

Spatial distributions of nutrients, dissolved organic carbon and nitrogen in the Chukchi and Beaufort Seas

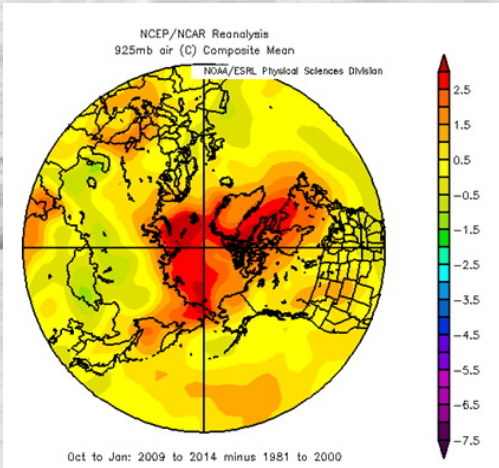
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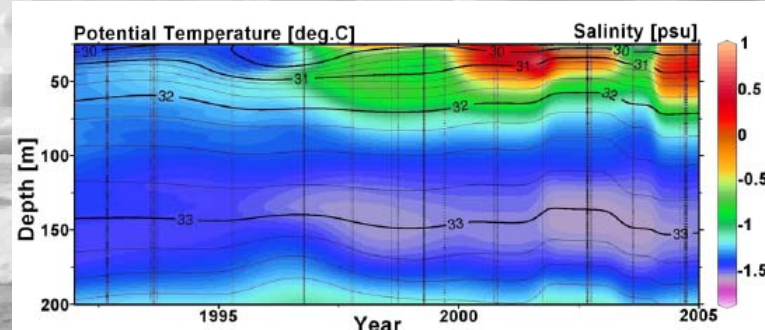
²Hanyang University, Ansan, Gyeonggi-do 426-791, Republic of Korea



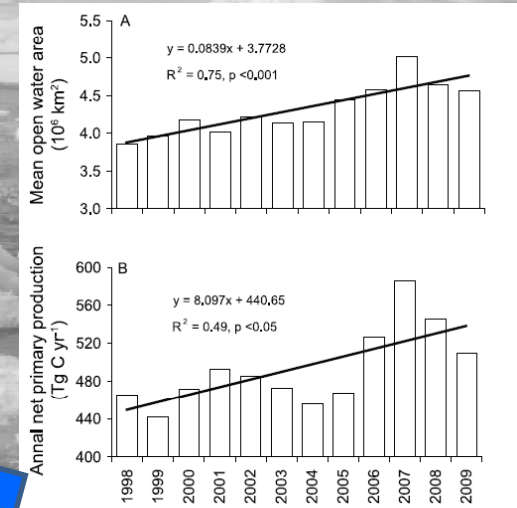
Environmental change of the Arctic Ocean



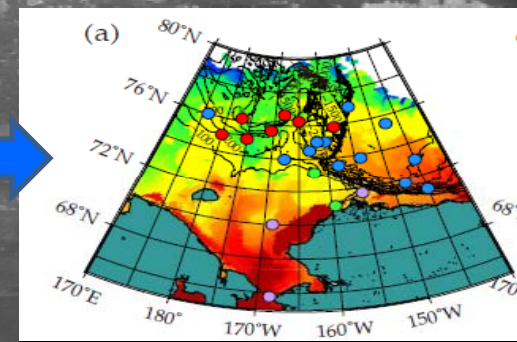
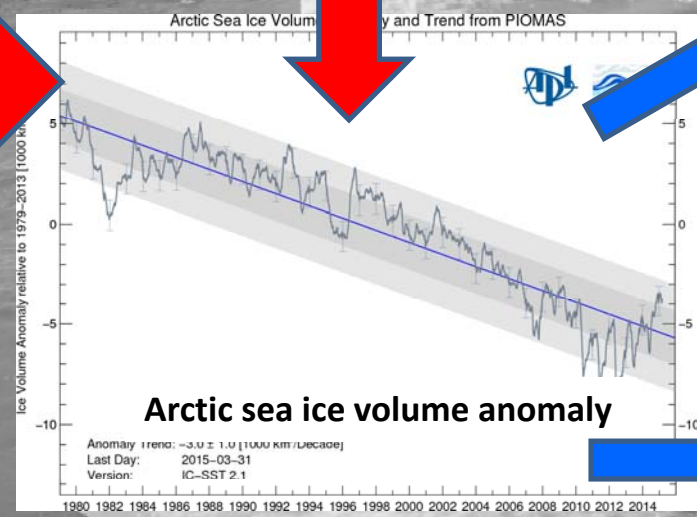
Warming
(Overland et al., 2014)



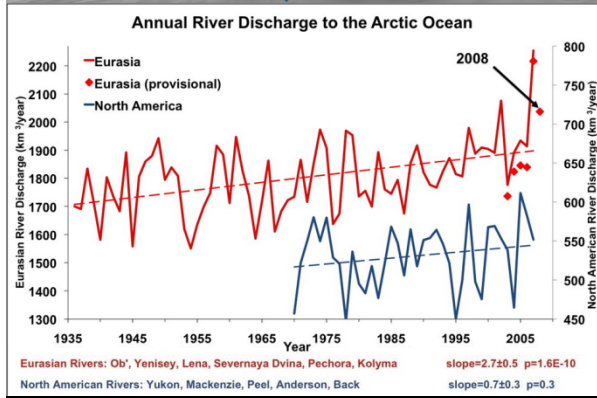
Advection of warm water
(Shimada et al., 2006)



Increases in open water area and primary production
(Arrigo and Dijken, 2011)



Phytoplankton structure change
(Fujiwara et al., 2014)



Increases in river discharge
(Shiklomanov, 2009)

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.

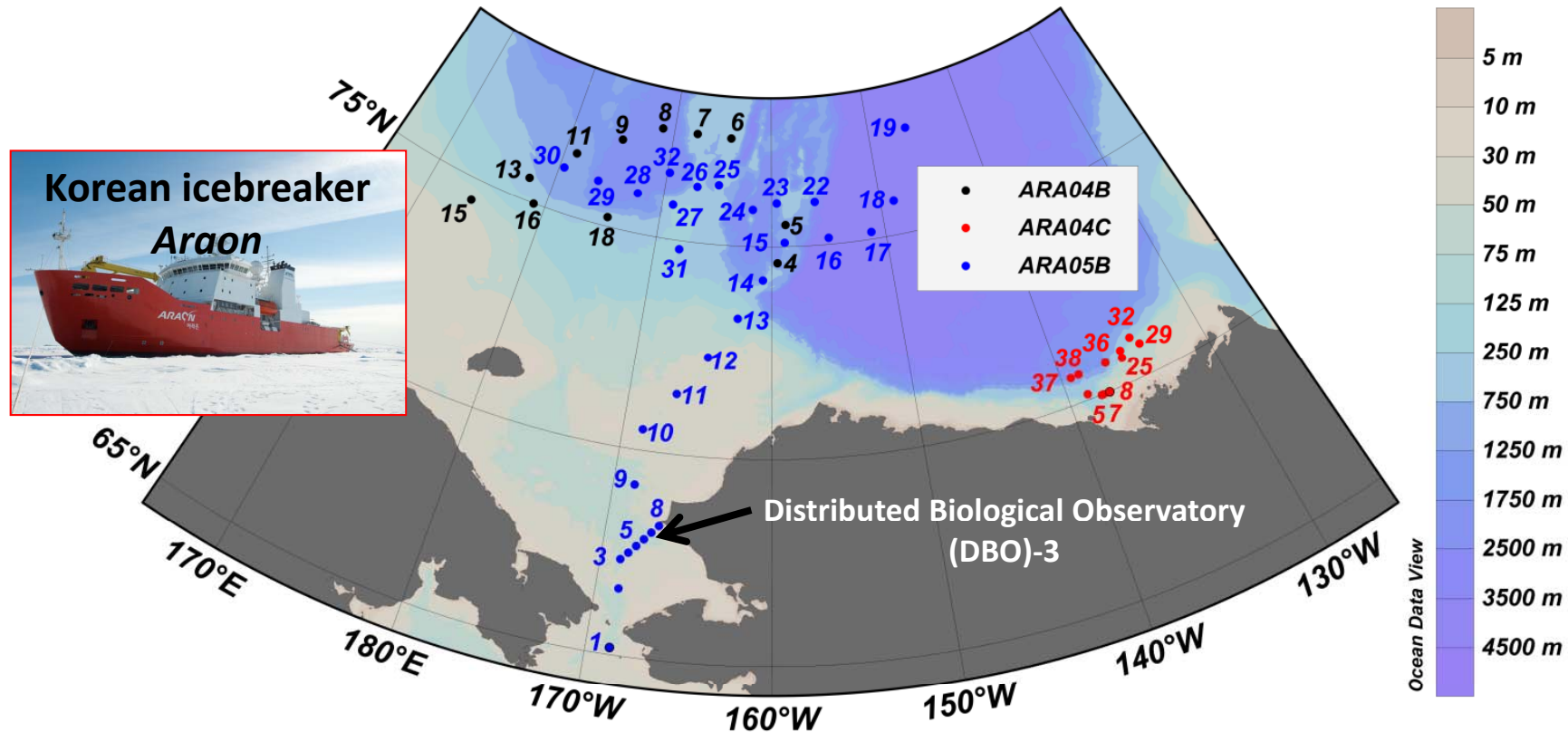
- **Major important features for Arctic DOM biogeochemical cycle**

