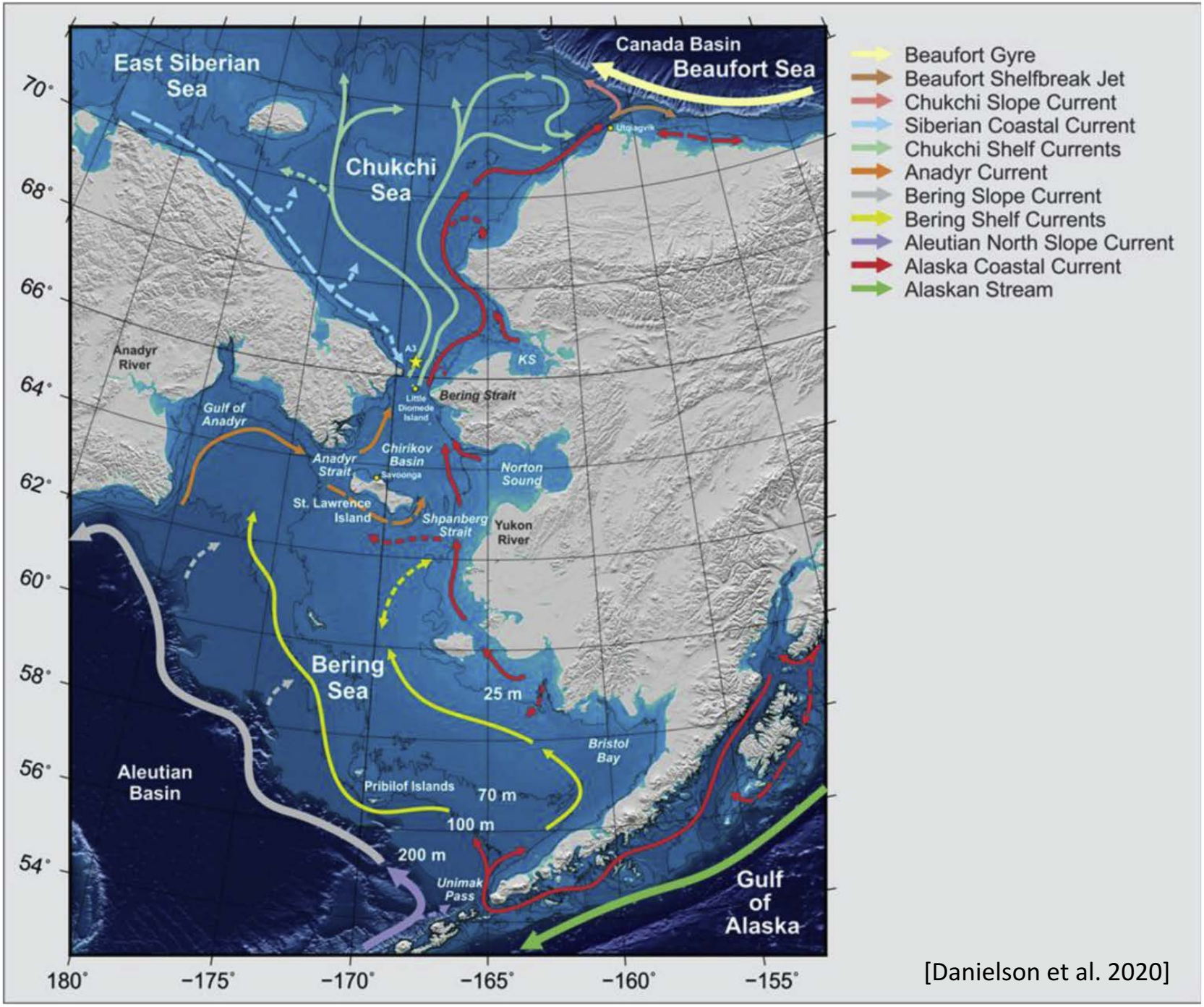
USA Country Report

Jacqueline M. Grebmeier,
Chesapeake Biological Laboratory
University of Maryland Center for Environmental Science, Solomons, MD, USA

Fall Pacific Arctic Group Virtual Business Meeting
November 24, 2020:1900-2200 EST

DBO: Distributed Biological Observatory (Jackie Grebmeier, UMCES)
EcoFOCI: Ecosystems & Fisheries Oceanography Coordinated Investigations (Phyllis Stabeno, NOAA/PMEL, others)
Bering Strait moorings (Rebecca Woodgate, UW)
CEO: Chukchi Environmental Observatory (Seth Danielson, UAF)
Saildrone (Alex De Robertis, NOAA)
Monitoring the Western Arctic Boundary Current (Robert PIckart, WHOI)



[Danielson et al. 2020]

2020 PAG and DBO Cruise Plan Table-Nov 24, 2020

2020 PAG and DBO Field Season (version 11_24_20): Sampling Contributors. Projects Key: AON=US Arctic Observing Network (National Science Foundation); ArCS=Arctic Challenge for Sustainability; DBO=Distributed Biological Observatory; EcoFOCI= Ecosystem & Fisheries Oceanography Coordinated Investigations, JAMSTEC= Japan Agency for Marine-Earth Science and Technology; JOIS=Joint Ocean Ice Study/BGOSS=Beaufort Gyre Observatory System; KOPRI = Korea Polar Research Institute; **DBO Region Key**: DBO1=So. St. Lawrence Is., DBO2=Chirikov Basin, DBO3=So Chukchi Sea, DBO4=NE Chukchi Sea, DBO5=Barrow Canyon, DBO6=East Beaufort Sea, DBO7-Beaufort Sea Central, DBO8=Bathurst polynya region.

Dates 2020 (Port calls)	Ship	DBO Region	Projects	PAG contact	Chief Scientist
July 15-Sept 28 (Shanghai-Shanghai)	Xuelong2	-	Chukchi Plateau, Central Arctic Ocean	Jianfeng He	China's Ministry of Natural Resources
July 17-Sept 15 (Incheon-Incheon)	Araon	3, then Chukchi Borderland	K-AOOS (Korea-Arctic Ocean Observing System	Sung-Ho Kang shkang@kopri.re.kr	Eun Jin Yang ejyang@kopri.re.kr
Aug 11 (Victoria, BC-Victoria, BC)	Sir Wilfrid Laurier	-	Transit to Canada	Crew only	Crew only
Aug 24-Sept 25 (Seattle-Kodiak)	Oscar Dyson	Bering Sea and DBO regions 1,2,3,4,5	DBO-EcoFOCI	Jackie Grebmeier jgrebmei@umces.edu and Phyllis.stabeno@noaa.gov	Jackie Grebmeier jgrebmei@umces.edu
Sept 2-20 (Homer-Nome)	Norseman II--crew only	3 moorings; T/S surface	Bering Strait Mooring Project/AON	Rebecca Woodgate woodgate@apl.washington.edu	Crew only
Sept 19-Nov 2 (Shimizu, Japan-return)	Mirai	5	JAMSTEC	Takashi Kikuchi takashik@jamstec.go.jp	Shigeto Nishino nishinos@jamstec.go.jp
Sept 3 –Oct 13 (St, John, Newfoundland, Canada-return)	Louis S. St-Laurent	-	JOIS/BGOS	Bill.Williams@dfo-mpo.gc.ca	Bill.Williams@dfo-mpo.gc.ca
Oct 2-22 (Nome-Nome)	Norseman II	1,2,3,4,5	DBO/AMBON/CEO	Jackie Grebmeier jgrebmei@umces.edu	Jackie Grebmeier jgrebmei@umces.edu
Oct 13-Nov 13 (Seward-Seward)	Sikuliaq	3,5,6	Beaufort mooring/AON	Robert Pickart rpickart@whoi.edu	Robert Pickart rpickart@whoi.edu

DBO-this talk

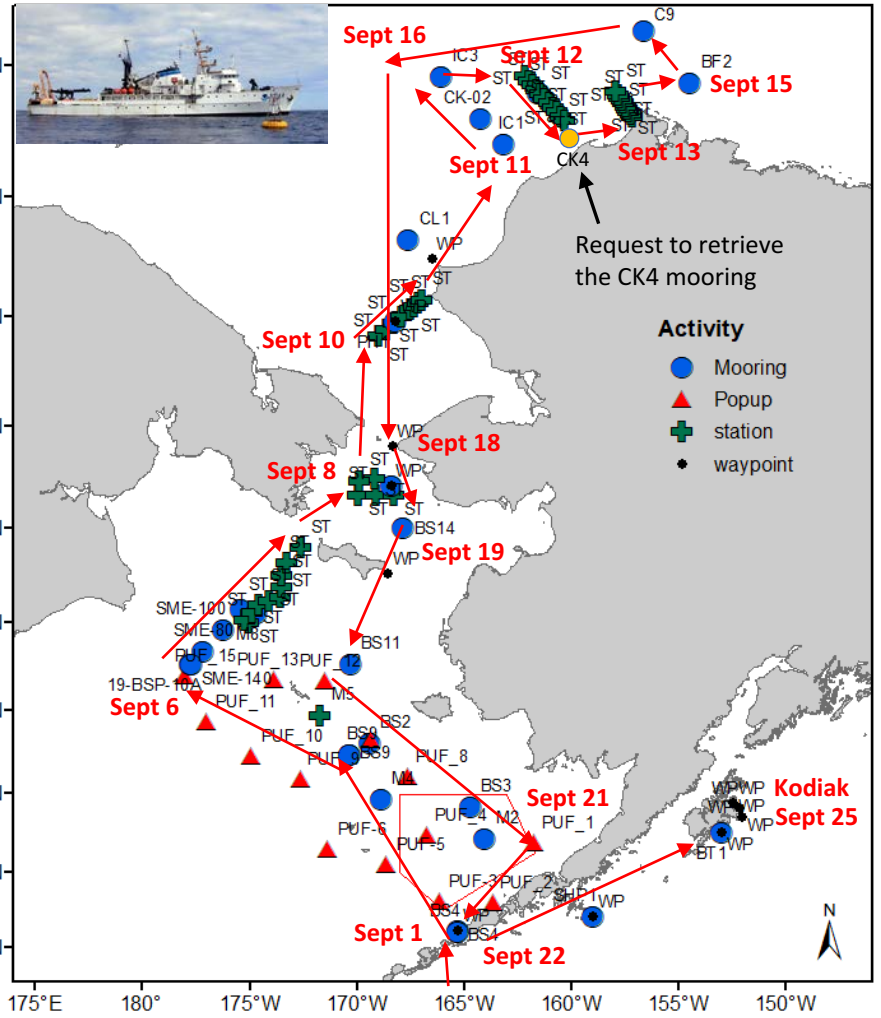
2020 DBO/EcoFOCI Joint Cruise

August 24-September 25, 2020; Seattle-to-Kodiak;
NOAA Ship Oscar Dyson

Goal: evaluate ecosystem status and change at the DBO and EcoFOCI time series stations and deploy/retrieve ~25 NOAA time series moorings

