

Distributions of nutrients and dissolved organic matter in the Chukchi and Beaufort Seas

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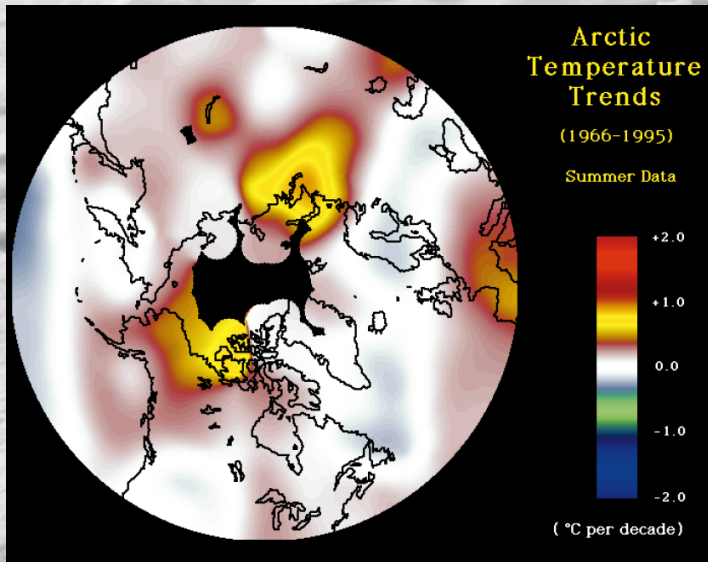
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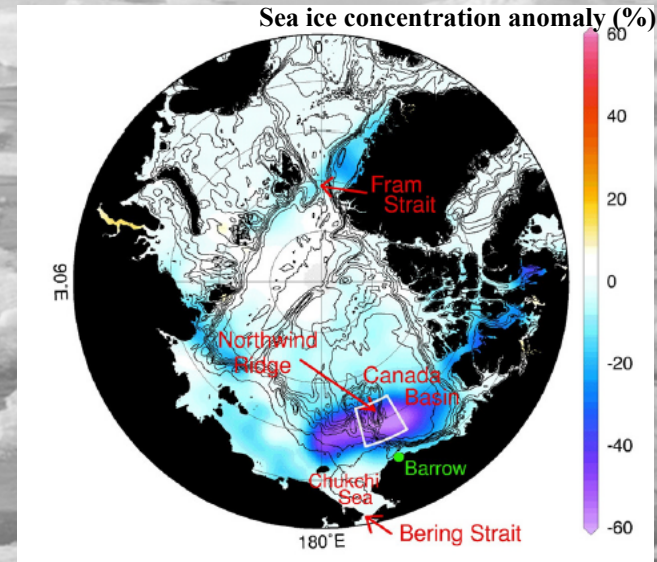
Arctic Change 2014

8-12 December - Ottawa Convention Centre - Ottawa, Canada

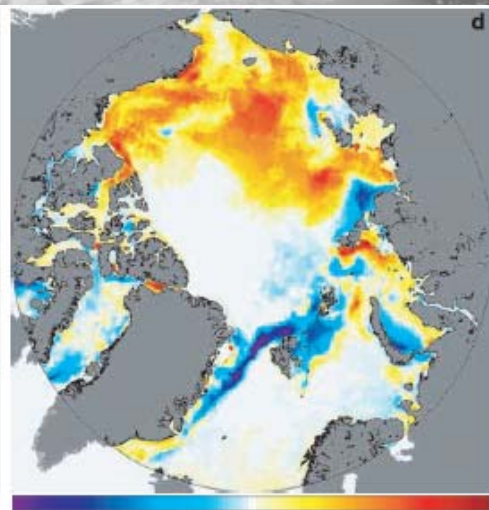
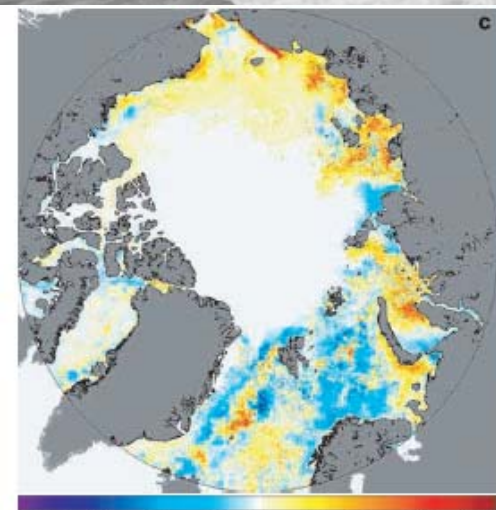
Environmental change of the Arctic Ocean



Warming (Serreze et al., 2000)



Sea ice loss (Shimada et al., 2006)



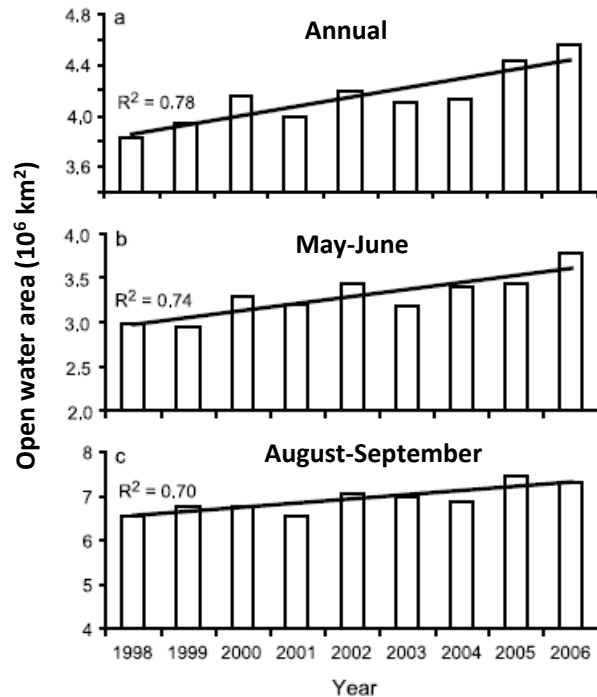
Difference in annual production, 2007-2006 ($\text{g C m}^{-2} \text{yr}^{-1}$)

Difference in growing season, 2007-2006 (days)

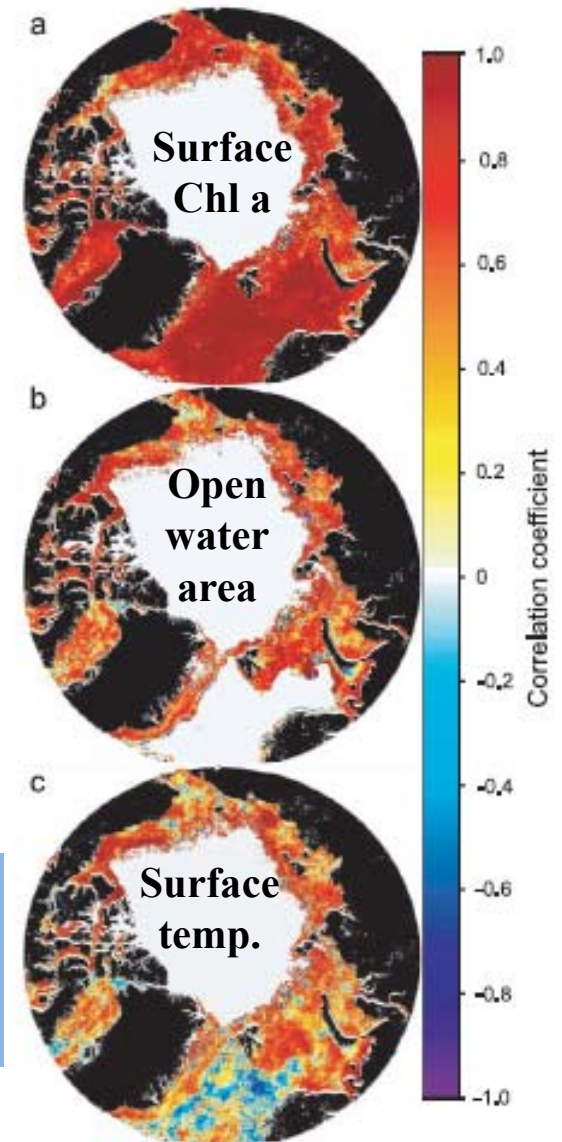
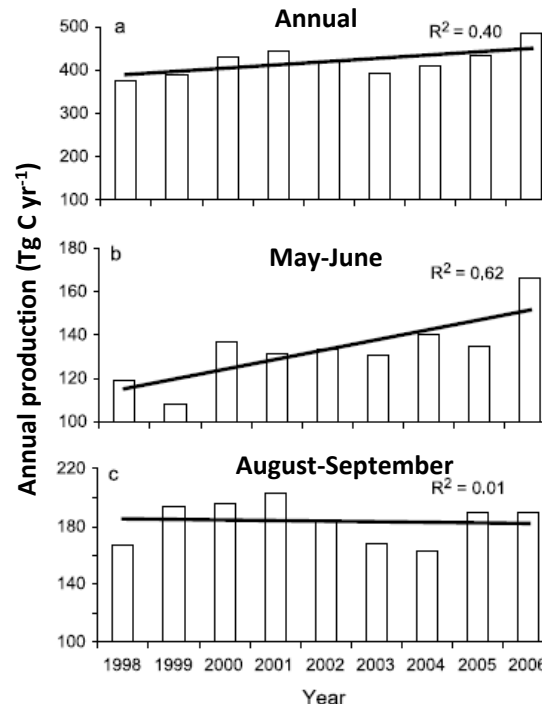
Ecosystem structure change (Arrigo et al., 2006)