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

Research stations surveyed in 2013 and 2014



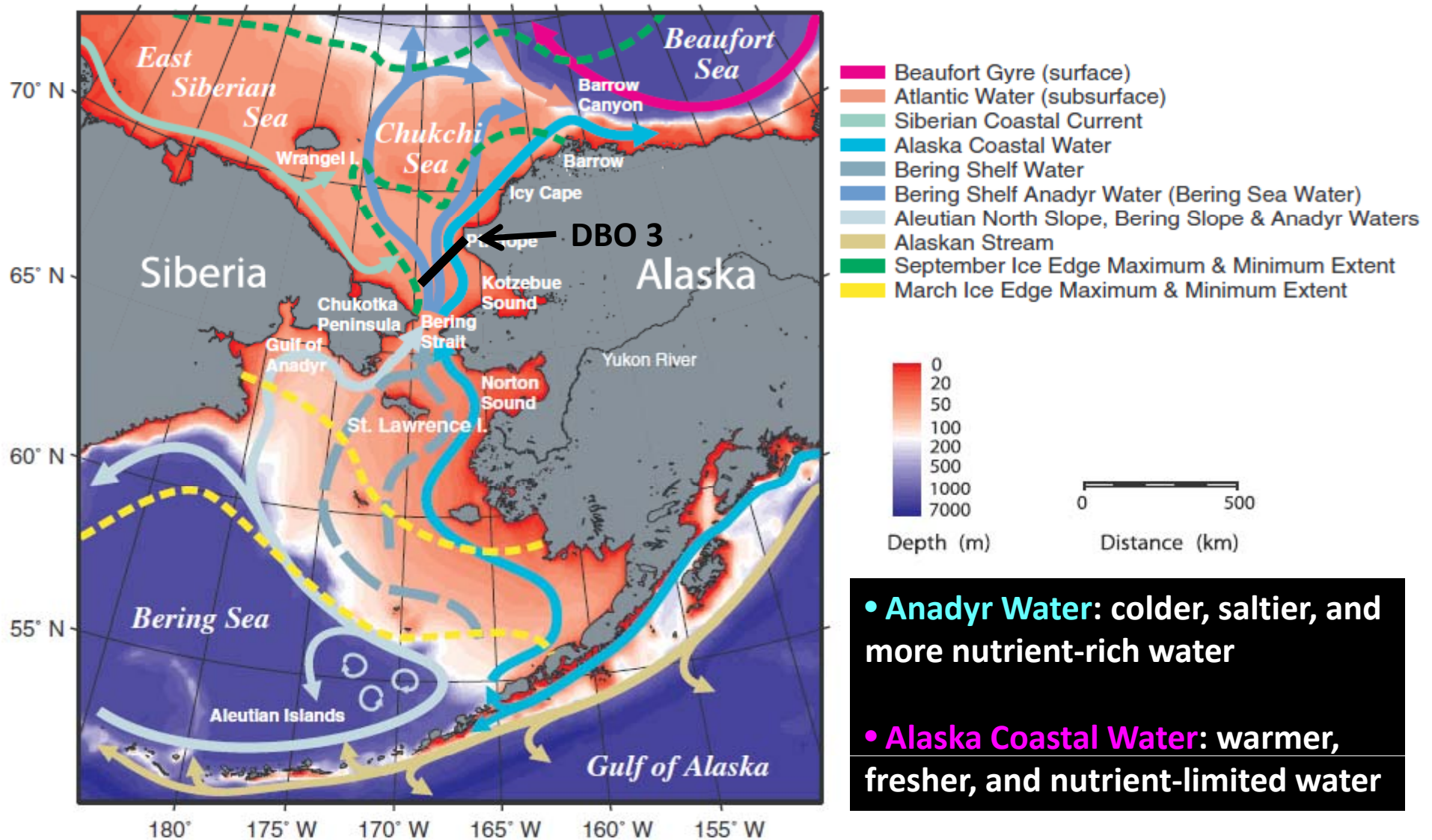
ARA04B cruise: August 25–September 1, 2013 (11 stations)

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

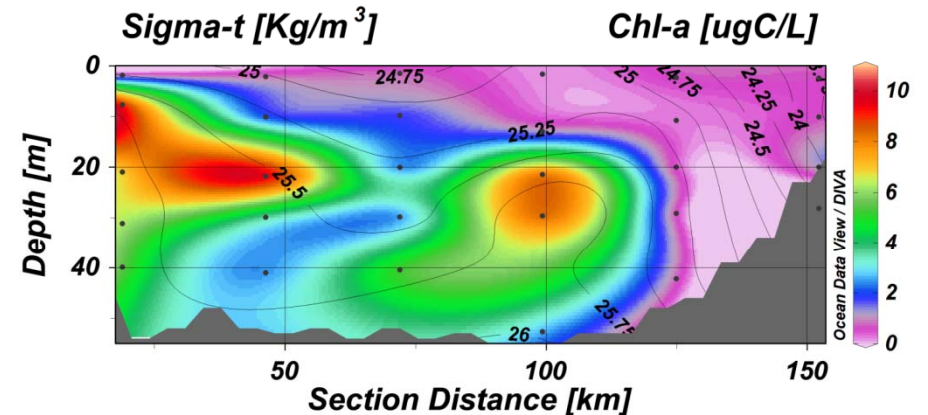
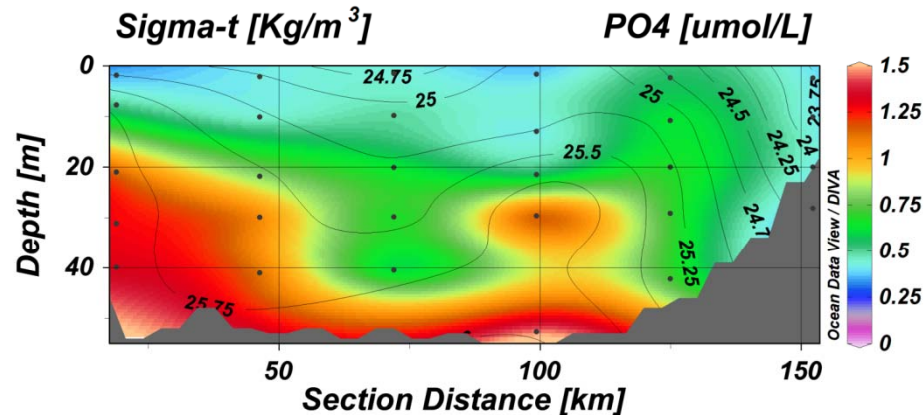
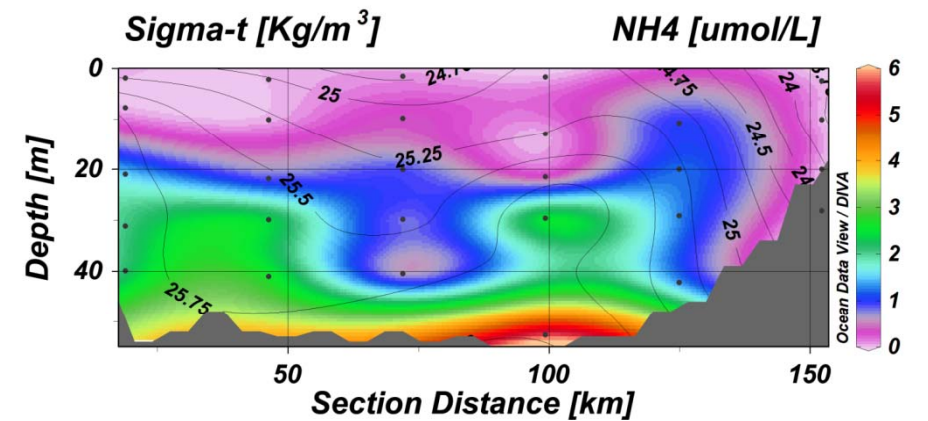
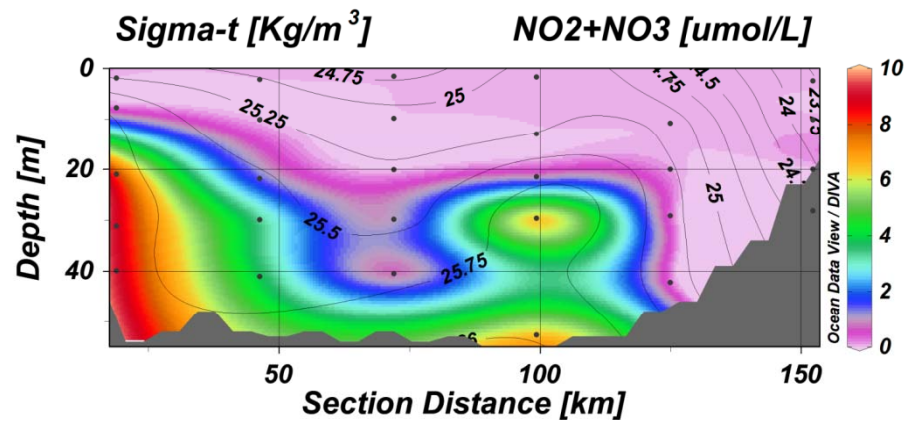
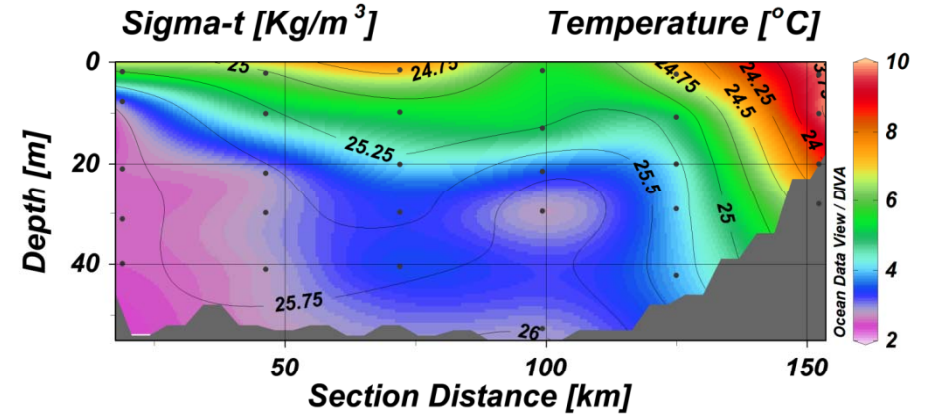
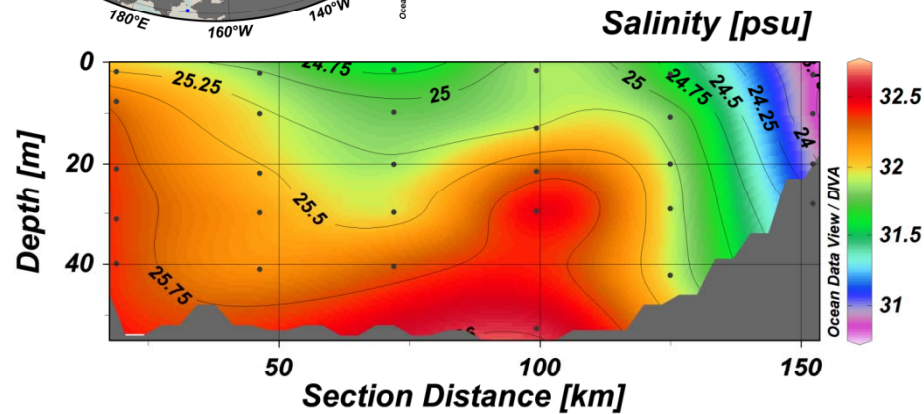
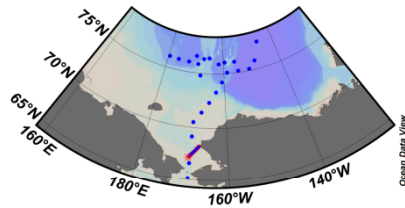