Standard measurements and process studies:

- Physical: CTD/rosette; mooring retrieval and replacement (NOAA and UAF), deploy pop-up buoys
- Water column: nutrients, oxygen, chlorophyll-a, eDNA, Harmful Algal Blooms (HAB) phytoplankton type
- Bongo net: zooplankton abundance and biomass
- Seabird surveys



Contact: Chief Scientist (virtual): Jackie Grebmeier/UMCES: jgrebmei@umces.edu;
DBO=Distributed Biological Observatory (DBO)

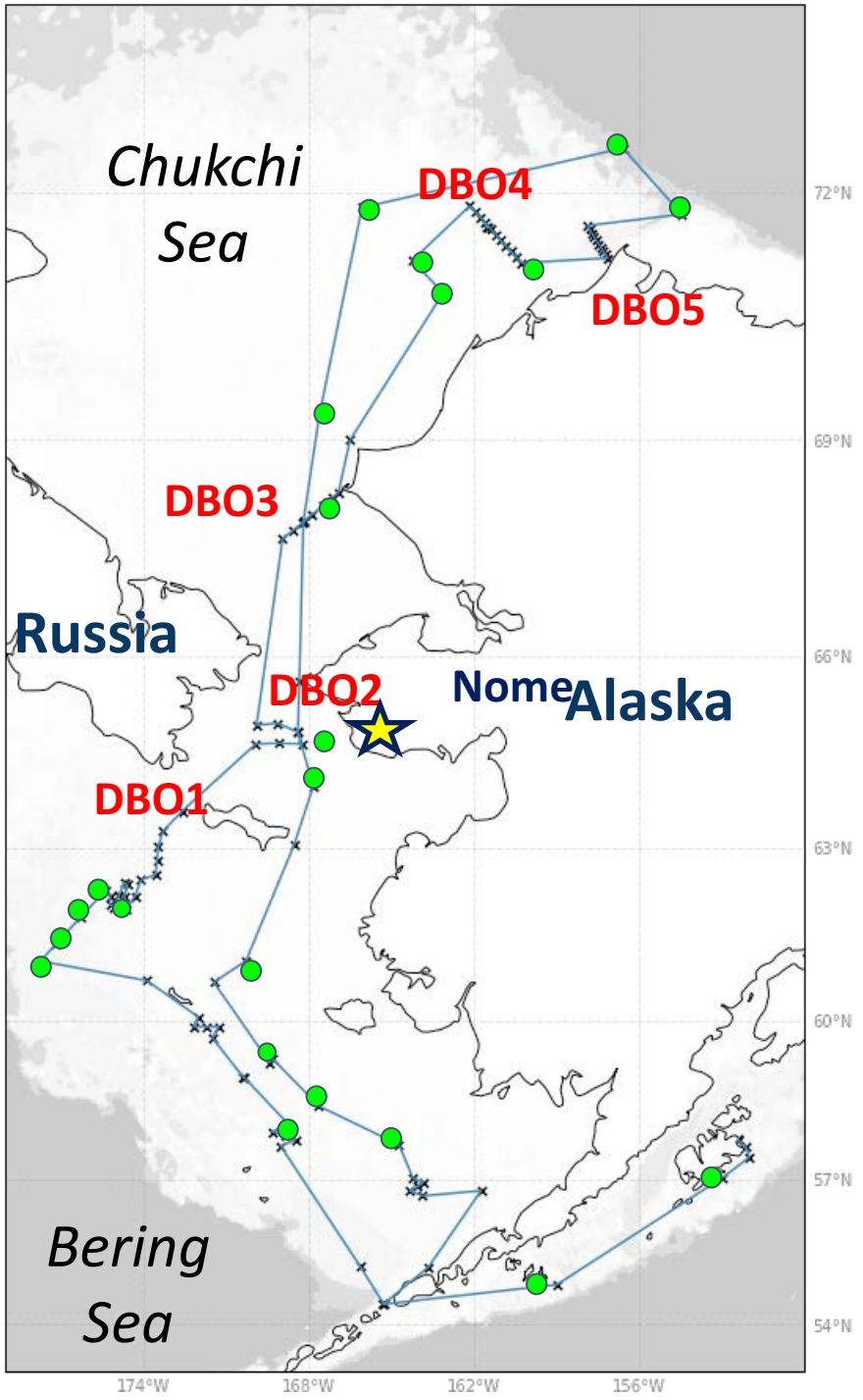
EcoFOCI
Ecosystems & Fisheries-Oceanography Coordinated Investigations

Contact: Phyllis Stabeno/NOAA: phyllis.stabeno@noaa.gov

R/V Dyson accomplishments

- >6,000 km traveled, 25 days at sea
- Sampled 5 Distributed Biological Observatories (DBO)
- Seabird Observer
- ~20 mooring sites (biophysical, marine mammals, and echo sounders), pop-up buoys,
- 68 CTD (nutrients, oxygen, chlorophyll-a), satellite-tracked drifters,
- 24 eDNA genetics samples
- 30 water column HABS
- 50 zooplankton tows

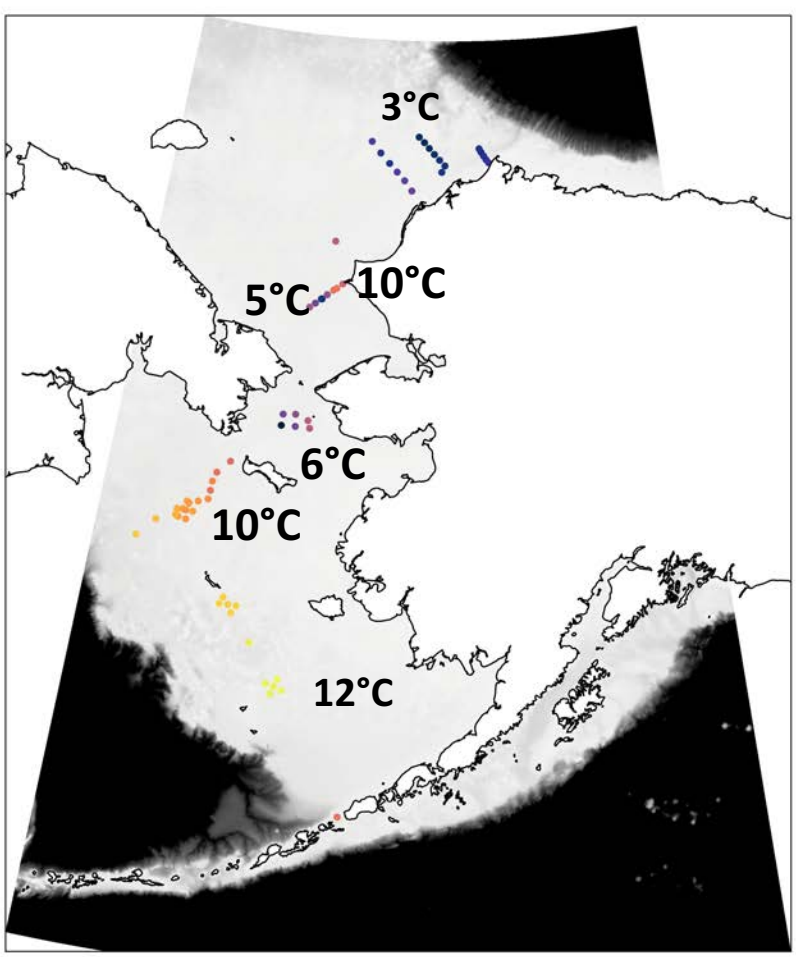
This cruise was a collaborative effort by NOAA's Arctic Research Program, AFSC, PMEL, and academic partners. It was accomplished through the hard work of the shore - based staff, sea-going scientists, and the crew and officers of Dyson.



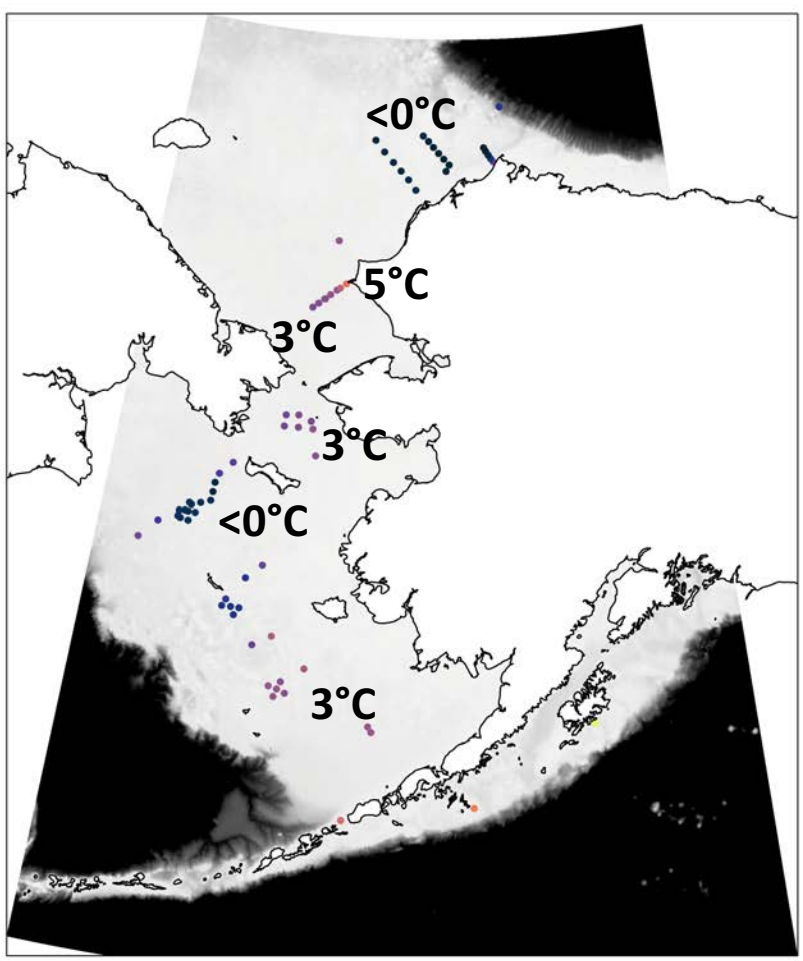
Surface & bottom water temperature values: DYSON 20-12

