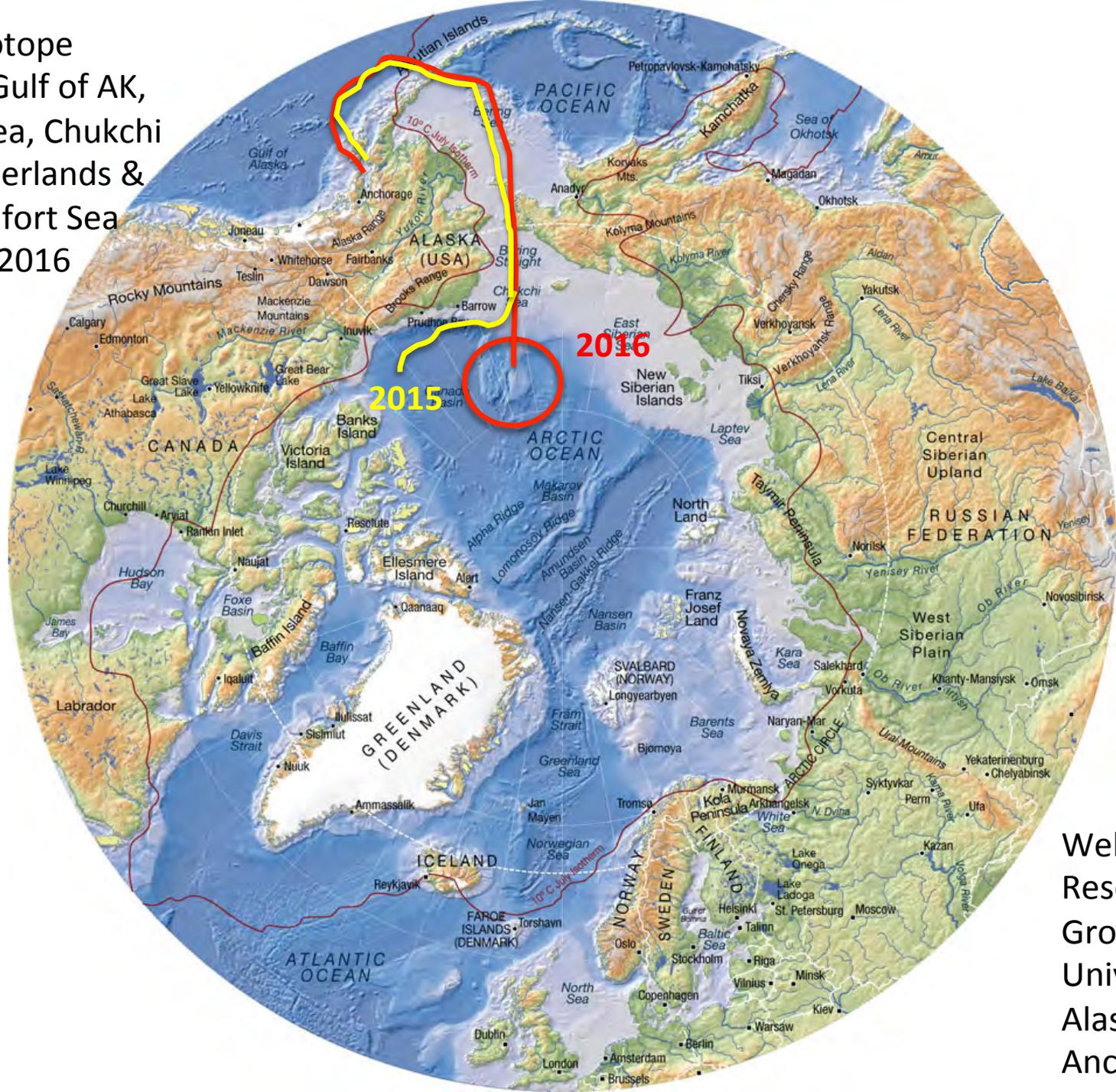


**Continuous, In situ water vapor & seawater isotopes and  $^{13}\text{C}$  isotopes of  $\text{CO}_2$  and  $\text{CH}_4$ -advances in ship-based measurements to understand processes in the Arctic and sub-Arctic Oceans**

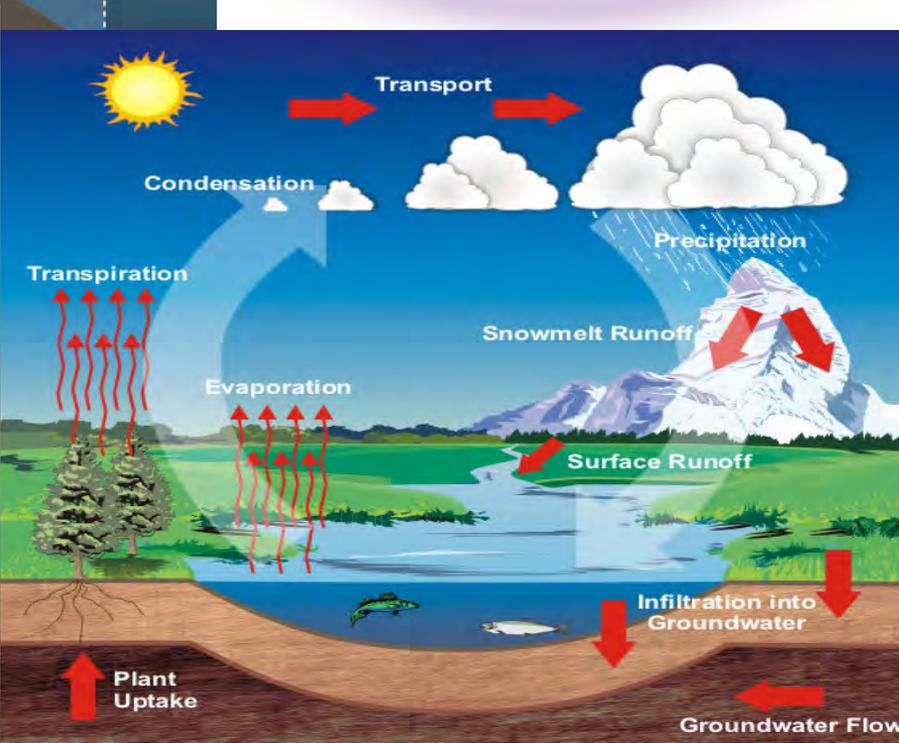
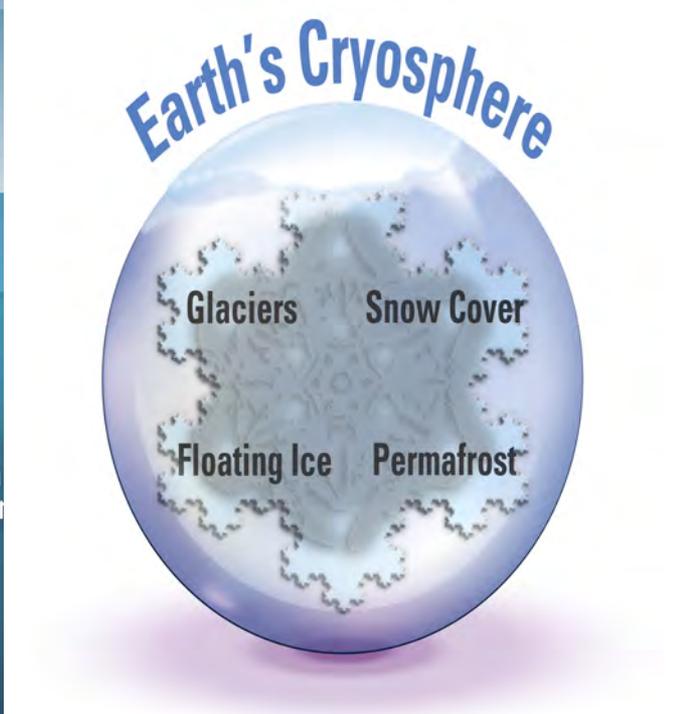
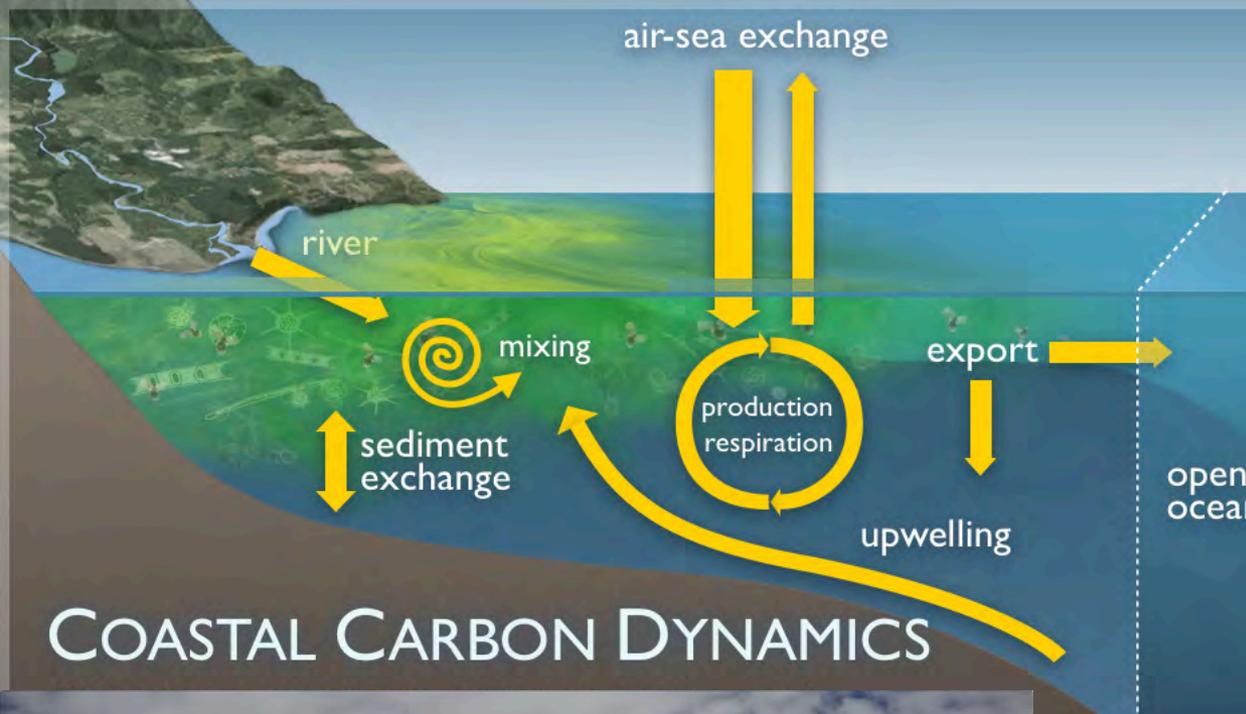
***Jeff Welker, Fulbright Distinguished US Arctic Chair  
Eric Klein, Research Scientist***

