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Inter-comparison of surface and column measurements of the stable isotope composition of atmospheric water vapour

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The stable isotope composition of water vapour is determined by evapotranspiration, condensation and mixing processes in the atmosphere. Continuous monitoring of stable isotopes in water vapour can therefore provide valuable insights into the atmospheric hydrological cycle at any point in time. With the introduction of new optical techniques, it has recently become possible to routinely collect records at the surface or vertical profiles from towers. In addition, retrievals from satellite-borne instruments have now enabled global mapping of column-integrated water vapour isotopes, which is ideal for comparison with isotopically-enabled global climate models. However, it is not generally clear how column measurements of water vapour stable isotopes from satellites relate to isotope values at the surface and in the planetary boundary layer; the most active regions participating in the hydrological cycle. In addition, although total column measurements from ground-based Fourier Transform Spectrometers (FTS) have been used to provide validation data for satellites, such measurements have their own uncertainties. In this study, we use continuous surface measurements of stable isotopes in water vapour to provide insights into the total column measurements collected by a ground-based FTS system located at Wollongong, a coastal site near Sydney, Australia. As the surface isotope measurements are calibrated regularly, an understanding of the relationship between these two measurements will help to better constrain the total column measurements. We use vertical profiles of humidity derived from radiosonde and modelled data to estimate water vapour stable isotope profiles from the surface measurements. Vertical integrals of these estimated profiles are then compared with the FTS total column measurements. The aim of this study is to determine the accuracy of the ground-based FTS column measurements, and to characterise the extent to which they capture the variability of the atmospheric hydrological cycle in the planetary boundary layer.