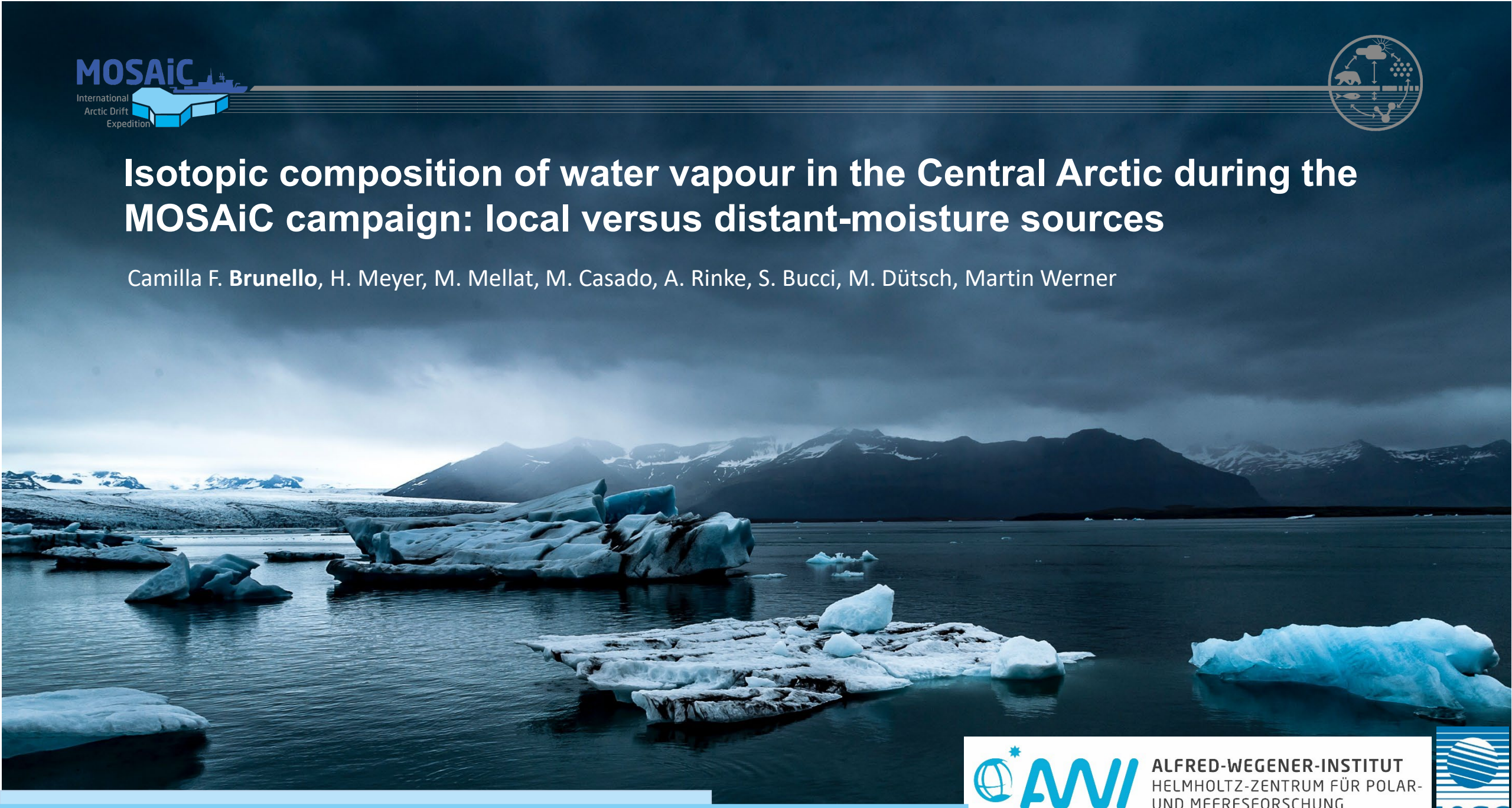
Isotopic composition of water vapour in the Central Arctic during the MOSAiC campaign: local versus distant-moisture sources

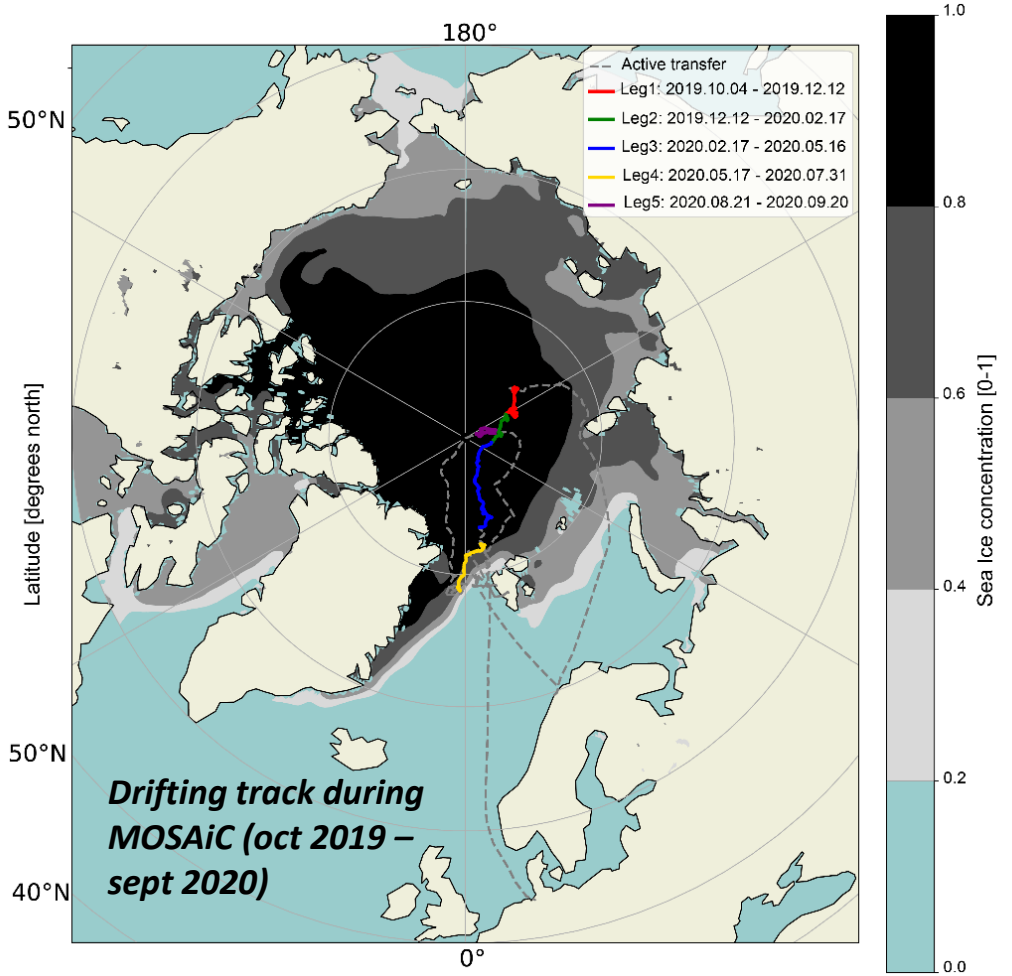
Camilla F. **Brunello**, H. Meyer, M. Mellat, M. Casado, A. Rinke, S. Bucci, M. Dütsch, Martin Werner



ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

The Arctic water cycle is changing rapidly

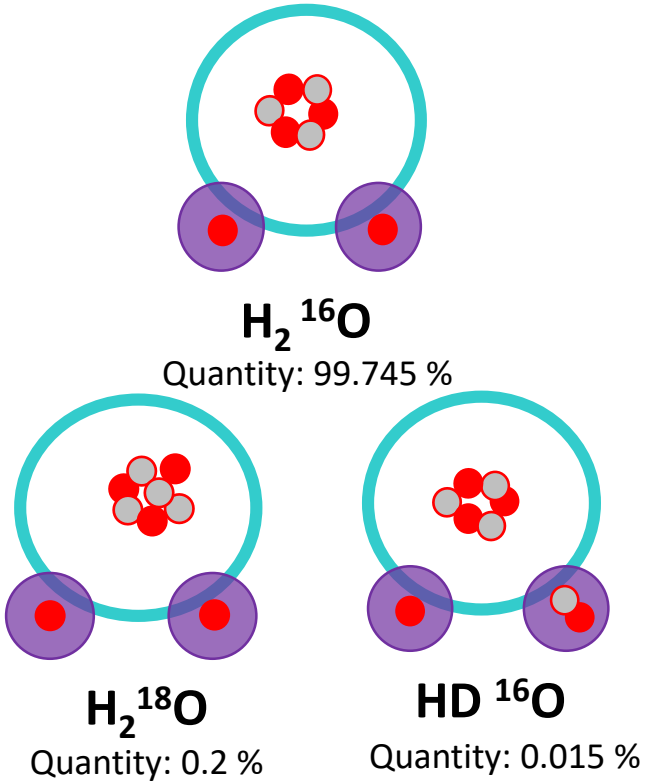
1. Arctic sea ice is decreasing
2. Arctic atmosphere is moistening
3. Arctic moisture serves as new source of precipitation
4. The origin of Arctic moisture is still debated



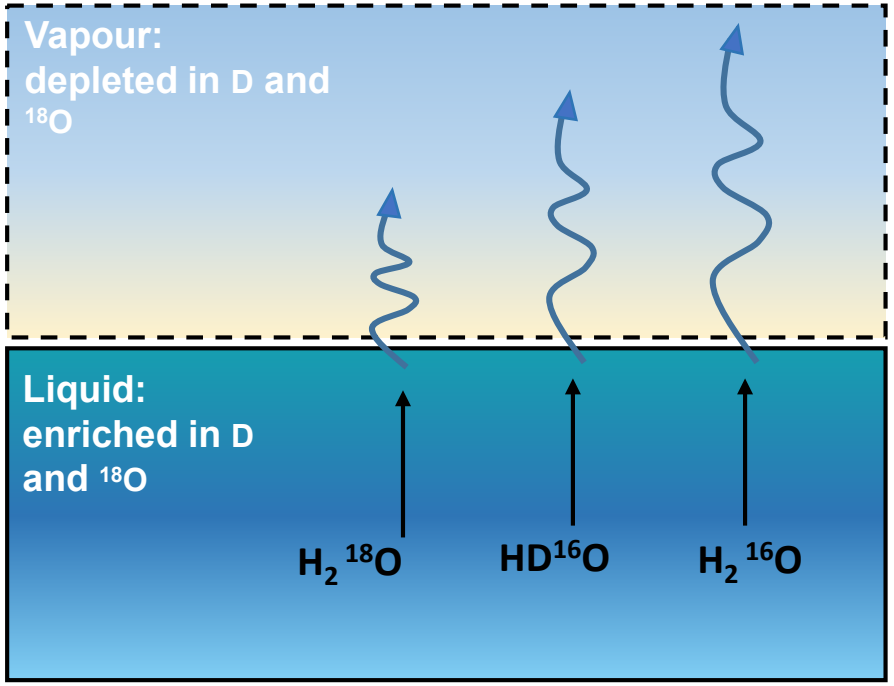
Objective: characterization of the new Arctic moisture

Water stable isotopes as a tracer of the water cycle

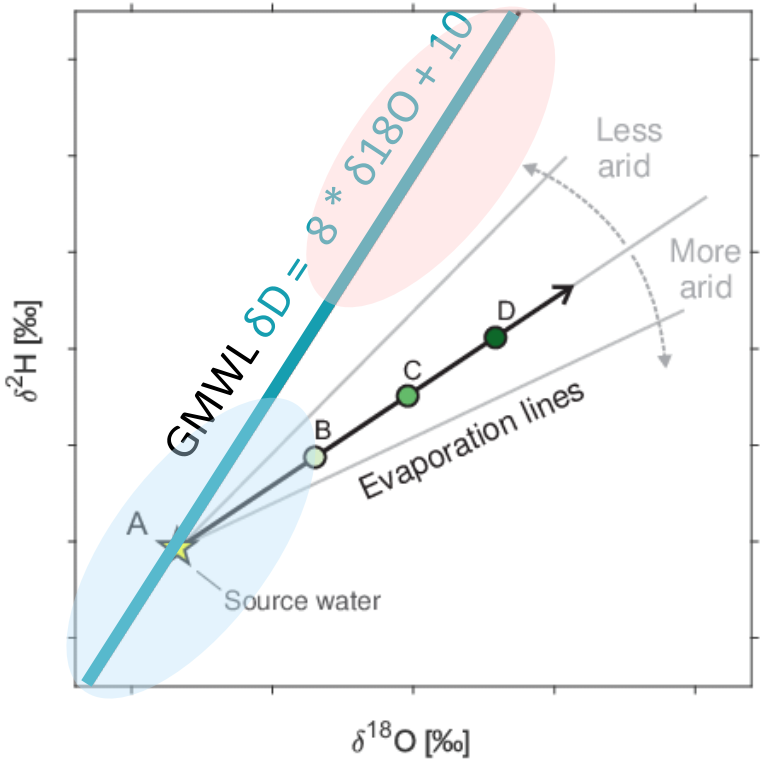
Several **isotopologues of water** exist in the Earth's water cycle



Fractionation: water isotopes segregate during phase changes



Deuterium excess = δD – 8 * δ18O
second-order parameter sensitive to T and RH at the evaporative sites



