Updates on the 2020 Distributed Biologcal Observatory Field Program

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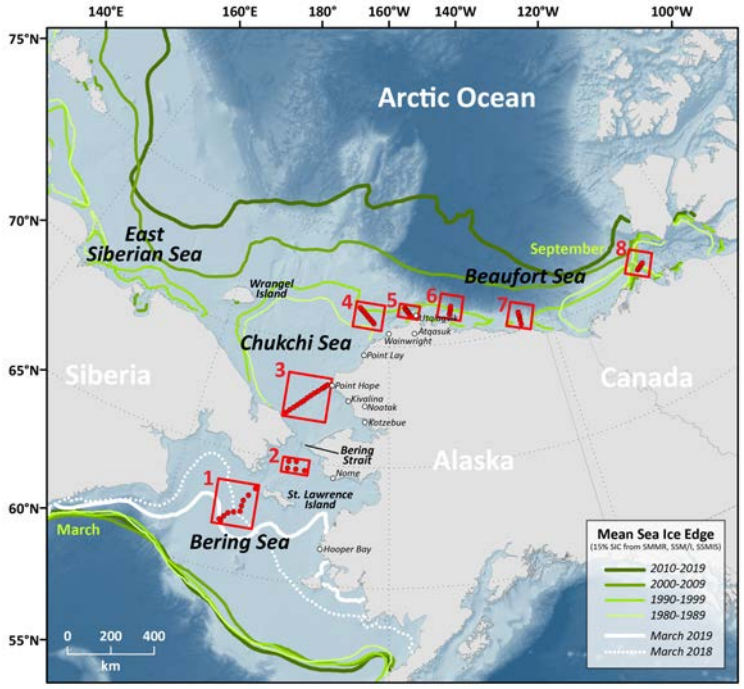
Fall Pacific Arctic Group Virtual Business Meeting
November 25-26, 2020:1900-2200 EST

- Reduction in sea ice and warming seawater changing Pacific Arctic ecosystems
- Recent studies of biological change, predator-prey relationships
- Use of sediments to understand ecosystem health
- Highlights 2020 Dyson August-September and Norseman II October cruises

Background



[updated from Grebmeier et al. 2019, DBO DSR 162:1-7]

- DBO serves as a change detection array for consistent monitoring of biophysical drives and responses, evaluate water column hydrography, plant production, plankton and animals in underlying sediments

- Sites normally occupied multiple times during the year, but limited due to COVID-19 in 2020

- Time series effort in the Distributed Biological Observatory (DBO) evaluates water column and sediment samples at regional biological hotspots

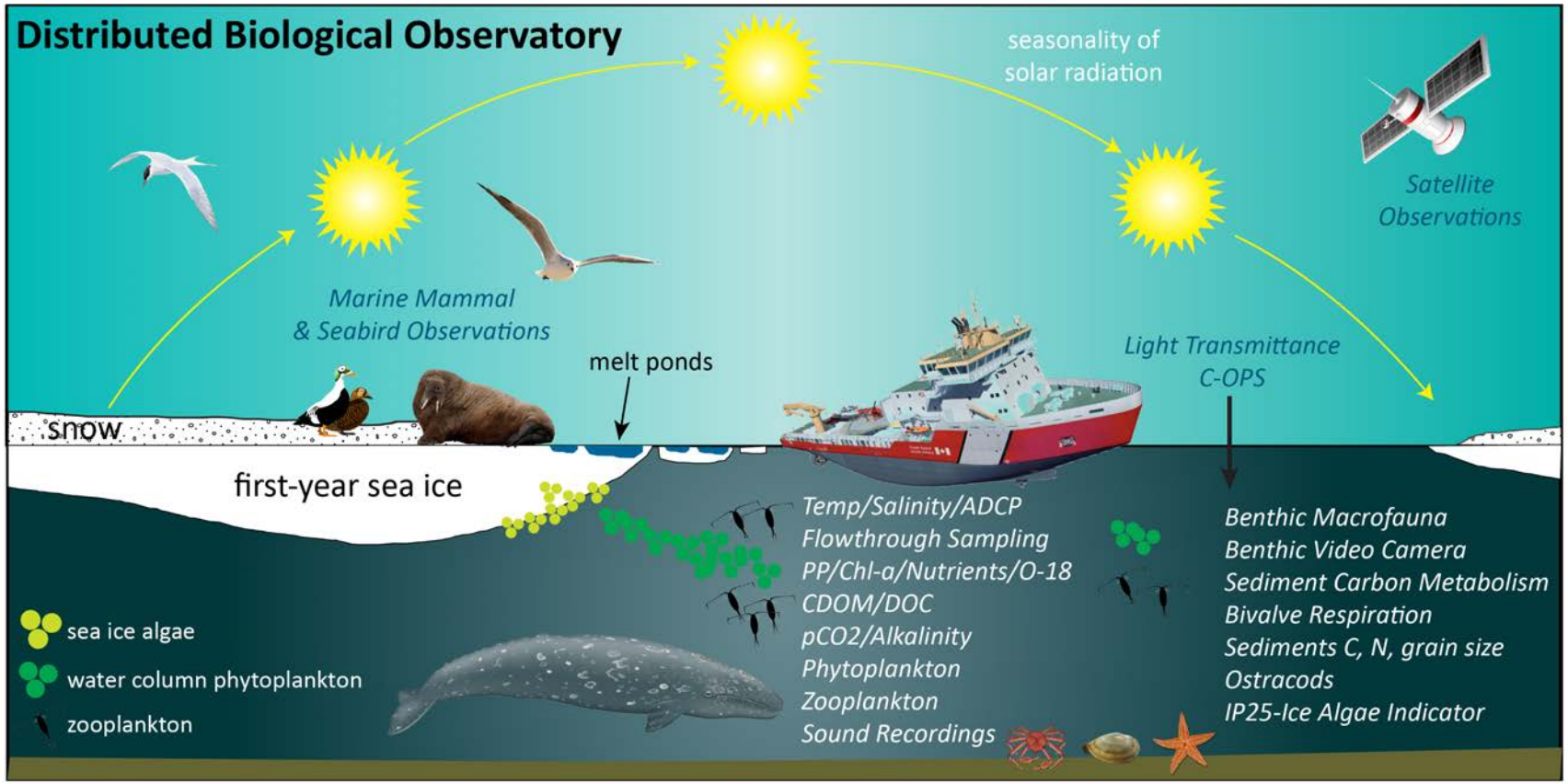
- NOAA NMFS EcoFOCI (Ecosystem and Fisheries Oceanography Coordinated Investigations) program to understand the relationships among climate, fisheries, and the marine environment to ensure sustainability of Alaskan living marine resources and healthy ecosystems

