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Comparison of different water vapour absorption line lists to measured atmospheric absorptions using ground-based MAX-DOAS observations

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Water vapour absorptions can be found from the microwave to the near ultraviolet spectral region. They overlay the absorption structures of a number of other trace gas species. Precise knowledge of the water vapour absorption cross-section can therefore be crucial for precise spectroscopic measurements of various other trace gases, such as e.g. NO_2, O_3, HONO, O_4, IO and Glyoxal. Based on absorption spectra measured by ground-based MAX-DOAS instruments at medium spectral resolution (typically 0.5 nm), we present an assessment of how well present water vapour absorption line lists represent measured absorptions in the Earth's atmosphere in different spectral regions from 333 nm (30 000 cm^{-1}) to 570 nm (17 500 cm^{-1}). These measurements were done in the course of a whole year at the south coast of England and thus provide measurements at different absolute humidities. We compare the line lists HITRAN 2008, HITRAN 2012 / HITEMP, HITRAN 2016, BT2 and POKAZATEL. We show that recent ab-initio absorption spectra represent water vapour absorption increasingly well. For the UV spectra range we could show before that certain line lists predict the shape and wavelengths of water vapour absorption bands quite well. In this presentation we now show that recent improvements increase also the agreement in the blue spectral regions, where previously differences in the magnitude of more than 50% were reported. We use the MAX-DOAS measurements to compare them the measured absorption structures to currently available water vapour line lists in order to provide a quantitative measure of their agreement with atmospheric observations. In this study we also estimate potential cross-interferences of the respective water vapour absorption line list on the retrieved amount of tropospheric absorbers of interest. In the blue spectral range, differences between NO_2 evaluations of up to 5×10^{15} molec/cm^{-1} were observed under mid-latitude summer conditions using the listed line lists above. This corresponds to about 0.2 ppb of NO_2 for a light path length of 10 km. This is significant for measurements in pristine regions. Significant differences are also found for IO, glyoxal and other compounds. These findings are therefore of interest for the spectral retrieval of various atmospheric absorbers measured by any type of DOAS setup.