

# Distributed Biological Observatory (DBO)

*Linking Physics & Biology in the Arctic*

## 5<sup>th</sup> DBO Data Workshop

Jacqueline M. Grebmeier

Chesapeake Biological Laboratory

University of Maryland Center for Environmental Science, Solomons, MD, USA

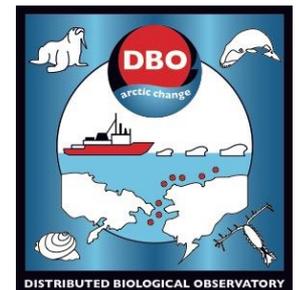
5<sup>th</sup> DBO Data Workshop

January 23, 2020

Seattle, Washington, USA



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



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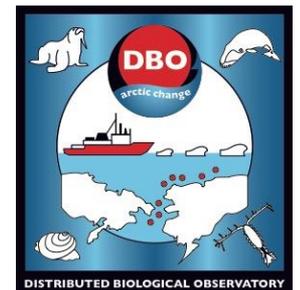
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## DBO in the US Interagency Arctic Research Policy Committee (IARPC) Marine Ecosystem Collaborative Team Activities

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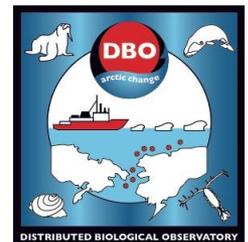
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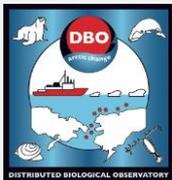
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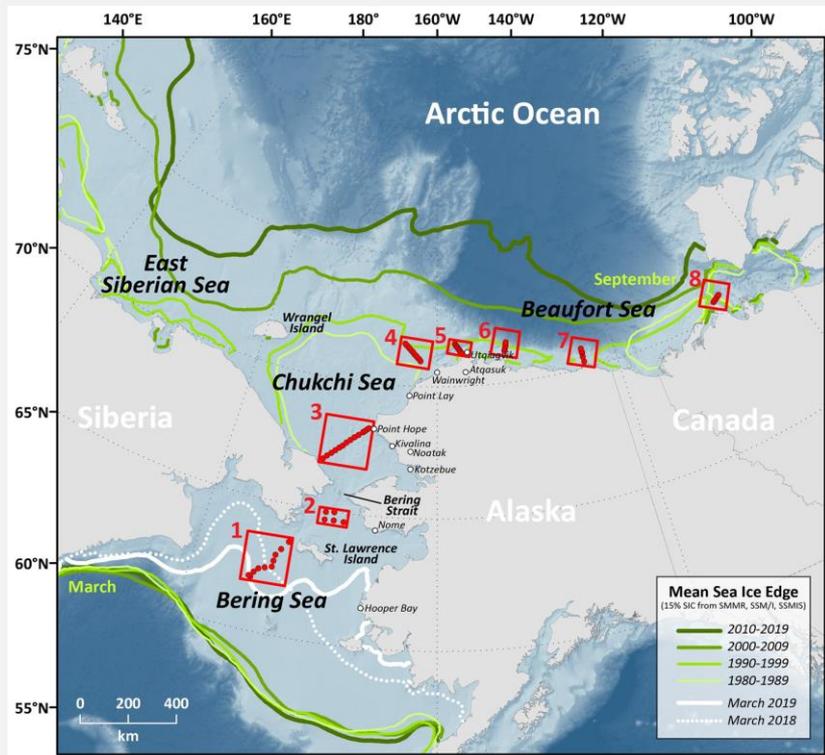
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## Timeline

