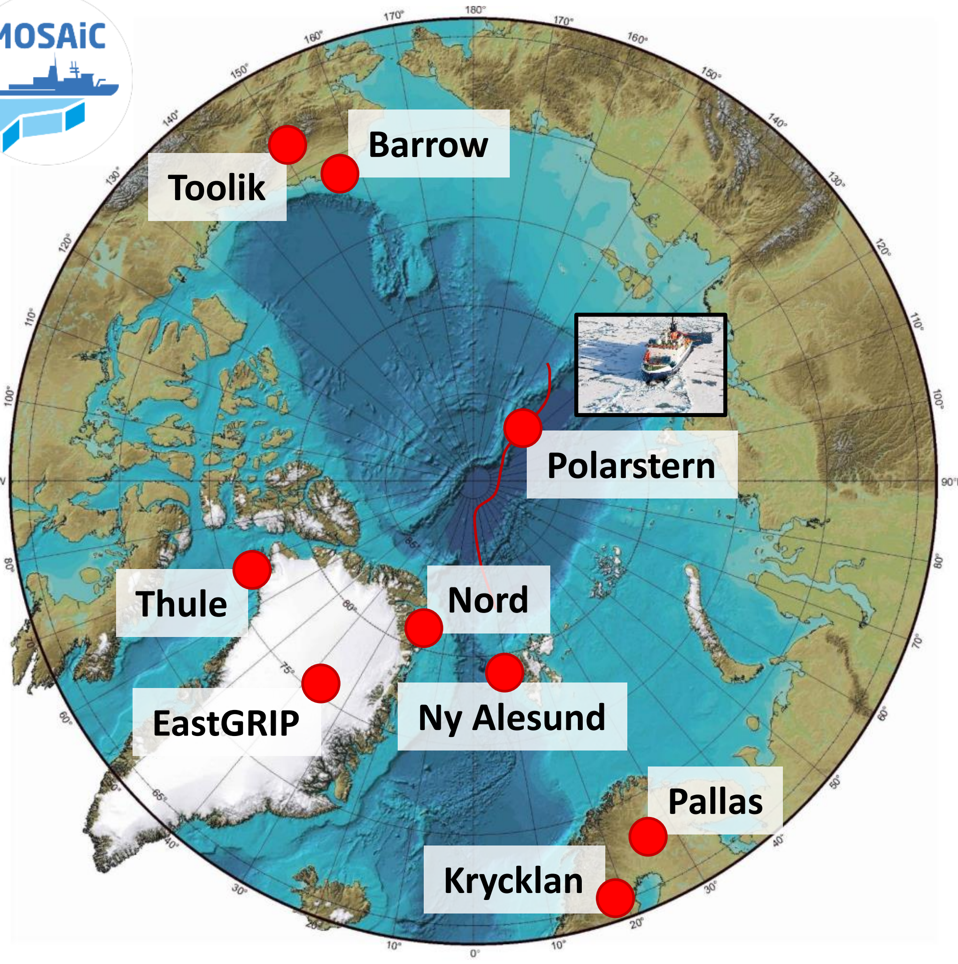
MOSAiC’s Pan Arctic Water Isotope Network: Sea ice-water vapor isotope interactions and transport processes within, into and out of the Arctic



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First step: **Identify recurring transport patterns connecting multiple sites**