***University of Alaska Anchorage***

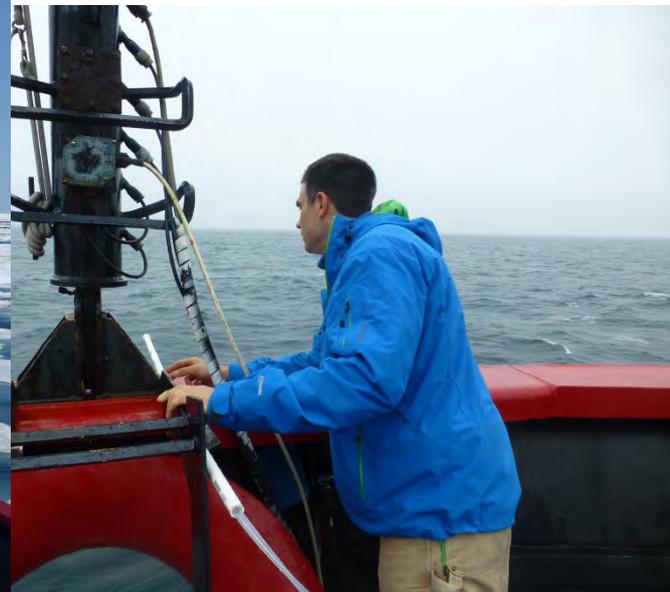
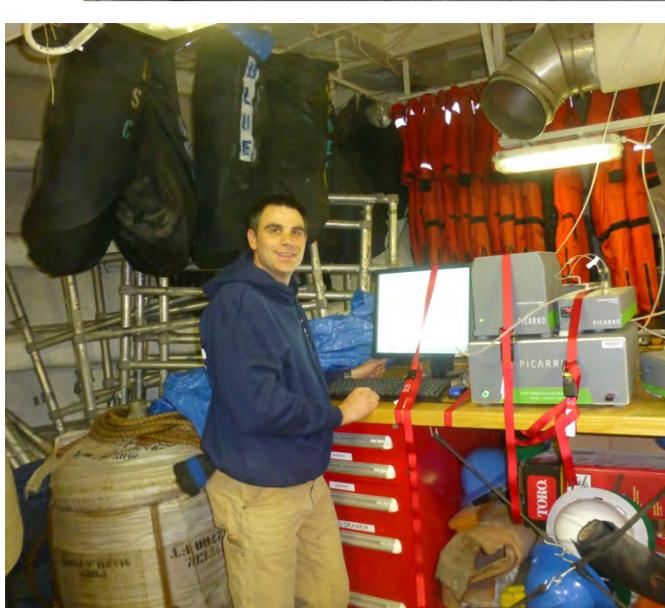
Healy Isotope  
Cruises-Gulf of AK,  
Bering Sea, Chukchi  
Sea Borderlands &  
the Beaufort Sea  
(2015 & 2016)



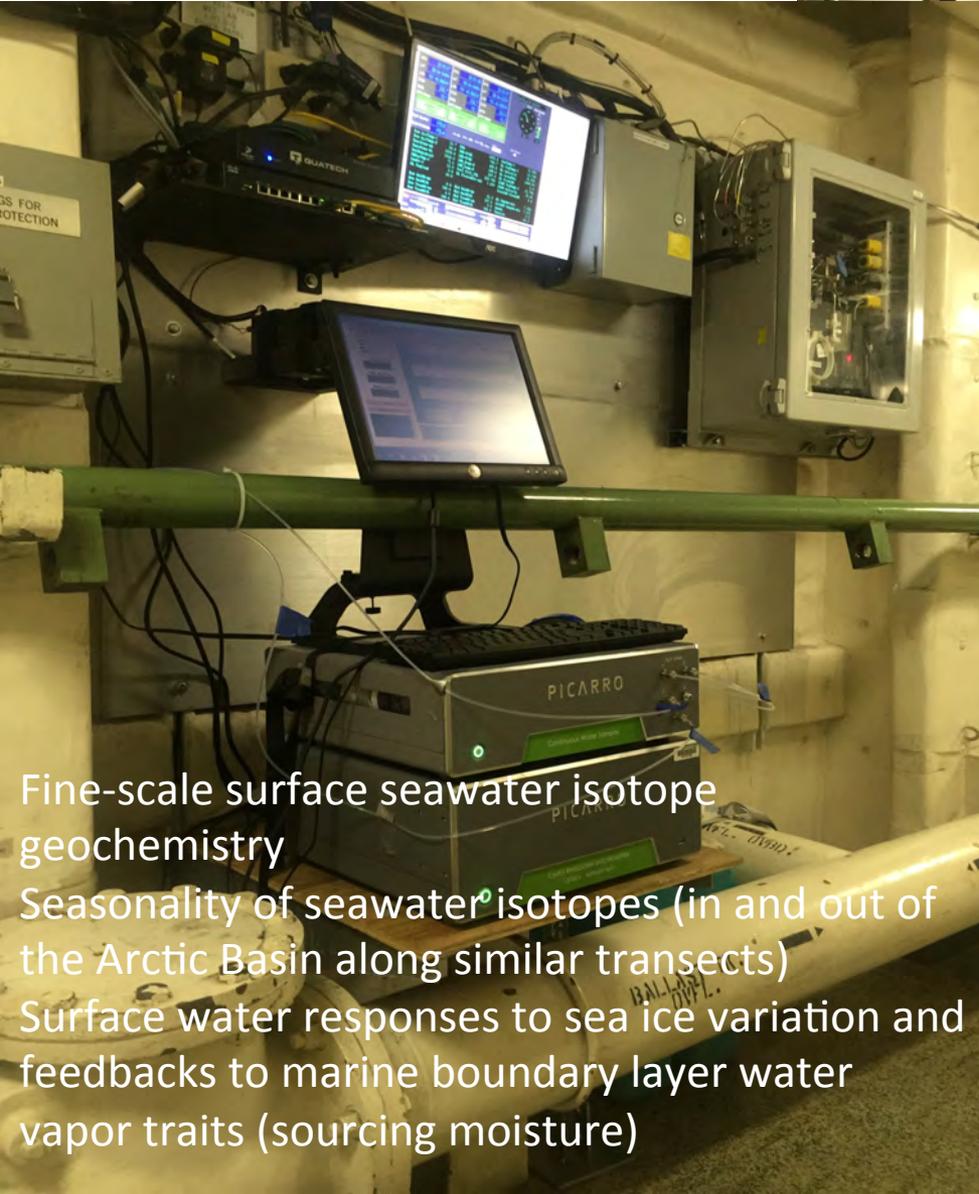
Welker  
Research  
Group-  
University of  
Alaska  
Anchorage



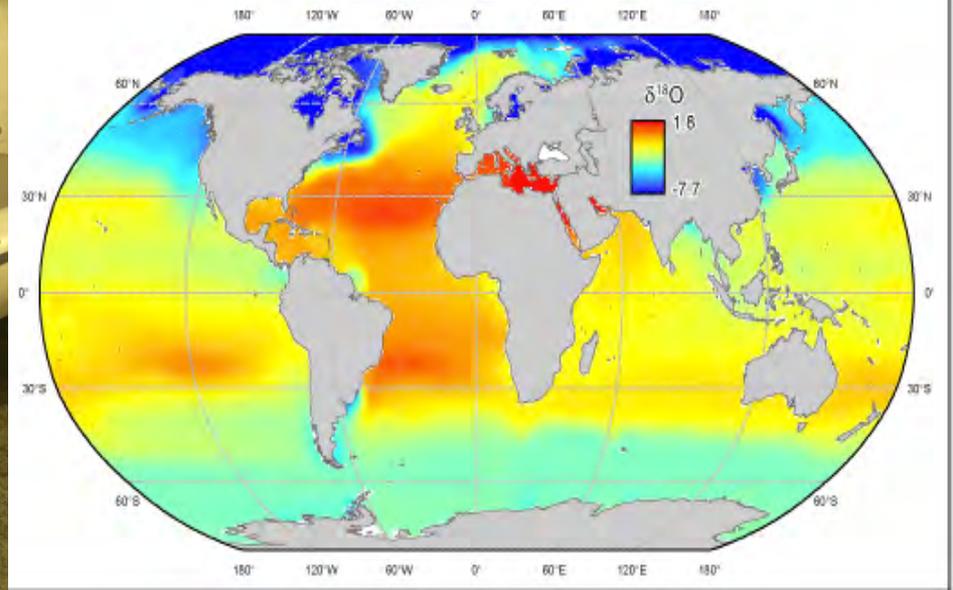
# Healy Water Vapor , Seawater CO<sub>2</sub> & CH<sub>4</sub> Isotopic Research



# Healy 1601: In-situ seawater ( $^{18}\text{O}/^{2}\text{H}$ ) isotope geochemistry



Fine-scale surface seawater isotope geochemistry  
Seasonality of seawater isotopes (in and out of the Arctic Basin along similar transects)  
Surface water responses to sea ice variation and feedbacks to marine boundary layer water vapor traits (sourcing moisture)





