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Investigation of the HDO/H_2O ratio on Venus from SOIR solar occultations on board Venus Express

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The SOIR instrument performs solar occultation measurements in the IR region (2.2 - 4.3 μm) at a resolution of 0.12 cm^{-1}, the highest on board Venus Express. It combines an echelle spectrometer and an AOTF (Acousto-Optical Tunable Filter) for the order selection.

The wavelength range probed by SOIR allows a detailed chemical inventory of the Venus atmosphere at the terminators in the upper mesosphere and lower thermosphere (70 to 170 km) with an emphasis on vertical distribution of the gases. H_2O and HDO have been routinely monitored at various latitudes of the Venus terminator, using the temperature profiles obtained from the SOIR CO_2 density profiles. The HDO/H_2O ratios are obtained from an altitude region extending from 70 km up to 100 km, and show a vertical gradient.

Observations made at the IRTF telescope in Hawaii in 2010 showed a disk-averaged mixing ratio of HDO is 0.22 $\pm$ 0.03 ppm for a representative height region of 62-67 km. Based on many previous H2O measurements, the HDO/H_2O ratio is found to be 140 $\pm$ 20 times larger than the telluric ratio. This lies between the ratios of 120 $\pm$ 40 and 240 $\pm$ 25, respectively, reported for the 30-40 km region [De Bergh et al. 1991] by ground-based night-side spectroscopy and for the 80-100 km region by solar occultation measurement on board the Venus Express [Fedorova et al. 2008].

In addition to this, past observations at an altitude of 70 km show that HDO on Venus in the early evening shows a latitudinal structure, and HDO mixing ratio at higher latitude is two times larger that in the lower latitude regions. So there is probably a vertical distribution or/and a latitudinal structure.

From measurements obtained by SOIR on Venus Express at the Venus terminator, the D/H ratio seems to be very variable, and we confirm that the D/H ratio is larger at higher altitude.