5th DBO Data Meeting
January 22-23, 2020
NOAA/PMEL
Seattle, WA, USA

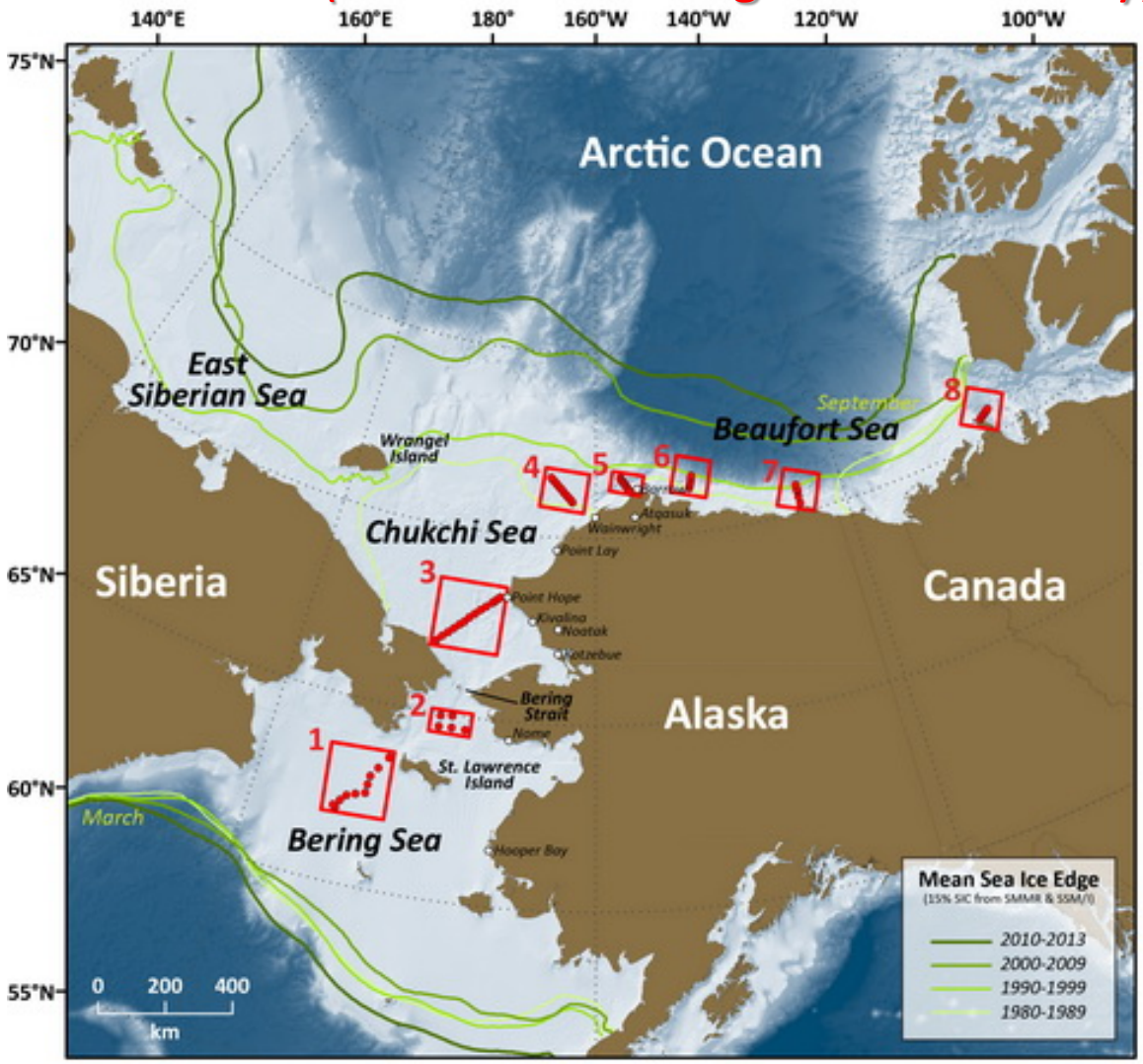
Japanese activities for DBO: hydrography and moorings

Shigeto Nishino
(JAMSTEC)

