Distributed Biological Observatory: A Change Detection Array in the Pacific Arctic 2019 Update

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Pacific Arctic Group Meeting
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Overview of Project

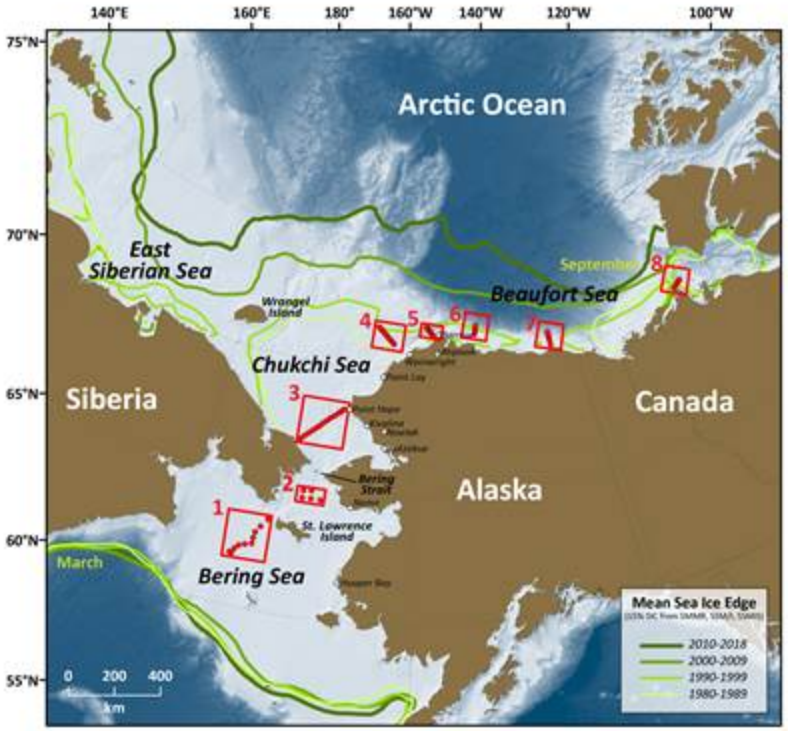
Goal of Distributed Biological Observatory (DBO) is to document and understand ongoing changes to the Pacific-Arctic ecosystem in light of the changing physical drivers (e.g., early spring ice retreat, later fall sea ice formation, increasing seawater warming, both surface and bottom)

To address this goal, we collect data from the water column and sediments at a series of standard transects from the northern Bering Sea to the northeast Chukchi Sea as part of the Distributed Biological Observatory (DBO) national and international network

In addition to the time series observations, multiple national and international ships include process studies in the water column and sediments, seabird and marine mammal observations

These combined studies are helping to determine how the Arctic system is/will respond to a warming climate and the changing physical drivers and associated ecosystem response

The Distributed Biological Observatory (DBO): Linking Physics to Biology

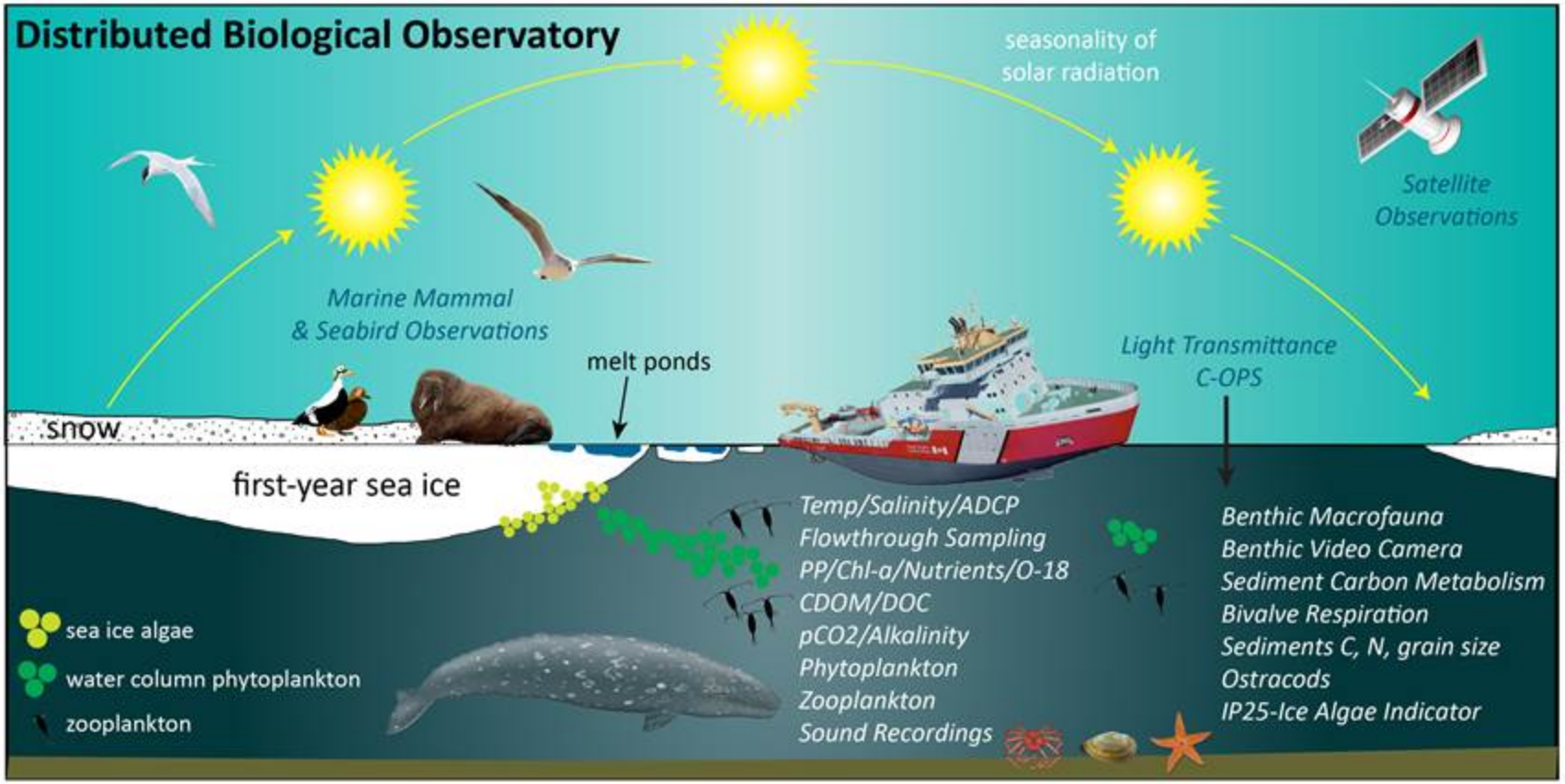


[Grebmeier et al. 2019, DBO DSR Special Issue 162:1-7]

- **Core Ship-based sampling:**
  - CTD and ADCP
  - Chlorophyll, nutrients, carbon products
  - Plankton (size, biomass and composition)
  - Benthos (size, biomass and composition)
  - Seabird and marine mammal surveys
  - Fishery acoustics
  - Bottom trawling (every 3-5 years)
- **Autonomous sensor sampling:**
  - Gliders, moorings, saildrone
  - Satellite observations
- **DBO lines also embedded in process cruises**

- DBO sites (red boxes) are **regional "hotspot"** transect lines and stations, based on high productivity, biodiversity, and/or overall **rates of change**
- DBO serves as a **change detection array** for consistent monitoring of biophysical responses
- Sites occupied by **national and international entities** with shared data plan