- 2020: NOAA ship Oscar Dyson (Aug 24-Sept 25) and Norseman II (Oct 2-22) to sample water column and sediments (NS2 only) parameters

- Collaboration between DBO, EcoFOCI, Arctic Marine Biodiversity Observing Network (AMBON), and Chukchi Ecosystem Observatory (CEO) programs

- Deploy and turnaround multiple moorings, with sensors and sediment trap arrays, gliders, buoys

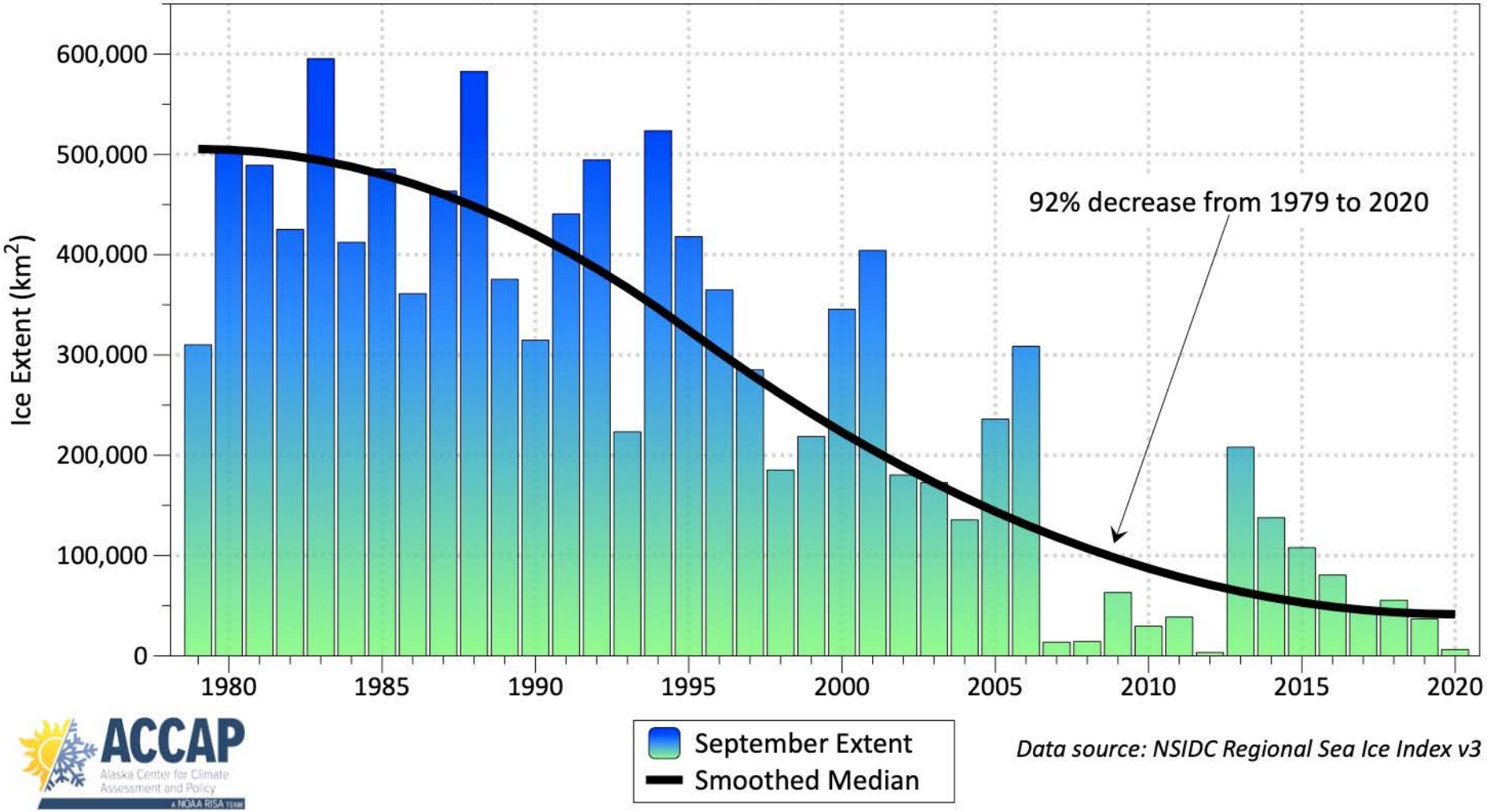
Sampling Components of the Distributed Biological Observatory



[Grebmeier et al. 2019, DSR 162:1-7]

Key: C-OPS=Compact-Optical Profiling System, Temp= Temperature, ADCP= Acoustic Doppler Current Profiler, C=Carbon, CDOM=Chromophoric Dissolved Organic Matter, Chl-a=Chlorophyll a, DOC=Dissolved Organic Carbon, IP-25=Ice proxy with 25 C atoms, N=Nitrogen, O-18=Oxygen-18/16 ratios, PP=Primary Production. All lower taxa analyses include composition, abundance and biomass data.

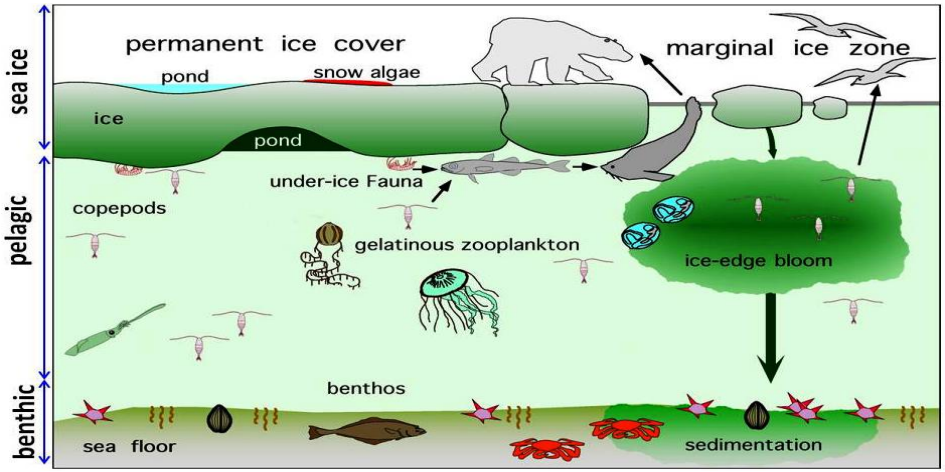
Chukchi Sea
September Average Ice Extent, 1979-2020



