A photograph of a vast Arctic sea ice field with numerous icebergs of various sizes floating in the water. The sky is clear and blue.

Continuous Arctic Ocean Water Vapor Isotope Ratio ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) Measurements During a Summer Icebreaker Expedition

Eric S. Klein

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November, 18, 2015

Jeff Welker - University of Alaska Anchorage



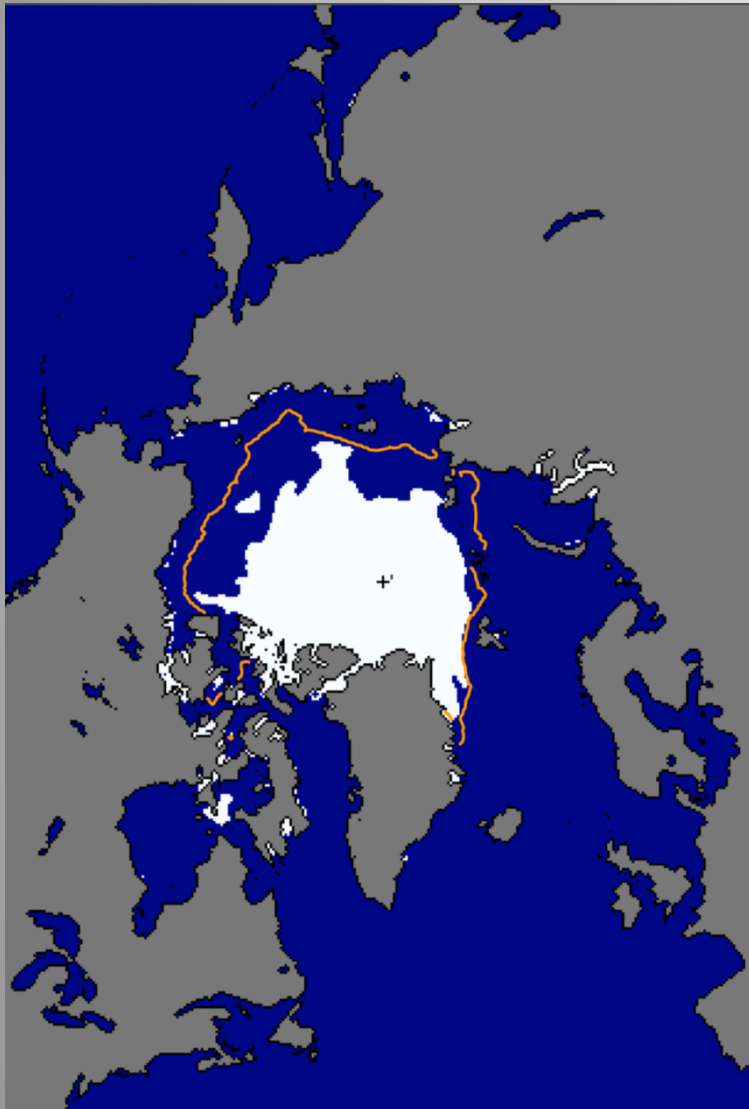
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Outline

- Brief Arctic Alaska and water isotope overview
- Water vapor isotopes collected during a July 2015 Arctic research cruise
- Other applicable studies



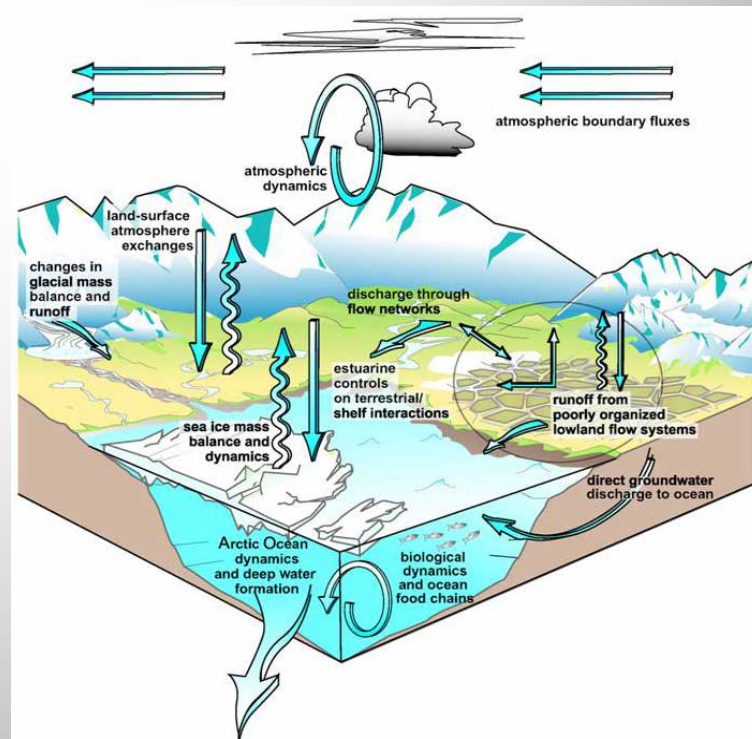
Reduced Arctic sea ice extent



National Snow and Ice Data Center

2015:
Sea ice minimum
(4th lowest on record)