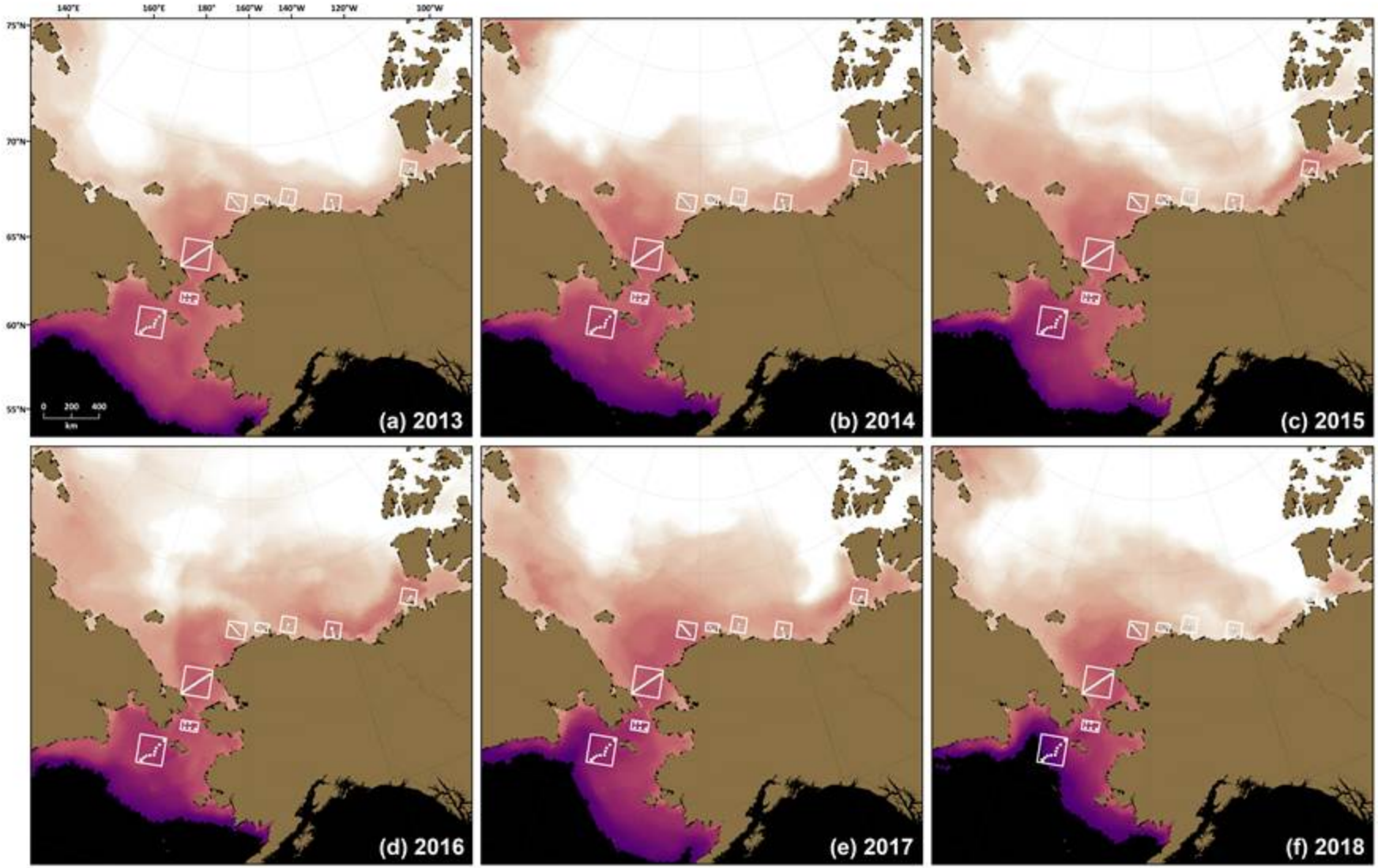
Sampling Components of the Distributed Biological Observatory



[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.

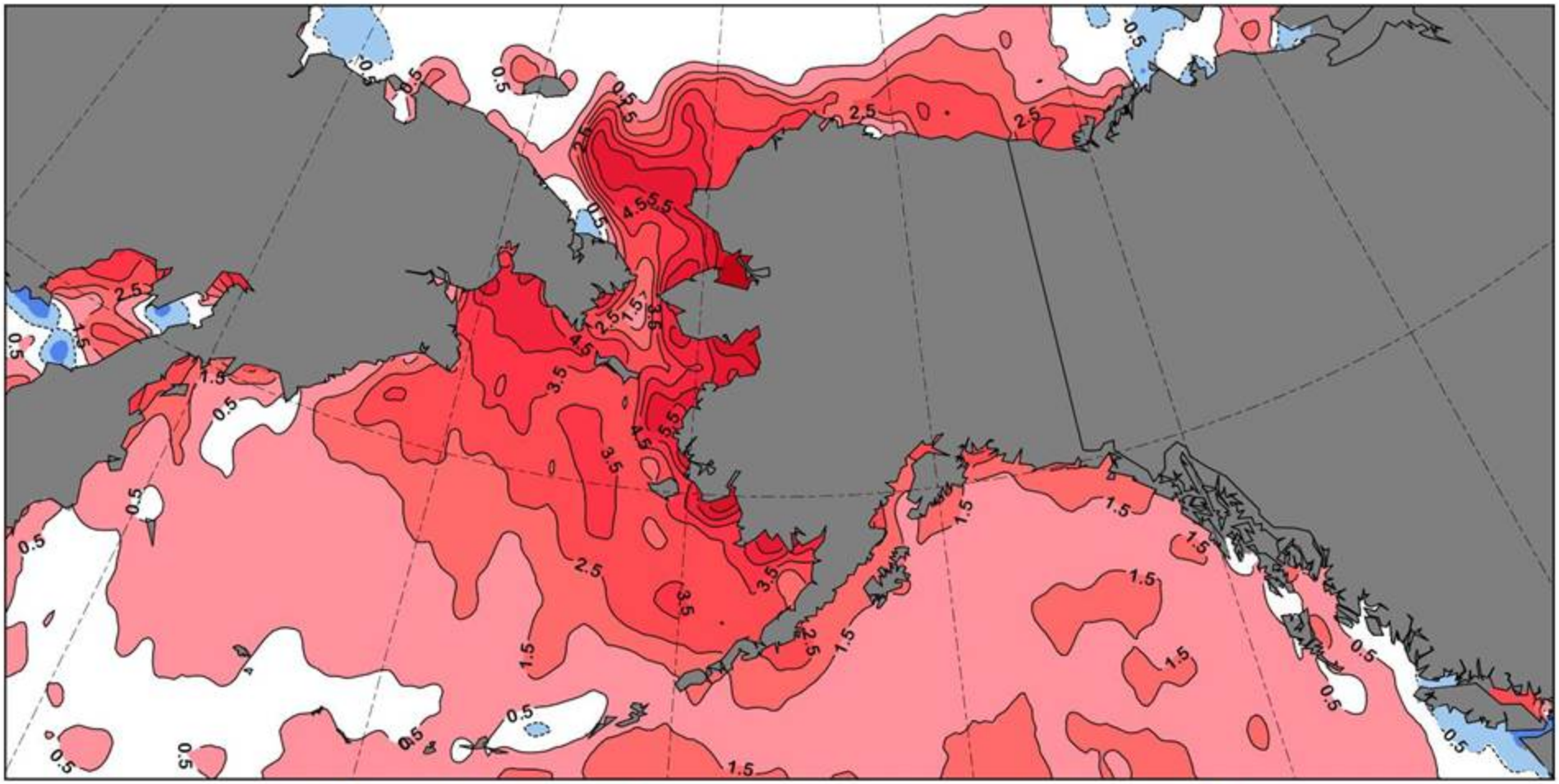
Annual sea ice persistence (# of days/year of sea ice presence) across the DBO1–8 regions in the Pacific Arctic from 2013–2018



[Grebmeier et al. 2019]