Fractionation coefficients are temperature dependent

Changes of water Isotopes in the Arctic Sea ice, Ocean and Atmosphere
CiASOM

DISCRETE SAMPLING OF SEA ICE, OCEAN, SNOW, MELT PONDS

CONTINUOUS MONITORING OF ATMOSPHERIC VAPOUR ISOTOPES

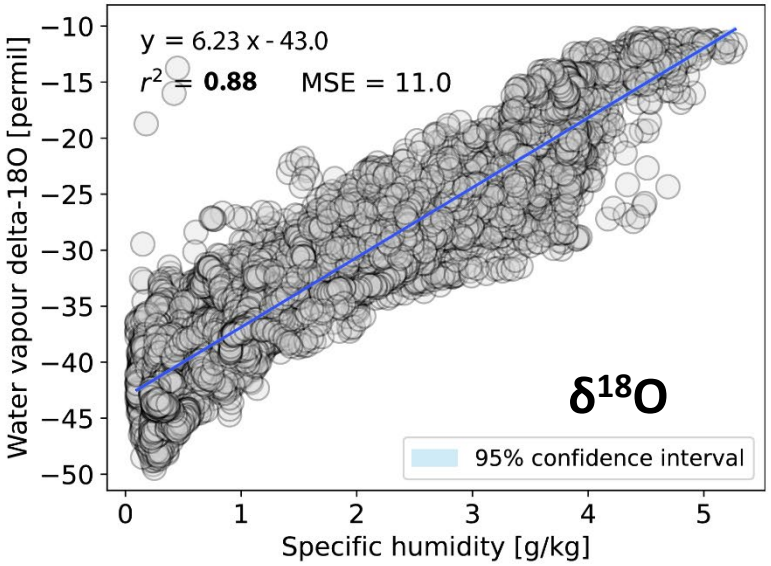
REGIONAL NETWORK OF LAND-BASED OBSERVATIONS

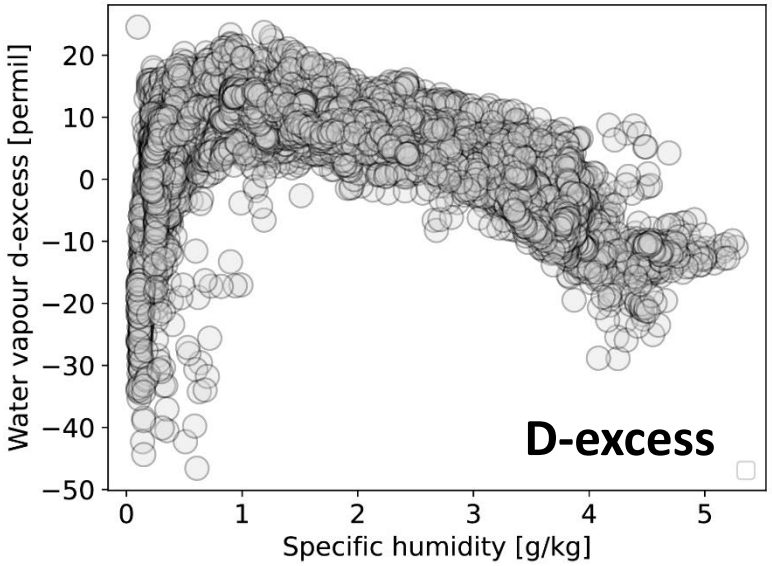
AWINN, Jeff Welker

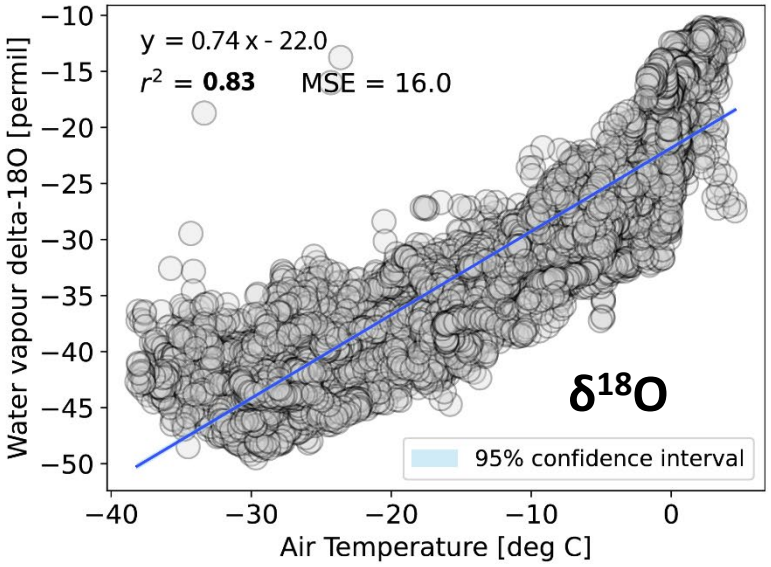
ISOTOPE ENHANCED – ATMOSPHERIC GCM

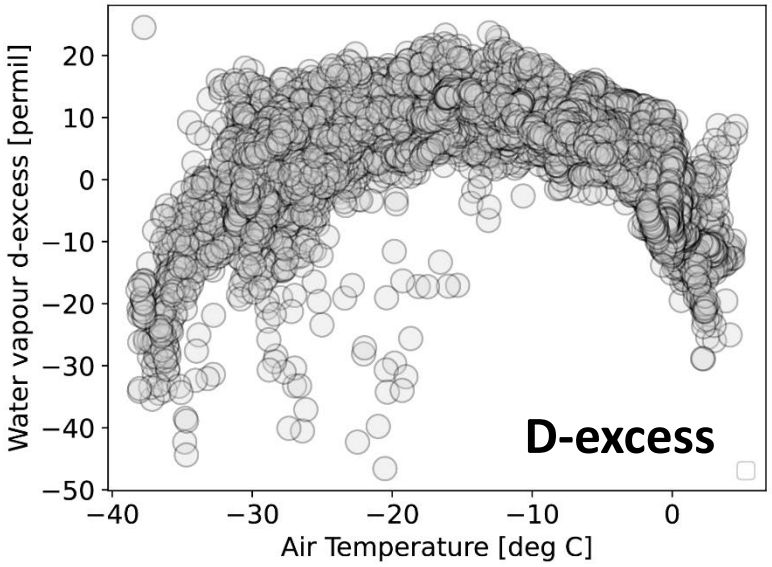
Laser spectrometer installed on deck A, in the aerology laboratory.