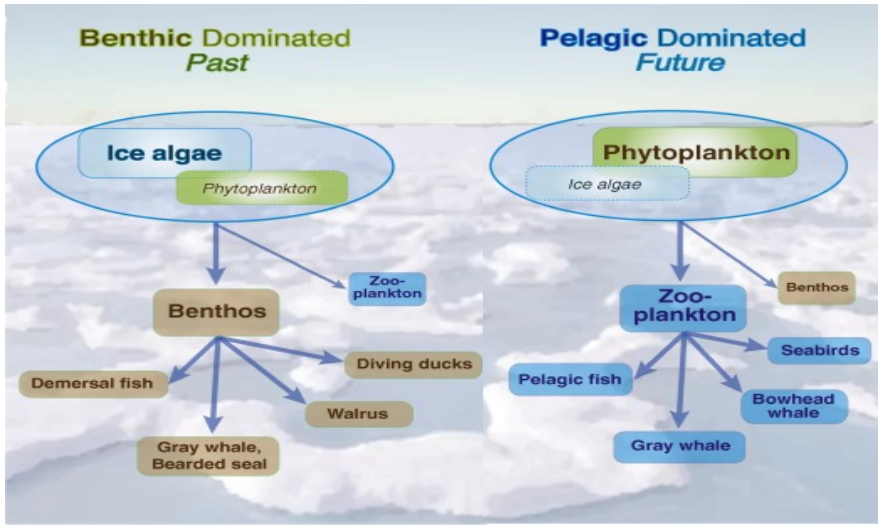
ACCAP
Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM

Data source: NSIDC Regional Sea Ice Index v3

Food in the Water Column and Benthos



[Gradinger et al. 2010]



[Moore and Stabeno 2015]

Warming seawater temperatures

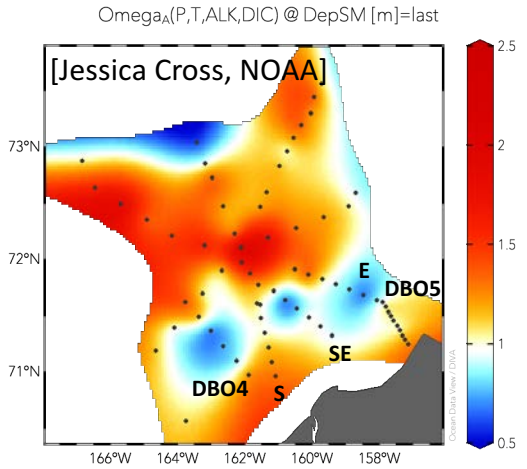
- Change timing of spring sea ice retreat and reduce under ice production and timing of spring bloom
- Could also increase zooplankton growth, abundance, and grazing (Coyle et al. 2007)
- If zooplankton grazing increases and matches the timing of blooms, less organic material may be deposited to the bottom, limiting available food for the benthic organisms
- **Food security issues:** changing prey composition and abundance of animals in water column and sediments, food supply within food webs, harmful algal bloom toxins, and ocean acidification

Examples of environmental stressors occurring in the Pacific Arctic

- Ocean acidification could impact ecosystem services in the Arctic region

Implications of ocean acidification in the Pacific Arctic: Experimental responses of three Arctic bivalves to decreased pH and food availability

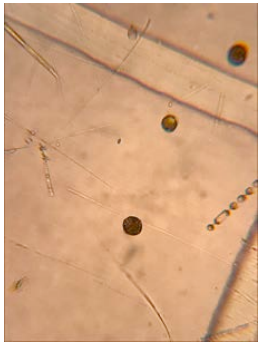
Christina L. Goethel, Jacqueline M. Grebmeier, Lee W. Cooper, Thomas J. Miller

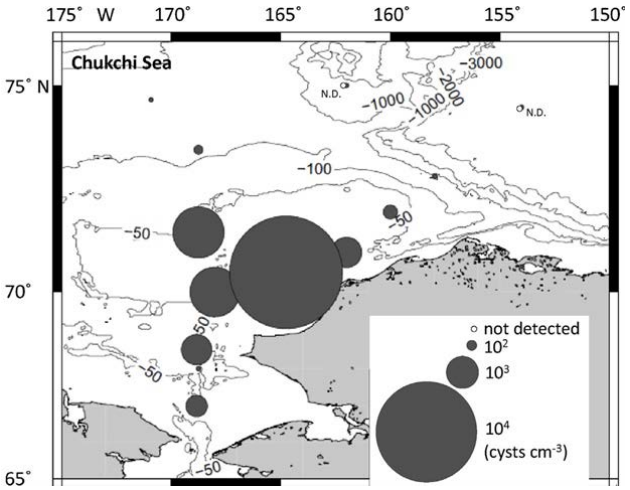


- Corrosive waters (blue) prevalent on SE side of Hanna Shoal, area of focused carbon deposition and high bivalve biomass

Harmful Algal Blooms (HABs) are increasing in Pacific Arctic with declining sea ice, more sunlight and warmer seas

- Blooms of *Alexandrium* sp. that are dinoflagellates that cause paralytic shellfish poisoning.
- Don Anderson (WHOI) has found overwintering cysts in the mud and hotspot of seasonal blooms (DBO-NCIS cruises 2018-2019)