Sea Surface Temperature Departure From Normal

June 2019



ACCAP
Alaska Center for Climate Assessment and Policy
a NOAA RISA team

Graphic by @AlaskaWx

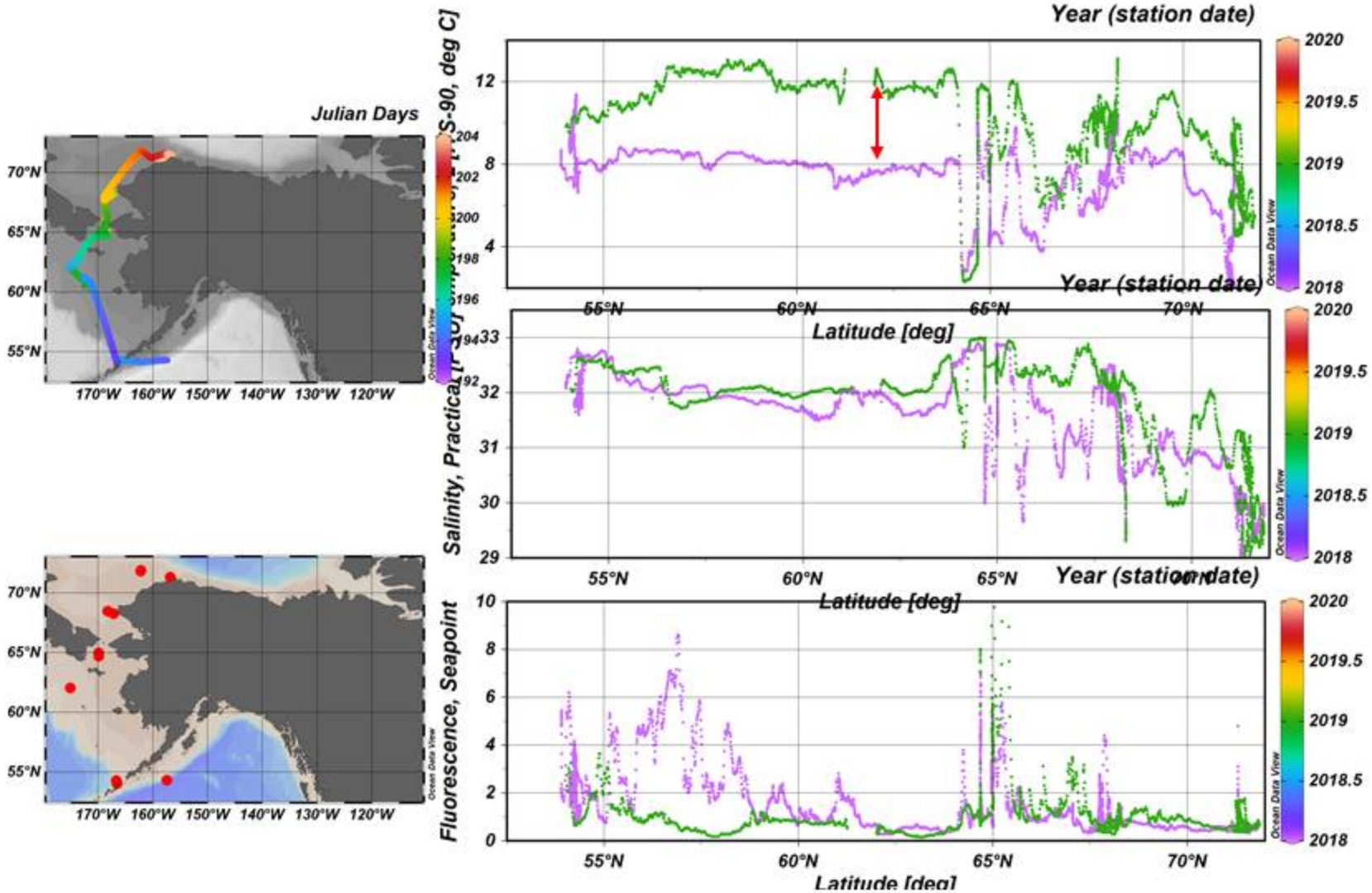
OISSTv2 courtesy of NOAA/PSD/ESRL

2019 PAG and DBO Cruise Plan Table

2019 PAG and DBO Field Season (version 10_08_19): Sampling Contributors. Projects Key: AON=US Arctic Observing Network (National Science Foundation); ArCS=Arctic Challenge for Sustainability; ArcticEIS2=Arctic Ecosystem Integrated Survey, C30=Canada's Three Oceans; CHINARE=Chinese Arctic Research Expedition; DBO=Distributed Biological Observatory; EcoFOCI= JAMSTEC= Japan Agency for Marine-Earth Science and Technology; JOIS=KOPRI = Korea Polar Research Institute; MOSAiC= Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC); NIPR = National Institute of Polar Research; NOAA=National Oceanic and Atmospheric Administration; Office of Naval Research (ONR) Marginal Ice Zone (MIZ) project; PMEL=Pacific Marine Environmental Laboratory. **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.

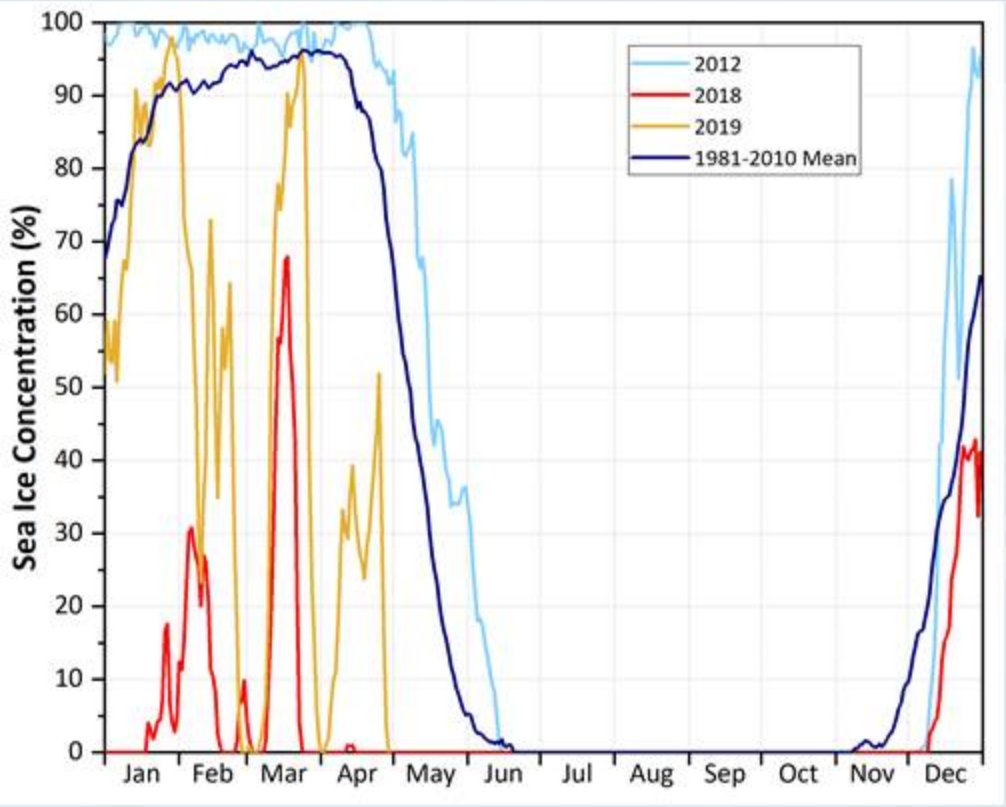
Dates 2019 (Port calls)	Ship	DBO Region	Projects	PAG contact	Chief Scientist
July 12-24 (Dutch Harbor-Utqiaġvik)	Sir Wilfrid Laurier	1,2,3,4,5	C30/DBO (AON)	Jackie Grebmeier jgrebmei@umces.edu	John Nelson John.Nelson@dfo-mpo.gc.ca
June-Sept (Shanghai-Shanghai)	Xuelong	-	CHINARE/MOSAiC	Jianfeng He hejianfeng@pric.org.cn	Jianfeng He hejianfeng@pric.org.cn
Aug 1-Oct 2 (Dutch Harbor-Nome-Nome-Nome-Dutch Harbor)	R/V Ocean Starr	2,3,4,5	Arctic IES (Integrated Ecosystem Survey)	Ed.Farley@noaa.gov	Geoff Lebon, Geoff.t.lebon@noaa.gov Ed Farley, ed.farley@noaa.gov Kris Cieciel, Kristin.cieciel@noaa.gov
Aug 1-25 (Dutch Harbor-Utqiaġvik)	Araon	1,2,3	K-AOOS (Korea-Arctic Ocean Observing System	Sung-Ho Kang shkang@kopri.re.kr	Eun Jin Yang ejyang@kopri.re.kr
Aug 27 – Sept 20 (Dutch Harbor-Nome-Nome-Dutch Harbor)	F/V Northwest Explorer	,2	Northern Bering Sea Assessment	Ed.Farley@noaa.gov	Jim Murphy jim.murphy@noaa.gov
Aug 2-22 (Nome-Nome)	Healy	1,2,3,4,5	DBO/NCIS=Northern Chukchi Integrated System	Jackie Grebmeier jgrebmei@umces.edu	Robert Pickart rpickart@whoi.edu and Jackie Grebmeier jgrebmei@umces.edu
Sept (Nome-Nome)	Norseman II	3	Bering Strait Mooring Project/AON	Rebecca Woodgate woodgate@apl.washington.edu	Rebecca Woodgate woodgate@apl.washington.edu
Sept 18-Oct 6 (Dutch Harbor-Kodiak)	Dyson	1 and M8	EcoFOCI	Phyllis Stabeno, Phyllis.stabeno@noaa.gov	Geoff Lebon geoffrey.t.lebon@noaa.gov
Sept -Oct	Louis S. St-Laurent	-	JOIS/AON-BGOS	Bill.Williams@dfo-mpo.gc.ca	Bill.Williams@dfo-mpo.gc.ca
Sep 27- 10 Nov 2019 (Sekinehama, Japan, return Sekinehama, Japan)	Mirai	1,2,3	Japanese Atmospheric cruise; National Institute of Polar Research (NIPR)	Takashi Kikuchi takashik@jamstec.go.jp	Dr. Kazutoshi Sato stakashik@jamstec.go.jp
Oct	Sir Wilfrid Laurier	4,8	C30	Bill.Williams@dfo-mpo.gc.ca	Humfrey.Melling@dfo-mpo.gc.ca