Correlation with local temperature and specific humidity



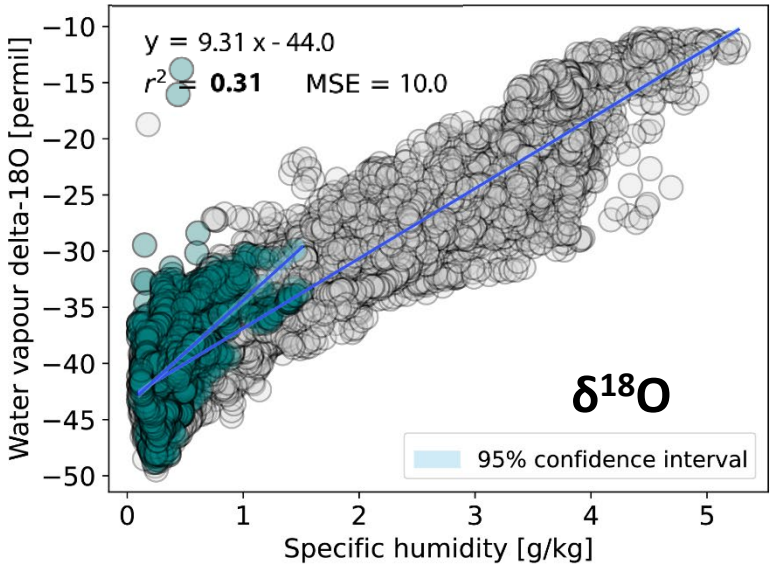


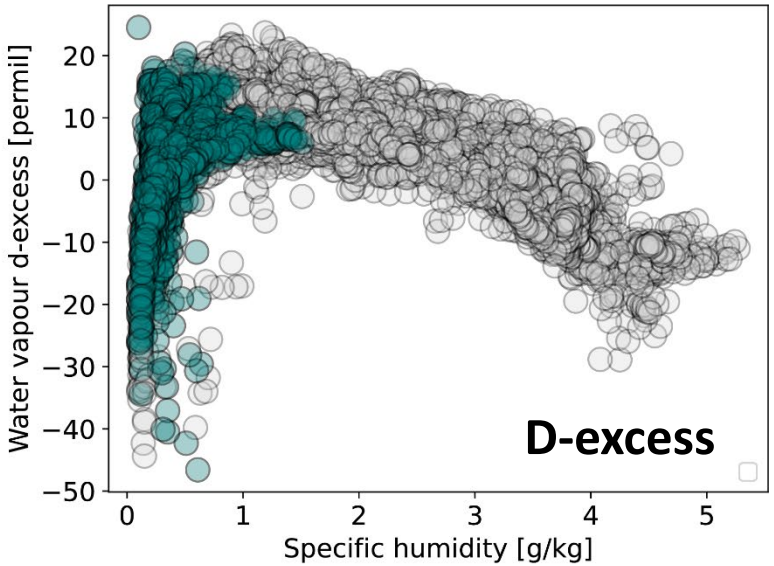


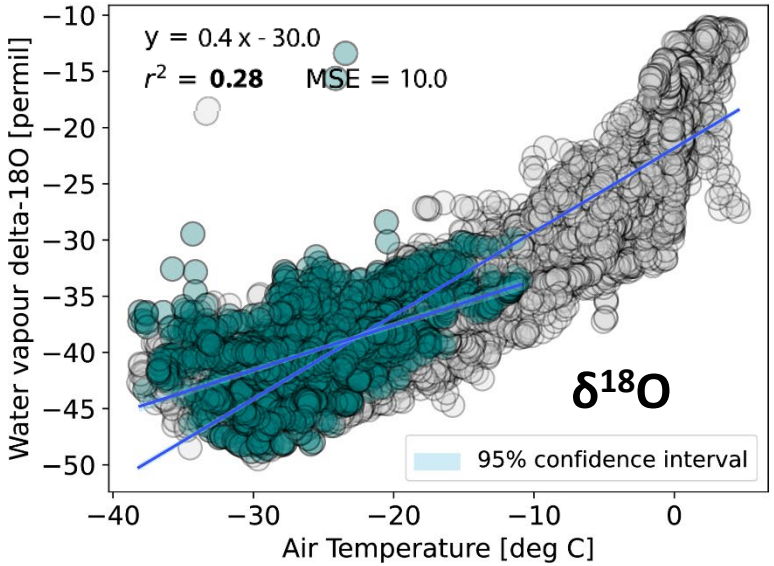


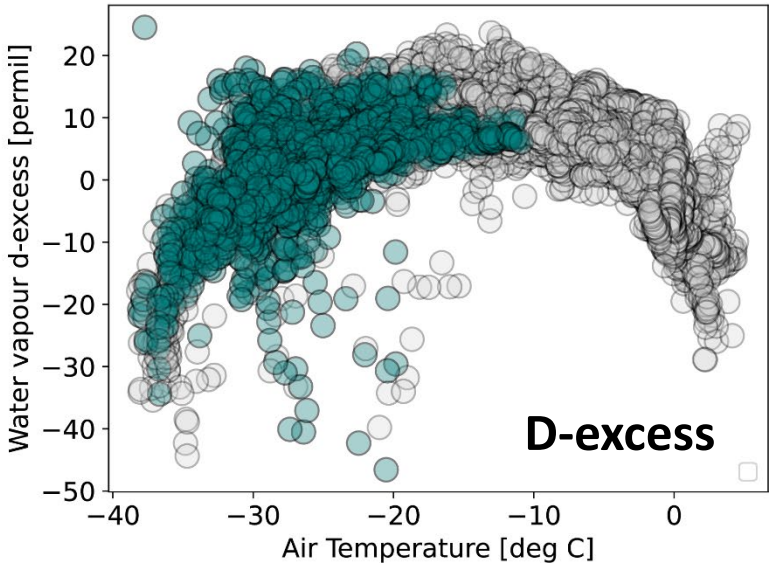
Correlation with local temperature and specific humidity