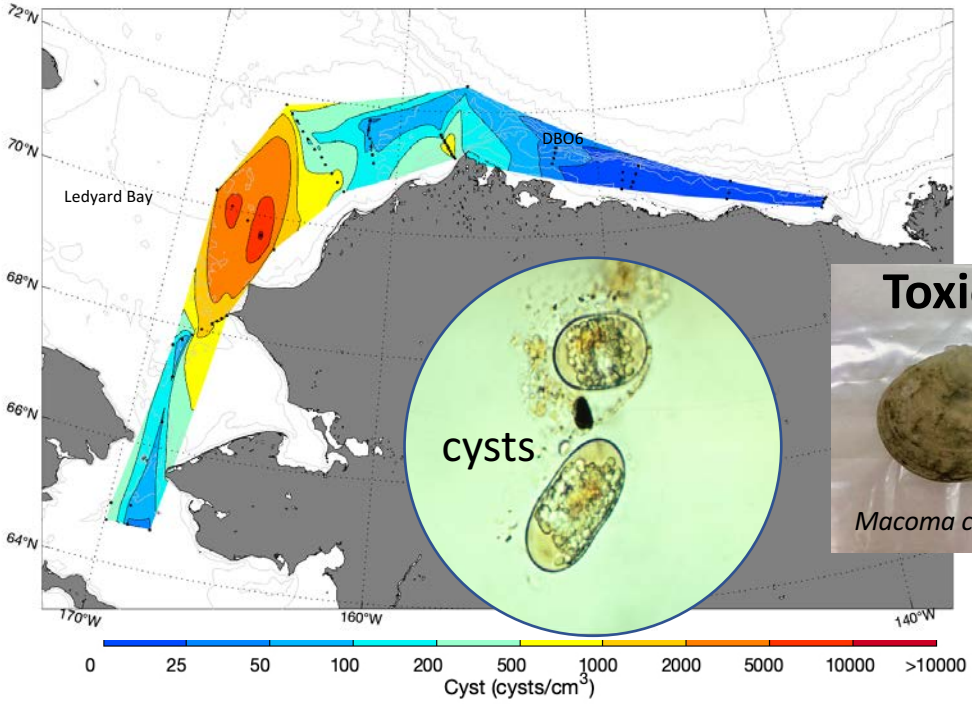




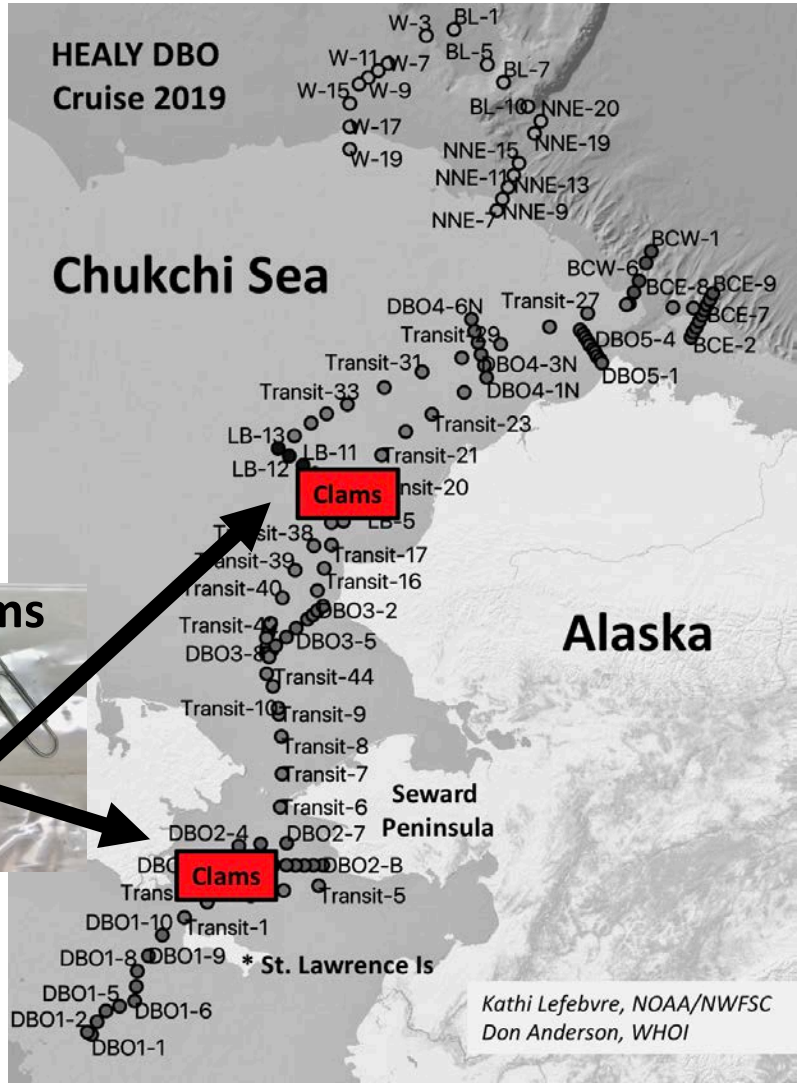
(Anderson et al. 2018, figure modified from Natsuike et al. (2013)

Potential for problems from Harmful Algal Blooms

- Macrofaunal and sediment collections made HLY1901: DBO-NCIS cruise August 2019 (Grebmeier et al.) **[collected Oct 2020, too]**
- Analyses indicated accumulation HAB cysts in central Chukchi Sea sediments **[+Oct 2020]**



Cyst Map – 2018. Don Anderson, WHOI

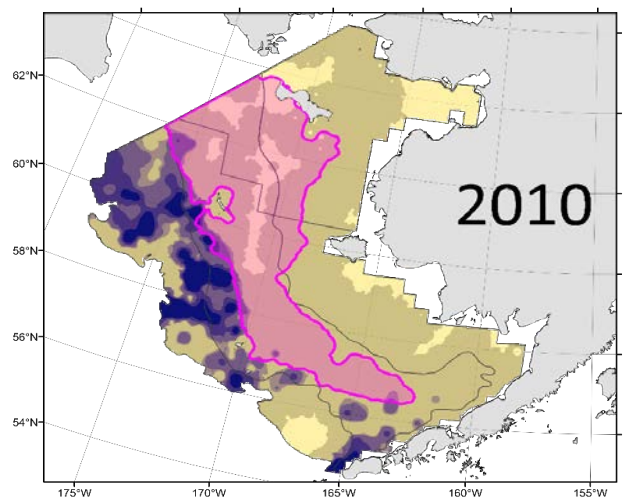


- Analyses indicated accumulation toxins in clams at select sites, **highest clams in Chirikov Basin an central Chukchi Sea**