1981-2010:
Median minimum



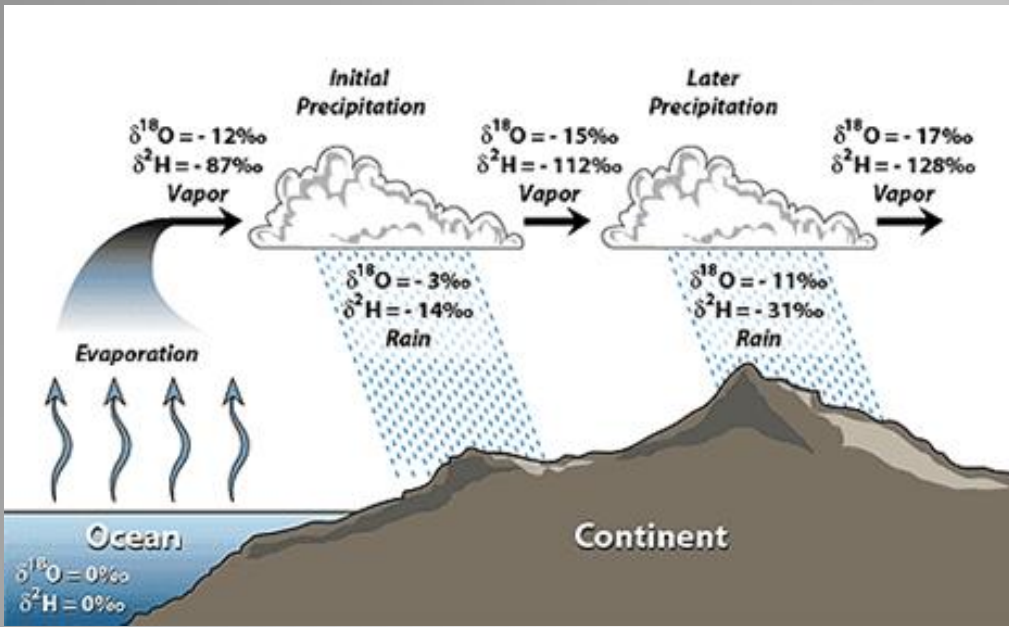
<http://www.wsag.unh.edu/arctic.html>

Help understand Arctic water cycle



Toolik Lake, Arctic Alaska

Water isotope research in Arctic Alaska
(marine and terrestrial)



GNS Science

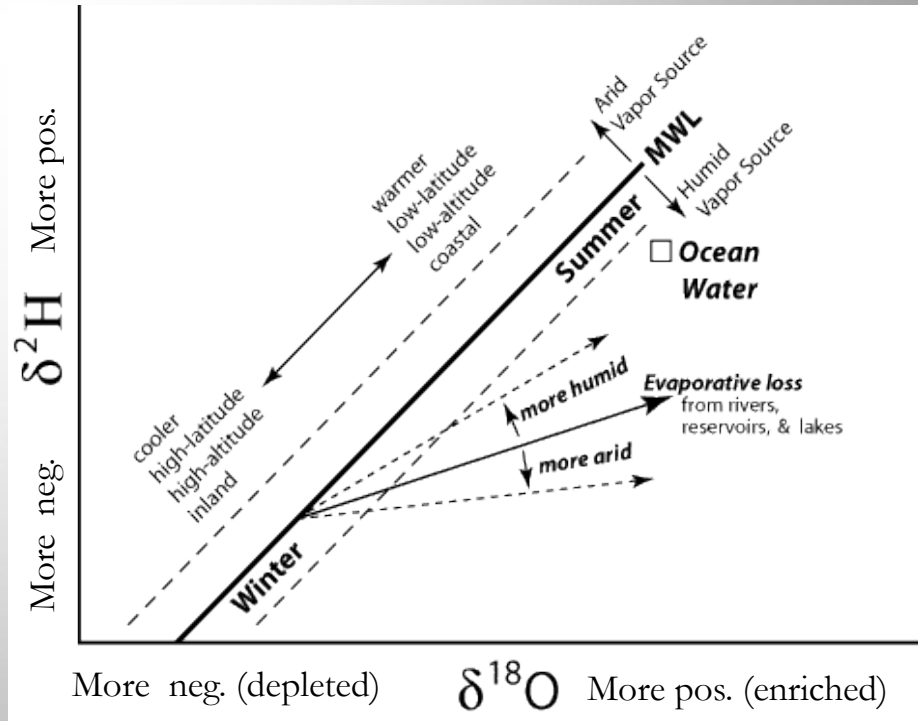
Isotopes in the water cycle

- Light and heavy isotopes of oxygen (^{16}O , ^{18}O) and hydrogen (^1H , ^2H) in water
- Preferential evaporation/precipitation