Winter





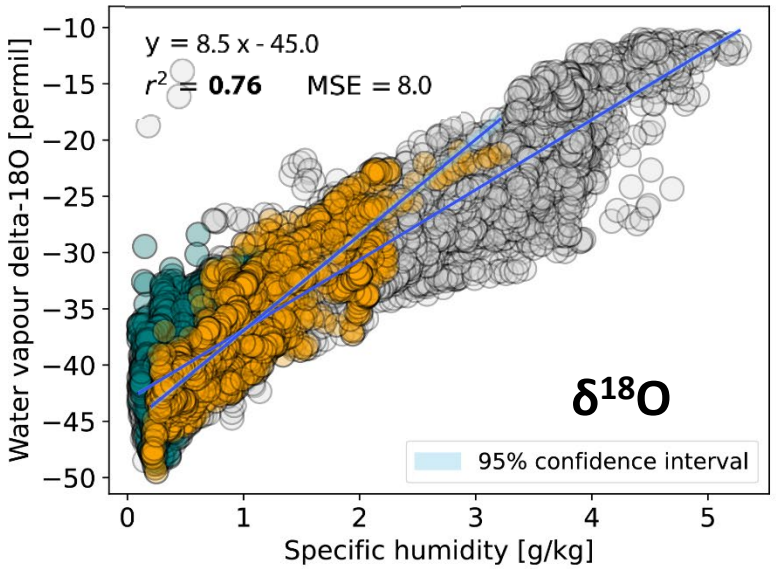


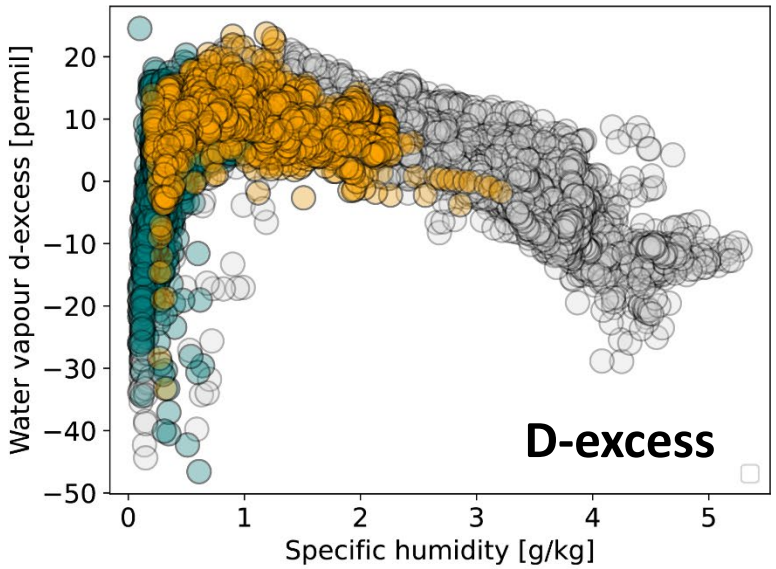


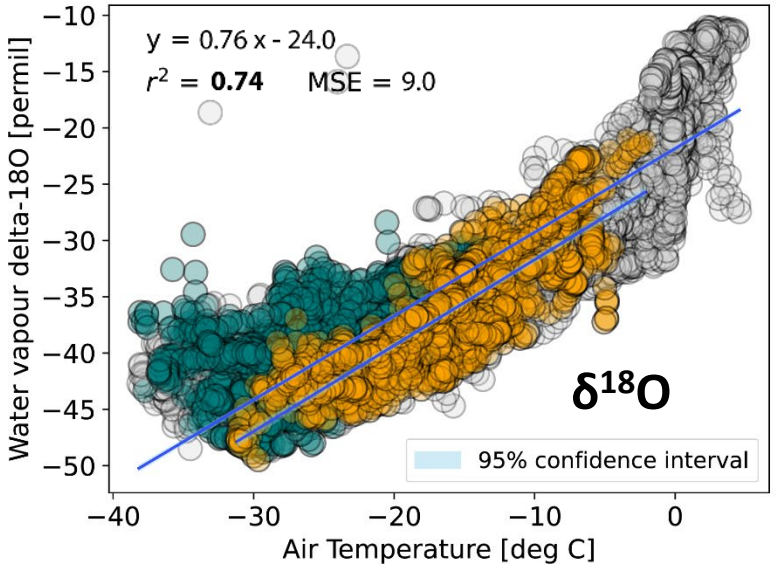
Correlation with local temperature and specific humidity

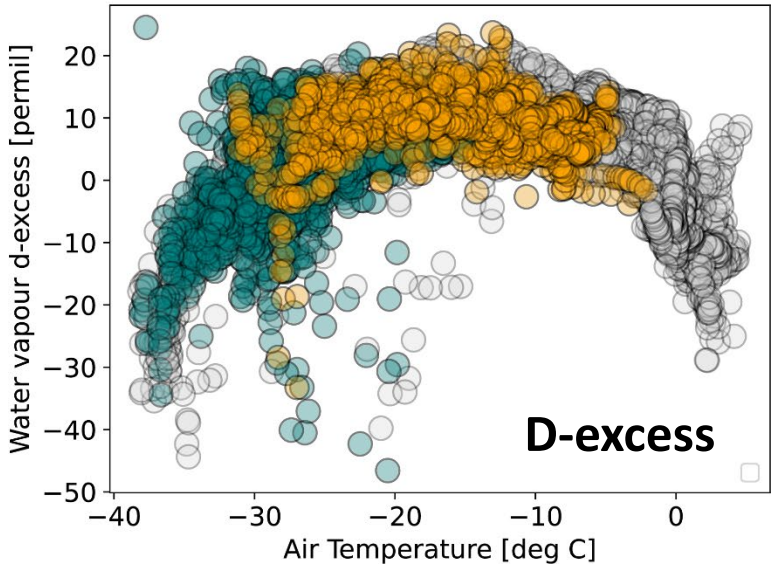
Winter

Autumn







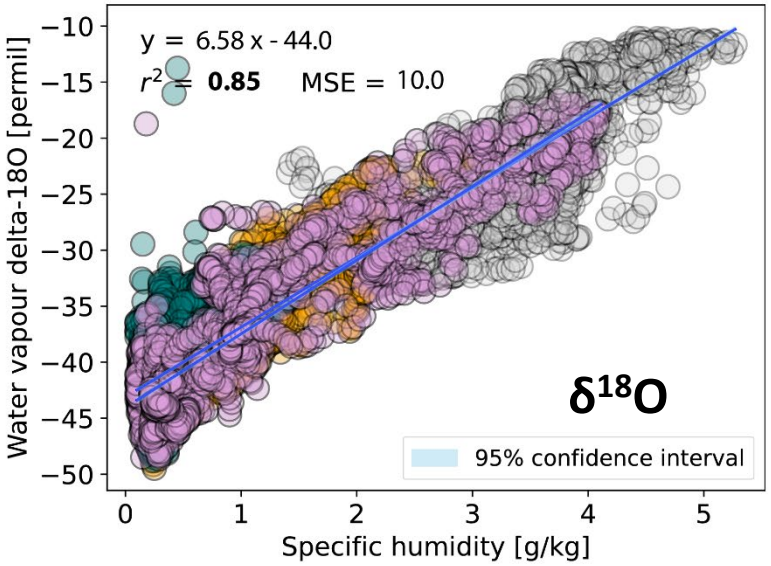


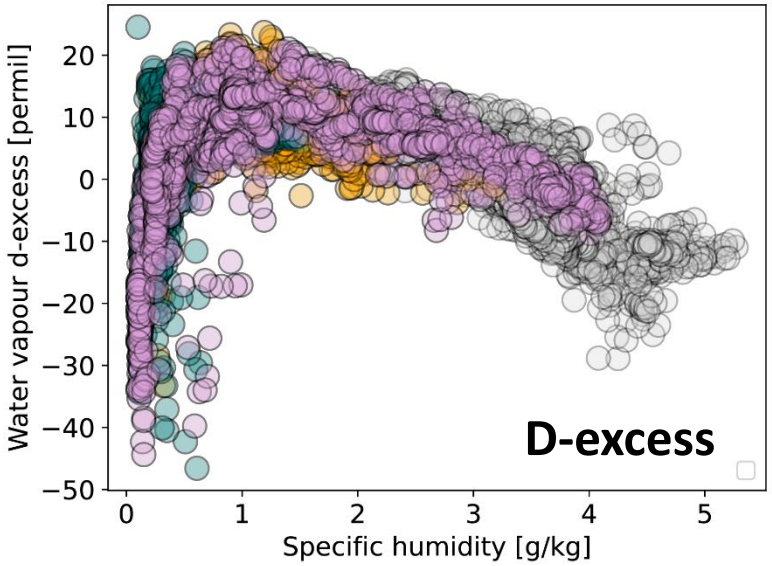
Correlation with local temperature and specific humidity

