Microwave radiometry and sensor synergy at the AMF during COPS

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Setup and Motivation

During the ARM Mobile Facilities deployment in the Black forest, Germany, additional microwave radiometers and lidars were operated in the Murgtal Valley in order to:

- Intercompare microwave radiometers
- Evaluate water vapour (IWV) profiles and radiative transfer models
- Gather aerosol characteristics
- Analyze spatial inhomogeneity of WV & clouds
- Investigate cloud-aerosol interactions
- Improve sensor synergy methods

Lidar Systems
- Backscatter Extinction Ratio
- Temperature Humidity profiling
- Apparatus (BERTHA)
- TPRO (2.2 μm Doppler Wind Lidar)

Clear sky case: Challenges

- Water vapour absorption at higher microwave frequencies is uncertain
- Vertical resolution of profiles from passive microwave observations is limited

Boundary layer clouds: New approaches

- Fair weather cumuli showing liquid water paths < 100 g m⁻² can be well observed using higher microwave frequencies
- Doppler wind lidar shows complicated up- and downdraft structure in the planetary boundary layer (PBL) below cumuli

Scanning microwave radiometry

30 deg azimuth scans

Diurnal development

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<th>July/August statistics</th>
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Typical diurnal course of IWV (top), 30° temperature (middle) and LWP (bottom) for different sectors (North, East, South, West). Differences occur mainly during daytime when convective cumulative clouds are present.

Evaluation using aircraft

On 28 July 1 August 2007 the Metair Dimona aircraft performed in situ observations in order to map the humidity field in the vicinity of the AMF. The airplane was ascending or descending in six azimuth directions (colors) giving vertical sections of the fields.

Reconstruction of humidity field

- IWV measured with HATPRO shows similar dependence on azimuth direction as IWV calculated from interpolated humidity fields (horizontal lines)
- Differences in IWV could originate from uncertainties in the interpolated field.

Integrated Profiling Technique

Application on 7 July 2008

- Detailed IL temperature profiles through inclusion of HATPRO elevation scans
- Humidity profiles constrained by cloud occurrence
- Retrieval of (multiple layer) liquid clouds, also in drizzling cases

Combining Microwave and Infrared Radiometry

Integration of the Atmospheric Emitted Radiance Interferometer (AERI) to:
- Develop a powerful, complementary retrieval tool (AERI+MW +lidar radar)
- Improve accuracy & vertical resolution for temperature and humidity profile retrieval in clear-sky cases (and below cloud)
- Allow accurate retrieval of cloud properties over a wider range of LWP (from very low to precipitating), including of ice microphysics

Outlook

- Statistical analysis of 4 months of continuous volume scans with HATPRO
- Evaluation of microwave gas absorption model through comparison of radiometer obs. with lidar observations from ground/lidar
- Application of IFT to the full AMF deployment period and subsequent model intercomparisons

Acknowledgements: We thank the ARM Program, the German Science Foundation (DFG) and the EURAM project for their support.