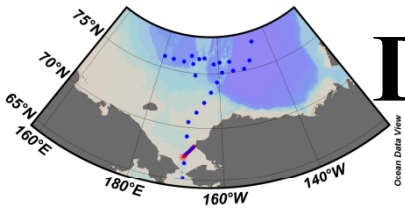
• **Anadyr Water:** colder, saltier, and more nutrient-rich water

• **Alaska Coastal Water:** warmer, fresher, and nutrient-limited water

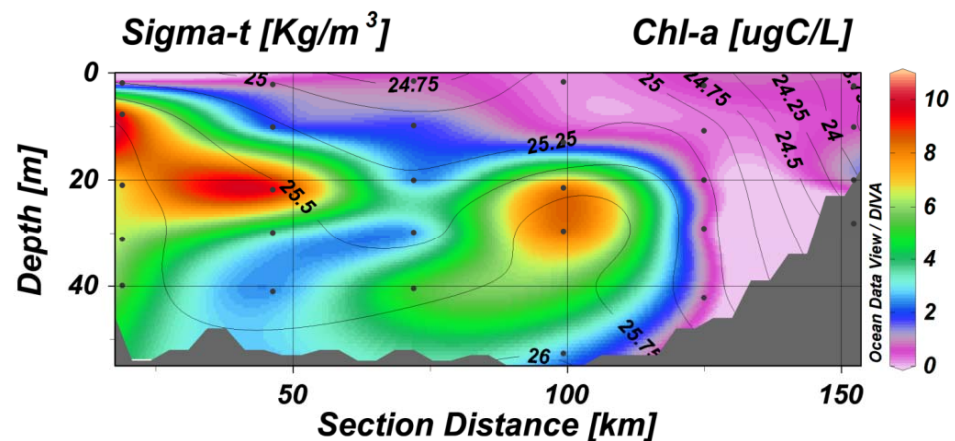
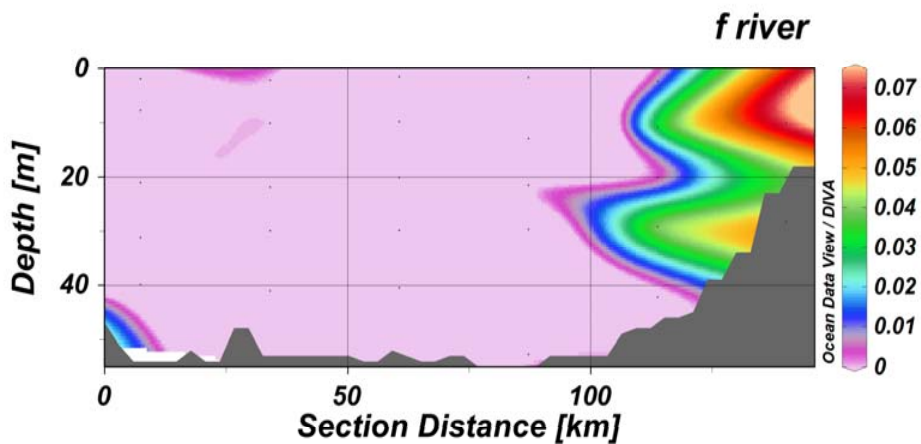
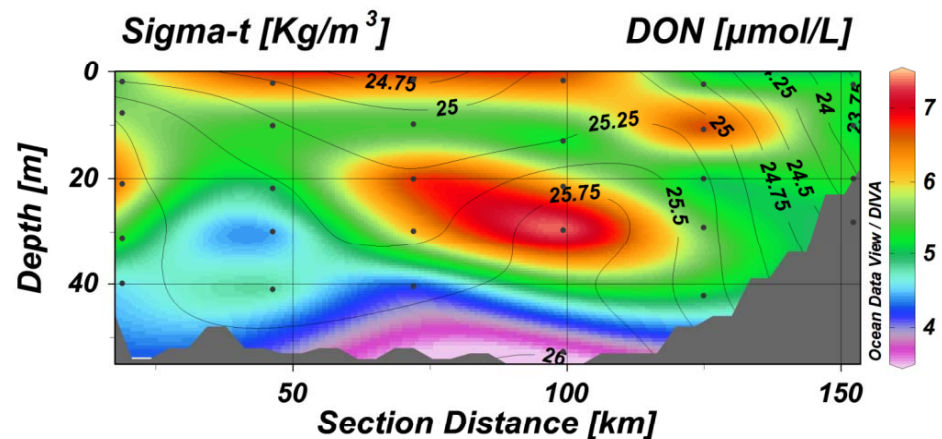
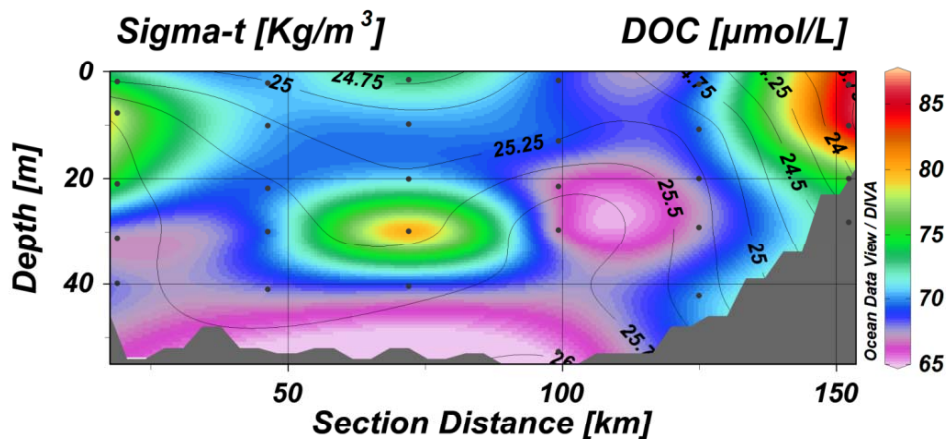
(Grebmeier et al., 2006)

