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Tracing near-surface deuterated water vapour and its seasonal variations from space and ground

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The hydrological cycle and its response to, e.g. rising global temperatures or tropical deforestation, is of prime importance for future climate predictions. Detailed information on hydrology, climatology and atmospheric sciences can be gained from the isotopic composition of water vapour, which records the evaporation history of air parcels. However, global measurements of water vapour isotopologues in the lowest layers of the atmosphere, where most water vapour resides, are hitherto missing. Here we show the first satellite-based retrievals of HDO using absorption spectroscopy in the short-wave infrared, a wavelength region that is highly sensitive to the boundary layer. We observe large seasonal amplitudes of the isotopic signal, which are surprising especially in the vicinity of the warm North-Atlantic ocean. Also small scale features, such as relatively high HDO abundances over the Red Sea can be detected. The space-borne retrievals of HDO in the short-wave infrared provide unprecedented insight into distributions of near-surface water isotopologues. The results will add a new dimension to research into hydrological cycles.