 **AGU PUBLICATIONS**



## Reviews of Geophysics

### REVIEW ARTICLE

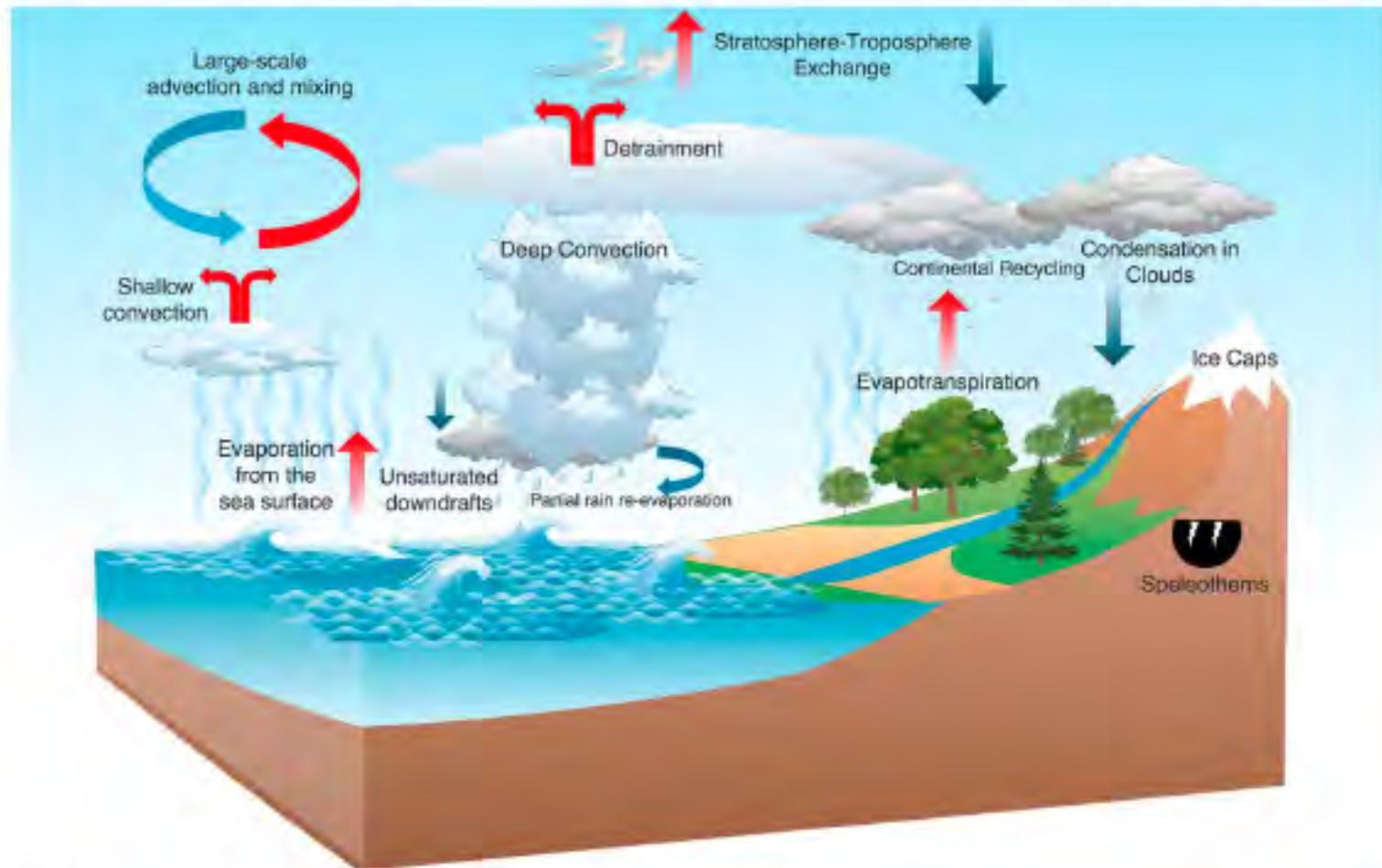
10.1002/2015RG000512

## Stable isotopes in atmospheric water vapor and applications to the hydrologic cycle

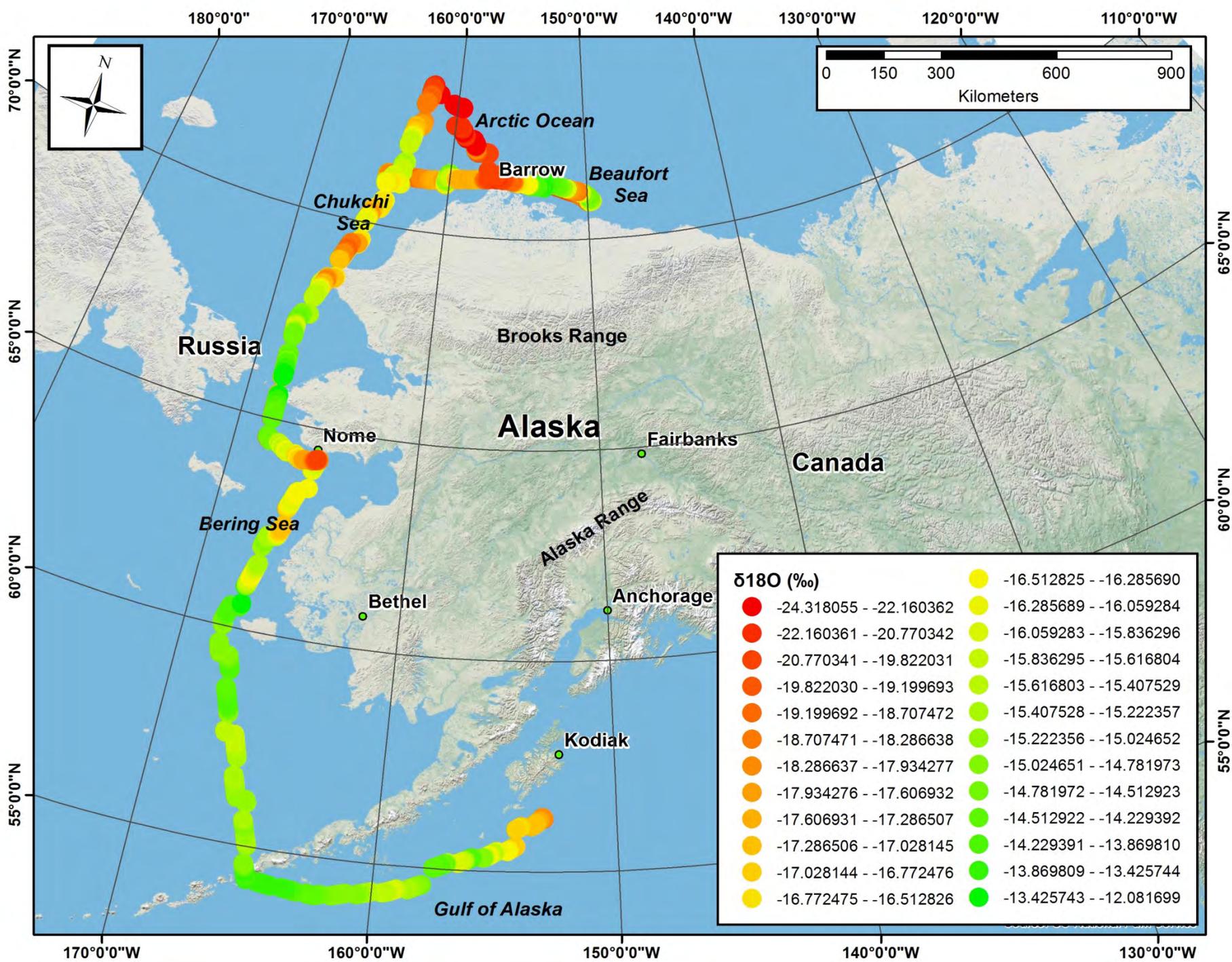
Joseph Galewsky<sup>1</sup>, Hans Christian Steen-Larsen<sup>2,3</sup>, Robert D. Field<sup>4,5</sup>, John Worden<sup>6</sup>,  
Camille Risi<sup>7</sup>, and Matthias Schneider<sup>8</sup>

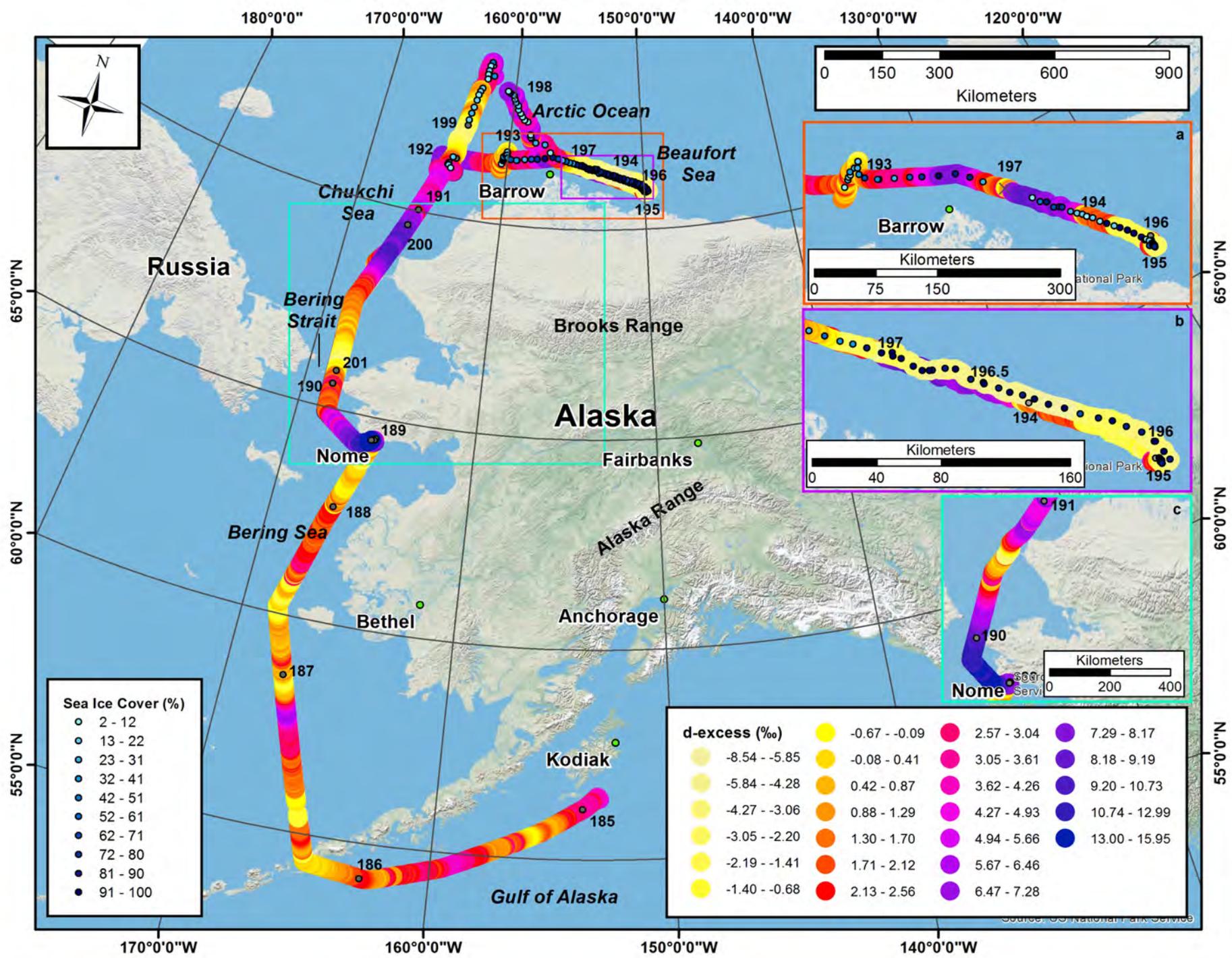
#### Key Points:

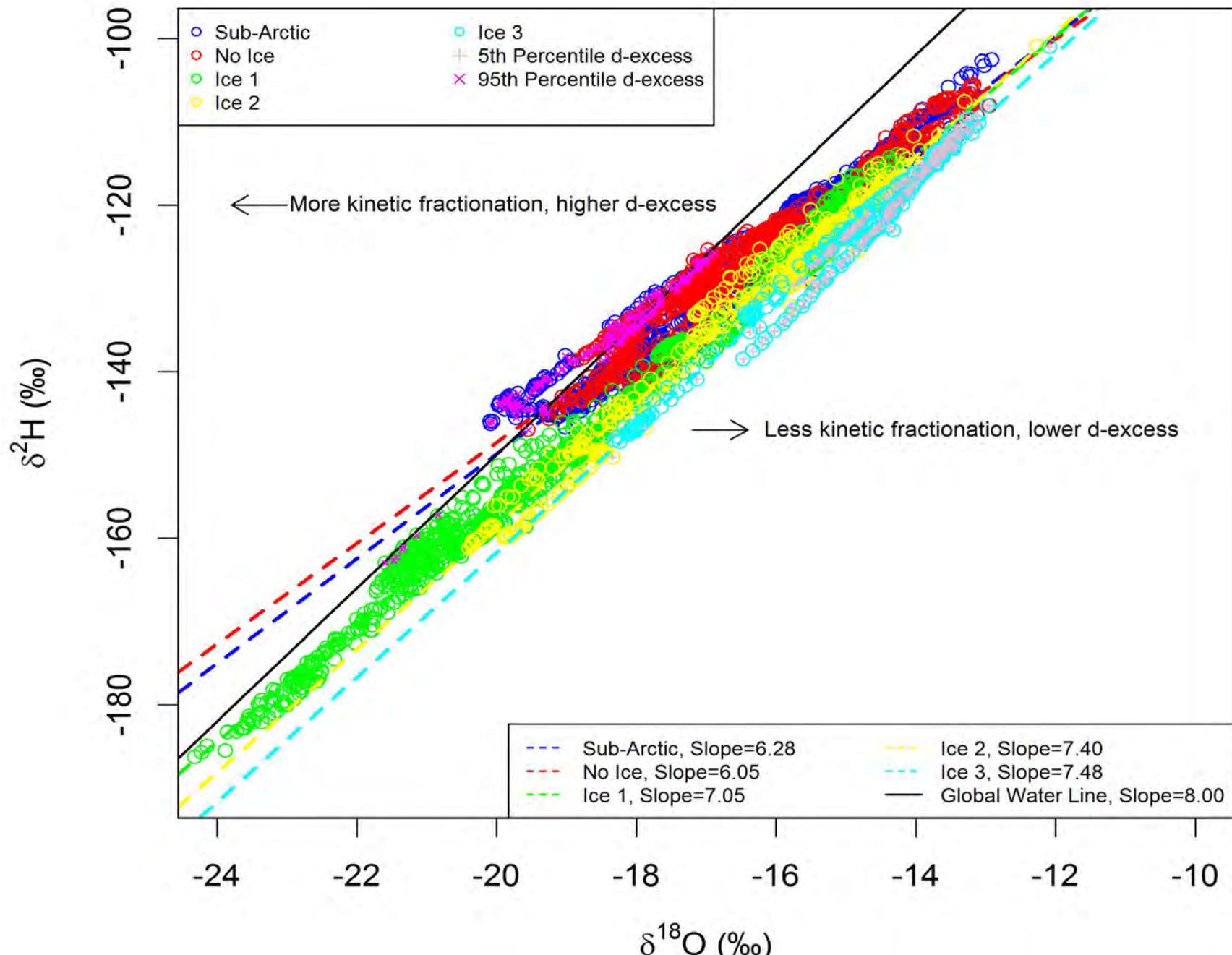
- Measurement and simulation of water vapor isotopes is now a mature field
- Analysis of water vapor isotopes



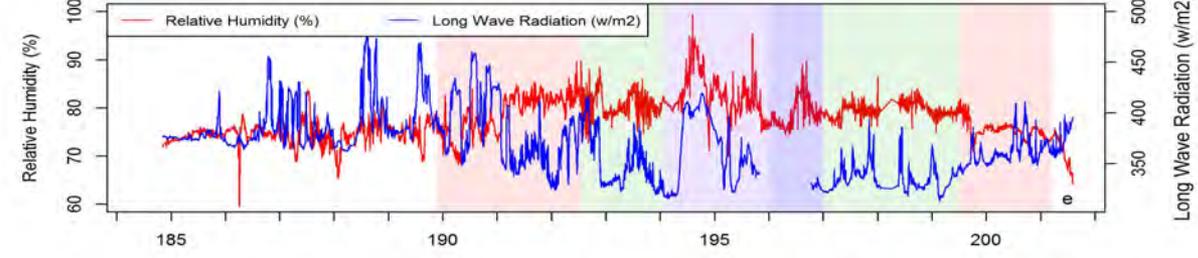
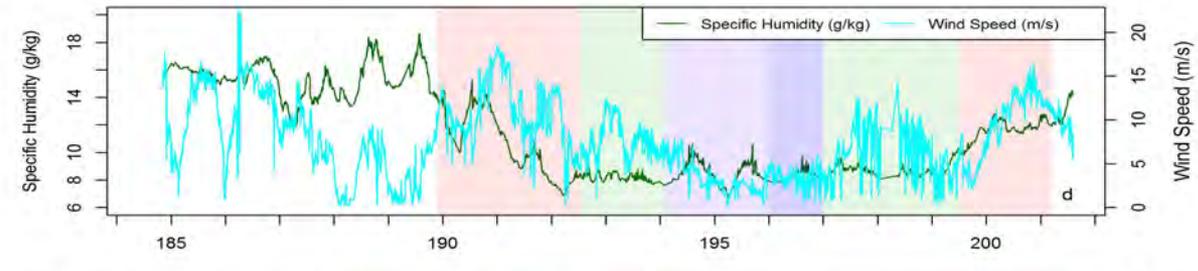
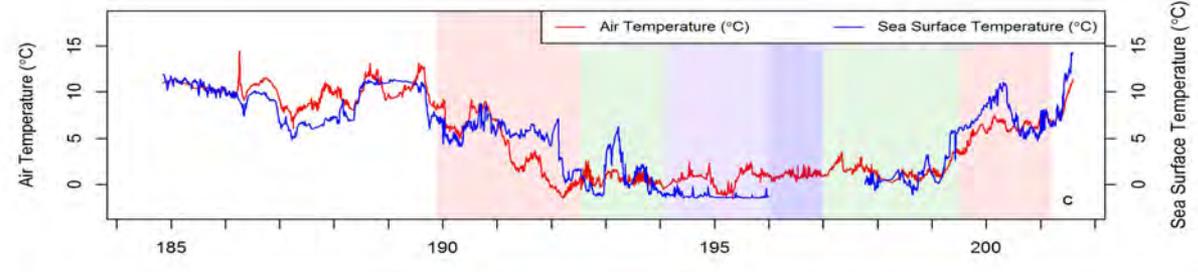
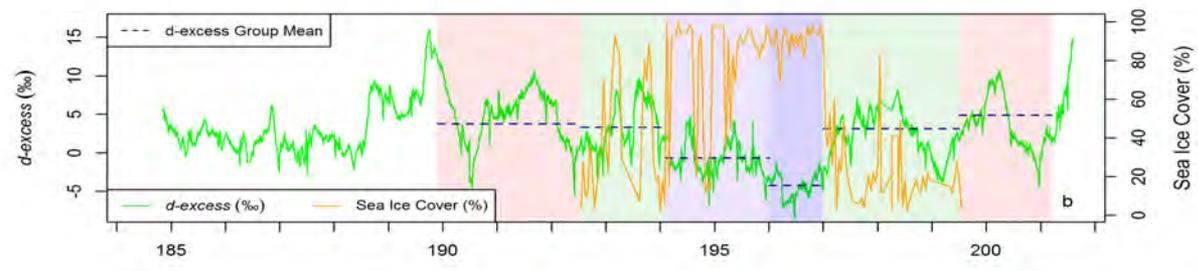
**Figure 1.** Cartoon illustrating key processes governing the isotopic composition of atmospheric water vapor. Blue arrows indicate processes that tend to isotopically deplete water vapor, and red arrows indicate processes that tend to isotopically enrich water vapor. The paleoclimate archives in glacial ice and in speleothems are also influenced by these processes, which are discussed in detail in section 6.







# Ocean Water Vapor Isotope Data Summary (2015 - Healy)



## No Ice

- Greater wind speed
- Lower RH
- Warmer SST
- More kinetic fractionation
- Higher d-excess

## Ice 1

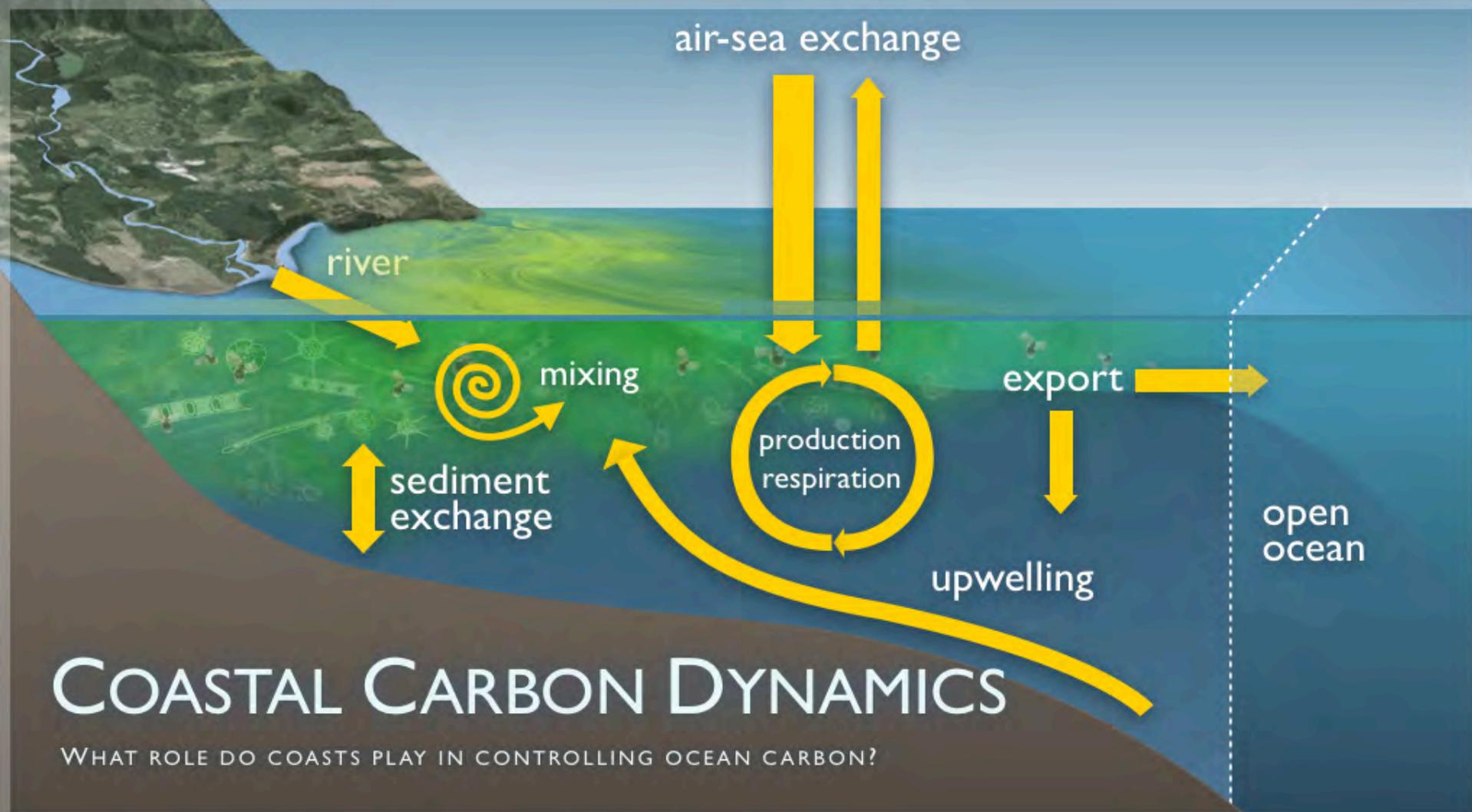


## Ice 3

- Lower wind speed
- Higher RH
- Colder SST
- Less kinetic fractionation
- Lower d-excess

