Semi-Annual Progress Report for Alaska Ocean Observing System (AOOS)
NOAA Award # NA05NOS4731078

March 1, 2006 through August 31, 2006

Prepared by Molly McCammon, AOOS Executive Director
September 31, 2006

I. GOALS AND OBJECTIVES: Accomplishments as of August 31, 2006

These accomplishments were achieved by the AOOS project leader, Molly McCammon and the AOOS subcontractors: the Alaska SeaLife Center (ASLC), the University of Alaska Fairbanks (UAF), and Prince William Sound Science Center/Oil Spill Recovery Institute (PWSSC/OSRI). In addition, funds were withheld from the original funding source for NOAA's Pacific Marine Environmental Laboratory (PMEL) to perform some activities in which they had singular expertise.

A. Identify Additional Stakeholders and Stakeholder Benefits; Develop Education and Outreach

Implement Education and Outreach Plan (ASLC)

Stakeholder and user group outreach continues with funding from the AOOS administrative/planning grant. Extensive outreach efforts have occurred and are underway including numerous presentations and participation at state symposia (oil and gas user needs workshop in Anchorage, North Pacific Research Board meetings), and national symposia such as the Coastal Society and Ocean Literacy conferences. These funds were also used to develop an education plan that was finalized in December 2005, with an outreach plan currently under preparation by the Alaska Sea Grant Program. Implementation of the Education Plan, developed in December 2005, has been delayed due to hiring difficulties. An education coordinator is now expected to be hired in October 2006. The coordinator will work with AOOS, which, as part of its education and outreach effort, is playing a lead role (along with the Alaska SeaLife Center and the Alaska Sea Grant Program) in developing a proposal for FY 2007 for a COSEE-Alaska (Center for Ocean Science Education Excellence, a National Science Foundation initiative) that would serve as a collaboration catalyst for ocean education and outreach in Alaska.

B. Expansion of Observing Capacity: AOOS Region 1: Gulf of Alaska

Southeast moorings (PMEL)

After examining the data collected in 2005 in Cross Sound and discussing the results with scientists working in southeast Alaska, a decision was made to deploy two moorings in the region: one in Cross Sound and the second in Chatham Strait. These are the two major entrances and exits to this region of southeast Alaska, which are critical to understanding the inflow and outflow of ocean waters through this series of channels. The PI used the *R/V Media* which regularly conducts research cruises to this region. CTD sections are done in the vicinity of both of these moorings each year by other researchers. The moorings will be recovered in early spring 2007. The exact data of recovery will depend on the availability of the *R/V Media*. Data from this deployment is being analyzed this winter to assist in

designing a long-term mooring system to determine the timing and magnitude of the freshwater pulses that enters the Alaska Coastal Current and the timing of primary production.

Mooring ID	Latitude (°N)	Longitude (°W)	Deployed	Recovered	Water depth (m)
CSP-1A	58° 10’	136° 34.3’	8/28/06		305
CHP-1A	56° 30.1’	134° 23.6’	8/27/06		392

Table 1. Moorings deployed in southeast Alaska from the *R/VMedia*. Each mooring is instrumented with an upward looking 75 kHz ADCP and a Seabird Micro-CAT located with 15m of the bottom.

Cook Inlet Nutrients and Chlorophyll (PWSSC/OSRI)
AOOS funded the lab analysis of water samples collected from the ongoing nutrient monitoring program in Cook Inlet’s Kachemak Bay along the hydrographic lines across Kennedy and Stevenson Entrances. These were analyzed for nitrate (NO3-), nitrite (NO2-), ammonium (NH4+), phosphate (PO4), silicate, total suspended solids, chlorophyll, and phaeopigments.

