Arctic Research Program Goals and Activities FY12

Program Goals:

1. Build and maintain a suite of Arctic climate observing networks (ocean, sea ice, atmosphere) in association with national and international partners
2. Support continuing analysis of Arctic climate data derived from the Arctic Research Program and other sources
3. Support analysis of data from unmanned aircraft systems in the Arctic
4. Provide data to and support synthesis and assessment activities, nationally and internationally
5. Participate in public education and outreach

Current Activities:

Most of the resources of the Arctic Research Program support observing networks. The intent is to maintain the existing set of observing activities for climate-relevant periods, meaning a decade or more. The external science teams conducting this work were selected on a competitive basis, while the NOAA teams were chosen based on a record of performance. The current science teams are expected to continue their efforts as long as quality is maintained. Significant resources are directed to various analysis, synthesis, and assessment tasks. The data analysis tasks are conducted by both NOAA and external scientists. The mix of scientists depends on the specific task, although the analysis and modeling work at PMEL and at GLERL is expected to continue indefinitely.

Major ongoing Arctic Research Programs are:

1. Atmospheric Observatories – the Arctic Research Program provides partner support to a network of atmospheric climate observatories around the Arctic rim dedicated to improving knowledge of clouds, aerosols, pollutants, greenhouse gases and radiation and their impacts on climate variability and change. We have contributed to observatory activities at Eureka and Alert Canada in close collaboration with Meteorological Services Canada and the University of Toronto. We have worked with Roshydromet of Russia to develop an observatory at Tiksi. A significant amount of instrumentation has been delivered to Russia and installed, a formal opening of the Tiksi Observatory occurred in August 2010 and NOAA-Roshydromet have established formal contracts for co-operating the installation. At the target observatories, we have good collaborations and cost-sharing strategies with NSF and NASA. In addition to partnership with Russian and Canadian Environmental monitoring agencies, there is a significant partnership with the Finnish Meteorological Institute. The NOAA ESRL laboratory is responsible for implementation of this work and provides significant cost sharing to funds provided by CPO, however this is a NOAA wide activity and leverages

from additional contributions from for example the NOAA USCRN Program at NOAA's National Climatic Data Center. ESRL also provide an integrating function to promote cross observatory science throughout the pan-Arctic region through the International Arctic Systems for Observing the Atmosphere project (www.IASOA.org). IASOA seeks to organize atmospheric observatory data and promote cross observatory synergism and science and the objectives of the USCRN program are closely aligned with those of the GMD's Baseline Observatories Program. The objectives of these programs are closely assigned with the GMD Baseline Observatories Program which includes the Atmospheric Baseline Observatory at Barrow, Alaska that conducts up to 200 different atmospheric measurements, a majority of them continuously (http://www.esrl.noaa.gov/gmd/obop/brw/). Many of these measurement programs have been in operation for 35 years and constitute the longest and largest record of Arctic atmospheric composition in existence. The Barrow Observatory supports a NOAA Climate Reference Network site. The Barrow site is host to the Department of Energy North Slope of Alaska Atmospheric Radiation Monitoring Facility (http://www.arm.gov/sites/nsa) that constitutes the largest and most sophisticated radiation monitoring facility in the Arctic. NOAA operates a manned Atmospheric Baseline Observatory at Summit, Greenland in conjunction with the National Science Foundation. NOAA continuous surface ozone measurements are conducted at Heimay Island, Iceland in conjunction with the Iceland Meteorological Service. Through cooperative programs NOAA collects air samples and Pallas, Finland and Ny-Alesund, Spitsbergen and operates a continuous methane analyzer at Cherskiy, Russia. In conjunction with Environment Canada, NOAA operates an aerosol and radiation monitoring facilities at Alert Station on Ellesmere Island.

