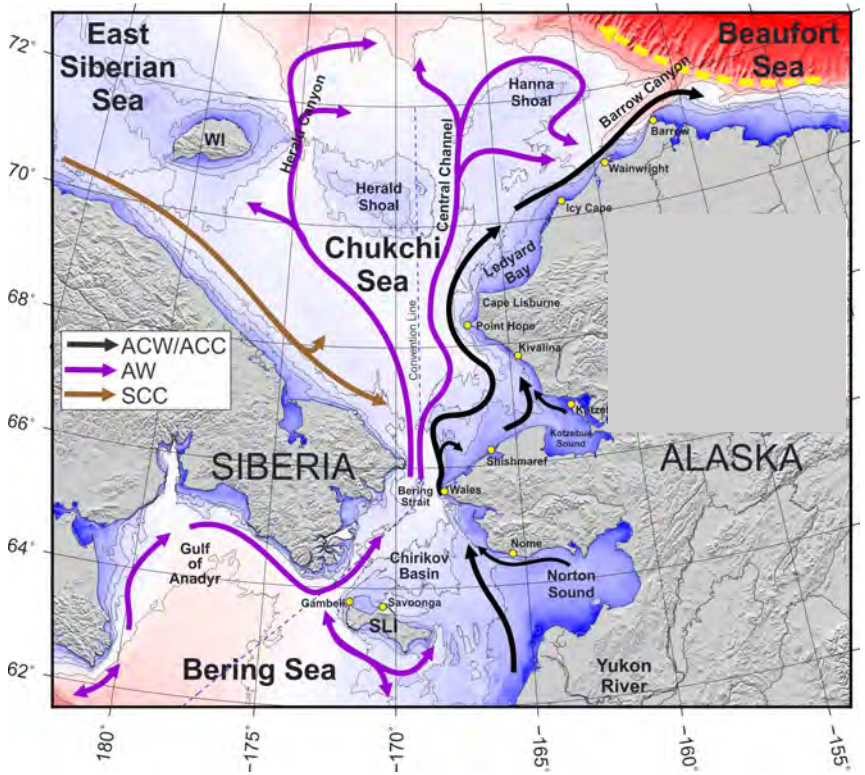
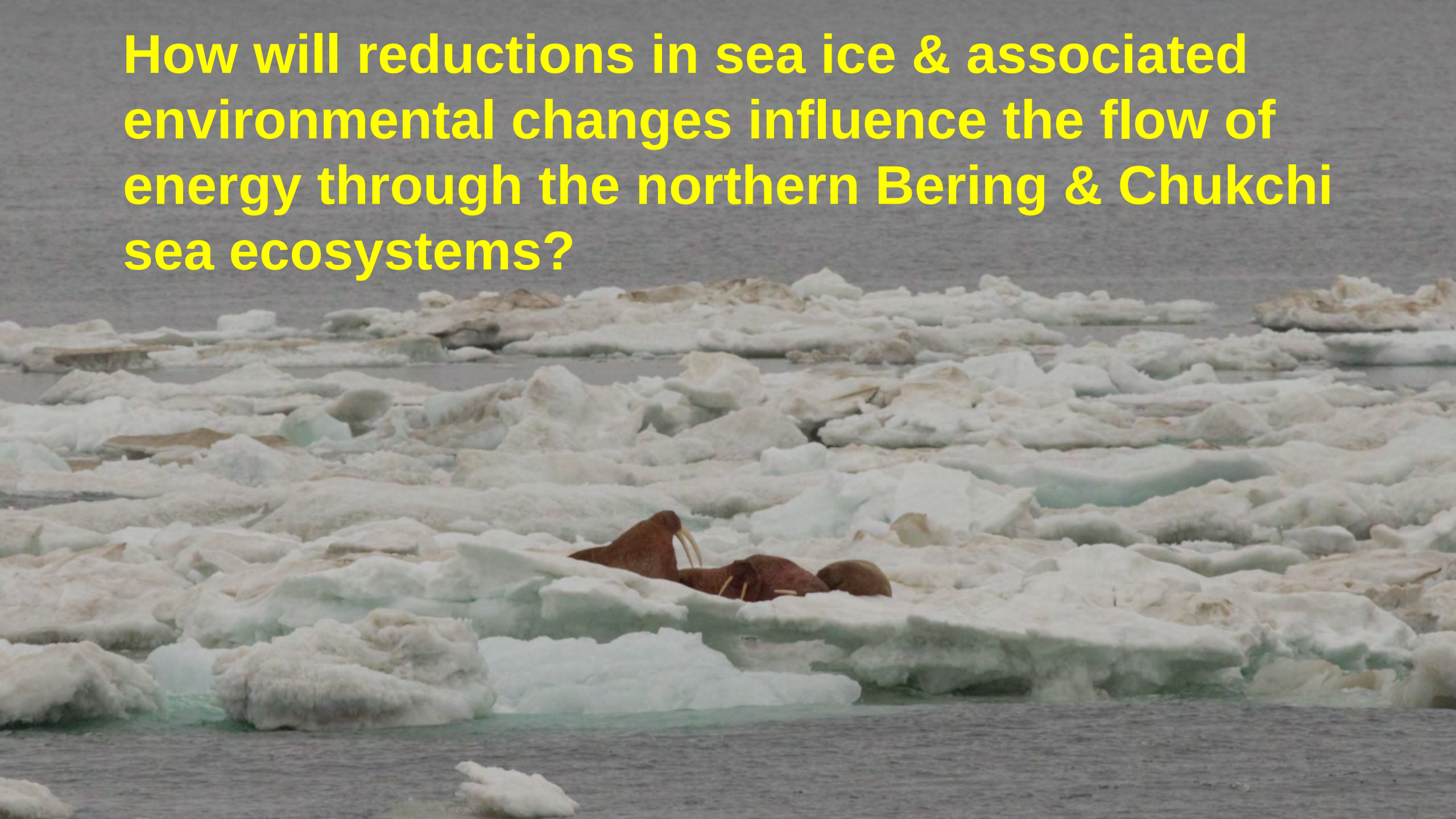
Variations in spring and summer phytoplankton size structure and composition across water mass gradients in the northern Bering and Chukchi seas



Lisa B. **Eisner**[1], Michael W. Lomas[2], and Jens M. Nielsen[1]

[1]NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, USA.

[2]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME, USA.



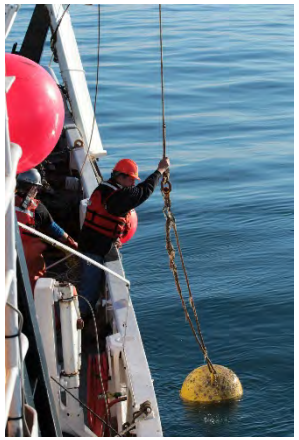
How will reductions in sea ice & associated environmental changes influence the flow of energy through the northern Bering & Chukchi sea ecosystems?

Data collection

1. **Spring** Field Expeditions 2017 & 2018: Arctic Shelf Growth, Advection, Respiration & Deposition (ASGARD) Rate Experiments Project.

2. **Summer** Field Expeditions 2017 & 2019: Arctic Integrated Ecosystem Survey (Arctic IES phase 2). Additional surveys in summer 2012 and 2013 (Arctic IES phase 1)

