



Water vapor measurements in- and outside cirrus with the novel water vapor mass spectrometer AIMS-H₂O

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Water vapor plays a crucial role for the earth's climate both directly via its radiative properties and indirectly due to its ability to form clouds. However, accurate measurements of especially low water vapor concentrations prevalent in the upper troposphere and lower stratosphere are difficult and exhibit large discrepancies between different instruments and methods. In order to address this issue and to provide a comprehensive water vapor data set necessary to gather a complete picture of cloud formation processes, four state-of-the-art hygrometers including the novel water vapor mass spectrometer AIMS-H₂O were deployed on the DLR research aircraft HALO during the ML-Cirrus campaign in March/April 2014 over Europe. Here, we present first water vapor measurements of AIMS-H₂O on HALO. The instrument performance is validated by intercomparison with the fluorescence hygrometer FISH and the laser hygrometer SHARC, both also mounted in the aircraft. This intercomparison shows good agreement between the instruments from low stratospheric mixing ratios up to higher H₂O concentrations at upper tropospheric conditions. Gathering data from over 24 flight hours, no significant offsets between the instruments were found (mean of relative deviation <3%). Within the scope of ML-Cirrus, the accurate water vapor measurements can be combined with the comprehensive set of particle measurements in order to obtain an insight in properties and lifecycle of cirrus clouds formed under different atmospheric conditions. The investigated conditions cover a range from clean and cold jet stream cirrus, frontal cirrus and aviation induced cirrus clouds. In a case study of a jet stream cirrus over Spain and Portugal, we were able to perform measurements in cirrus forming regions, sublimation regions as well as areas with stable cirrus for one synoptic situation. Thereby we can show that the combination of information on ice particles and relative humidity over ice enables to draw a consistent picture of the lifecycle of specific cirrus systems.