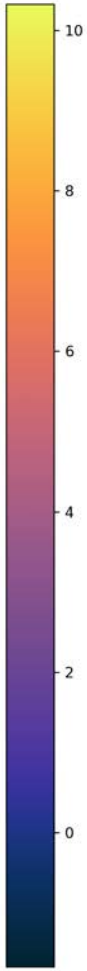
- Seawater temperatures: both surface and bottom waters were warmer than annual average for this period; moorings also showed warm bottom water temperatures

Surface temperature



Bottom temperature



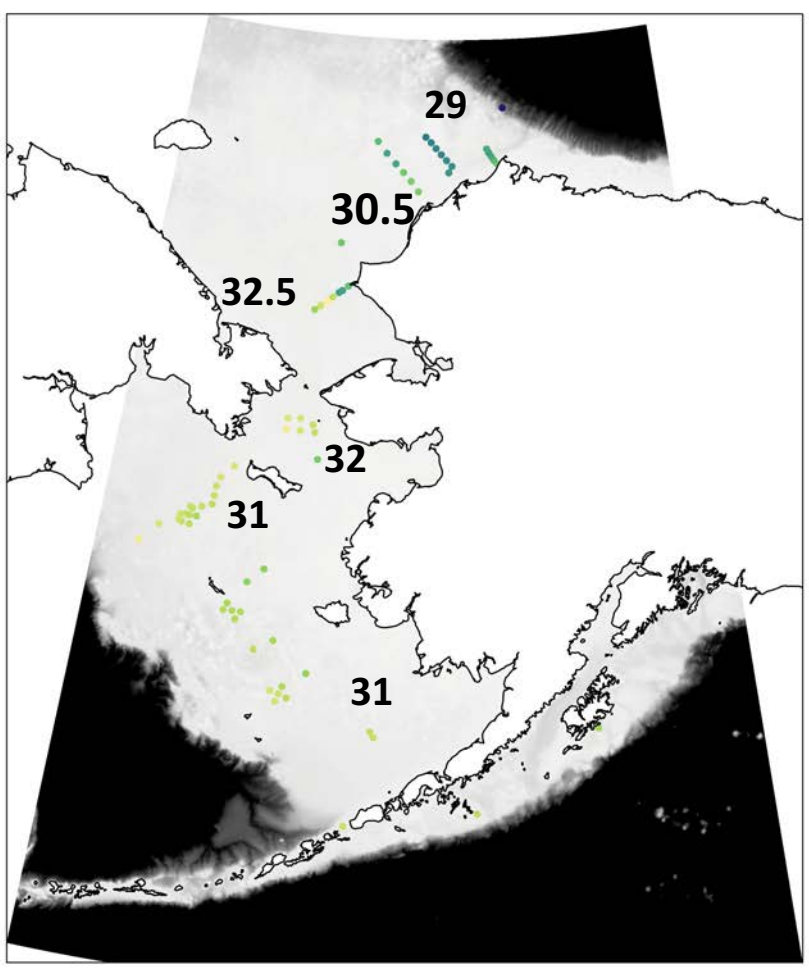


[courtesy Shaun Bell, NOAA]

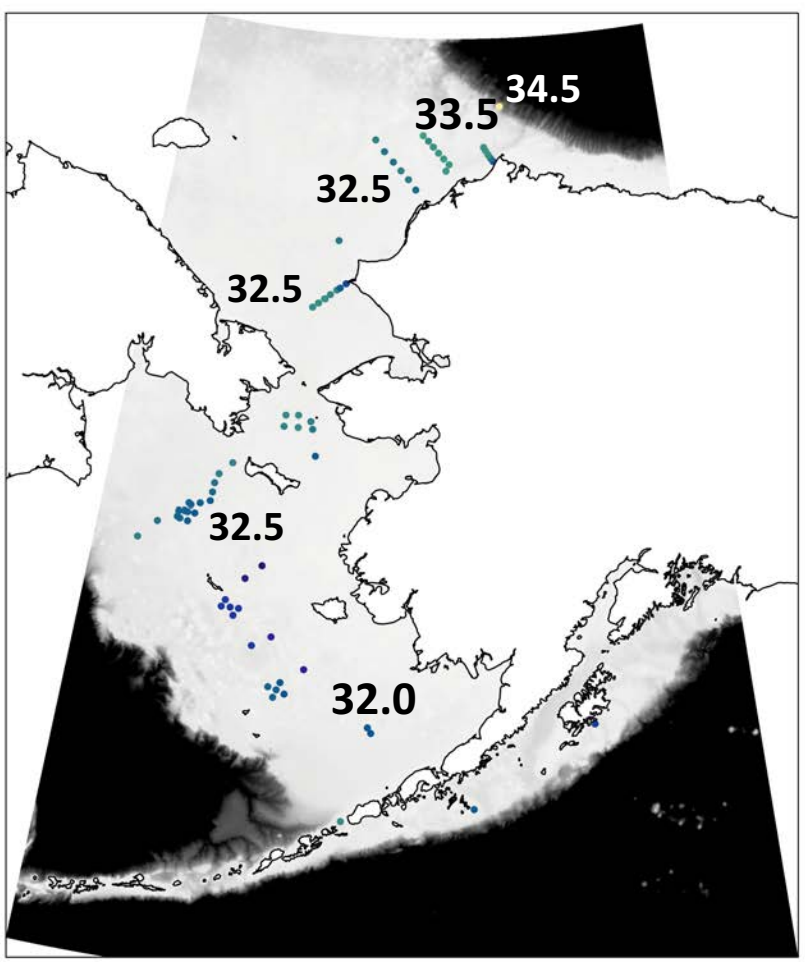
Surface & bottom water salinity values during DYSON 20-12

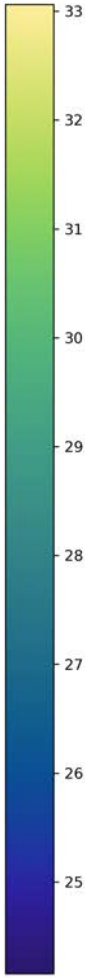
- Salinity varies by latitude and water mass: Bering Shelf water, Bering Sea summer and winter water, Alaska Coastal water, Atlantic water, sea ice melt

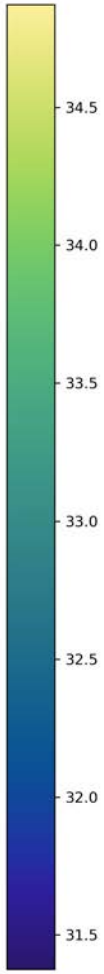
Surface salinity



Bottom salinity

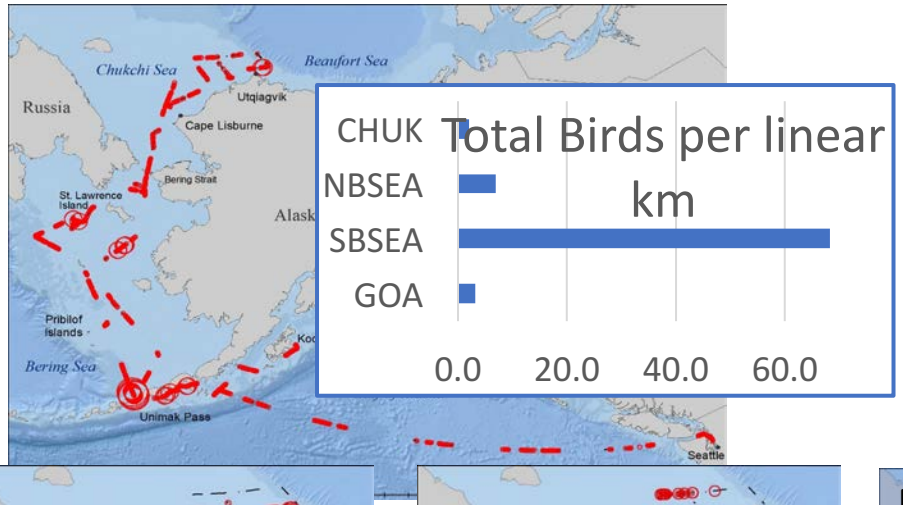




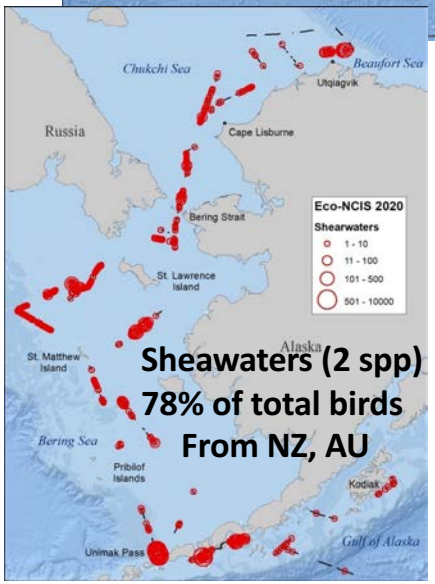


[courtesy Shaun Bell, NOAA]

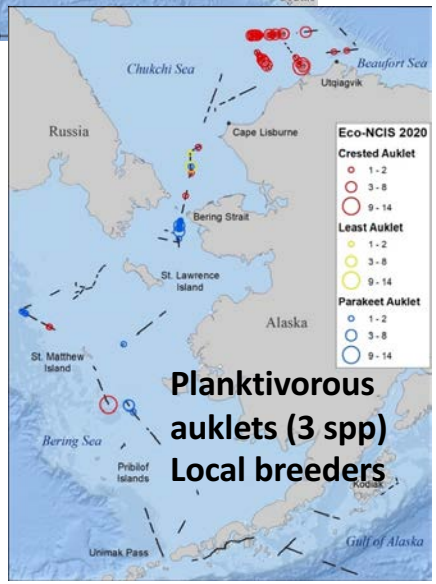
Marine Bird Surveys
Oscar Dyson, Aug-Sept 2020



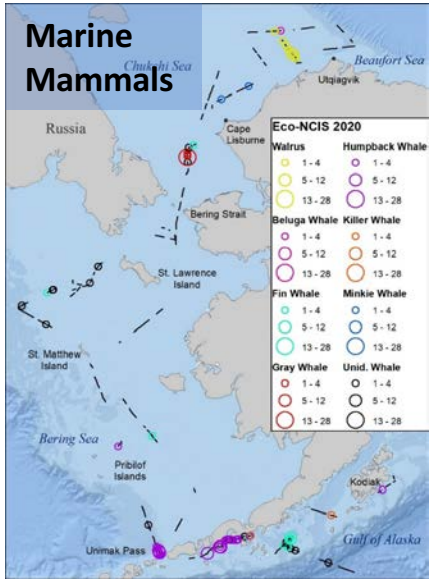
3200 km of transects; 'On transect':
>40,200 birds & 252 marine mammals
Species Richness: GOA > Bering > Chukchi
Highest densities: Southern Bering Sea