Nutrients in the DBO3

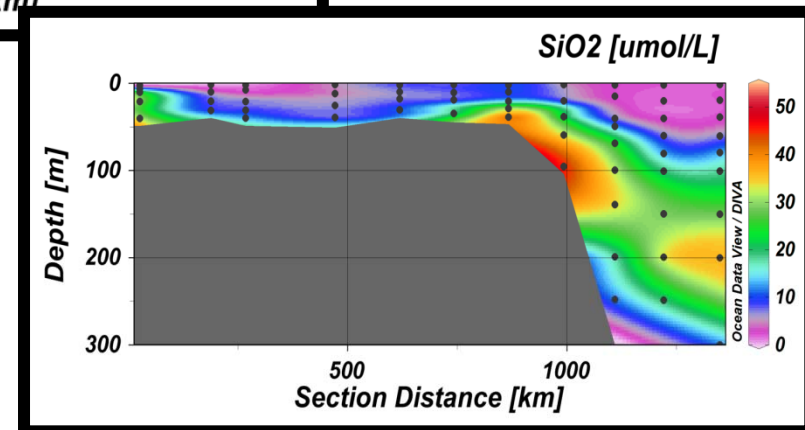
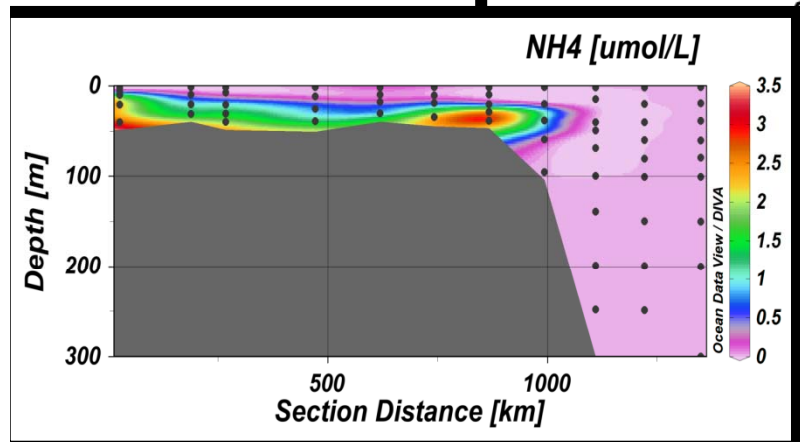
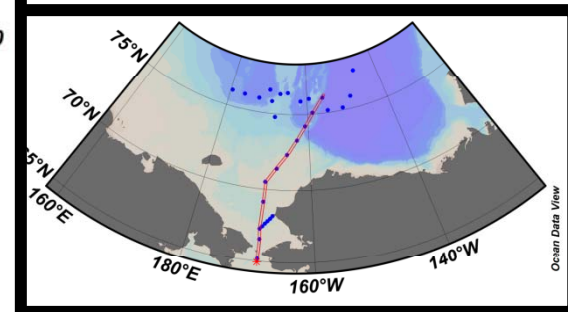
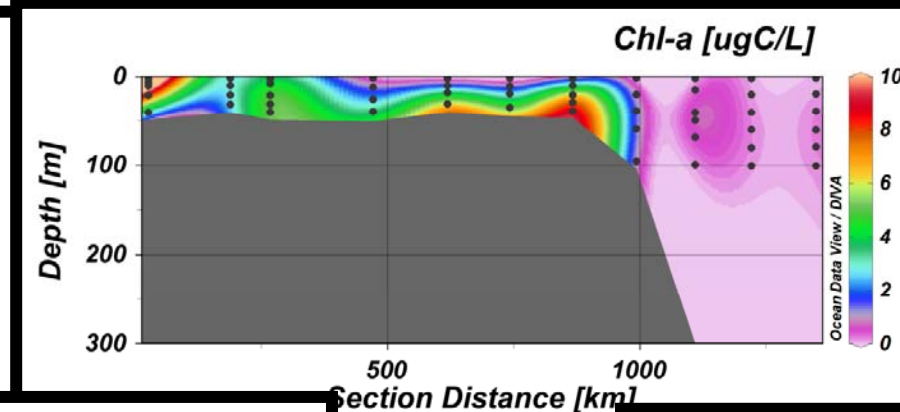
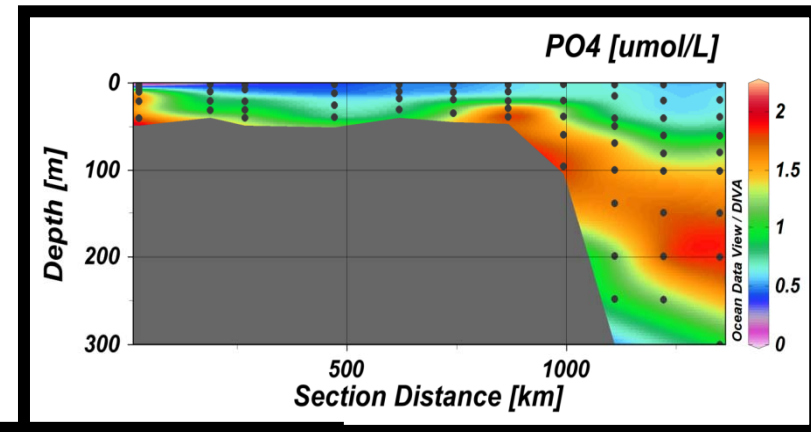
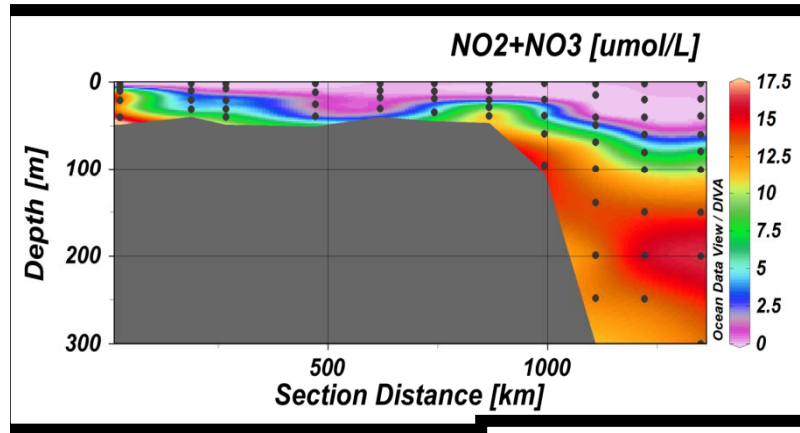




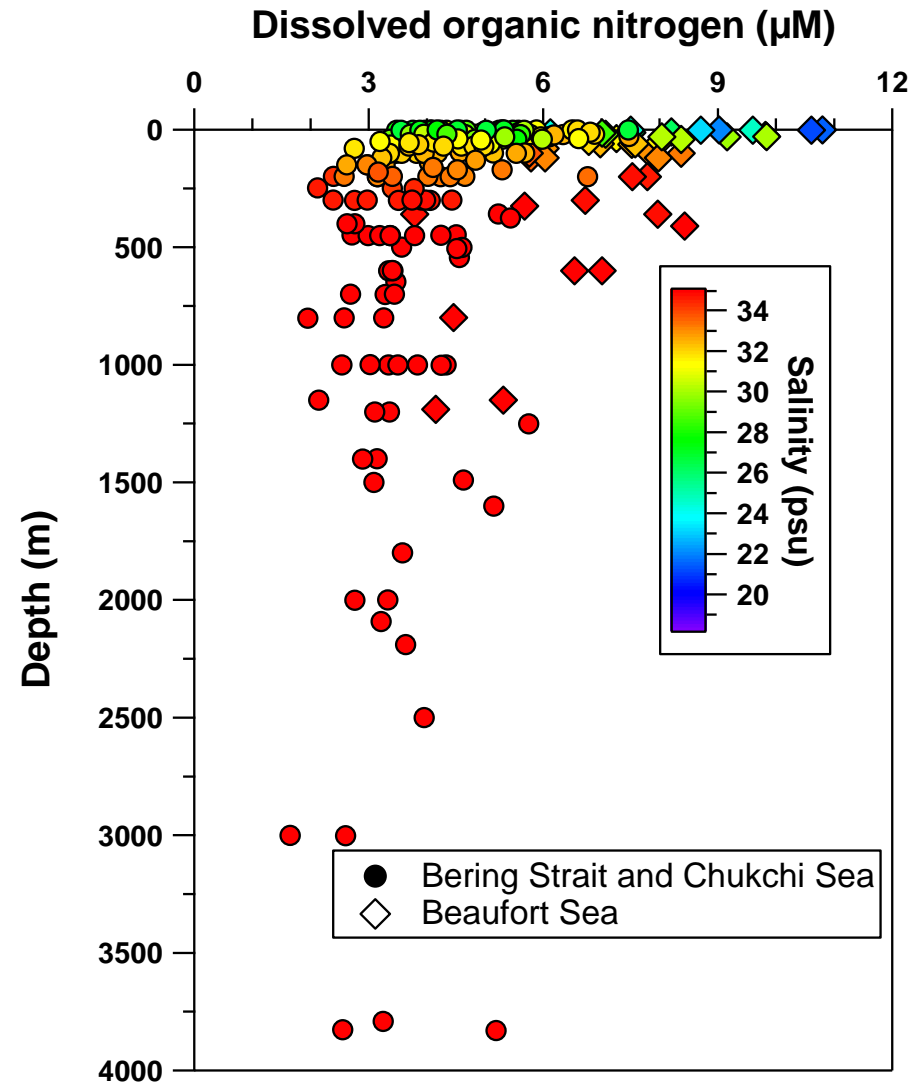
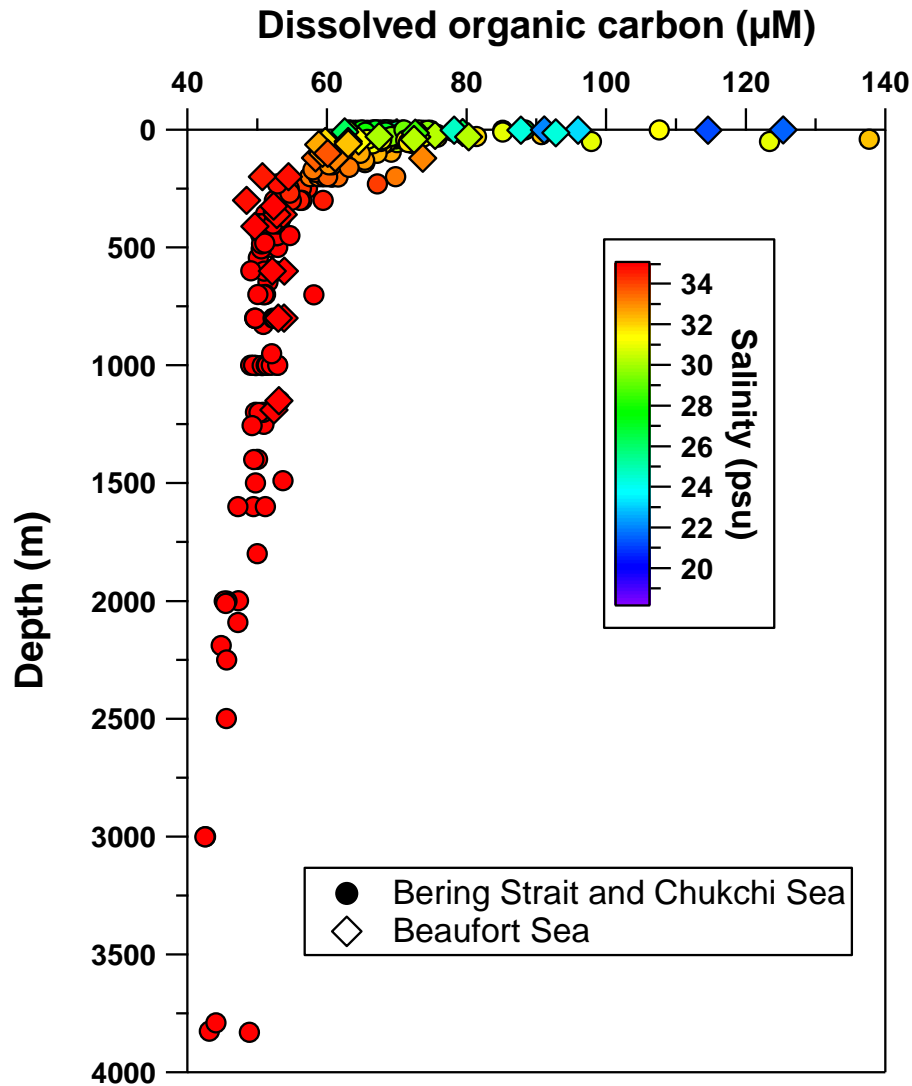
DOC and DON in the DBO3



