GROUND-BASED OBSERVATIONS OF PRECIPITATING CLOUDS BY A SCANNING POLARIMETRIC TRIPLE-FREQUENCY RADIOMETER

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Motivations

Past studies (Liu et al., 2001, Marzano et al., 2005-2006) have shown the potential of multi-wavelength ground-based radiometer observations in retrieving integrated rain contents of precipitating clouds. In addition, by exploiting dichroic nature of precipitation, Czekala et al., 2001 proposed measurements at horizontal and vertical polarization to distinguish between integrated rain and cloud liquid water contents. Few ground-based observations with multi-wavelength polarimetric radiometers have been performed up to now (Czekala et al., 2001). The **AD**vanced **MI**crowave **RA**diometer for **R**ain **I**dentification (***ADMIRARI***) has been developed to fill this lack of measurements and to test the feasibility of the concept.

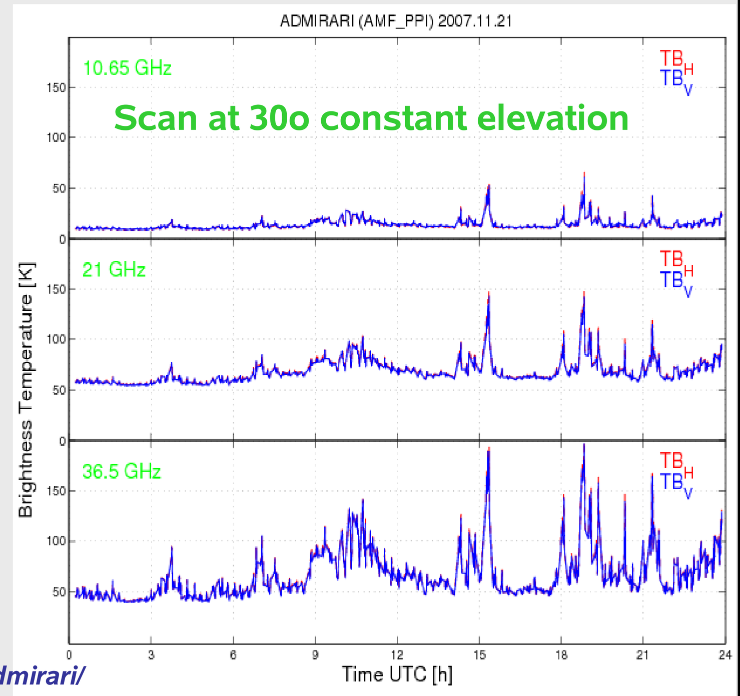
Specifics of the instrument

- **10.65 / 21.00 / 36.5 GHz (V/H)**
- **5 degrees beam-width**
- **Direct detection**
- **Full internal calibration (Dicke switch / Noise Injection)**
- **Steerable in zenith and azimuth**
- **Water-repellent coating on the antennas**

Measurements

During Convective and Orographically induced Precipitation Study, ADMIRARI has been continuously measuring from August 8th to December 19th at the supersite M in the Murg Valley (Black Forest).

Different scanning modes with fixed elevation/azimuth angles have been adopted during the field campaign.