- **2009** – Biology-Sea Ice Workshop, development of Pilot DBO plan
- **2010-2012** – DBO **Pilot Phase**, sampling coordinated by the Pacific Arctic Group (PAG)
- \* **2012** – **Interagency Arctic Research Policy Committee (IARPC) DBO Collaboration Team: *Sea Ice and Marine Ecosystems* theme (Chair: Sue Moore and Jackie Grebmeier**
- \* **2012** – NSF Arctic Observing Network (AON) program provides US \$ support to sample DBO regions 1-5
- **2012-2015** – **IARPC DBO CT Completes Milestones**, including expansion of sampling into the Beaufort Sea and development of guidelines for the periodic assessment of the physical and ecological state of the Pacific Arctic marine environment
- **2015-2024** – **Implementation Phase, 8 DBO regions (Moore and Grebmeier, *Arctic 2018*)**; evaluation DBO via IASC MWG; also current development of Atlantic DBO, DBO-like lines in Baffin Bay, Davis Strait, discussions with Russians DBO lines Kara Sea
- **2017-2021** – **DBO included in IARPC MECT** (co:chairs: Auad, Dickson, Grebmeier)
- **2017-onwards**– **NSF AON and NOAA ARP core field \$ support, with BOEM, NASA, NPRB, DOI USFWS and USGS** DBO studies within ongoing programs; international programs
- **2020** – next 5 yr IARPC 5 year plan (2022-2027) in development: continue DBO in



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



[updated from 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



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- Seabird standard surveys (no additional ship time)
- Marine mammal watches & surveys (no additional ship time)



## Second tier ship-based sampling:

- Fishery acoustics (less effort than standardized bottom trawling)
- Bottom trawling (every 3-5 years)

## Shipboard measurements

- Record underway measurements from the seawater loop, meteorological sensors, sounder, and navigation information

# Distributed Biological Observatory Additional Sampling

## Examples of additional sampling on various DBO cruises in 2019 (national and international):

- Optical studies for satellite calibration
- Colored dissolved organic matter (CDOM) and dissolved organic carbon (DOC), alkalinity
- Sea ice tracers (e.g., Oxygen-18)
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- Benthic camera for videos of benthos
- Genetics for microbial, meiofaunal, macrofaunal, and epifaunal studies
- Moorings and saildrones, gliders
- Contaminants and potential HABs impacting various trophic levels



**Notably, DBO sampling embedded in larger process-study cruises**

**Performance element 4.3.1 Continue Distributed Biological Observatory (DBO) sampling in regions 1-5 and make data publicly available through upload of metadata to the Earth Observing Laboratory/DBO data portal, now to Arctic Data Center.**

- Agency: [NASA](#), [NOAA](#), [NSF](#), [DOI-BOEM](#), [DOI-FWS](#)
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**Examples:**

1. NASA provide up-to-date data and visualization of weekly sea ice cover, winds, chlorophyll a distribution, surface temperature and cloud cover in the study regions and the entire Arctic. Sea surface salinity, which is very relevant to the project, is now included as one of the parameters.
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**Performance element 4.3.2-Continue DBO coordination activities including annual workshops, via participation in the Pacific Arctic Group (PAG), and produce the first Pacific Arctic Regional Marine Assessment (PARMA) in 2018.**

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**Examples:**

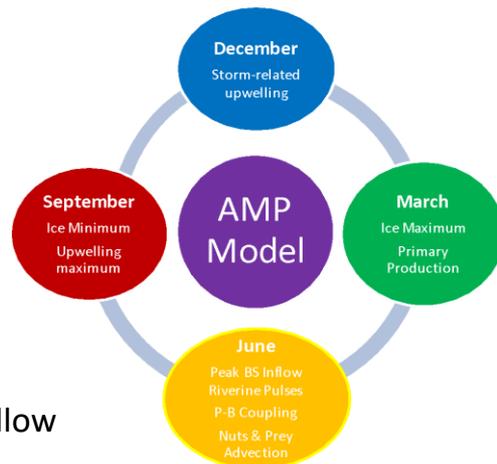
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5. IASC MWG evaluation of DBO in progress-complete 2020
6. Participation in annual fall and spring PAG meetings for coordination of DBO studies.