## Ice 2

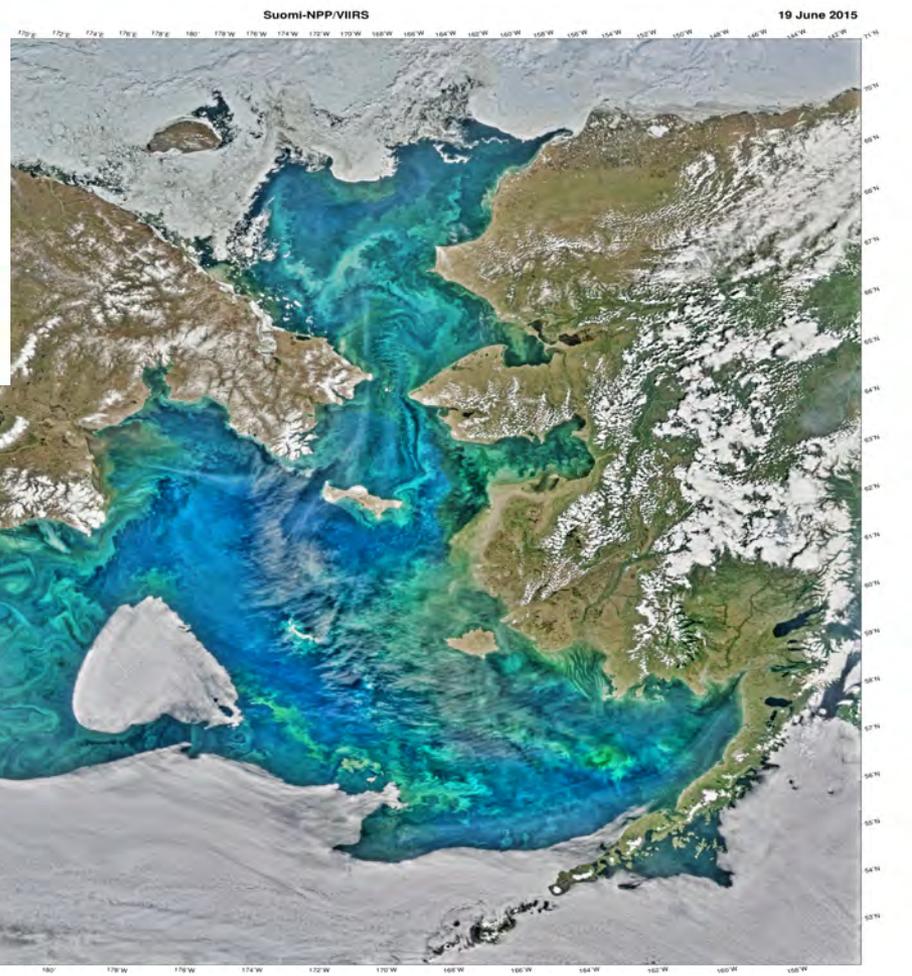
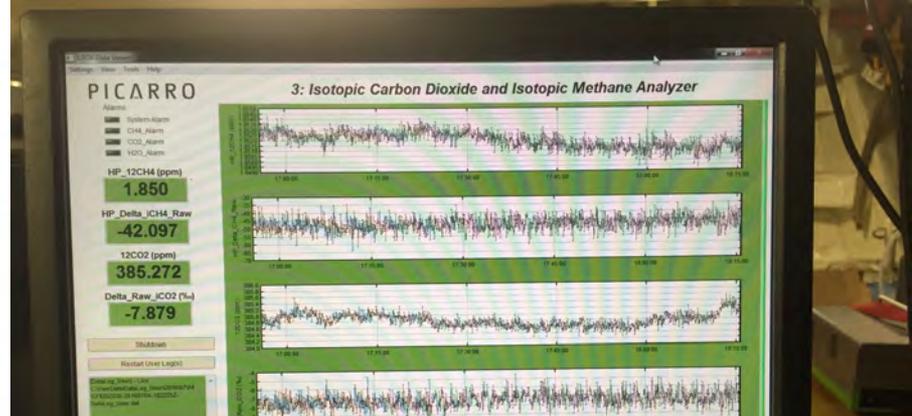
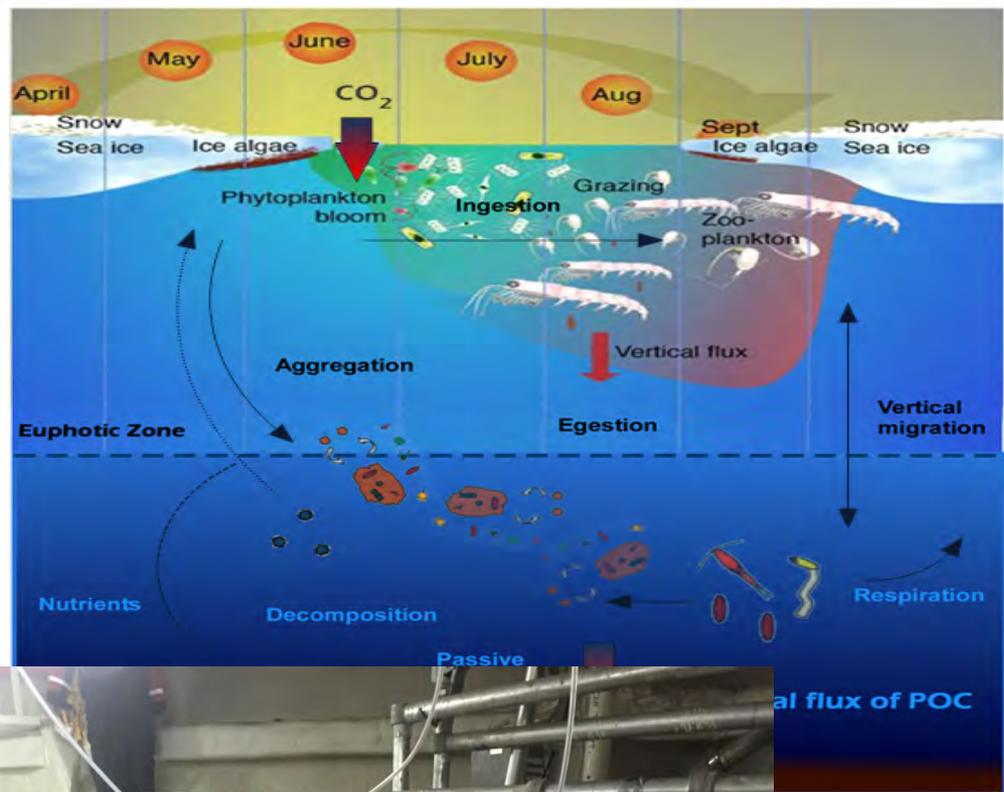




# COASTAL CARBON DYNAMICS

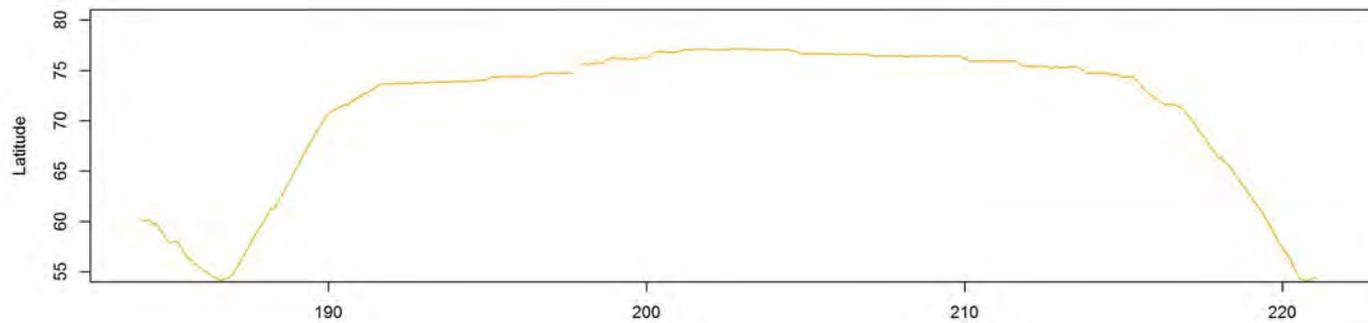
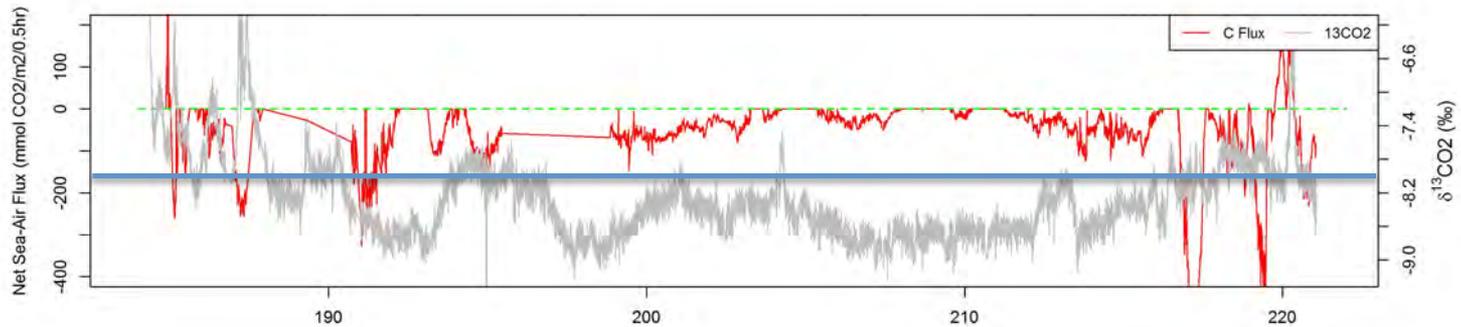
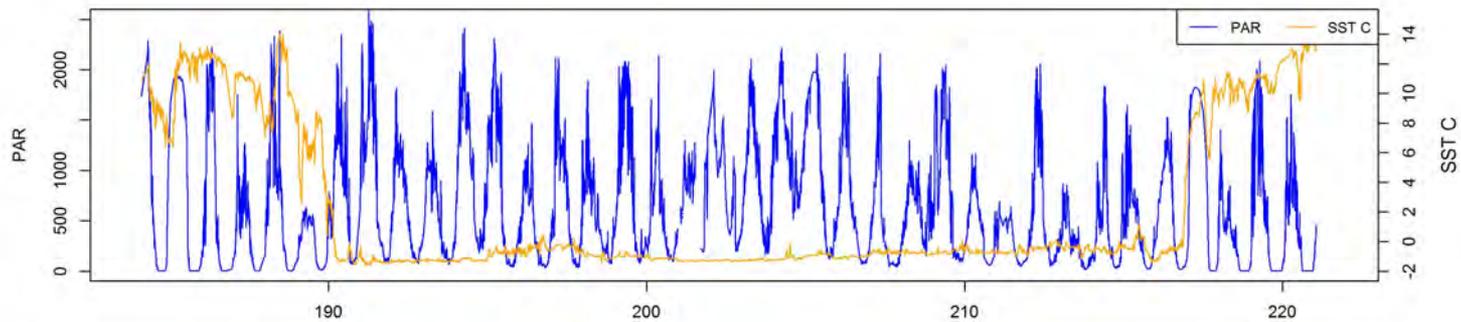
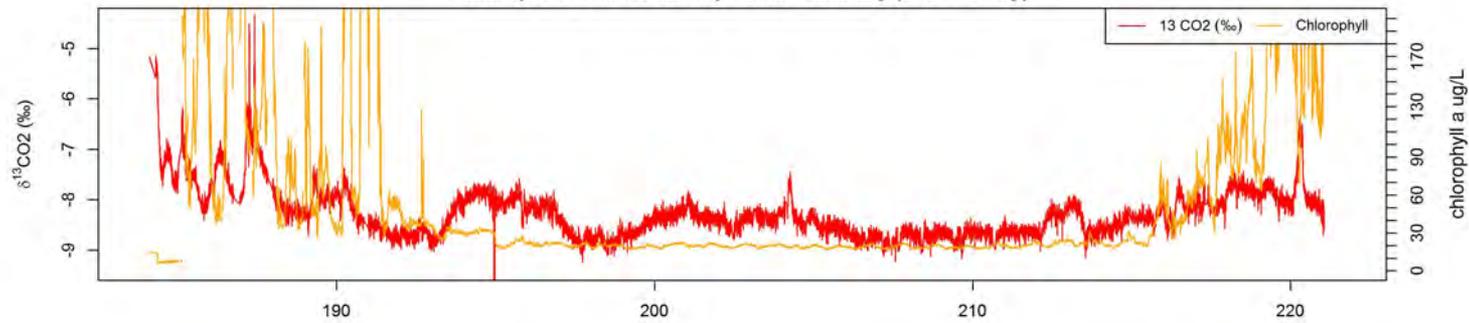
WHAT ROLE DO COASTS PLAY IN CONTROLLING OCEAN CARBON?

