

2017-2018: Unprecedented Changes in the Bering Sea

WHERE DO WE GO FROM HERE?

Even though 2019 is colder than the past few past years, the recent unprecedented changes to the Bering Sea's physical and biological conditions in 2017-2018 concern local residents and subsistence users, commercial fishermen, and researchers and agency managers. These changes were highlighted at the 2018 AGU Conference and the 2019 Alaska Marine Science Symposium and are generating discussion about what to do next. Some highlights are included here.

Wide Ranging Changes

- By far the lowest sea ice cover ever led to open water winter conditions in northern Bering.
- First time absence of "cold pool" separating northern and southern Bering.
- Massive primary productivity blooms.
- Northward movement of pollock and Pacific cod; decline in Arctic cod.
- Mass stranding of ice seals in northern Bering; starvation suspected in sea bird die offs.

Implications for the Future

- Progressively later date of fall sea ice freeze-up and thinner ice later in the winter.
- Less stable and shorter duration shore-fast ice.

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National Institute for Occupational Safety and Health / Wiki Commons

With a changing ecosystem, Bering Sea commercial fishermen face potential changes to pollock and cod fisheries.



Changing distribution and increasing variability of subsistence resources dependent on sea ice, such as this ringed seal, cause food security concerns.

Josh London, NOAA

Using Ship Tracking Data

Integrating Subsistence Use, Vessel Traffic, and Spill Trajectories

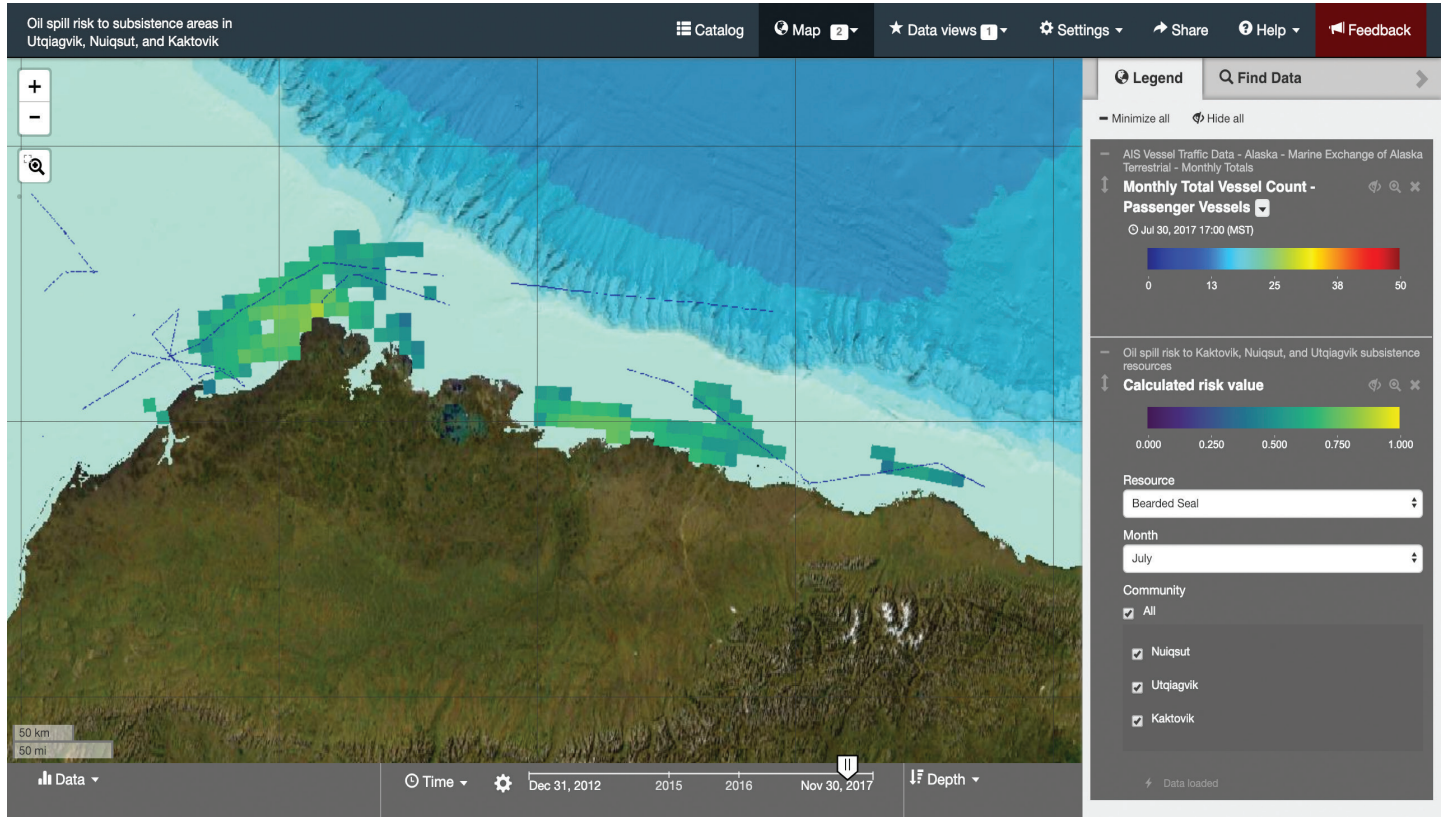
A new Arctic oil spill risk assessment tool will provide Alaska agency managers, researchers and local communities new opportunities for aiding spill response and prevention planning for the Beaufort Sea. The product is the result of a two-year award from the National Academy of Sciences' Gulf Research Program to the Alaska Ocean Observing System, Axiom Data Science, and Stephen R. Braund & Associates.

