

Distributed Biological Observatory (DBO)

Linking Physics & Biology in the Arctic

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

Jacqueline M. Grebmeier

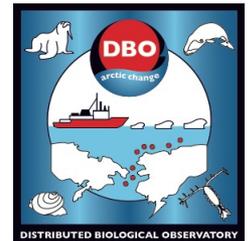
Chesapeake Biological Laboratory

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

5th DBO Data Workshop
January 23, 2020
Seattle, Washington, USA



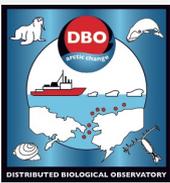
<https://www.iarpccollaborations.org/>



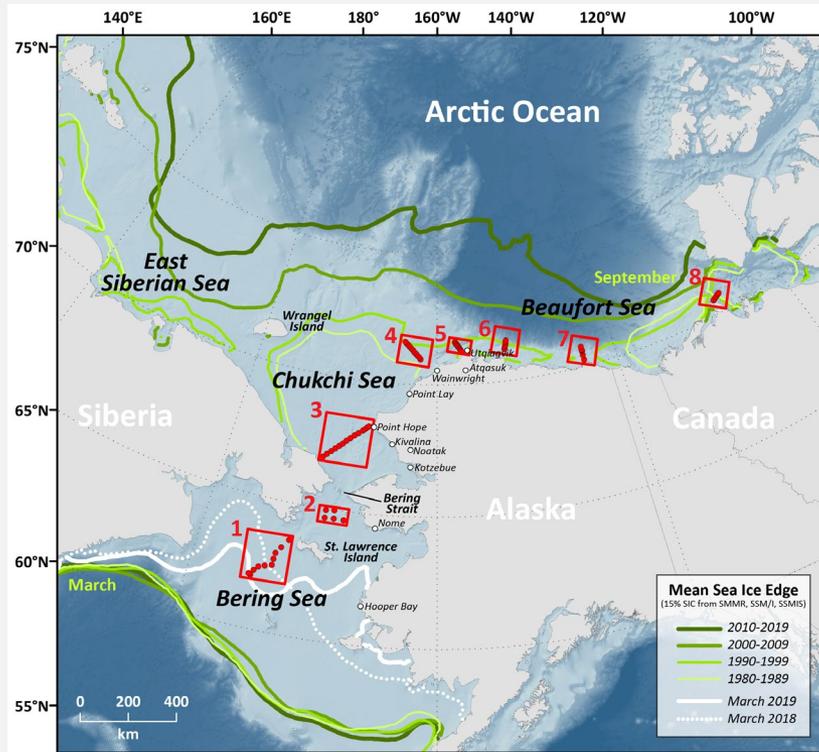
Distributed Biological Observatory (DBO)

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 MECT activities and milestones



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**

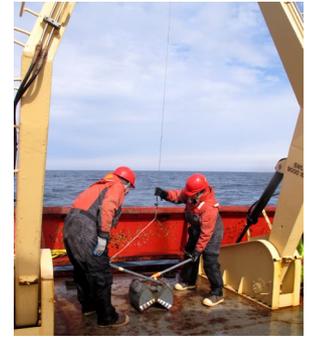
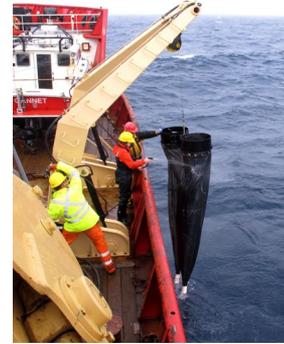
- DBO sites (red boxes) are regional “hotspot” transect lines and stations, based on high productivity, biodiversity, and/or overall rates of change
- DBO serves as a change detection array for consistent monitoring of biophysical responses
- Sites occupied by national and international entities with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



Distributed Biological Observatory Standardized Sampling

Core ship-based sampling:

- CTD and ADCP
- Chlorophyll
- Nutrients
- Ice algae/Phytoplankton (size, biomass and composition)
- Zooplankton (size, biomass and composition)
- Benthos (size, biomass and composition)
- 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)
- Ocean acidification and carbon cycling
- Phytoplankton growth rates (primary production)
- Lower trophic production studies
- Epifaunal and fish biodiversity studies
- 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](#)
- Aligns with 2016 and 2018 Arctic Science Ministerial Deliverables

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.
2. NSF provides core research support for the annual July DBO cruise with Canadian colleagues on the CCGS Sir Wilfrid Laurier for DBO sampling in DBO regions 1-5 and NOAA Arctic Research Program for DBO-NCIS program. Co-supported with scientists in DFO/Canada who also occupy DBO4 and DBO lines in the Beaufort later in the season. NOAA and USFWS support upper trophic level surveys.
3. NOAA provides core research support for the Aug-Sept USCGC Healy 2017-2020 cruises for both DBO sampling and NCIS (Northern Chukchi Integrated Study) process efforts. Also NOAA support for collaboration with EcoFOCI program.
4. BOEM through the AMBON (Arctic Marine Biodiversity Observing Network) project occupied DBO3 and DBO4 in 2015 and 2017 on RV Norseman II. NOAA, NSF and USFWS and previous Shell Oil supports science in AMBON. New AMBON effort in coordination with DBO field program 2019-2022
5. NPRB Arctic Program projects included some DBO lines in 2017-2019 field programs.