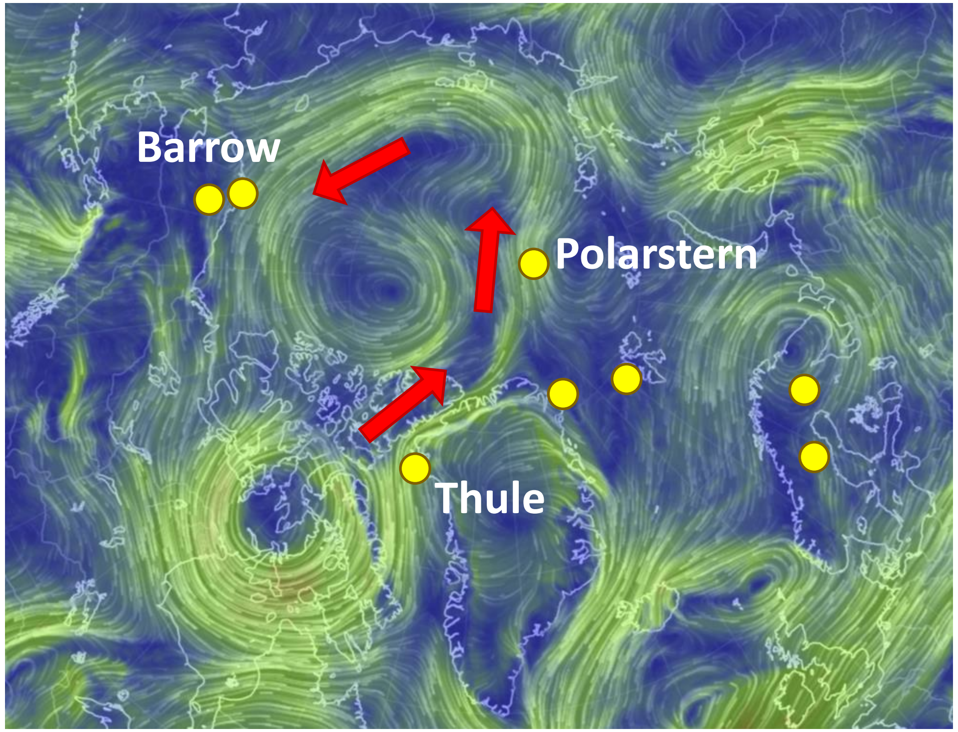
We examine wind patterns during first months (October-December) of MOSAiC to see common transport patterns of moisture into, within, and out of the Arctic

Two major pathways of transport are identified for initial analysis:

1. Transport into Arctic via Baffin Bay, across central Arctic, and out the Bering Strait
2. Transport into Arctic via the North Atlantic (across Scandinavian peninsula), across central Arctic, and out the Bering Strait

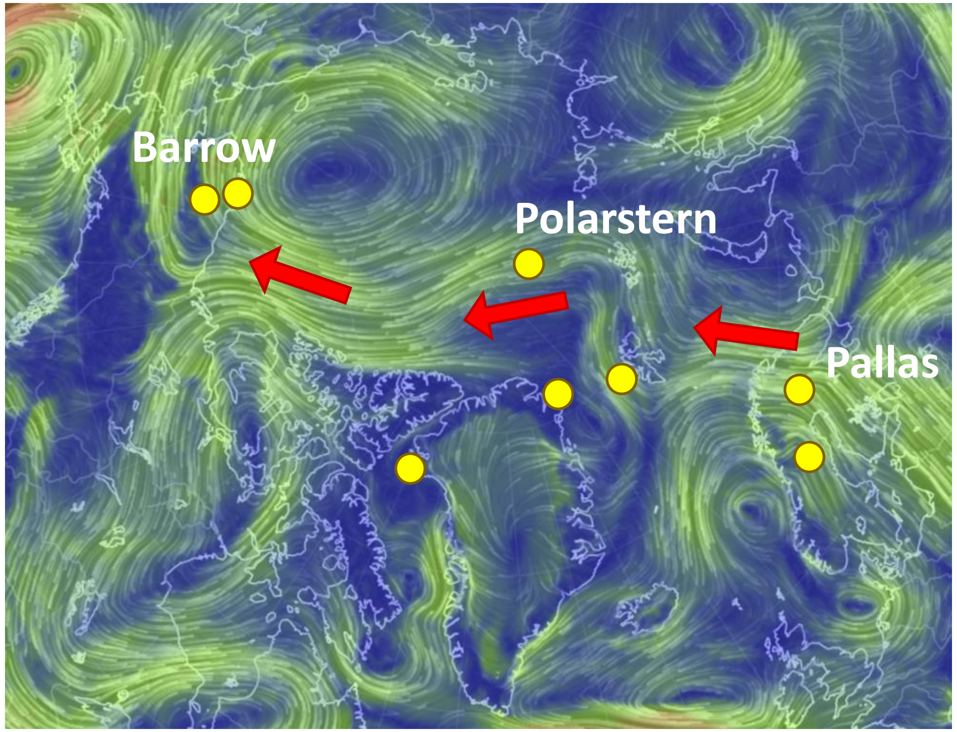
Example of site-to-site connections observed by isotopic analyzers:

1. Thule to Polarstern to Barrow



Oct 10 12z at 850 hPa

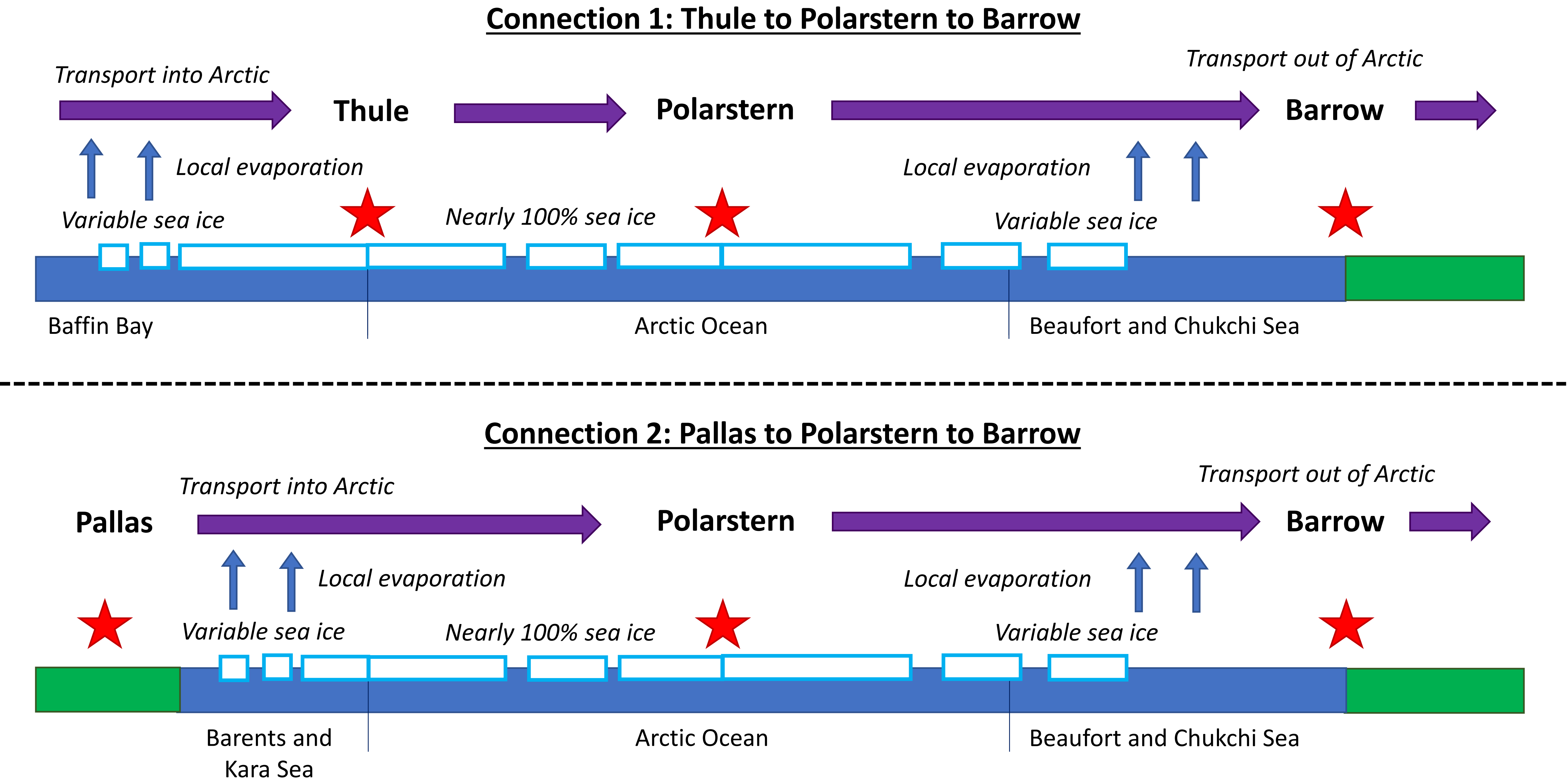
2. Pallas to Polarstern to Barrow



Nov 13 06z at 850 hPa

