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Variations of δ^2H in an idealised extratropical cyclone

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Numerical model simulations of stable water isotopes help to improve our understanding of the complex processes driving isotopic variability in atmospheric waters. We use the isotope-enabled COSMO model to study the governing mechanisms of δ^2H variations in an idealised extratropical cyclone. A set of experiments with differing initial conditions of δ^2H in vapour and partially deactivated isotopic fractionation allows us to quantify the relative roles of cloud fractionation and vertical and horizontal advection for the simulated δ^2H signals associated with the cyclone and fronts. Horizontal transport determines the large-scale pattern of δ^2H in both vapour and precipitation, while fractionation and vertical transport are more important on a smaller scale, near the fronts. During the passage of the cold front fractionation leads to a V-shaped trend of δ^2H in precipitation and vapour, which is, for vapour, superimposed on a gradual decrease caused by horizontal advection.