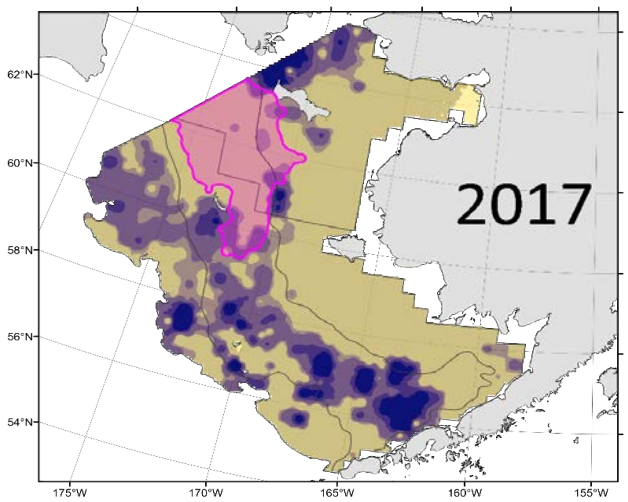
Seafood Safety Regulatory Limit for Saxitoxin
80 ug STX per 100 grams of Shellfish =
800 ng STX per gram shellfish

Bering Sea: Adult Pollock Distribution

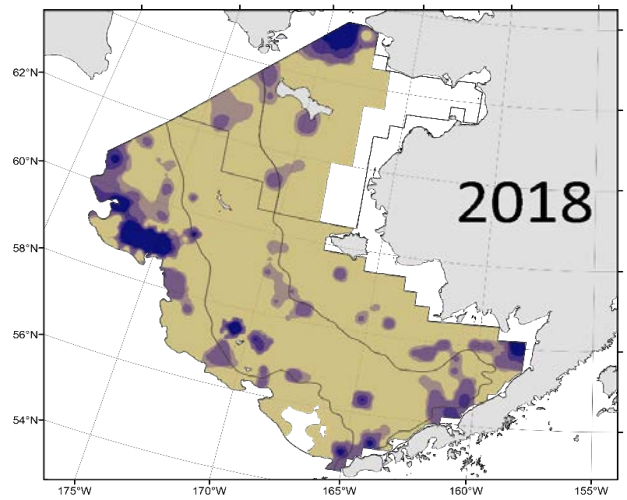
Bottom Temperature < 0° C



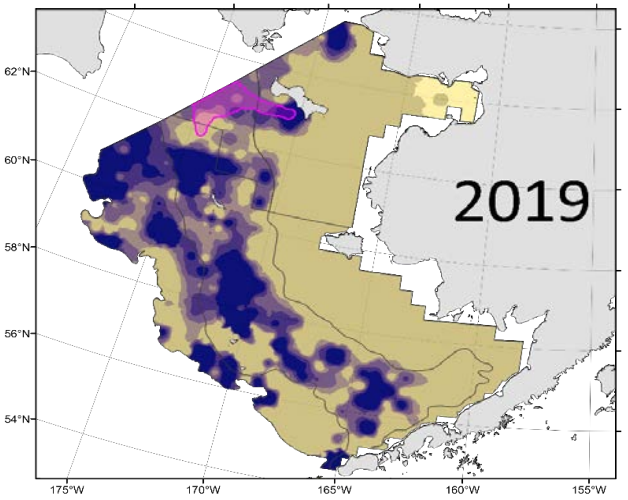
Bottom Temperature < 0° C



Min. Bottom Temp. = 1.6° C

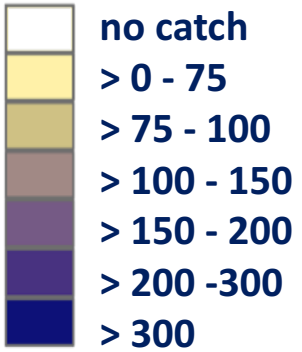


Bottom Temperature < 0° C



***northward movement of commercial fish with contraction of cold pool**

Walleye Pollock (kg/ha)



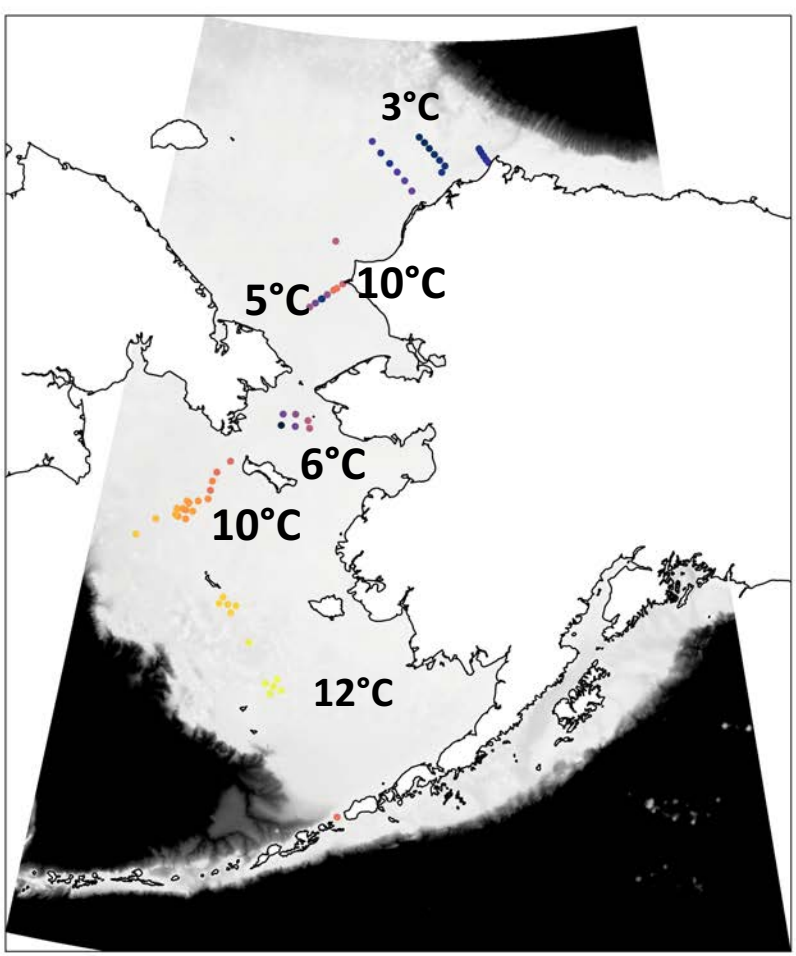
***no NOAA annual trawl surveys in 2020 due to Covid-19**

[graphics by Lyle Britt, NOAA, AFSC]

