

Environmental Studies Program: Ongoing Study

Title	Western Beaufort and Chukchi Sea Surface Current Analysis (AK-19-02-04)
Administered by	Alaska Regional Office
BOEM Contact(s)	Dr. Heather Crowley (heather.crowley@boem.gov)
Procurement Type(s)	Cooperative Agreement
Conducting Organizations(s)	CMI, UAF
Total BOEM Cost	\$77,640, plus Joint Funding (\$77,640)
Performance Period	FY 2019–2022
Final Report Due	June 2022
Date Revised	September 16, 2022
PICOC Summary	
<i><u>Problem</u></i>	A substantial amount of high-frequency radar (HFR) data was collected in the western Beaufort Sea and northeastern Chukchi Sea from 2015 to 2018. Effort is required to process and archive these data to facilitate its use in analyses of ocean circulation.
<i><u>Intervention</u></i>	Process and analyze previously collected data from high-frequency radars to evaluate the relationship between surface currents measured by the HFR systems and subsurface currents as measured by seasonal and year-round oceanographic moorings and assess the relation between the wind and the surface flow field structure and evolution.
<i><u>Comparison</u></i>	This study will develop a new understanding of surface circulation in the western Beaufort Sea from Point Barrow to Smith Bay, as well as surface-to-subsurface relationships throughout the study area.
<i><u>Outcome</u></i>	Results from the study will help to improve understanding of the complex oceanic flow field in the vicinity of Barrow Canyon.
<i><u>Context</u></i>	Western Beaufort and Northeastern Chukchi Sea region

BOEM Information Need(s): Improving BOEM’s understanding of the regional circulation is directly related to identifying potential effects of offshore drilling. The results can help improve existing oil spill trajectory models, risk assessment, and emergency planning.

Background: This study will develop a new understanding of surface circulation in the western Beaufort Sea from Point Barrow to Smith Bay, as well as surface-to-subsurface relationships throughout the greater western Beaufort and northeastern Chukchi Sea region. Though initially part of BOEM study 2017-065 (Weingartner, et al., 2017), since 2015, real-time HFR surface current observations have been collected in the Chukchi and Beaufort Seas with support from the Alaska Ocean Observing System (AOOS), the North Slope Borough (NSB), and Shell Oil. However, no funding was available for quality control, data analysis, or peer-review.

Improving our understanding of the regional circulation will help to better interpret the observed environmental change in the U.S. Arctic. With record low sea ice cover in recent years, there are longer periods of open water. These changes directly affect the livelihood of local communities and their relationship with the marine environment and could potentially cause changes in marine mammal and seabird behavior. Past measurements of surface currents using HFR and satellite-tracked drifters in the western Beaufort Sea have captured westward currents near the Beaufort coast which often converge with northeastward currents flowing past Point Barrow.

Objectives:

- Process and quality control surface HFR current data from 2015-2018 and archive the data with ISO compliant metadata.
- Explore the connection between regional winds and circulation patterns over the western Beaufort Sea and Barrow Canyon.
- Compare surface currents with subsurface mooring derived currents from previous deployments in the western Beaufort and northeastern Chukchi Seas.
- Summarize the findings in a project report and one peer-reviewed publication.

Methods: For this study, real time HFR backscattered spectra data will undergo both visual and initial processing steps. Further processing will ready the data for higher level analysis. This analysis will consist of general statistics and the self-organized mapping technique (Liu, et al., 2006) to define major circulation patterns along with their wind conditions, similar to Fang et al. (2017). Wind data from two sources will be used for the current/wind analyses. The complete record of the National Weather Service Station data from the Wiley Post Will Roger Memorial Airport in Utqiagvik and hindcasts from the European Centre for Medium-Range Weather Forecast (ECMWF) ERA-5 atmospheric reanalysis.

Moored ADCP data overlapping HFR surface velocity fields both temporally and spatially will be used for comparison. Surface and subsurface datasets will be compared using correlation analysis to determine flow concordance throughout the water column. Other surface data collected in 2014 in the Alaskan Arctic include GPS fixes of 1-m drogued satellite-tracked oceanographic drifters. A number of these drifters were deployed in the northeastern Chukchi Sea and in the central Beaufort Sea (in Camden Bay). When concurrent in space and time these data will be included in the analysis of the surface currents in the western Beaufort Sea.

Analysis of current data will include the computation of flow statistics on an inter-annual basis. Metrics will include mean and net speed and direction, variance, principle axis of variation, and eccentricity. These will be computed at each HFR grid point and for the ADCP depth bins in the underlying water column. Time-lagged correlation analysis will provide the basis for relating the flow field variations to the wind conditions. Findings will be grouped based on primary modes of system behavior. When available, visible, sea ice, sea surface temperature, and chlorophyll-a satellite imagery will be overlaid to provide further context. Satellite tracked oceanographic drifters will provide some Lagrangian points for comparison against the HFR surface field.

Specific Research Question(s):

1. What is the relation between winds and circulation patterns in the western Beaufort Sea and Barrow Canyon?

2. What is the relationship between surface and subsurface currents in the western Beaufort and northeastern Chukchi Seas?

Current Status: Completed.

Publications Completed:

Danielson S. An analysis of surface currents in the western Beaufort and northeast Chukchi Seas. Oral presentation to the Alaska Eskimo Whaling Commission. February 2022.

Affiliated WWW Sites:

<http://www.boem.gov/akstudies/>

<https://marinecadastre.gov/espis/#/search/study/100265>

<https://www.uaf.edu/cfos/research/cmi/>

References:

Fang, Y.-C., R. A. Potter, H. Statscewich, T. J. Weingartner, P. Winsor, and B. K. Irving. (2017) Surface Current Patterns in the Northeastern Chukchi Sea and Their Response to Wind Forcing. *J. Geophys. Res. Oceans*, 122, 9530-9547, doi:10.1002/2017JC013121.

Liu, Y., R. H. Weisberg, and C. N. K. Mooers. (2006) Performance Evaluation of the Self-organizing map for feature extraction. *J. Geophys. Res.* 111(C05018), doi:10.1029/2005JC003117.

Weingartner, T. J., R. Pickart, P. Winsor, et al. (2017) Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas. Fairbanks, AK: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-065. 221 pp.