The project is officially entitled "Synthesizing AIS ship tracking data, GNOME oil spill model results, and subsistence use information into a unique, interactive tool to aid research and planning in coastal communities bordering the Alaska Beaufort Sea." It uses data products describing vessel traffic patterns from AIS datasets provided by the Marine Exchange of Alaska with funding from the Arctic Domain Awareness Center and subsistence use data from the Beaufort Sea communities of Utqiagvik, Nuiqsut, and Kaktovik. These were combined with results from over 100,000 hypothetical oil spill simulations initialized at locations and times corresponding with historical vessel traffic. The products from this integration are relative oil spill risk maps by month and subsistence resource for these communities.

Subsistence use patterns were produced by aggregating individual subsistence mapping, harvest, and other socio-economic surveys from the three communities. These previously unavailable subsistence datasets include species descriptions, timing and area for targeted species, and other traditional ecological variables for each community. The subsistence mapping and species distribution data were then compared to generated oil spill impact density maps to estimate how different subsistence activities and their relative timing could be impacted in the event of a spill.

The data gathered and synthesized through this project are now publicly accessible through an interactive web-based mapping tool and data portal as a mechanism for increasing public, private sector, government, and community knowledge about possible spill impacts to subsistence uses in the Beaufort Sea. For more information, visit the NAS project webpage on the AOOS website: <https://aoos.org/ais-oil-spill-support/> and the project web portal: <https://nas-osra.aoos.org>. ■

We acknowledge funding support through the National Academy of Sciences under Grant Award 2000007630.



Monthly total counts of passenger vessels in the region during July 2017, and the calculated risk values for Bearded Seal for the month of July.

in Decision Making Tools

AIS PAC: AIS data for Prioritizing Arctic Charting

AIS vessel tracking data are also used to help prioritize bathymetric surveys in the Arctic and increase awareness and understanding of nearshore bathymetry. The products, developed by AOOS with Axiom Data Science and the Marine Exchange of Alaska and funded by the Arctic Domain Awareness Center (ADAC), are especially critical given that decreased sea ice coverage is leading to northern shipping lanes remaining open for longer periods and the potential for continued increase in vessel traffic. These routes as well as uncharted areas in the Arctic must now be surveyed to modern day navigational charting standards. The data products from this project now provide some additional guidance to NOAA, the US Coast Guard, and others to help set charting priorities.