Sheawaters (2 spp)
78% of total birds
From NZ, AU



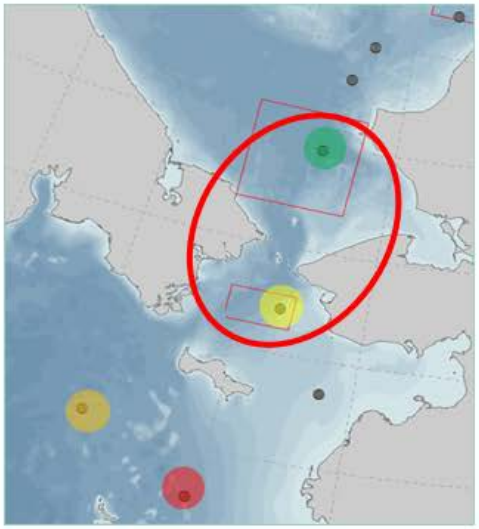
Planktivorous auklets (3 spp)
Local breeders



Observer: Charlie Wright (UW)
Funds: AMBON (K. Iken, UAF)
Data: K. Kuletz (USFWS, Alaska)

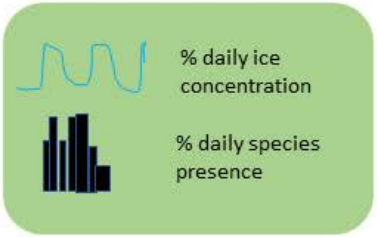
Marine Mammals

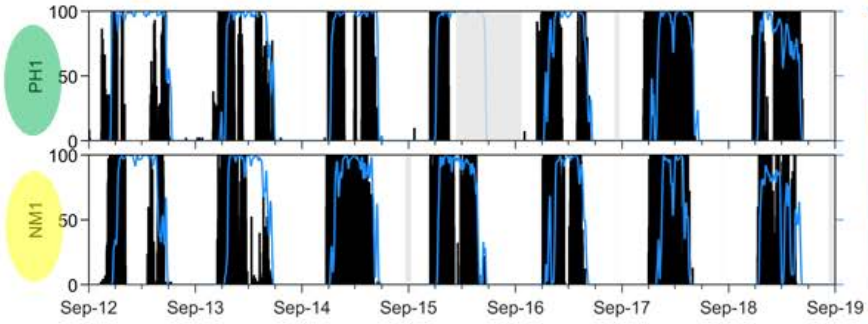
Catherine Berchok, MML, AFSC

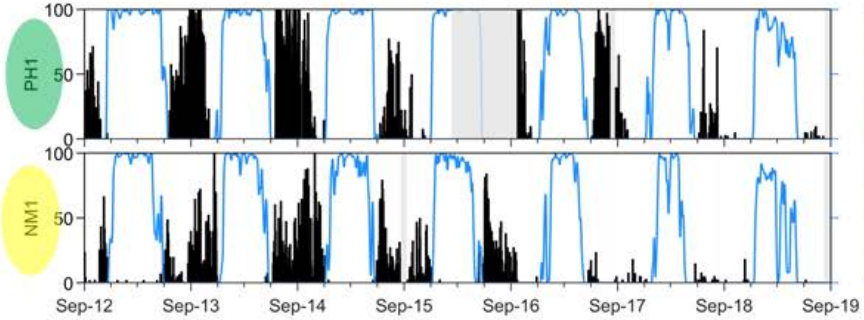


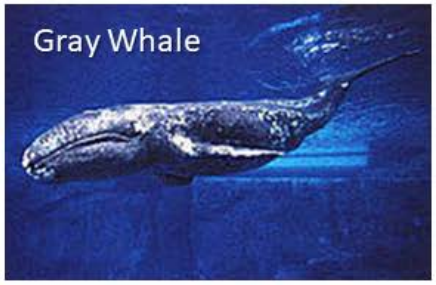
Bering Strait

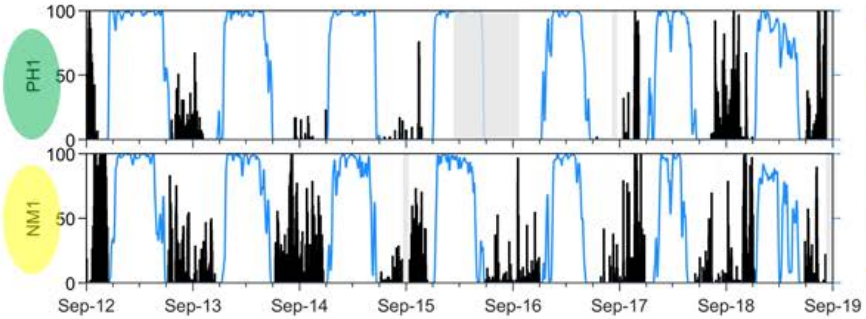
2012-2019







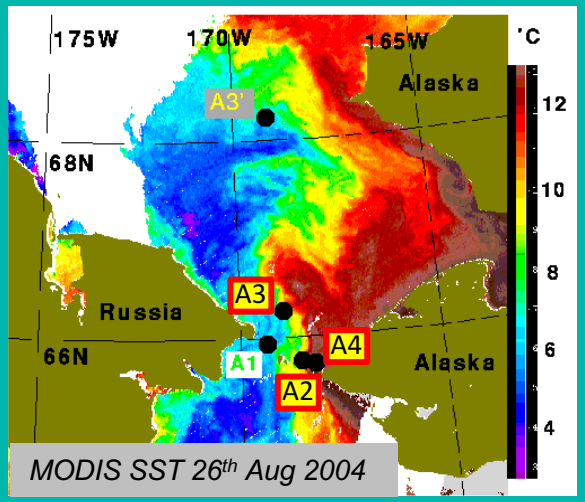




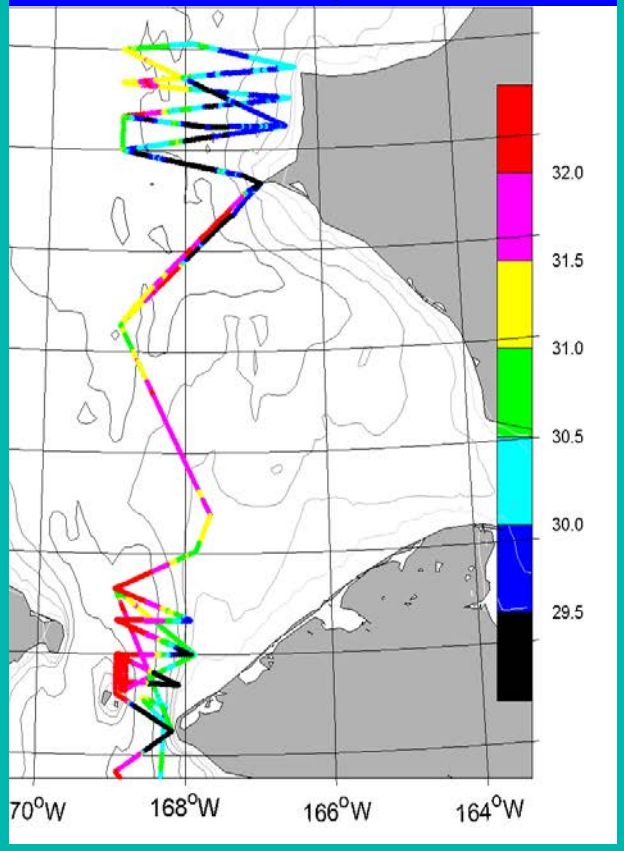
Bering Strait Mooring Project 2020 Cruise

8th-18th Sept 2020, R/V Norseman2

PIs: Rebecca Woodgate & Cecilia Peralta-Ferriz
University of Washington, USA
woodgate@uw.edu



Underway Surface Salinity (psu)
8th-18th Sept 2020



Due to Covid, our Norseman2 cruise operated without scientists on board, but using high speed internet to direct operations from land.

= 3 UW- Bering Strait moorings deployed at usual sites in US waters (A2, A3, and A4)
= 1 NOAA marine mammal mooring set in N Bering Sea
= 1 UAF Glider deployed in Chukchi Sea
= Sea surface temperature & salinity and full depth velocity sampled by underway systems on usual CTD lines.

All moorings are planned to be recovered in July 2021, also from the Norseman2. (Ship contract currently being finalized.)

Funded by US National Science Foundation
Office of Polar Programs, Arctic Observing Network

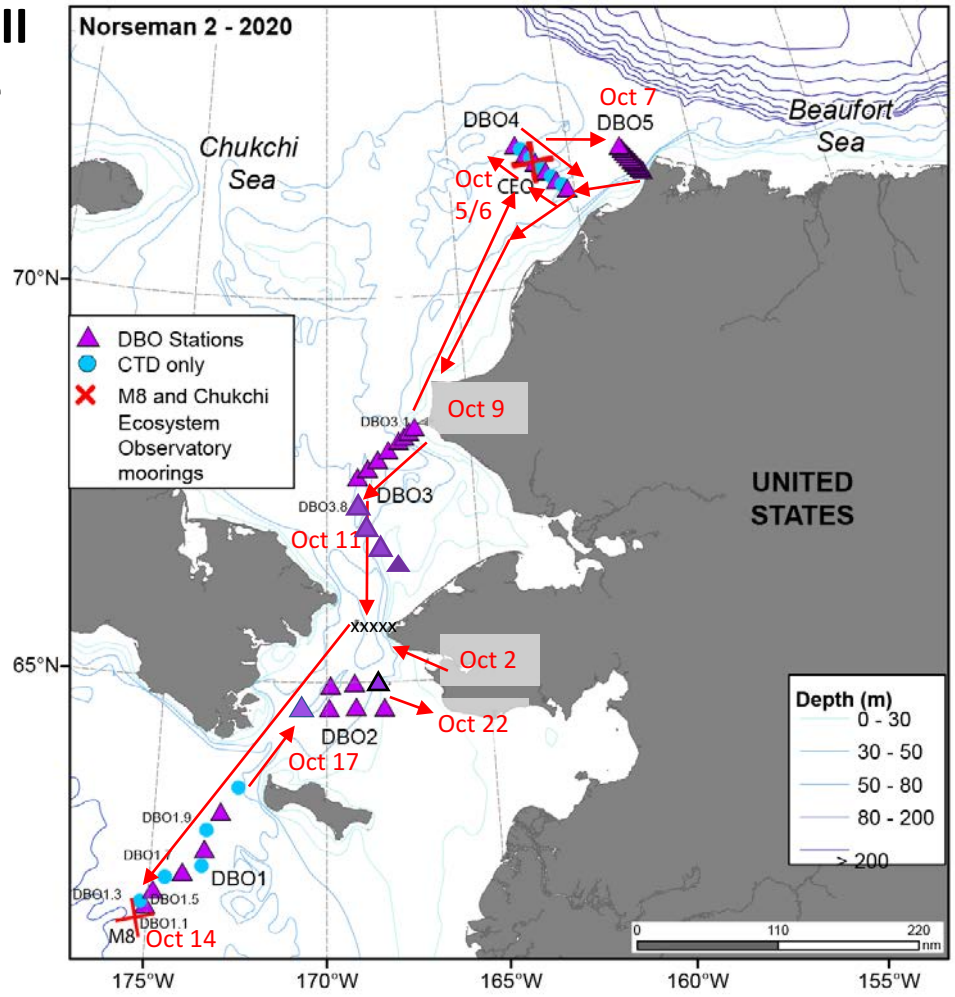
2020 Fall DBO Cruise, Norseman II

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)