Primary production in the Arctic Ocean

Open water area, 1998–2006



Primary production, 1998–2006



- Continued reductions in Arctic sea ice and the associated increase in primary production are expected to enhance organic matter flux in the Arctic Ocean.



Why dissolved organic matter?

- Dissolved organic matter (DOM) has been recognized as an important component of the oceanic carbon cycle with a pool size of 700 Pg C, which matches the amount of carbon in the atmosphere.

- Major important features for Arctic DOM biogeochemical cycle

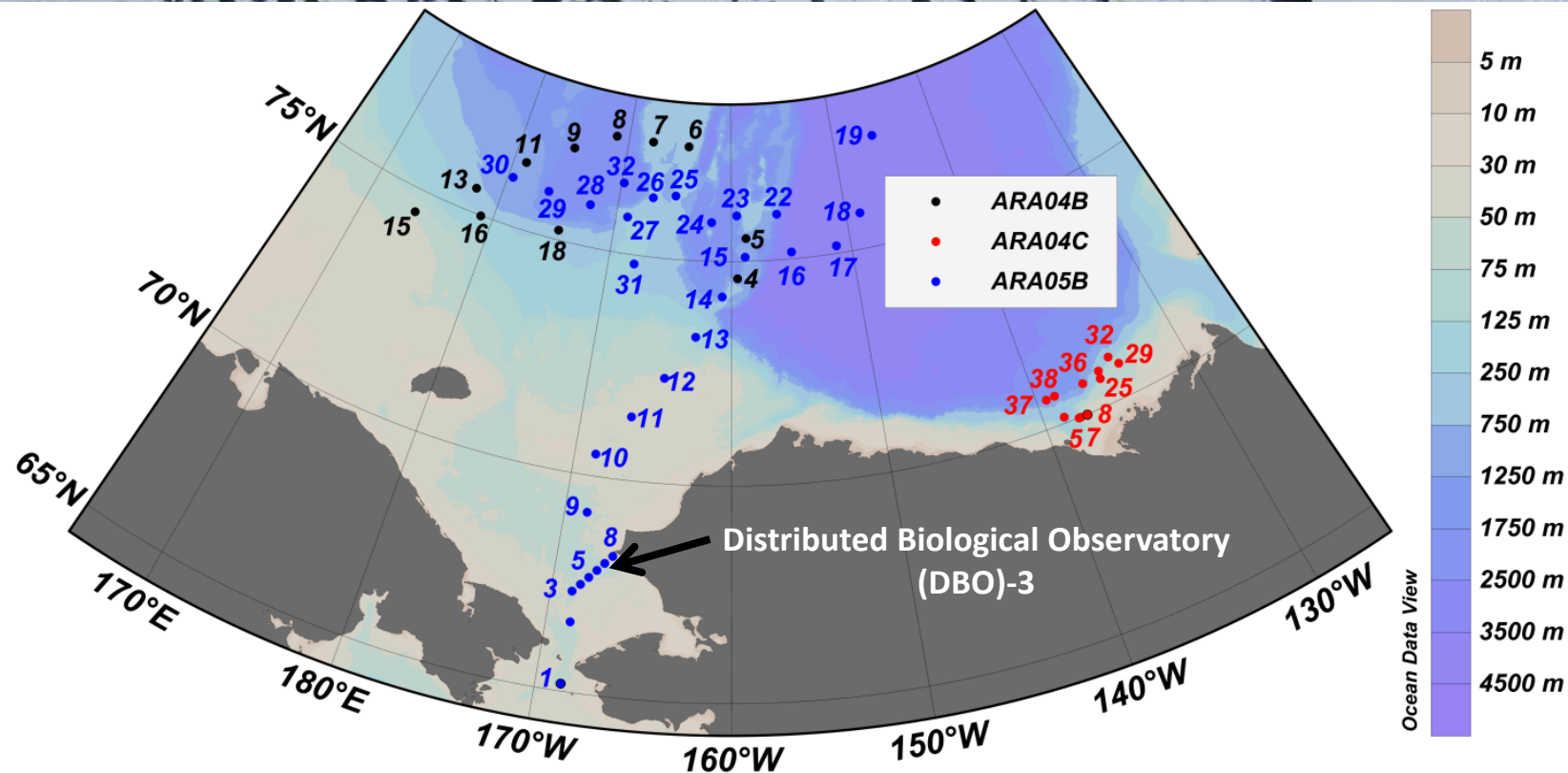
1. The large input of river water and concurrent terrestrial DOM

2. The unique vertical stratification with cold and fresh surface water on top of warmer water supplied by the Atlantic Ocean