Surface water in July 2018 and 2019 from CCGS Sir Wilfrid Laurier -5 m intake



[courtesy S. Zimmerman, DFO]

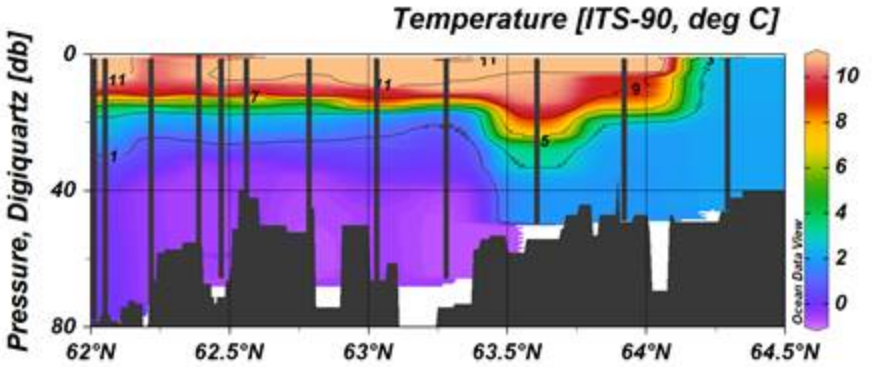
DBO1 region, Northern Bering Sea

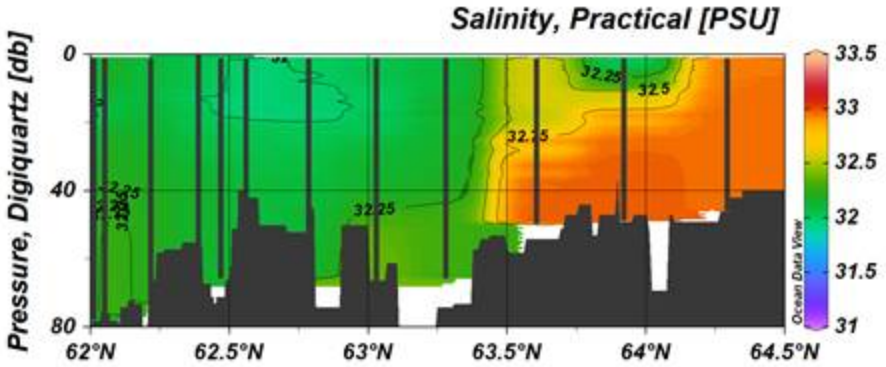


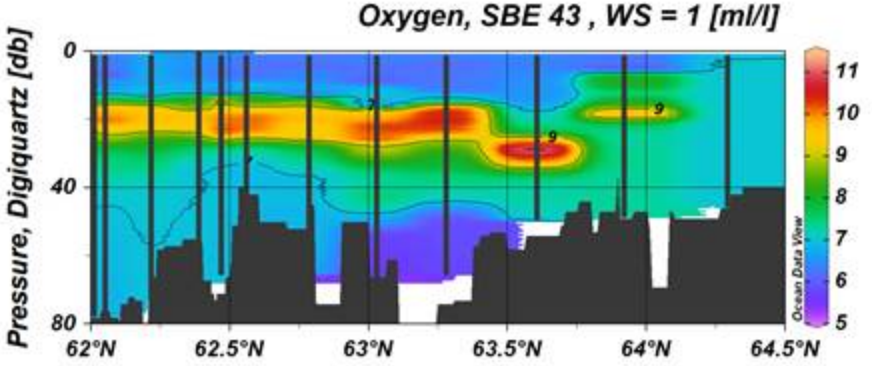
[K. Frey, Clark Univ]

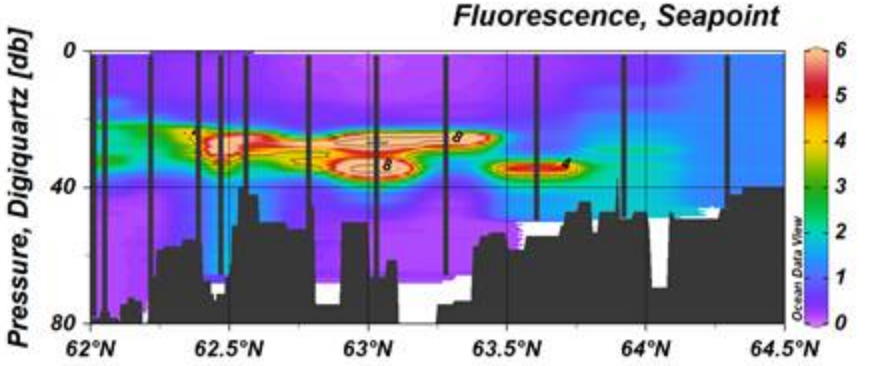
- The lack of a thermal cold-water barrier south of St. Lawrence Island (DBO1) in 2018 resulted in key commercial fish (cod, pollock) moving north to Bering Strait
- Ongoing DBO-NCIS activities with national and international networking of seasonal sampling (e.g., DBO, EcoFOCI) track key drivers and trophic response to ongoing sea ice reduction and warming surface and bottom waters in the northern Bering and Chukchi Sea
- Region may be at tipping point, and ecosystem moving to a new state with unknown consequences