Biological hotspots in the Pacific Arctic Region

GRENE (2011-2016) & ArCS (2015-2020) – Japanese Arctic Projects

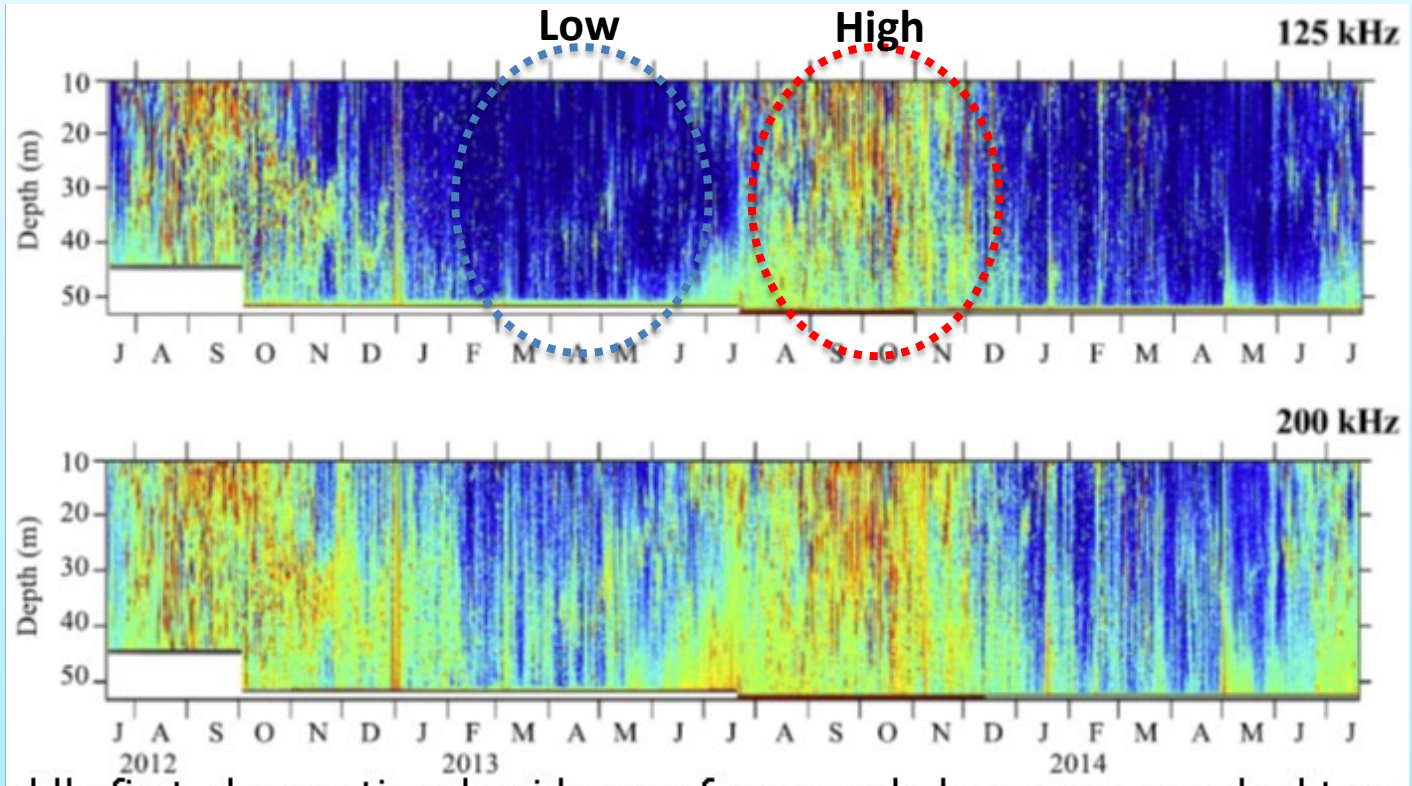
DBO (Distributed Biological Observatory)



[DBO webpage]

DBO-3 mooting results on fall bloom, ocean acidification and zooplankton dynamics

1. Nishino et al., *Biogeosciences,* 2016 (Press released)
2. Yamamoto-Kawai et al., *Biogeosciences,* 2016 (Press released)
3. Kitamura et al., *Cont. Shelf Res.*, 2017

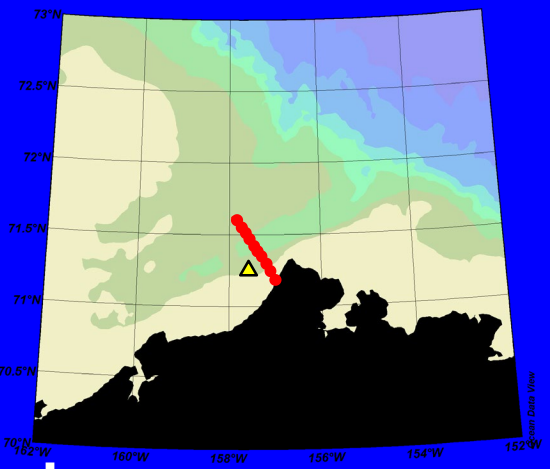


World's first observational evidence of seasonal change on zooplankton dynamics in the Hope Valley of the southern Chukchi Sea revealed by Acoustic Zooplankton Fish Profiler [Kitamura et al., 2016]

