Improving the instantaneous vertical profiling of precipitation using ground based radar measurements and passive microwave radiometers

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Abstract

Current passive-microwave retrieval approaches that are based on the a-priori knowledge provided by a representative database of columns of atmospheric variables and their corresponding microwave signatures, depend crucially on the realism of the representation of the cloud and precipitation in the column. Most approaches rely on columns produced by cloud-permitting model simulations, which suffer from oversimplifications of the very variables to which the microwave brightness temperatures are most sensitive, namely the type, concentration and relative sizes of the hydrometeors. Others rely on retrieved descriptions obtained from imperfect remotely-sensed measurements, imperfect because they hardly ever account for the cloud as well as the precipitation simultaneously. Indeed, the TRMM radar is a single-channel instrument, and therefore cannot, by itself, identify the phase of the condensation. The GPM radar is slightly better, due to its additional Ka-band frequency, however the sensitivity of both channels is so poor as to miss much of the condensation in the upper levels. This presentation will summarize our approach of using higher-sensitivity ground-based measurements to address these shortcomings. Indeed, during the CINDY-DYNAMO experiment that took place in 2011-2012, the dual-wavelength polarimetric radar SPolKa was deployed, providing a unique set of observations. Three complementary measurements are available: the Zdr, and the S- and Ka-band reflectivities. This allows insight into rainfall characteristics for different species. Using a Bayesian approach with Mie-scattering calculations, the rainfall rate, cloud liquid water, mean diameter and other parameters can be retrieved from SPolKa data. Different assumptions (on hydrometeor habit and size distributions) for those simulations were used, and their impact on the retrievals evaluated. The next step will be to simulate the brightness temperatures for the most realistic cases obtained and for both TRMM and Megha-Tropiques radiometers. This study will allow the elaboration of a new passive-microwave retrievals' database, accounting for the quantitative vertical distribution of precipitation.

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