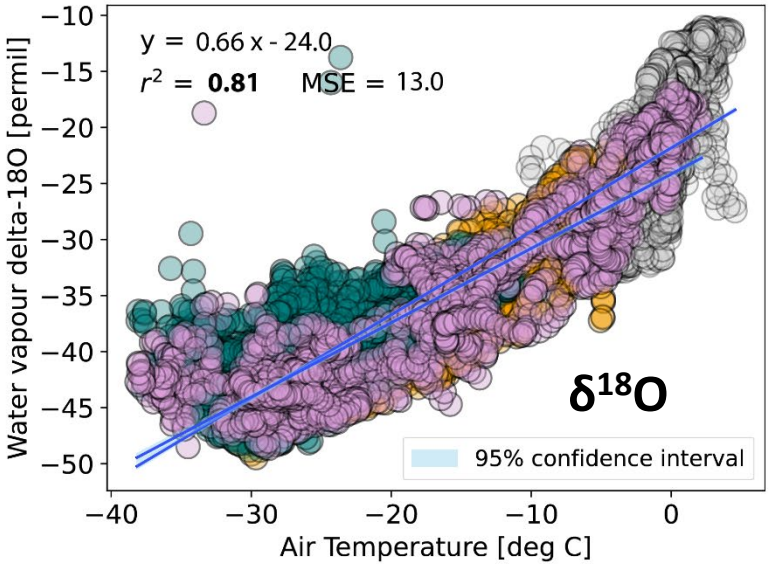
Winter

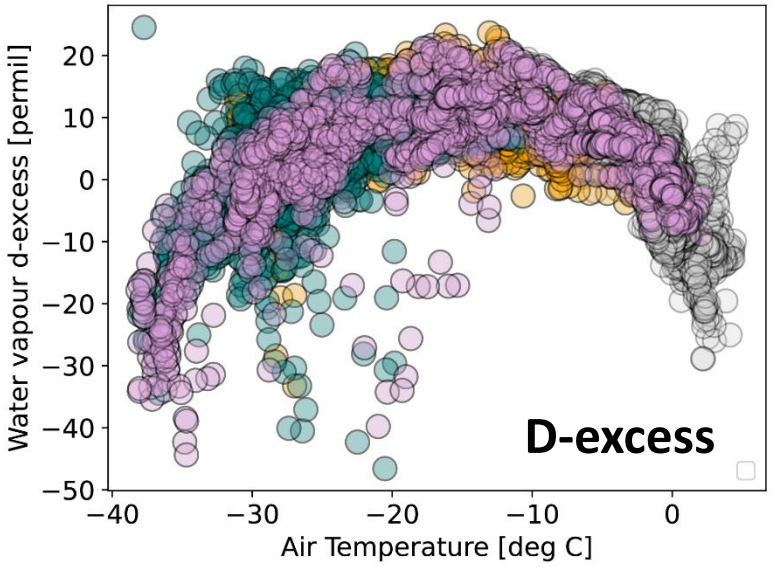
Autumn

Spring









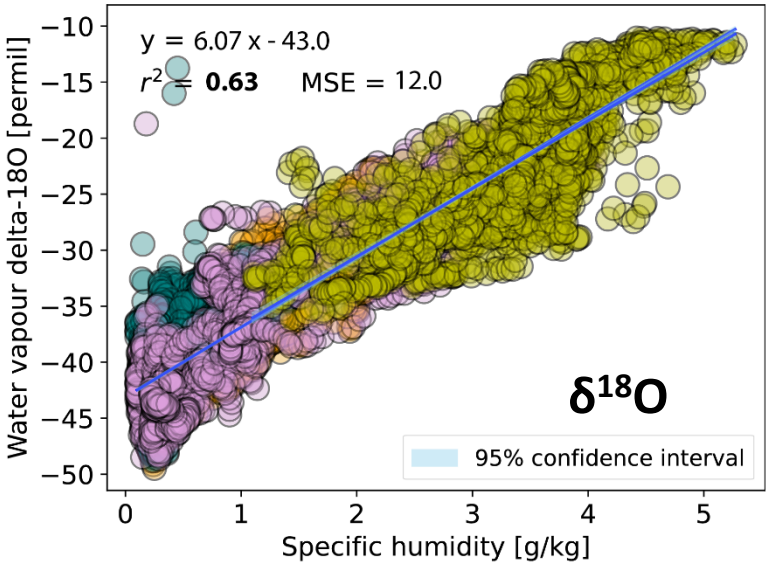
Correlation with local temperature and specific humidity