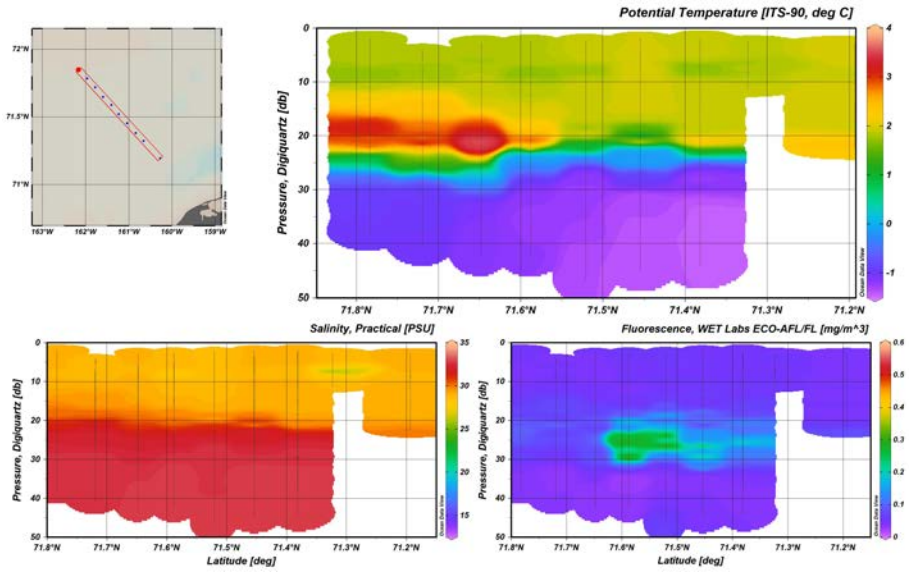
Contact: Chief Scientist: **Jackie Grebmeier/UMCES**: jgrebmei@umces.edu; DBO

Consortium of projects:

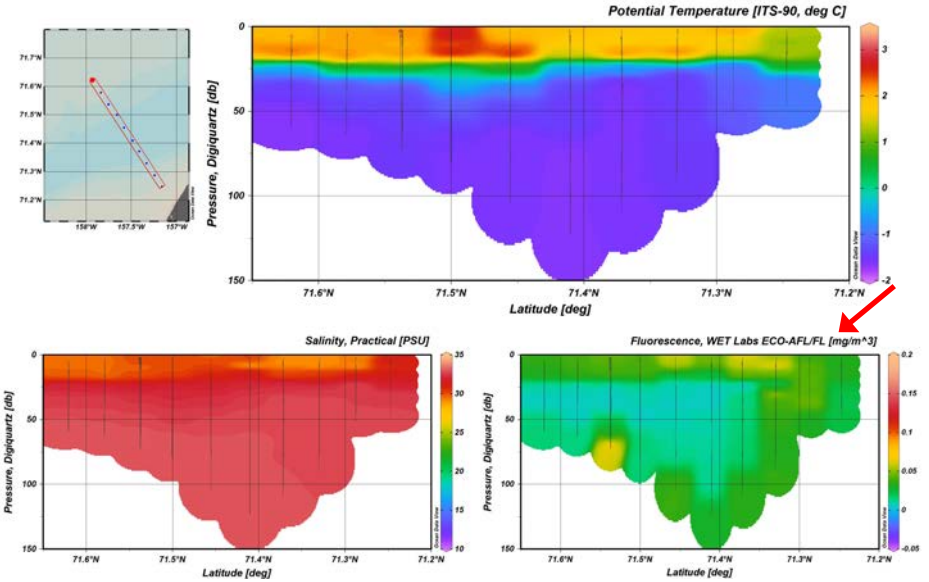
DBO=Distributed Biological Observatory
AMBON=Arctic Marine Biodiversity Observing Network
CEO=Chukchi Ecosystem Observatory
EcoFOCI=Ecosystems & Fisheries - Oceanography Coordinated Investigations

Norseman 2-Oct 2020

Hydrographic data for DBO4-off Wainwright

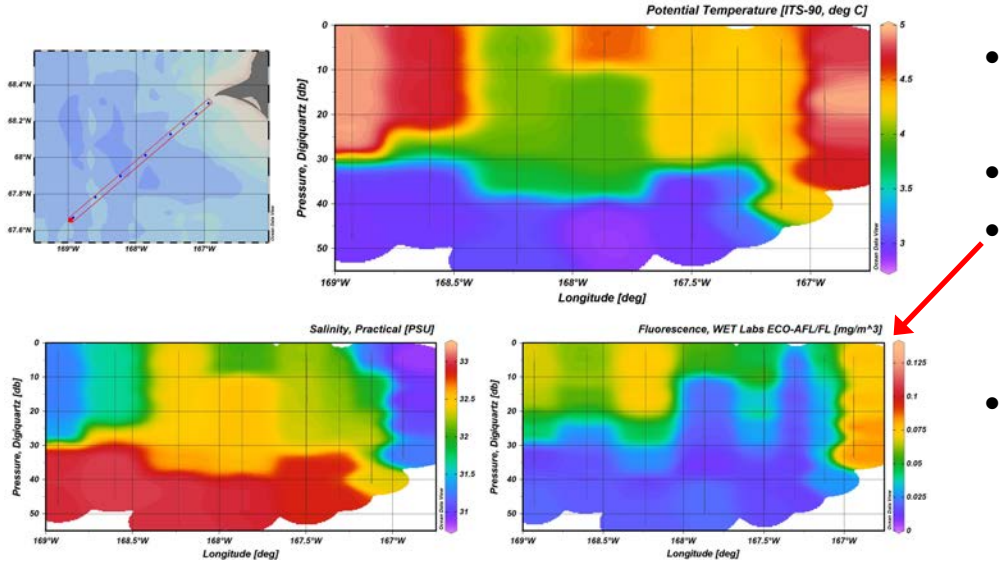


Hydrographic data for DBO5-off Utqiaġvik



[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

Chukchi Ecosystem Observatory (CEO) at Hanna Shoal

Developing a better mechanistic understanding of the Arctic marine ecosystem.

Fostering coordination and cooperation among research programs.

71.6 ºN, 161.5 ºW
Contact: Seth Danielson
sldanielson@alaska.edu

Updates:

- 6 years of data in hand
- Presently funded through 2024
- AMBON addition of eDNA analysis via water sampler collections
- 2021 AOOS addition of Benthic Time-Lapse Camera
- Now in final stages of archiving 2014-2019 data online

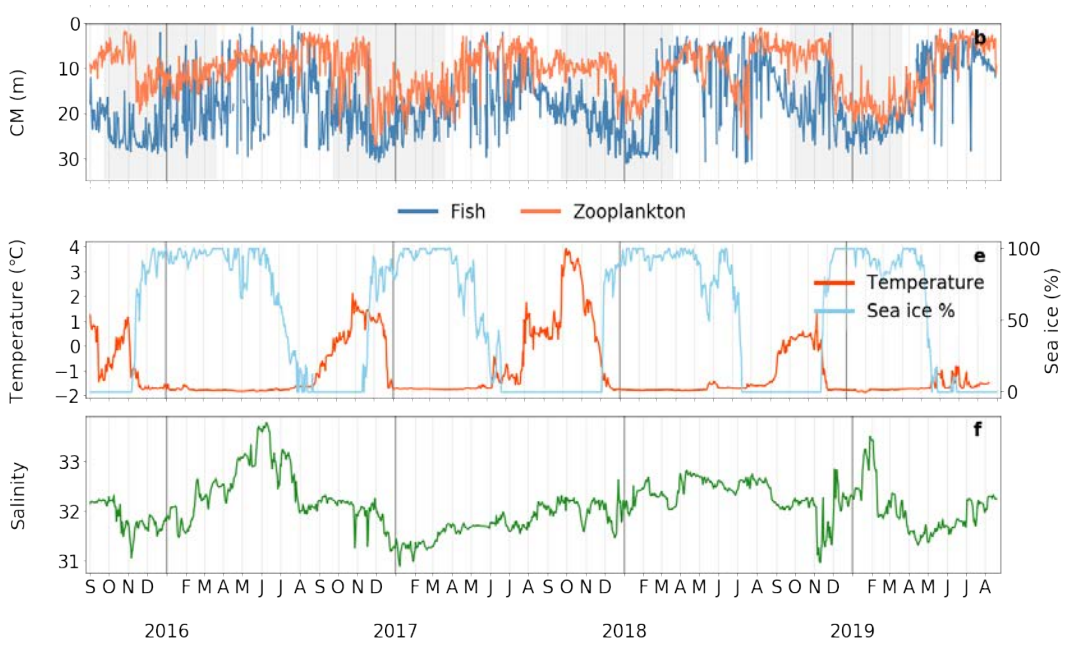
Data Streams:

Ice draft, PAR, Current Velocity, Temperature, Salinity, Pressure, O_2, NO_3, NO_2, NH_4, SiO_3, PO_4, $delO^{18}$, pH, pCO_2, CDOM, Chlorophyll-a Fluorescence, Optical Backscatter, eDNA, Sediment trap phyto- & zooplankton species, Particulate organic carbon & nitrogen, Acoustic Backscatter, Underwater Sound, Benthic Time Lapse Camera

Contact us if you plan to stop by

- Calibration CTD casts are greatly appreciated (nutrients, O2, DIC, net tows, etc.)
- We can provide sample bottles, instrument depth listings for calibration, etc.