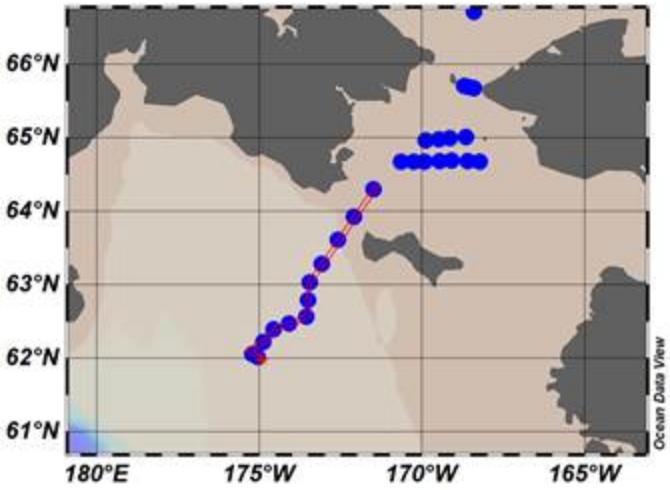
DBO 1-SWL19, July 2019

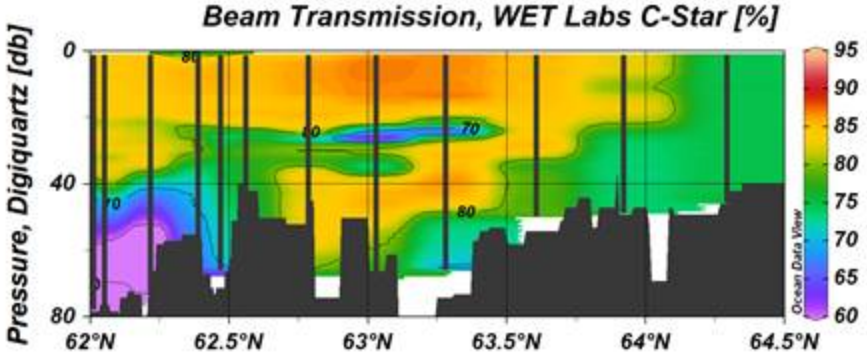






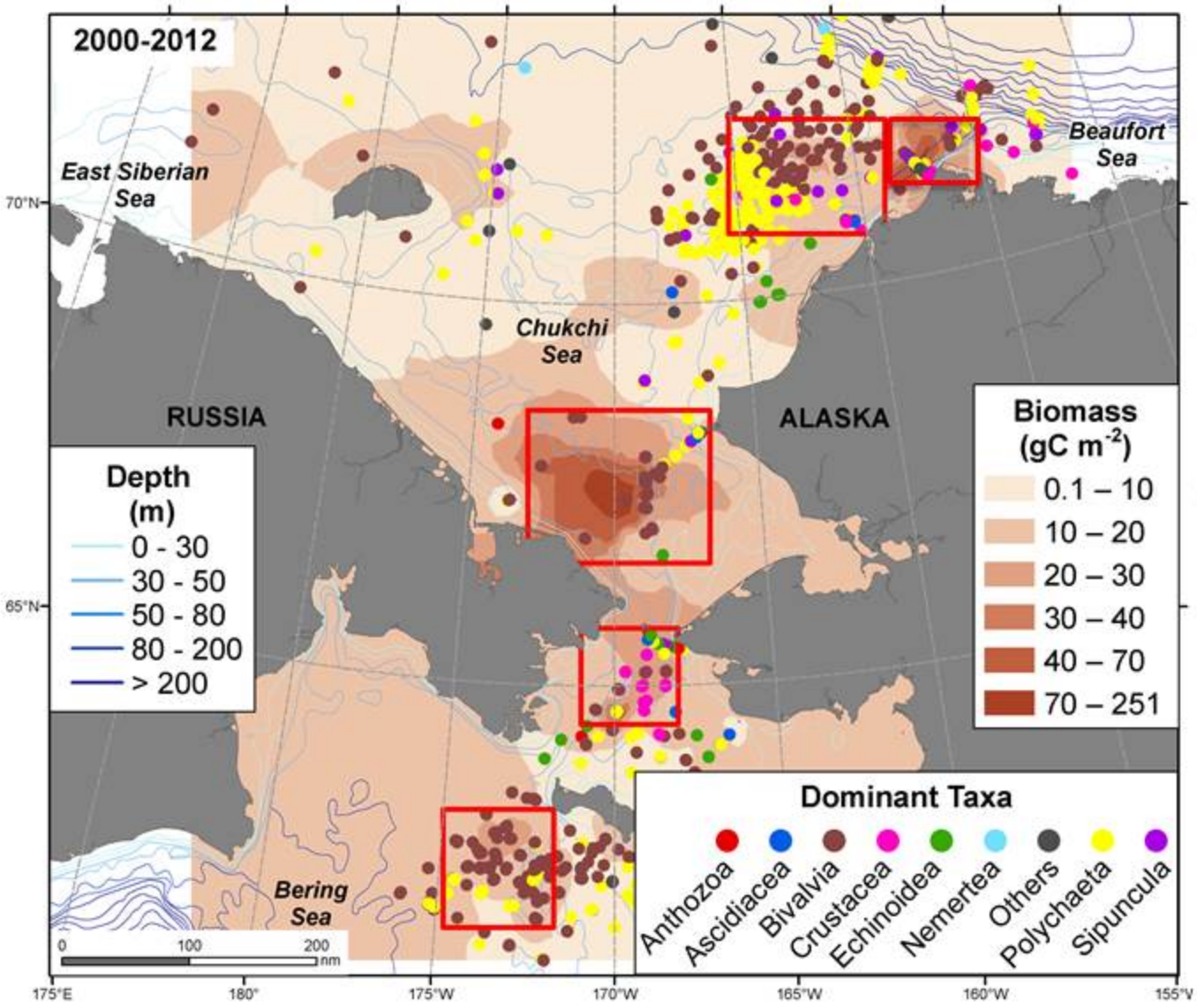






[courtesy S. Zimmerman, DFO]

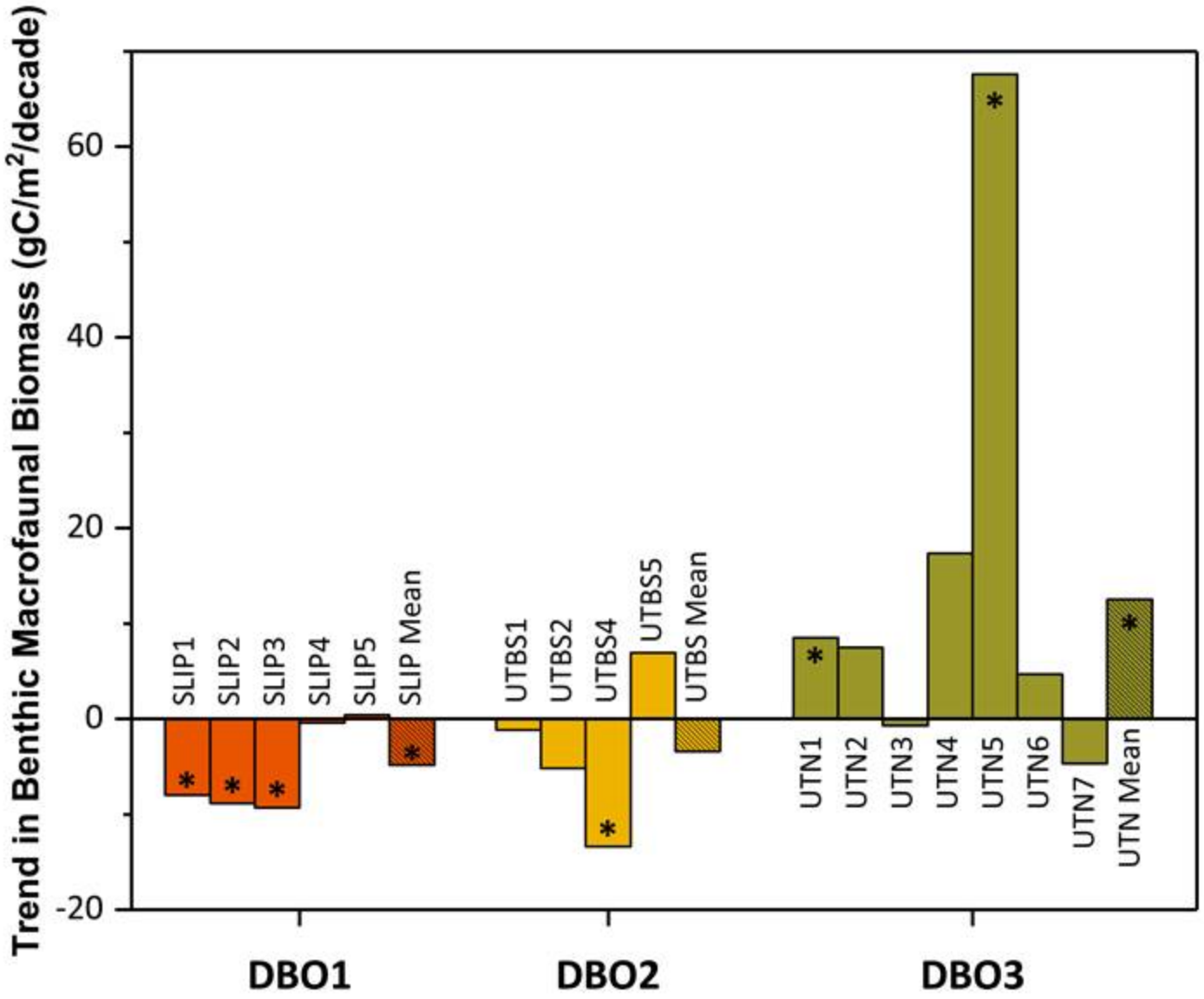
Rich benthic communities on the western side of the Bering/Chukchi Sea system 2000-2012



[modified from Grebmeier et al. 2015, Prog. Oceangr.]