3. The extended shelf areas on the Eurasian side of the Arctic Ocean



The Arctic Ocean surveyed in 2013 and 2014



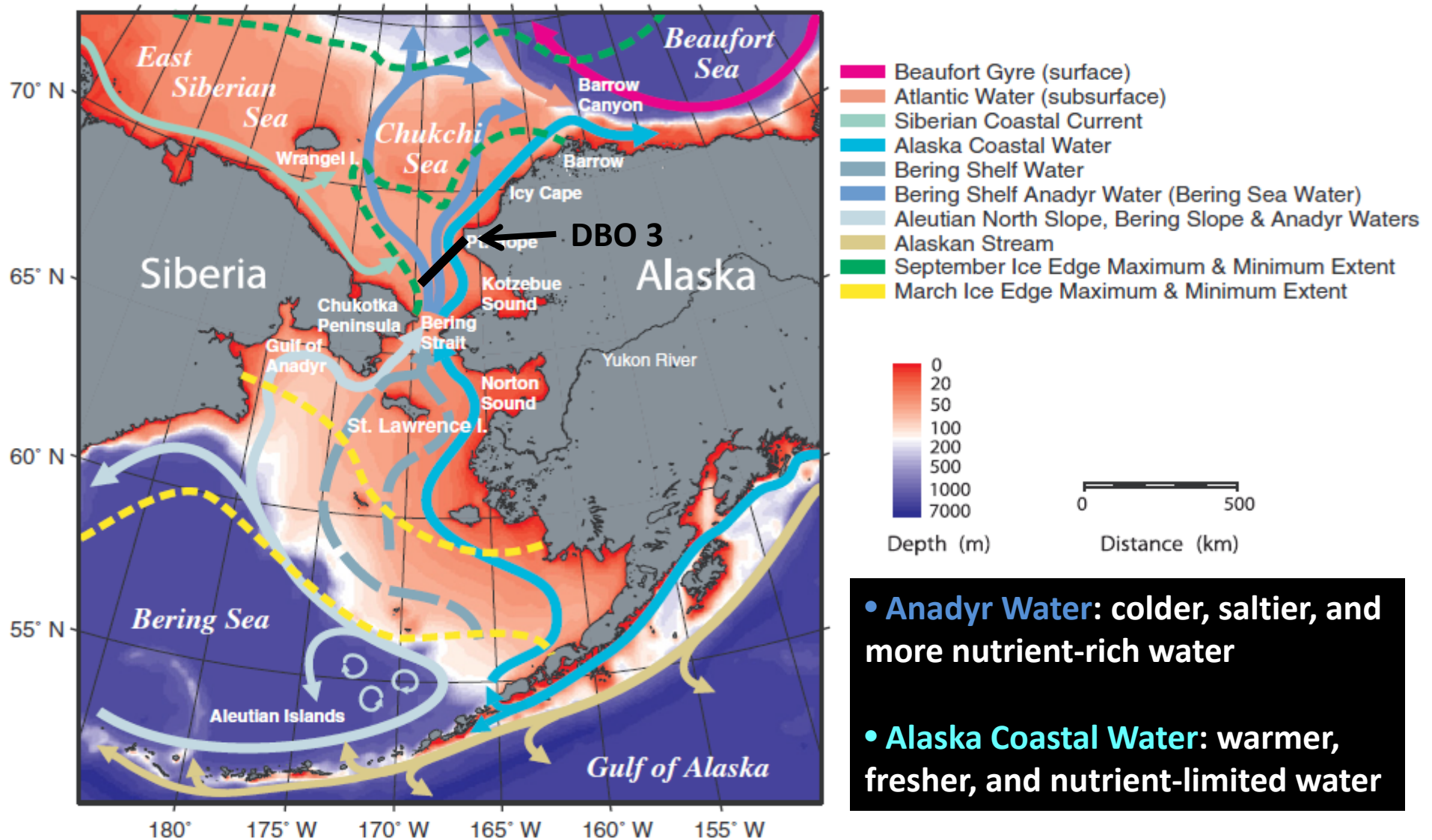
ARA04B cruise: August 25–September 1, 2013 (11 stations)

ARA04C cruise: September 7–28, 2013 (11 stations)

ARA05B cruise: July 31–August 25, 2014 (30 stations)

Nutrients (NH_4 , NO_2+NO_3 , PO_4 , SiO_2), dissolved organic carbon (DOC) and dissolved organic nitrogen (DON)

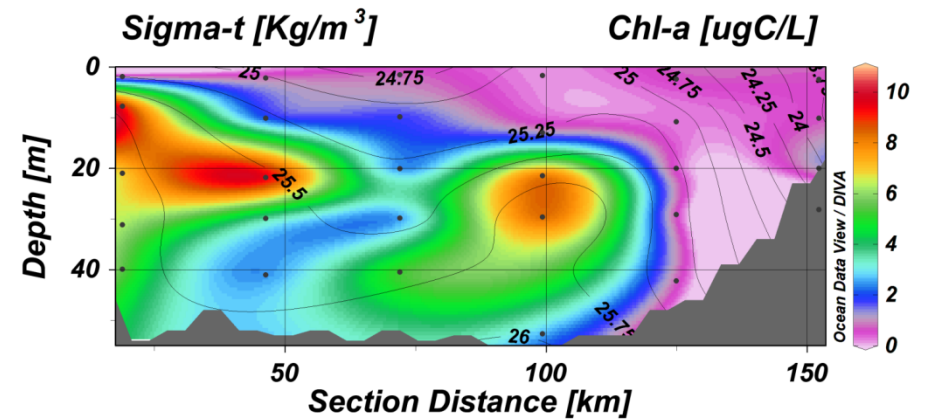
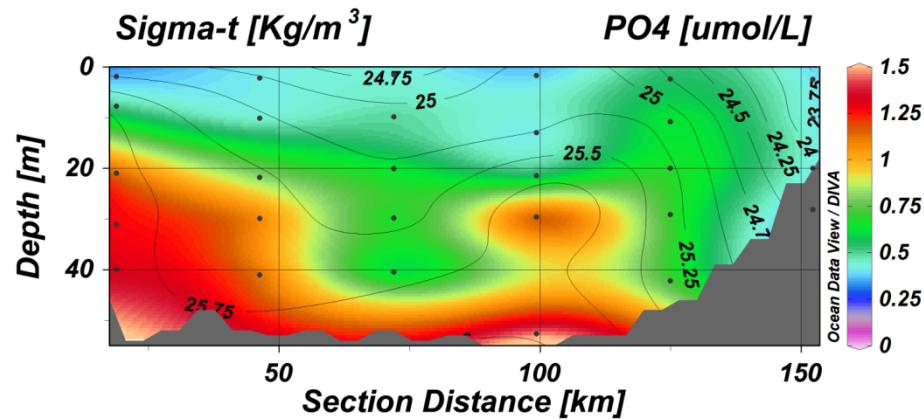
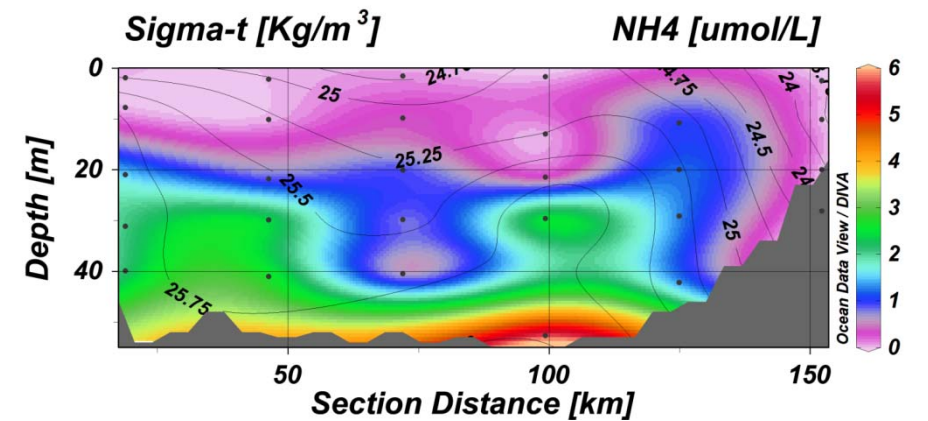
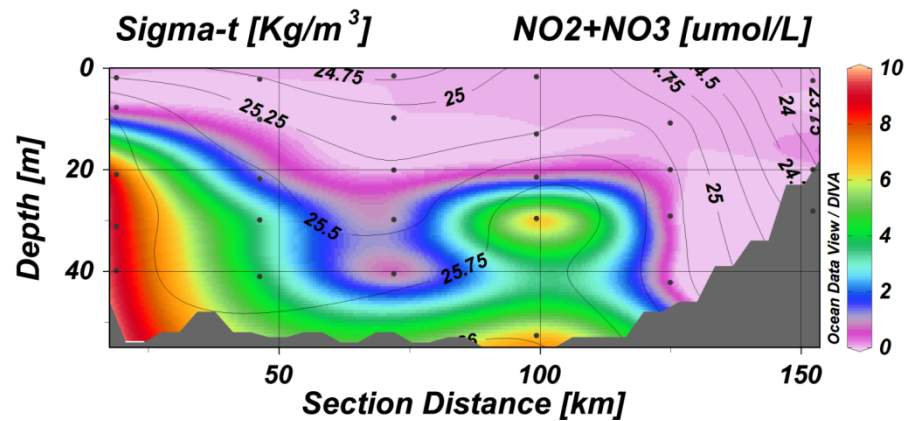
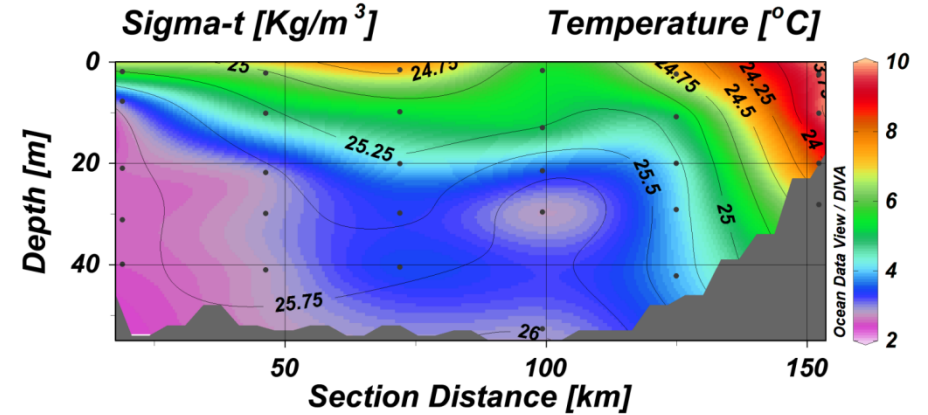
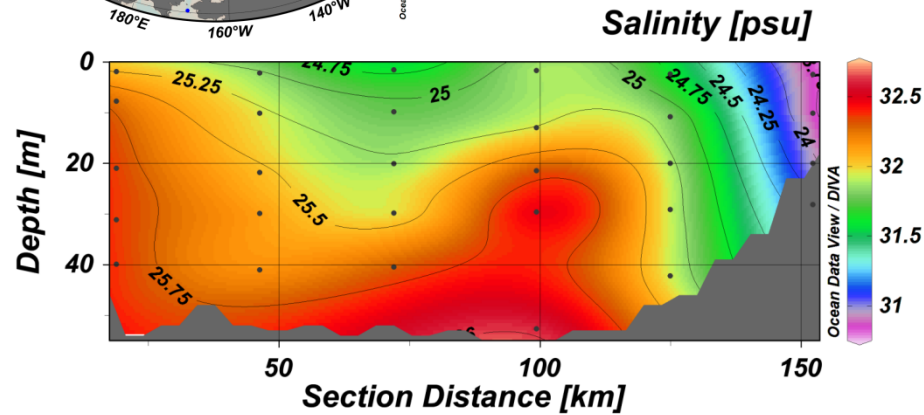
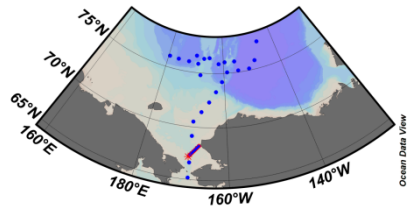
Schematic of water mass type in the northern Bering and Chukchi Seas