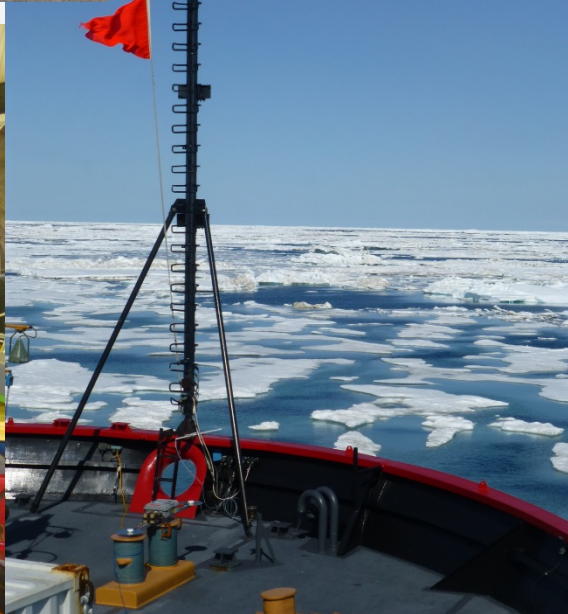
Modified from Clark and Fritz, 1997

Water lines

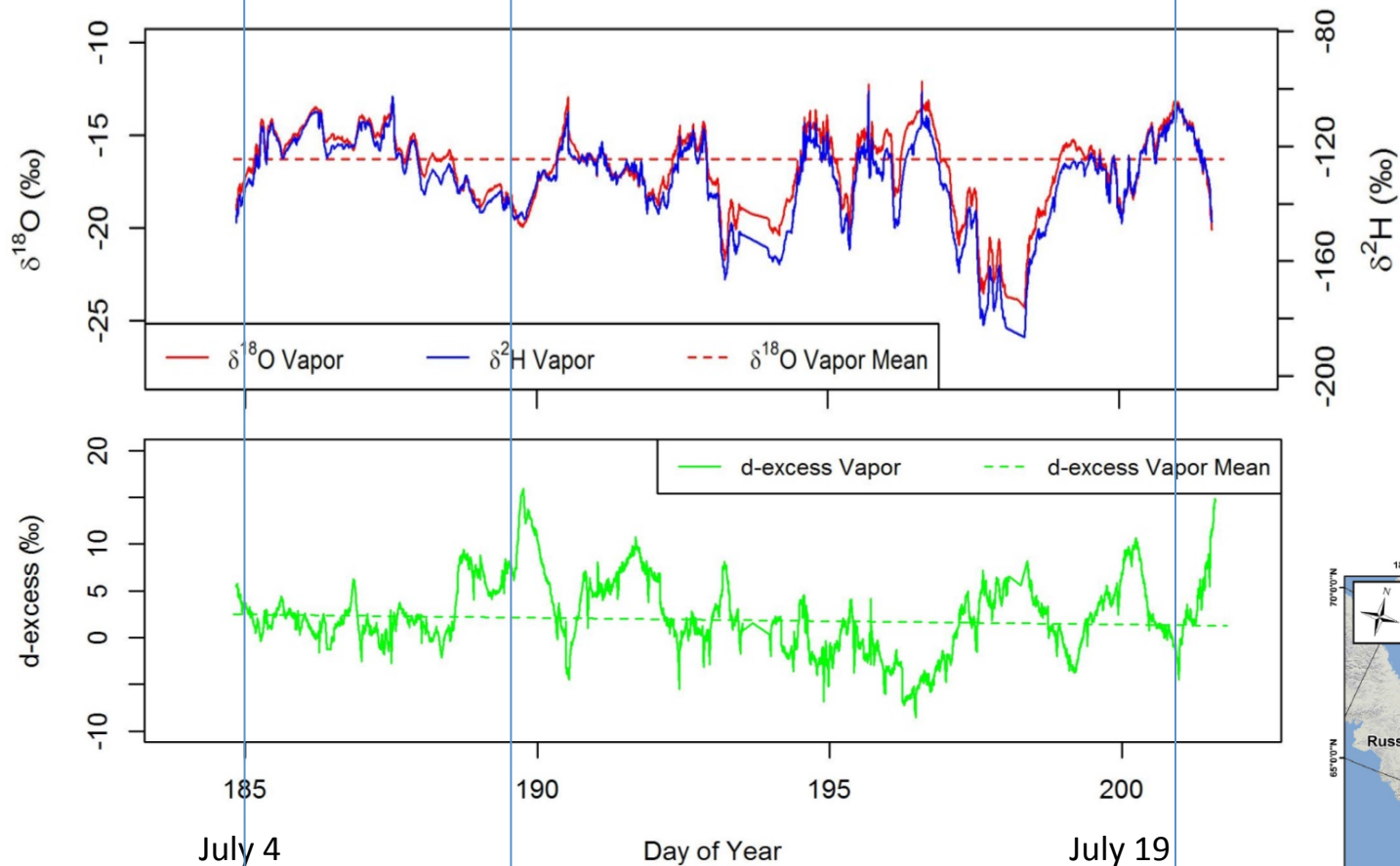
- Display relationship between isotope ratios
- Can vary across locations and climates



Summer 2015 Healy Research



Ocean Water Vapor Isotope Data Summary (2015 - Healy)