Seasonal … revealed by Acoustic Zooplankton Fish Profiler [Kitamura et al., 2016]
southern Chukchi Sea between Jul. 2012 and Aug. 2013 [Yamamoto-Kawai et al., 2016]

DBO-5 repeat section results on interannual variabilties of fluxes in Barrow Canyon for 2010-2019

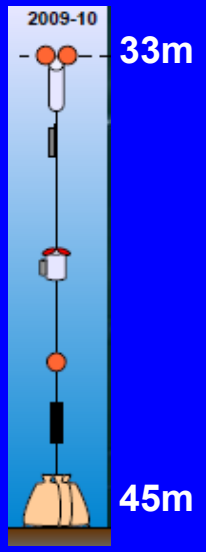
M. Itoh, T. Kikuchi, S. Nishino (JAMSTEC),
Y. Fukamachi (Hokkaido Univ.), R. Pickart, C. Ashijian (WHOI), S. Vagle (IOS)



Motivation

Itoh et al. (DSR, 2015) examined volume and heat fluxes in Barrow Canyon during summer 2010 using 6 occupations of DBO-5 repeat hydrographic section.
Heat flux was consistent with that estimated from mooring (T) and wind data nearby the section.

Heat flux = Heat Content (T at mooring) × Volume flux (wind)