**Performance element 4.3.3-Build connections between DBO and existing community-based observation programs and encourage data sharing. For example, the DBO Implementation Plan discusses fostering connections to existing community-based observation programs in an effort to link offshore observations of biological change to local observations and Indigenous Knowledge.**

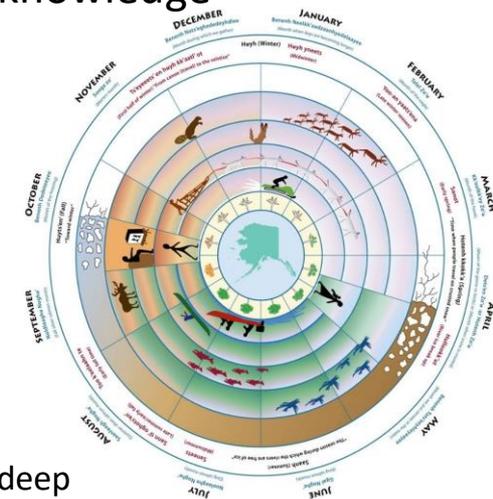
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1. Continue develop connections of conventional science mode with local community groups evaluating seasonal events by conventional science and indigenous knowledge



\*Spatially broad/time shallow



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# Working Towards an International Pan-Arctic DBO

Ex. Atlantic DBO Workshop, November 2016



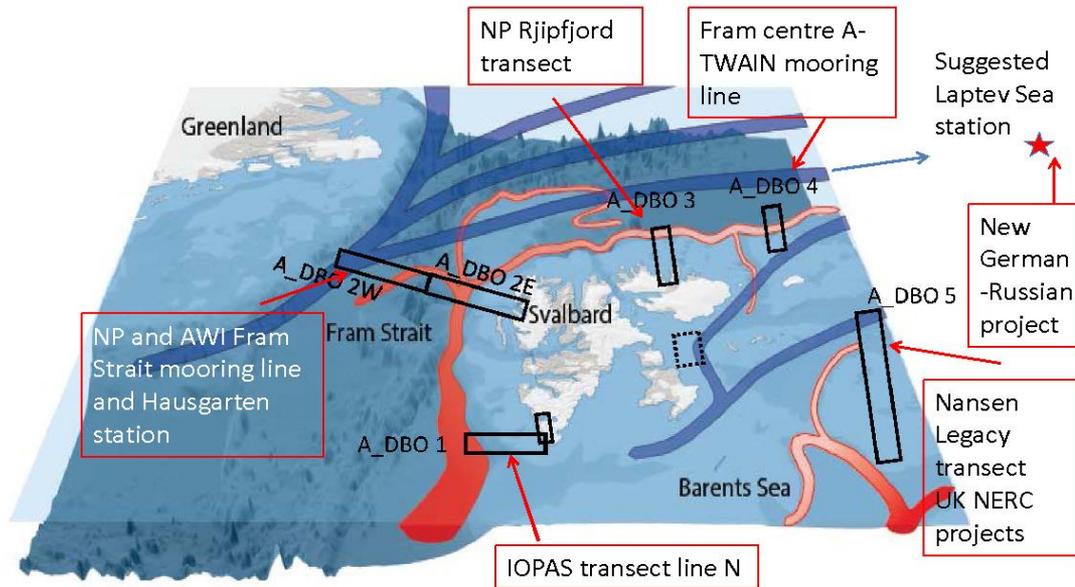
- Norway, Germany, Poland, UK, France, USA
- Physical oceanography, plankton, benthos, vertical flux, molecular studies
- moorings, time series, coordinating initiatives, planned initiatives



2017

Further information contact: [marit.reigstad@uit.no](mailto:marit.reigstad@uit.no)

## Suggest five A-DBO transect lines



## Summary for Pan-Arctic network:

- Pacific DBO-ongoing
- Atlantic DBO-developing
- Baffin Bay DBO-developing
- Davis Strait DBO-developing

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

# Thank you for your attention.

## Questions and comments?

Thank you to all Pacific Arctic Region science colleagues and DBO collaborators, field and laboratory technicians over the years for the time series efforts. Financial support for the science provided by the US NOAA, NSF, BOEM, NASA, and ongoing national and international science partners in the Pacific Arctic Group.