Kodiak

Bering Strait

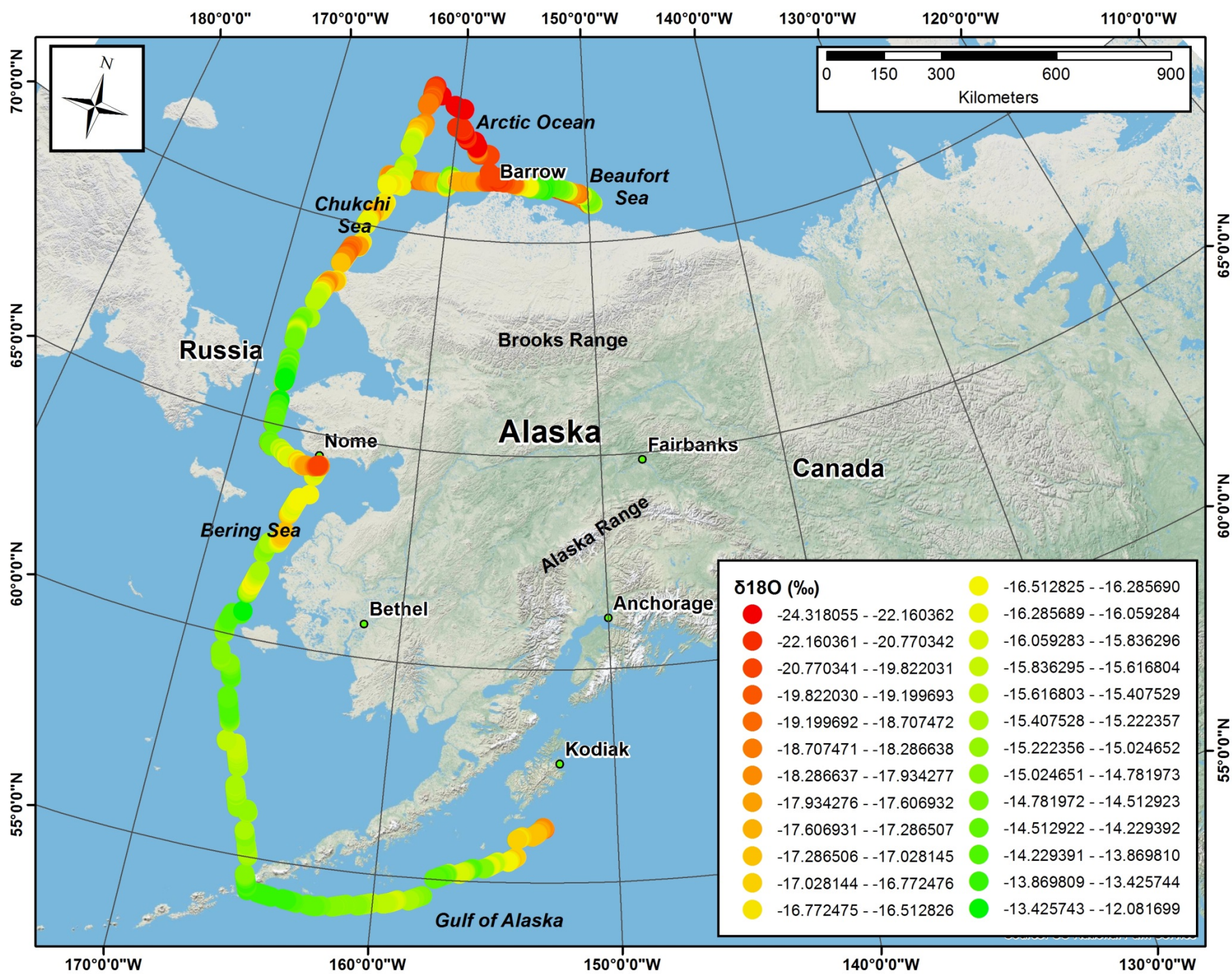
Bering Strait

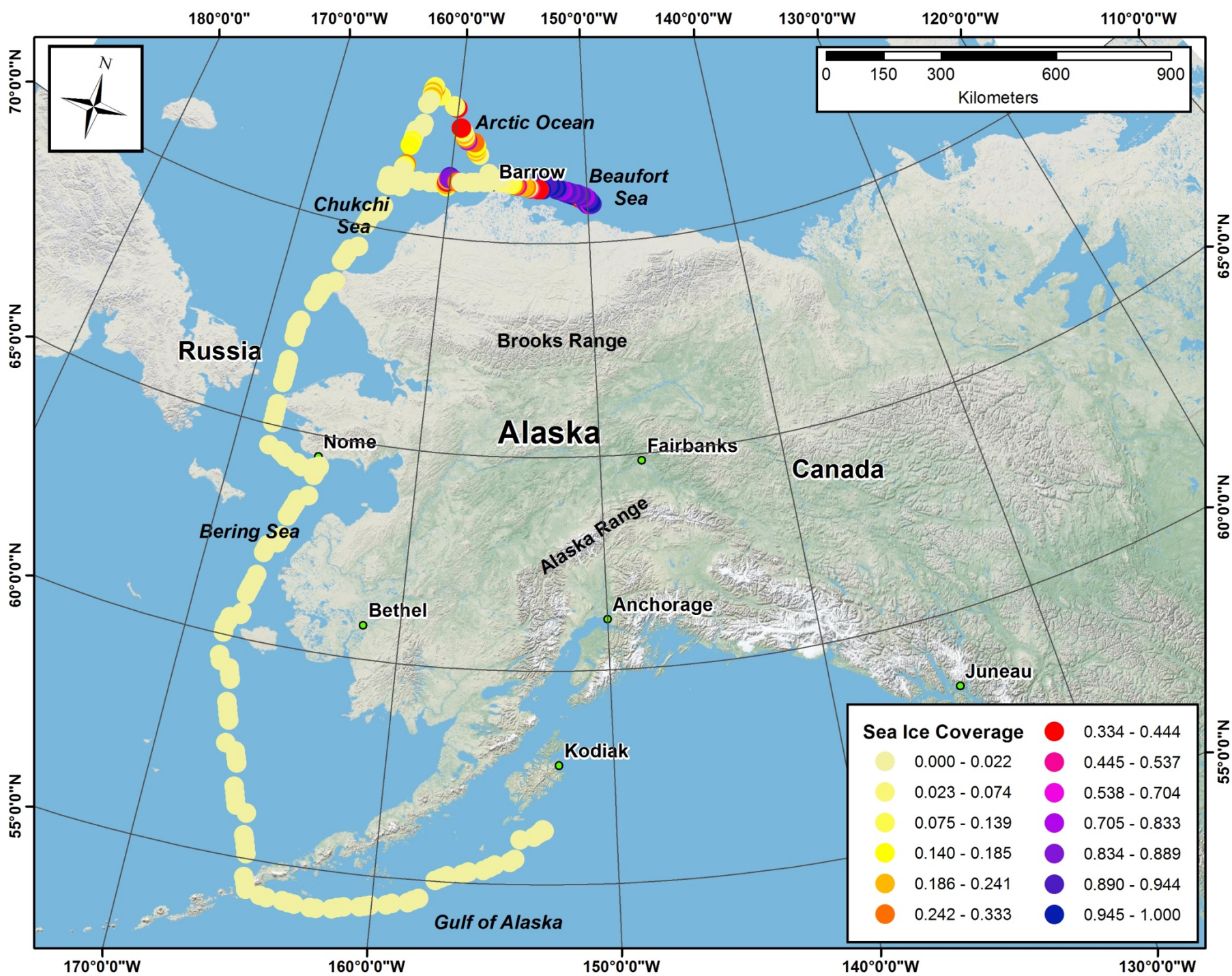


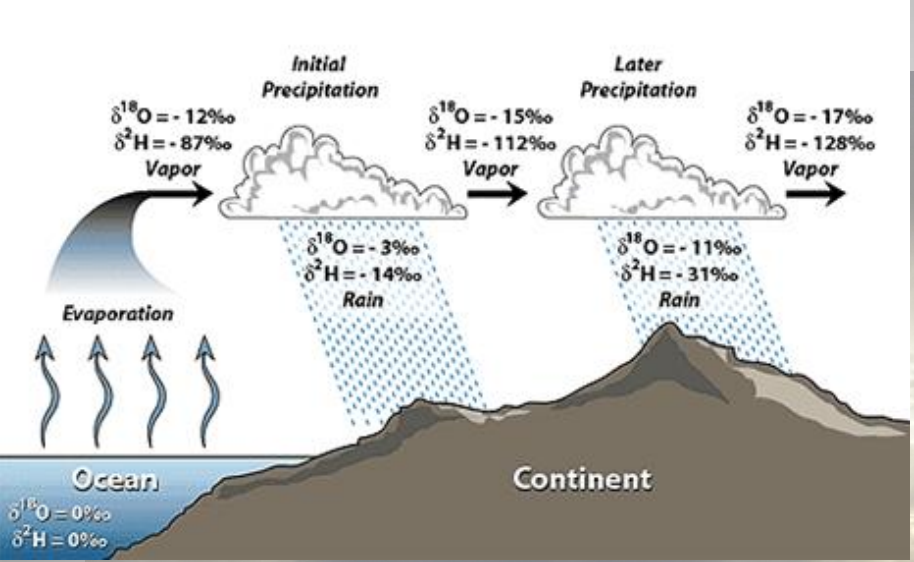
Bering Strait

Kodiak

Nome



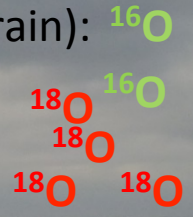




Vapor:
 08:30, 7/7/15
 $\delta^{18}\text{O} -16.8314$
 $\delta^2\text{H} -136.2479$