Spatial distributions of nutrients



Vertical distributions of DOC and DON



DOC-salinity relationships

Flow-weighted DOC conc.
in the Mackenzie River in
August:

381 μM (Le Fouest et al., 2013)



If ~30% of runoff DOC is
removed during transport
to the Arctic Ocean

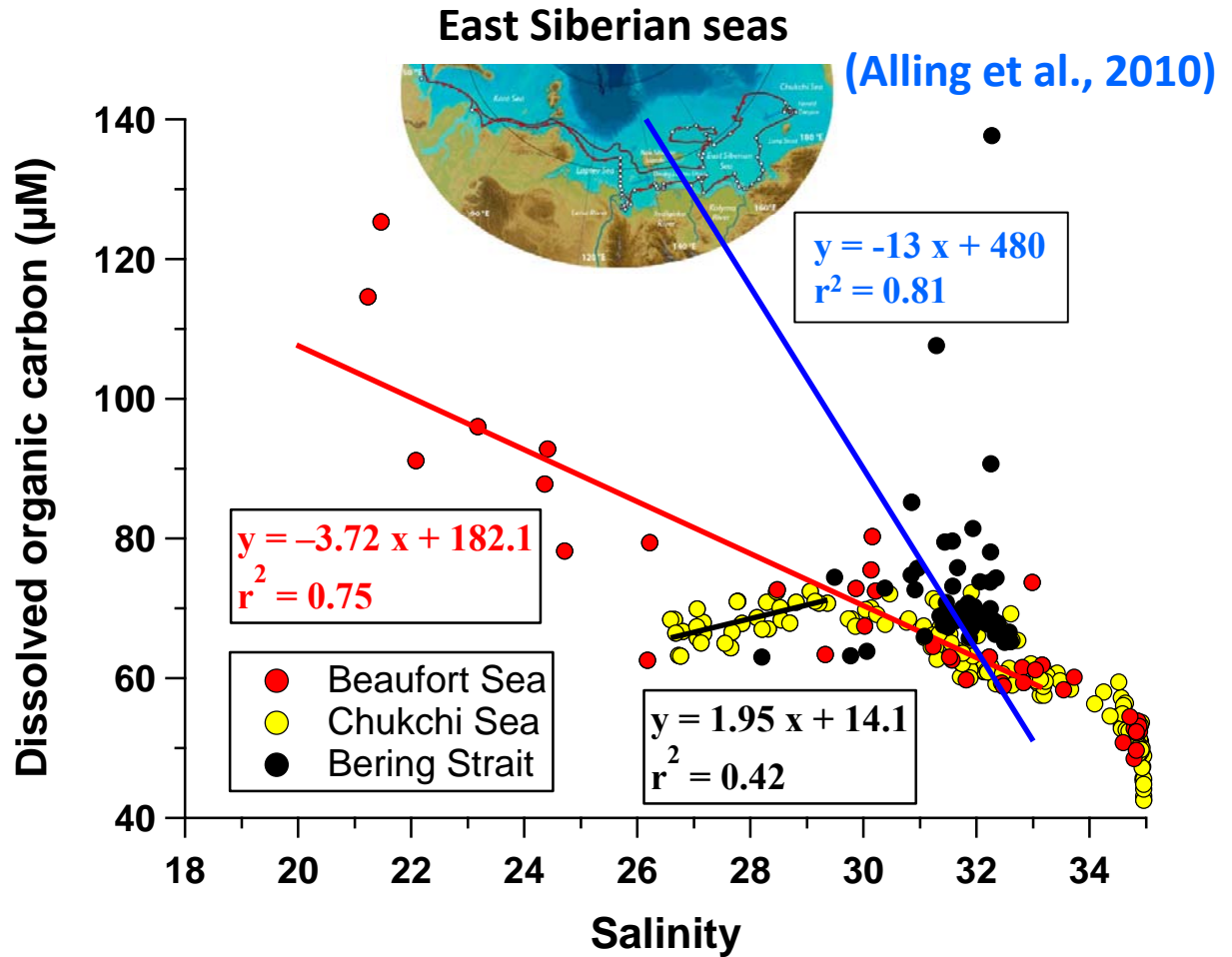
(Cooper et al., 2005):

267 μM



The zero-salinity DOC
intercept (182 μM)
indicates:

85 μM (32%) of DOC loss



- The differences of slopes obtained from the relationships between DOC and salinity in the western and eastern Arctic systems reflect that terrigenous DOC removal rates are different between these two regions.

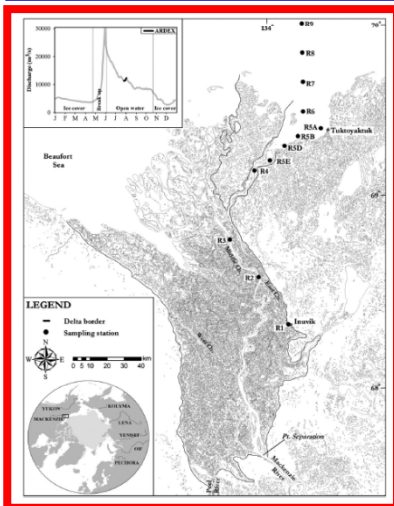
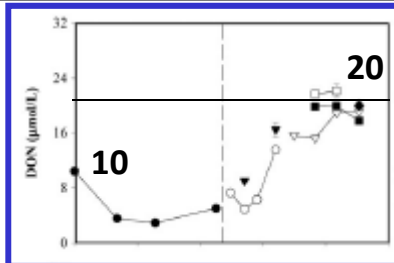
DON-salinity relationships

Flow-weighted DON conc.
in the Mackenzie River in
August:

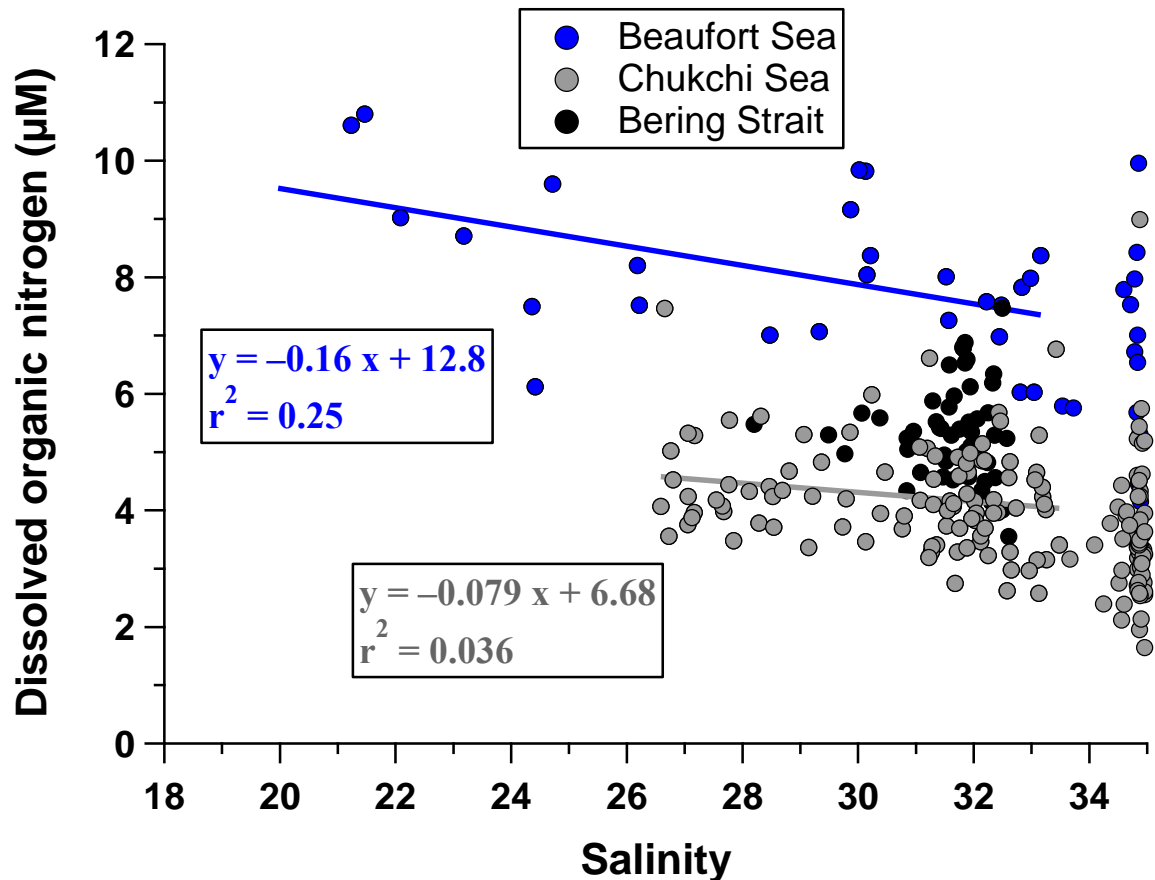
8.7 μM (Le Fouest et al., 2013)



