BEST-BSIERP
Bering Sea PROJECT
UNDERSTANDING ECOSYSTEM PROCESSES IN THE BERING SEA 2007–2013

New Insights into Bering Shelf Circulation Structure

WINTER WIND DIRECTION ELICITS STRONG OCEAN CURRENT RESPONSE

Southeasterly winds (winds blowing from the southeast to the northwest) tend to promote shelf flow toward Bering Strait that originates south and east of St. Lawrence Island, and waters in the Gulf of Anadyr are more likely to flow west past Cape Navarin. In contrast, northwesterly winds tend to promote flow toward Bering Strait that originates west of St. Lawrence Island, while waters east and south of St. Lawrence Island reverse and flow southward. These results are applicable during winter months (October-April). During summer months (May-September), winds are lighter, the shelf stratification is stronger, and the flow field is more strongly controlled by other processes.

How We Did It

We deployed eight oceanographic moorings equipped with profiling current meters on the Bering Sea shelf from July 2008 to July 2010. Analysis of the current meter data in conjunction with the local wind field showed close connections between the winds and the currents.

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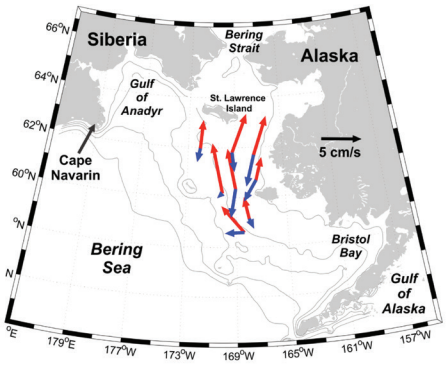
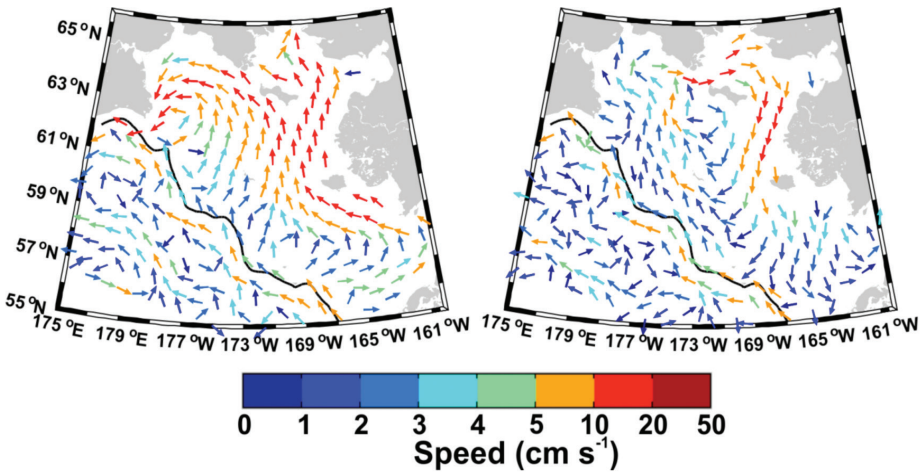


The Bering shelf. Vectors, emanating from the eight mooring deployment locations, show mean vertically averaged currents during southeasterly (red) and northwesterly (blue) winds from July 2008 - July 2010. Isobaths are drawn at 200, 100, 70, 50 and 20 m depth levels.



Vertically averaged hindcast current vectors from the 3D model for a month with strong southeasterly winds (December 2000, left) and strong northwesterly winds (December 1999, right). The shelfbreak (200 m isobath) is denoted with a black line.

The Big Picture

The Bering Sea ecosystem is fundamentally dependent upon the physical mechanisms and characteristics that determine the shelf habitat: ice extent and timing regulates light penetration into the water column and provides a seasonal platform for marine mammals; temperatures control metabolic processes and set limits on geographic distributions; currents carry zooplankton and fish larvae onto the shelf from the slope; frontal systems aggregate prey items; stratification in spring and wind mixing in fall promotes phytoplankton blooms. All of these processes depend in part on shelf currents.

A component of the BEST-BSIERP Bering Sea Project, funded by the National Science Foundation and the North Pacific Research Board with in-kind support from participants.

UAF and UW mooring technicians David Leech, Kevin Taylor and Jim Johnson, with the assistance of Coast Guard personnel, prepare to deploy a bottom-anchored sub-surface taut wire mooring in July 2008. The mooring is held in place by a railroad wheel anchor; a large orange float provides buoyancy and houses the data loggers. This mooring made hourly measurements of temperature, conductivity, pressure, and currents until it was recovered in July 2009.

We were able to reproduce the basic nature of the observed current response using a very simple, "idealized" numerical model. More complex (fully 3-D) numerical models run in hind-cast mode demonstrate how the greater shelf circulation responds in areas far removed from the mooring array.

Why We Did It

A fuller understanding of the Bering Sea ecosystem requires knowledge of the continental shelf flow field and what controls it, because currents are responsible for conveying nutrients, plankton, eggs, and larvae from one place to another. Are nutrients carried onto the shelf continuously or in pulses? Do fish eggs or crab larvae get carried to the same places every year? Better knowledge of the circulation field and its variations will help us answer these questions.

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The Bering Sea Project is a partnership between the North Pacific Research Board's Bering Sea Integrated Ecosystem Research Program and the National Science Foundation's Bering Ecosystem Study. **www.nprb.org/beringseaproject**