Images from: https://earth.nullschool.net/

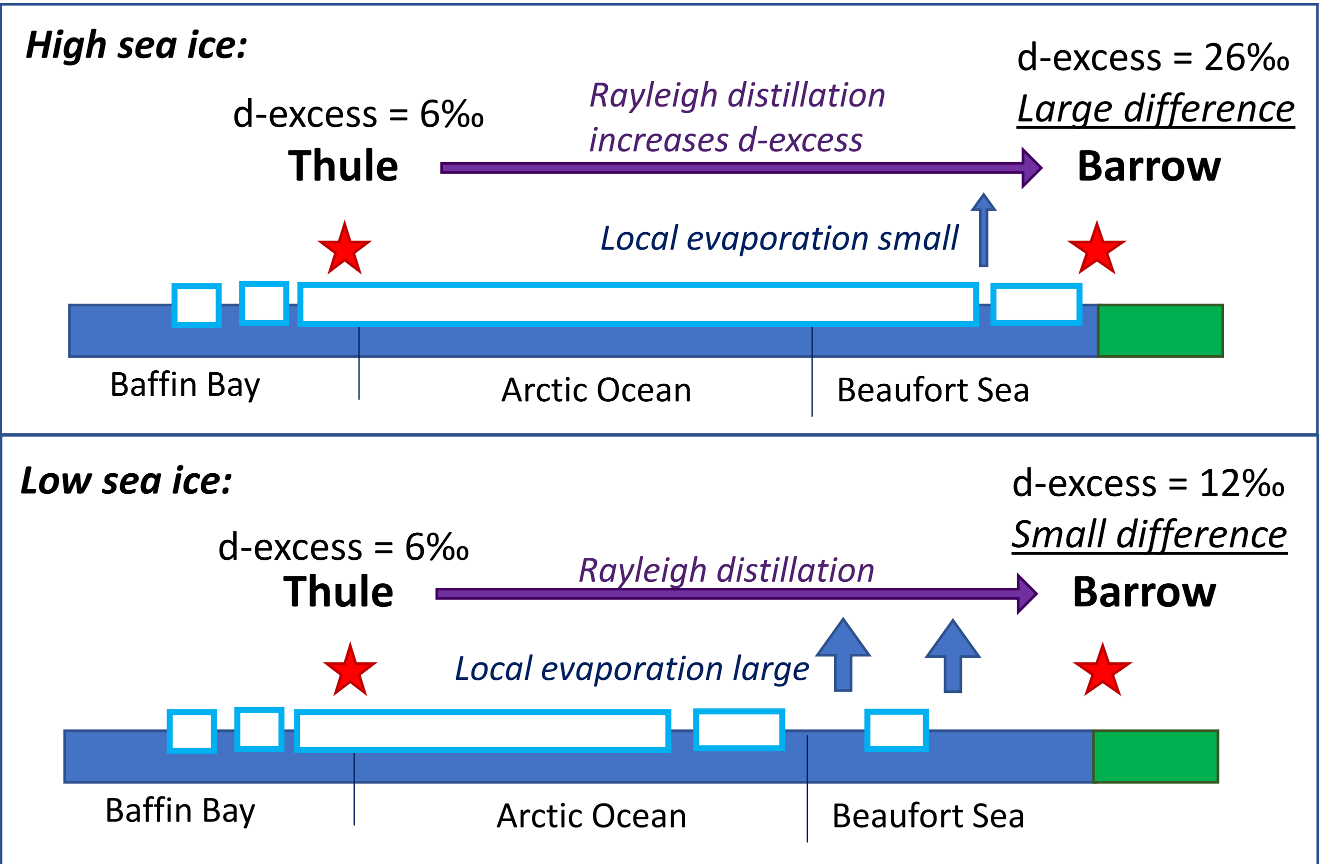
How does transport and sea ice impact vapor from site to site?