If it is so, no loss?

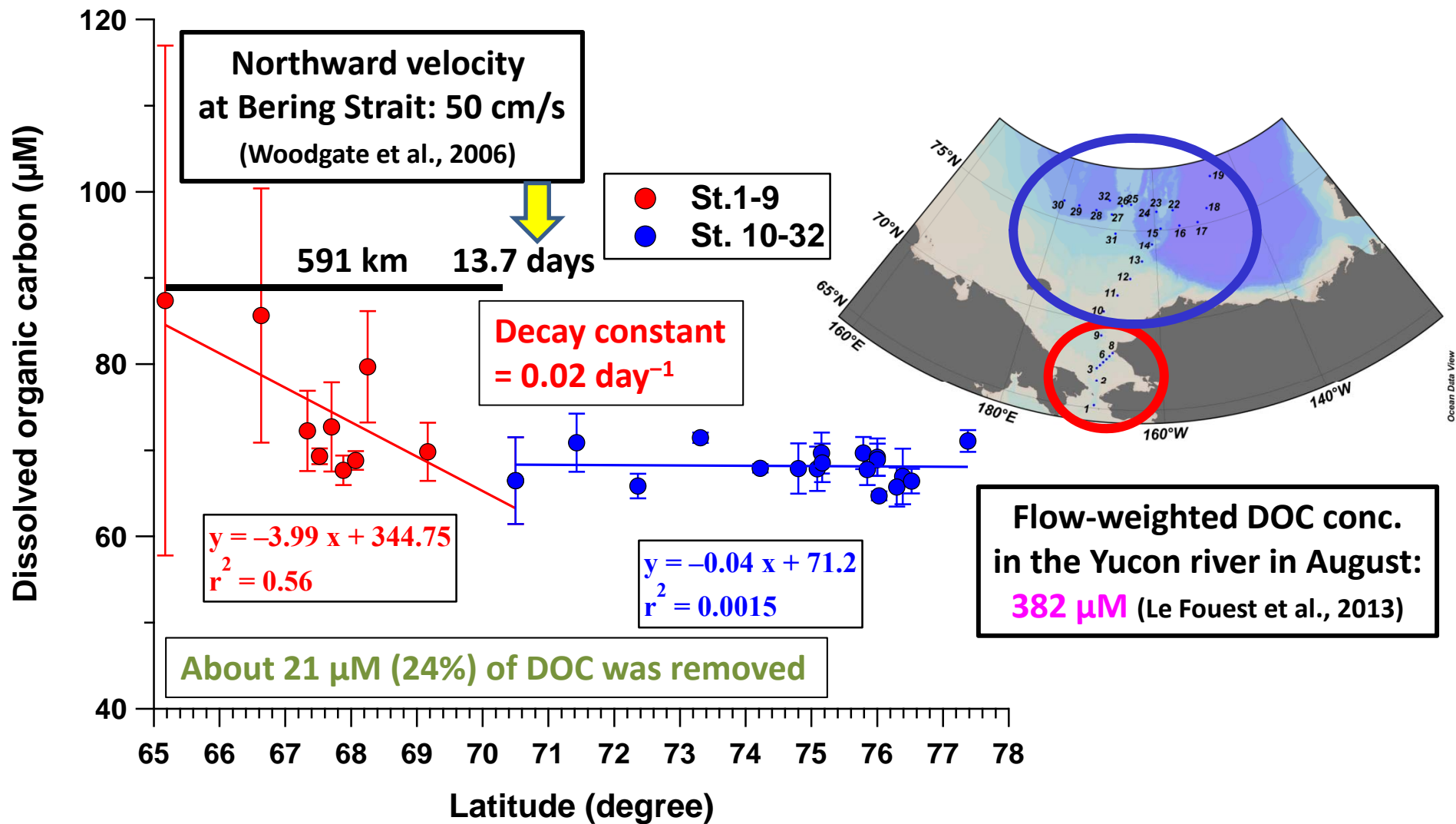


(Emmertson et al., 2008)

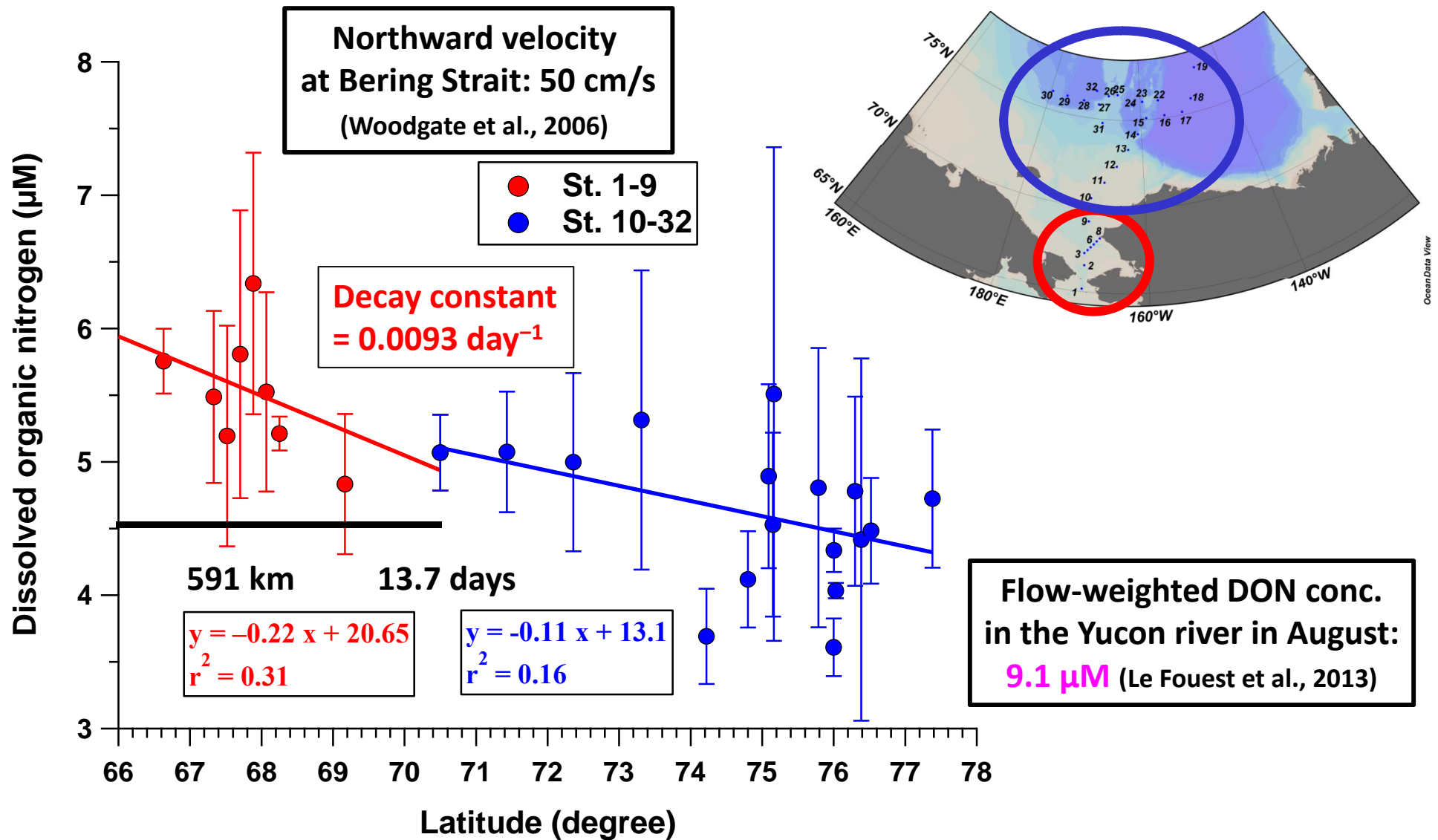


- Assuming 20 μM of DON enters the Arctic Ocean through the Mackenzie River, 7 μM of DON was removed.
- However, further studies are required to investigate DON in the Arctic Ocean.