Seward GAK 1 mooring and GOA ocean observation scientist (UAF/ASLC)
Two ISUS (In Situ Ultraviolet Sensor) nitrate sensors were purchased and incorporated into the GAK 1 mooring at 20 m and 150 m depth. The mooring was deployed at the mouth of Resurrection Bay near Seward Alaska and within the Alaska Coastal Current (ACC) in May 2006 and will provide data to better understand synoptic, seasonal, interannual, and inter-decadal variability of this vital plant nutrient in the ACC. Additional instruments on the mooring include temperature/conductivity recorders and a fluorometer.

The Alaska SeaLife Center continued to pursue hiring an Ocean Observation Coordinating Scientist. Following an in-depth review of applicants, the position was offered to a senior level scientist, who then declined the offer. The secondary candidate is no longer available for the position. The position has not been reposted to date pending ASLC-UAF discussions regarding the position.

Continued operation of Surface Current Mapper (UAF)
Funds support High Frequency (HF) Radar instrumentation in Prince William Sound (PWS) at Shelter Bay and at Knowles Head to provide real-time surface currents of the PWS central basin. This project has produced intermittent data return primarily because of the unreliability of the remote power source. The PI has recently tendered his retirement to UAF and has been replaced. Under limited funding, the new PI (Johnson) decided to shut down the PWS radar for the winter to conserve resources and focus on the PWS field experiment during summer 2007. Johnson developed a successful collaboration with the US Coast Guard to provide helicopter support in PWS to remove an inoperable generator at no cost to this project. It is hoped that this collaboration will continue and allow better use of funds. NOAA CO-OPS (Jennifer Ewald)

plans to install HF Radar in the sound summer 2007 to assist with the PWS Field Experiment. We are working with CO-OPS to consider a long-term deployment of this technology in the sound.

Prince William Sound – A Pilot Program for AOOS (PWSSC/OSRI)
The PWS pilot project is progressing as planned under the leadership of PI Dr. Carl Schoch. Current activities include:

SNOTEL Gauges for Meteorological and Precipitation Data
Freshwater is a major forcing function of local circulation in PWS. To quantify the volume of fresh water contributed by precipitation, a series of weather stations are being deployed at sea level and near tree line in the PWS watersheds. A new weather station was deployed at the mouth of the Copper River in June 2006 to estimate conditions on the Copper River Delta for model calibration and as an aid to local fishermen. This station is reporting real-time data to the web site: www.ambcs.org. Delays in obtaining permits from the U.S. Forest Service may result in fewer deployments of the SNOTEL gauges than planned for this field season. Three weather stations await deployment permits. An MOU between the Prince William Sound Science Center and the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) has been finalized and all equipment has been purchased. The cooperation of the U.S. Coast Guard helicopter group out of Kodiak has been instrumental in accommodating our logistical requirements to date.

Central PWS Mooring
The deployment of this mooring has been delayed until October 2006 after the fall fishing season has closed. This mooring will help determine the magnitude and frequency of currents that renew the waters in deep basins of PWS. Data will be used to validate and improve circulation forecasts from the ocean circulation models which require information on residence times of water masses. The mooring hardware has been purchased, and a CTD from the inventory of the PWS Science Center will be used to measure salinity, depth, and water temperature.

Real-time telemetry for the Copper River stream gauge
The stream gauge came on line in June 2006 and is providing real-time data to the web page: http://waterdata.usgs.gov/nwis. With real-time data telemetry, discharge measurements from the Copper River stream gauge can be assimilated into the ROMS ocean circulation model. An MOU is in place between the PWS Science Center and the U.S. Geological Survey for the operation of this gauge.

Thermosalinograph/fluorescence surveys
A thermosalinograph has been installed on a small high-speed fishing boat from Cordova (*Alena K*). The installation includes a fluorometer for surface chlorophyll measurements and a transmissometer to quantify turbidity. The University of Alaska in Fairbanks was contracted to develop software that combines these measurement values with a GPS position and record to a computer hard drive. Eight surveys are scheduled each year for at least the next two years. Surface salinity mapping will help quantify fresh water inputs to PWS for assimilation by the ROMS model. Chlorophyll fluorescence also will be measured in PWS to provide a measure of interannual and seasonal variability.