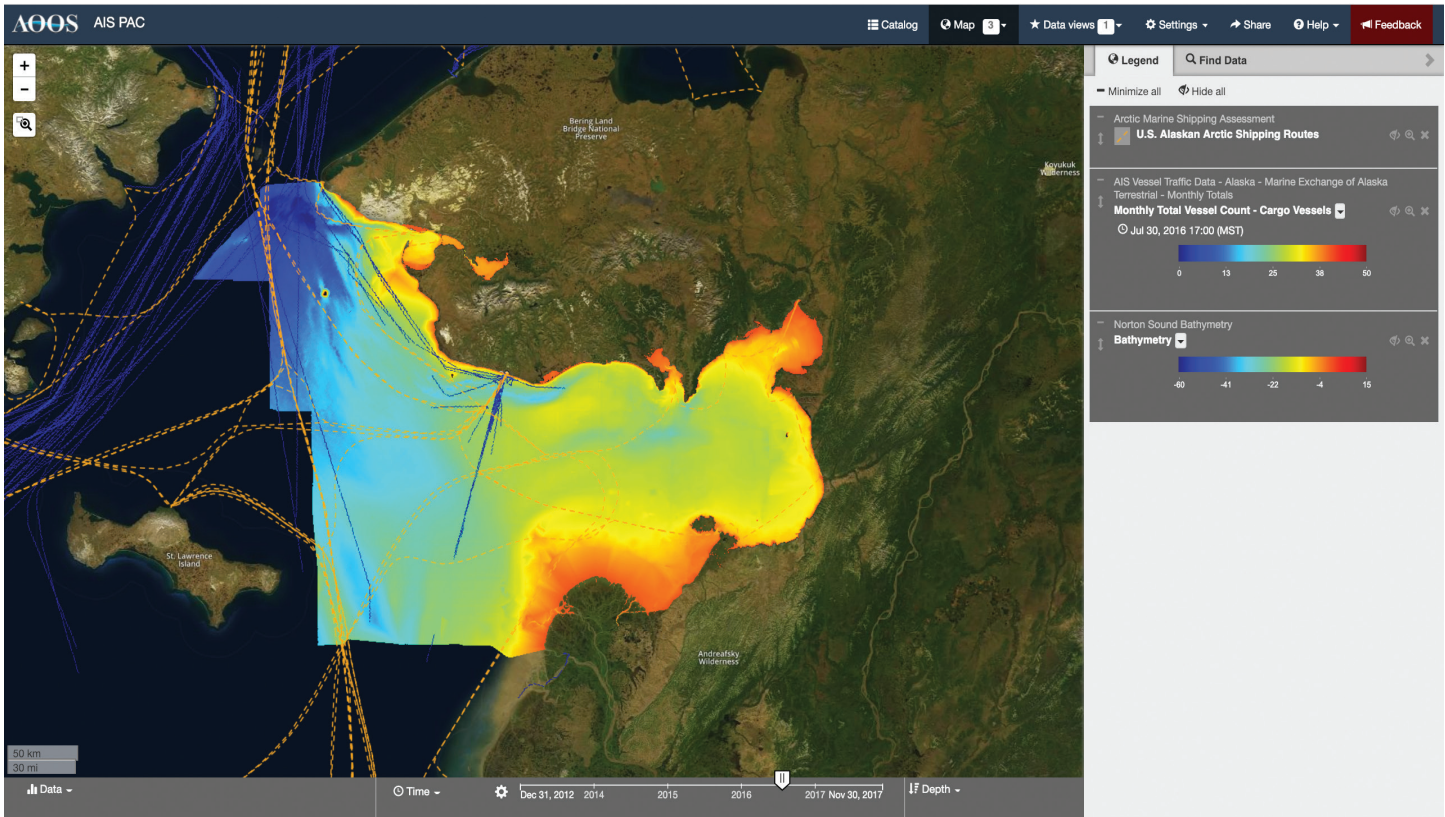
The project's biggest challenge was to provide access to a quality controlled, historical AIS dataset from the US Arctic north of the Aleutian Islands to the eastern Beaufort, standardized in formats that can be downloaded and used directly by stakeholders. Axiom Data Science processed and analyzed five years (2013-2017) of historical records from the Marine Exchange of Alaska's 48 terrestrial AIS stations in the Arctic. Since a single year of AIS data for the entire US is about 75 billion records, a major accomplishment of this project was

developing the capability to significantly reduce the execution time for handling and analyzing extremely large collections of AIS vessel tracking data. This enabled the study team to produce a variety of AIS-derived data products in the form of heatmaps that can be used directly as inputs to NOAA's Hydrographic Health Model to identify vessel safety risk areas, such as those with outdated bathymetry or insufficient detail for safe passage of vessel traffic.