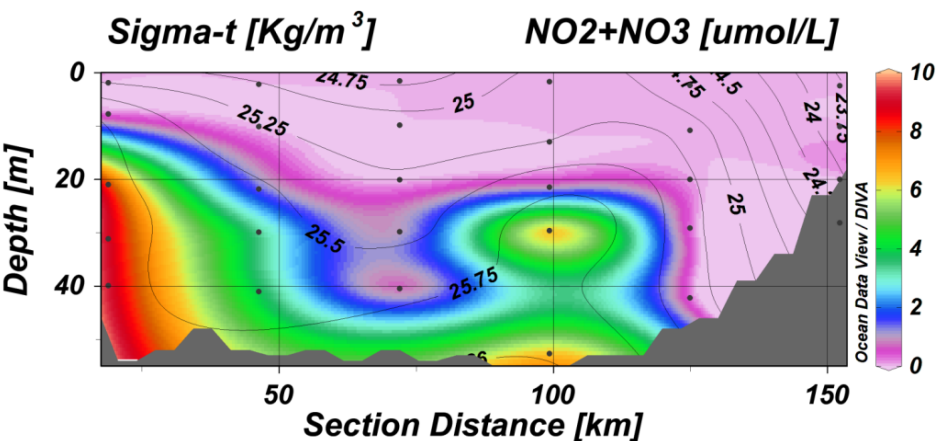
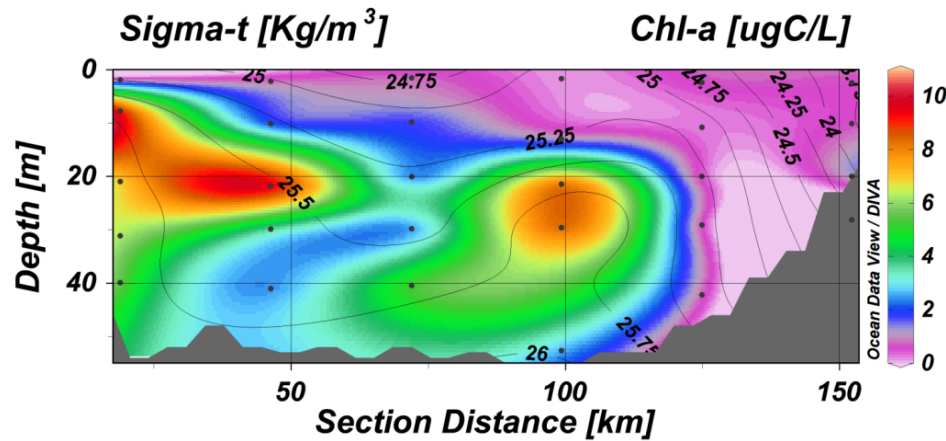
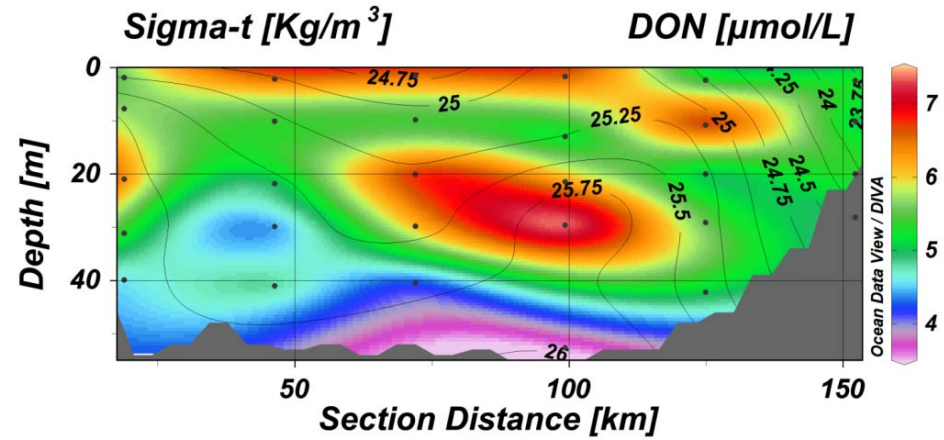
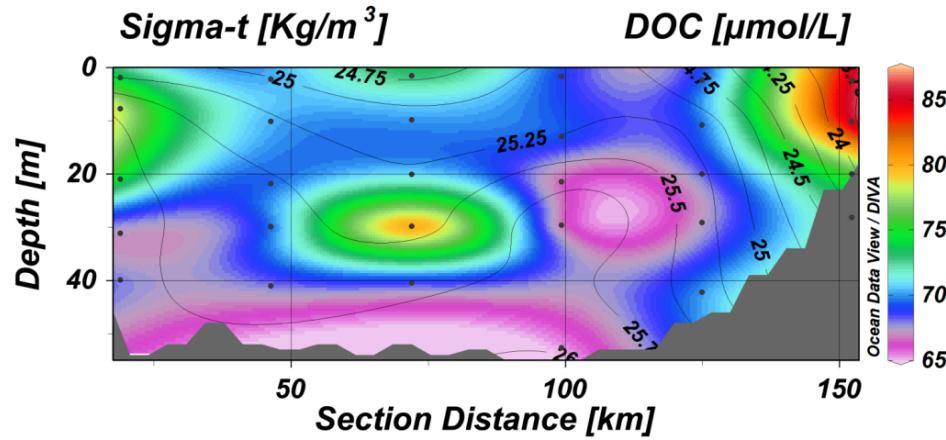
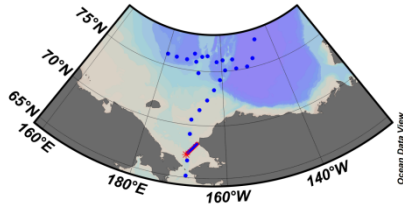
(Grebmeier et al., 2006)