2. Long-term ocean and ecosystem observatory in the Bering and Chukchi Seas - In collaboration with Russia, the Arctic Research Program conducts the Russian-American Long-term Census of the Arctic (RUSALCA) Program. Since 2004, we have observed continuously the flow of mass, heat, salt, and nutrients through both the western and eastern halves of the Bering Strait and analyzed these data in relation to atmospheric dynamics and climate. The addition of Russian territorial water moorings increased our coverage of the strait by a factor of 2. (Between 1994 and 2004, only measurements in US waters had been possible.) Since 2007, a high resolution array of 8 moorings has been placed in the strait (US and Russian waters). Since previous sampling (1990-2004) was only by 3 moorings and those only generally only in US waters (1994-2004), this new array more than doubles our confidence in quantifying the fluxes through the strait. More importantly the coastal currents and stratification contribute an extra ~ 50% to previous estimates of the fluxes of heat and freshwater through the strait. For reference, note that the Bering Strait oceanic heat flux is comparable to heat flux into the ocean from the atmosphere in the Chukchi, and that the Bering Strait oceanic heat flux likely acts as a trigger for the onset of summer sea-ice melt in the western Arctic. The Bering Strait freshwater flux is 1/3rd of all freshwater inputs to the Arctic and likely the input with the largest inter-annual variability. The US NSF is a funding partner in this effort. Additionally, we have conducted multidisciplinary(2004, 2009, and proposed

2012) campaigns over a broad area of the Chukchi and East Siberian Seas to evaluate changes in the biophysical "climate" of the this part of the Pacific Arctic Ocean, including loss of sea ice, and impacts of physical change on the marine ecosystem. This work is done through peer-reviewed proposals from academia, NOAA and the Russian Federation. In FY2008, a new ice-ocean-ecosystem modeling and data assimilation effort was initiated to improve analysis of observational data and provide a means for anticipating future evolution of the marine system in the study region. The modeling effort is led by NOAA GLERL, with participation of academic partners. The observation and modeling work is designed to characterize the dynamics of the U.S. Arctic and neighboring areas in the context of regional Arctic climate change. How is “our” and the neighboring marine Arctic changing; what is the linkage between physical change and ecosystem change; can we detect a climate signal in the Bering Strait fluxes; why is loss of sea ice so great in this area; can we reproduce the observations in a numerical model and can the model provide guidance to future change in this region? For FY2012, two legs on the R/V Khromov are scheduled for mid- July and from mid-August to early September. The RUSALCA program will be up for comprehensive review in 2013.

3. Sea ice - The Arctic Research Program is one of several supporters of the International Arctic Buoy Program, which provides the only real-time observations of air temperature and pressure over the Arctic Ocean for weather forecasting purposes. Additionally the IABP collects real-time data on sea ice drift that supports ship operations in the Arctic and modeling of sea ice extent and thickness. This work is conducted by the University of Washington. We also support deployment of a network of ice buoys that provide detailed information on sea ice thickness and both atmospheric and ocean forcing of sea ice melt. Again, the US NSF is a funding partner in this effort. This work is conducted by scientists from the Army Corps of Engineers Cold Regions Research and Engineering Laboratory, PMEL, and academia. In FY2010, additional “seasonal” ice mass balance buoys (ones that will float if the ice on which they are placed melts away, and will refreeze into the ice during the fall), and ice drift buoys were purchased and deployed. A new effort was to procure 2 “upper ocean temperature buoys” and deploy them in open water to observe the relation between upper ocean heat content and ice melt and regrowth. These buoys are deployed from a variety of ships of opportunity over the summer.
4. Climate change detection and analysis - The Arctic Research Program supports efforts to acquire and analyze Arctic climate data and model outputs to detect changes in Arctic climate, understand the role of various forcing factors, and to evaluate the utility of various climate models in describing observed changes in the Arctic. In concert with international partners, assessments are conducted of past and potential future trends,

and their projected impacts on Arctic human society and ecosystems. This effort is conducted by NOAA PMEL and through various international groups such as the Arctic Monitoring and Assessment Program of the Arctic Council, and the International Arctic Science Committee.