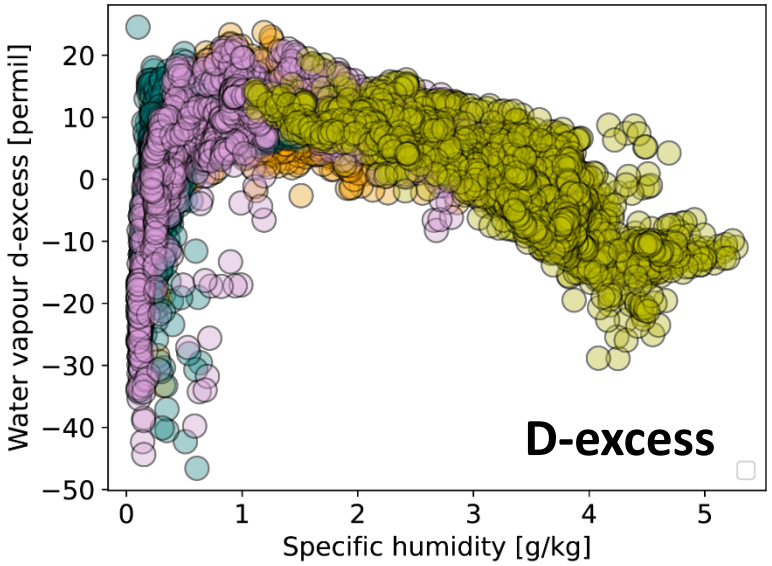
Winter

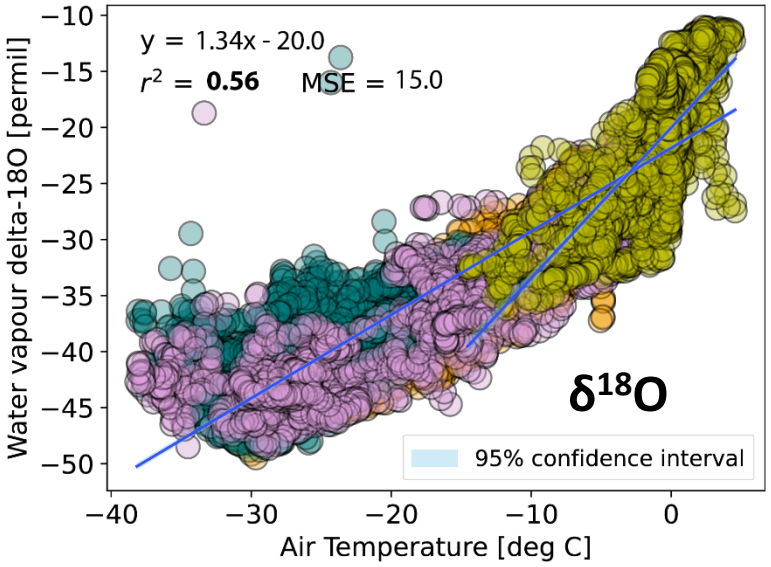
Autumn

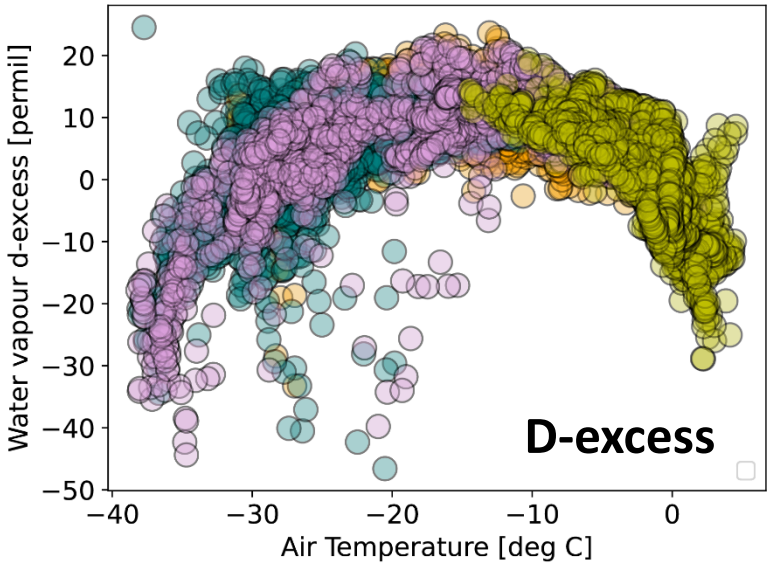
Spring

Summer





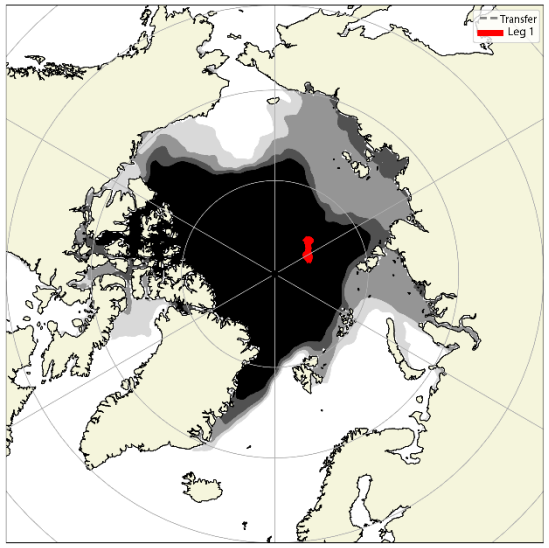




Deuterium excess as a diagnostic for moisture sources

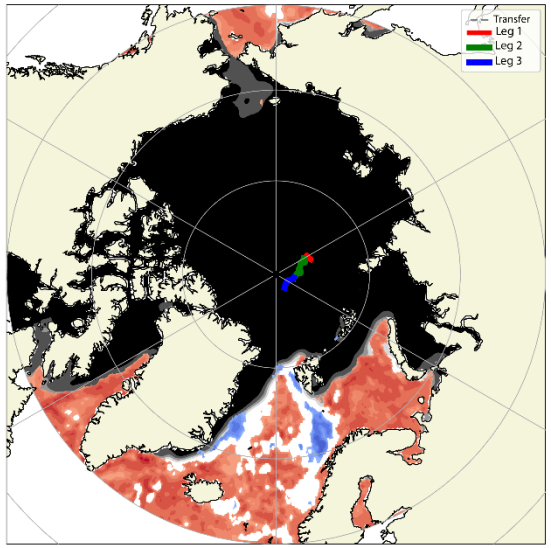
Correlation with SST

Autumn - ON



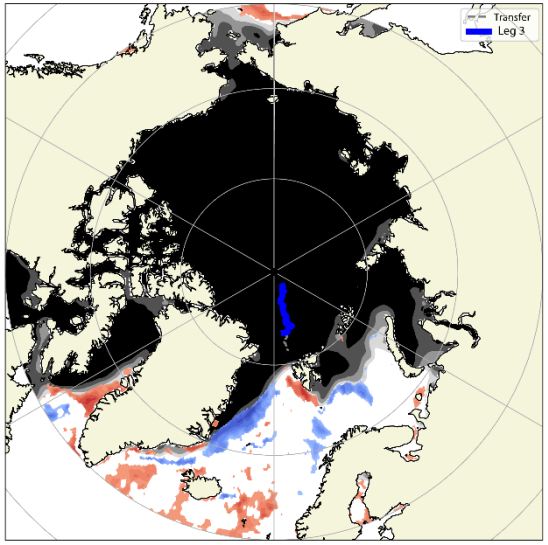
No correlation with SST.
H1: local moisture recycling.

Winter - DJF



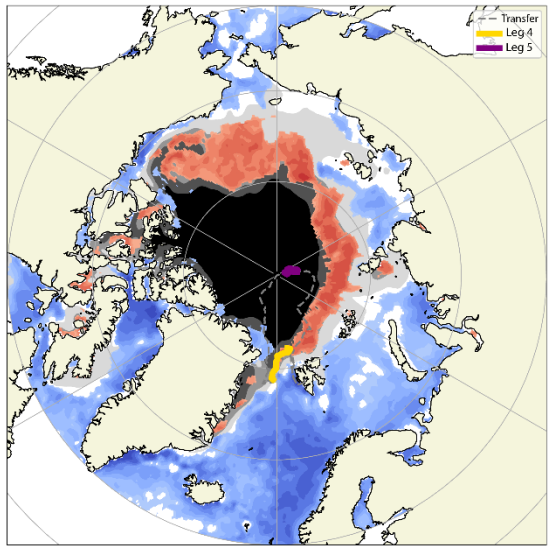
Positive correlation with large-scale SST.
H1: long distance advection.

Spring - MAM

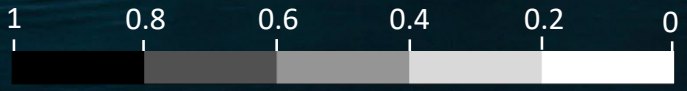


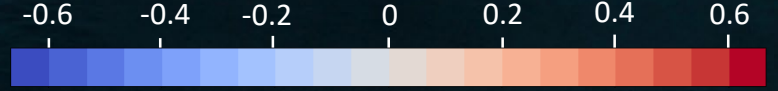
Low, sparse correlation.
H1: in-Arctic recycling and source transition.

Summer - JJAS



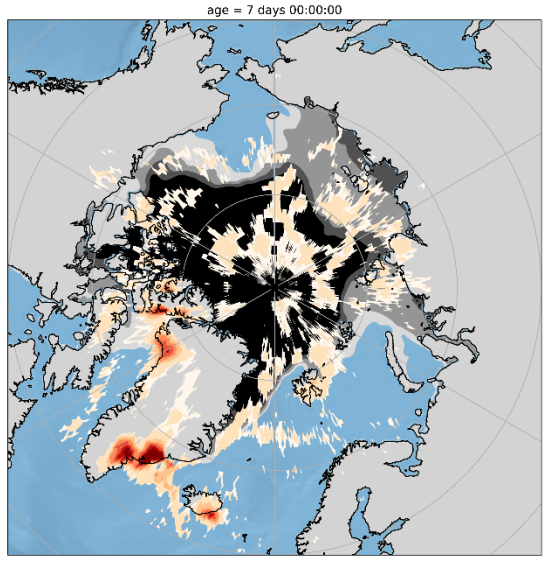
Positive correlation with Arctic open ocean.
H1: injection of moisture from the retreating sea ice margin.