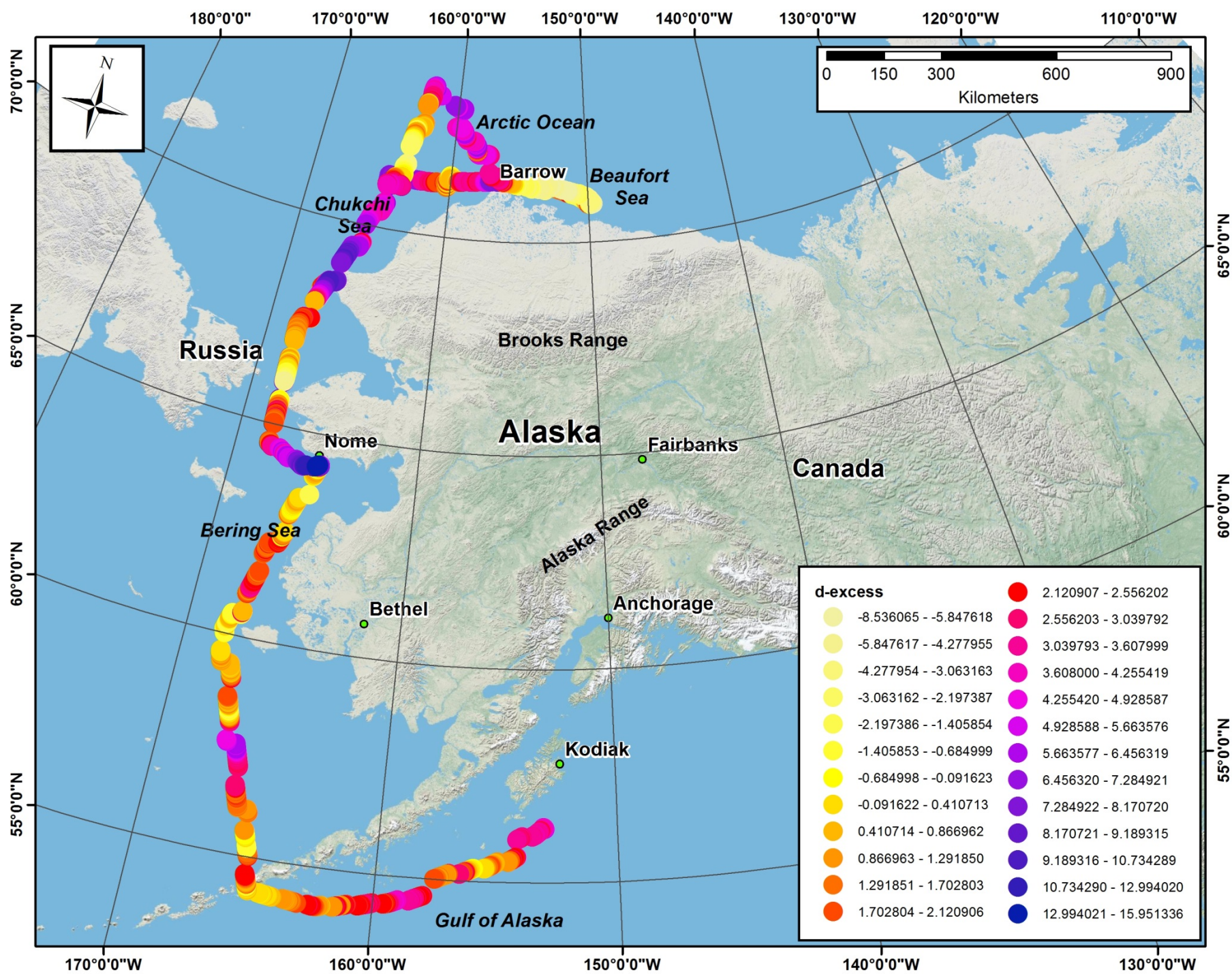


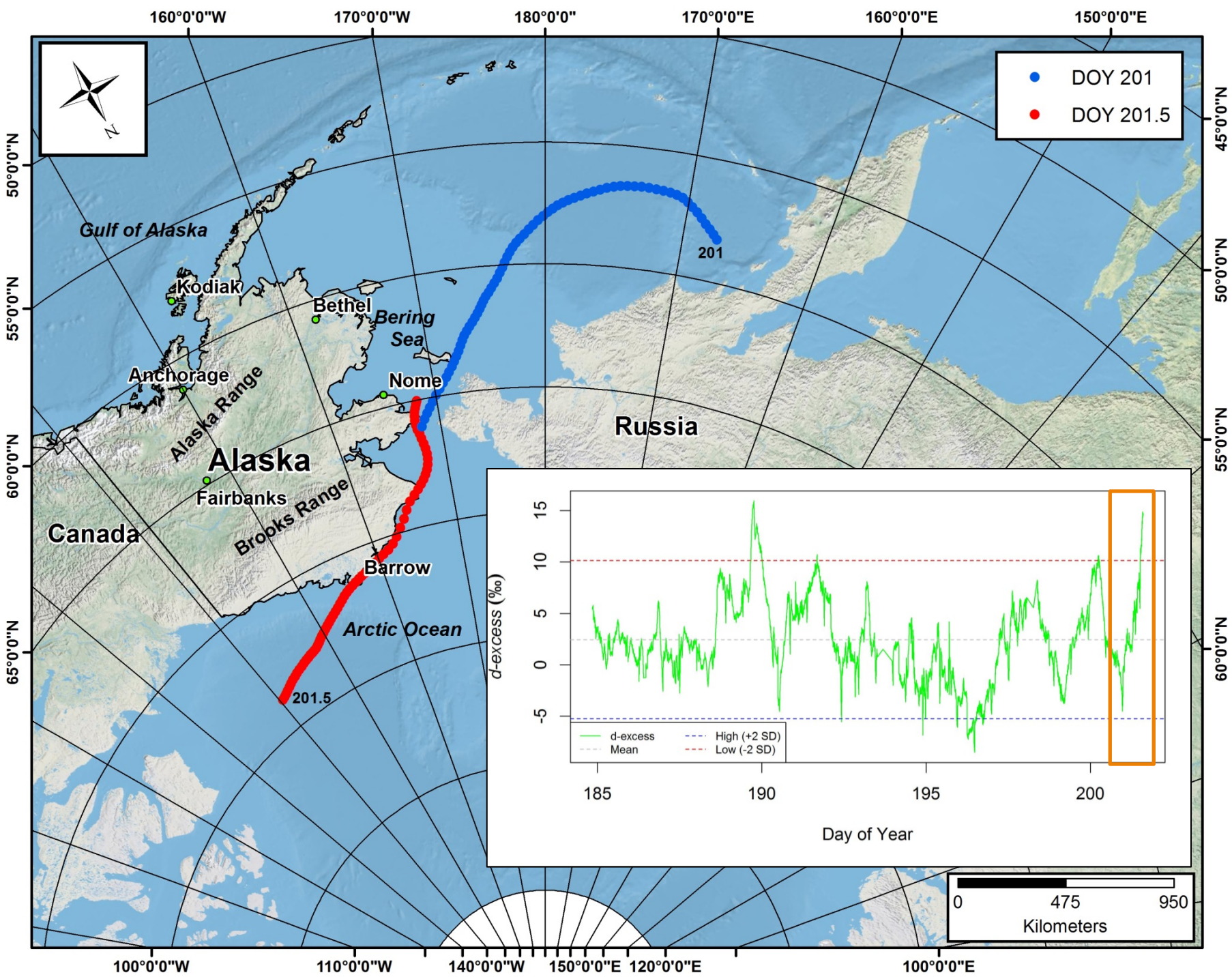
Precipitation (rain):
 09:50, 7/7/15
 $\delta^{18}\text{O} -9.95445$
 $\delta^2\text{H} -82.9931$