Mooring enhancements to measure biophysical coupling
Key factors in the ecology of PWS are the abundances of nutrients and plankton relative to water volume transport and physical properties of flow through the major entrances of PWS. Four CTDs and

fluorometers were purchased in the fall of 2005 and deployed at 30 meters depth on four existing oceanographic moorings in Hinchinbrook Entrance and Montague Strait. These data will be processed as part of the on-going mooring program maintained by the Prince William Sound Science Center.

C. Expansion of Observing Capacity: AOOS Region 2: Bering Sea and Aleutian Islands

Amukta Pass moorings (PMEL)

Amukta Pass (sill depth ~450m) is a key passage for monitoring volume transport and other fluxes from the North Pacific into the Bering Sea. Four moorings were deployed in October 2005 in Amukta Pass. Each mooring was instrumented with a bottom mounted 75 KHz acoustic Doppler current profiler and a SBE-37 to measure temperature and salinity. Recovery occurred in March 2006. No moorings were deployed at that time, because PMEL planned to modify the instruments by adding an auxiliary battery pack. This would permit the deployment of the moorings for a year, rather than the present 6-7 months. This should reduce the costs of the moorings and also help to resolve the problem of limited ship time. Amukta Pass is approximately18 hours from Dutch Harbor, AK and transiting to the pass twice a year is becoming more difficult with available ship time. The moorings were successfully modified (instrumented with ADCPs and Micro-CATS) and successfully deployed in May 2006, with a planned recovery in May 2007. Deployments and recoveries were done on NOAA's *Miller Freeman*.

All ADCPs functioned and provided data from the moorings deployed in October 2005. Three of the SBE-37s functioned and provided data. The Micro-CAT on AMP-4A appeared to be damaged on deployment and collected no data. In addition, during each deployment, a series of 4-5 CTD casts were done across Amukta Pass. All of these data are available on the PMEL data server and will eventually be on the AOOS website.

Mooring ID	**Latitude (°N)**	**Longitude (°W)**	**Deployed**	**Recovered**	**Water depth (m)**
AMP-1A	52° 26'	171° 27'	10/1/05	3/2/06	408
	52° 26'	171° 27'	5/4/06		411
AMP-2A	52° 25'	171° 40'	10/1/05	3/2/06	460
	52° 25'	171° 40'	5/4/06		456
AMP-3A	52°24'	171° 55'	10/1/05	3/2/06	313
	52°24'	171° 55'	5/4/06		308
AMP-4A	52° 23'	172° 7'	10/1/05	3/1/06	356
	52° 23'	172° 7'	5/4/06		356

Table 2. Moorings deployed in Amukta Pass. Each mooring is instrumented with an upward looking 75 kHz ADCP and a Seabird Micro-CAT located within 15m of the bottom.

Maintaining and Enhancing Physical and Nitrate Monitoring of Bering Strait (UAF)
Funds provided enhancements to Bering Strait moorings with ADCPs, current meters and nutrient sensors that were successfully deployed in the summer of 2006. At the present time, it is expected that all equipment is operating fully. A subcontract with R. Woodgate at the University of Washington is going well and has been extended at no cost to the project. The deployed equipment is to be recovered in summer of 2007.

D. Expansion of Observing Capacity: AOOS Region 3: The Arctic

Monitoring sea ice edge and motion (UAF)
Real-time information on sea ice motion and the position of the sea ice edge provides data on the extent, velocity and evolution of coastal sea ice. The installation of the radar is complete, and data are being logged and available on the AOOS web site. A challenge with the radar manufacturer who was using proprietary data formatting has been addressed. The ice edge radar provides useful data to coastal residents near Barrow and to researchers at UAF and elsewhere.