<http://arctic.cbl.umces.edu>

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

<http://pag.arcticportal.org>

<http://neptune.gsfc.nasa.gov/csb/index.php?section=270>

[https://www.eol.ucar.edu/field\\_projects/dbo](https://www.eol.ucar.edu/field_projects/dbo)

<http://arcticdata.io> (Arctic Data Center, then use DBO as search term)



**January 23, 2020 – Thursday (0800-van transport from Silver Cloud Hotel to PMEL)**

0900 **Overview of Day 1 and plan for Day 2 (Jackie Grebmeier)**

0915 **5. Modeling efforts within the DBO (Lee Cooper)**

- ∇ Modeling the biological response to changing sea ice and ocean conditions in the Beaufort and Chukchi Seas (Mike Steele)
- ∇ Modeling the changing physical and biological drivers for the northern Bering and Chukchi continental shelf (Zhixuan Zhang by Jackie Grebmeier)

0945 **6. Data access and management: National and International Data Access (Jackie Grebmeier)**

- ∇ DBO data parameters file (Jackie Grebmeier)
- ∇ Introduction to the NSF Arctic Data Center (Jeanette Clark)
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- ∇ Japanese Data Centers, DARWIN and ADS (Shigeto Nishino)

1030 **7. Charge to Break-out groups (Jackie Grebmeier), then Coffee break** **Group Photo**

1100 **Breakout groups to discuss DBO sampling and data protocols, coordination activities (physical oceanography, hydrography, lower and upper trophics, modeling, future activities) (Jackie Grebmeier)**

1230 Lunch (NOAA Cafeteria, no host)

# Overview Day 1

## ➤ Highlights of DBO 2010-2019 data time series

- Remote Sensing, Hydrography and Moorings
  - trends sea ice loss, later fall formation and earlier spring retreat
  - lower DBO1 chl vs higher chl northern DBO regions
  - Increase fall blooms, increase zooplankton biomass fall
  - Change advective flow patterns, winter patterns, upwelling events
  - Increase seawater temperatures and salinity
- Export Fluxes: change timing and quantity of carbon, timing zooplankton production, important resuspension events
- Lower and Upper Trophic Levels: processes and populations
  - phenology and type of algal types
  - HABs increasing with warming seawater, less ice
  - variable water column production and sediment carbon cycling
  - fish type dependent on water temperature, prey, commercial fish moving northward
  - seabird, gray whale, ice seals die offs: issue of “food, heat, predation”
  - subarctic marine mammals further north

# Overview Day 1

- Connection to societal issues and coastal observing: shipping impacts relation changing marine ecosystem; other human impacts, dramatic environmental changes impacting coastal communities Bering Strait region, further north
- Status of efforts for pan-Arctic DBO
  - Atlantic sector
    - fish track water masses, borealization of fish, more piscivorous, less benthic feeders
    - more open water, move towards generalists, change connectivity
    - time series sites: physical, water column and benthic
    - Atlantic DBO incorporation of long time series transects/locations in development
  - Canadian Beaufort Sea
    - multiple interdisciplinary transects, including DBO8: high biodiversity
    - Bottom trawls dominated by adult Arctic cod
    - Moorings. Links to other national projects
  - Baffin Bay: new Canadian nutrient/carbon processing monitoring program, inclusion DBO-like transect lines

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**Change to only 2 groups (modeling in both):**

- Physical oceanography & hydrography, including moorings
- Lower and upper trophic levels

**Charge:** discuss DBO findings and activities, developing science questions, coordination/collaboration, modeling, data issues



# Day 2 Agenda (cont).

## 1345 Brief out from breakout groups and open discussion

- ∨ physical oceanography
  - ∨ hydrography
  - ∨ lower trophics
  - ∨ upper trophics
  - ∨ modeling
- 2 groups:**
- Physical oceanography & hydrography, including moorings and modeling
  - Lower and upper trophic levels, including modeling

## 1430 8. Sustained DBO sampling (Jackie Grebmeier)

- ∨ DBO Data Users/Providers community can interface with the Arctic Observing Summit 2020 and SAON (Hajo Eicken)
- ∨ DBO as one of Pacific Arctic Group's core activities (Jackie Grebmeier)
- ∨ DBO within the US-IARPC Marine Ecosystem Collaborative Team and planning for next US 5 yr. IARPC plan (Jackie Grebmeier)