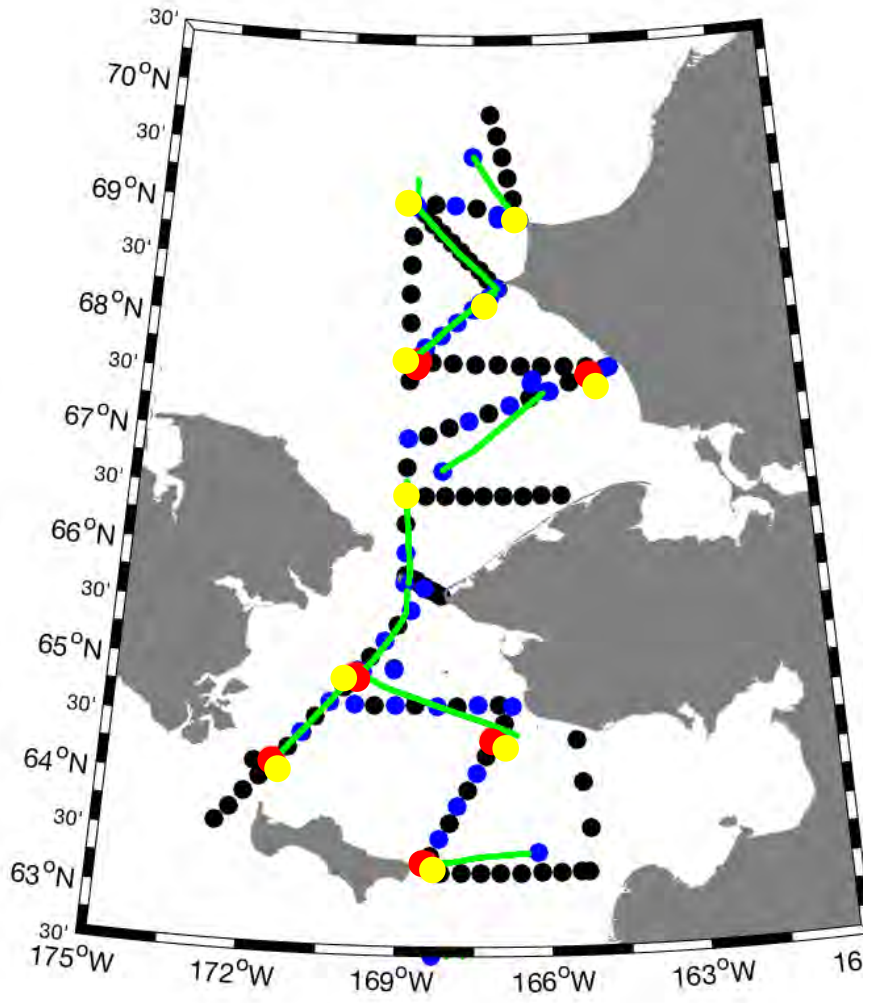
3. **Year-round** moorings



ASGARD

June 2017 & 2018

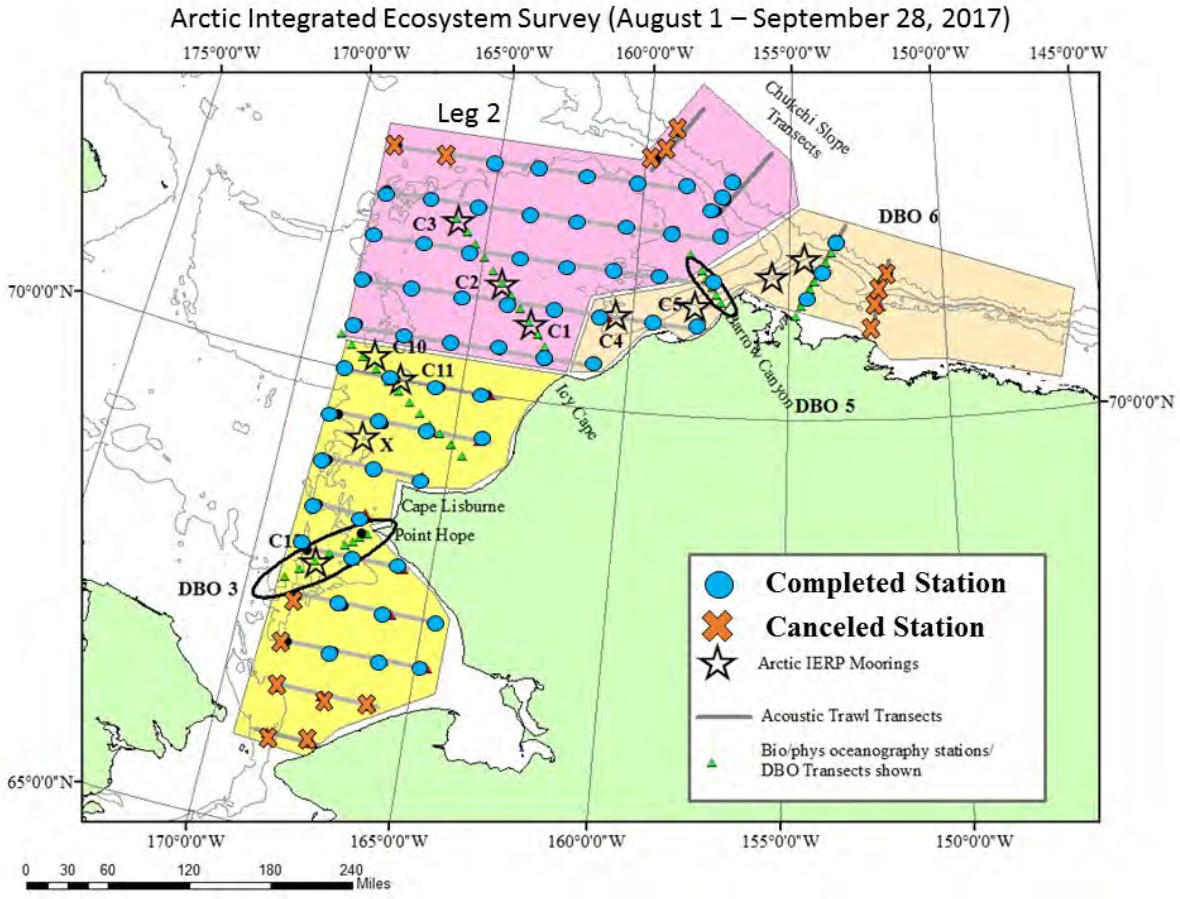
- Mooring
- Process Station
- 2017 Station
- 2018 Station
- 2018 Acrobat



Arctic IES

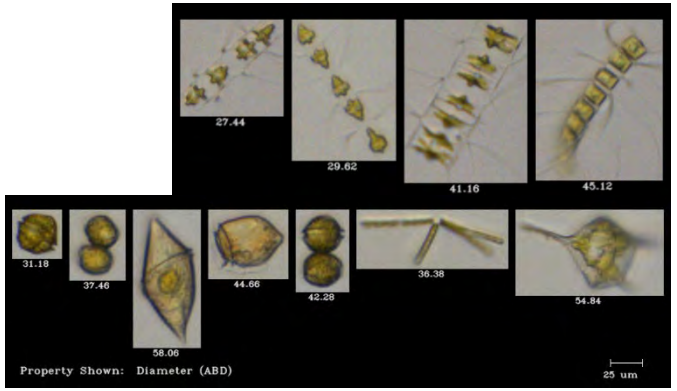
August-September

2017 & 2019

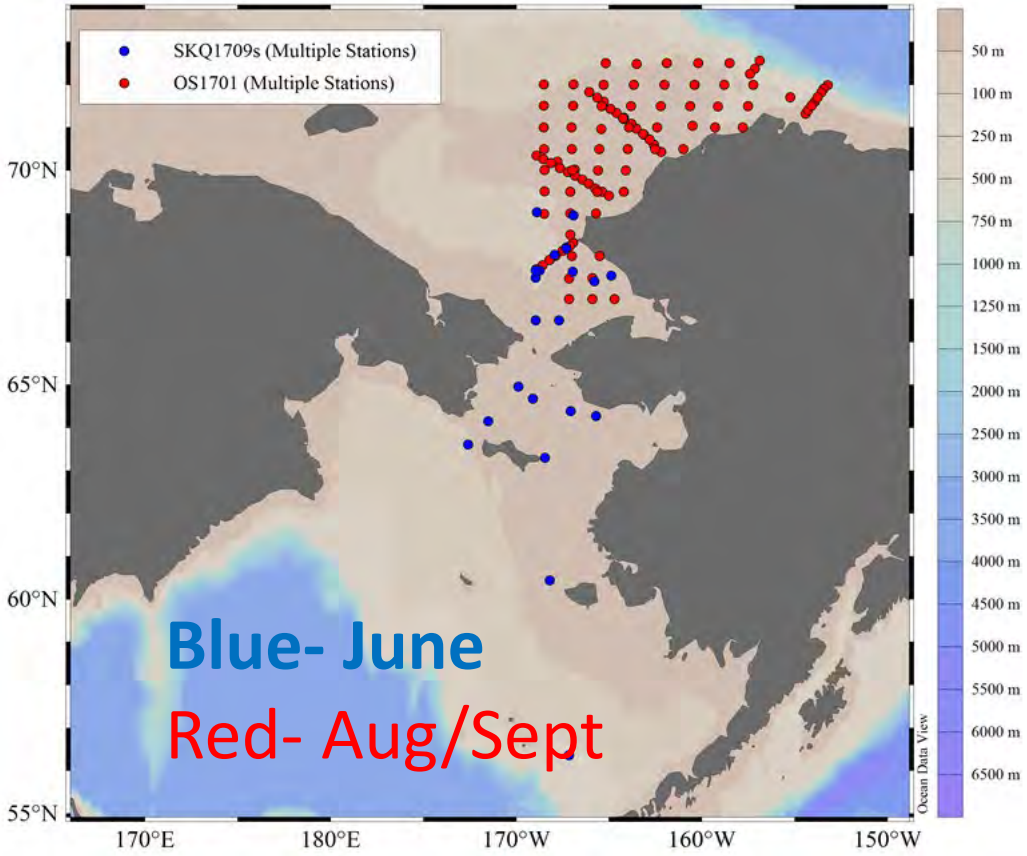


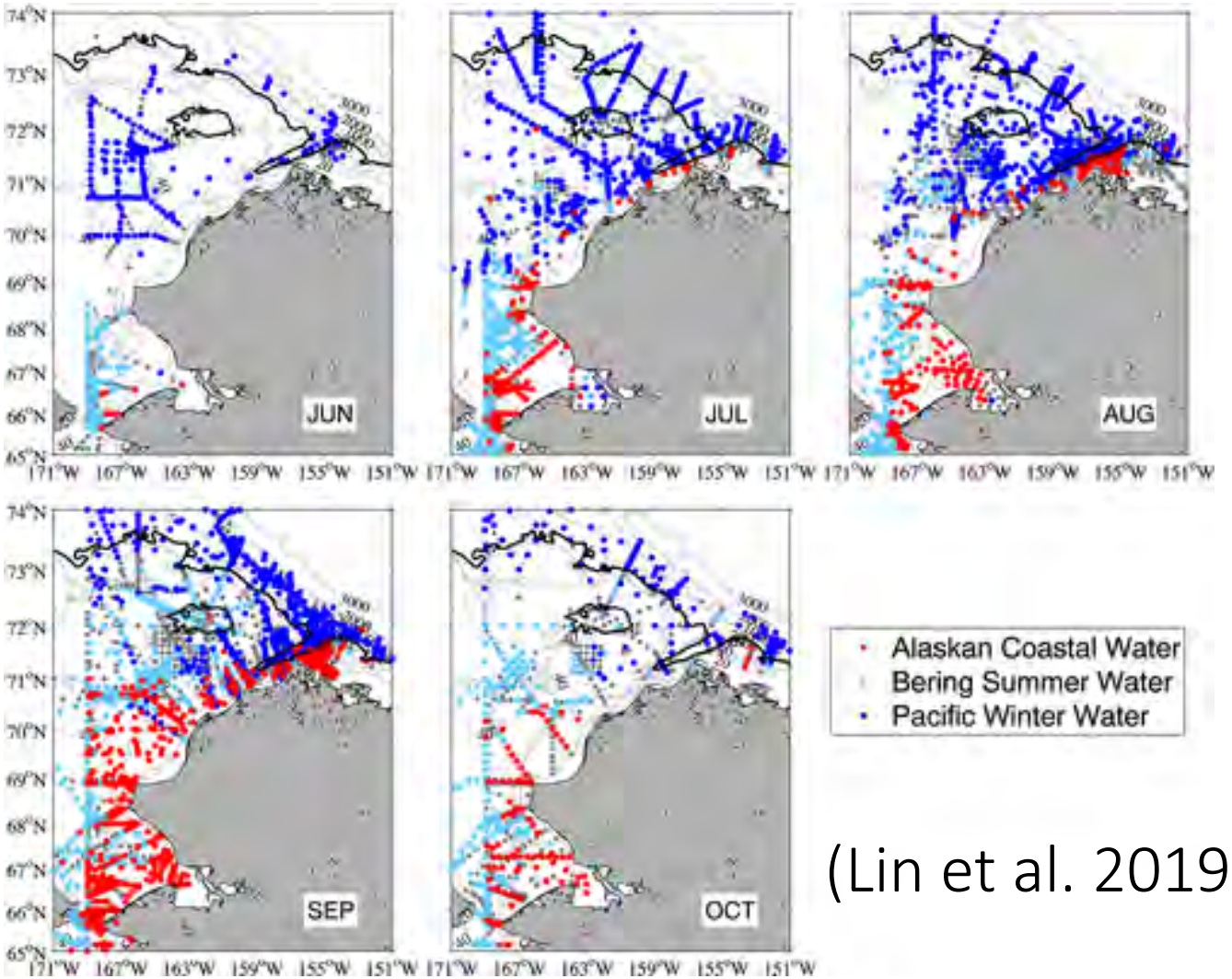
Survey Components
(biomass & rates)

- Underway Currents & Atmospheric Data
- Water: physical, chemical, optical properties
- Particles & sedimentation
- Microbes
- Microzooplankton & Mesozooplankon
- Ichthyoplankton & Fish (distribution, diet, condition)
- Epifauna & Infauna
- Marine Mammals & Seabirds
- **Phytoplankton**
  - **Chlorophyll a (total and size fractionated)**
  - **Taxonomy (large: FlowCam, small: Flow Cytometry)**
  - **Harmful algae (counts, toxin concentration)**
  - **Fatty acids (seston, zooplankton, fish)**
  - ***Primary production (13C, 15NO3, 15NH4)***