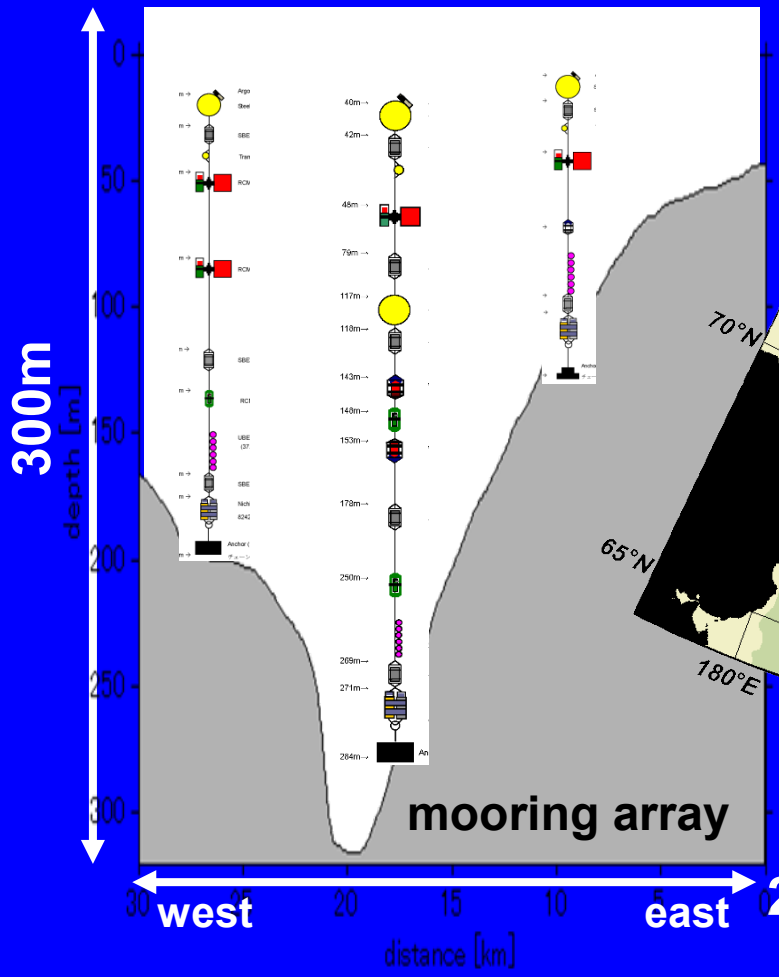


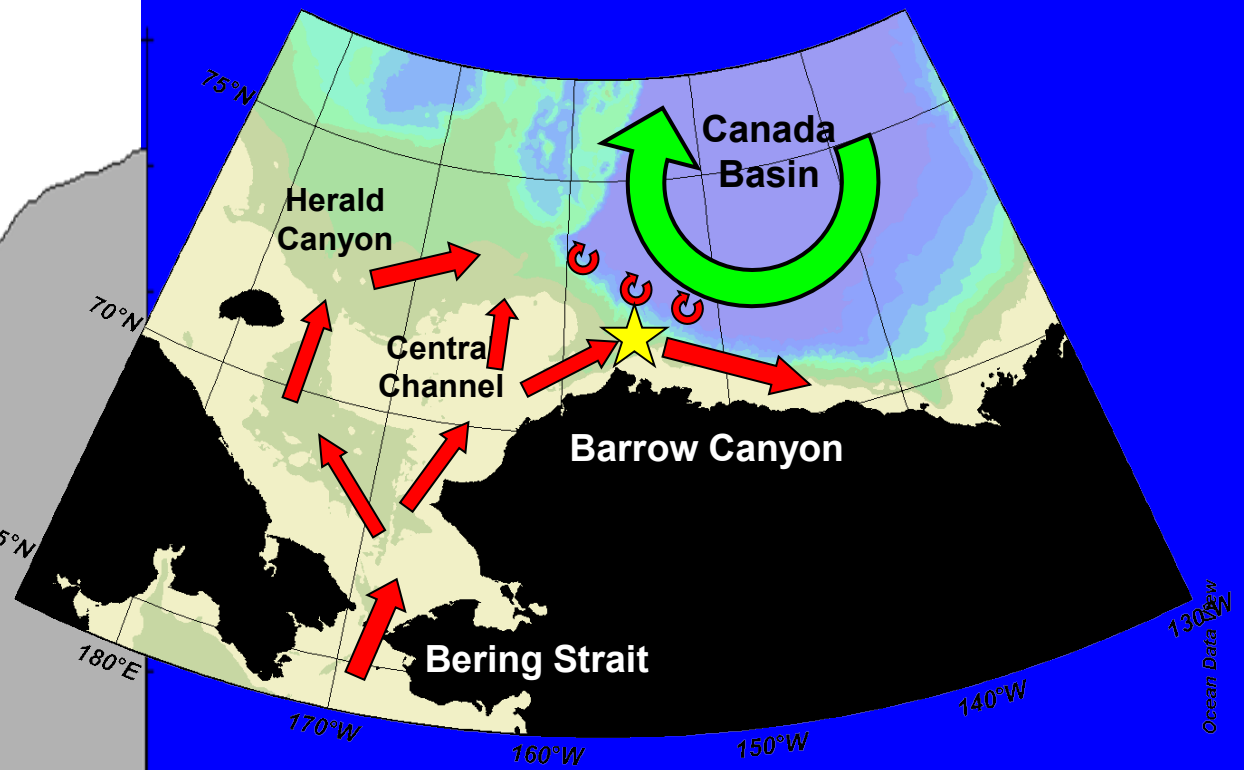
Now, there are more CTD and ADCP occupations for 2010-2019.

We can extend the period to 2010-2019 and examine interannul variabilities of fluxes of DBO-5 section.

Mooring observations in the Barrow Canyon

- Three moorings have measured T, S, V for 2000-2008 and 2010-now.
- Since 2016, several chemical sensors (DO, Chl-*a*, pH) have also been attached.