- **"foot prints"** of high benthic biomass reflect pelagic-benthic coupling and export of carbon to sediments
- macrofauna dominated by amphipods, bivalves, polychaetes, and sipunculids

Trends in benthic macrofaunal biomass at time series sites in DBO1, DBO2, and DBO3



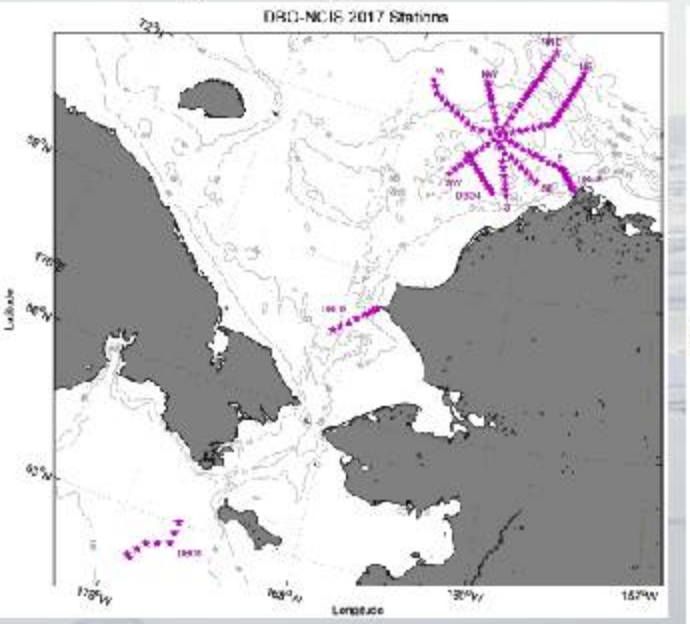
*** indicates significant trend, p <0.05**

[Grebmeier et al. 2018]

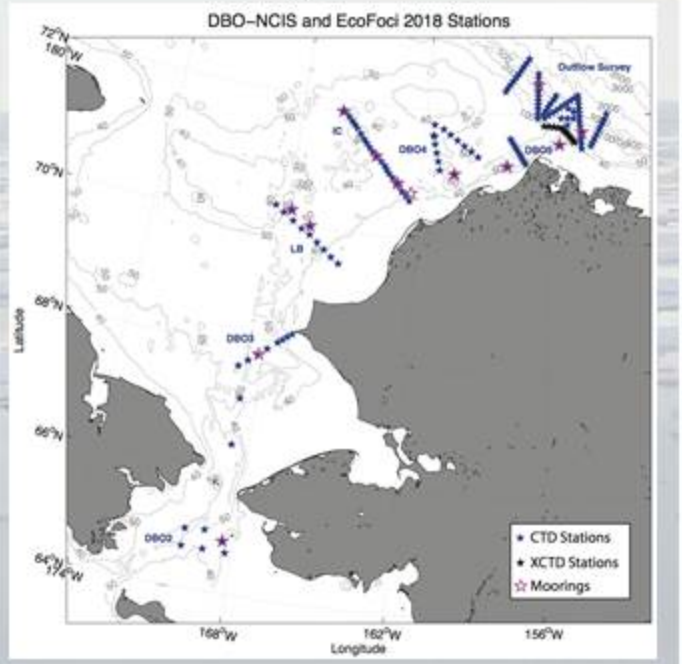
DBO-Northern Chukchi Integrated Study: field activities, USCGC Healy

Transects: T/S, currents, nutrients, chlorophyll, O_2, zooplankton, ichthyoplankton, benthic macrofaunal and carbon cycling

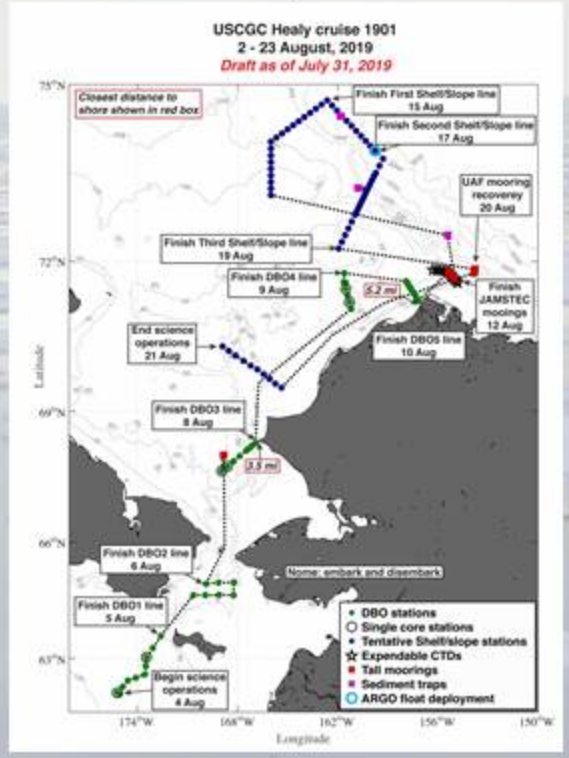
26 August – 15 September 2017



7 – 24 August 2018



2 – 23 August 2019



Northern Chukchi Integrated Study

With PolarTREC Teacher Piper Bartlett-Browne

& Team Researchers Dr. Lee Cooper and Dr. Jackie Grebmeier

https://www.polartrec.com/

Community talks in Nome:

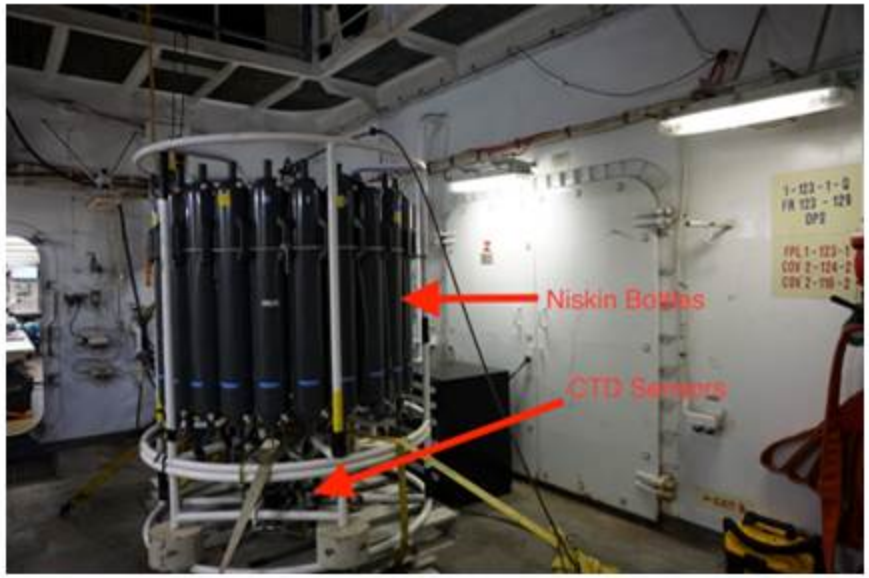
Jackie Grebmeier Aug 1, 2019

and Bob Pickart Aug 23, 2019

CTD

[Piper Bartlett-Browne]

- Conductivity, Temperature, and Depth sensors.
- Taken at every throughout the expedition to compliment the data collected by the research teams.
- 24 Niskin bottles around the floret collect water at different depths.
- Teams are looking at primary productivity, acidification, algal blooms, and much more.