Site-to-site changes of deuterium excess show more local moisture input when less sea ice

Deuterium excess (d-excess = $\delta D - 8\delta^{18}O$) of water vapor controlled by conditions at evaporation site

Moisture from **Arctic source has low d-excess** as evaporation for this analysis is taking place over large stretches of cold open water with generally high RH



Hypothesis: less sea ice = more Arctic moisture added between sites = lower d-excess difference

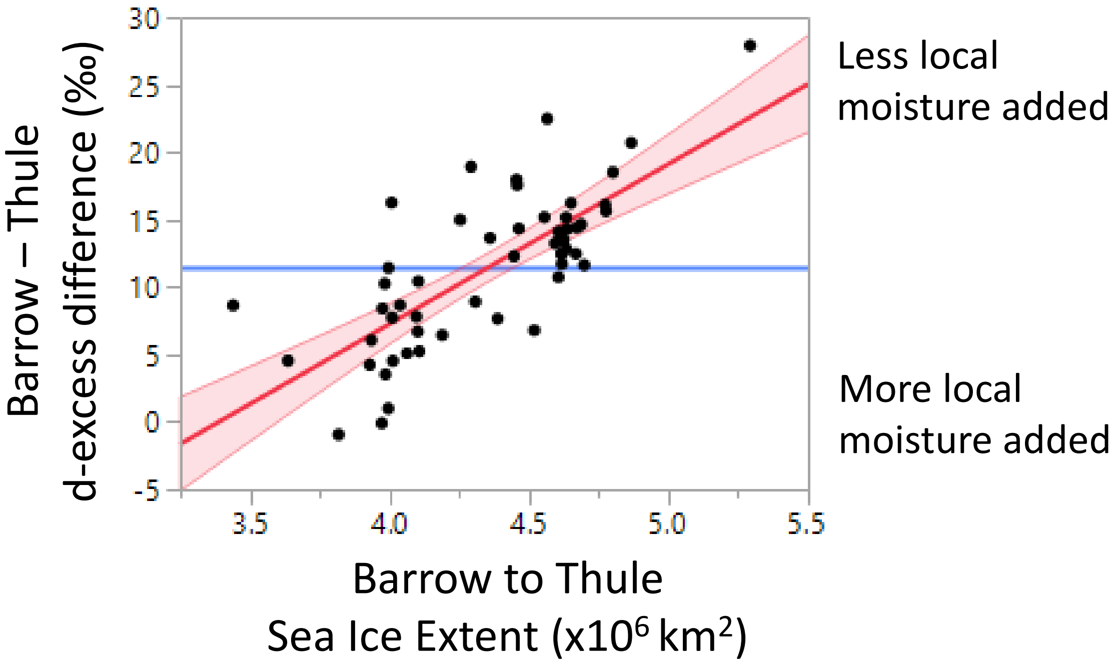


*Figure above part of multiple regression that also accounts for Rayleigh distillation between sites – vapor transport modeled through framework presented by Mattingly et al. (2018) – *JGR-Atm*

Sea ice extent is daily sum of all basins moisture crosses between sites

d-excess measurements 6-hour averages; assume 48 hour lag between sites (i.e. Barrow is 48 hours after Thule) to account for transport time

Site-to-site changes of deuterium excess show more local moisture input when less sea ice

Sea ice is an important control everywhere*

- Less sea ice = lower d-excess difference →

  Significant local moisture incorporated into to air mass transported to downwind site

*Pallas to Polarstern connection not significant, could be due to:

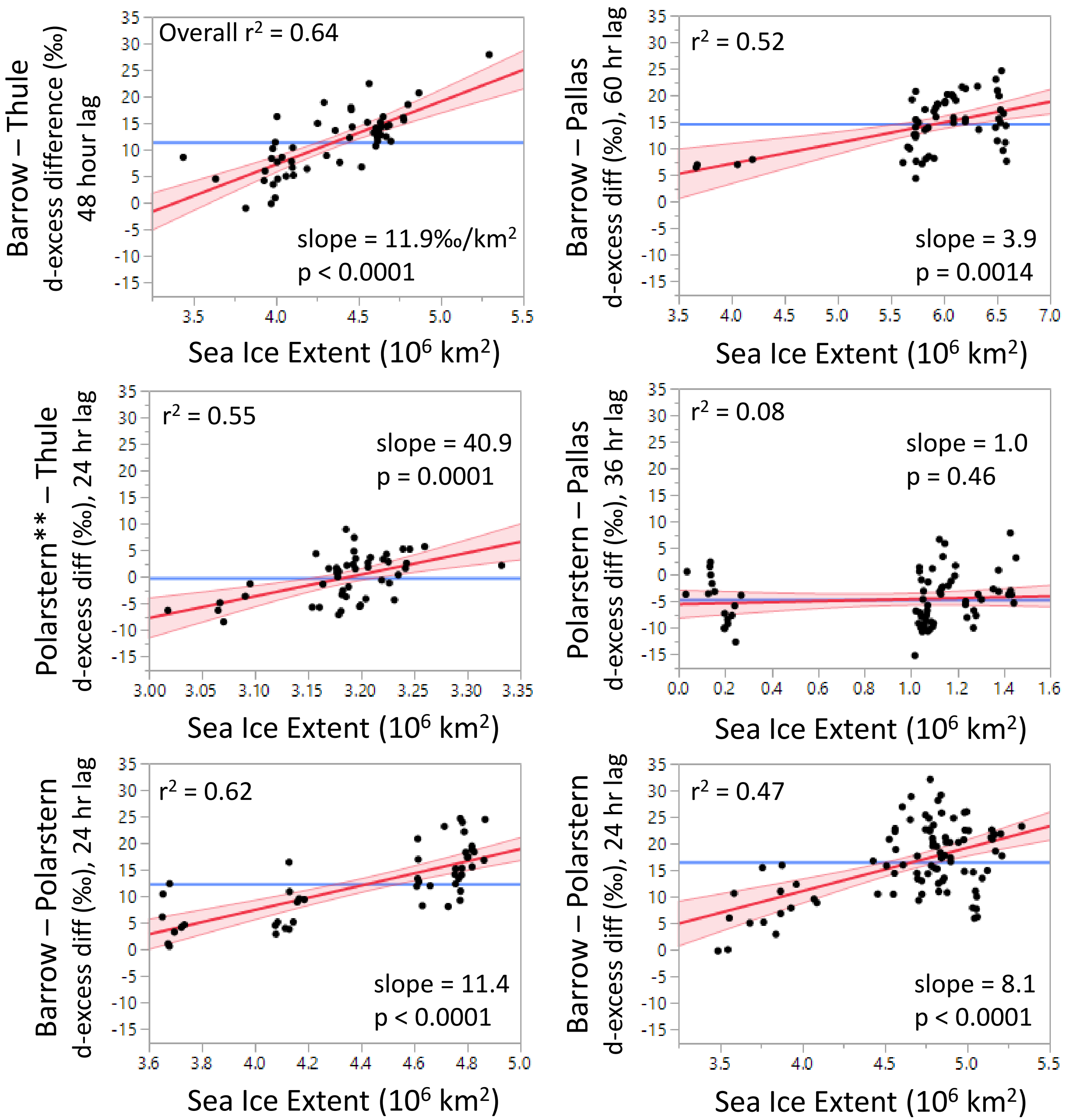
- Connection not representative of air entering Arctic from North Atlantic
- Sea ice extent so low over this stretch that small variations are not important (we can test this later in MOSAiC)

Moisture entering the Arctic from Baffin Bay (Thule) is consistently impacted by variations of sea ice – significant moisture added along transport pathway