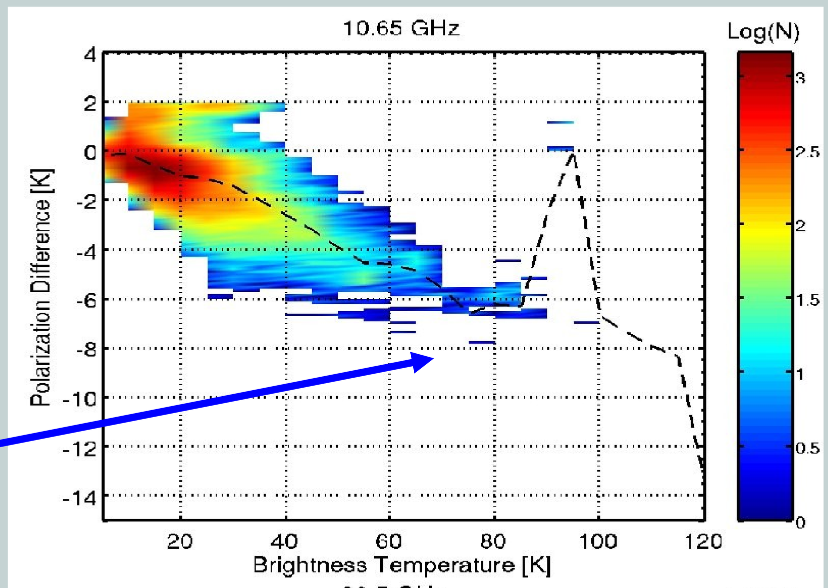


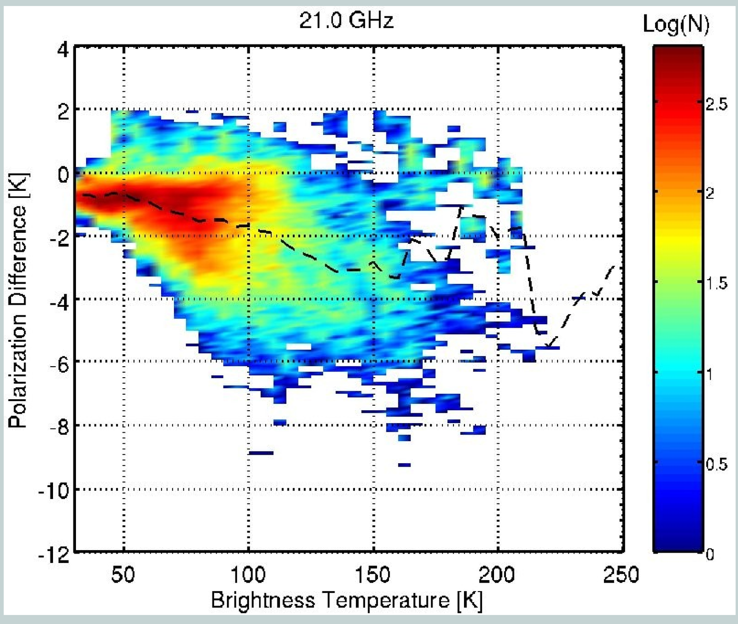
Quicklooks available @ www.meteo.uni-bonn.de/forschung/gruppen/admirari/

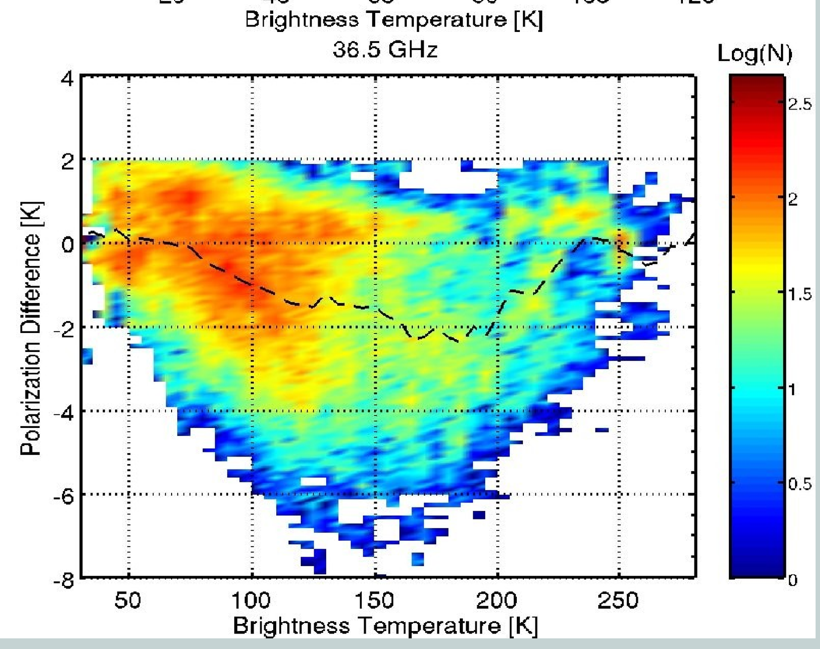
Global Analyses For Rain Cases

Rainy cases with RR>1 mm/h are selected according to the Atmospheric Mobile Facility gauge measurements: data from 6 min. before and after a rain event are included as well. 30° elevation observations are here shown.

The 10 GHz channel is never saturated, PDs generally decrease with TBs (value as low as –12 K have been observed)







The higher frequency channels (21-36.5 GHz) saturates for high/medium rain rates. PDs are lower than at 10 GHz (as expected from theory, Czekala et al, 2001).

