Seal-Borne Satellite Transmitters Provide Ocean Conditions Along Seal Tracks in the Pacific Arctic

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Introduction

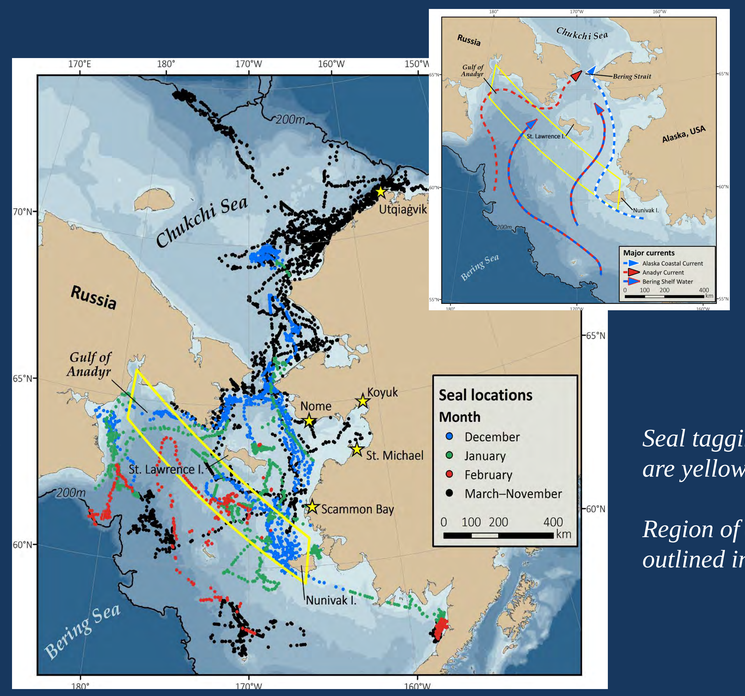
Studying habitat selection of Arctic seals is difficult due to remote, seasonally ice-covered waters with little daylight during winter months. Satellite-linked transmitters that collect oceanographic data (conductivity and temperature at depth), called CTD tags, were deployed on ice seals in Alaska in 2016. These tags recorded oceanographic conditions as seals traveled in the Bering Sea between the Gulf of Anadyr, Russia, and Nunivak Island, Alaska, from December 2016 to February 2017. By combining CTD data from multiple seals within the same region and months, we observed regional changes in the oceanographic environment through the winter.

Seal captures and instrumentation

In 2016, 2 ringed, 3 bearded, and 9 spotted seals were instrumented with CTD tags manufactured by the Sea Mammal Research Unit in St. Andrews, Scotland.

Tags were glued to neoprene and then glued to the hair on the seal's back, as seen on this spotted seal.

We plotted the locations where CTD tags on seals recorded and uplinked oceanographic data and identified an area across the central Bering Sea (yellow polygon) to monitor December – February. Salinity and temperature profiles were compared by month.



General depiction of currents in the Bering Sea

Seal tagging locations are yellow stars

Region of analysis is outlined in yellow.

Black dots on the salinity profiles and white dots on the temperature profiles are data collected by the CTD tags.

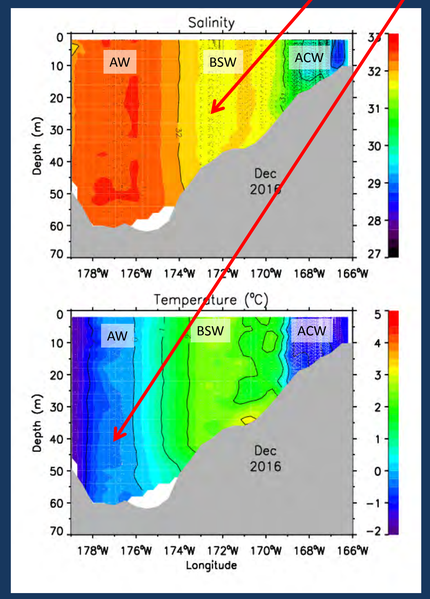
Irregularly spaced CTD data were interpolated to a regular grid using IDL (Harris Geospatial Solutions) subroutines GRID_INPUT, TRIANGULATE and TRIGRID to fill areas with few or no data.

December 2016

Anadyr Water (AW) is salty and cold.

Bering Shelf Water (BSW) is fresher and warmer than AW. It retains heat from summer warming over the shelf.