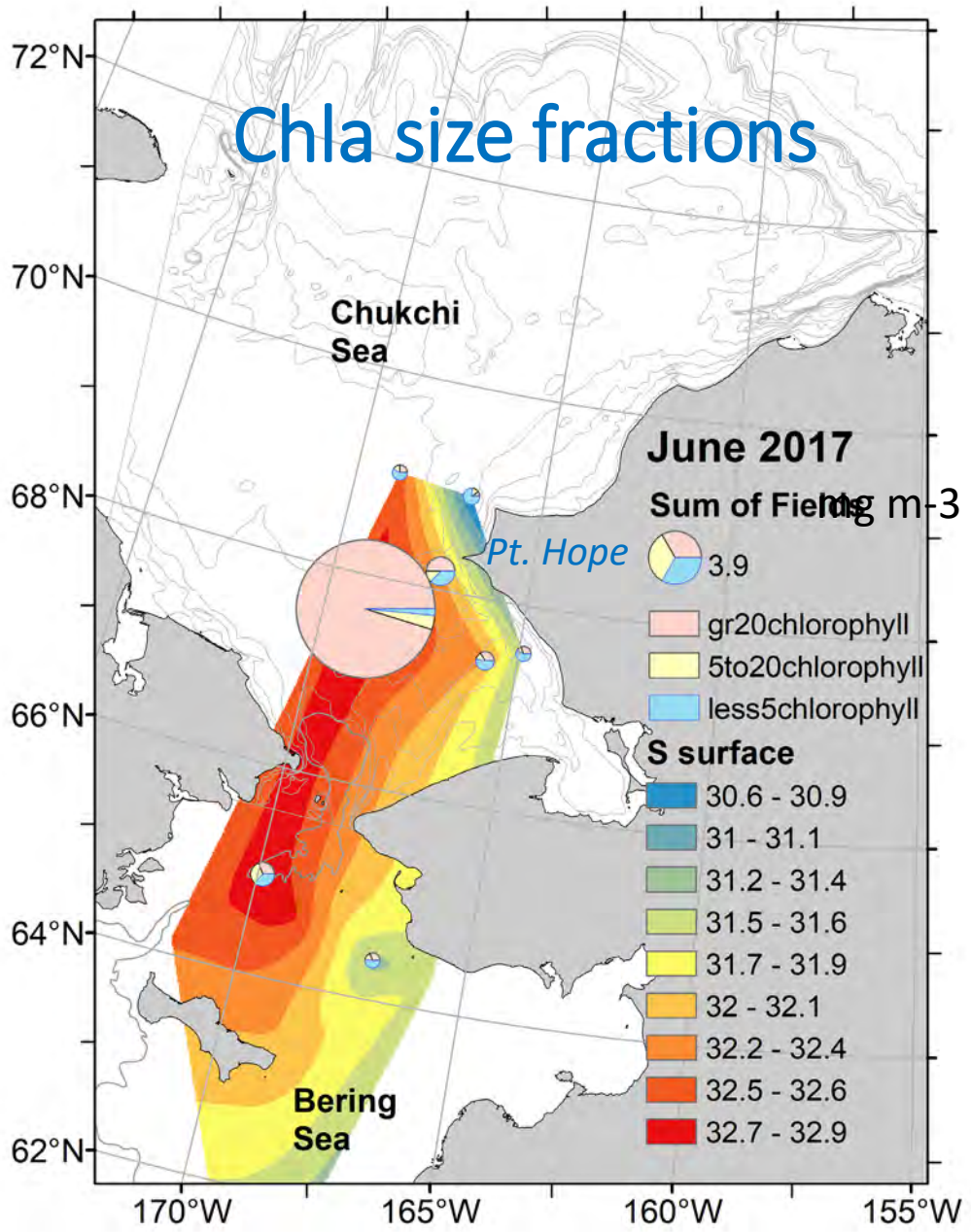
2017: Chlorophyll and phytoplankton taxa collection

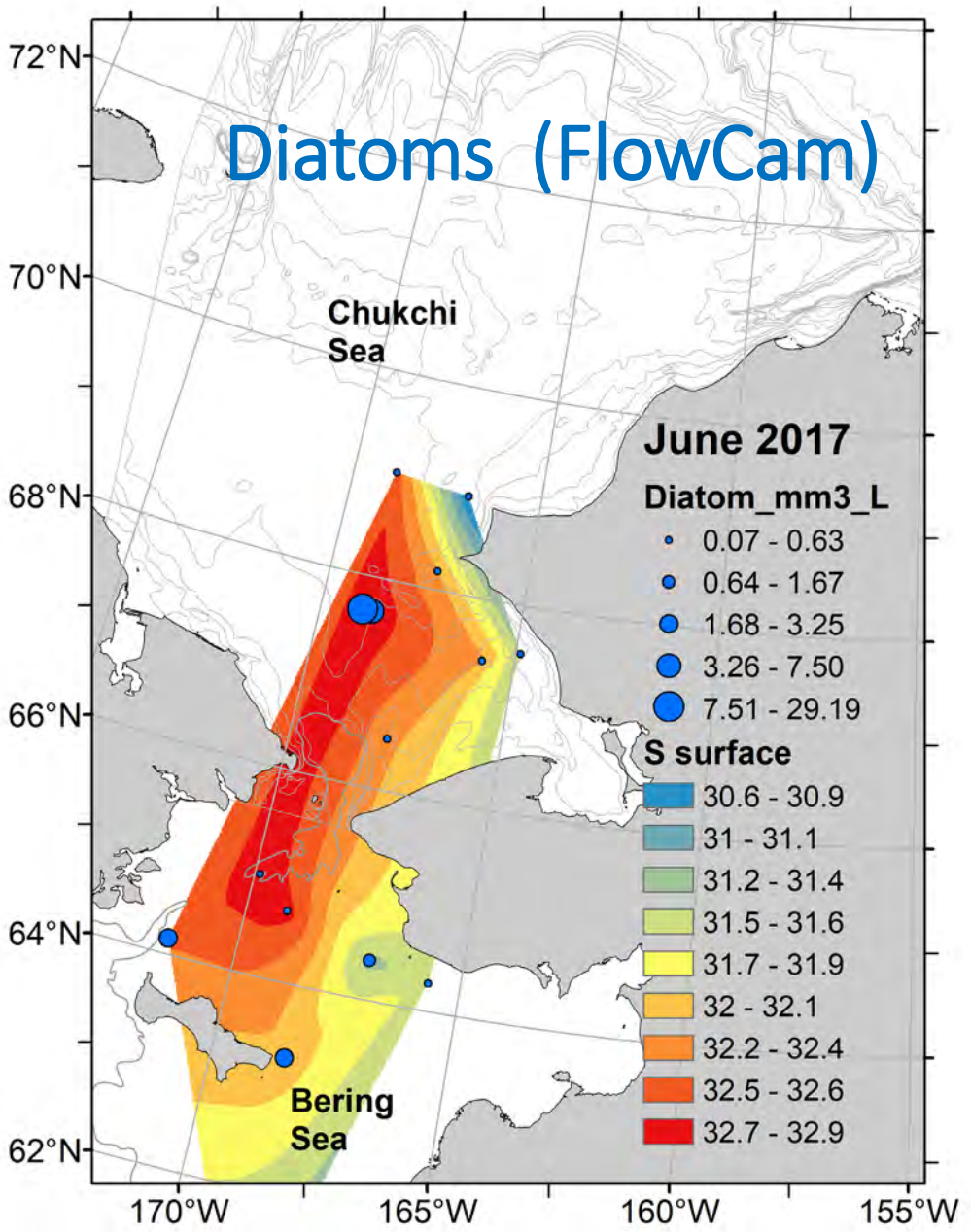




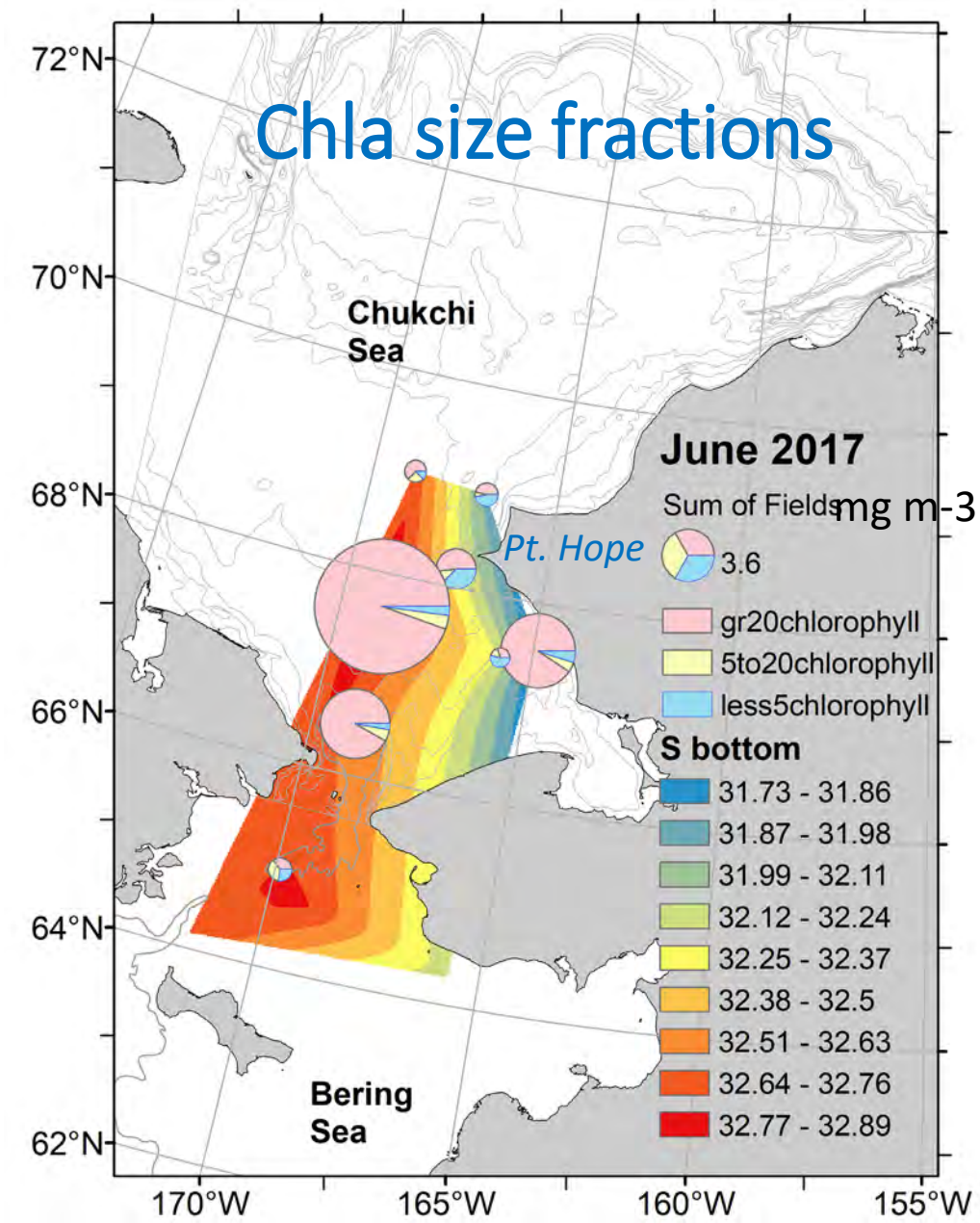
(Lin et al. 2019)

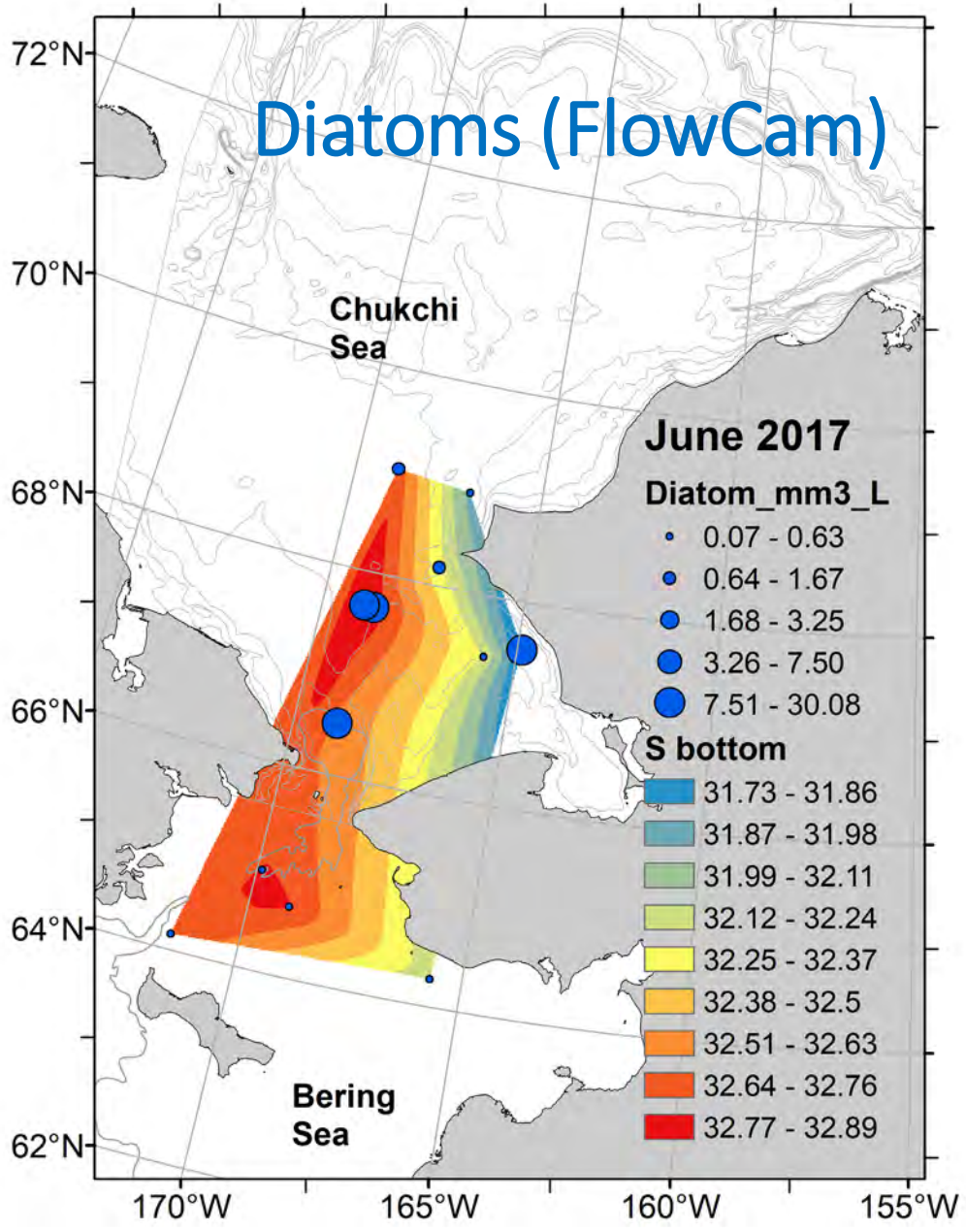
Chlorophyll and diatoms– June 2017, surface