The AIS data products can now be used by stakeholders for other applications, such as visualizing with information such as sensitive environmental information (e.g., walrus haul-out areas, historical information on migratory bird colonies) on the project data portal. This 5-year record of AIS data also serves as a baseline for vessel traffic trends in the US Arctic. Project supporters would like to see it maintained on an annual basis to allow continued trend analysis of future ship traffic patterns.

For more information visit the project webpage on the AOOS website: <https://www.aos.org/ais-4-bathy/> and the AIS PAC data portal here: <https://pac.portal.aos.org/>.

We acknowledge funding support through ADAC's Department of Homeland Security Grant Award Number 2014-ST-061-ML0002.



Historic AIS cargo vessel tracks combined with recently collected Norton Sound bathymetry data can highlight priorities for new charting.

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- Coastal communities impacted by increased erosion due to winter storm wave action on shores previously protected by shore-fast ice.
- Changing distribution and increasing variability of subsistence resources dependent on sea ice causes food security concerns.
- Ecosystem wide physical and biological changes with potential for merging of southern and northern Bering Sea ecosystems.
- Challenges for managing commercial fisheries.
- Potential risks to public health and economic losses.

Where do we go from here?

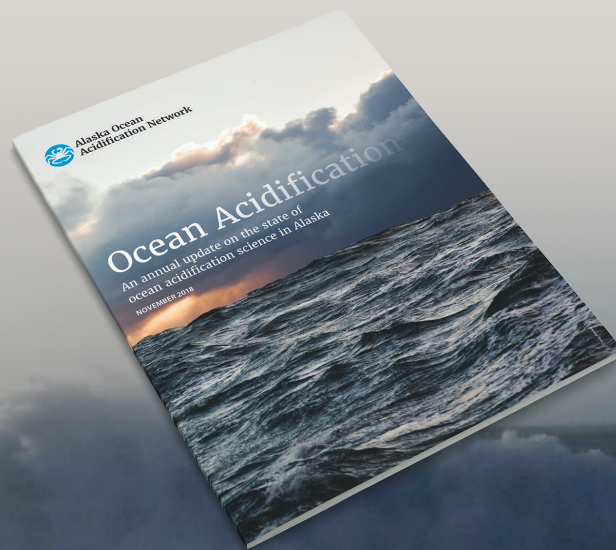
- Long-term monitoring and synthesis programs enabled detection of changes and system-wide impacts and must be supported to establish better understanding of tipping points.
- Co-locating field and community observations with long time-series enhances ability to establish connections and understand mechanisms of change.

- Many questions still to be answered: How likely will ice and atmospheric conditions reverse to more “typical” conditions? Would that reverse cascading ecosystem changes? How will northbound species react to cooler waters? How would the Bering Sea ecosystem respond to year to year variability of winter ice that includes occasional years with very little ice (as low or lower than 2017-18)?
- Need increased synthesis of existing data to better forecast, direct research, and prepare to adapt to changes.
- Need to enhance collaboration and communication between Bering Sea residents and communities, other stakeholders, scientists, and agency managers. Who has responsibility for doing so?
- Contact AOOS if you would like to be involved in this discussion. ■

Alaska Ocean Acidification Network Publishes First Annual State of the Science Report

In response to a request from the fishing community, the Alaska OA Network has produced an easily readable 8-page brochure describing the latest research on species response to OA in the lab, current forecasting efforts, and what we know so far about regional drivers and influences.

Read the full report at https://www.aos.org/wp-content/uploads/2018/11/2018_State_of_OA_in_AK_medres.pdf



Staff Update

In September, AOOS welcomed Sea Grant Fellow Kayla Schommer to the team. Born and raised in Anchorage, Kayla spent her last three years working with the ADF&G Division of Subsistence, while also completing her master's in Marine Affairs from the University of Washington. Kayla is spending her time helping to coordinate the Alaska Harmful Algal Bloom network.