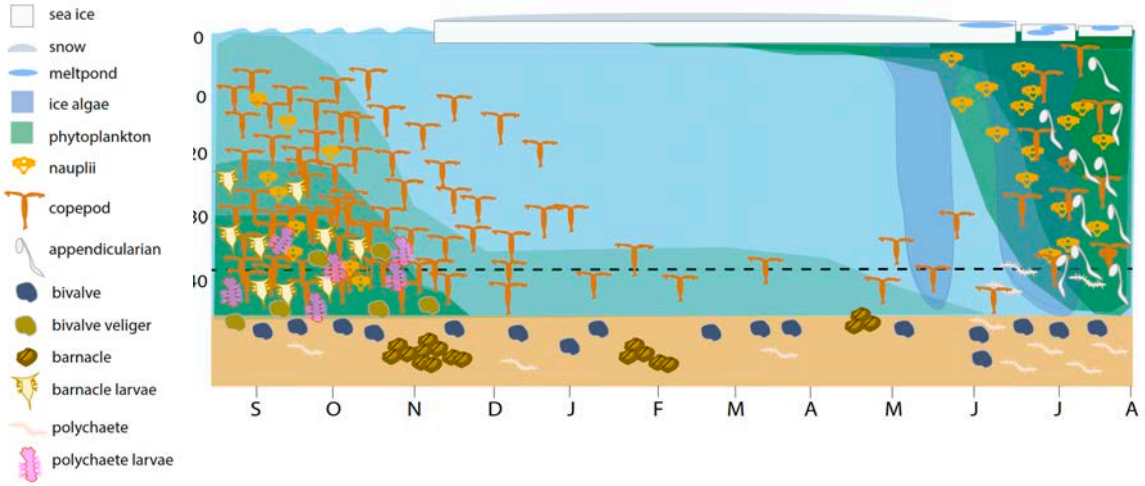
CEO Emerging Results



Multi-year assessments of:

- Co-variability of fish & zooplankton across tidal to interannual time scales
- Relations of backscatter variability to environmental conditions

[Silvana Gonzalez, in prep.]



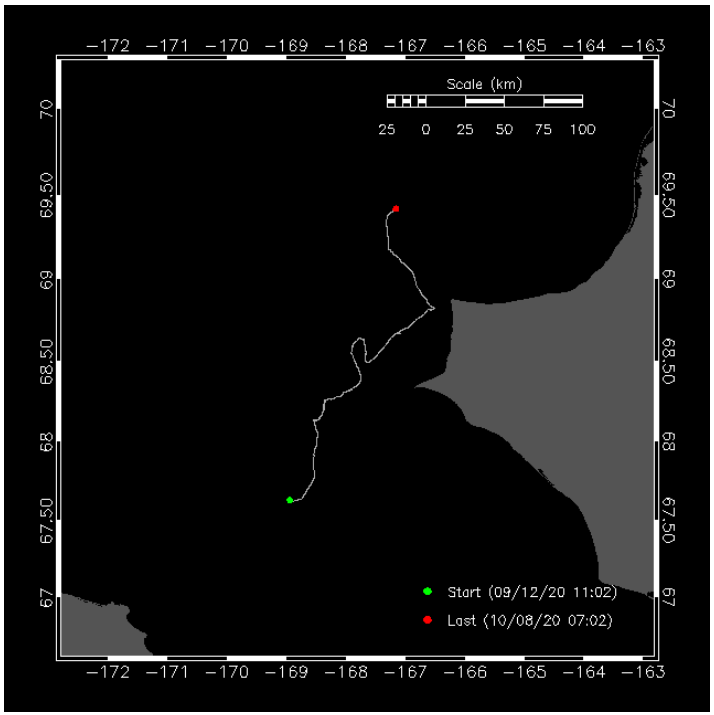
Sediment trap view of the world:

- Cycles of phyto- and zooplankton
- Carbon export to benthos

[Catherine Lalande 2020; in prep.]

Autonomous Real-time Marine Mammal Detections
Woods Hole Oceanographic Institution
Chukchi Sea, Arctic, Fall 2020

- Slocum G2 glider to study the occurrence of several species of marine mammals, including fin, bowhead, and beluga whales, as well as bearded seals and walrus
- Temperature and salinity of seawater
- Kate Stafford (Univ Washington), Seth Danielson (Univ Alaska Fairbanks), and Mark Baumgartner (WHOI)

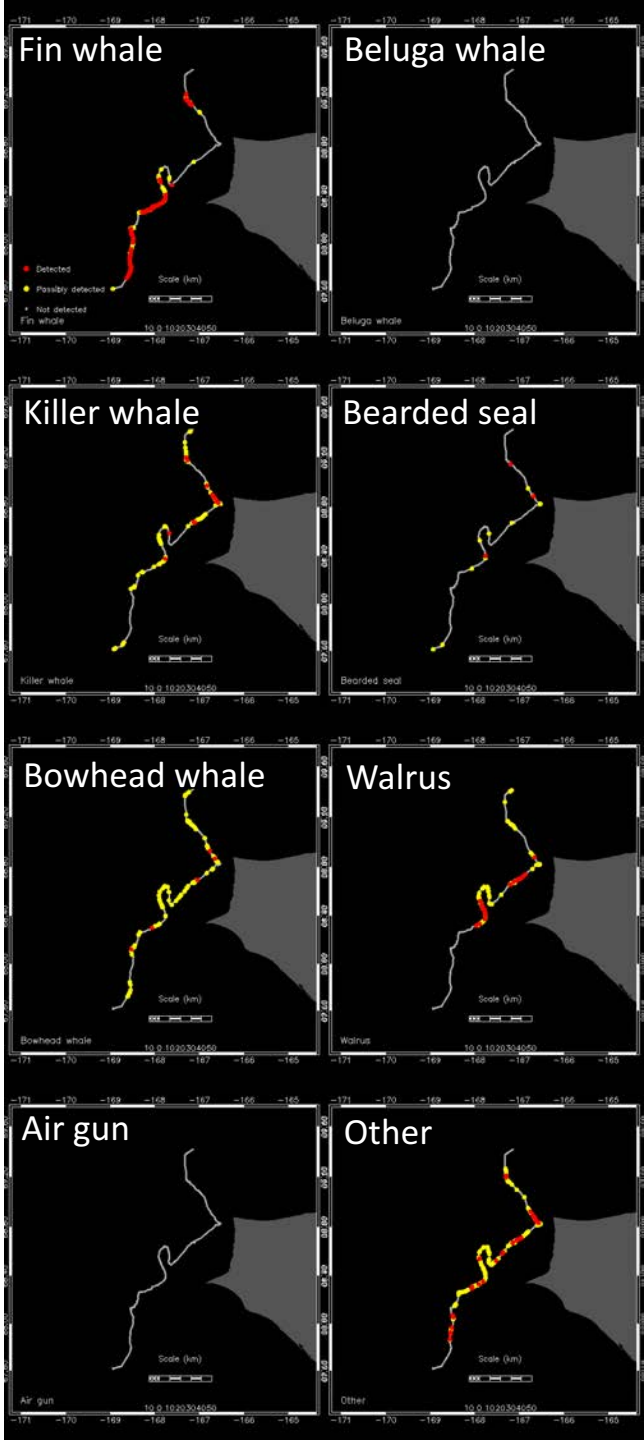


Detected

Possibly detected

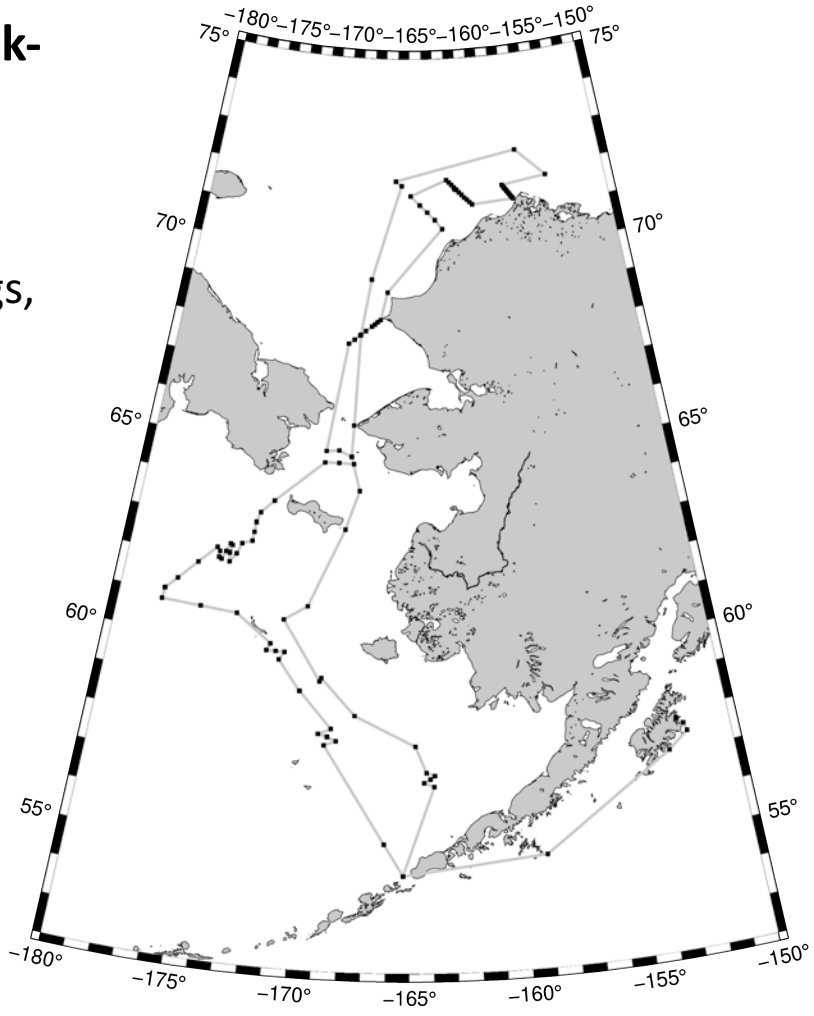
Not detected

[courtesty Mark Baumgartner]



2021 DBO/EcoFOCI Joint Cruise
August -September, 2021; Seattle or Kodiak-to-Kodiak; Ship: TBD

Goal: evaluate ecosystem status and change at the DBO and EcoFOCI time series stations and deploy/retrieve NOAA and CEO time series moorings, along with AMBON collaboration



Standard measurements/process studies:

- Physical: CTD/rosette; mooring retrieval and replacement (NOAA and UAF), deploy pop-up buoys, sediment traps (M8 and CEO)
- Water column: nutrients, oxygen, chlorophyll-a, eDNA, Harmful Algal Blooms (HAB) phytoplankton type
- 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)
- Seabird and marine mammal survey

Contact: Chief Scientist: Jackie Grebmeier/UMCES: jgrebmei@umces.edu; DBO=Distributed Biological Observatory (DBO)

Contact: Phyllis Stabeno/NOAA: phyllis.stabeno@noaa.gov

EcoFOCI
Ecosystems & Fisheries-Oceanography Coordinated Investigations

USV pollock acoustic survey

Contingency plan to fill information gaps from cancelled acoustic-trawl surveys of the Bering Sea shelf.

