element as a way of addressing observing system design and dealing with questions pertaining to redundancy.

A prioritization of observing components is generally looked at with the following criteria:

- **Those observations needed to produce or maintain a Climate Data Record (CDR) of a GCOS Essential Climate Variable.** By CDR, it is meant that the record is to be long, calibrated, homogeneous, and with associated metadata; that is, in keeping with the Climate Monitoring Principles. It is implicit that preserving a long record would take precedence over initiating a new one. Reference observing systems, particularly those in-situ systems that could be used to bridge gaps or discontinuities that may appear in the satellite data record, are of particular interest.
- **Those observations to support a new research or service effort.** In the context of the Strategic Vision and Framework, observations to support societal challenges should receive priorities. Observing systems rarely if ever are built de novo but rather are the legacies of research or service programs.
- **Those observations supporting internationally agreed goals and plans** (of WCRP, IPCC, GCOS and GOOS), because NOAA operates many of its activities as a partner with the entire international community.
- **Those observations that provide demonstrated support for prediction.** The TAO network would be one example of such a system.
- **Those observations that provide demonstrated support for services.** Existing practitioners of climate services, for example the regional climate centers, are some of the strongest supporters of HCN-M and the regional surface networks.
- **Those observations that provide critical support for climate assessments.** The Total Solar Irradiance Sensor record does not have a strong stakeholder constituency; perhaps only a handful of investigators know how to work with the data. However, there is no substitute for a consistent solar record in distinguishing a natural vs. anthropogenic climate signal.

COA-2007-54: NOAA needs to speak on climate attribution issues, and must do so in a way that maintains agency credibility and reliability. The science of attribution is still not that well developed, nor likely sufficient to support an operational “attribution service.” Extreme care should be taken to stay within the science.

NOAA is not yet ready for an attribution service, but ready for a more organized and better-funded climate attribution program. An attribution service is a worthy goal.

COA-2007-55: NOAA has to weigh in on climate change and extremes, and stay within the science. An expanded climate attribution program would help NOAA be more effective in meeting this objective. *** Note that Panel consensus was not reached here. Concerns that NOAA might be moving too fast, and that NOAA credibility and reliability could be compromised if this operational “attribution service” was developed too quickly. Others were more sympathetic to the urgent needs for a regular and expanding attribution program. Extreme caution warranted in any case, as are much improved coordination and a careful articulation of uncertainties in all attribution statements. *** Deeper issues of accountability existed – many Panel Members expressed concerns about producing an authoritative source of attribution information that might have serious legal implications.***

COA-2007-56: The NOAA climate attribution program should work across NOAA climate program goals: COA, Climate Forcing, Climate Predictions and Projections, and Regional Decision Support.

Climate Attribution is an attempt to provide an explanation of evolving climate conditions and to assess their impacts (particularly at the regional or local levels). We continue to develop plans for an attribution service within NOAA and envision this as a component of assessment services within an NCS. An experimental attribution team has begun at our Boulder ESRL Physical Sciences Division (<http://www.esrl.noaa.gov/psd/csi>). The team is comprised of members from a number of NOAA laboratories and centers. Several experimental products and analyses were provided by this team within the past year. Products are not appraised through an independent review process.

COA-2007-57: A committee – made up of NOAA and non-NOAA experts in climate attribution, as well as user oriented scientists – needs to guide and provide oversight that NOAA represents the community consensus on what we can and cannot say about climate attribution.

NOAA is following the guidelines and practices provided by the Information Quality Act to oversee products produced by the attribution team.

Space-based Observing Systems and related Data Stewardship

COA-2007-58: COA should continue to actively engage both the NASA and NOAA satellite programs to ensure that climate requirements are considered, to develop innovative strategies to address likely gaps in critical data records, and to assess new measurement capabilities for possible incorporation into the sustained observing system.

We do engage both NASA and NOAA satellite programs. See response to COA-2007-47.

COA-2007-59: Create a separate Climate Service line office within NOAA to ease many of the

perceived management difficulties; an observations group under a Climate Service might be responsive to this comment.

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