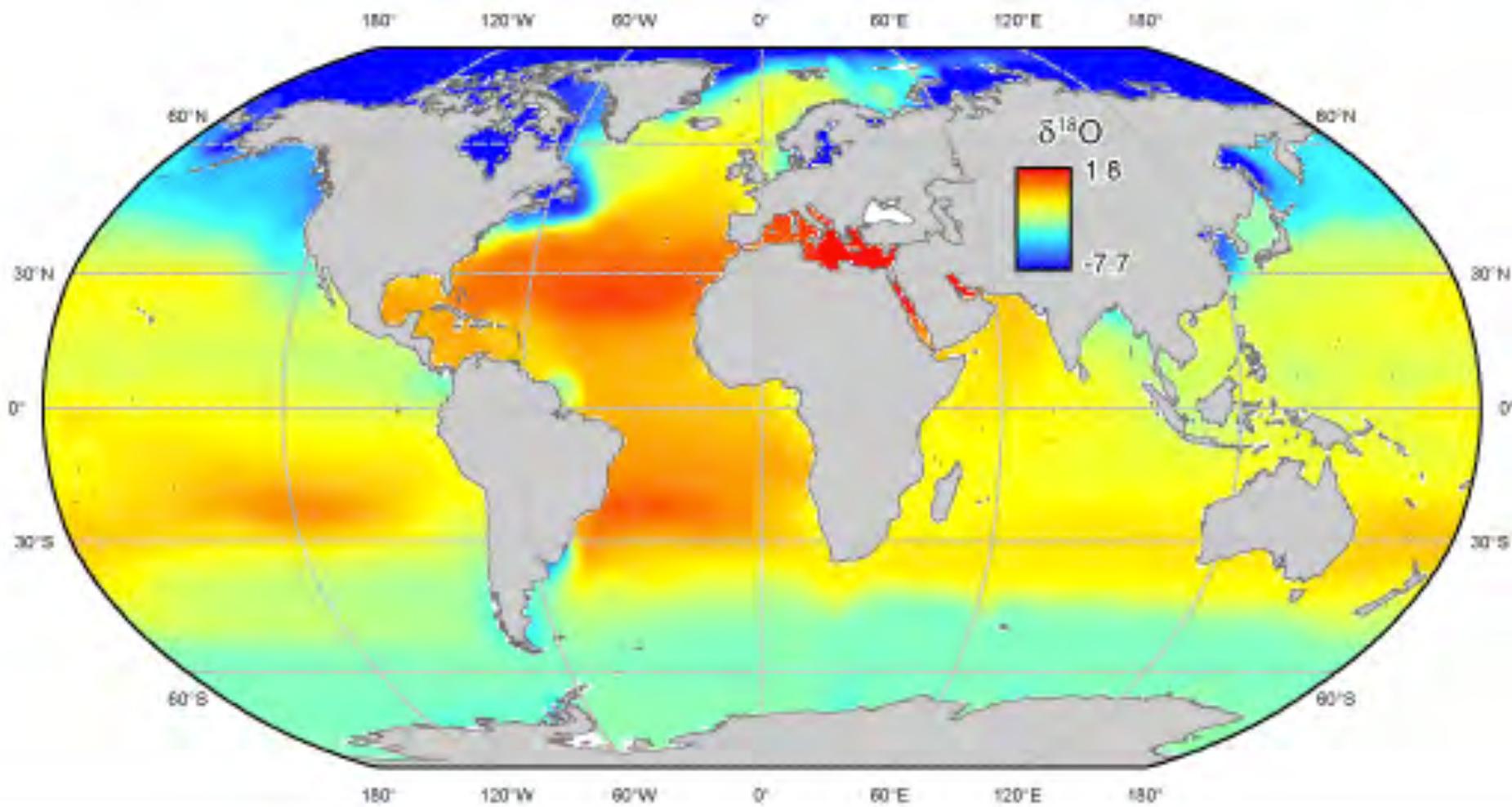




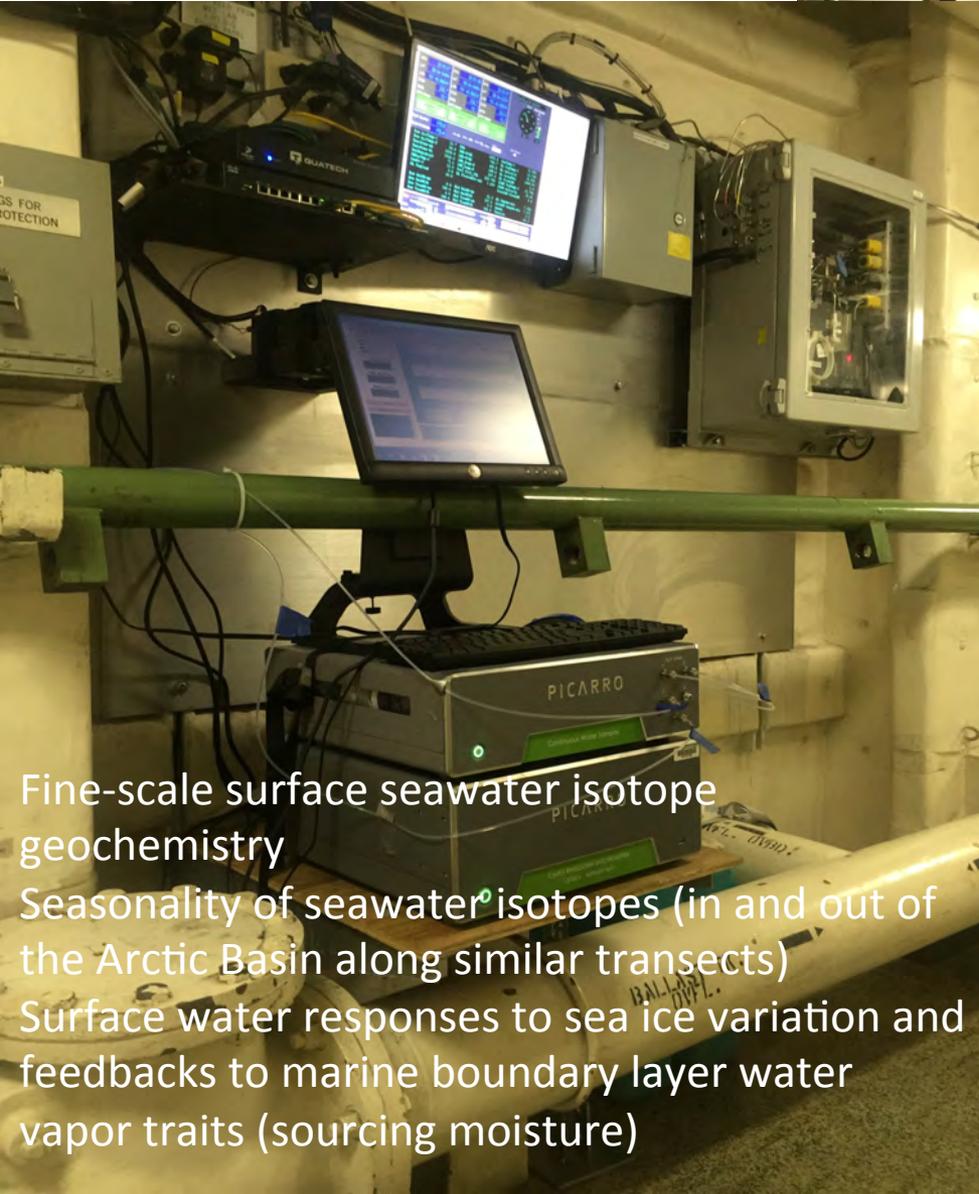
Transverse Mercator projection about 172° West

