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Modelling of stable water isotopes in Central Europe with COSMOiso

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Atmospheric water in form of vapor or clouds is responsible for $\sim$75 % of the natural greenhouse effect and carries huge amounts of latent heat. For this reason, a best possible description of the hydrological cycle is a prerequisite for reliable climate modelling. As the stable isotopes $H_2^{16}O$, $H_2^{18}O$ and HDO differ in vapor pressure, they are fractionated during phase changes and contain information about the formation of precipitation, evaporation from the ground, etc. Therefore, the isotopic composition of atmospheric water is an useful tracer to test and improve our understanding of the extremely complex and variable hydrological cycle in Earth's atmosphere.

Within the project PalMod the isotope-enabled limited-area model COSMOiso will be used for high-resolution isotope simulations of paleo-climates. For validation with modern observations we compare 12 years of modelled isotope ratios from Central Europe to observations of the Global Network of Isotopes in Precipitation (GNIP) and to observations of isotope ratios of water vapor at different locations in Germany.

We find a good agreement of modelled and observed isotope ratios in summer. In winter, we observe a systematic overestimation of modelled isotope ratios in precipitation and low-level water vapor. We relate those differences to specific circulation regimes with predominantly easterly moisture transport and the corresponding strong dependence of modelled isotope ratios on lateral boundary data. Furthermore, we investigate the dependence of modelled isotope ratios in winter on the type of isotope fractionation during surface evaporation at skin temperatures close to the freezing point.