DOC vs. latitude in surface water (< 50m)



DON vs. latitude in surface water (< 50m)

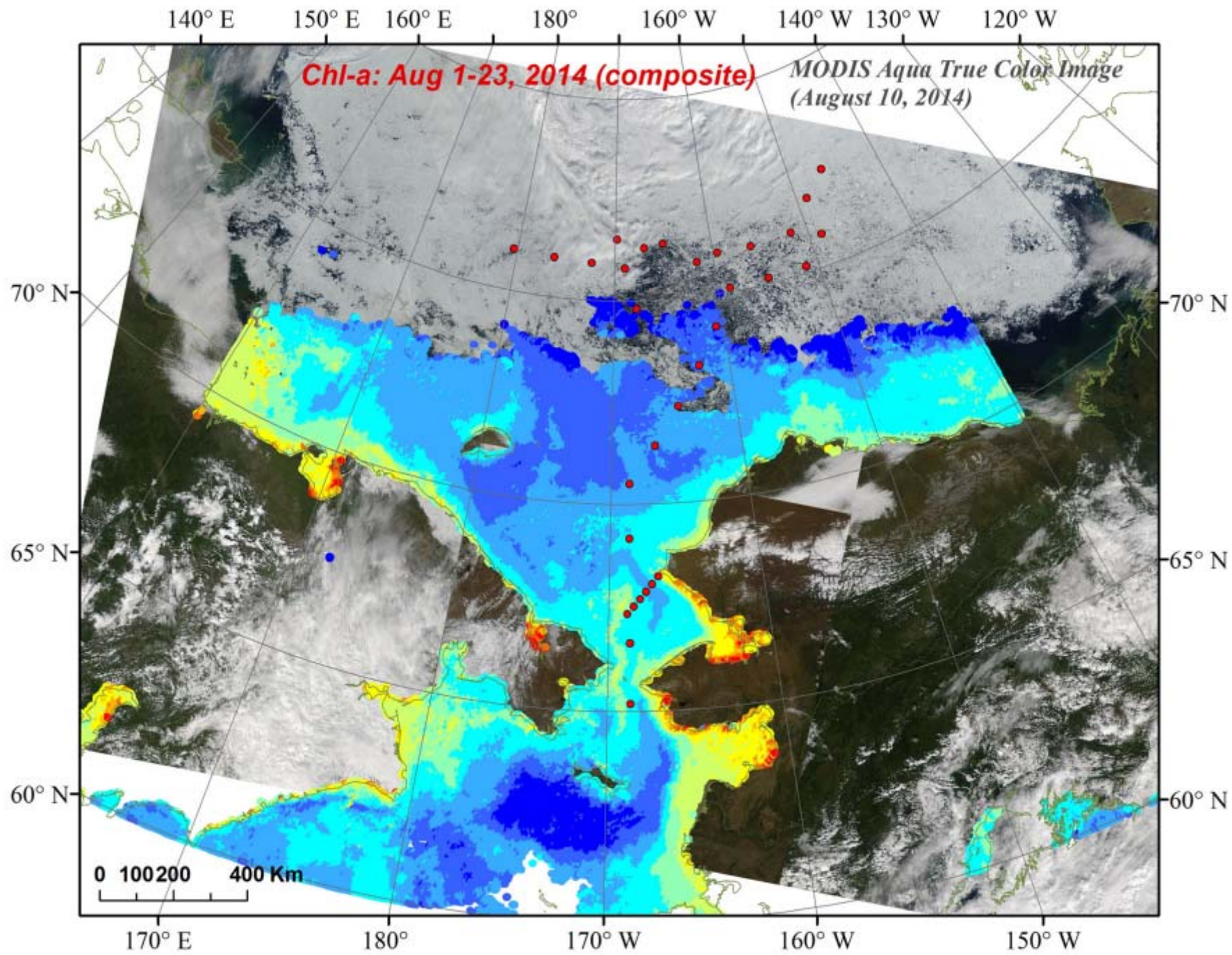


Summary

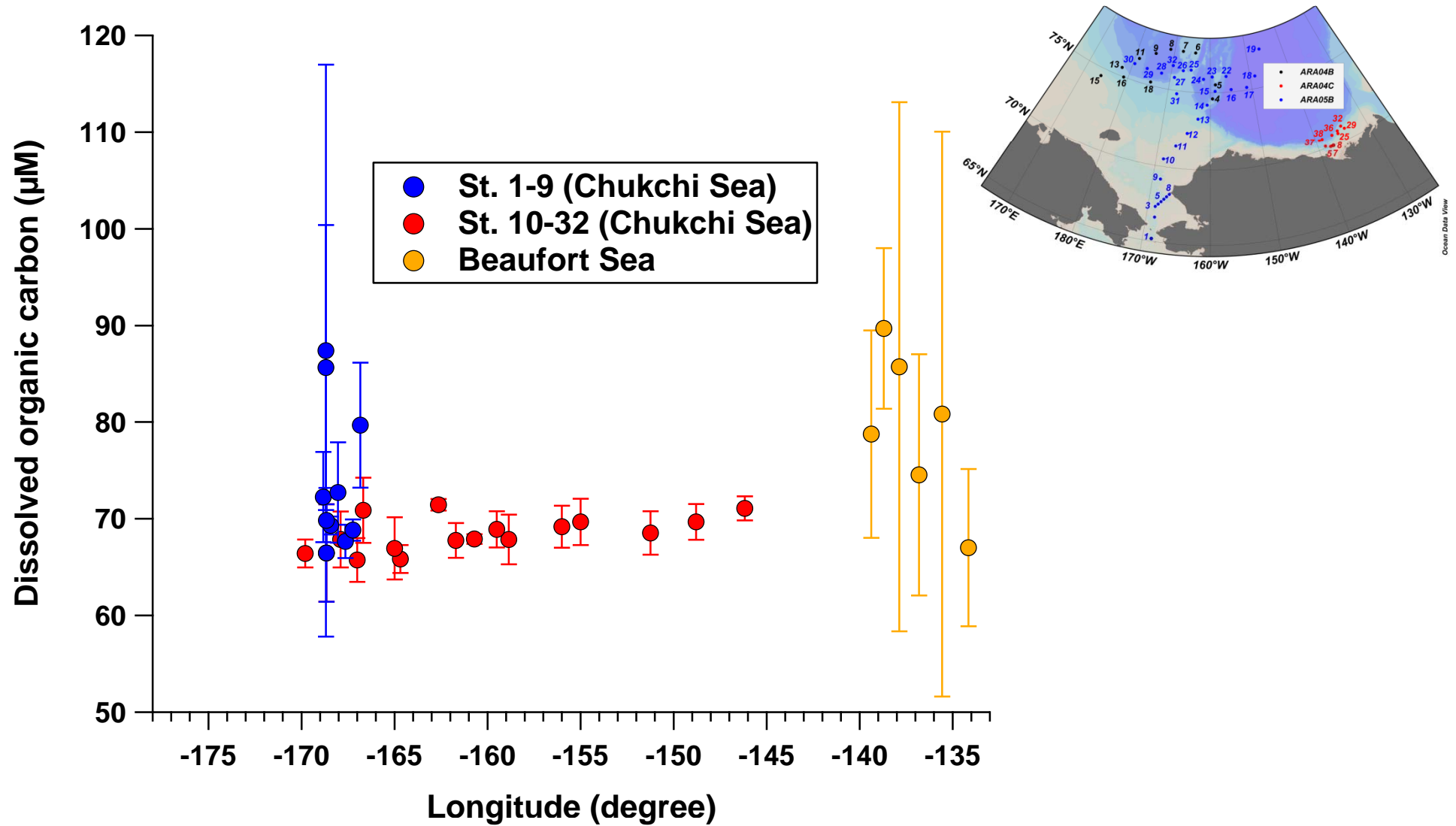
- The distributions of nutrients, dissolved organic carbon (DOC) and nitrogen (DON) were investigated from the Bering Strait to the Chukchi Sea and in the Beaufort Sea during the summer periods of 2013 and 2014.
- The characteristics of Anadyr Water and Alaska Coastal Water were clearly observed in the DBO-3.
- In the southern Chukchi and Beaufort Seas, significant DOC removal was inferred.
- Our data set suggests that the degradation rate of DON is slower than that of DOC, and that DON is more influenced by marine biological activities.
- To improve our understanding of DOM biogeochemical cycle, future fieldwork should focus on the degradation mechanism of DOM through co-works with physical and biological groups.

A wide-angle photograph of a sunset over a vast field of icebergs. The sun is a bright, glowing orb in the center of the sky, casting a warm, golden light across the scene. The sky transitions from a pale yellow near the horizon to a soft orange and then to a pale blue at the top. The icebergs are numerous and vary in size, scattered across the dark water. The water reflects the golden light of the sun, creating a shimmering path of light that leads towards the horizon. The overall mood is serene and majestic.