USVs used to extend existing acoustic time series of pollock abundance for fisheries management.

Feasible because:

- Fish backscatter on EBS shelf is dominated by pollock
- Approach relies on recent research and development efforts.

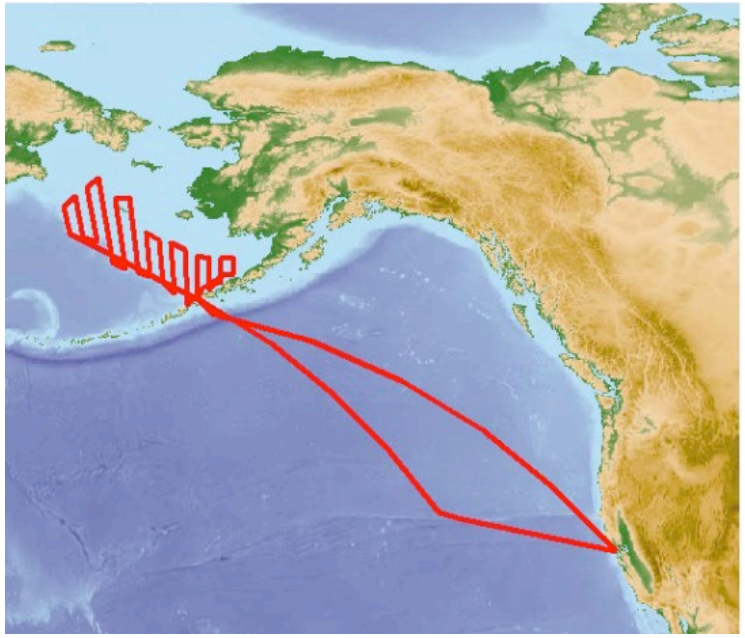
Saildrones are wind and solar powered robots, instrumented with calibrated 38/200 kHz echosounders, oceanographic, and meterological sensors

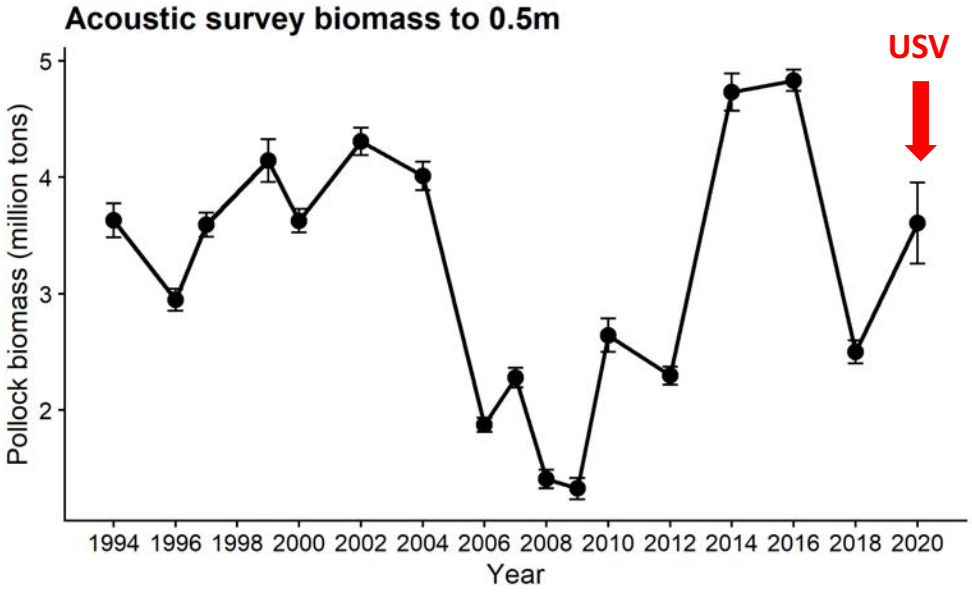
[Alex De Robertis, NOAA Fisheries]

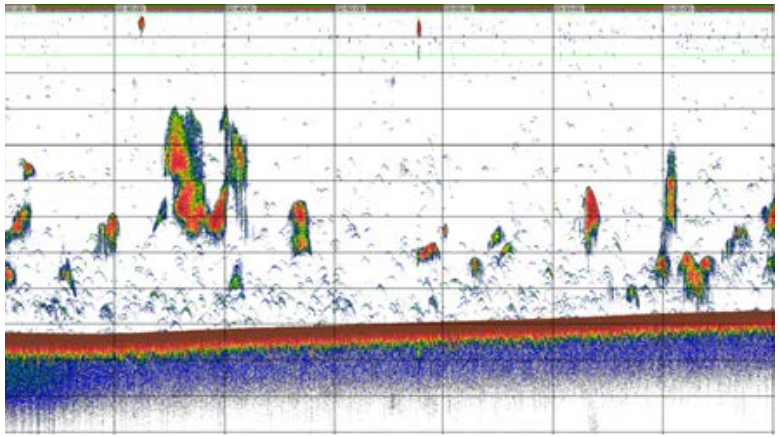
USV pollock acoustic survey (cont)

Approach

- Sail to/from Alaska
- 3 saildrones
- Acoustic survey at 40 nmi spacing
- Convert backscatter to fish biomass based on historical information
- Inflate uncertainty to account for backscatter to biomass conversion







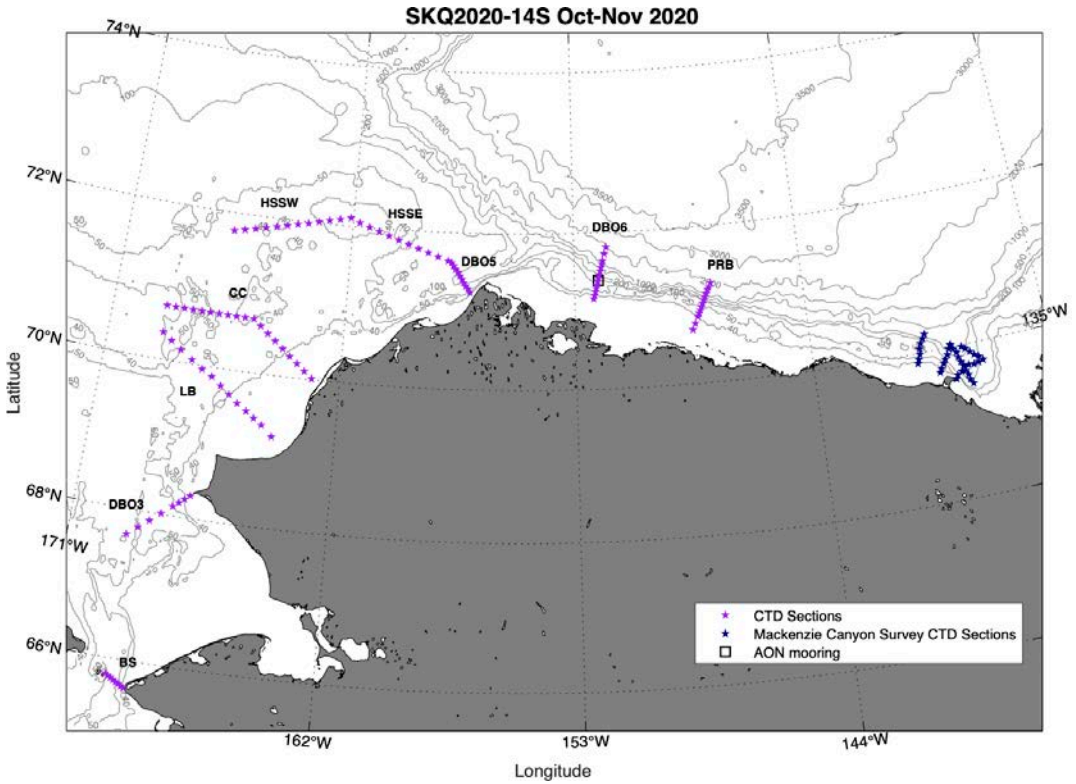
[Alex De Robertis, NOAA Fisheries}

Monitoring the Western Arctic Boundary Current in a Warming Climate: Atmospheric Forcing and Oceanographic Response

Principal Investigator: Robert Pickart, *Woods Hole Oceanographic Institution*

Cruise Dates: Oct–Nov, 2020
Ship: R/V *Sikuliaq*
Funding: National Science Foundation (AON)

- *We serviced the long-term AON mooring located in the Beaufort Shelfbreak Jet east of Barrow Canyon.*
- *We conducted a high-resolution CTD/ADCP survey of Mackenzie Canyon.*
- *We supported ancillary programs, including biogeochemistry, HABS, nutrients, microstructure, ocean acidification, and microplastics.*



Completed stations

[R. Pickart]

Mackenzie Canyon Survey 29 Oct – 1 Nov 2020

We were unable to complete our full survey due to the presence of multi-year ice to the northeast

