Boundary layer temperature profile observations using ground-based microwave radiometers

Bernhard Pospichal[1], Susanne Crewell[1], Ulrich Löhnert[1], Thomas Rose[2]
[1] Meteorological Institute, University of Munich, Germany
[2] Radiometer Physics GmbH, Meckenheim, Germany

Microwave profilers can retrieve temperature profiles by observing the thermal emission along the oxygen band at 60 GHz. Here we present observations by a 14-channel ground-based microwave radiometer (HATPRO) which has been used under various climatic conditions to obtain boundary layer observations with a high temporal resolution. The instrument measures atmospheric thermal emission in 14 different frequency channels along the 22.235 GHz water vapour line and the 60 GHz oxygen absorption complex.

Typically, brightness temperatures are continously acquired in zenith direction with a theoretical error of <2 K for the retrieval of temperature profiles. The high stability of HATPRO allows – under assumption of horizontal homogeneity - to exploit brightness temperatures under several elevation angles from 90 to 5 degrees. The angular information is added to the spectral one which improves the retrieval performance for the lowest 1500 m of the troposphere significantly (error <0.5 K). Therefore, the evolution of night-time temperature inversions can be observed with high vertical as well as temporal resolution. The quality of these measurements is shown by using auxillary meteorological measurements of the boundary layer.

During the last year, HATPRO microwave radiometers have been operated under very different climatological conditions. The data set includes observations from the high mountain station Schneefernerhaus in the German Alps in winter, results from the LAUNCH campaign in summer 2005 at Lindenberg (Germany) which show mid-latitude summer conditions. Furthermore, tropical measurements in Darwin as part of the Tropical Warm Pool International Cloud Experiment (TWP-ICE) as well as in Djougou, Benin as part of the African Monsoon Multidisciplinary Analysis (AMMA) project are presented.