Links between the moisture origin and isotopic signature in water vapour,snowfall and snow pack at Finse Alpine Research Center (1222m) in Southern Noway

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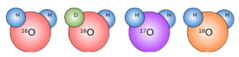
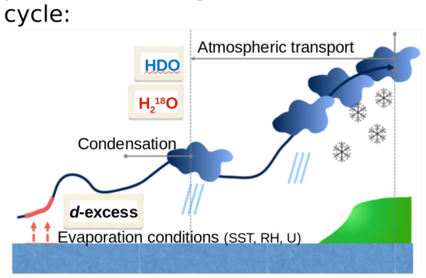
WATER ISOTOPES

Differing number of neutrons in the oxygen or hydrogen atom. Most abundant are:



They fractionate during phase transition, thus taking part in and acting as a tracer for the hydrological cycle:



Isotopic values are expressed as delta-values, in terms of ratios relative to a reference.
For main parameters:

$$\delta^{18}\mathrm{O} = \left(\frac{\left(\frac{[^{18}\mathrm{O}]}{[^{16}\mathrm{O}]}\right)_{sam}}{\left(\frac{[^{18}\mathrm{O}]}{[^{16}\mathrm{O}]}\right)_{ref}} - 1 \right) \cdot 1000$$

And derived parameter, deuterium excess [1]:

$$\mathrm{d} = \delta\mathrm{D} - 8 \cdot \delta^{18}\mathrm{O}$$

FIELD CAMPAIGN

Campaign for isotopic observations was carried out in winter 2018-2019 at Finse research station [2]. Measurement includes:

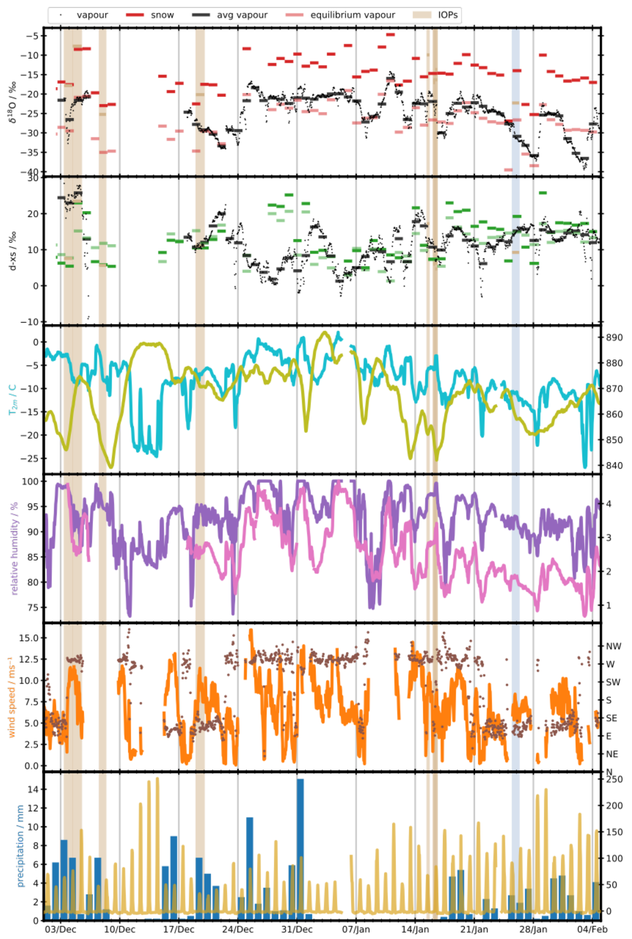
Snow sampling at train station and research station

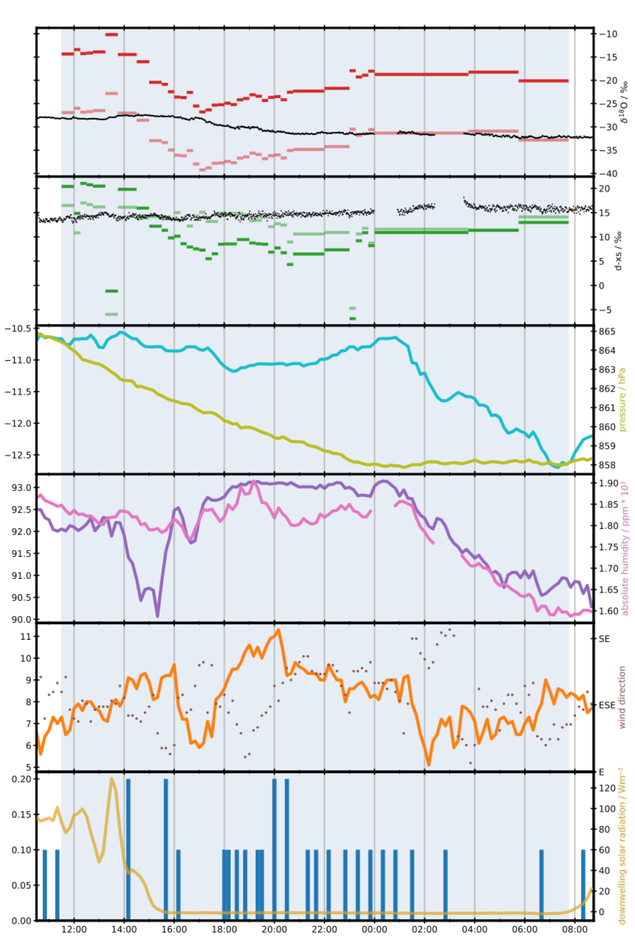
Snowpits in the marsh throughout the season

