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**High accuracy determination of water vapour, liquid water and temperature with a novel suite of microwave channels in an alpine environment**

**Abstract:**
In 2005/2006 the Environmental Research Station Schneefernerhaus (UFS), located at Germany's top (Zugspitze) at 2650m NN, has been equipped with a dual system of new state-of-the-art microwave radiometers. One, the commercially available HATPRO (Humidity and Temperature PROfiler), has the possibility of continuously retrieving highly resolved profiles of temperature and humidity via statistically or physically based algorithms. These profiles can be gained via brightness temperature measurements and 14 different channels located around the 22.235 and the 60 GHz absorption features. Additionally, due to its very beneficial alignment, elevation scans are possible practically down to 0°. This ensures a novel characteristic for a microwave profiler, namely the retrieval of vertically highly resolved (~125m) profiles up to a height of ~3500m NN. In conjunction with routine meteorological observations at the Zugspitz-summit (2962m NN) and the air-chemistry observations within the WMO Global Atmospheric Watch programme, the continuous vertical profiles will give detailed insights into the air mass origin and support process studies.
The second instrument, a special development for the University of Munich, consists of two receivers at 90 and 150 GHz, the latter with the possibility of measuring the incoming radiation in both parallel and perpendicular polarization components. A first application of this novel instrument consists of enhancing the detection of super-cooled cloud layers at high altitudes. Theoretical studies indicate that, together with distinct HATPRO channels, the accuracy for retrieving liquid water path may be on the order of 10 $gm^{-2}$. This is highly relevant for the detection of the often observed thin persisting super-cooled cloud layers with liquid water contents lower than ~30$gm^{-2}$, however with high radiative impact. Interestingly, also non-precipitating super-cooled water clouds with higher amounts of liquid water path (>200 $gm^{-2}$) have been observed on a frequent basis. A further application of this instrument is the evaluation of atmospheric absorption models concerning the water vapour continuum contribution at 150 GHz. This can be accomplished by applying different radiative transfer models of interest to close-by radiosonde profiles and then comparing simulated and measured brightness temperatures.

In this high alpine environment, the combination of both instruments has an enormous potential to improve climate and numerical weather prediction models as well as monitor the atmosphere in an especially sensitive environment.