- **Anadyr Water:** colder, saltier, and more nutrient-rich water
- **Alaska Coastal Water:** warmer, fresher, and nutrient-limited water

Nutrients in the DBO3

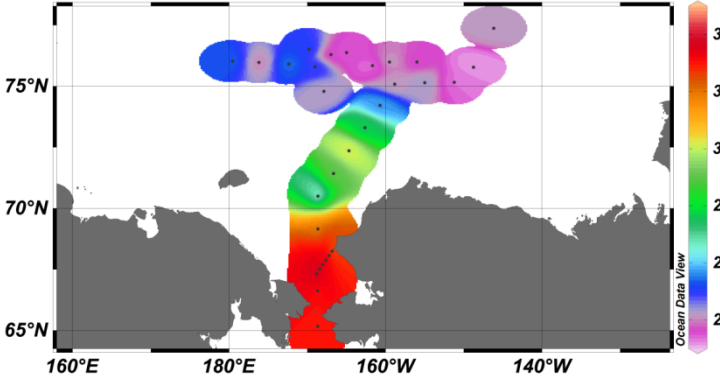


DOMs in the DBO3

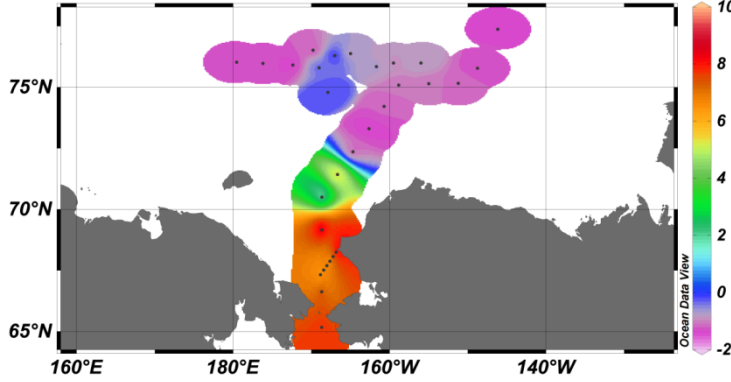


Surface water in the Chukchi Sea

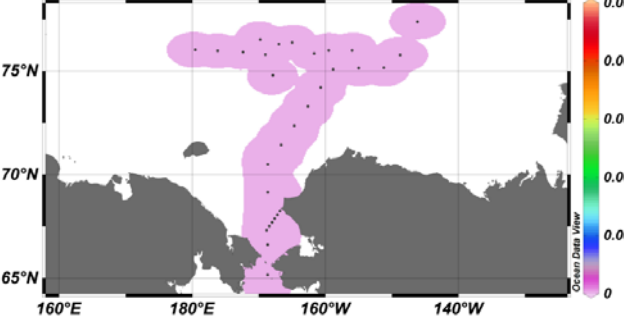
Salinity [psu] @ Depth [m]=first



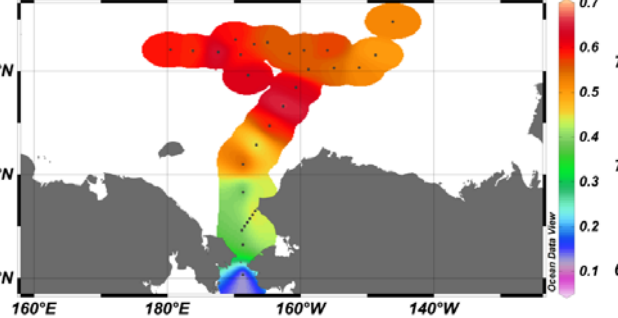
Temperature [°C] @ Depth [m]=first



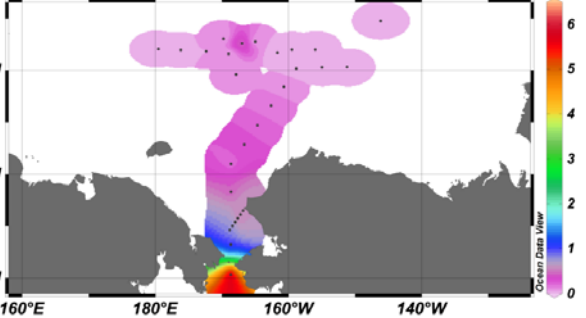
NO₂+NO₃ [μmol/L] @ Depth [m]=first



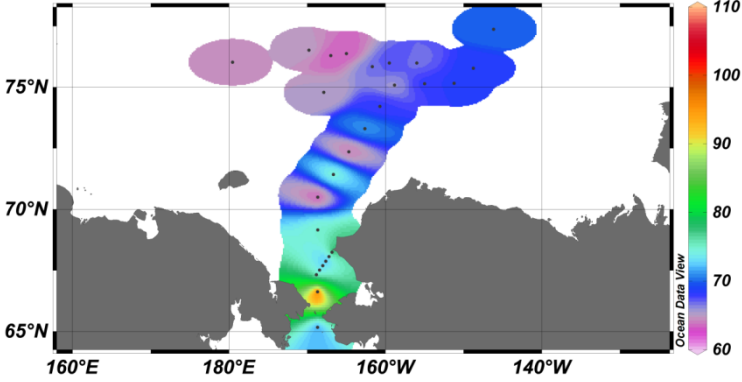
PO₄ [μmol/L] @ Depth [m]=first



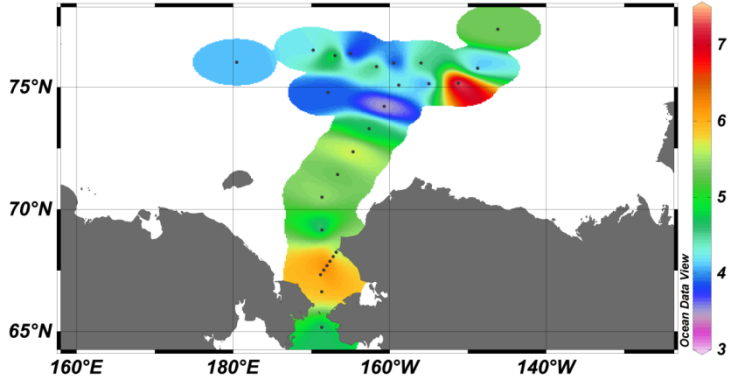
Chl-a [ugC/L] @ Depth [m]=first



