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Characterization of water vapor isotope signals during rain events in northeastern Switzerland

Pascal Graf, Franziska Aemisegger, Stephan Pfahl, Harald Sodemann, and Heini Wernli
Institute of Atmospheric and Climate Science, ETH, Zurich, Switzerland (pascal.graf@env.ethz.ch)

The availability of novel laser spectroscopic water isotope measurements allows detailed evaluations of isotope signals in vapor on the hourly to daily time-scale. However, still little is known about processes governing the evolution of water vapor isotopes at these timescales in the mid-latitudes. Isotopes may provide important additional information on moisture origin, air parcel history as well as local microphysical exchange processes of rain with ambient water vapor during the passage of frontal systems and precipitation events.

In this work, we present data from two 6 months periods of water isotope measurements in surface vapor with high temporal resolution. The measurements started in 2011 and are ongoing. They are conducted with a cavity ring-down spectrometer (Picarro L1115-i), which is deployed in the prealpine hydrometeorological monitoring site Rietholzbach in northeastern Switzerland. The instrument is situated in a cellar using a heated tubing as a sample inlet, which ends on a height of $\sim$1.5m and is surrounded by agricultural grassland. The instrument is calibrated using two standards covering a wide range of the delta scale. The overall uncertainty of the measurements is determined by a detailed characterization of the system. Calibrations are done at environmental water vapor mixing ratio and 3000 ppmv below and above in order to correct also for the water vapor mixing ratio dependency.

Time-series analysis of the two periods shows interesting features linked to boundary layer dynamics and moisture source region and conditions. A seasonal trend towards more depleted water vapor and increased day to day variability of the signal from summer to winter is found, reflecting the shift towards more remote moisture sources. On shorter time-scales, clear signals from single weather events can be distinguished: During most rain events a significant drop in the isotope signal with subsequent recovery occurs. This typical evolution is related to the change of air mass temperature and origin, but it also contains the imprint of local microphysical exchange processes between precipitation and boundary layer water vapor. The relative importance of these processes controlling the observed signal is investigated in more detail.