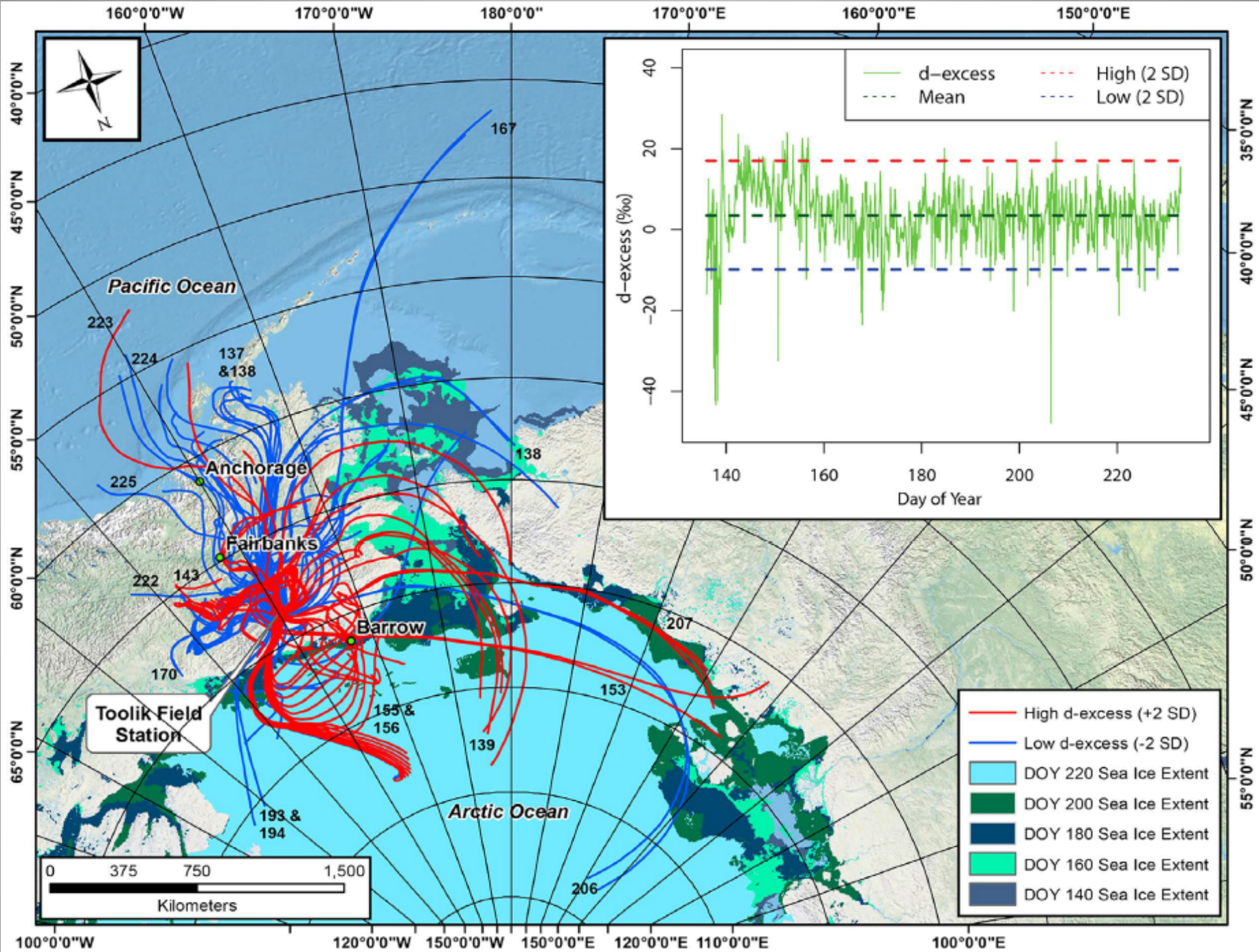


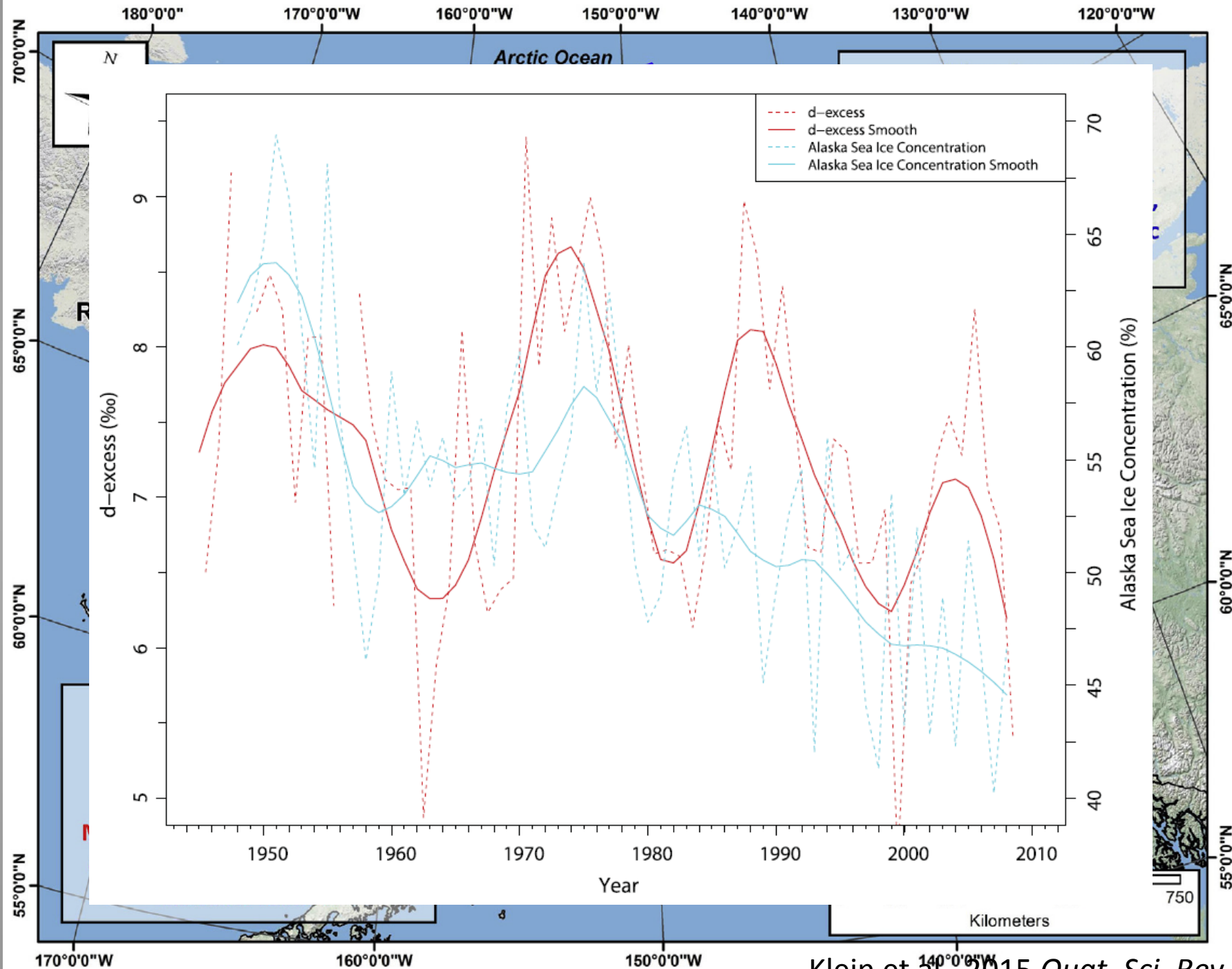
Ocean water (at surface):
 08:10, 7/7/15
 $\delta^{18}\text{O} -1.4571$
 $\delta^2\text{H} -10.0435$





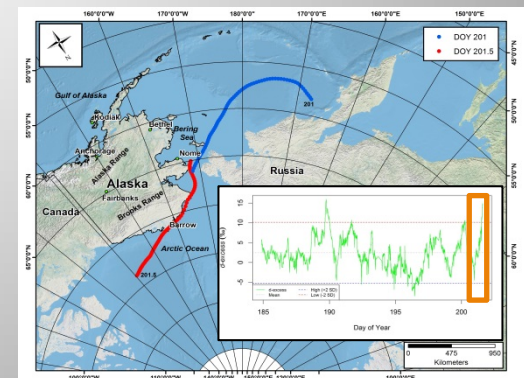
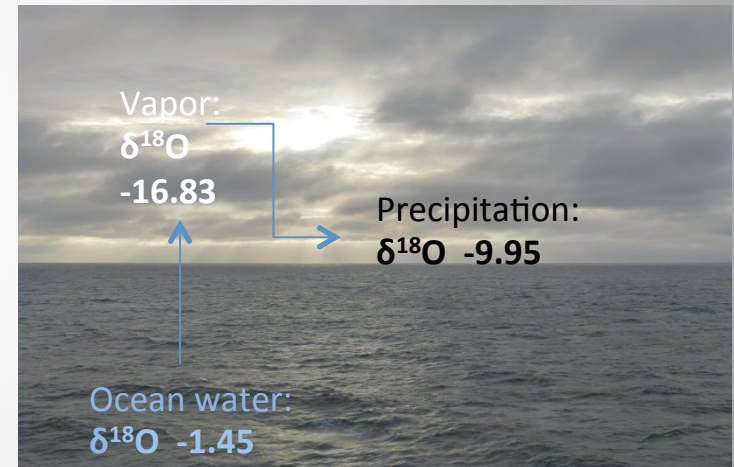
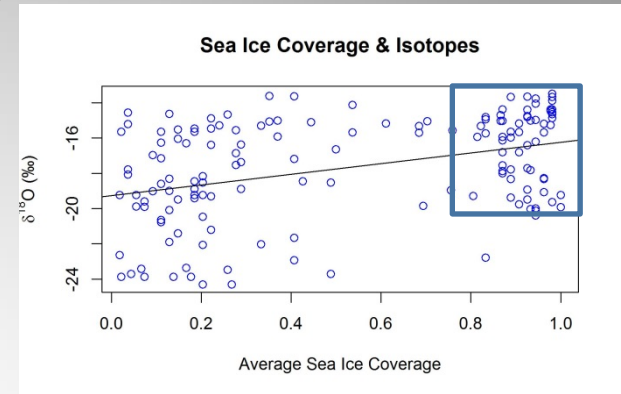






Summary

- Enriched $\delta^{18}\text{O}$ vapor values associated with more sea ice
- Ocean-vapor-precipitation fractionation consistent with expectations
- Lower *d-excess* values related to more southern moisture sources, and vice versa
- Reduced sea ice extent influencing water isotopes
- McCall Glacier ice core shows increase in precip with open water source



Acknowledgements



United States Coast Guard:
Healy Crew
&
Research and Development
Center