DOC [μmol/L] @ Depth [m]=first

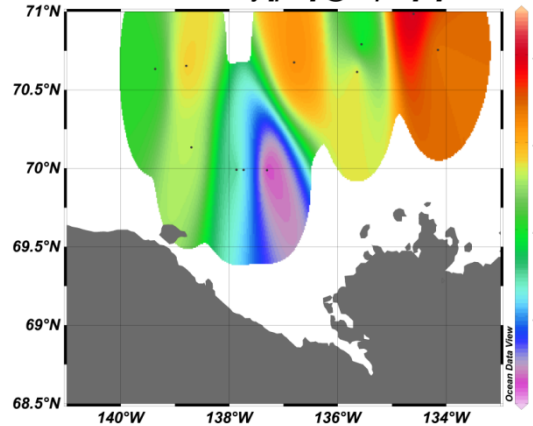


DON [μmol/L] @ Depth [m]=first

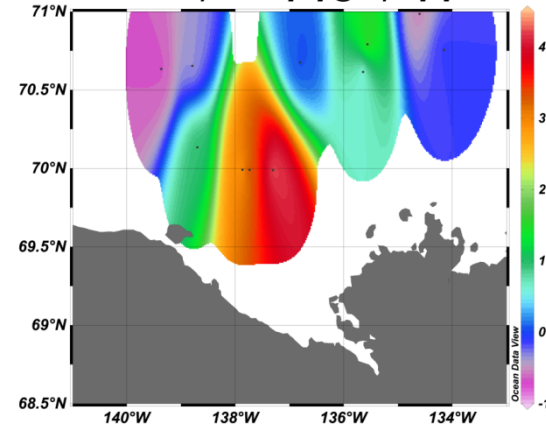


Surface water in the Beaufort Sea

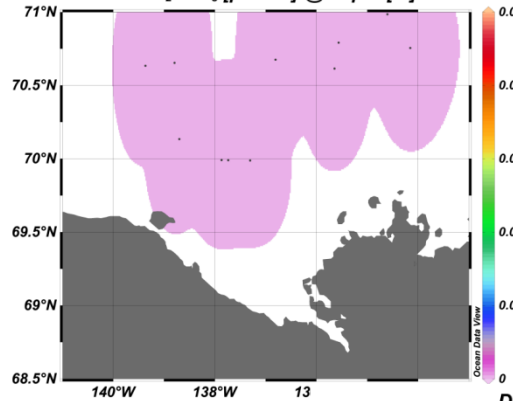
Salinity [psu] @ Depth [m]=first



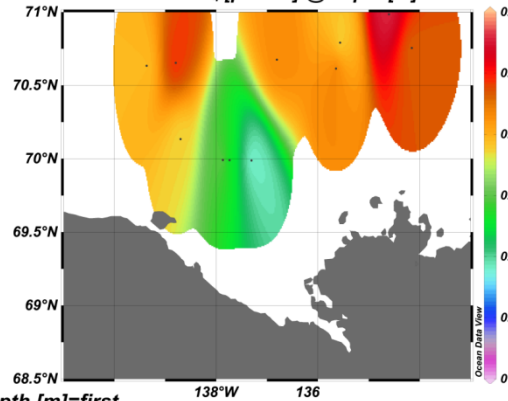
Temperature [°C] @ Depth [m]=first



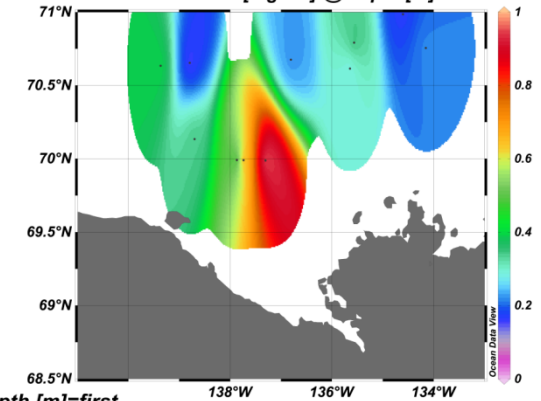
NO₂+NO₃ [μmol/L] @ Depth [m]=first



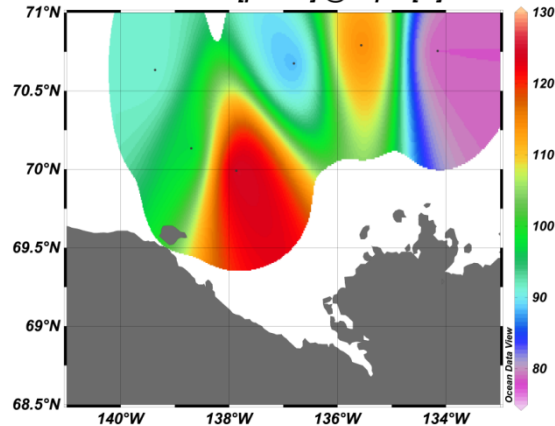
PO₄ [μmol/L] @ Depth [m]=first



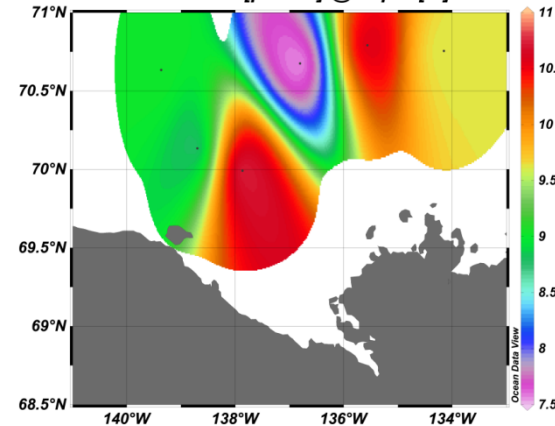
Fluorescence [mg/m³] @ Depth [m]=first



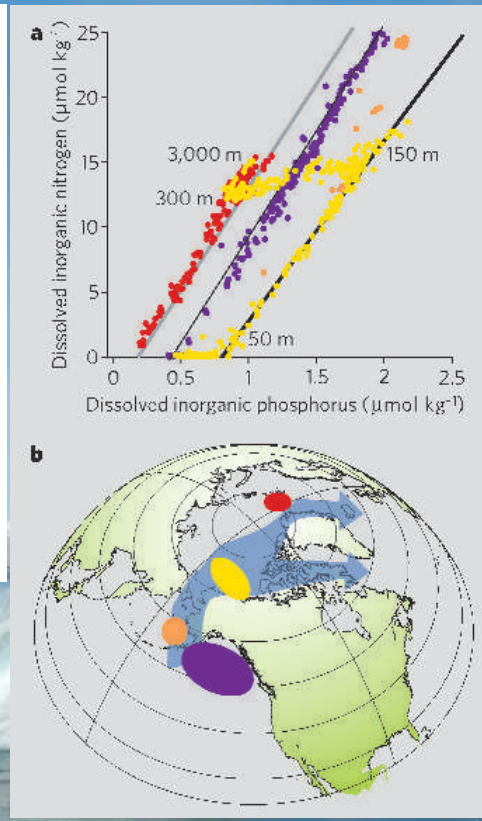
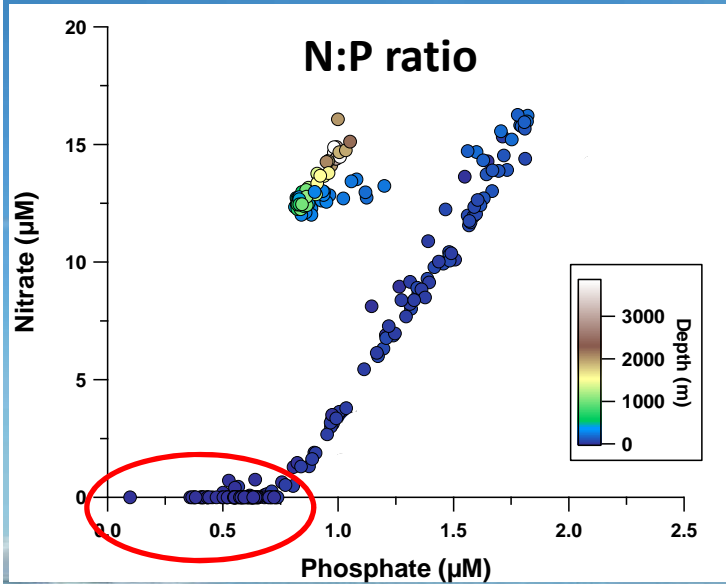
DOC [μmol/L] @ Depth [m]=first