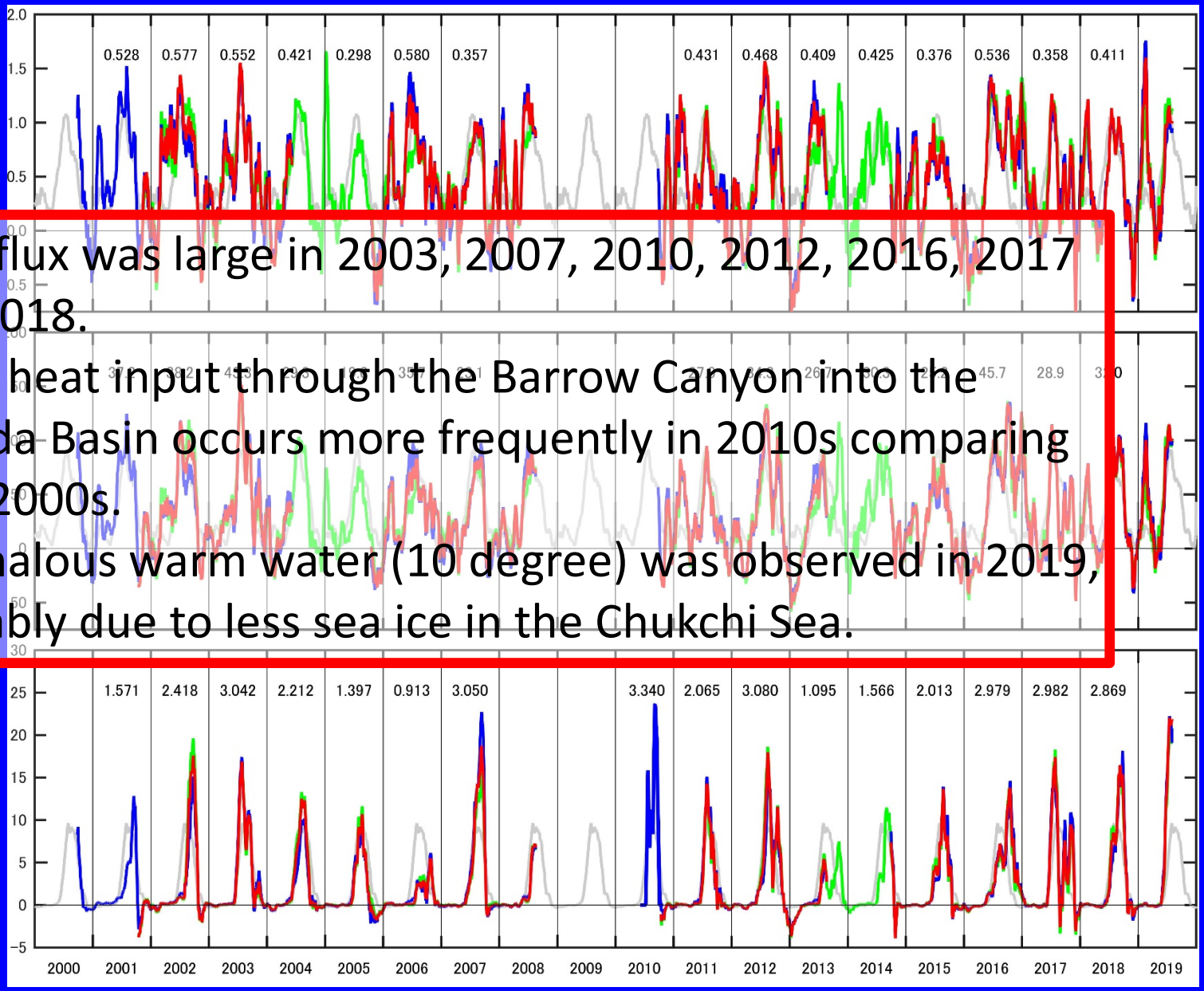


Barrow Canyon volume, fresh water and heat fluxes

Volume flux
0.46 Sv
(error 13%)

Freshwater flux
(ref. sal = 34.8)
33 mSv
(error 19%)

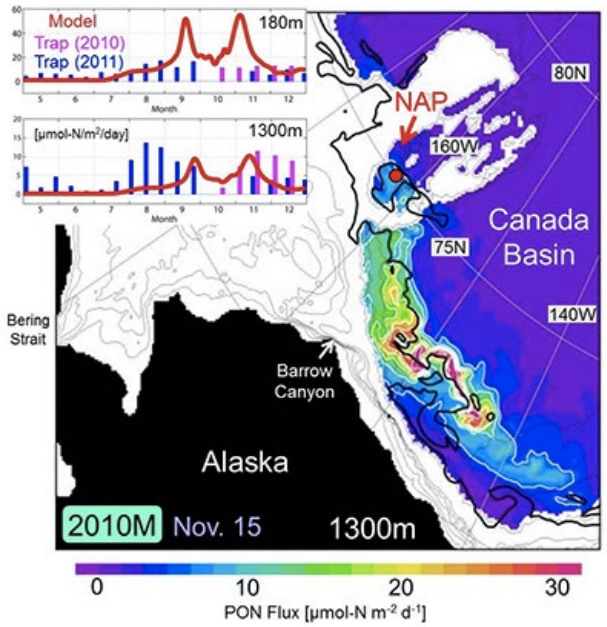
Heat flux
(ref. freezing temp)
2.39 TW
(error 8%)



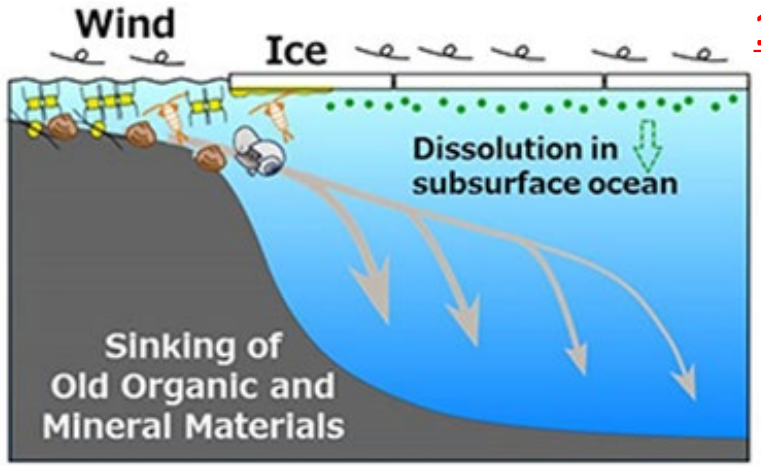
- ✓ Heat flux was large in 2003, 2007, 2010, 2012, 2016, 2017 and 2018.
- ✓ Large heat input through the Barrow Canyon into the Canada Basin occurs more frequently in 2010s comparing with 2000s.
- ✓ Anomalous warm water (10 degree) was observed in 2019, probably due to less sea ice in the Chukchi Sea.

