NOPP: Circulation, Cross-Shelf Exchange, Sea Ice, and Marine Mammal Habitats on the Alaska Beaufort Sea Shelf

Thomas Weingartner (PI)
Institute of Marine Science
University of Alaska, Fairbanks, AK 99775-7220
Phone: 907-474-7993 (Office) (Fax) 907-474-7204 E-mail: weingart@ims.uaf.edu

Ben Holt (Co-PI)
NASA Jet Propulsion Laboratory
4800 Oak Grove Dr., Mail Stop 300-235
Pasadena, CA 91109
Phone: (818)354-5473 Fax: (818)393-6720 E-mail: ben.holt@jpl.nasa.gov

Ron Kwok (Co-PI)
NASA Jet Propulsion Laboratory
4800 Oak Grove Dr., Mail Stop 300-235
Pasadena, CA 91109
Phone: (818)354-5614 Fax: (818)393-3077 E-mail: ron.kwok@jpl.nasa.gov

Robert Pickart (Co-PI)
Department of Physical Oceanography MS 21
Woods Hole Oceanographic Institution, Woods Hole, MA 02543
Phone: (508)289-2858 Fax: (508)457-2181 E-mail: rpickart@whoi.edu

Al Plueddemann (Co-PI)
Department of Physical Oceanography MS 21
Woods Hole Oceanographic Institution, Woods Hole, MA 02543
Phone: (508)289-2789 Fax: (508)457-2181 E-mail: aplueddemann@whoi.edu

Susan Moore (Co-PI)
Applied Physics Lab
University of Washington
1013 NE 40th St, Seattle WA 98105-6698
Phone: 206-685-2125 Fax: 206-543-6785 E-mail: sue.moore@noaa.gov

Kate Stafford (Co-PI)
Applied Physics Lab
University of Washington
1013 NE 40th St., Seattle WA 98105-6698
Phone: 206-685-8617 Fax: 206-543-6785 E-mail: stafford@apl.washington.edu

Award Number: N00014-07-1-

LONG-TERM GOALS

Our long-term goal is to understand how the circulation, stratification, sea-ice dynamics, and marine mammal utilization of arctic shelves will change in response to a diminishing ice cover. We thus seek

to understand better the wind-forced response of the shelf and the shelfbreak, and the cross-shelf exchange of mass, materials, and momentum. These responses will likely affect the use of arctic shelves by marine mammals. Our study is applying a variety of recently developed technologies in a synergistic manner. These include passive acoustic recorders, moored profiling temperature/salinity sensors, autonomous underwater vehicles, shore-based current mapping radars, and geophysical processing tools to determine ice displacement and deformation. An additional long-term goal is to demonstrate the applicability of these technologies and their synergistic usage to other arctic shelves.

OBJECTIVES

Predicting how arctic shelves will adjust to changes in ice conditions requires that we address several critical unknowns pertinent to the present-day functioning of arctic shelves. These unknowns motivate our specific proposal objectives, which are to determine:

1. The annual cycle of shelf circulation and stratification,
2. How circulation and stratification change across the shelf due to variations in sea-ice distribution, river runoff, and winds,
3. The seasonal and synoptic variations in the exchange of mass, momentum, and water properties across the shelf, and
4. How marine mammal occurrence on the shelf and slope varies in response to seasonal and synoptic changes in winds and ice-cover.

APPROACH AND WORK PLAN

To attain these objectives we will conduct in-situ measurements and retrospective analyses of historical data, which in aggregate, encompass a broad range of space and time scales. The observational components and the investigators primarily responsible for each of these are:

1. a cross-shelf array of moorings (Pickart and Weingartner);
2. high resolution surveys from the REMUS, an autonomous underwater vehicle (Plueddemann);
3. high-frequency surface current mapping radars (Weingartner);
4. autonomous acoustic recorders for marine mammal vocalizations (Moore and Stafford); and
5. satellite-derived estimates of sea ice concentration, displacement, deformation, and characteristics of the sea surface (Holt and Kwok).

The majority of the fieldwork will occur between summer 2008 and summer 2009. Our winter and spring 2008 activities are largely directed at preparing for the field work. The moorings (including the acoustic recorders) will be in place over this year-long period and the surface HF radar mapping will operate during fall 2008. The hydrographic REMUS operations will include a fall survey (2008) and a summer survey (2009), with both surveys occurring while the moorings are in the water. Finally, the satellite analyses will also concentrate on the summer 2008 to summer 2009 period. The field program will occur on the central Alaskan Beaufort Sea (ABS) shelf, offshore of the Colville River, and is structured about the cross-shelf oceanographic mooring array (Figure 1).