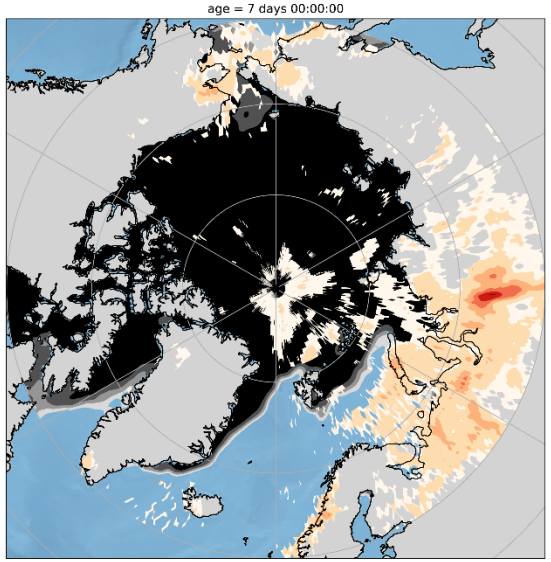
Flexpart backward simulation: moisture uptake

Autumn - ON



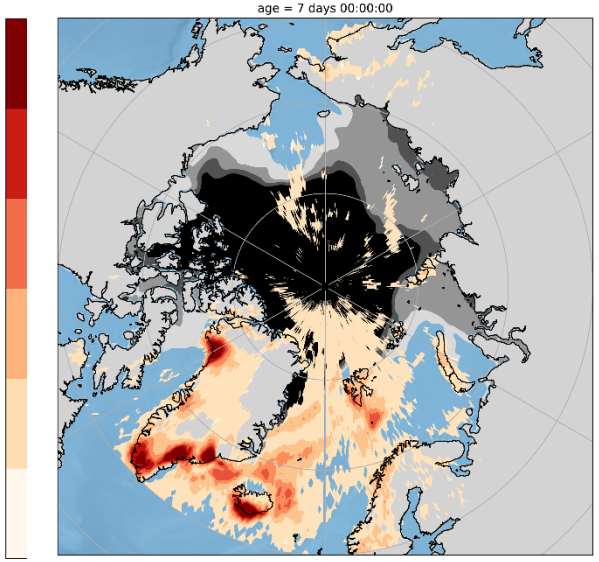
No correlation with SST.
Local moisture recycling.

Winter - DJF



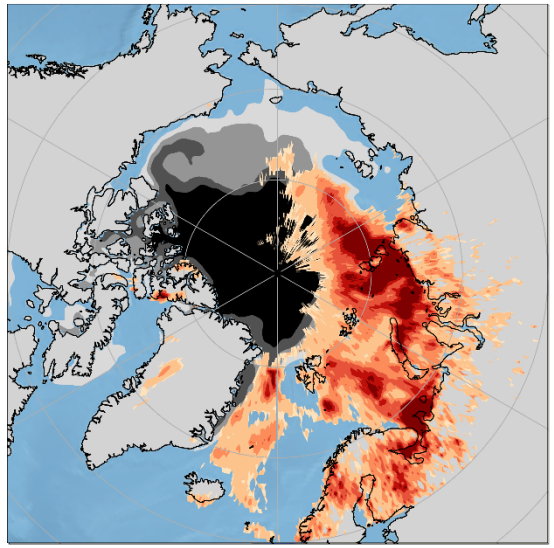
Positive correlation with large-scale SST.
Long distance advection from Siberia.

Spring - MAM

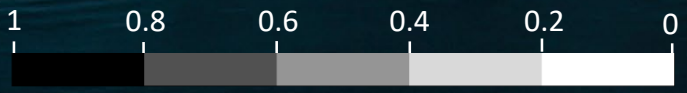


Low, sparse correlation.
In-Arctic recycling and source transition.

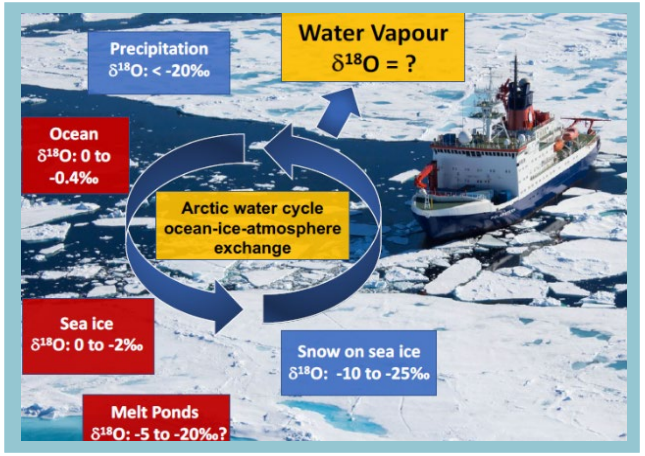
Summer - JJAS



Positive correlation with Arctic open ocean.
Injection of moisture from the retreating sea ice margin.



Conclusions and outlook



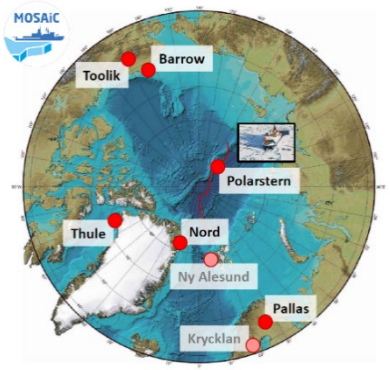
CONTINUOUS MONITORING OF ATMOSPHERIC VAPOUR ISOTOPES

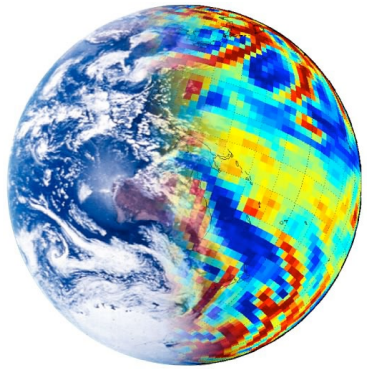
We presented one year of high resolution water vapor isotope measurements from the central Arctic

- **The $\delta^{18}O$ signal correlates with local air temperature and specific humidity**
- **The d-excess reveals seasonal changes in the moisture sources:**
  - **Autumn: interaction with in-Arctic hydrological compartments**
  - **Winter: distant advection from Siberia**
  - **Spring: local sources and transition**
  - **Summer: evaporative injections from the margin of the retreating sea ice**

AWIN: Isotope Network

paired observations from stations connected during synoptic events





- global atmosphere model (resolution: 0.9°x0.9°, T127L95)
- simulation nudged to ERA5
- explicit simulation of isotopes in the water cycle

Any interest? Any advice?

camilla.brunello@awi.de