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.

- Agency: [DOI-BOEM](#), [NOAA](#), [NSF](#)
- Aligns with 2016 and 2018 Arctic Science Ministerial Deliverables

Examples:

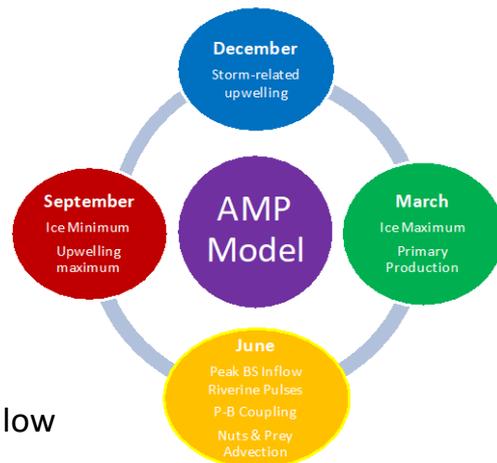
1. NOAA sponsored DBO data meetings, such as the 5th DBO data meeting in January 2020
2. US and international agency support for scientists to attend DBO data workshop.
3. International Arctic Science Committee (IASC) Marine Working Group (MWG) providing early career support for participants to the 5th DBO data meeting, similar to previous DBO data workshops; DBO endorsed by MWG, Pacific Arctic Group (PAG)
4. Paper outlining the development of the DBO project in journal Arctic (Moore and Grebmeier, 2018)
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.

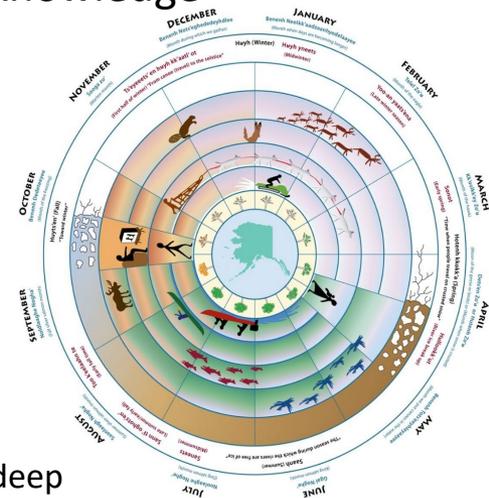
- Agency: [NASA](#), [NOAA](#), [NSF](#), [DOI-BOEM](#), [DOI-FWS](#)
- Aligns with 2016 and 2018 Arctic Science Ministerial Deliverables

Examples:

1. "The Arctic Marine Pulses Model: Linking Annual Oceanographic Processes to Contiguous Ecological Domains in the Pacific Arctic" by Sue Moore is relevant to this PE (<http://www.iarpcollaborations.org/members/events/8927>).
2. Continue develop connections of conventional science mode with local community groups evaluating seasonal events by conventional science and indigenous knowledge



*Spatially broad/time shallow



**Spatially focused/time deep



2017 ASSW

Working Towards an International Pan-Arctic DBO

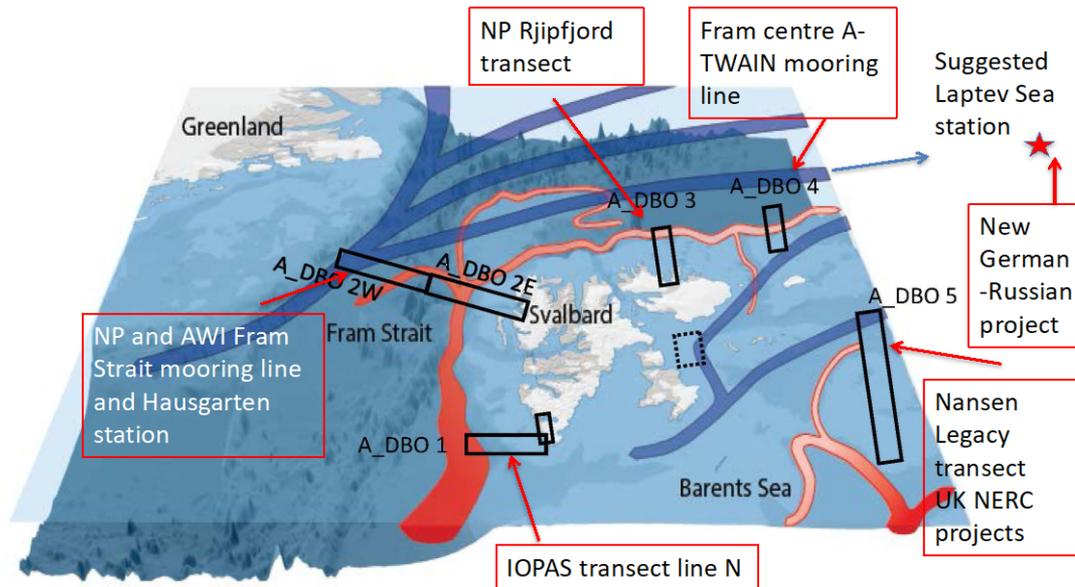
Ex. Atlantic DBO Workshop, November 2016



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

Further information contact: 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

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