# Atmospheric Carbon Isotope Data Summary (2016 - Healy)

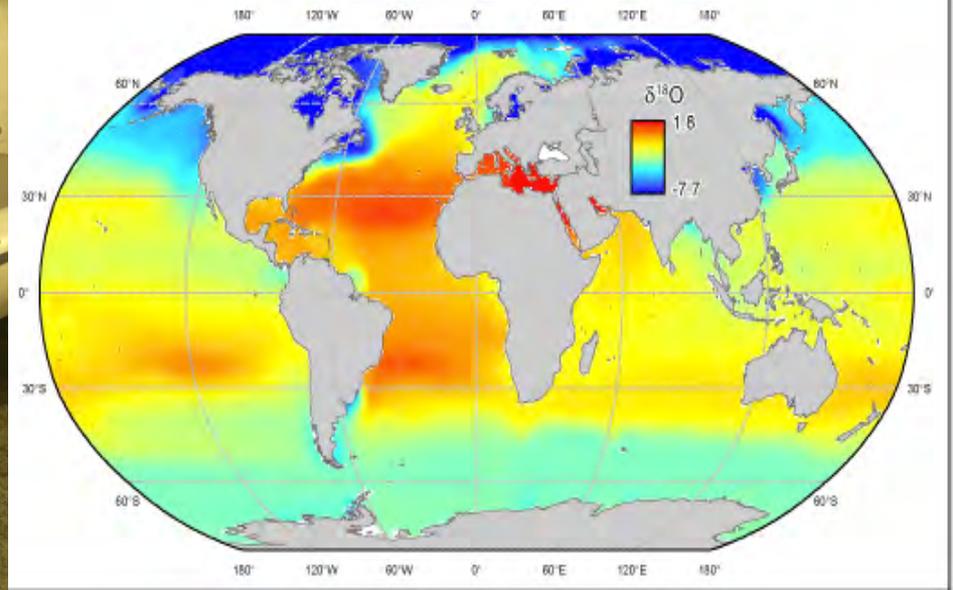




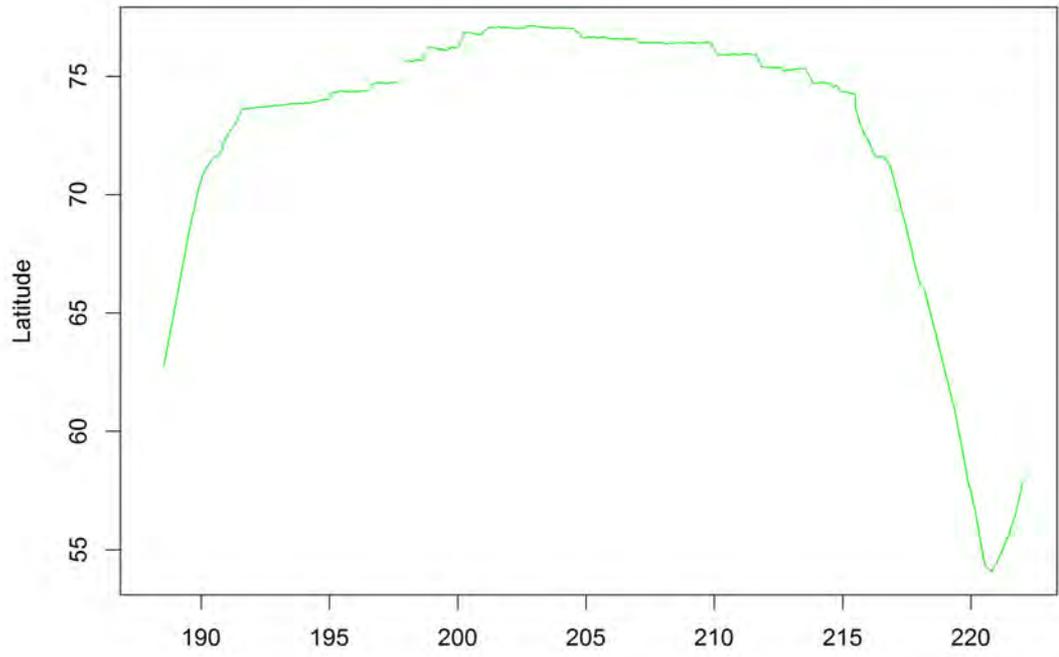
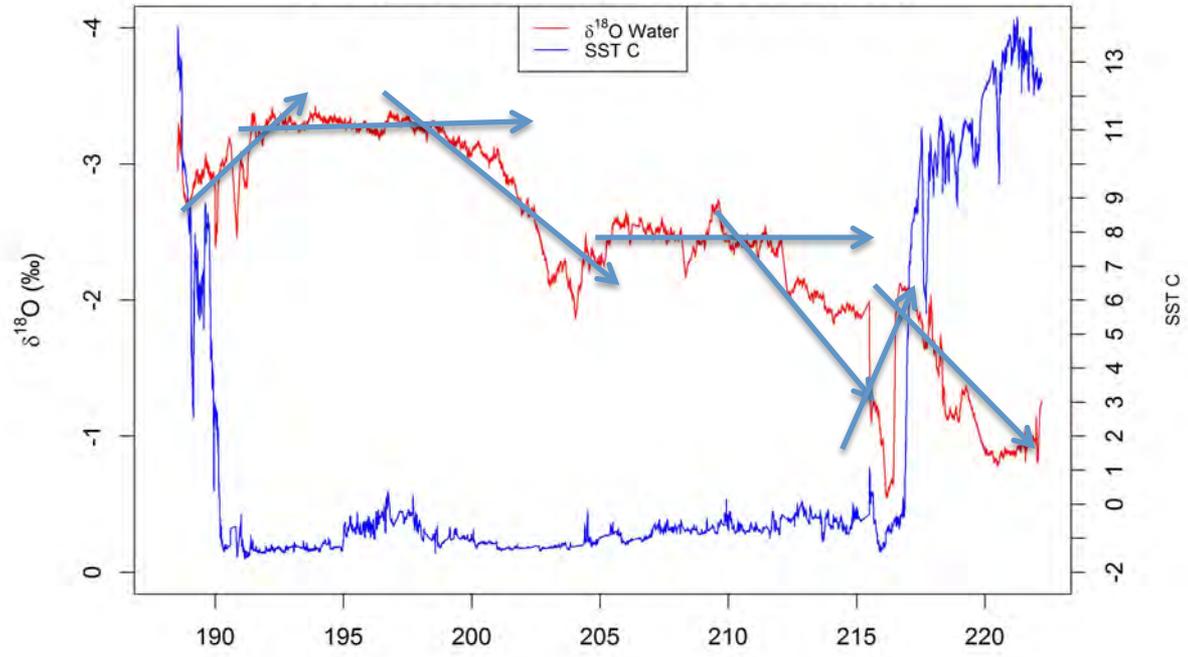
# Healy 1601: In-situ seawater ( $^{18}\text{O}/^{2}\text{H}$ ) isotope geochemistry

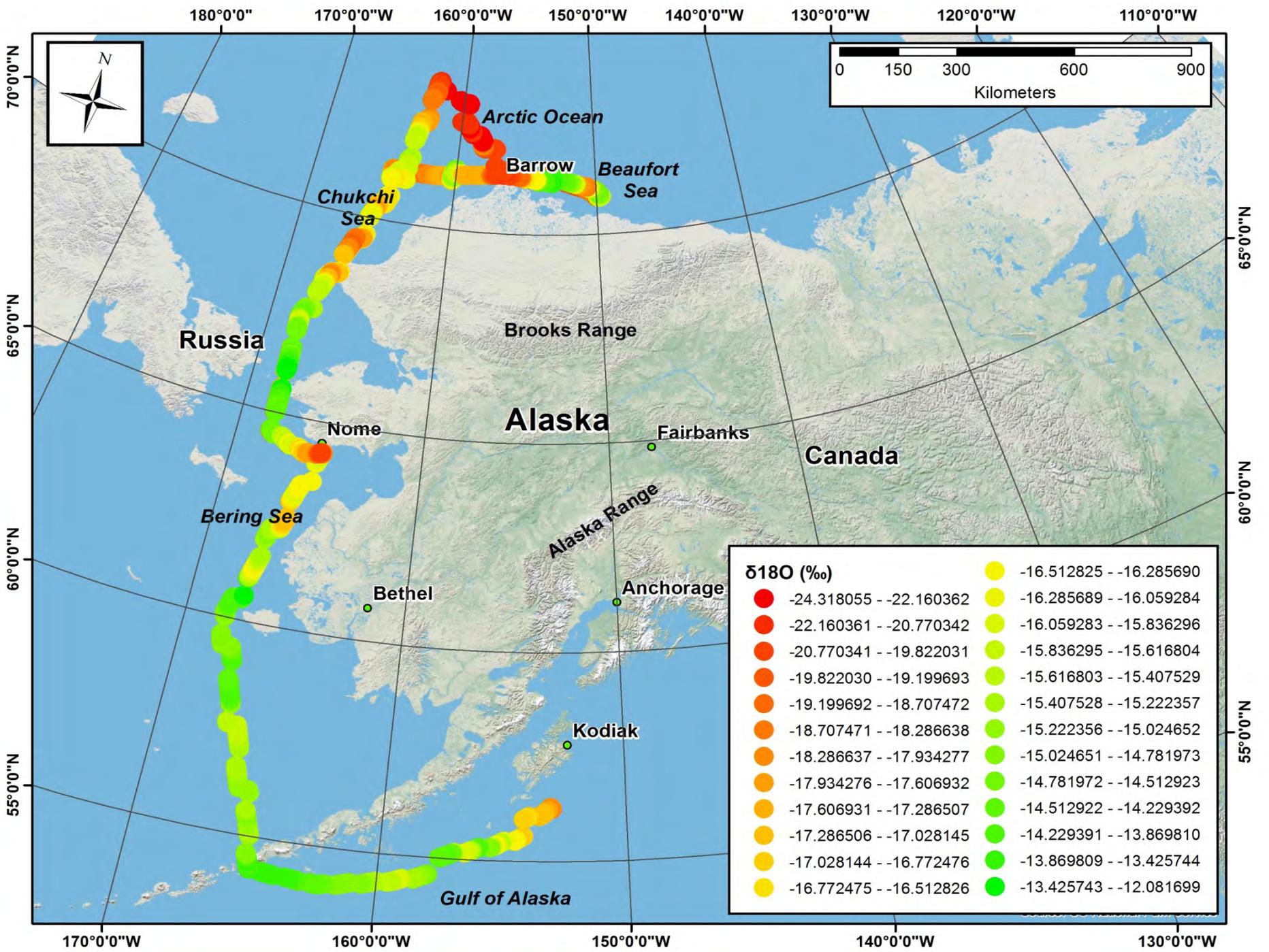


Fine-scale surface seawater isotope geochemistry  
Seasonality of seawater isotopes (in and out of the Arctic Basin along similar transects)  
Surface water responses to sea ice variation and feedbacks to marine boundary layer water vapor traits (sourcing moisture)