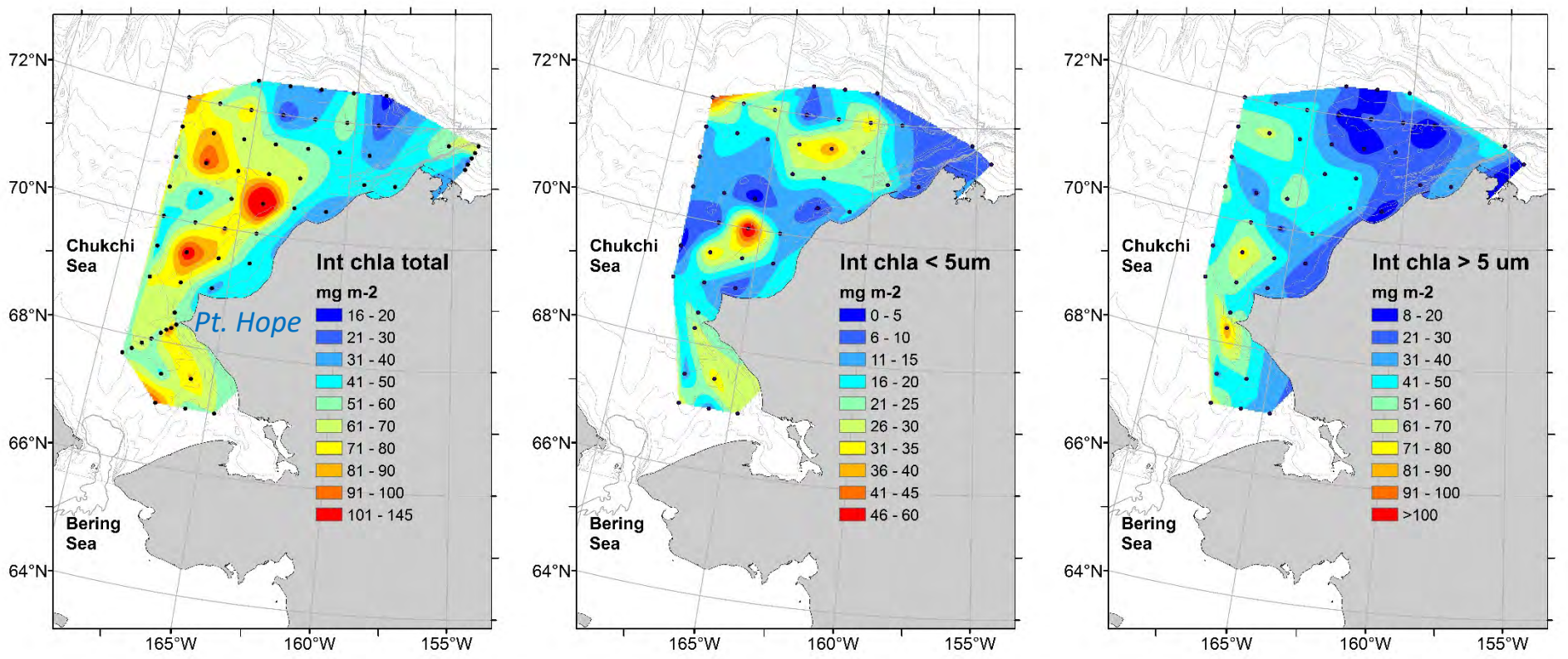


Chlorophyll and diatoms– June 2017, subsurface



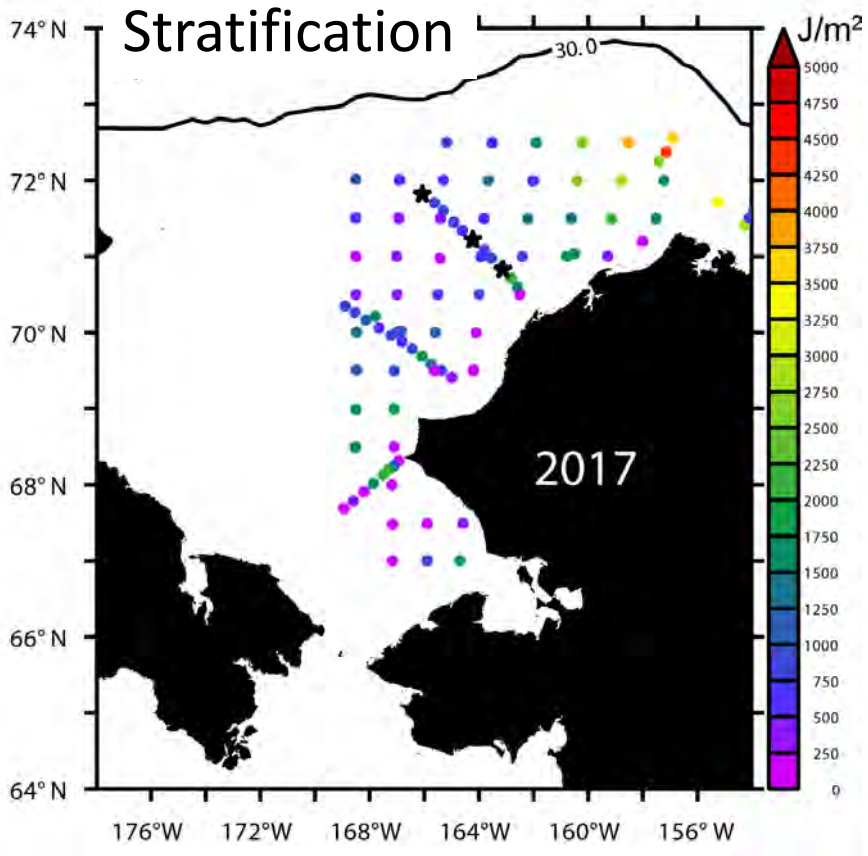


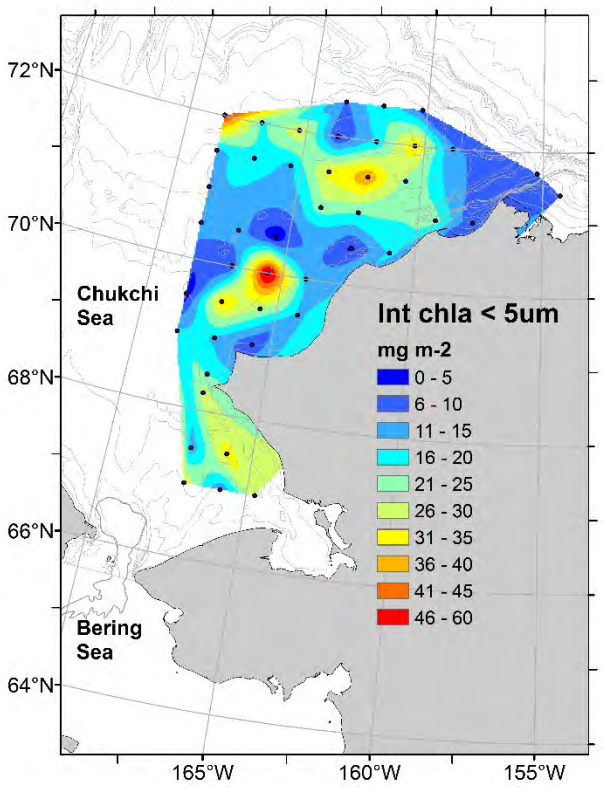
Chlorophyll – Aug/Sept 2017

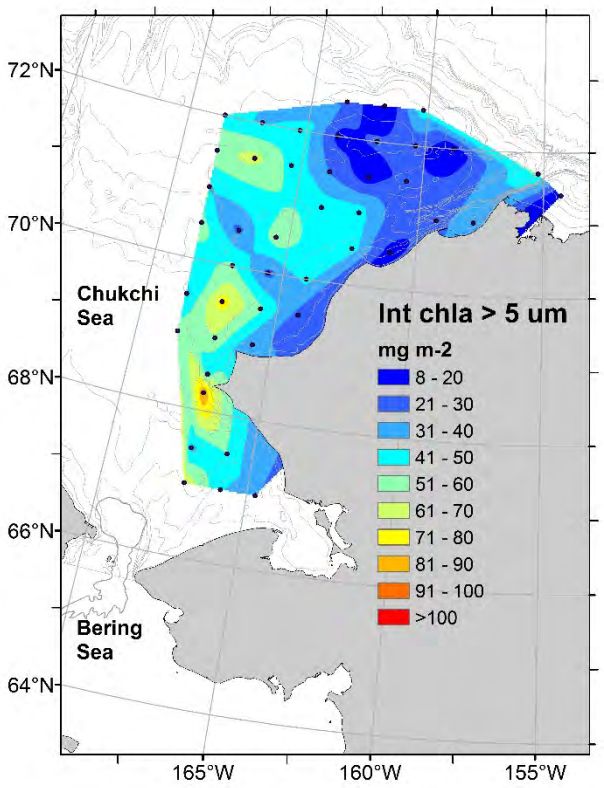


- Highest Chla associated with >5µm size fraction (expected)

Chlorophyll – Aug/Sept 2017



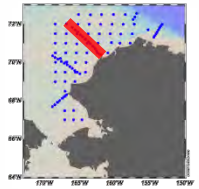




Carol Ladd, Session 5

- Highest Chla associated with >5µm size fraction (expected)
- High stratification in NE associated with low biomass of large size fraction

August 2017
Icy Cape Line



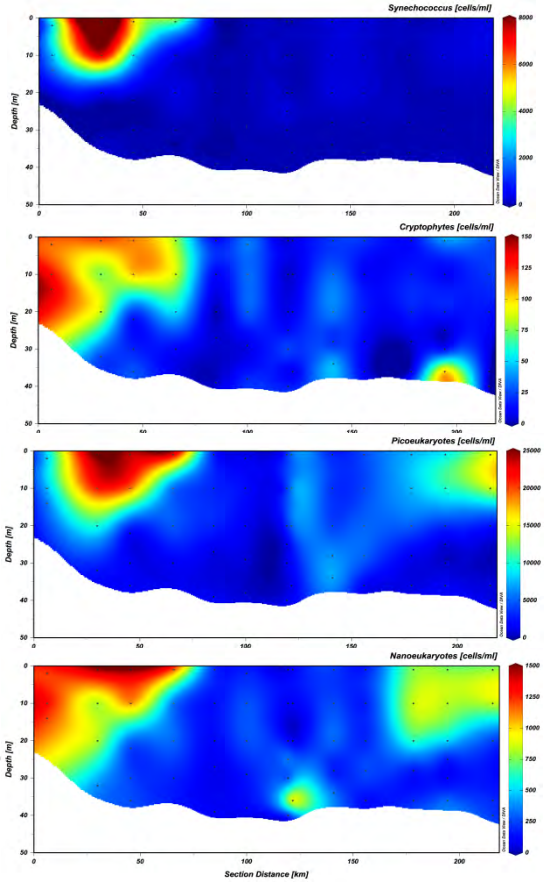
Small Phyt (< 10 µm)