1500 Coffee break

## 1530 9. 2<sup>nd</sup> DBO DSR special issue discussions (Jackie Grebmeier)

## 1600: 10. Upcoming DBO discussions (Jackie Grebmeier)

- ∨ AGU/ASLO Ocean Sciences Meeting, San Diego, CA, USA-February 2020 (Jackie Grebmeier)
- ∨ ISAR-6, SAS session and side meeting, Tokyo, Japan-March 2020 (Shigeto Nishino)
- ∨ ASSW2020, Akureyri, Iceland, March 2020 (Jackie Grebmeier)
  - DBO/Synoptic Arctic Survey (SAS (Jackie Grebmeier))

1615 Action Items & Timeline: future plans, open discussion (Jackie Grebmeier)

1700 End of workshop and van transport to hotel

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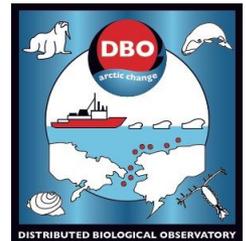
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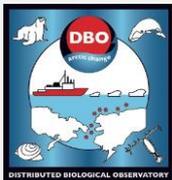
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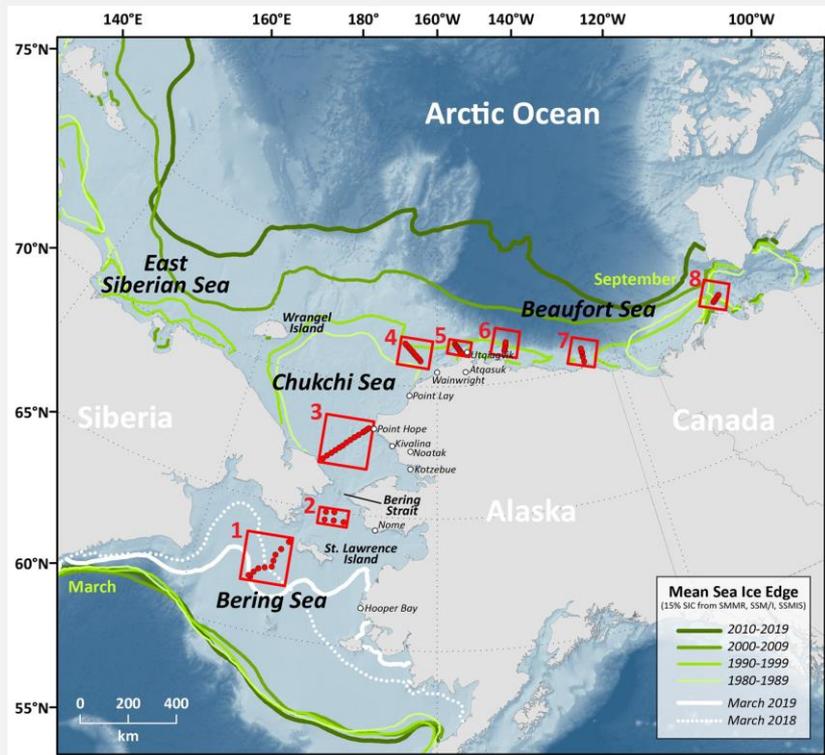
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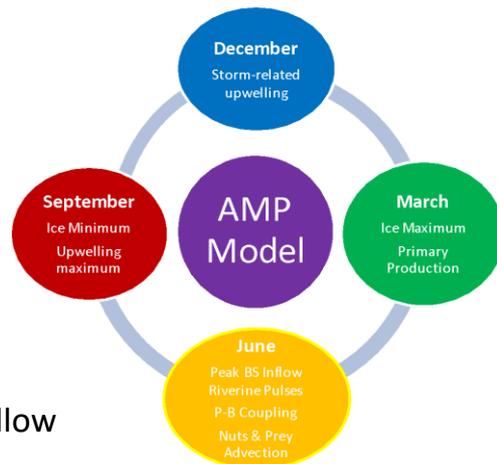