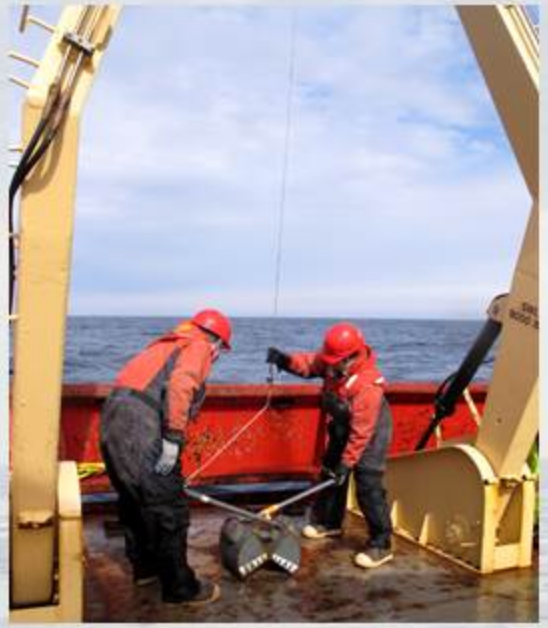
Healy (left) and Sir Wilfrid Laurier (right)

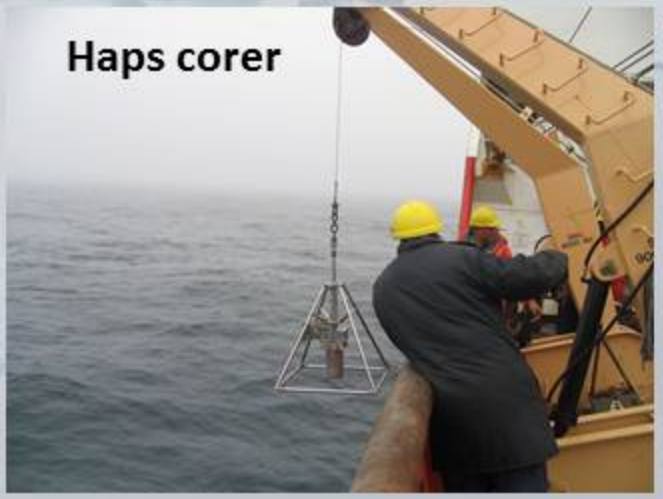
Plankton Team (HLY1901)

- Janet Duffy-Anderson, Jan Benson, and Chrissy Hayes are looking at fish larvae (Arctic Cod specifically) to study distribution and abundance.
- Their data help to determine if Arctic species are being out-competed by sub-arctic species moving north
- Arctic Cod thrive in cold waters. Climate change is warming bottom temperatures and their population is at risk of declining.

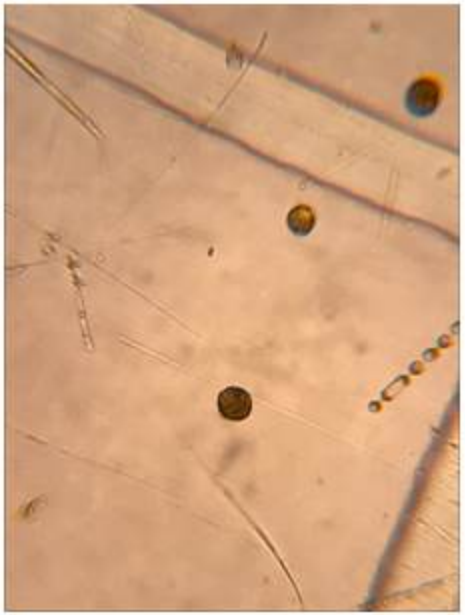
[Piper Bartlett-Browne]

Benthic grab sampling (Sir Wilfrid Laurier)





Harmful Algal Bloom (HABs)



- Evie Fachon and her team from the Don Anderson's Lab at Woods Hole Oceanographic Laboratory are studying harmful algal blooms on HLY1901.
- HABs are photosynthetic so with declining sea ice, they have access to more sunlight and warmer seas. This results in frequent and long-lasting blooms.
- *Alexandrium* sp. are dinoflagellates that cause paralytic shellfish poisoning.
- They have overwintering cysts that live in the mud and can re-animate when conditions improve.

[Piper Bartlett-Browne]

Ocean acidification and ecosystem response

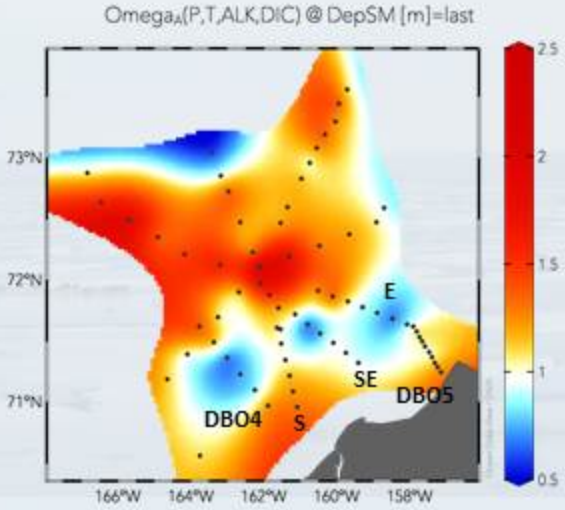
- Ocean acidification could impact ecosystem services in the Arctic region

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

[2017, DSR 133:112-124]

[CBL PhD Student: Christina Goethel]



Corrosive waters (blue) prevalent on SE side of Hanna Shoal

- Focused carbon deposition & sediment respiration
- High benthic bivalve biomass

[Jessica Cross, PMEL]

Saildrones

- Drones use wind power to move and solar energy to power sensors.
- They can be remote controlled and spend May through October collecting data in the Arctic.
- The Healy met up with one to calibrate the sensors.
- There are at least 16 sensors on the saildrones that include atmospheric, ocean surface, and ocean sub-surface sensors.

[Jessica Cross, NOAA]