Synechococcus (~ 1 µm)

Cryptophytes

Picoeukaryotes (<3 µm)

Nanoeukaryotes (3-10 µm)

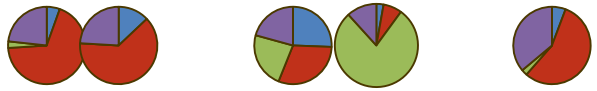


Inshore offshore

Large Phyt (20-200 µm)
at Chla max depth

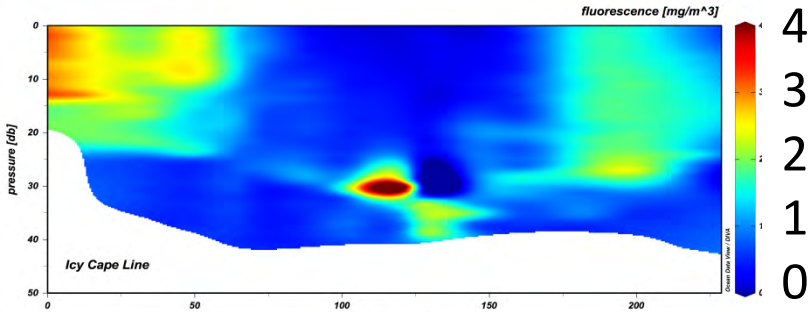
- Cilliate
- Dinoflagellate
- Diatom: centric chain
- Diatom: pennate

images: 73 54 82 179 122

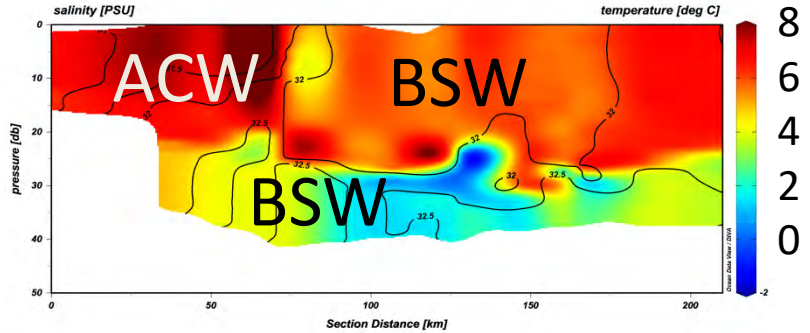


* * *

Chla fluor.

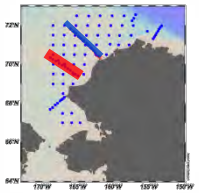


T -color
S -lines



*** indicate *Alexandrium* spp. (potentially toxic dinoflagellate) may be present.**

August 2017
Cape Lisburne



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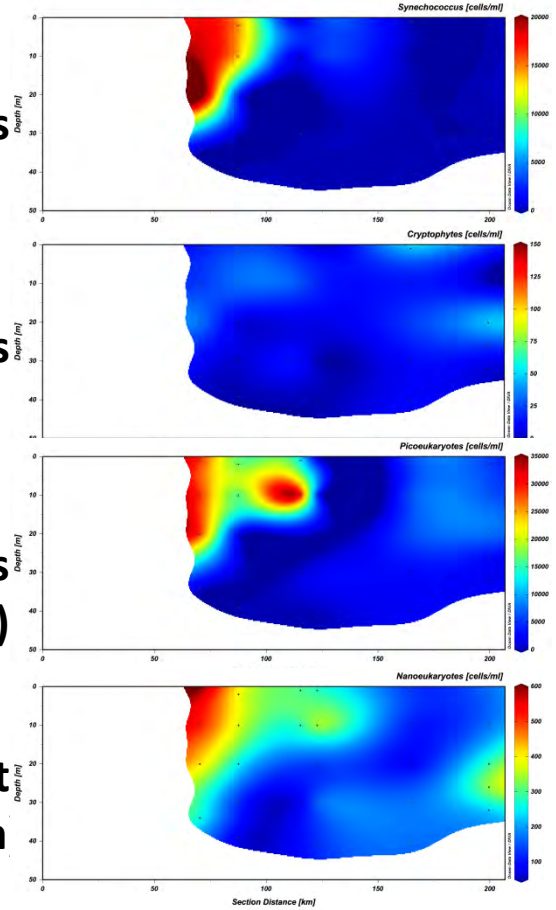

Inshore offshore

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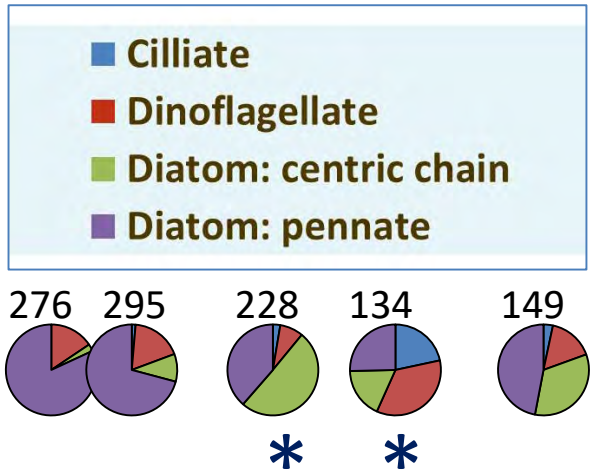
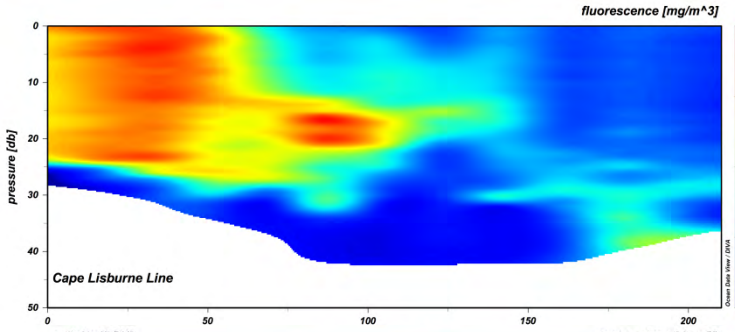
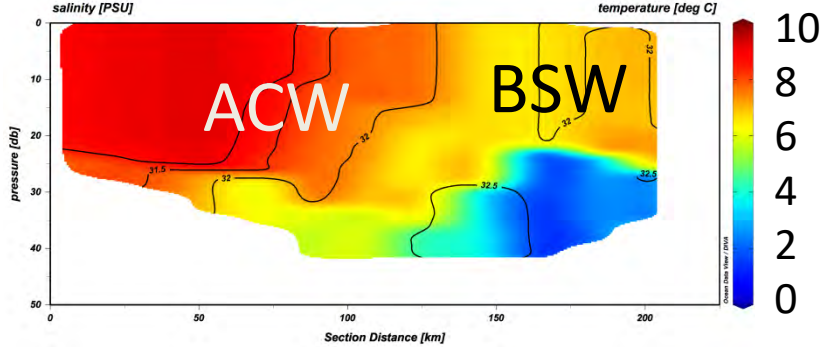
at Chla max depth



Chla fluor.

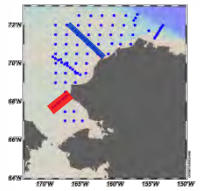


T -color
S -lines



* indicate *Alexandrium* spp. (potentially toxic dinoflagellate) may be present.

August 2017
Pt Hope Line



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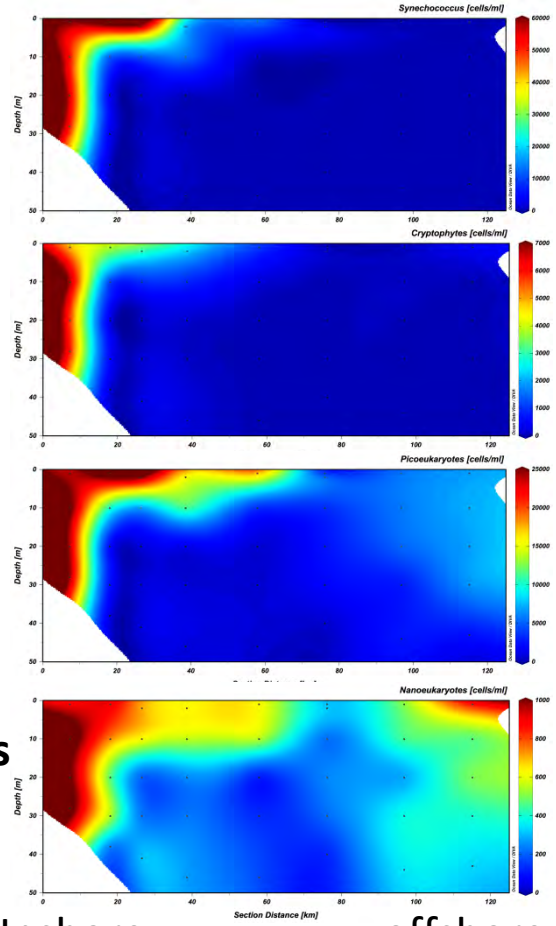

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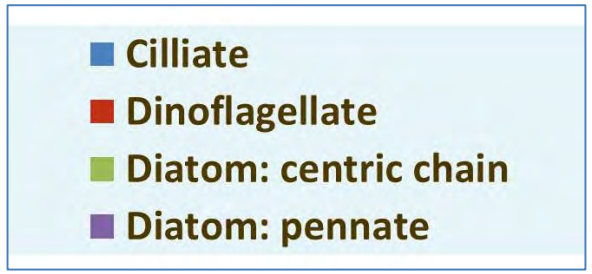
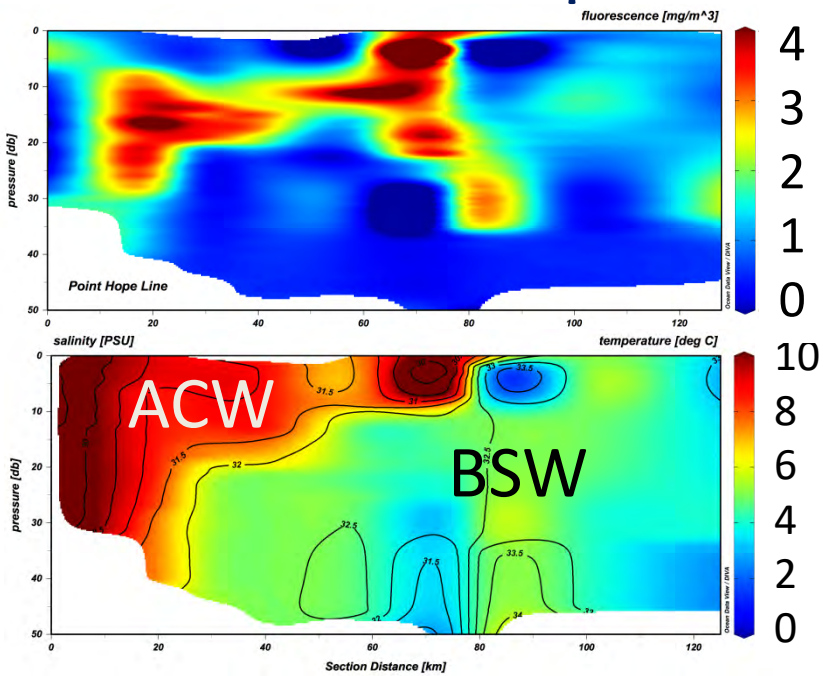


images 637 248 768 455 61

*

Chla fluor.

