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On the feasibility to combine observations from multi-wavelength radar and the multi-frequency radiometer ADMIRARI to retrieve precipitating clouds parameters.

P. Saavedra (1), A. Battaglia (2), and C. Simmer (1)

(1) University of Bonn, Meteorological Institute, Bonn, Germany (pablosaa@uni-bonn.de), (2) University of Leicester, Department of Physics and Anstronomy, UK

Theoretical studies have highlighted the possibility to estimate the cloud liquid water content from dual-wavelength radar observations. The advantage of that kind of techniques is that they don't require assumptions about the nature of the size distribution but simply that observations fall into the Rayleigh regime for both frequencies. Other authors have made first attempts for the application of multi-wavelength techniques to stratiform rain conditions by exploiting radar differential attenuation of droplets and raindrops and differential backscattering of raindrops; however, large uncertainties are typically introduced in the cloud product depending on the rain rate.

The passive microwave ADMIRARI radiometer from University of Bonn, has successfully taken advantage from the polarization information produced by non-spherical raindrops to partition rain and cloud from the total liquid water content. ADMIRARI's triple-frequency helps covering the atmospheric microwave signatures at different rain regimes. Its Bayesian retrievals have a good performance for large cloud and rain water content, while it is prone to larger uncertainties in the cloud component when low liquid water contents are observed. In such cases, dual-wavelength radar techniques can improve the performance of retrievals by adding information to the passive instrument.

In order to properly combine the active (radar) and passive (radiometer) observations in a unified retrieval approach, an important issue must be resolved, i.e. the mismatch between the sampled volumes. Typically radar retrievals are applied to vertical observations while ADMIRARI retrieves cloud/rain parameters for slant configurations. The development of innovative scanning multi-wavelength radars as part of the ARM and GPM programs provide a unique opportunity to overcome this drawback.During the last two NASA GPM Ground Validation field campaigns ADMIRARI has been operating nearby two dual-frequency radars: the Ka/W band (SACR) and the Ku/Ka band (D3R) in Oklahoma, USA and Canada respectively. The D3R Ku/Ka band radar has been performing synchronized observations with ADMIRARI during the cold season field campaign GCPEx at the CARE research facility in Canada.

The present work present the first results from the aforementioned field campaigns with a first attempt to combine these multi-sensor, multi-frequency, dual-polarized measurements in a common retrieval approach; limitations and pitfalls will be critically discussed as well.