Water vapour measurements at the research station

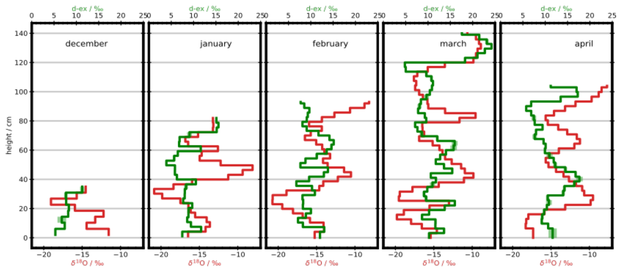
OBSERVATION MEASUREMENTS

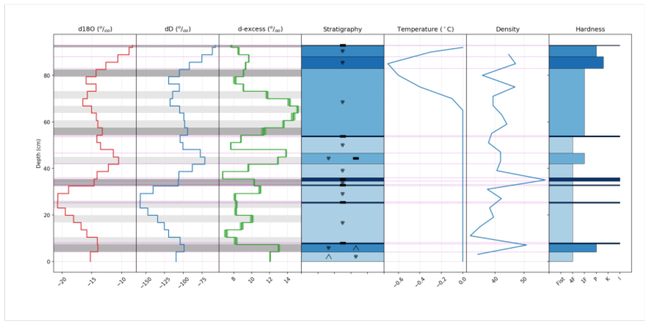
Isotopic measurements of water vapour and snowfall and auxillary meteorological observations [3].
Left is full dec-jan, right is zoom in on the last of the intense observation periods (IOPs)





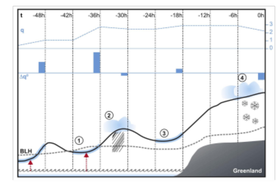
Snowsamples where taken from snowpits five times during the winter. Accompanying snow pit stratigraphy and parameters aids in the interpretation of the isotopic signal preservation after deposition.

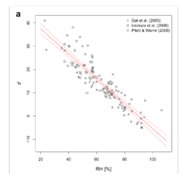




MOISTURE SOURCES

With trajectories from FLEXPART and input data from ERA-I, WaterSip [4] backtracks changes in absolute humidity and assaigns an uptake location:

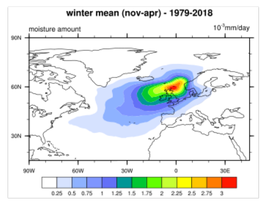


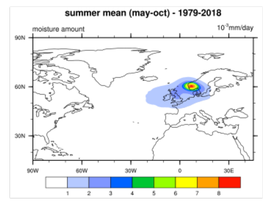


Among the diagnostics variables is eg. the derived isotopic parameter *deutetrium excess*, a proxy for relative humidity at the source location [5].

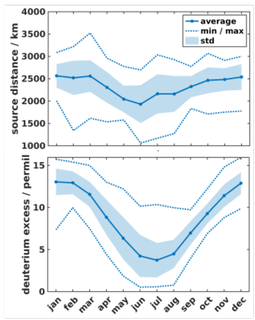
CLIMATOLOGY

Precipitation arriving in Finse 1979-2018, 1x1 degree centered on 60.6N and 7.5E (black box bottom plot) was backtracked for moisture sources.



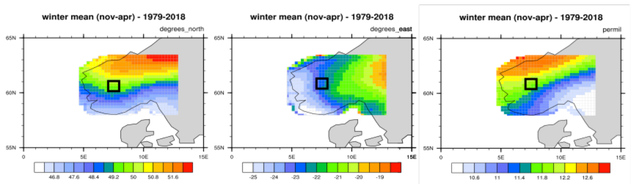


The climatological means show a clear seasonal difference with higher degree of local and terrestial sources in summer.



The annual trend is apparent in many of the diagnostics, but some also exhibit a more varied behaviour.

An larger arrival box is shown below for context for Finse (black box), with diagnostics projected to arrival grid.



ACKNOWLEDGEMENTS
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[4] H. Sodemann, C. Schwierz, and H. Wernli. Interannual variability of Greenland winter precipitation sources: Lagrangian moisture diagnostic and North Atlantic Oscillation influence. Journal of Geophysical Research, 113(D3):D03107, feb 2008b. doi: 10.1029/2007JD008503.
[5] Pfahl, S. and Sodemann, H.: What controls deuterium excess in global precipitation?, Clim. Past, 10, 771–781, https://doi.org/10.5194/cp-10-771-2014, 2014.