Measuring sea ice thickness (UAF)
A proposal to NSF by Johnson (and co-PI Bill Emery) received excellent reviews but was declined due to lack of overall funds at NSF. Johnson, Emery, Eicken, and others are now preparing a proposal for airborne thickness work to the Office of Naval Research for a November 30, 2006 deadline. If that proposal is successful, AOOS will contribute funds to purchase a helicopter mount for the airborne sea ice thickness instrument (IcePic) to be flown both offshore and over nearshore areas with landfast ice. The instrument would provide measurements of thickness that cannot be gained by other means (satellites do poorly when the sensor sees both land and ocean).

E. Integrate Data across Components, Regions, Agencies, Funding Sources

Data Management and Communications (DMAC) (UAF)
The DMAC team has been established and demonstrated ability and knowledge in both data management and communications and is connecting well to the national IOOS DMAC effort. Significant real-time data is now on line, along with the popular web-cams from a number of statewide locations. DMAC is working directly with stakeholders in PWS, Coast Guard Search and Rescue, and others to update and improve the web pages to meet specific stakeholder needs. AOOS is developing a collaboration with the North Pacific Research Board to hire a new data and web manager to help launch the Alaska Marine Information System, which will include a project browser, metadata browser, and direct access to data. A significant challenge continues to be working with AOOS stakeholders in the three Alaska regions to ensure their information needs are being met. For example, the web pages are currently being used by PWS charters who use the AOOS data regularly to plan their activities. They are requesting that the meteorological forecasts by AEFF be run earlier to better fit their timetable. Also, AOOS provided satellite data on sea ice to the US Fish and Wildlife Service during their walrus surveys in March/April 2006. One of the main goals at the present time is designing the new look and feel for the web site, which is expected to be re-tooled in spring 2007.

F. Data and Information Product Development

Data Visualization (UAF)
Data visualization has become a shared task among the full AOOS team.

Satellite Data Products (UAF)
Funds are being used for 25% time of a satellite technician. We have successfully absorbed the satellite data products already developed for UAF's SALMON project and placed images onto the AOOS site. AVHRR, MODIS, SAR, and other data are now available via collaboration between AOOS (R. Potter) and GINA (K. Engle). A proposal to the Alaska SAR facility (Johnson, Atwood, and Potter) has been submitted to acquire SAR data along the coast between Point Hope and the Mackenzie River to aid Barrow and North Slope stakeholders. This proposal is a direct result of the stakeholder meeting in Barrow in February 2006. Potter has been working with McCammon to survey Alaska satellite data users in preparation for the Remote Sensing Conference in October 2006.

Modeling and Analysis Group (MAG) (UAF)
A critical need as forecast models are developed is analysis and validation of the accuracy and performance of a model. The MAG team – in collaboration with the University of Alaska's Arctic Region Supercomputer Center – was developed to do this. Johnson hired a physical ocean modeler who worked on the freshwater flux problem into the Gulf of Alaska, and that person has now completed his first year appointment. A biological modeler has been hired and is currently conducing experiments on fisheries problems in the Bering Sea. Johnson and AOOS modeler S. Gaffigan have completed an analysis of sea ice models and compared them with observations. Those data are now on the AOOS web site, and a publication describing the results has been accepted for publication in the Journal of Geophysical Research. Gaffigan is now evaluating the RAMS model as part of the PWS pilot project atmospheric modeling effort and comparing RAMS model forecasts at the 6, 12, and 24 hour lead times with observations. The results will be used to improve the RAMS model.

Additional comparisons between observations and other models (NCEP, MM5, and NOGAPS) are expected to follow to address how well RAMS does when compared to other models.

The MAG group is working closely with the DMAC team to ensure that model output is displayed in ways that are useful to various AOOS stakeholder groups. Discussions are underway on how the Alaska region will conduct the overall modeling required to meet IOOS needs. A short position paper was prepared by Johnson suggesting that several million dollars in funding may be required to carry out the necessary ocean modeling now being done at UAF, JPL, and other locations to meet IOOS needs.

