## Environmental Studies Program: Ongoing Study

| Field | Study Information |
|---|---|
| Title | Cook Inlet Physical Oceanography Data Curation, Visualization, and Analyses |
| Administered by | Alaska Regional Office |
| BOEM Contact(s) | Caryn Smith, caryn.smith@boem.gov |
| Procurement Type(s) | Cooperative Agreement |
| Conducting Organization(s) | University of Alaska Fairbanks |
| Total BOEM Cost | $500,000 (plus joint/in-kind funding) |
| Performance Period | FY 2022–2025 |
| Final Report Due | July 2025 |
| Date Revised | October 18, 2023 |
| Problem | Physical oceanographic information for Cook Inlet is not synthesized into a regional framework and is difficult to access. This dispersion of data, particularly for the most recent period, adds complexity for evaluating a changing baseline or for using it in general circulation model (GCM) verification and validation. |
| Intervention | This project will collate physical oceanographic data since 2000 in Cook Inlet and Shelikof Strait. Researchers will synthesize the data into a regional framework and identify information needs for sampling and improved modeling approaches to support future oceanographic modeling efforts. |
| Comparison | This study will compare areas to assess the patterns and mechanistic causes of spatiotemporal variability and examine the processes that affect the seasonal evolution of water mass exchange between Cook Inlet/Shelikof Strait and adjacent water masses. |
| Outcome | A comprehensive and understandable reference of Cook Inlet oceanography datasets and data visualization tools that are readily available to support future environmental analyses and modeling efforts. |
| Context | Cook Inlet Planning Area |

BOEM Information Need(s): BOEM uses baseline physical oceanographic information, including their seasonal variation and how the baseline is changing, to inform National Environmental Policy Act analyses in Cook Inlet. Teasing apart impacts to the environment from multiple stressors, including a warming Gulf of Alaska, requires historical and up-to-date physical oceanographic measurements. These measurements are also necessary to verify and validate GCM output to assure quality products for use in BOEM's oil spill trajectory analyses.

Background: Because Cook Inlet oceanographic data depict relatively short-term deployments focused on specific features of Cook Inlet's complex oceanography, there is a need to: assemble the data and make it accessible, synthesize it into a comprehensive understanding of the spatial and temporal circulation of the region, and plan for coordinated focused sampling where information needs are

identified to improve ocean models (Johnson and Okkonen 2000; Two Crow 2006). Recently Johnson (2021) compiled surface and upper layer Lagrangian drifter data, collected mostly from spring through fall.

Accurate information on surface wind fields, ocean currents, and sea ice is important for oil spill trajectory simulations and the potential impacts on Cook Inlet physical, biological, or social resources from a large spill. It is particularly important to know locations and seasonal changes in oceanographic features that have substantial impact on oil transport. Prior GCM validation by Danielson et al. (2016) identified areas for improvement in Cook Inlet, including a bias towards summer conditions, inability to model high resolution features that are known to impact oil fate in the Inlet (e.g. convergence zones on the scale of ~100 m), and over-stratification of the water column by the model (sometimes by 10 psu). In addition, the Gulf of Alaska is warming substantially (Litzow et al. 2020) and the downstream influences on the oceanography of Cook Inlet and Shelikof Strait are not well documented.

Objectives:

- Improve access to and utility of existing oceanographic data in Cook Inlet.
- Enhance the understanding of the large-scale surface and subsurface circulation and density fields and their interannual variation with focus on these primary areas:
    - Assess the patterns and mechanistic causes of spatiotemporal variability in Cook Inlet and Shelikof Strait subtidal currents.
    - Investigate the seasonal impact freshwater coastal discharge (river runoff and glacial ablation) and tides on estuarian circulation and lateral/vertical stratification.
    - Examine the processes that affect the seasonal evolution of water mass exchange between Cook Inlet/Shelikof Strait and adjacent water masses, such as those carried by the Alaskan Coastal Current, shelf waters, and Gulf of Alaska basin waters.
- Develop recommendations for additional oceanographic measurements and modeling approaches that can improve our ability to understand and predict Cook Inlet currents.

Methods: This partnership will identify and gather existing, relevant, and readily available physical oceanographic datasets for the Cook Inlet and Shelikof Strait. The datasets will be organized into a common framework for review and identification of specific information needs to guide planning for future fieldwork. Researchers will identify areas with low resolution or dated sampling to develop recommendations for additional measurements needed to provide stratification, freshwater forcing, and higher resolution surface and subsurface current data to enhance the ability to model 3-D currents. Researchers will conduct a field campaign aimed at collecting new measurements that better quantify the dynamics of known rip current zones in middle Cook Inlet. Information from all project components will be synthesized to discuss the physical oceanography of Cook Inlet and Shelikof Strait within a regional framework. Data products and associated metadata will be disseminated through the Cook Inlet Response Tool on AOOS web portal.

Specific Research Question(s):

1. What is the current physical oceanographic baseline in Cook Inlet and Shelikof Strait?
2. Where and what types of additional data collections and algorithms will improve ocean model output in Cook Inlet?

Current Status: Ongoing, data gathering and field planning underway.

Publications Completed: None

Affiliated WWW Sites: http://www.boem.gov/akstudies/

References:

Danielson SL, Hedstrom KS, Curchitser E (University of Alaska, Fairbanks, AK). 2016. Cook Inlet circulation model calculations. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. 156 p. Report No.: OCS Study BOEM 2015-050. https://espis.boem.gov/final%20reports/5561.pdf

Johnson MA. 2021. Subtidal surface circulation in lower Cook Inlet and Kachemak Bay, Alaska. Regional Studies in Marine Science. 41:101609.

Johnson MA, Okkonen SR, editors. 2000. Proceedings Cook Inlet oceanography workshop. November 9, 1999; Kenai, AK. Fairbanks (AK): University of Alaska Coastal Marine Institute, Oil Spill Recovery Institute, and U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region. 108 p. Report No.: OCS Study MMS 2000-043. https://www.boem.gov/BOEM-Newsroom/Library/Publications/2000/2000_043.aspx

Two Crow, ed. 2006. Cook Inlet physical oceanography workshop proceedings. Kenai (AK): AOOS, CIRCAC and Kachemak Bay Research Reserve. 172 pp.