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The Variable Outflow from the Chukchi Shelf to the Arctic Ocean

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LONG TERM GOALS

My long-term goal is to understand the mean and time-varying density structure and circulation dynamics of the continental slope of the Arctic Ocean and how the slope interacts with the adjacent shelves and basin.

OBJECTIVES

The field effort and data analyses are addressing the following questions and objectives:

1. What are the characteristics of the shelf outflow from the Chukchi Sea?
2. What is the variability of these outflows and their water properties?
3. Which upstream processes are principally responsible for the variability?

APPROACH

Our effort is part of a broader, interdisciplinary effort being undertaken by the NSF-ONR Shelf-Basin Interactions (SBI) project as part of NSF's global change program, ARCSS (Arctic System Science). To address our specific objectives, Knut Aagaard, Rebecca Woodgate (both at U. Washington) deployed 4 oceanographic moorings on the Chukchi Shelf and slope from the USCG icebreaker Polar Star in July-August 2002. The shelf moorings (in Barrow Canyon and the Central Channel) will examine the flow and thermohaline properties of the shelf and the slope moorings will measure these characteristics near the shelfbreak of the northern Chukchi Sea. Each mooring includes ADCPs for measuring vertical profiles of currents and temperature-conductivity recorders for measuring temperature and salinity. Terry Whitledge (U. Alaska) and L. Codispoti (U. Maryland) deployed a moored nitrate analyzer and bio-optical sensors on the Central Channel mooring. We also worked with R. Pickart (Woods Hole) to collecting two CTD and LADCP (Lowered-ADCP) transects over the Chukchi shelf and four across the Chukchi-Beaufort shelfbreak and slope. We also deployed a passive acoustic recorder (for detecting whales) for S. Moore (Nat. Marine Mammal Lab) on the Beaufort slope.

WORK COMPLETED

We had a highly successful cruise in which we deployed 13 moorings, occupied 90 CTD-LADCP stations (most with nutrient sampling) and successfully launched 30 XCTDs. The CTD, LADCP, and XCTD data are being processed and analyzed now.

RESULTS

Preliminary inspection of the data indicates that we detected eddies on each cross-slope transect with these eddies formed at the mouth or east of Barrow Canyon and to the west of Barrow Canyon. Each eddy contained Chukchi shelf water with T/S properties of $\sim -1.7^{\circ}\text{C}$ and ~ 33 psu. Each eddy had relatively high concentrations of chlorophyll (as indicated by the fluorometer on the CTD), suspended sediments, and nutrients – particularly dissolved silicate. All of these properties were similar to those detected in Chukchi shelf waters indicating that this shelf water was the principal source water for the eddies.

IMPACT/APPLICATIONS

Our work will provide the observations and interpretations required to understand how Pacific waters influence the structure and dynamics of the Arctic Ocean. In addition it will provide the other SBI PIs with ancillary information necessary for the interpreting biological and geochemical data collected during SBI. Our measurements will provide the basis for numerical model evaluation and testing and are essential in understanding the flow dynamics along the Chukchi-Beaufort sector of the Arctic Ocean.

TRANSITIONS

We anticipate that our data and interpretations will be used by all SBI participants in examining their data sets.

RELATED PROJECTS

Our SBI project complements moored observations and CTD sampling being collected in this region by K. Shimada (JAMSTEC) and E. Carmack (Institute of Ocean Sciences).