Alaskan Coastal Water (ACW) is freshest and coldest. This shallow water cools faster.

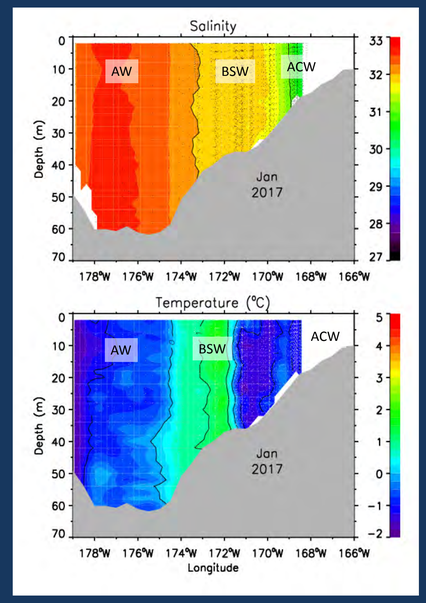


AW has cooled and colder water extends farther east (to 174°W) now.

BSW is also cooling under the sea ice with the shallower eastern side cooler than the deeper western side.

No seals traveled east of 168°W, so much of where we expect to see ACW is blank. Some relatively fresh (<31 green) ACW can be seen on the right side of the salinity profile.

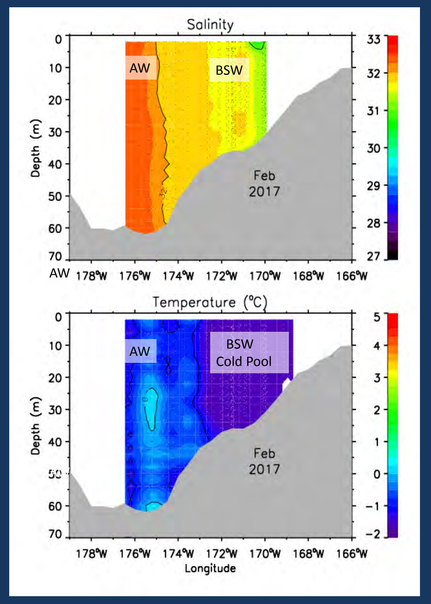
January 2017



AW is now warmer than BSW because warmer water is being carried north by the Anadyr Current. Sea ice is forming above the BSW southeast of St. Lawrence Island and contributing to the formation of the Bering Sea "cold pool".

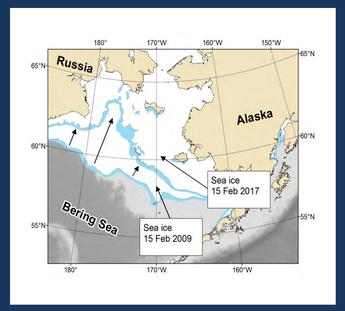
The area 176-174°W is usually ice covered in February, however in February 2017 it was largely ice-free. Here we can see the water temperature was ~0°C, which is not cold enough to support sea ice.

February 2017



Conclusions

- CTD tags deployed on ice seals allowed us to monitor water masses through winter. We observed Bering Shelf Water develop into the Bering Sea "Cold Pool".
- We monitored oceanographic anomalies. Temperatures in the north Pacific were above average in 2017 and we observed warm waters (>0°C) intrude into the Bering Sea via the Gulf of Anadyr preventing sea ice from forming.
- The area from 176-174°W, typically covered in sea ice, was largely ice free in the winter of 2016-17. See figure to the right showing ice edge in February 2009 relative to the ice edge in February 2017.



- The ability to monitor water masses through time will greatly increase our understanding of seal movements and habitat preference in areas far from shore, under sea ice, and at depth.

Acknowledgements

This project was primarily funded by the Office of Naval Research, USA, with logistic support for capture operations shared by Bureau of Ocean Energy Management, USA. This project would not be possible without the support of the Ice Seal Committee, North Slope Borough, Native Villages of Koyuk, St. Michael, Scammon Bay, Nome, and their hunter-taggers (Merlin Henry, Alexander Niksik Jr., Palsson Fitka, Morgan Simon, Wybon Rivers, River Simon, and Tom Gray). Assistance from North Slope Borough personnel (Joe Skin and Isaac Leavitt) was critical for captures near Utqiaġvik, and Dease Inlet. Research was conducted under NMFS permit #15324 issued to the Alaska Department of Fish and Game and IACUC #2016-23.