5. Synthesis – The Arctic Research Program initiated four synthesis activities in 2009 as a result of competitive proposals submitted to the summer 2008 Climate Program Office solicitation. When completed, these efforts will produce: new updates on sea level over the entire Arctic Ocean basin; a review of recent ocean carbon data from the Chukchi Sea; an integrated assessment of the Chukchi Sea; and a contribution to a pan-Arctic synthesis of the Arctic cryosphere. These efforts were continued in 2010 and results will be available starting in 2011-2012. In addition in FY11 the ARP initiated a data management effort for the RUSALCA program. It is anticipated that there will be a full scale assessment of the program in 2013.
6. Analysis of Arctic Data from Unmanned Aircraft Systems (UAS) – This effort was begun in late FY2009 and is focused on applying UAS data to climate issues of concern in the Arctic. Current use of UAS in the Arctic is limited but is expected to grow considerably over the coming decade. In anticipation of this new data source, the ARP will construct data sets from traditional sources that can provide context and meaning to data from UAS and will work to promote use of UAS on topics of high interest. Three new tasks were started in 2010. One is focused on analysis of thousands of aerial digital photos obtained by a NOAA UAS campaign in 2008. Another is focused on analysis of images and sensor data from various campaigns over the past several years by scientists at the Univ. of Colorado. And the third study is not an analysis task, but an investment in sensor development to enable NOAA to make measurements of black carbon from a small UAS system. The NOAA UAS Program has been deployed in a joint operation with Norway and Russia in 2011 to sample atmospheric carbon in Svalbard.
7. International collaboration – Because the Arctic is mostly "owned" by various countries, an international approach is essential to meet program goals. Staff of the Arctic Research Program plays key roles in three international groups, the Arctic Monitoring and Assessment Program (AMAP) and the Conservation of Flora and Fauna (CAFF) of the Arctic Council, and the Pacific Arctic Group. The Arctic Council is a high level intergovernmental forum for discussing science and policy-related issues and seeking common ground on environmental and sustainable development issues. In the past, the ARP was a supporter of the Council's Arctic Climate Impact Assessment, and recently been a supporter of a new assessment on Climate Change and the Cryosphere in the Arctic. The ARP also supports AMAP work on short-lived climate forcers (e.g., black carbon), use of unmanned aircraft, and sustained observing networks. CAFF efforts were focused on chairing the Circumpolar Biodiversity Marine Monitoring Program (CBMP-Marine). The Pacific Arctic Group (PAG) is an ad hoc forum among China, Japan, South Korea, Russia, Canada and the US designed to foster collaboration in Arctic science. The PAG is preparing an international post-IPY synthesis of knowledge of the oceanography and ecology of the Chukchi Sea and surrounding ocean regions that will serve as a baseline for assessing climate-driven change in this area. Another beneficial outcome of PAG efforts is placement of US scientists on cruises sponsored by other

countries and reciprocal arrangements. These shared activities allow collection of more data than could be done otherwise.

8. Arctic Observing Network – The ARP is working through the Interagency Arctic Research Policy Committee to develop and implement an integrated Arctic Observing Network (AON). The NSF has the lead in this development and NOAA's role is to identify and conduct its observing responsibilities and to engage in interagency data sharing and synthesis. Also, the ARP is engaged in a process to extend the AON concept to the international arena through the Sustaining Arctic Observing Networks (SAON) activity. This activity was initiated as an IPY activity to encourage and facilitate collaboration by the interested governments to implement a set of sustained observing networks. Both bi-national and multi-national paths will be followed to develop a coordinated and sustained Arctic observing network. Significant effort has gone into development of SAON and one of its subunits, the Circumpolar Biodiversity Monitoring Program (CBMP), Marine Expert Monitoring Group (MEMG). Staff of the ARP have co-chaired both the SAON and CBMP-Marine program of CAFF for all of 2010-2011 and will continue in this activity through 2012.