Updated from Itoh et al., (JGR, 2013) and Itoh et al., (DSR I, 2015)

Enhanced role of eddies in the Arctic marine ecosystem

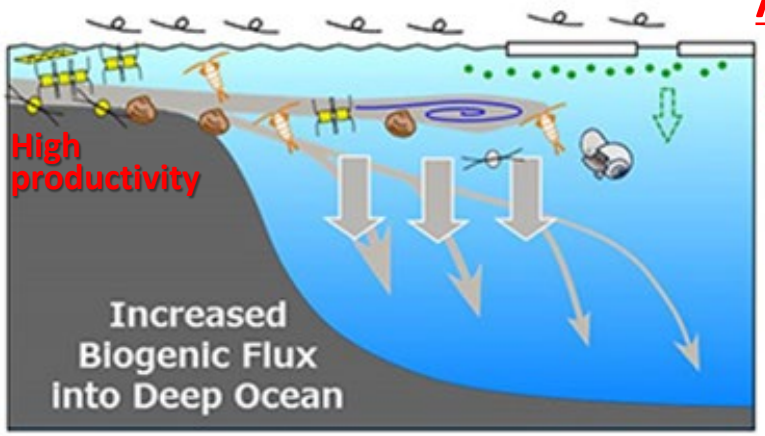


Sea ice retreat causes high biological productivities on the (nutrient-rich) shelves and enhances eddy activity and ocean current in the deep basin area. As a result, plankton habitat is expanding along eddy pathway.



1990s (sea ice covered)

- Small Phytoplankton
- Diatom
- Pteropoda
- Bivalvia
- Copepoda



After sea ice retreat

High Eddy Activity
Strong Ocean Current

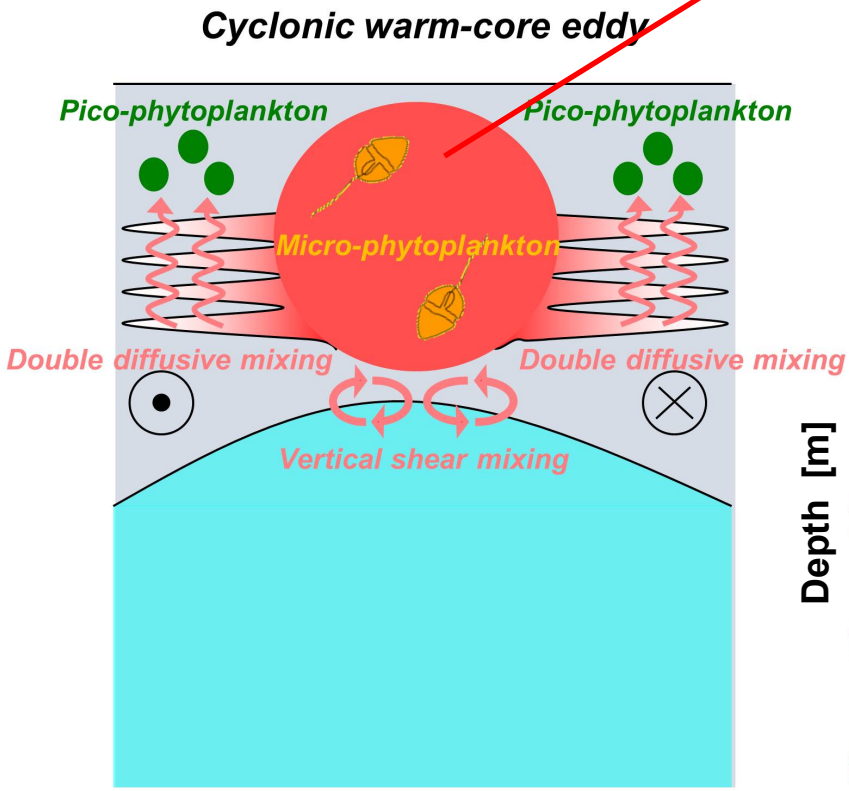
Plankton Habitat is expanding along Eddy Pathway