T -color
S -lines



* indicate *Alexandrium* spp. (potentially toxic dinoflagellate) may be present.

Giesbrecht et al. (2019) DSR2

JULY

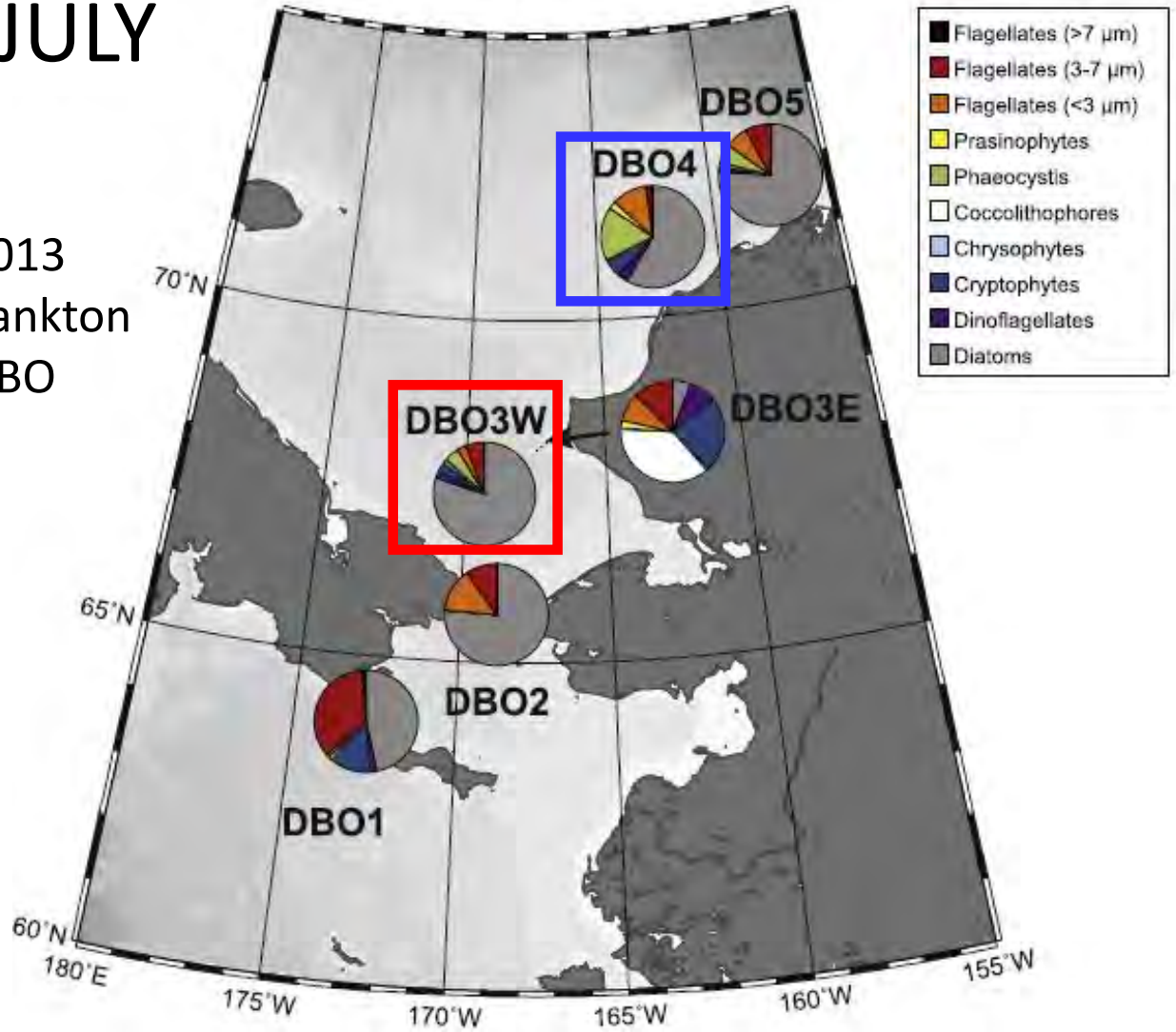
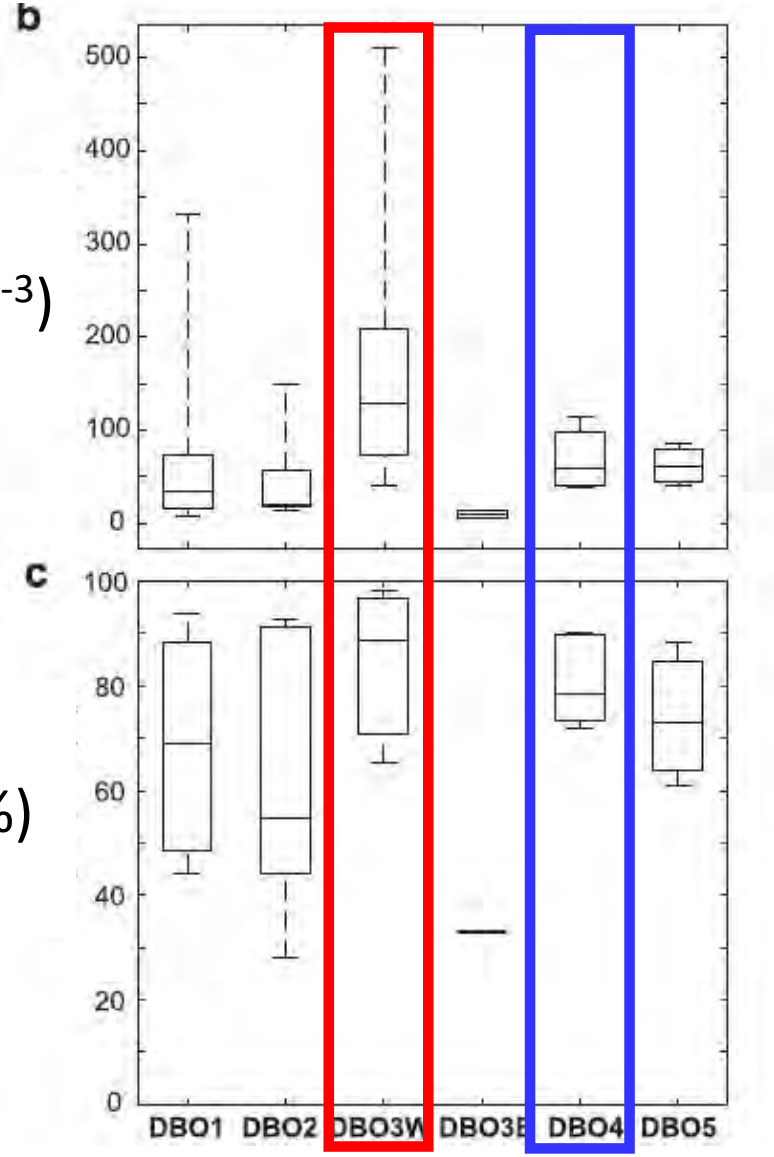


Fig. 5. 2013 phytoplankton axa at DBO Regions

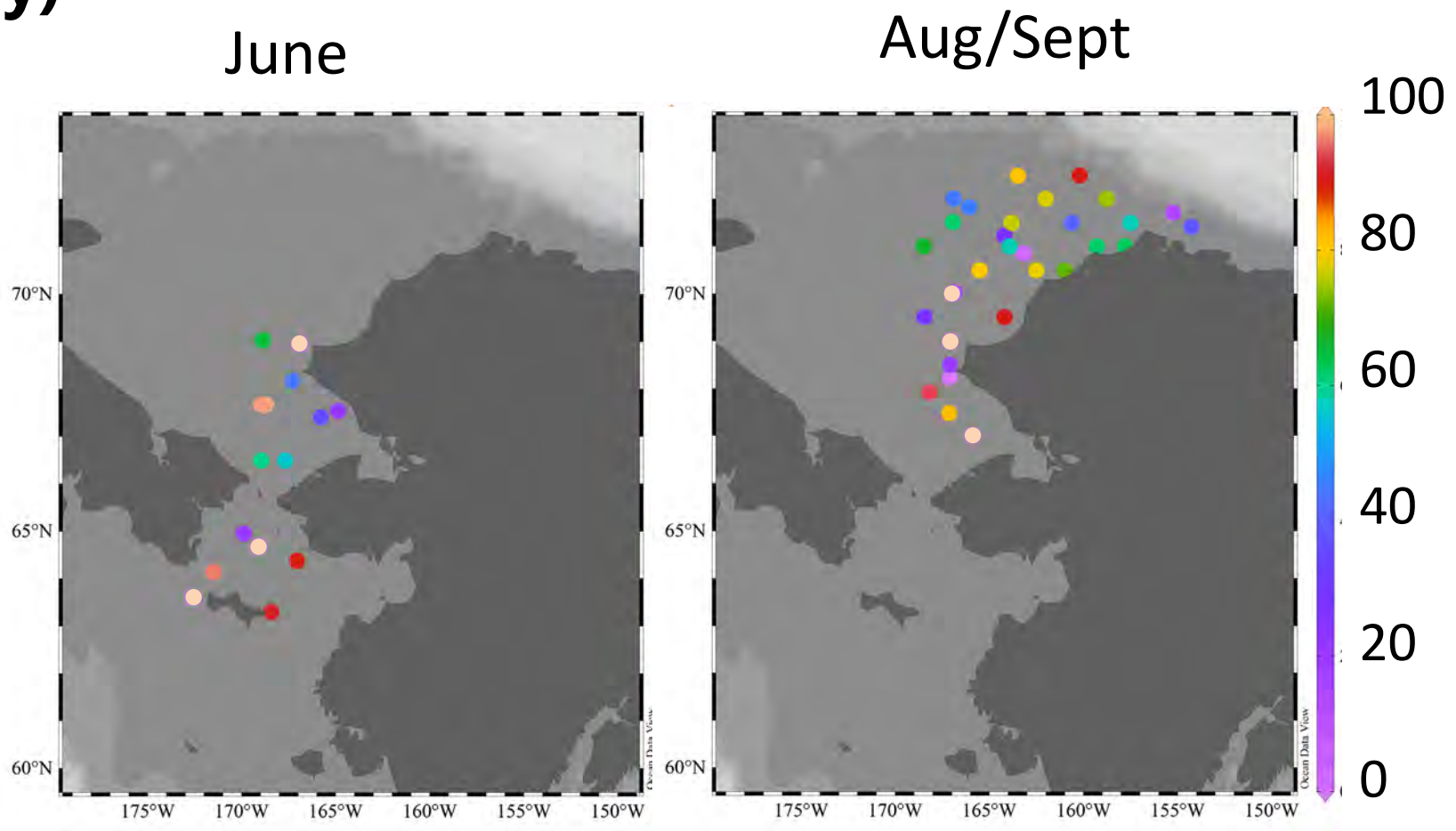
Chla (mg m^{-3})



> 5 µm Chla (%)