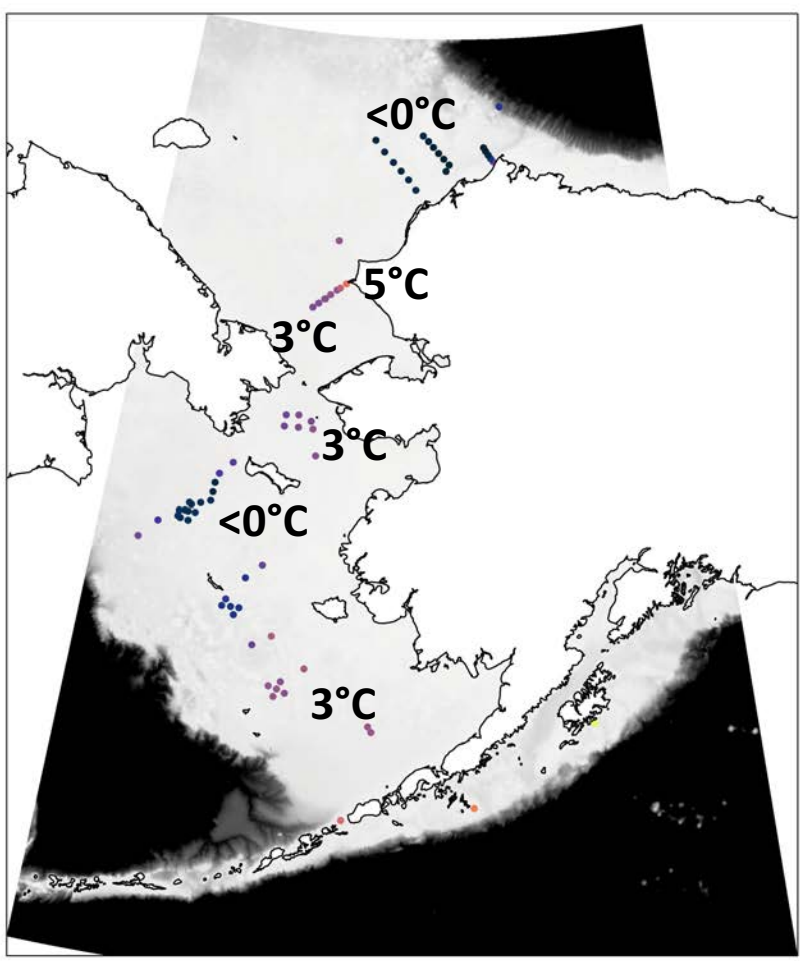
Surface & bottom water temperature values: DYSON 20-12

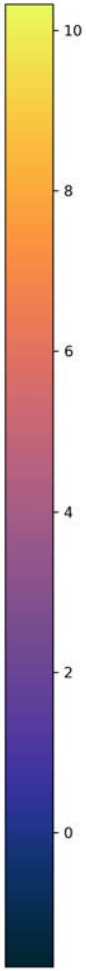
- Seawater temperatures: both surface and bottom waters were warmer than annual average for this period; moorings also showed warm bottom water temperatures

Surface temperature



Bottom temperature





[courtesy Shaun Bell, NOAA]

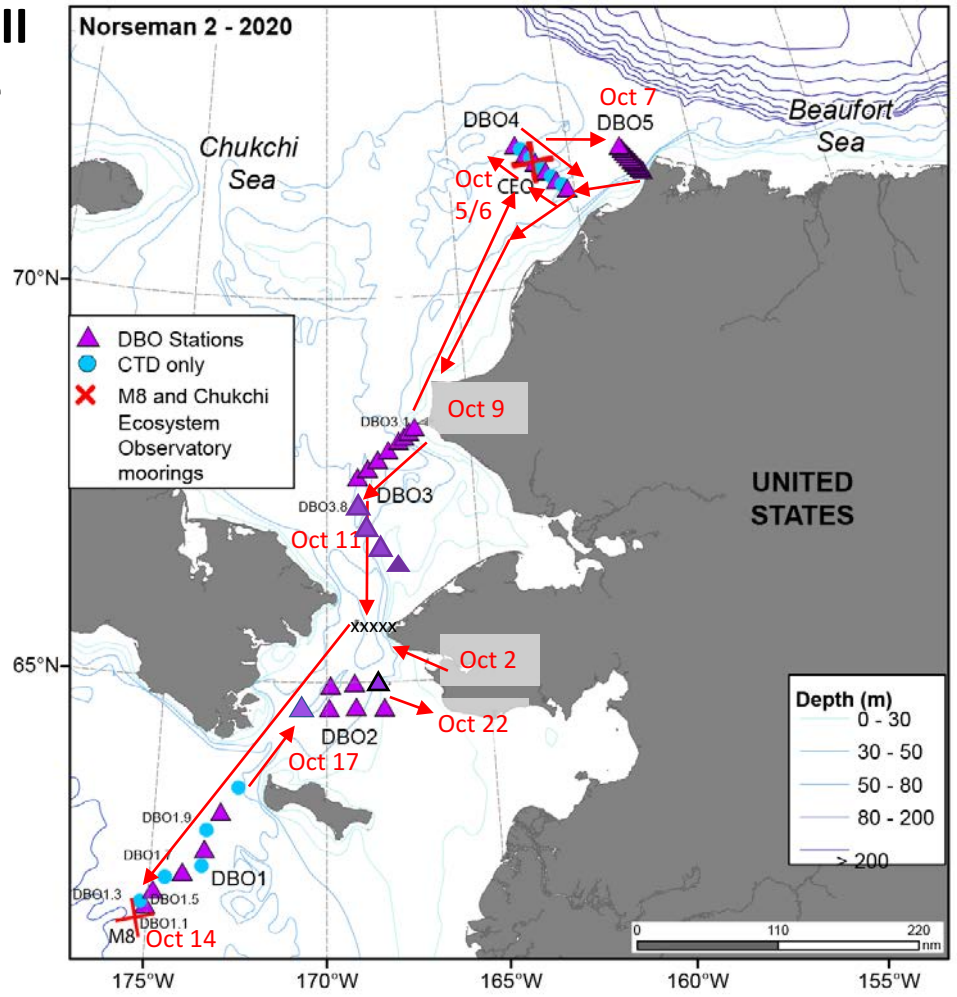
2020 Fall DBO Cruise, Norseman II

October 2-22, 2020; Nome-Nome

Goal: evaluate ecosystem status and change at time series site; deploy sediment trap at MS and turnaround Chukchi Environmental Observatory mooring

Standard measurements and process studies:

- Physical: CTDs for T/S, and sediment trap deployment (M8) and CEO mooring turnaround
- Chemical: nutrients, oxygen-18
- Chlorophyll-a, eDNA
- Zooplankton abundance and biomass
- Benthos: macrobenthos abundance, biomass and population structure, HABs
- Sediment: organic carbon/nitrogen content, chl-a content, grain size, HABs
- Benthic oxygen uptake and nutrient exchange (4 stations)



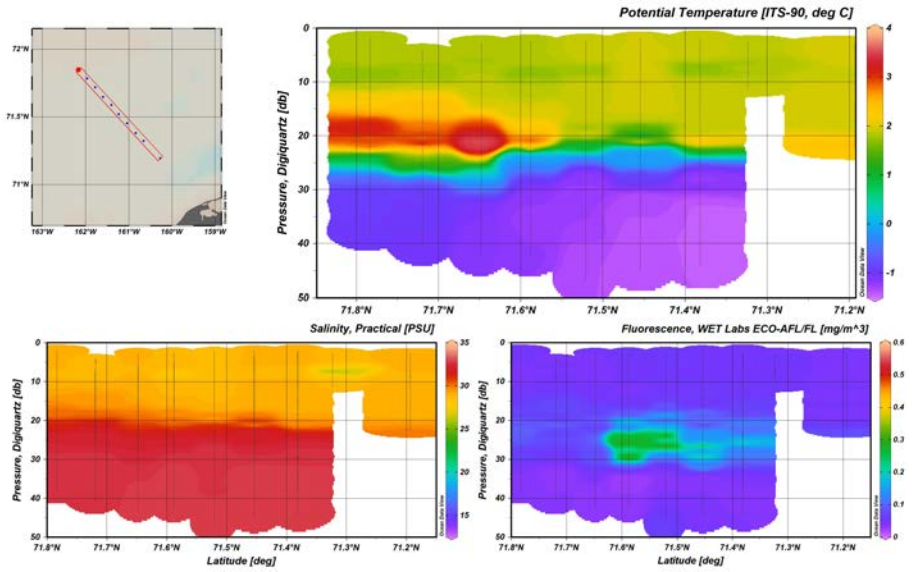
Contact: Chief Scientist: **Jackie Grebmeier/UMCES**: jgrebmei@umces.edu; DBO

Consortium of projects:

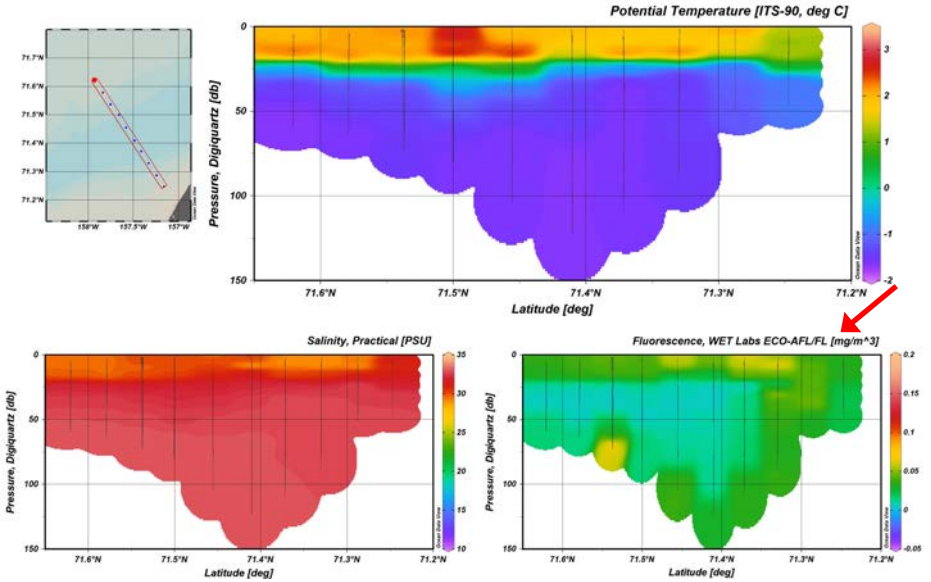
DBO=Distributed Biological Observatory
AMBON=Arctic Marine Biodiversity Observing Network
CEO=Chukchi Ecosystem Observatory
EcoFOCI=Ecosystems & Fisheries - Oceanography Coordinated Investigations

Norseman 2-Oct 2020

Hydrographic data for DBO4-off Wainwright

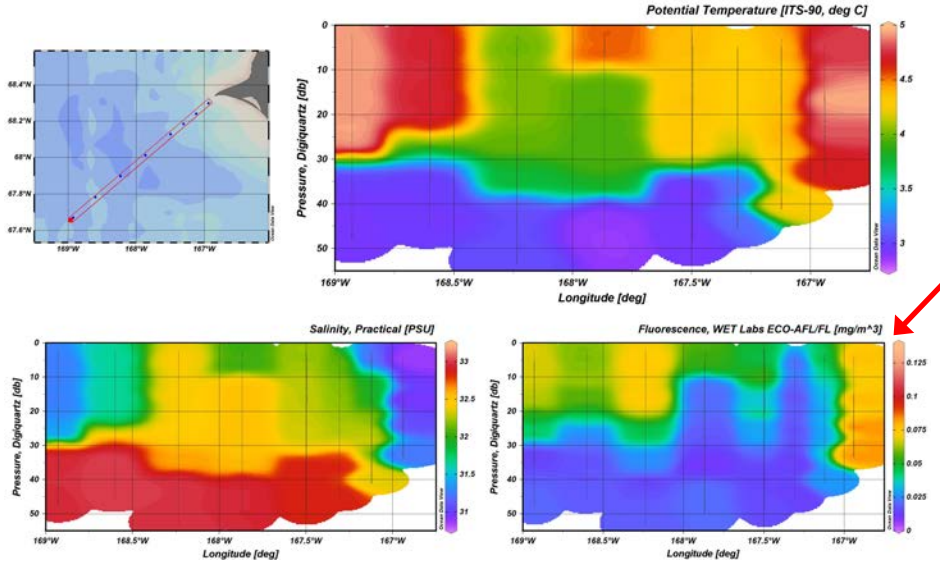


Hydrographic data for DBO5-off Utqiaġvik



[graphics courtesy Savannaugh Sandy/UAF]

