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Variability of the vertical stable water isotope composition from airborne measurements in the western Mediterranean in October 2012

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Stable water isotopes are useful indicators of meteorological processes on a broad range of scales, reflecting for example evaporation, precipitation and airmass mixing processes. Here we present a detailed analysis of the first set of airborne spectroscopic stable water isotopes measurements in the western Mediterranean. Measurements have been acquired by a customised Picarro L2130i instrument with enhanced data acquisition rate by a dual-laser system. The instrument was deployed in cooperation with the Karlsruhe Institute of Technology (KIT) onboard the Dornier 128-6 research aircraft D-IBUF of the Institute of Flight Guidance, TU Braunschweig together with a meteorological flux measurement package during an international field campaign within the framework of HYMEX (Hydrological Cycle in Mediterranean Experiment) in Corsica, France.

Vertical profiles of δD and δ^{18}O show strong variability between flights depending on the prevailing meteorological situation, and in the vertical during individual flights. The principal factors influencing the vertical variability are shown to be advection and the temperature structure of the marine boundary layer. In particular, strong inversions at the top of the marine boundary layer can at times lead to step-like changes in δD exceeding 100 permil within 100 meters in the vertical. The isotopic information of the sampled water vapour is generally consistent with indicators of moisture source age and distance obtained from a Lagrangian method. Finally, the significance of the observed temporal and vertical variability for the representation of the atmospheric isotope composition in GCMs and remote-sensing retrievals are discussed.