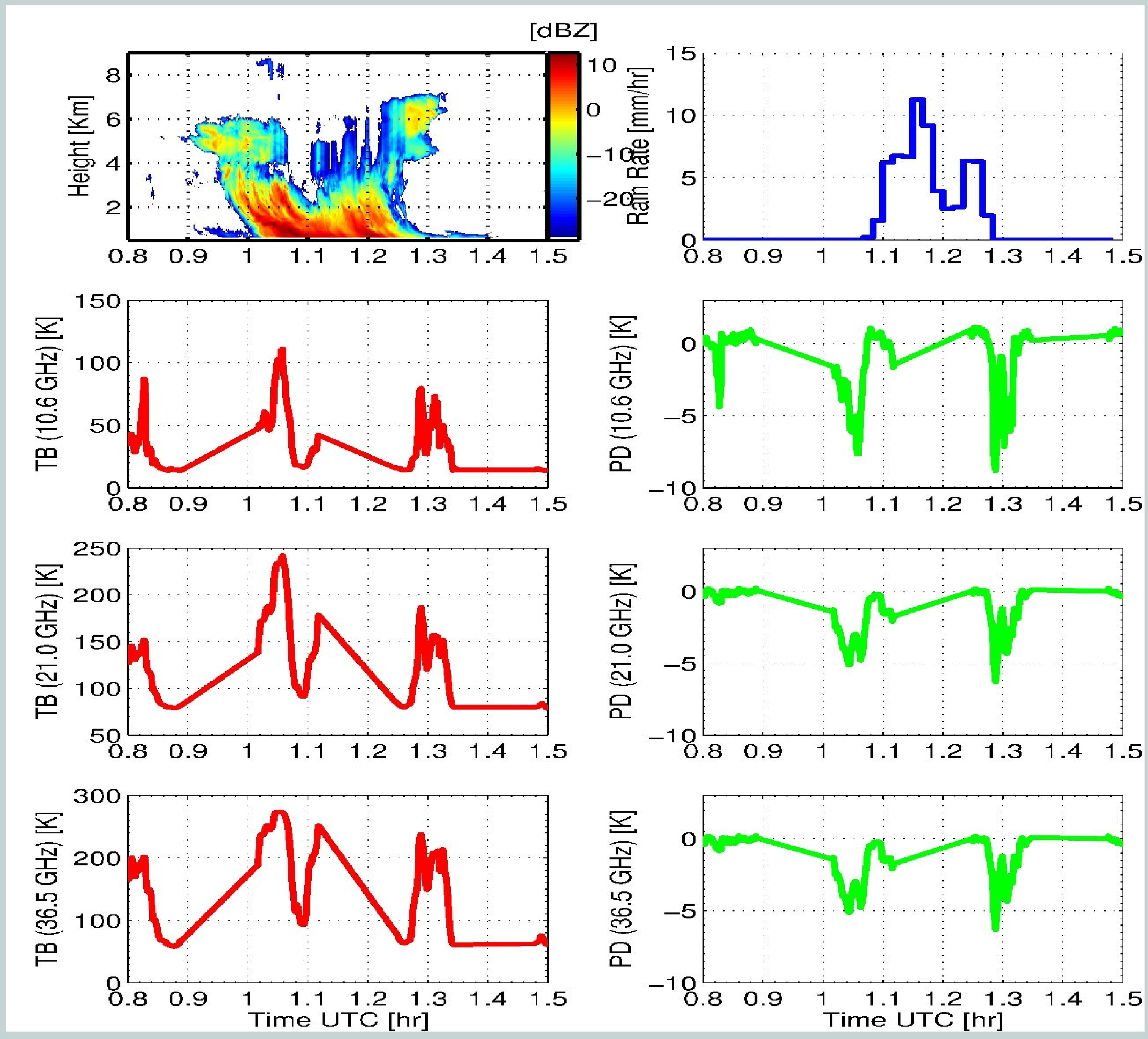
Case study 13.08.2007: convective precipitation

ARM W-band nadir observation +gauge

ADMIRARI at 30° elevation, different azimuths

$PD=TB_V-TB_H$

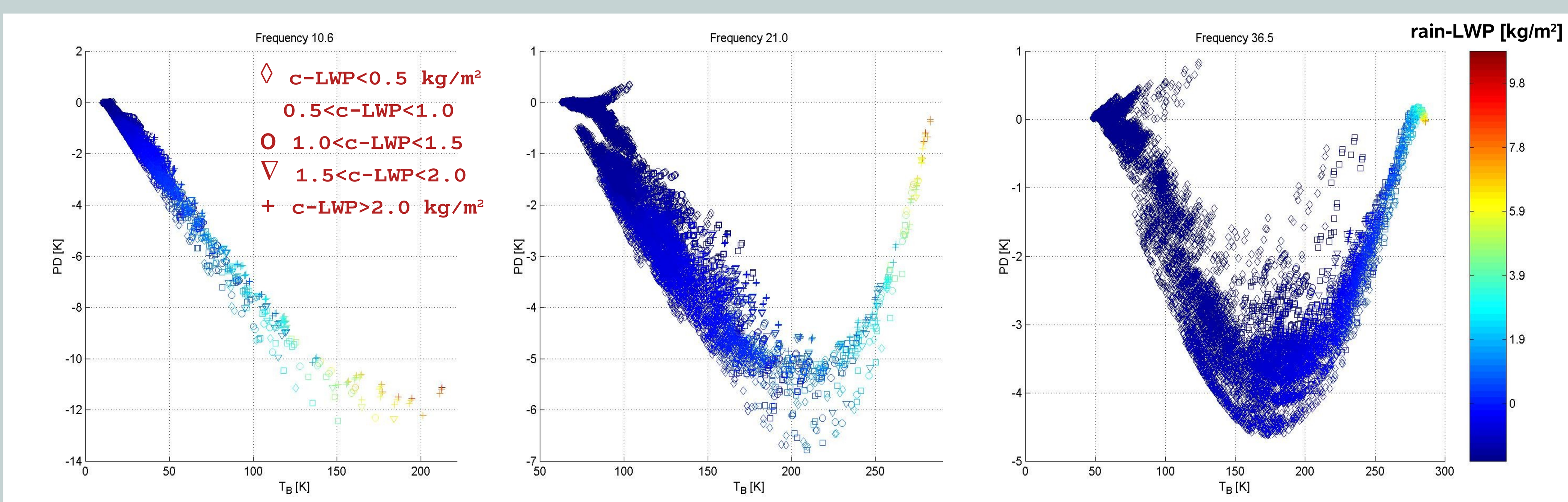
The presence of non-spherical particles in preferential orientation (like raindrops) is indispensable to explain the observed negative strong polarization differences (Battaglia and Simmer, 2007).