Fig. 3. Averages by DBO region for 2006-2016

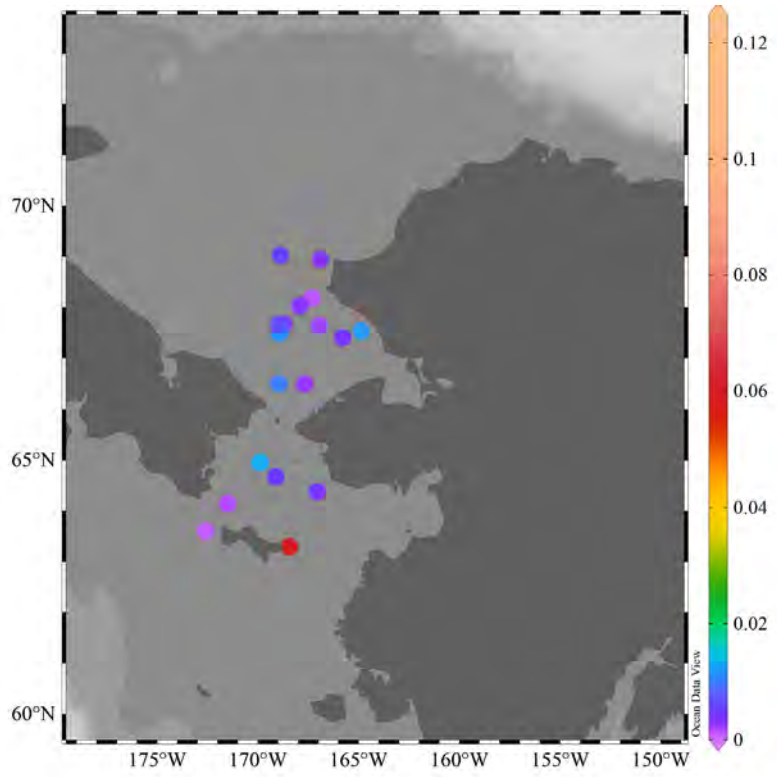
Picoplankton (<3 µm): % of Particulate Organic Carbon (flow cytometry)



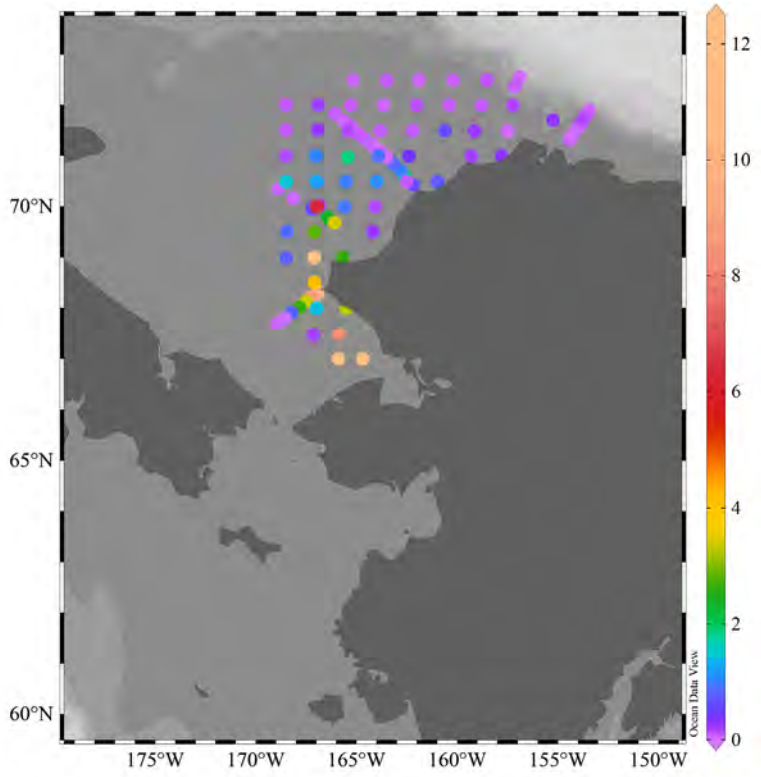
- Not completely unexpected, but encouraging that % <3µm POC is really high in late summer.
- Perhaps a new observation, but prior observations are limited.

Synechococcus (~1 µm) Carbon Biomass (flow cyt)

June



Aug/Sept



Unexpected:

- 100x increase in biomass with season
- Widespread, but 'restricted' to < 71ºN.

Synechococcus (~1 µm) Carbon Biomass (flow cyt)

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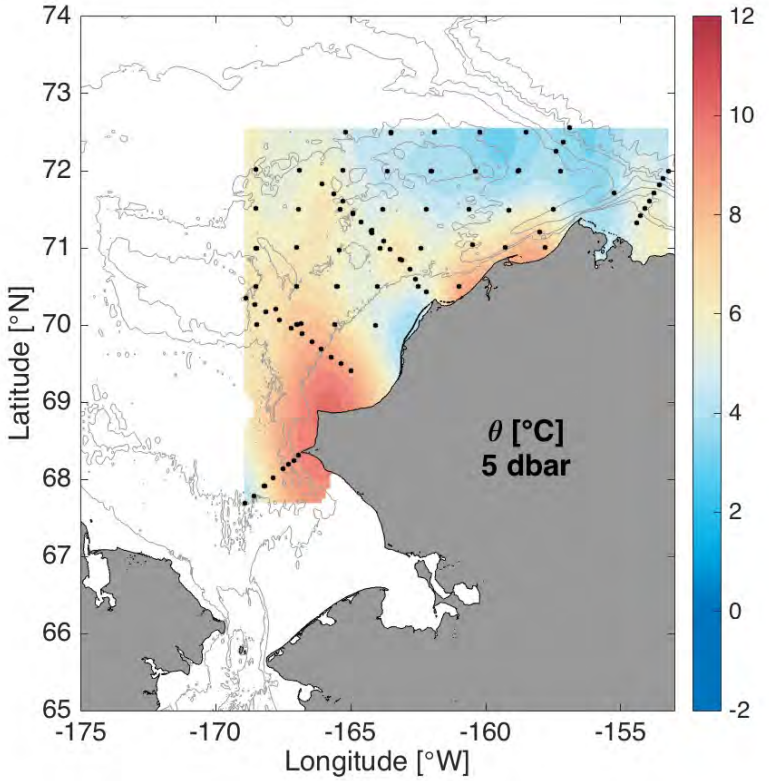
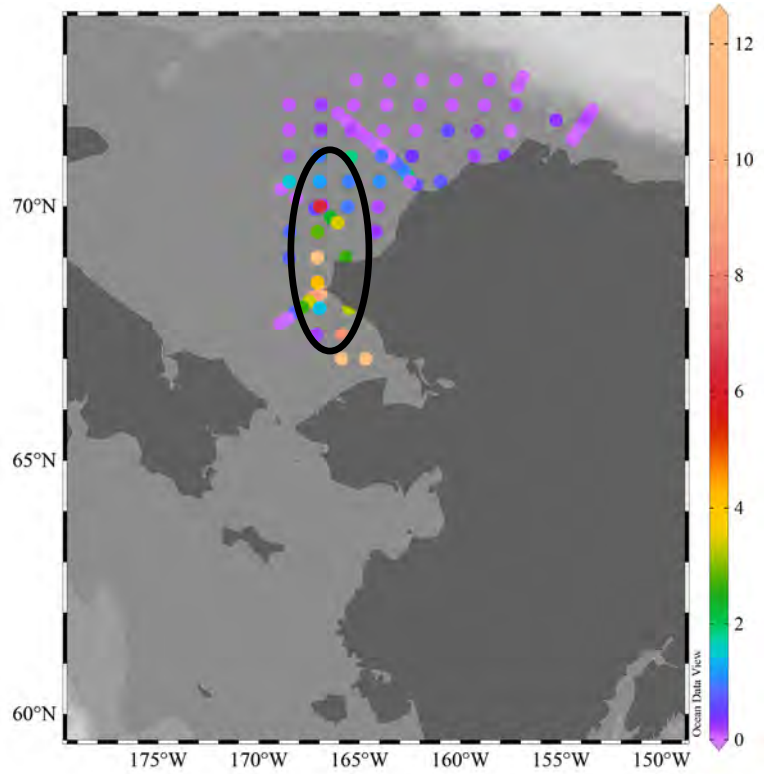