II. Overall Program Issues and Concerns
The following issues were identified in March 2006 and continue to be of concern to the overall development of AOOS:

A. Funding uncertainty
AOOS began operating in the summer of 2005 using a $2 million FY 2005 earmark. That earmark was reduced to $1.7 million in FY 2006. We have $2.5 million in the Senate version of the NOAA budget

for FY 2007, but will not know its success until late fall 2006. This funding uncertainty continues to make it very difficult to develop and sustain a program, hire and keep qualified personnel, and proceed forward with long-term planning. The reduction in 2006 has required AOOS to drop its financial support for the Bering Strait moorings during that year. We are working with NSF and other funding entities to pick those costs up.

In addition, if the AOOS program is looking at approximately $2 million a year as its base funding for the near future (as opposed to ramping up from a $2 million minimum), the AOOS board likely would re-consider how it approaches the issue of expanding observation capacity in the three AOOS regions. The board would consider focusing more of its financial resources on the data and modeling components of AOOS and using those to integrate existing observation efforts. In addition, we would continue our existing efforts to leverage the AOOS data system with other agency programs that might have future funding for observation components. One such effort is a current collaboration with UAF's International Arctic Research Center, the National Weather Service, and EPA using NOAA climate and EPA funds and the AOOS DMAC and MAG teams to develop decision-making tools for local managers in response to coastal inundation.

B. Future of HF Radar

The major issue regarding the use of HF radar as a tool in Alaska ocean observing relates to the lack of electricity and the need for a robust, cost-effective remote power source. If the power issue can't be resolved in the near future, AOOS may consider postponing use of HF radar as a long-term tool at least in the next several years. Apparently this is an issue of concern to other Regional Associations, and thus, might be appropriately addressed at the national level.

C. Integration with IPY

The International Polar Year will provide a pulse of activities in Alaska's Arctic and Bering Sea regions. AOOS needs to assess which of these activities might be sustained over the long-term and incorporated into the overall AOOS program.

D. Integration with OOI

AOOS is collaborating with NSF's planned Barrow Cabled Observatory (BC), part of its Ocean Observatories Initiative (OOI). AOOS and BCO co-hosted a workshop in April 2006 focusing on how ocean observing can meet the needs of the North Slope oil and gas industry. The key challenge will be to follow-up on recommendations coming out of that workshop, and to find the funding to do so.

E. DMAC and MAG development without national standards

A key challenge has been to develop the AOOS DMAC and MAG programs without clear national standards. The current DMAC planning documents are fairly generic. These teams are closely tapped into the national DMAC Steering Team, but progress is slow. In the absence of clear guidance, AOOS is moving forward on its own by making its own connections with DMAC teams from other regional OOSs.

Since March 2006, the following issues of concern have been identified:

F. Modeling needs

The ocean circulation models being developed for Alaska waters depend on the boundary conditions identified through large-scale North Pacific models. The other Pacific ocean observing systems will rely on these large-scale North Pacific models, as will international efforts such as the Global Ocean Observing System (GOOS). IOOS needs to address the issue of what are national responsibilities for modeling, and what are regional responsibilities.

Alaska's largest challenge is with ecosystem based management and models to support these efforts. There is still significant uncertainty regarding this.

G. Interaction with global efforts

An Arctic GOOS is reportedly under development. Since Alaska is the U.S. Arctic, the question arises regarding the role of AOOS in this effort. This is still to be defined. PICES, an international scientific organization, also has interest in developing a North Pacific GOOS alliance. How should AOOS play in this arena?

H. Expectation management

Given the uncertainty of future funding, AOOS staff have had a difficult time "selling" the IOOS program, particularly to state officials and commercial fishermen – potentially our largest customers and stakeholders. We need to develop a national strategy for this that can be used at the regional level.