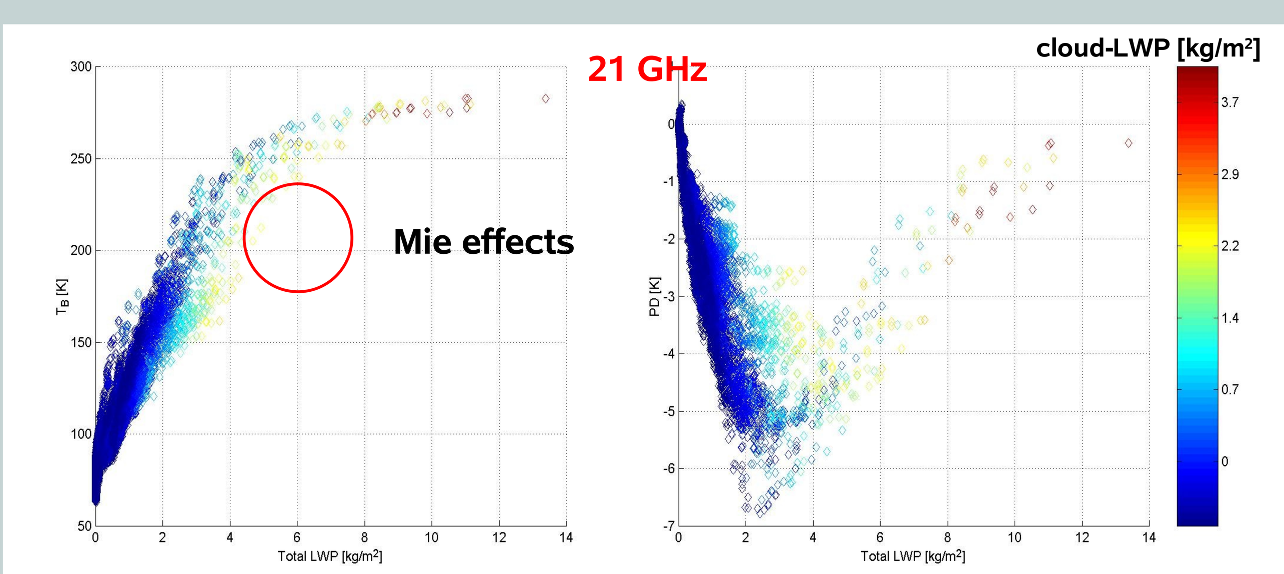
There is a strong azimuth dependence because of the observation mode and of the 3D nature of the event. Note that the rain signal appear for the ADMIRARI observations in advance and delayed compared to AMF site ➔3km rain layer @30° corresponds to a 5 km radius

Radiative Transfer Simulations

Different cloud resolving model simulations and runs of the COSMO model for the region around the Murg Valley have been used as input for radiative transfer simulations. Raindrops have been modelled as spheroids with size-dependent axial ratios. The simulations account for 3D slant view.



The simulation results reflect the general behavior of the measurements



A database of TBs and PDs and corresponding hydrometeor profiles has been created. This will represent the core of the physical retrieval algorithm.

Conclusions

First ADMIRARI measurements seem very promising for retrieving C-LWP and R-LWP simultaneously, a key quantity towards a better understanding of the precipitation mechanism. Based on a synthetic database of radiative transfer simulations (which include detailed microphysics and 3D-effects) a retrieval algorithm is now under development.

The interpretation of the ADMIRARI measurements will improve our understanding of radiative transfer within dicroic media and will provide an independent evaluation of canting/orientation effects of raindrops which plays a crucial role in polarimetric radars.

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