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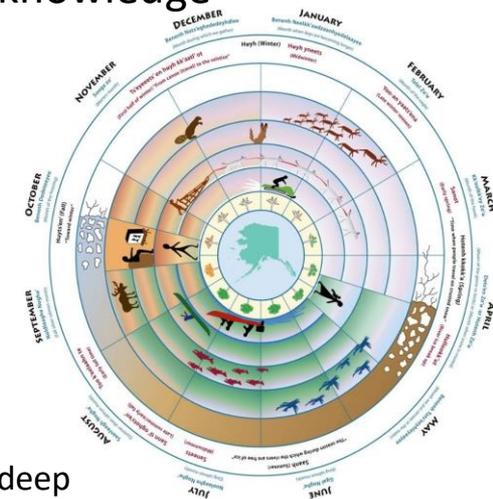
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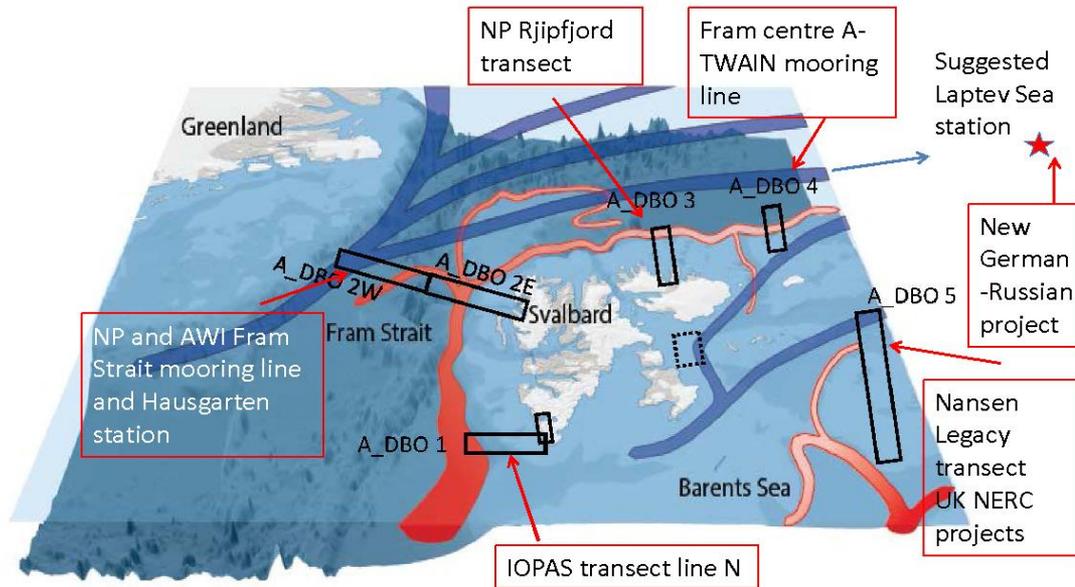
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- ∨ Japanese Data Centers, DARWIN and ADS (Shigeto Nishino)

1030 **7. Charge to Break-out groups (Jackie Grebmeier), then Coffee break** **Group Photo**

1100 **Breakout groups to discuss DBO sampling and data protocols, coordination activities (physical oceanography, hydrography, lower and upper trophics, modeling, future activities) (Jackie Grebmeier)**

1230 Lunch (NOAA Cafeteria, no host)

# Overview Day 1

## ➤ Highlights of DBO 2010-2019 data time series

- Remote Sensing, Hydrography and Moorings
  - trends sea ice loss, later fall formation and earlier spring retreat
  - lower DBO1 chl vs higher chl northern DBO regions
  - Increase fall blooms, increase zooplankton biomass fall
  - Change advective flow patterns, winter patterns, upwelling events
  - Increase seawater temperatures and salinity
- Export Fluxes: change timing and quantity of carbon, timing zooplankton production, important resuspension events
- Lower and Upper Trophic Levels: processes and populations
  - phenology and type of algal types
  - HABs increasing with warming seawater, less ice
  - variable water column production and sediment carbon cycling
  - fish type dependent on water temperature, prey, commercial fish moving northward
  - seabird, gray whale, ice seals die offs: issue of “food, heat, predation”
  - subarctic marine mammals further north