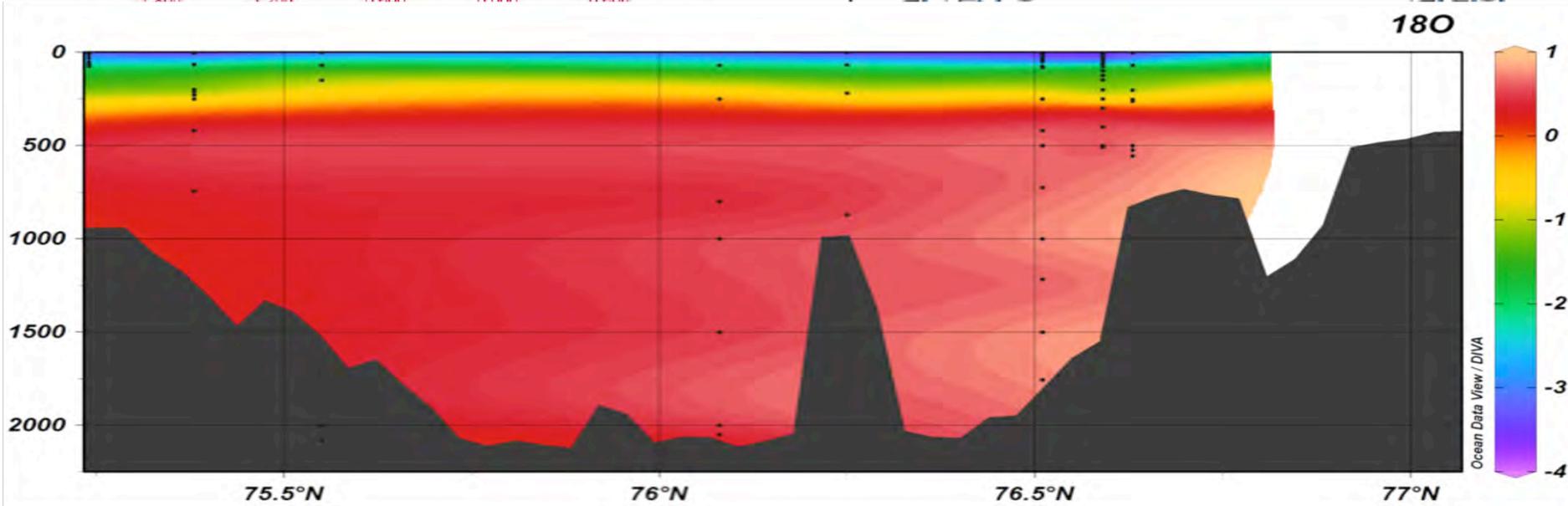
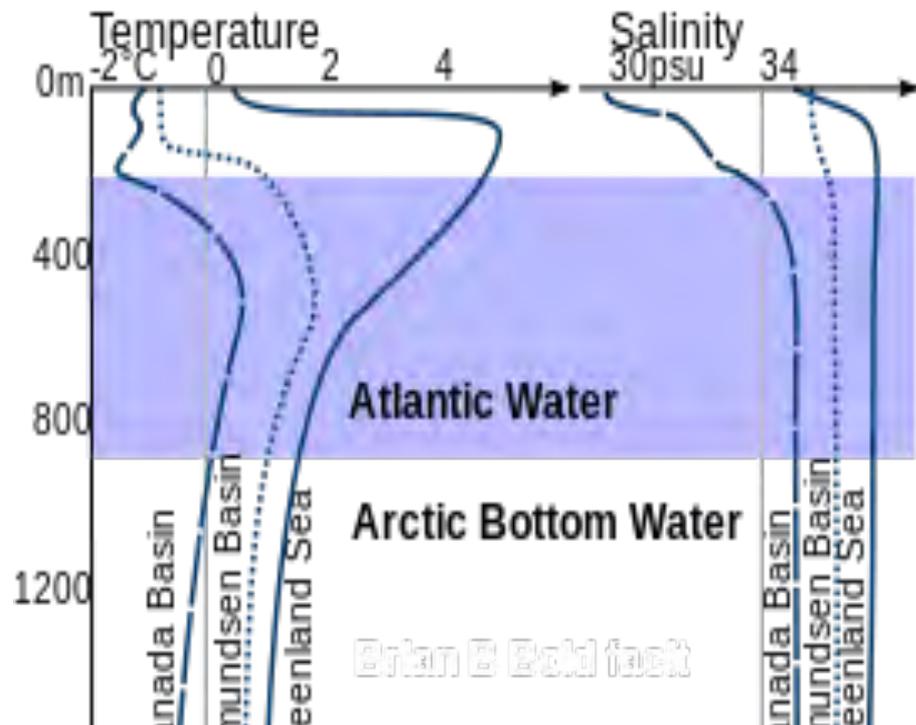
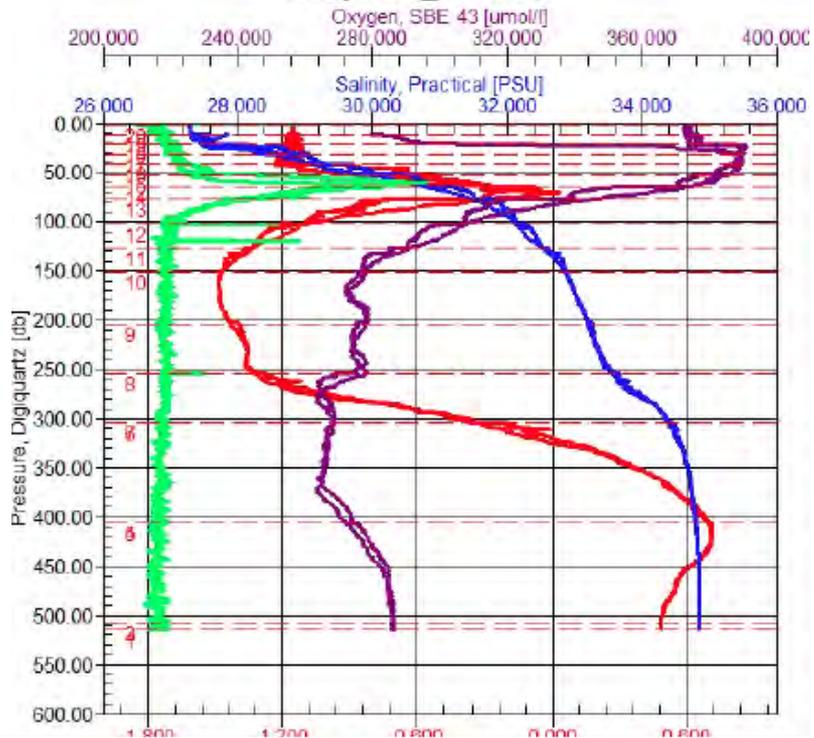


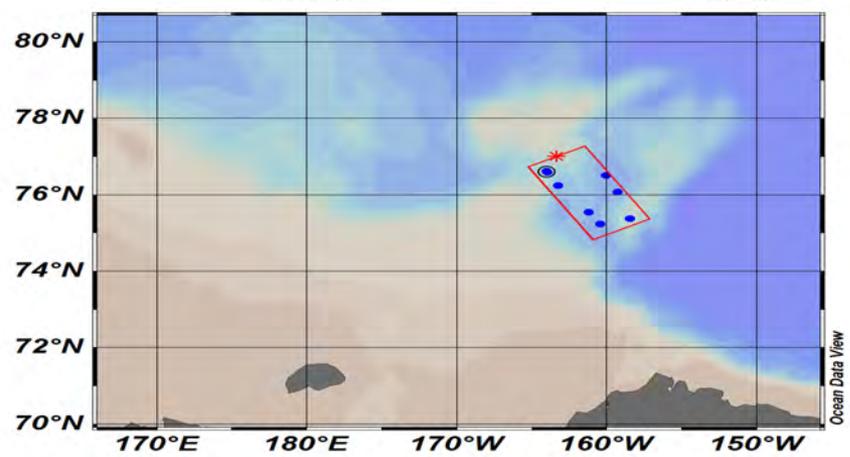
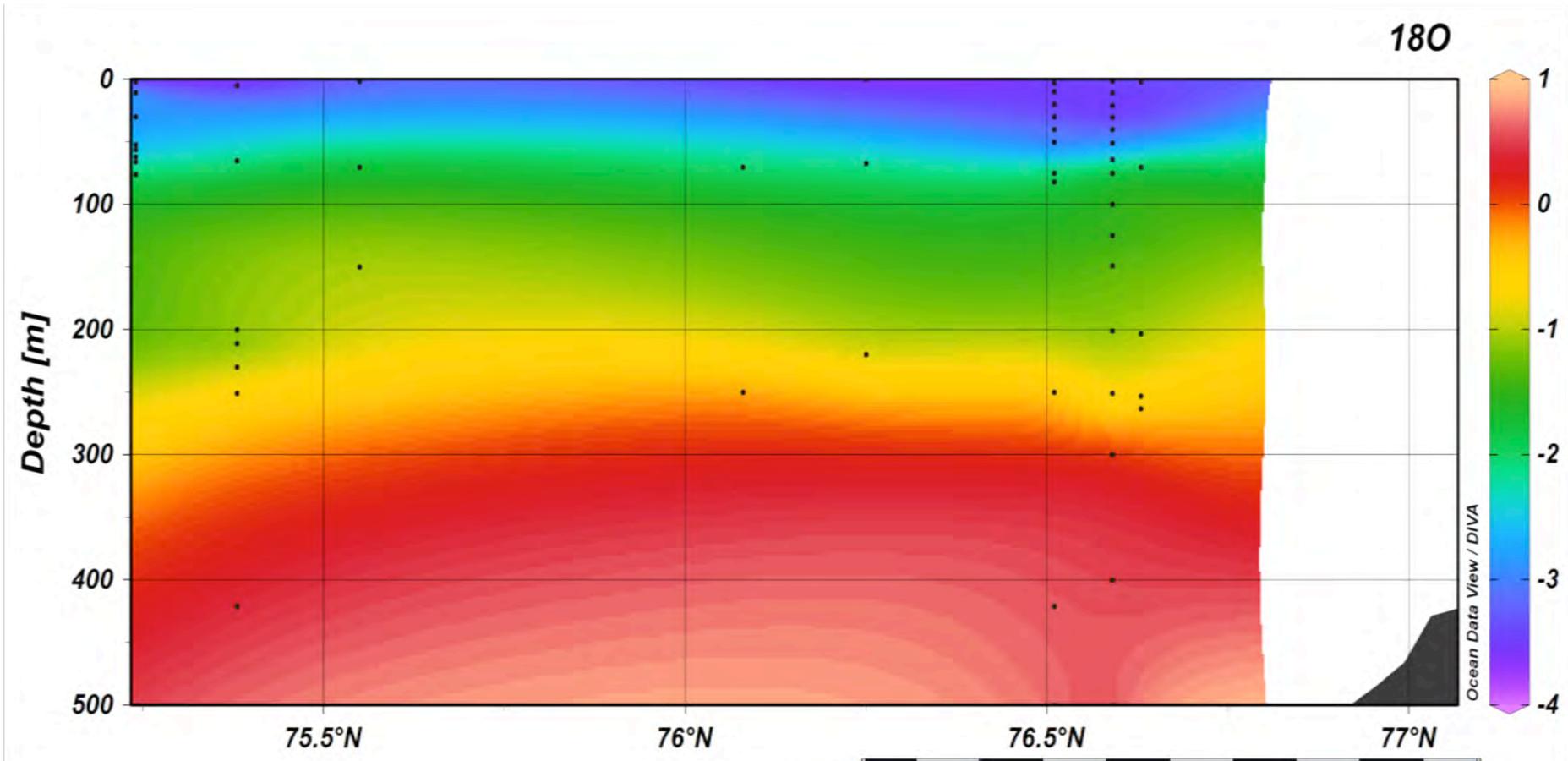
### Continuous Ocean Water Isotope Data (2016)



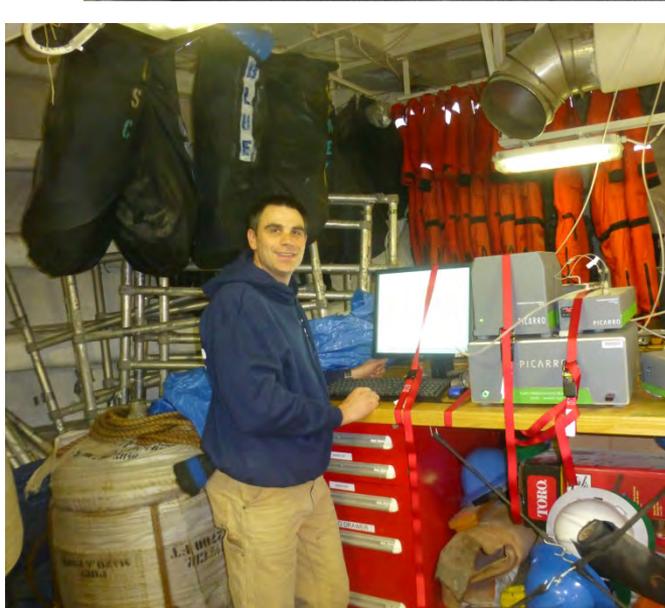


Healy1601\_019.hex





# Healy Water Vapor , Seawater CO<sub>2</sub> & CH<sub>4</sub> Isotopic Research



21<sup>st</sup> Century USNOLS Fleet: “Monitoring and measuring processes in the worlds oceans”  
Strengthening the in-situ capacity & mission of our ship-based platforms



**URGENT NEEDS:**

Dedicated advanced instrument packages installed and operational on the UNOLS vessels for Atmospheric, Cryospheric, Hydrologic, Oceanographic, Marine and Terrestrial System Research

CO<sub>2</sub>, CH<sub>4</sub> *in-situ* systems (fluxes and sources/*isotopes*), Water vapor and seawater isotopes, standard modern micromet systems (i.e. AOOS,/NEON-like)