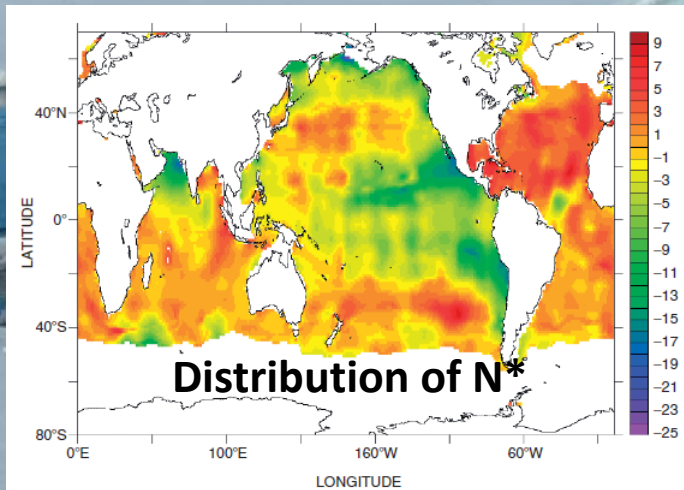
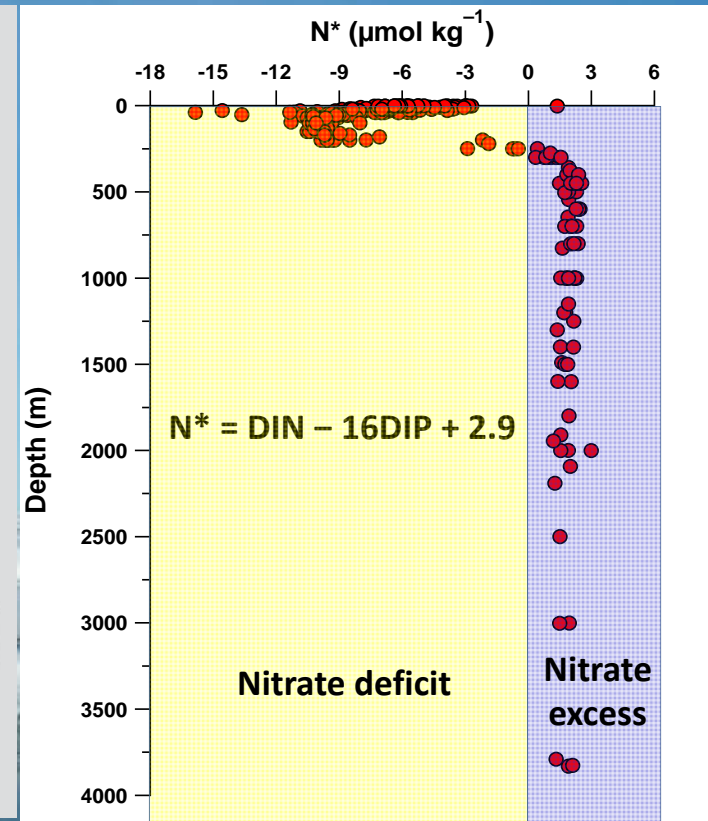
DON [μmol/L] @ Depth [m]=first



Role of the Arctic throughflow



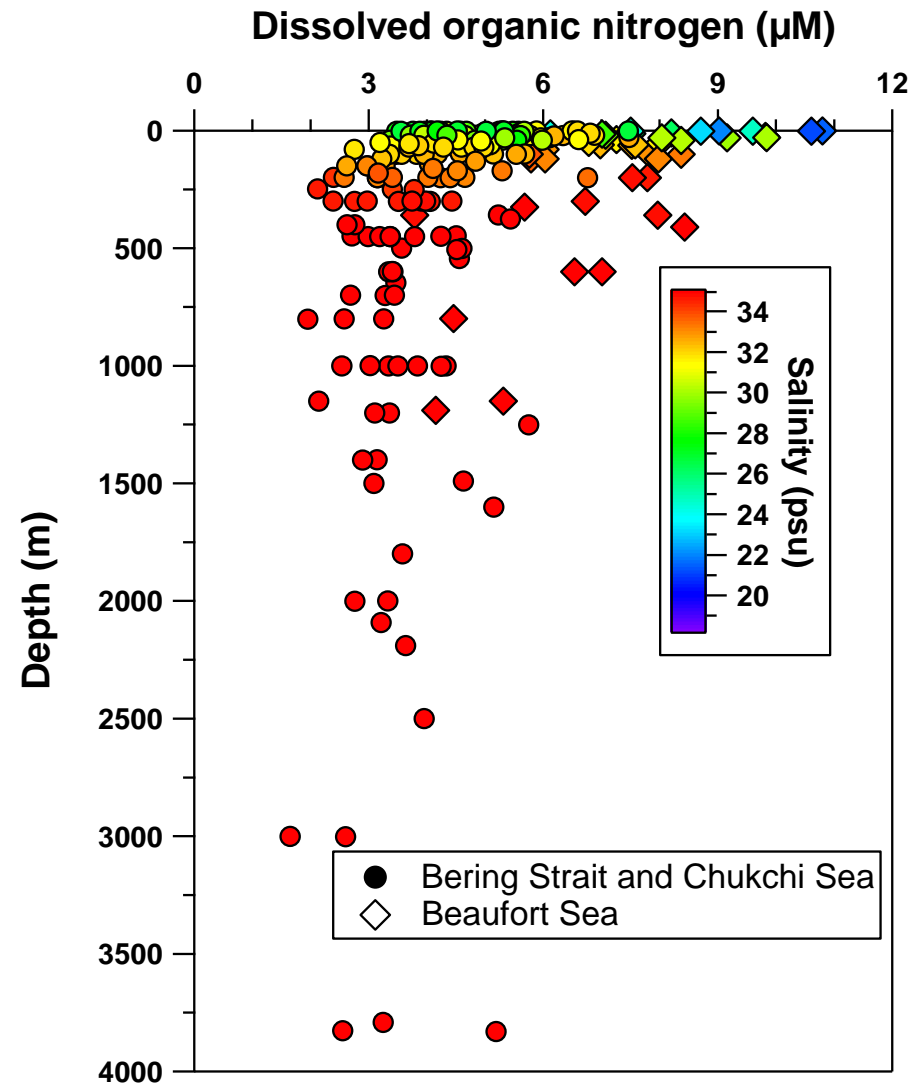
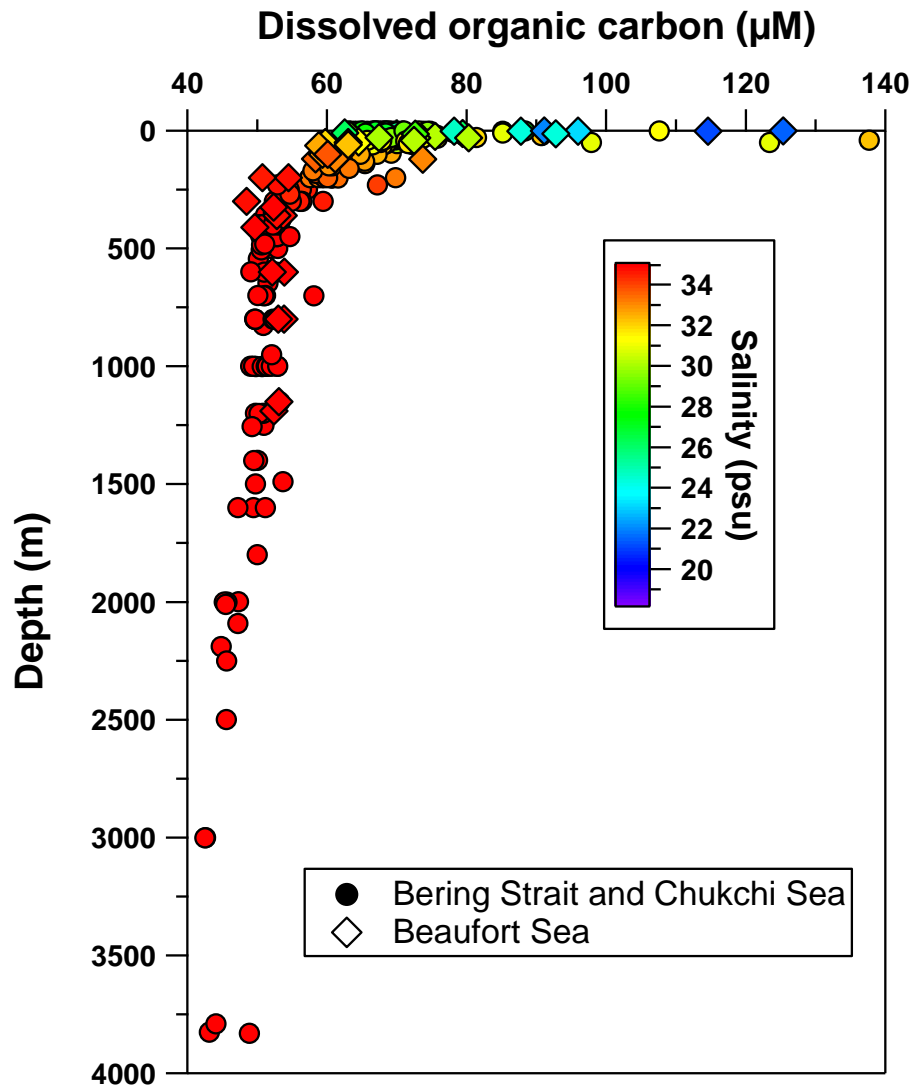
(Yamato-Kawai et al., 2006)



