A full-mission data set of H_2O and HDO columns from SCIAMACHY 2.3 μm reflectance measurements

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Atmospheric water vapour is a trace gas which is important for the energy budget of the atmosphere, but uncertainties are still large. Observations of isotopologues of water provide information about the "history" of the sampled air parcel due to a temperature-dependent isotopic fractionation during evaporation and condensation. In this work, the Shortwave Infrared CO Retrieval (SICOR) algorithm designed for the new Tropospheric Monitoring Instrument (TROPOMI) is applied to the Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY) instrument to obtain a full-mission data set of vertical column densities of the water vapour isotopologues H_2O and HDO. The data are retrieved from reflectance measurements in the spectral range 2339 nm to 2383 nm, ignoring atmospheric light scattering in the measurement simulation. The retrievals are validated with ground-based Fourier transform infrared measurements obtained within the Multi-platform remote Sensing of Isotopologues for investigating the Cycle of Atmospheric water (MUSICA) project. A good agreement for low-altitude stations is found in H_2O, HDO, and a posteriori computed δD. In a dedicated case study for measurements round high altitude stations, the TROPOMI cloud retrieval, which accounts for light scattering in the forward model and fits effective cloud parameters simultaneously with trace gas columns, is tested. Due to a large altitude difference between the satellite ground pixel and the mountain station, clear sky scenes yield a large bias. However, when selecting scenes with optically thick clouds within 1000 m above or below the station altitude, the bias in a posteriori δD is greatly reduced. The insights from the present study are expected to be directly transferable to TROPOMI data.