INVESTIGATION OF SPATIAL WATER VAPOR AND LIQUID WATER INHOMOGENEITY WITH SCANNING MICROWAVE RADIOMETRY

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1. INTRODUCTION

In the frame of the Convective and Orographically-induced Precipitation Study (COPS) in 2007, the University of Cologne deployed a newly developed scanning microwave radiometer (MWR) within the Black Forests Murg valley, Germany. The instrument was installed in May 2007 on the site of the Atmospheric Research Programs (ARM) Mobile Facility (AMF) and remained there until the end of the year. The instrument is a 14-channel microwave radiometer, e.g. the Humidity and Temperature Profiler (HATPRO), with an option to scan both in the azimuth and elevation. Additionally an infrared (IR)-radiometer was attached to the MWR which can detect even thin or ice clouds and water vapour anomalies in the scan direction of the MWR. This gives additional and independent information about cloud and water vapour distribution.

2. MEASUREMENTS

Different kinds of automated scan patterns were run in order to best characterize atmospheric variability. While elevation scans are best suited to derive high resolution temperature profiles, azimuth scans are well suited to investigate the spatial variability of the cloud field at a rather shorter time [1], [2]. For this study we analysed the full azimuth scans with fixed 30 deg elevation and 5 deg azimuth angle resolution which were run every 15 minutes from July to August 2007. Even in cloud free scenes, significant variability of a few mm in integrated water vapor content (IWV) could be observed – sometimes showing organized structures. From the end of August 2007 until the end of the year the radiometer performed full hemispheric scans with about 10 deg resolution lasting about 6 min.

3. EVALUATION

The availability of very different instruments at the AMF-supersite, especially multi-wavelength and Doppler lidars, a wind profiler, radiosondes (4 times a day) and a sky imager, makes it possible to evaluate the potential of the new full scanning MWR to detect spatial and temporal variations of the water vapour and cloud field. To further investigate finescale atmospheric structure in the Murg valley the Metair-DIMONA research aircraft flew distinct flight patterns over the supersite on two cloudfree days. During two flights on July 26 and August 1 significant variability (up to a factor of 2 in mixing ratio on short distances) could be revealed [3]. At the same time, the new MWR-system performed vertical scans in the azimuth direction of the flight path. The in situ aircraft measurements serve as a baseline to validate boundary layer observations by the radiometer. The results from HATPRO's different scan modi show good structural agreement with the aircraft-derived humidity fields.

4. STATISTICAL ANALYSIS

The influence of the local orography on the initiation of convection is one of the major scientific questions of the COPS experiment. In order to investigate the spatial distribution and variability of water vapor and cloud water we statistically analyzed the spatial structure for different weather situations. The results show for example, that the liquid water field has a significant spatial dependence while the water vapor field is almost independet on the azimuth direction.

5. REFERENCES

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