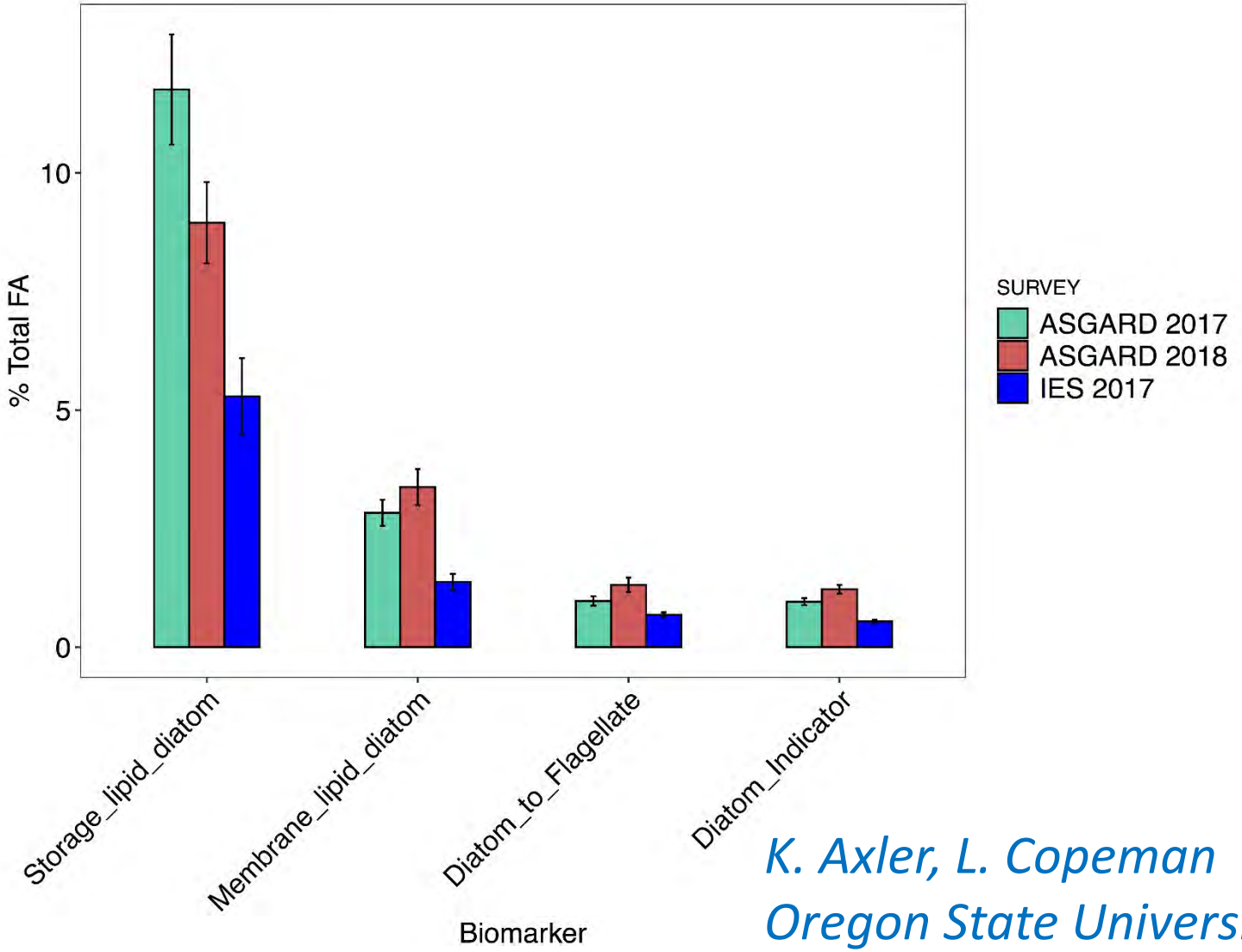
Aug/Sept

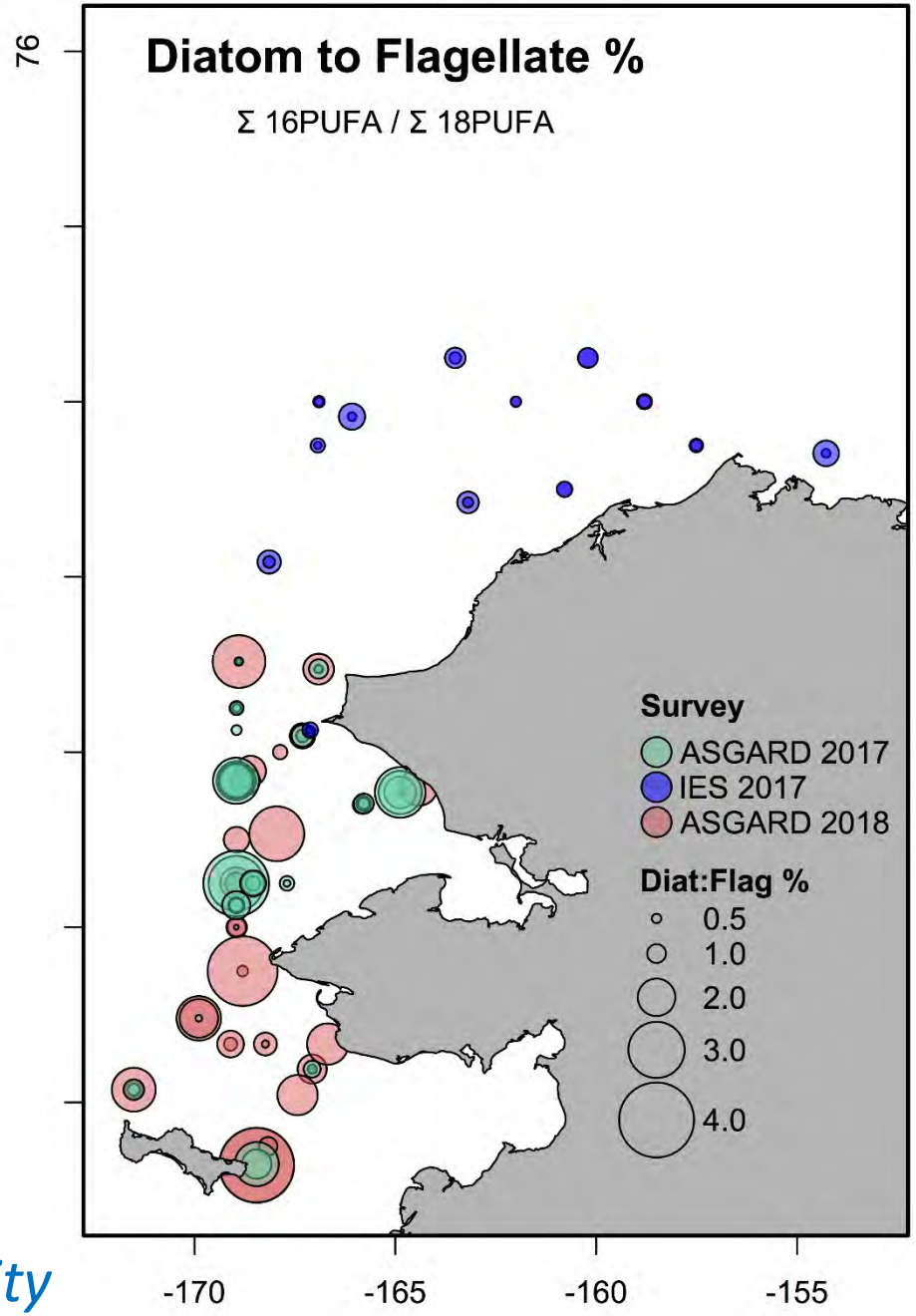


Unexpected:

- 100x increase in biomass with season
- Widespread, but 'restricted' to < 71°N.
- High values in ACW designated by T > 7°C south of ~71N, but not in ACW off north coast.

Phytoplankton Fatty Acids

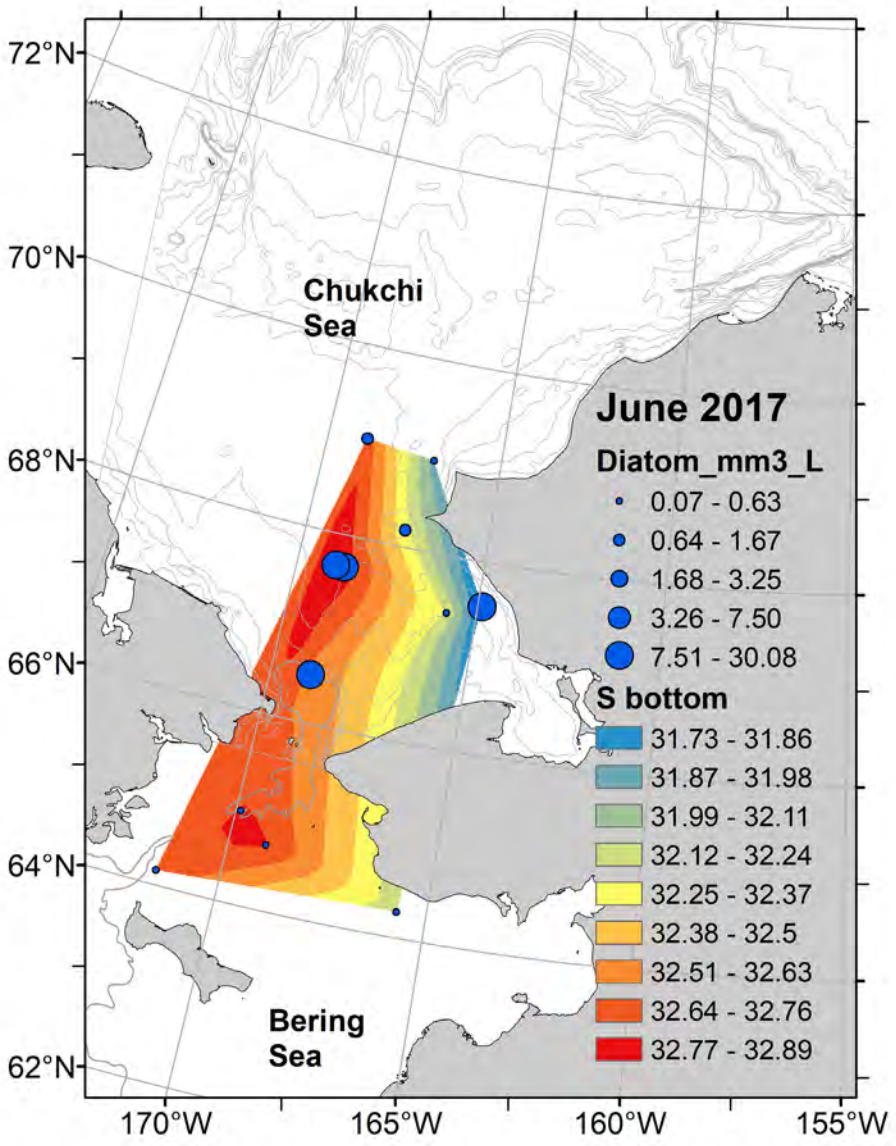


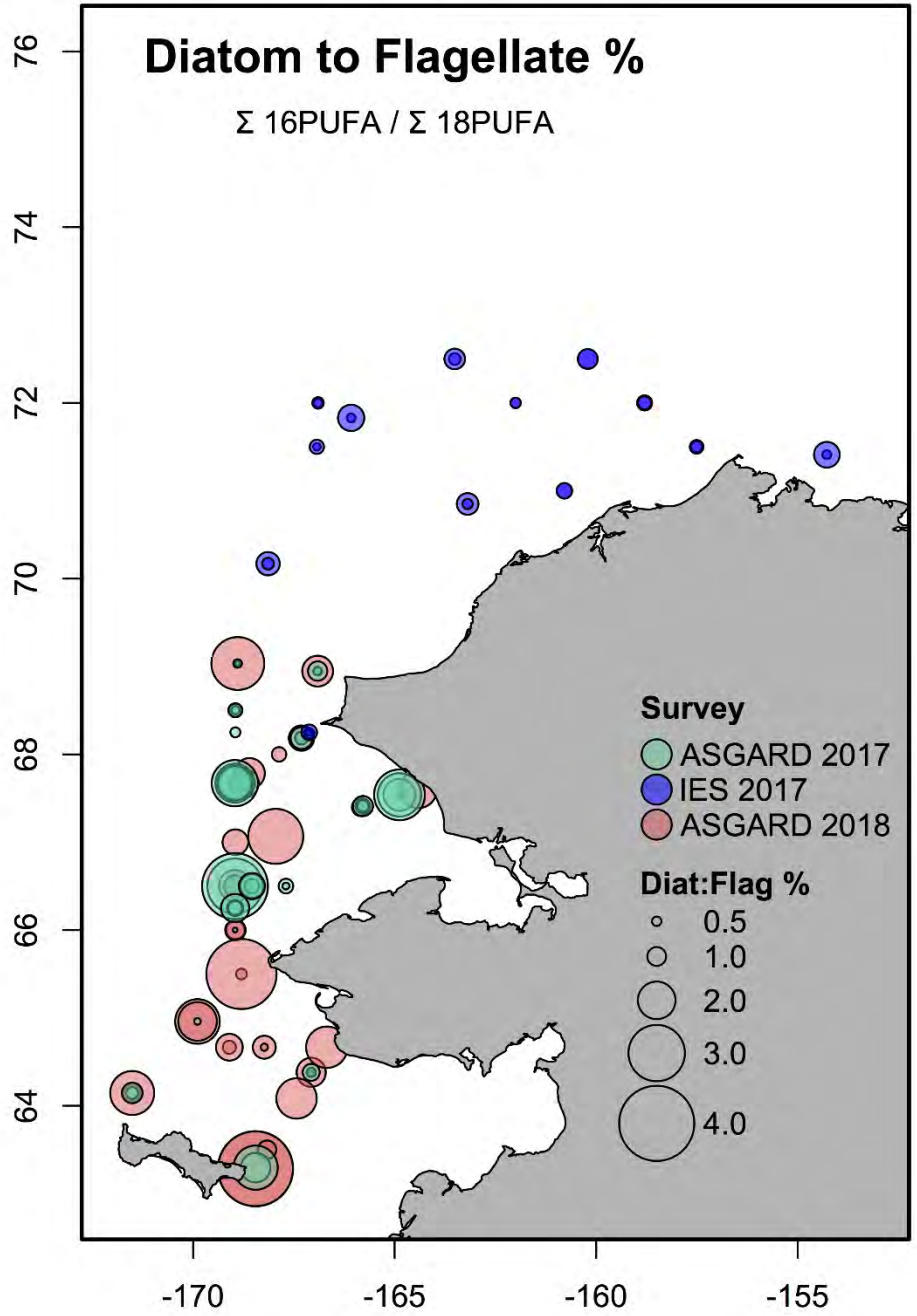


K. Axler, L. Copeman
Oregon State University

Phytoplankton Fatty Acids

Flow Cam Data





Summary

- High chla at hot spot off Pt. Hope in BSW in spring and in ACW in summer.
- Large fraction chla associated with diatoms in spring and diatoms and dinoflagellates in summer.
- In summer, more dinoflagellates north and more diatoms south. Low large and high small size fraction chla in stratified waters in NE Chukchi.
- Higher FA diatom markers in spring than summer. However, areas sampled from spring to summer had minimal overlap. Additional analysis of Flow Cam data will address seasonal differences
- ~50-100 % of POC is in small < 3 µm size-fraction in summer
- *Synechococcus* increased 100X from spring to late summer; association with ACW in summer.

What's next?

- Integrate phytoplankton data with physics and nutrients
- Evaluate potential energy transfer pathways
  - Compare fatty acids for phyt, zoo and fish
  - Overlap of in distribution of phyt, zoo, fish, seabirds, benthic invertebrates
  - Fish diet information
- The 2019 late summer data (just collected) will help with seasonal and spatial comparisons.
- Compare data to other phytoplankton research in this region