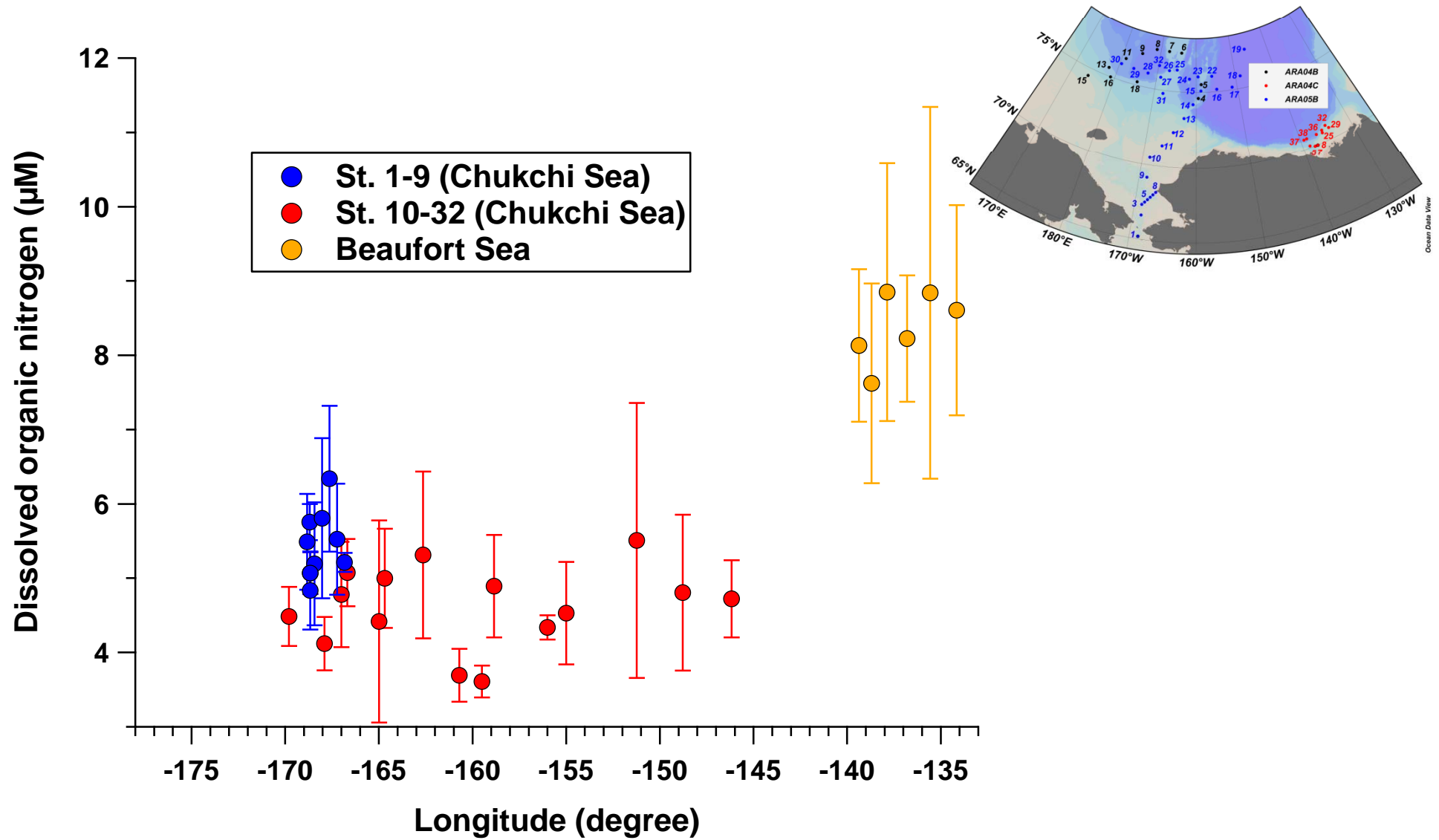
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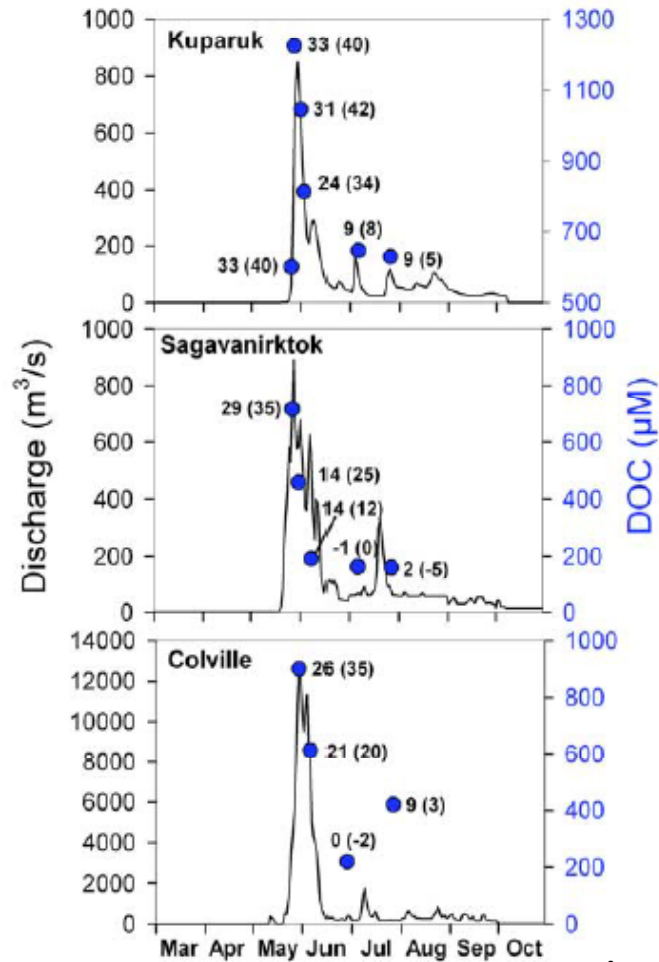
DOC vs. longitude in surface water (< 50m)



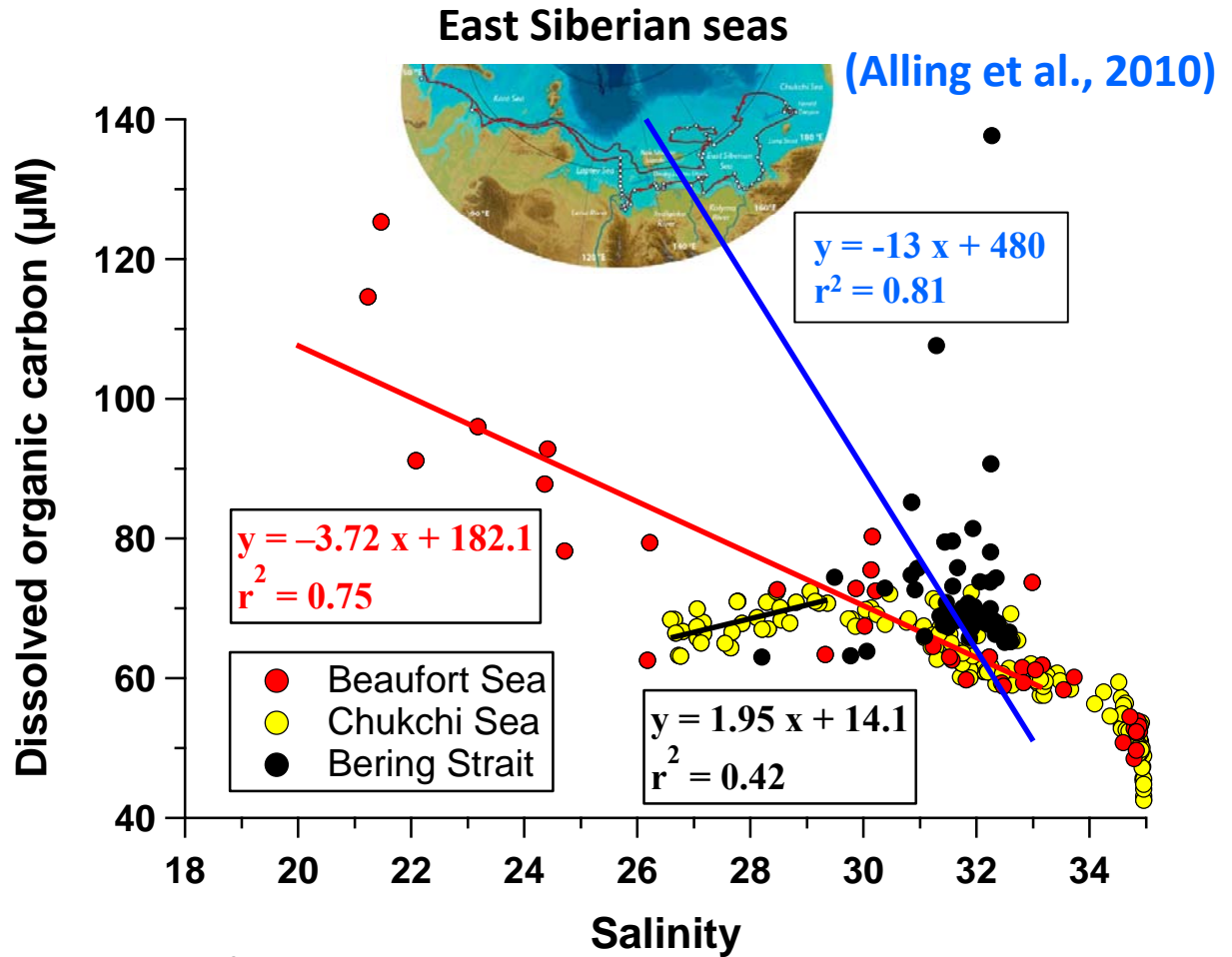
DON vs. longitude in surface water (< 50m)



Salinity-DOC relationships



(Holmes et al., 2008)



- The differences of slopes obtained from the relationships between DOC and salinity in the western and eastern Arctic systems reflect that terrigenous DOC removal rates are different between these two regions.