# Overview Day 1

- Connection to societal issues and coastal observing: shipping impacts relation changing marine ecosystem; other human impacts, dramatic environmental changes impacting coastal communities Bering Strait region, further north
- Status of efforts for pan-Arctic DBO
  - Atlantic sector
    - fish track water masses, borealization of fish, more piscivorous, less benthic feeders
    - more open water, move towards generalists, change connectivity
    - time series sites: physical, water column and benthic
    - Atlantic DBO incorporation of long time series transects/locations in development
  - Canadian Beaufort Sea
    - multiple interdisciplinary transects, including DBO8: high biodiversity
    - Bottom trawls dominated by adult Arctic cod
    - Moorings. Links to other national projects
  - Baffin Bay: new Canadian nutrient/carbon processing monitoring program, inclusion DBO-like transect lines

**January 23, 2020 – Thursday (0800-van transport from Silver Cloud Hotel to PMEL)**

0900 **Overview of Day 1 and plan for Day 2 (Jackie Grebmeier)**

0915 **5. Modeling efforts within the DBO (Lee Cooper)**

- ∇ Modeling the biological response to changing sea ice and ocean conditions in the Beaufort and Chukchi Seas (Mike Steele)
- ∇ Modeling the changing physical and biological drivers for the northern Bering and Chukchi continental shelf (Zhixuan Zhang by Jackie Grebmeier)

0945 **6. Data access and management: National and International Data Access (Jackie Grebmeier)**

- ∇ DBO data parameters file (Jackie Grebmeier)
- ∇ Introduction to the NSF Arctic Data Center (Jeanette Clark)
- ∇ NOAA Data Submissions (Eugene Burger)
- ∇ Japanese Data Centers, DARWIN and ADS (Shigeto Nishino)

1030 **7. Charge to Break-out groups (Jackie Grebmeier), then Coffee break **Group Photo****

1100 **Breakout groups to discuss DBO sampling and data protocols, coordination activities (physical oceanography, hydrography, lower and upper trophics, modeling, future activities) (Jackie Grebmeier)**

1230 Lunch (NOAA Cafeteria, no host)

**Change to only 2 groups (modeling in both):**

- Physical oceanography & hydrography, including moorings
- Lower and upper trophic levels

**Charge:** discuss DBO findings and activities, developing science questions, coordination/collaboration, modeling, data issues

# Day 2 Agenda (cont).

## 1345 Brief out from breakout groups and open discussion

- ∨ physical oceanography
  - ∨ hydrography
  - ∨ lower trophics
  - ∨ upper trophics
  - ∨ modeling
- 2 groups:**
- Physical oceanography & hydrography, including moorings and modeling
  - Lower and upper trophic levels, including modeling

## 1430 8. Sustained DBO sampling (Jackie Grebmeier)

- ∨ DBO Data Users/Providers community can interface with the Arctic Observing Summit 2020 and SAON (Hajo Eicken)
- ∨ DBO as one of Pacific Arctic Group's core activities (Jackie Grebmeier)
- ∨ DBO within the US-IARPC Marine Ecosystem Collaborative Team and planning for next US 5 yr. IARPC plan (Jackie Grebmeier)

1500 Coffee break

## 1530 9. 2<sup>nd</sup> DBO DSR special issue discussions (Jackie Grebmeier)

## 1600: 10. Upcoming DBO discussions (Jackie Grebmeier)

- ∨ AGU/ASLO Ocean Sciences Meeting, San Diego, CA, USA-February 2020 (Jackie Grebmeier)
- ∨ ISAR-6, SAS session and side meeting, Tokyo, Japan-March 2020 (Shigeto Nishino)
- ∨ ASSW2020, Akureyri, Iceland, March 2020 (Jackie Grebmeier)
  - DBO/Synoptic Arctic Survey (SAS (Jackie Grebmeier))

1615 Action Items & Timeline: future plans, open discussion (Jackie Grebmeier)

1700 End of workshop and van transport to hotel