(Devol et al., 2008)

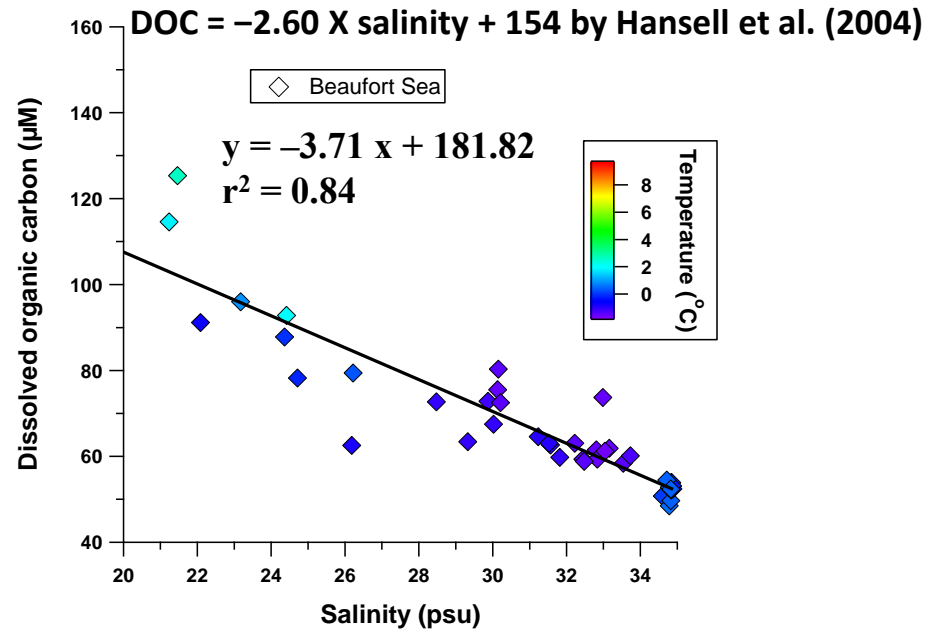
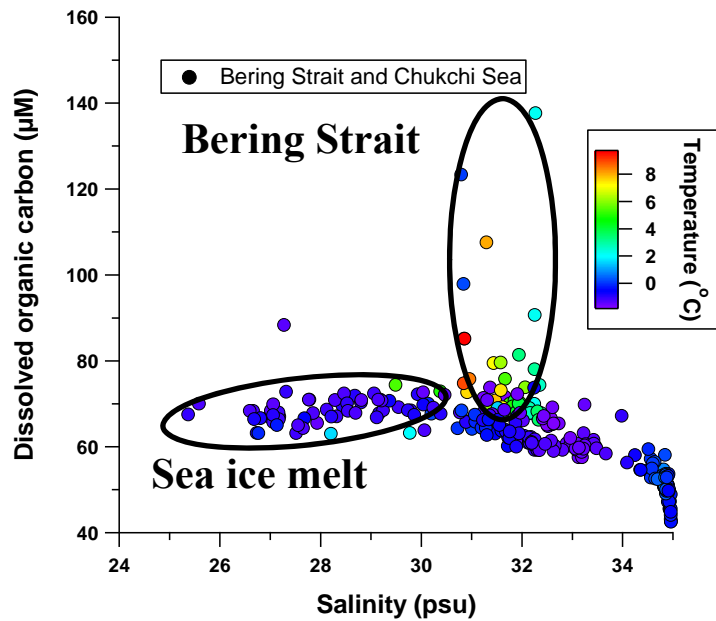
- The Arctic Ocean receives water from the Pacific Ocean, which is depleted in nitrate through the Bering Strait.
- Variations in N^* reflect only the net impact of nitrogen fixation and denitrification.
- The Arctic throughflow contributes to nitrogen fixation in the Atlantic Ocean.

Vertical distributions of DOC and DON

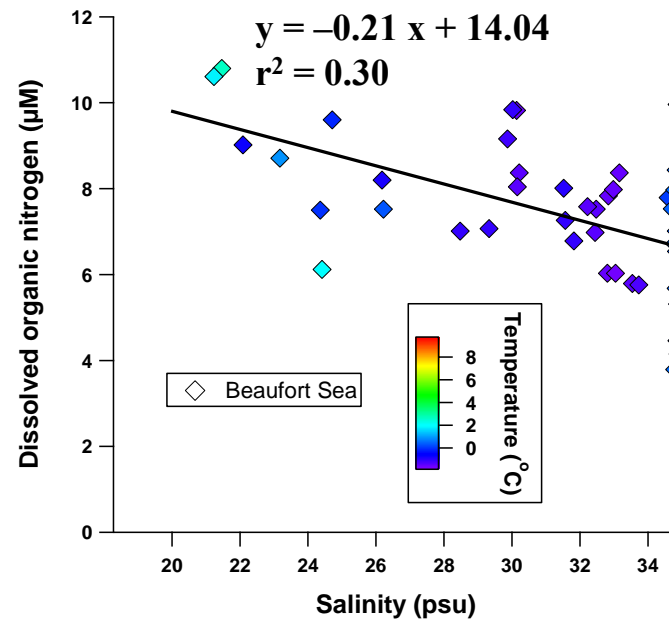
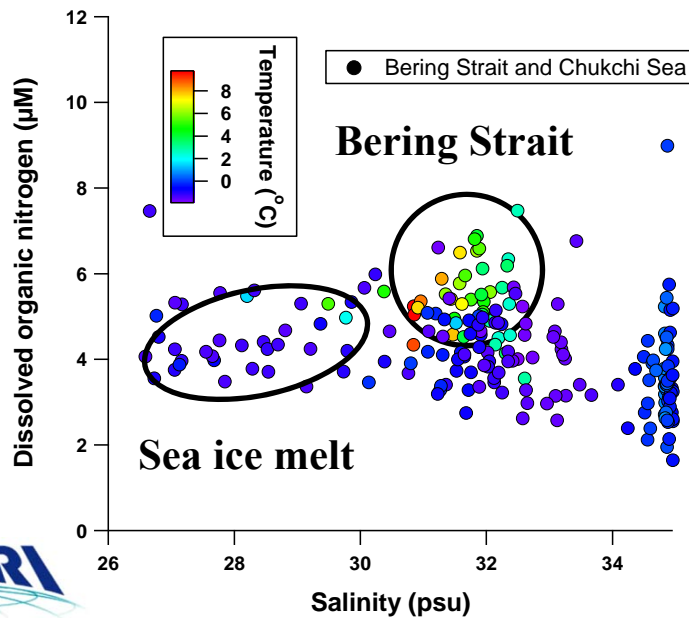


Salinity-DOM relationships

DOC



DON



Summary

- The distributions of nutrients, dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) were investigated in the Bering Strait, Chukchi and Beaufort Seas during the summer periods of 2013 and 2014.
- The characteristics of Anadyr Water and Alaska Coastal Water were clearly observed in the DBO-3.
- The vertical distribution of N^* suggested that that excess phosphate from Pacific origin water provides favorable condition for nitrogen fixation in the Atlantic Ocean.
- The vertical distributions and relationships of DOC and DON with salinity suggested that terrigenous DON is more resistant to microbial degradation than DOC. To improve our understanding of DOM biogeochemical cycle, future fieldwork should focus on the degradation mechanism of DOM through co-work with biological groups.





Thank you for your attention!