Hydrographic data for DBO3-off Point Hope



Summary

- Surface temperatures warmer in southern sites (DBO3) vs north (DBO4,5)
- Cold, saline bottom waters
- Moderate levels of chlorophyll production in surface waters in SE and NE Chukchi Sea than expected for fall season
- Long-line fishing observed in Oct 2020 in the Chirikov Basin for Pacific cod, plus large cargo ship passed in Bering Strait

Other DBO activities (discussed later in the PAG meeting)

2nd DBO Special Issue: PLOS ONE, 21 articles
Deadline: end February 2021 for manuscript submission
Project webpage and blog-under development

Arctic Science Summit Week 2021 Virtual Science Meeting https://assw2021.pt/, abstract deadline Nov 30, 2020 **:**

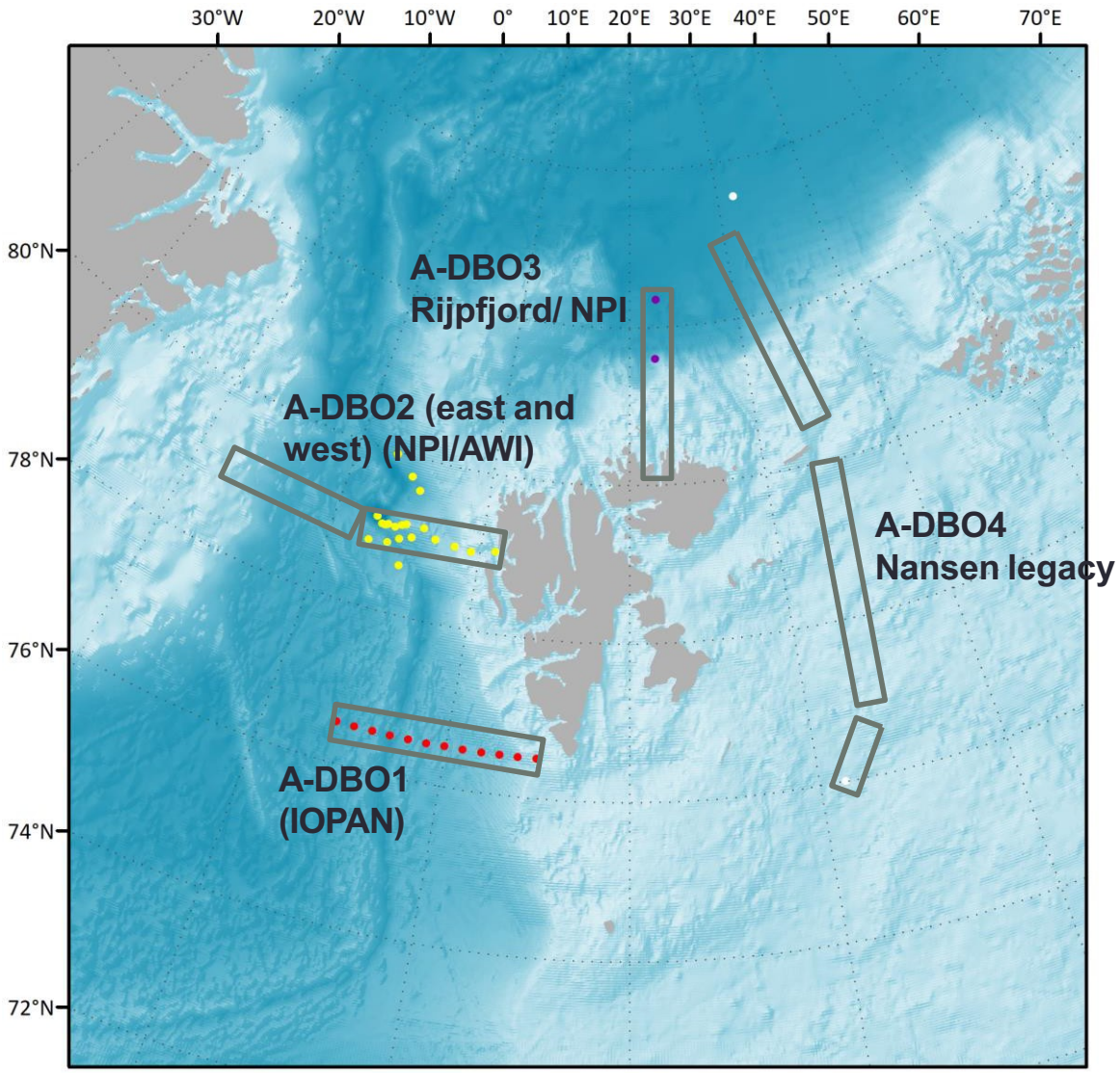
DBO Session #78-The Distributed Biological Observatory: A Change Detection Array in the Arctic

Variations in upper-ocean hydrography, light penetration, lower and upper trophic levels, pelagic-benthic coupling and carbon cycling are being evaluated through the Distributed Biological Observatory (DBO), which was initiated in 2010 in the Pacific Arctic. The DBO sampling approach emphasizes annual standardized sampling by an international suite of ships occupying agreed-to transect lines in order to measure the status and developing trends for the ecosystem. Continuous data are also obtained through mooring and satellite observations. The first decade of DBO sampling has revealed seasonal and interannual hydrographic changes are driving shifts in biological species composition and abundance, northward range expansions for some temperate species and negative impacts for some ice dependent species. This model of change detection is being expanded to other Arctic regions beyond the initial implementation in the Pacific Arctic. An Atlantic DBO is in development through coordination of ongoing international field activities in the Eurasian Arctic, and planning has started for an effort in Davis Strait/Baffin Bay. This session invites presentations on results related to ongoing and planned DBO activities in all Arctic regions.

Research Networking Activities for Sustained Coordinated Observations of Arctic Change (CoObs RNA); https://sites.google.com/alaska.edu/rna-observations/
Lead: Hajo Eicken, UAF/International Arctic Research Center, plus Co-Investigators and Institutional Partners

A-DBO planning: coordination

- Planning ongoing of coordination
- Building on long-term multi-national transects
- Ongoing efforts to find support for coordinator and web-based joint platform



[courtesy B. Bluhm, 5th DBO data workshop, Jan 2020]

Thank you for your attention.

Questions and comments?

Financial support from NOAA, NPRB, BOEM, NSF, NASA
and international partners within
the Pacific Arctic Group

https://dbo.cbl.umces.edu/
http://pag.arcticportal.org/