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One year observation of water vapour isotopic composition at Ivittuut, Southern Greenland

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In September 2011, an automatic continuous water vapour isotopic composition monitoring instrument has been installed in the atmospheric station of Ivittuut (61.21˚N, 48.17˚W), southern Greenland. Precipitation has been regularly sampled on site at event to weekly scales and analysed in our laboratory for isotopic composition. Meteorological parameters (temperature, pressure, relative humidity, wind speed and direction) and atmospheric composition (CO_2, CH_4, Atmospheric Potential Oxygen) are also continuously monitored at Ivittuut. The meteorological context of our observation period will be assessed by comparison with the local climatology.

The water vapour analyser is a Picarro Wavelength Scanned Cavity Ring-Down Spectrometer (WS-CRDS, model L2120i). It is automatically and regularly calibrated on the VSMOW scale using measurements of the isotopic composition of vaporized reference water standards using the Picarro Syringe Delivery Module (SDM). As measurements are sensitive to humidity level, an experimentally estimated calibration response function is used to correct our isotopic measurements. After data treatment, successive isotopic measurements of reference waters have a standard deviation of around 0.35 per mil for δ^{18}O and 2.3 per mil for δD. Our instrumentation protocol and data quality control method will be presented, together with our one year δ^{18}O, δD and d-excess measurements in water vapour and precipitation. The relationship between surface water vapour isotopic composition and precipitation isotopic composition will be investigated based on a distillation model. Specific difficulties linked to our low maintenance remote station will also be discussed.

The processes responsible for the synoptic variability of Ivittuut water vapour isotopic composition will be investigated by comparing our observational dataset with (i) atmospheric back-trajectories and (ii) results from an isotopically-enabled atmospheric general circulation model (AGCM).

Simulations of humidity transport based on an adapted version of the Lagrangian dispersion model Flexpart allows to diagnose Ivittuut moisture sources, to retrieve the evaporation conditions, and to distinguish the influence of local and remote processes on our measurements. This site is strongly influenced by large scale humidity transport from distant sources such as seas surrounding Greenland and western to eastern North Atlantic ocean. The consistency of Flexpart calculations with isotopic distillation will be investigated.

Our observations are finally compared to daily outputs of a nudged simulation conducted with the LMDZiso AGCM nudged to atmospheric analyses. This comparison will be performed at synoptic to seasonal scales allowing to assess the spatial representativeness of our station and to identify systematic model biases. The added value of water vapour isotopic data to constrain moisture sources and assess the realism of their simulation will be discussed.