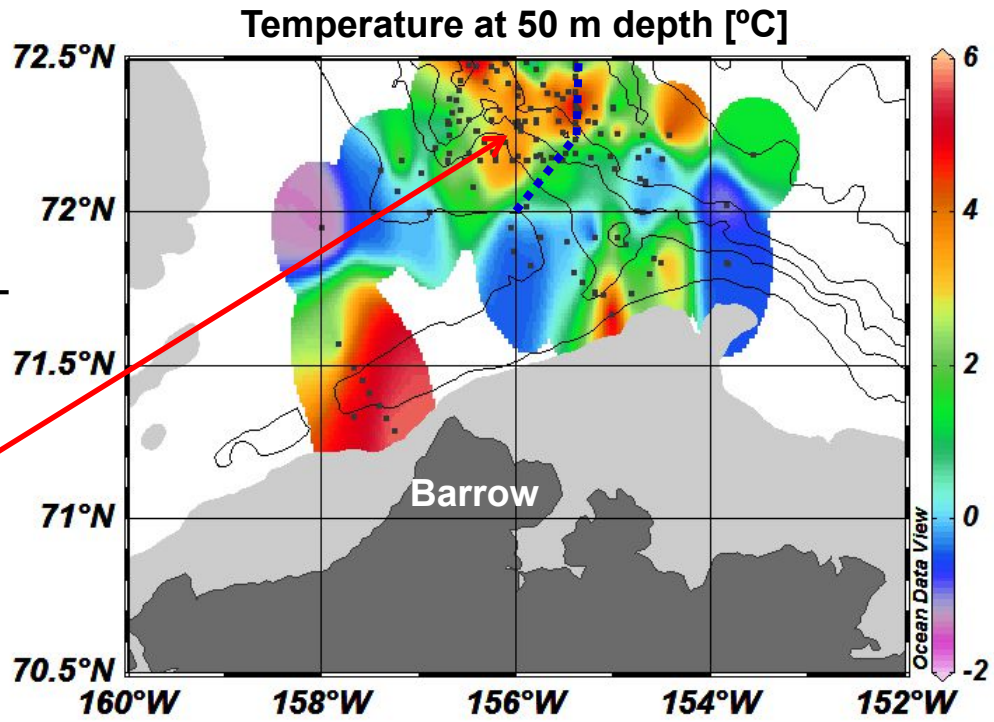
Biological pump might have doubled over the last two decades

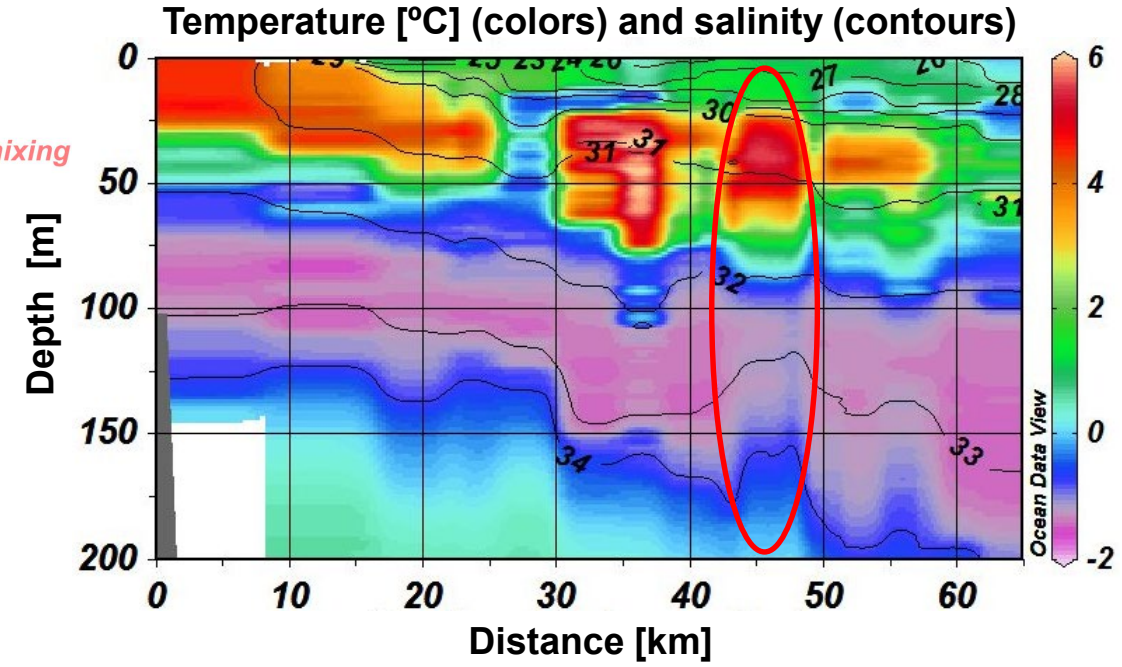
Watanabe *et al*. [2014; Nature Comm.]

