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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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Seasonal snow cover is a crucial resource for hydropower in Norway. Understanding water sources and processes related to inter-annual snow cover variability is therefore of fundamental societal relevance. The stable water isotope composition of precipitation provides a natural, integrated tracer of the condensation history during atmospheric water transport. The main parameters dD and d18O along with the secondary quantity d-excess give information about the origin and transport history of moisture from its source to its sink. When snow falls and deposits on the ground as a sediment, it creates a record in the form of the seasonal snow pack.

Here we utilize data acquired during a field campaign in the winter season of 2018-2019 at the Finse Alpine Research Station Center (1222m, 60.6N, 7.5E) in Norway, in order to investigate the transfer of the isotopic signal of source and transport conditions from vapour to snowfall, and to the snow pack.

Over a main period of two months, snowfall was sampled daily, while the water vapour was continuously measured from ambient air guided through a heated inlet to a Picarro L2130i infrared spectrometer, with daily calibration runs. During five periods with intense snowfall, we carried out higher frequency sampling down to 15 minute intervals. Covering the entire winter season, five snowpits were sampled for isotopic analysis as well as detailed stratigraphy. In total more than 400 snow samples where taken and analysed for their isotopic composition, accompanied by routine meteorological observations over the winter season at the site. In addition, we compare the variations in the observed isotope signal at Finse with one derived from moisture source analysis using the Lagrangian diagnostic WaterSip, based on the FLEXPART model and ERA Interim reanalysis data.

To investigate to what degree moisture source information is archived in the snow pack, and how it evolves during the season, we compare snow observations at different time resolution (daily and high frequency snowfall samples) with the record of the snow pack, aided by the snow model CROCUS. The meteorological observations supply context for understanding the snow formation conditions. In particular, deviations from isotopic equilibrium between vapour and precipitation at

ambient temperature conditions provide insight into the dominant condensation regime during different intense observation periods.