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Intercomparison of stratospheric water vapor profiles from an airborne microwave instrument with the ECMWF water vapor product

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Even though water vapor is one of the most important trace gases in the middle atmosphere, there are no long-term datasets available that use assimilated water vapor measurements. However, it is still possible to produce water vapor fields from models like ECMWF through estimated cross-tropopause transport, modeled stratospheric tracer transport and parameterisation of methane oxidation. This way, a model like ECMWF can produce approximate distributions of stratospheric water vapor. The quality of these distributions depends on the accuracy of assimilated temperature and wind fields.

Microwave radiometry offers several possibilities to observe water vapor in the middle atmosphere, especially above the altitude range that is accessible to balloon-borne instruments. There is a strong spectral line near 183 GHz is well suited for observations above the tropopause. Since 1998, the Institute of Applied Physics at the University of Bern has observed this spectral line with an airborne microwave radiometer that produces altitude profiles of water vapor from roughly 15-70 km altitude along the flight track. This instrument has been used in yearly campaigns over northern Europe and the African west coast that typically covered most latitudes from the North Pole to the tropics. The campaigns took place during all seasons and typically lasted for one week.

A first intercomparison of the measured microwave profiles with ECMWF's ERA-40 water vapor product showed very promising results. In a summer situation with a mostly climatological water vapor distribution, the agreement between the two data sets was very good in the 20-40 km range. Below that, the microwave retrievals de-

pend strongly on a priori information and can therefore not be expected to agree with the ERA-40 profiles. Above 40 km, the difference increases with altitude, most likely because ECMWF does not take water vapor photolysis into account. For other seasons - and especially under polar vortex conditions - the results are more difficult to interpret and need careful analysis.