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Investigations of the performance of a new airborne water vapour sensor (WVSS-II) for real time measurements onboard commercial aircraft

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Water vapor is one of the most prominent parameters in weather evolution and climate. Very little is known about the distribution of humidity in the upper troposphere (UT), which is the most sensitive region with respect to changes in radiative forcing by a change of the humidity content. Accurate and intensive monitoring of humidity is expected to considerably improve numerical weather and climate prediction. It is therefore of great interest to implement automatic humidity sensors onboard the fleet of commercial aircraft supplied with the AMDAR (Aircraft Meteorological DAta Relay) system as part of the synoptic network for weather prediction. Whilst the implementation of humidity measurements has a very high priority in AMDAR, there is presently no humidity sensor available that is proven to fulfil the technical and measuring requirements for routine aircraft operation.

Recently, a new compact aeronautical water vapour sensor based on tunable diode laser spectroscopy (WVSS-II, Spectra Sensor Inc., USA) designed for implementation in AMDAR onboard of commercial aircraft has become available. We have investigated the performance characteristics of the WVSS-II sensor in an environmental simulation chamber through comparison against an accurate Lyman (alpha) hygrometer. During these tests, pressure, temperature and frost point temperature were varied in the same fashion as they are typically observed during aircraft flights up to 12 km altitude. The discussion will focus on the characteristics and performance of the new sensor in terms of precision, accuracy and stability at varying pressure, temperature and humidity levels, particularly for the UT/LS region.