But we still managed good coverage of the southern portion of the canyon

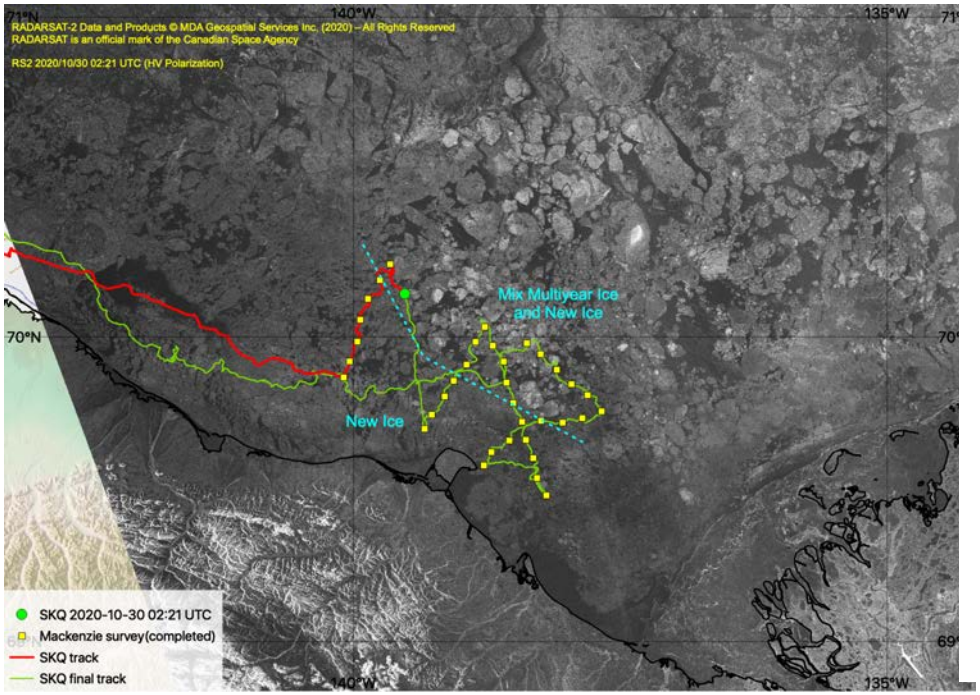
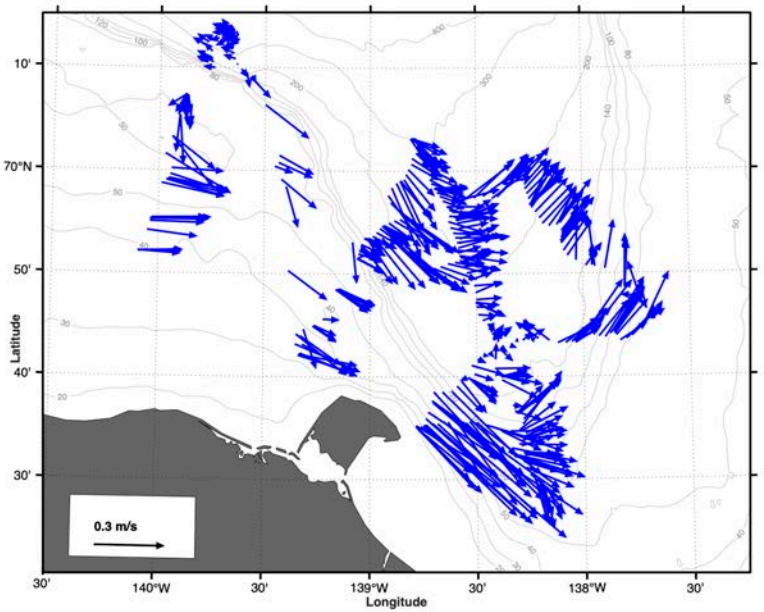


figure curtesy of S. Roberts



Depth-averaged flow vectors from the shipboard ADCP

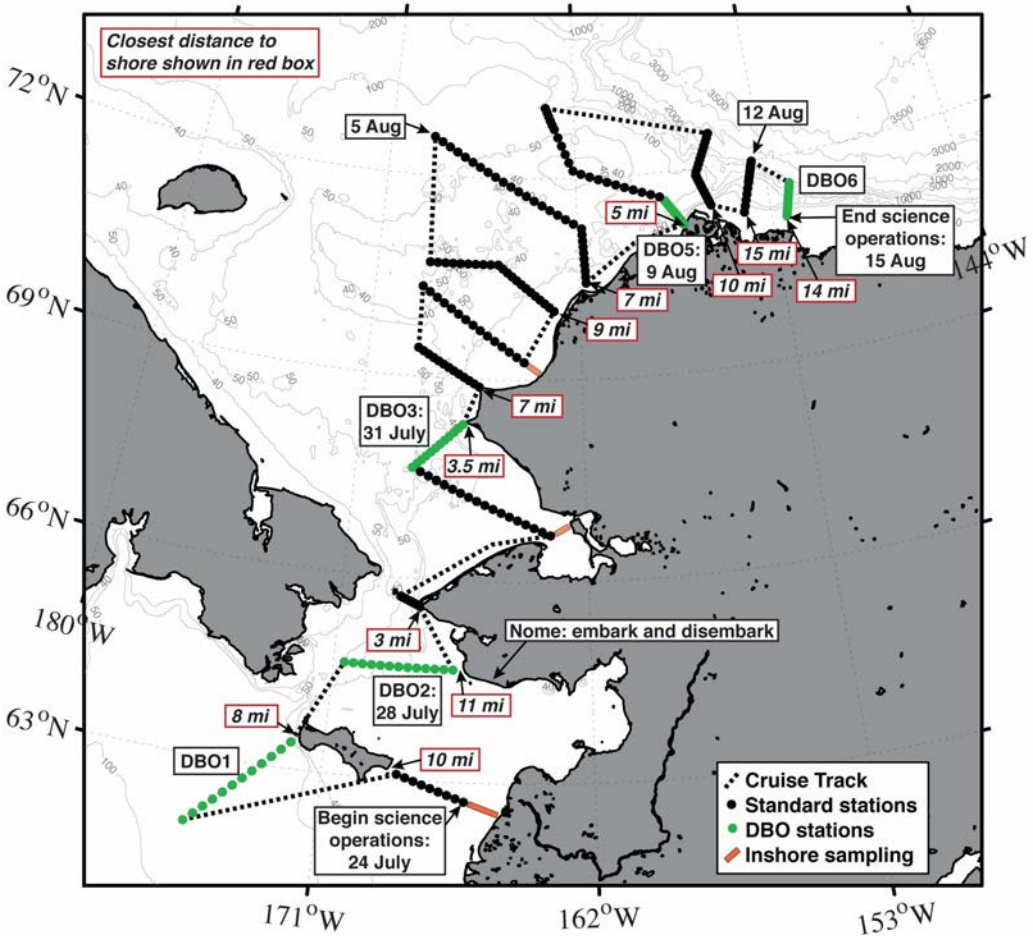
[R. Pickart]

Origin and Fate of Harmful Algal Blooms in the Warming Chukchi Sea

Principal Investigators: Donald Anderson and Robert Pickart, *Woods Hole Oceanographic Institution*

Cruise Dates: July–August, 2021
Ship: USCGC *Healy*
Funding: National Science Foundation

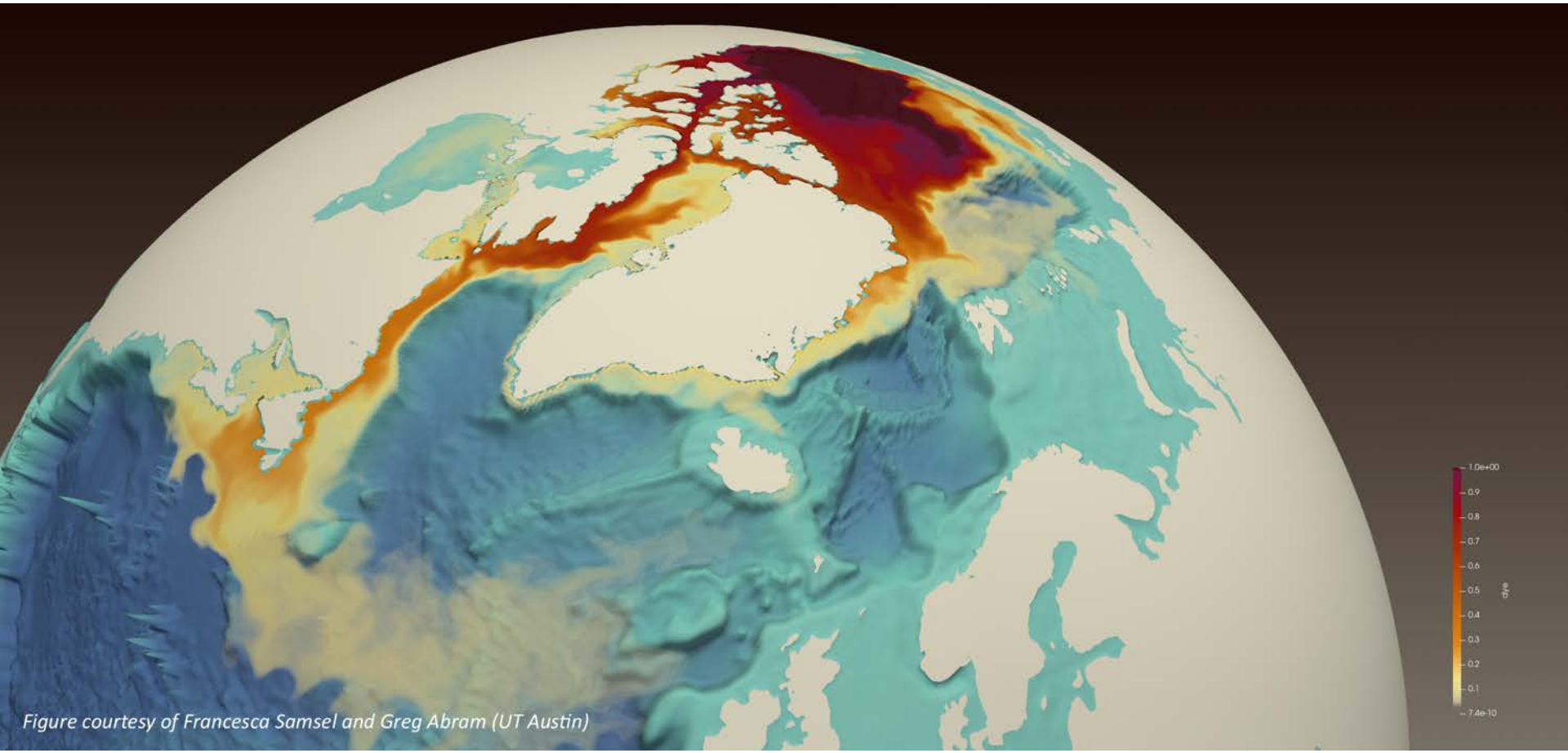
Dedicated study of harmful algal blooms using CTDs, underway systems, water samples, net tows, bottom grabs, sediment cores, small boat sampling near the coast.



Nominal station plan

[R. Pickart]

Arctic Modeling-NOAA



[courtesy Jiaxu Zhangshe/CICOES, University of Washington and, NOAA/PMEL]

Thank you for your attention.

Questions and comments?

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and international partners within
the Pacific Arctic Group

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http://pag.arcticportal.org/