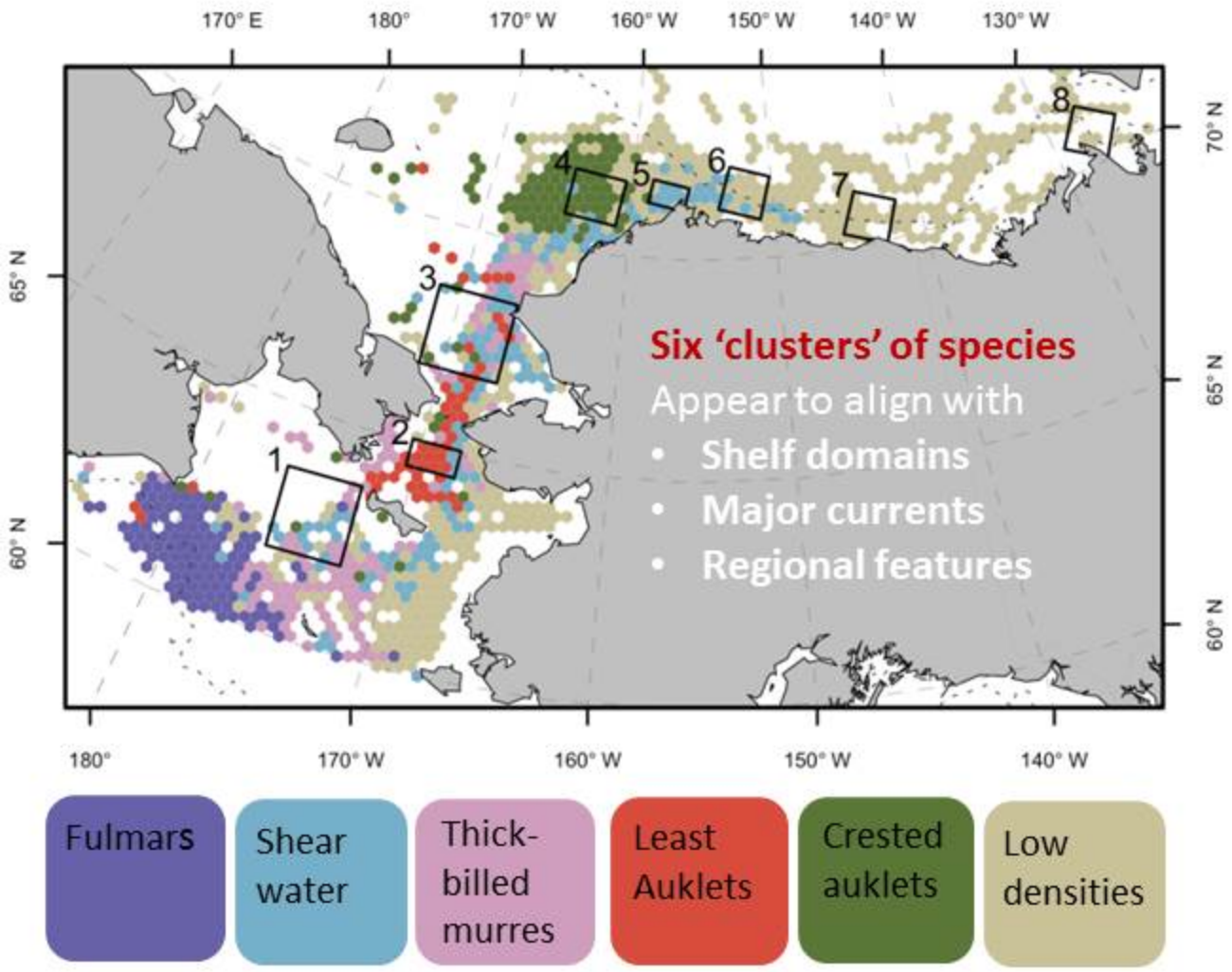
Marine Mammals

Identified and counted from the ship's bridge (SWL19 and HLY1901)

Seabird Communities in Pacific Arctic

Cluster Analysis, using at-sea survey data, 2007-2015

(Kuletz et al. 2019; DSRII)



At-sea surveys (USFWS)

- Identified six major communities
- Five had a dominant species
- One characterized by very low seabird densities (no dominant)
- Most captured well by DBOs (exception – Fulmar community)
- Need all DBOs to capture full seabird community for LMEs
- Beaufort effort too low to fully track low seabird densities offshore

*5th DBO Data Meeting, Jan 22-23, 2020 at NOAA PMEL

DBO Data Discovery Portal

https://arcticdata.io/

DBO International Data Policy, approved by partners within PAG in 2015

Distributed Biological Observatory

! Group

Group Id: DBO

4 years, 2 months Contributor since April 17, 2014

1,096 contributions

4,505 downloads

1 members

Matthew B. Jones
http://orcid.org/0000-0003-0...

DATASETS 11 TO 15 OF 122

Prev 1 2 3 4 5 ... 25 Next Sort by Most recent

Jacqueline Grebmeier. 2017. **Collaborative Research: The Distributed Biological Observatory (DBO): A Change Detection Array in the Pacific Arctic Region.** Arctic Data Center. urn:uuid:e09c44d9-96b3-4dac-a340-f757e69f3118.

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25 % & ,

Jacqueline Grebmeier. 2017. **The Distributed Biological Observatory (DBO) Conductivity-Temperature-Depth (CTD) data from 2010.** Arctic Data Center. doi:10.18739/A2Q24W.

$ (https://arcticdata.io/metacat/d1/mn/v2/object/resource_map_doi:10.18739/A2Q24W) 18 % &

Carin Ashjian. 2017. **Distributed Biological Observatory (DBO), Conductivity-Temperature-Depth (CTD) data along DBO5, from 2010 BOWFEST on R/V Annika Marie.** Arctic Data Center. doi:10.18739/A2TV6H.

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Robert Pickart. 2017. **Distributed Biological Observatory (DBO), Conductivity-Temperature-Depth (CTD) data along DBO5, from 2010 ICESCAPE on the USCGC Healy (HLY1001).** Arctic Data Cente doi:10.18739/A2ZJ9S.

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Kevin Arrigo. 2017. **Distributed Biological Observatory (DBO), Conductivity-Temperature-Depth (CTD) data along DBO3, from 2010 ICESCAPE on the USCGC Healy (HLY1001).** Arctic Data Cente doi:10.18739/A23C2N.

$ (https://arcticdata.io/metacat/d1/mn/v2/object/resource_map_doi:10.18739/A23C2N) 17 % &

Prev 1 2 3 4 5 ... 25 Next

- DBO data contributions since April 17, 2014
- 1,096 contributions DBO data
- 4,505 downloads of DBO data

*New DBO Project page from US Arctic Data Center in progress-will go live in fall 2019

https://arcticdata.io/catalog/#profile/CN=DBO,DC=dataone,DC=org

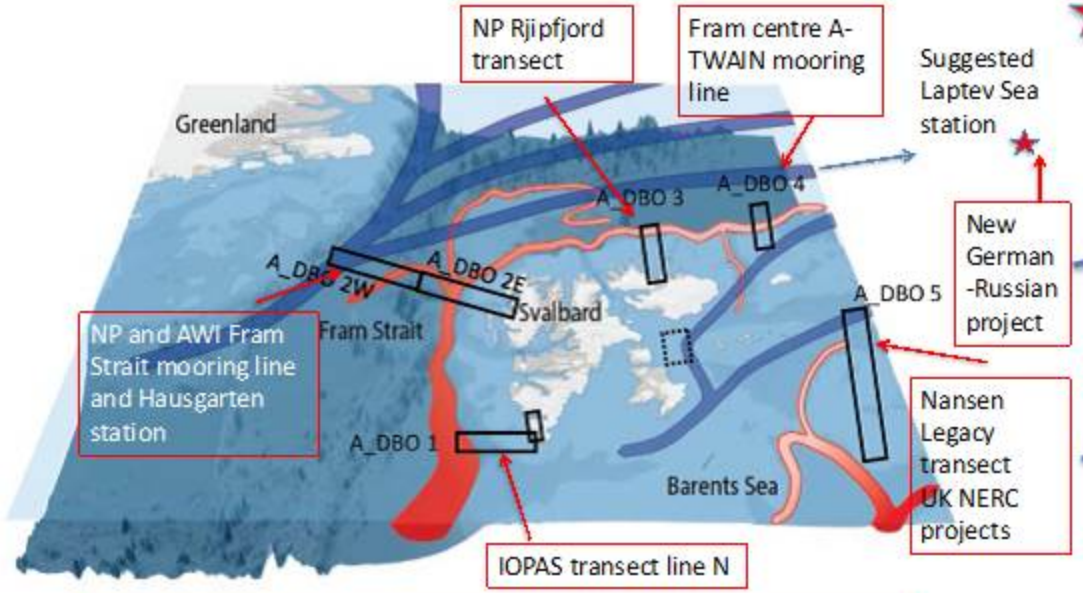
Working Towards an International Pan-Arctic DBO

Ex. Atlantic DBO Workshop, November 2016

The Research Council of Norway

- Norway, Germany, Poland,UK, France, USA
- Physical oceanography, plankton, benthos, vertical flux, molecular studies
- moorings, time series, coordinating initiatives, planned initiatives
- Updates planned for 5th DBO data workshop, Jan 22-23, 2020

Suggest five A-DBO transect lines



In addition to moorings in Kongsfjord and Rijpfjord operated by SAMS/UiT

★ Pending Baffin Bay-Davis Strait DBO area (C. Lee)

★ Potential Laptev Sea DBO line: Germany and Russia (H Kassens]

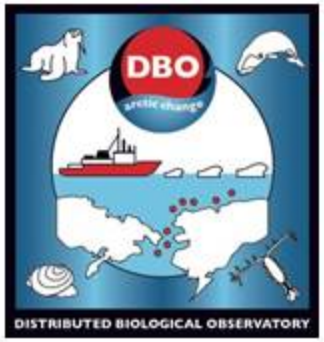
★ Revised location potentially part of NL core transect line

Further information contact: marit.reigstad@uit.no

Thank you for your attention.

Questions and comments?

Thank you to all DBO collaborators, field and laboratory technicians over the years for the time series efforts. We thank the Captain and crew of the USCGC Healy and CCGS Sir Wilfrid Laurier for support for the DBO program. Financial support for the science provided by the US NOAA, NSF, BOEM, NASA, and ongoing international science partners in the Pacific Arctic Group.



http://www.arctic.noaa.gov/dbo/

http://arctic.cbl.umces.edu

BOEM
Bureau of Ocean Energy Management

NASA

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

NSF

PAG