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HAI: A new TDLAS hygrometer for the HALO research aircraft

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Water vapor is the most important greenhouse gas in the Earth's atmosphere and a key component for several physical and chemical processes. Therefore it is a key parameter to be measured during most research campaigns. The Hygrometer for Atmospheric Investigations (HAI) is especially designed for operations on the research aircraft HALO (High Altitude and LOng range research aircraft). HAI permits both, the in-situ measurement of water vapor with an open-path cell and the measurement of total water with an extractive close-path absorption cell. We are using TDLAS (Tunable Diode Laser Absorption Spectroscopy) in two water absorption bands with different line strength to increase the dynamical range. With this concept it is possible to measure from the middle troposphere up to the stratosphere.

The open-path cell outside of the fuselage consists of a robust, aerodynamically designed aluminum structure with a single integrated White-cell for both laser beams. Although the mirror separation is only 15cm the cell allows an open absorption path of 4.8m. The detection of higher H2O concentrations is realized with a fiber coupled 1.4μm DFB diode laser. Inside the UTLS layer were small concentrations in the low ppm range are common, we employ up to 20 times stronger fundamental ro-vibration lines of the water molecule near 2.6μm. To supply this, the fiber coupled 2.6μm laser setup was developed and is a part of the HAI. Both detection wavelengths are introduced in the same open path cell via glass fibers which provide water measurements with a minimum of parasitic absorption.

We will present the spectrometer design for high-quality airborne water measurements. Furthermore, first laboratory measurements will be shown.