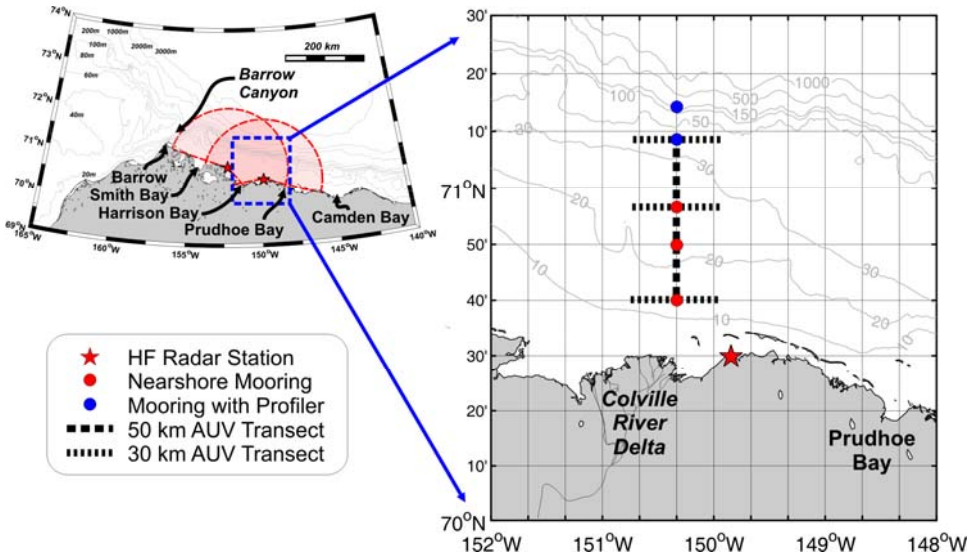

Figure 1. Projected field observations, which include the high frequency (HF) radar installations on the east and west sides of Harrison Bay (left panel) and the mooring and hydrographic lines offshore of the Colville River.

Pickart is responsible for the retrospective component. He will update a physical oceanographic database that was assembled in 2003. The updated database will include more recently collected hydrography and current meter data as well as older data that were not readily available during the earlier effort. He will comparatively analyze these data and interpret them within the context of satellite-derived sea-ice concentration maps and meteorological fields over the past 30 years.

WORK COMPLETED

Only a portion of our first year funding request has been received to date with those funds arriving in October and November. THE ABILITY TO DEPLOY MOORINGS IN THE SUMMER OF 2008 DEPENDS CRITICALLY UPON THE ARRIVAL OF THESE FUNDS SINCE SOME OF THE INSTRUMENTATION REQUIRES A LONG LEAD TIME FOR FABRICATION. We have begun to purchase equipment (mooring supplies, instruments, and high-frequency radar supplies and equipment) and to plan the field program. Planning includes coordinating vessel charters with the Beaufort Sea NOPP project head by Dr. Carin Ashjian (Woods Hole Oceanographic Institution). We have been discussing the field program with entities that control access to coastal sites where we will deploy the high-frequency radar system (US Bureau of Land Management, Arctic Slope Regional Corporation, ConocoPhillips Alaska, Inc.). We are working with NOAA on a blanket FCC application for transmissions from the high frequency radar.

RESULTS

There are no results since the project is only one month old.

IMPACT AND APPLICATIONS

National Security

There are several potential National Security and Homeland Defense implications of a reduced ice cover in the Arctic Ocean. These include the ramifications of an increase in marine industrial development and exploration, new shipping routes, and perhaps increased naval exercises and patrols. In response to decreased ice cover and increased offshore development the US Coast Guard has

recently announced that it will be establishing a station in either Barrow or Prudhoe Bay during the ice free season beginning in 2008. Our research provides information on the physical oceanography of this shelf that will be useful for navigational planning, search and rescue operations, and predicting the dispersal of marine contaminants.

Economic Development

We anticipate that this NOPP project will have indirect economic development influences on the oil industry in Alaska (as well as the State of Alaska and impacted communities). There is increasing interest on the part of this industry to explore and develop wells on the ABS shelf. Our data will contribute to environmental and engineering designs. The economic importance of this NOPP project is recognized by Shell Oil Inc., which has provided $184,000 to the project.

Quality of Life

This NOPP represents the most systematic effort undertaken to understand the oceanography of the ABS and its year-round use by marine mammals. The physical measurements provide a basis for understanding this marine ecosystem and how best to address potential environmental changes. Marine mammals are of primary importance to the subsistence communities along the Beaufort Sea coast. Improved knowledge of marine mammal use of this shelf habitat will enhance management of these species by local communities and resource agencies.

Science Education and Communication

We anticipate that numerous scientific papers will stem from this research. We will also prepare reports useful in developing oil spill response plans for the State of Alaska (see for example the report in http://www.ims.uaf.edu/beaufort/index3.html). Finally, we will develop a project website similar to those developed for previous projects in which the PIs have been engaged.

TRANSITIONS There are none at this time**.**

RELATED PROJECTS

This NOPP project will provide data for the evaluation of models that seek to predict the response of the Alaskan coastal system to an ice-diminished Arctic. That project, headed by W. Maslowski of the Naval Post-graduate School, can use our data sets to evaluate their numerical models. We will also be collaborating with another NOPP project headed by C. Ashjian of the Woods Hole Oceanographic Institution. Her project, on the western Beaufort Sea shelf near Barrow, seeks to understand the physical processes that enhance the feeding success of bowhead whales and how that success varies in response to ice cover. Our NOPP is also closely related to two of the Shelf-Basin Interactions Phase III programs recently funded by the National Science Foundation. These address the circulation on the ABS and Chukchi Sea shelves (D. Holland, Courant Institute, lead PI) and the impact of the storm climate and ice conditions on the cross-stream exchange of mass and properties on decadal timescales in the ABS (R. Pickart, lead PI).