Simultaneous observations from scanning radars and a vertically pointing micro rain radar and quantitative evaluation of polarimetric estimates

*Ricardo Reinoso-Rondinel[1,2], Marc Schleiss[2]

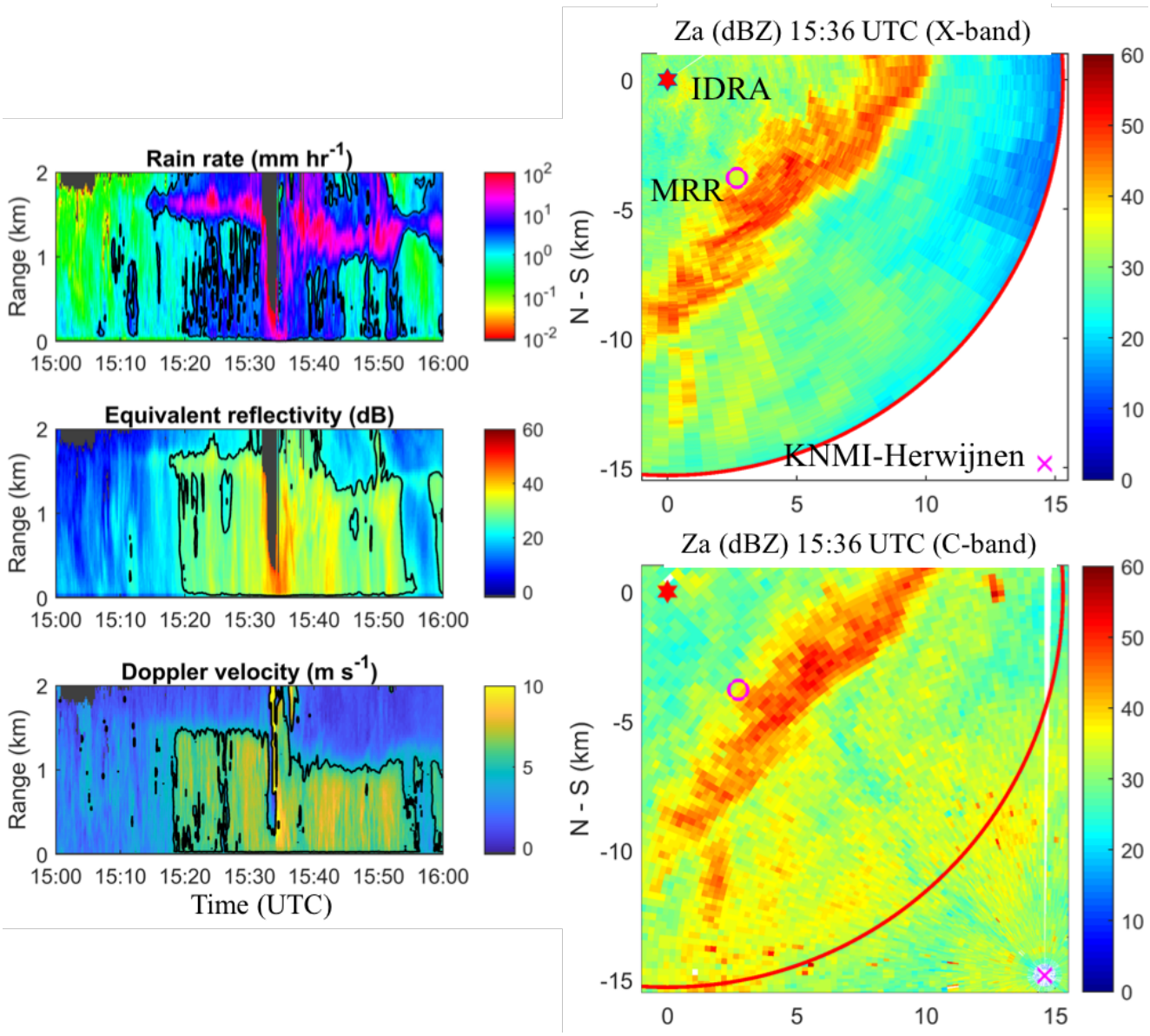
1. University of Bonn, 2. Delft University of Technology

Conventionally, micro rain radars (MRRs) have been used as a tool to calibrate weather radars, improve the relation between rainfall rate *R* and reflectivity *Z*, and study microphysical processes in precipitation. This is possible thanks to the MRR's capability of estimating vertical profiles of raindrop size distribution (DSD) from Doppler spectra profiles, from which relevant bulk quantities such as *Z* and *R* can be derived. So far, however, research has mostly focused on analyzing bulk numbers while limited attention has been given to the reliability of the retrieved DSDs and related polarimetric quantities.

This study sheds more light on these issues by examining: 1) the sensitivity of retrieved DSDs to the assumptions used to map Doppler spectra into size distributions, 2) the effect of the spatial variability of rain on simultaneous observations from radars operating at different frequencies and 3) the possibility to use a MRR to verify and improve polarimetric-based rainfall estimates in operational weather radars. To do this, a MRR-PRO was installed near the Cabauw site for atmospheric observation, right between the IDRA X-band research radar (30 m range resolution) and the operational C-band weather radar of KNMI in Herwijnen (225 m range resolution).

The measurements of the MRR at range gates between 105 and 385 m were used to retrieve average DSDs and simulate polarimetric variables such as differential reflectivity Z_{DR} and specific differential phase K_{DP}. The latter were then compared to Z, Z_{DR}, K_{DP}, and R from the weather radars to assess their accuracy. Preliminary results show a good agreement in terms of rainfall rate and reflectivity in light rain. In moderate to heavy rain, aliasing effects in the MRR measurements resulted in a few unrealistic DSDs with reasonable reflectivity but extremely large values of R above 50 mm hr^{-1}. Our analyses also revealed a large sensitivity of the retrieved DSDs to the maximum raindrop size assumed during the retrievals. Careful selection of this parameter appears to be necessary to get a reasonable agreement in terms of Z_{DR} between the MRR and the KNMI radar in Herwijnen.

Keywords: MRR, DSD, Polarimetric Radar


Rain rate (mm hr-1)
Equivalent reflectivity (dB)
Doppler velocity (m s-1)
Range (km)
Time (UTC)
15:00 15:10 15:20 15:30 15:40 15:50 16:00
Za (dBZ) 15:36 UTC (X-band)
Za (dBZ) 15:36 UTC (C-band)
IDRA
MRR
KNMI-Herwijnen
N - S (km)