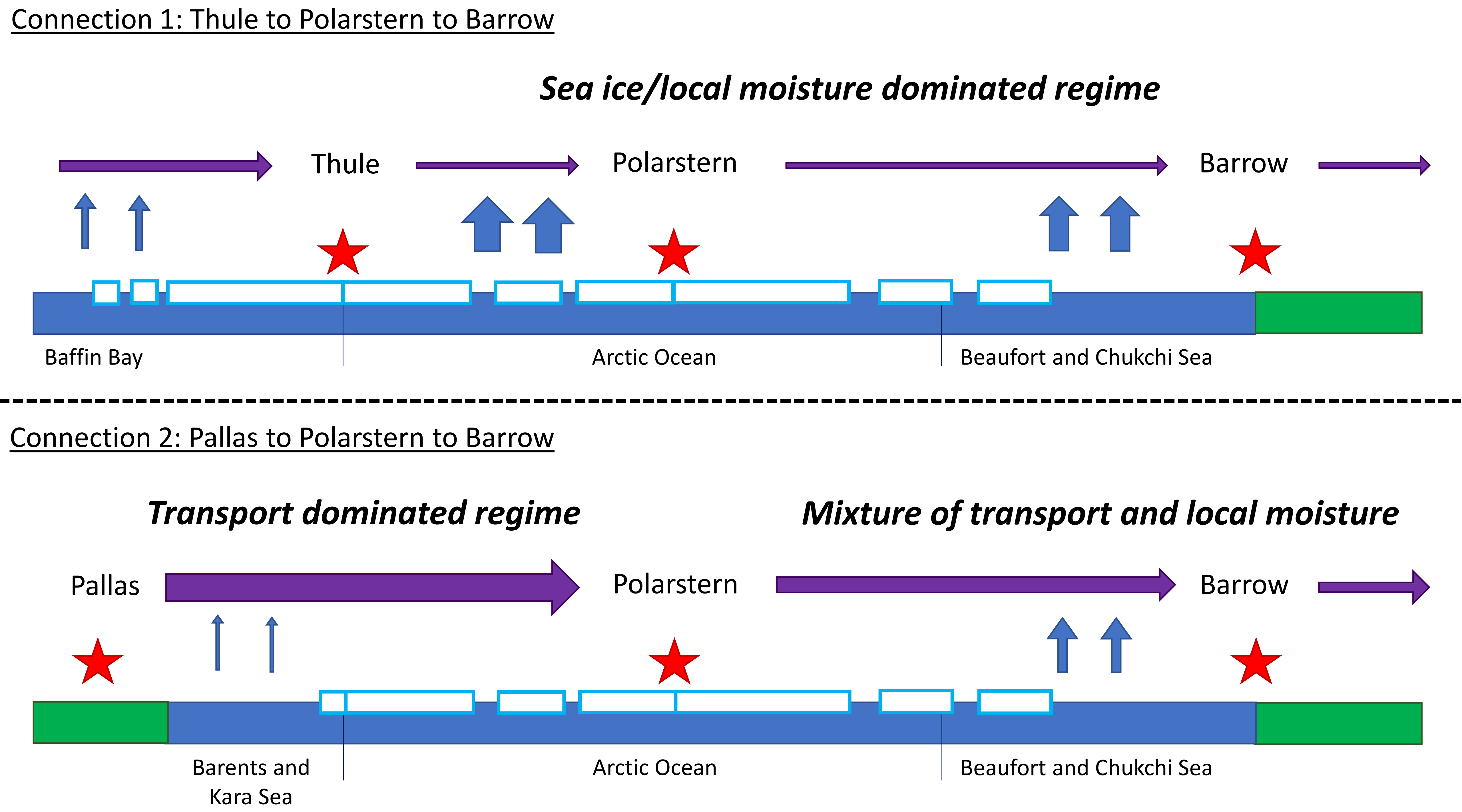
Moisture entering the Arctic via North Atlantic/Scandinavian Peninsula (Pallas) less impacted by sea ice – possibly more humid air masses less susceptible to new moisture

Connection 1: Thule to Polarstern to Barrow

Connection 2: Pallas to Polarstern to Barrow



***Polarstern data preliminary*


Connection 1: Thule to Polarstern to Barrow
Sea ice/local moisture dominated regime
Thule
Polarstern
Barrow
Baffin Bay
Arctic Ocean
Beaufort and Chukchi Sea
Connection 2: Pallas to Polarstern to Barrow
Transport dominated regime
Mixture of transport and local moisture
Pallas
Polarstern
Barrow
Barents and
Kara Sea
Arctic Ocean
Beaufort and Chukchi Sea

Summary

Multi-site Arctic Water Isotope Network (AWIN) allows us to examine transport processes into, within, and out of the Arctic

Sea ice is a significant regulator of moisture fluxes in Arctic: less sea ice = more local moisture

AWIN supports MOSAiC's mission, particularly through examining humidity fluxes and helping improve our understanding of ocean-atmosphere-cryosphere interactions

https://mosaic-expedition.org/