Cyclonic warm-core eddy and its impact on the Arctic marine ecosystem

Nishino *et al*. [2018; GRL]







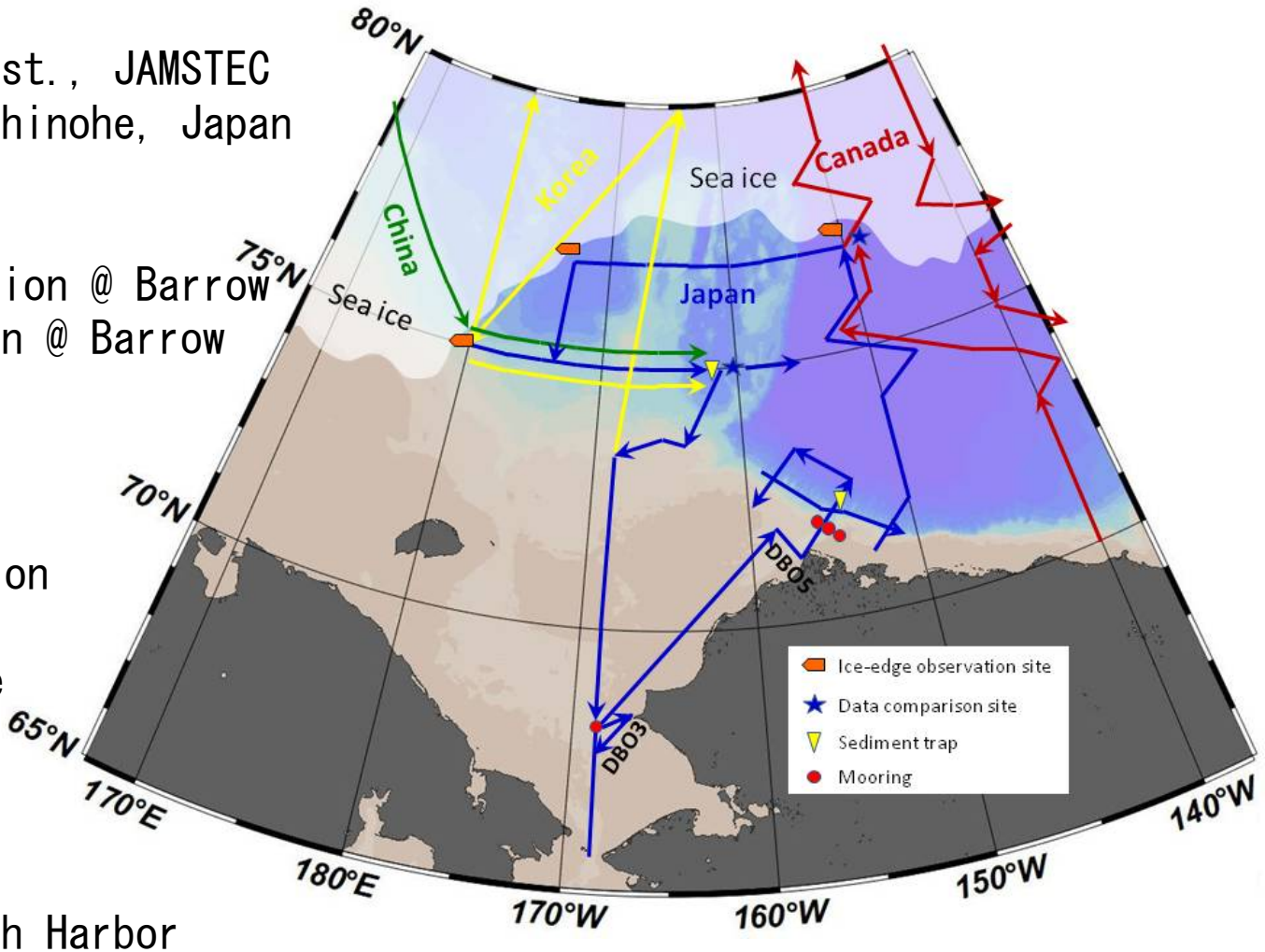
Cruise Plan: R/V Mirai Arctic cruise in 2020

Schedule (Tentative)

28 Aug: Leave Mutsu Inst., JAMSTEC
29 Aug: In and out Hachinohe, Japan
7 Sep: Off Nome
8 Sep: via Bering St.
11 Sep: Start observation @ Barrow
15 Sep: End observation @ Barrow

Canada Basin
150W Line
Joint with LSSL
Ice edge observation
Chukchi Borderland
Ice edge, 75N Line
Makarov Basin?
Chukchi Sea
168W Line, DBO3

12 Oct: Arrive in Dutch Harbor
14 Oct: Leave Dutch Harbor
27 Oct: In and out Hachinohe, Japan
28 Oct: Arrive in Mutsu Inst., JAMSTEC



R/V Mirai cruise plan in 2020


Snow
Ice
Nutrients
Dark
Pre-bloom,
net heterotrophic
No interaction
Limited ice
Late Spring/
Early Summer
Strong ice-pelagic-benthic
coupling

[SWIPA, 2017]