1.9 IMPACT EVALUATION OF VERTICAL AIR VELOCITY ON THE MICROPHYSICAL RETRIEVALS BY K BAND RADAR PROFILERS USING COMBINED UHF AND S BAND PRODUCTS

M. MONTOPOLI[1 2], E. ADIROSI[13], N. ROBERTO[1], L. BALDINI[1]
[1]Institute of Atmospheric Sciences and Climate (ISAC)- CNR Rome, Italy
[2]Center of Excellence in Telesensing of Environment and Model Prediction of Severe Events, University of LAquila, Italy
[3]RaSS-CNIT, Galleria G.B. Gerace 18, Pisa, Italy
m.montopoli@isac.cnr.it

Doppler microwave radar profilers are recognised as key tool because they give new insights on microphysical precipitation processes. The backscattered power signal returned by these systems when they observe falling particles, is distributed in a Doppler velocity domain (Doppler spectrum), which covers the set of velocities of the falling particles. The amplitude of the Doppler spectrum in each Doppler bin depends by the particles size, composition and orientation. Thanks to the relationship between diameter and particle velocity, Doppler spectrum brings information of the falling particle size distribution (PSD). In still air, the retrieved PSD can suffer by system calibration, beam broadening and, eventually, radome attenuation. In the presence of turbulence effects and vertical air motion Doppler spectrum broadening and shifting drastically compromises the final PSD retrieval.

In [1], a first quantification of the impact of updrafts on estimated concentration of raindrops, was given. Few more recent studies proposed solutions for compensating of Doppler widening and shift contamination. Recently, [2] exploited the differences in the retrieved characteristic fall velocity closest the surface from K-band (24.24 GHz) radar and that from a collocated ground disdrometer to compensate for Doppler shift due to vertical air velocity and assuming a constant propagation of that velocity shift along the vertical column. Instead, [3] uses a multi-frequency approach at Ka and W band (35-94 GHz) for retrieving rain PSD simultaneously with the vertical wind speed, the air density, and the air broadening caused by turbulence and wind shear.

However, as far as the authors have been able to ascertain, none of the previous studies used collocated air velocity measurements from wind profilers to support their conclusions. In this work, we want to verify the impact of vertical air motion based on measurements collected by a K-band vertically pointing Doppler radar and microphysical estimation obtained from them by using air velocity from a product that combine measurements from UHF (449 MHZ) wind profiler and S band (2.835 GHz) radar profiler. Numerical simulations at K-band will be also used to corroborate our findings. The mid-latitude continental convective clouds experiment (MC3E) which took place in Oklahoma, during April-June 2011 [4], gave us the unprecedented opportunity to analyse simultaneous measurements from NASA K-band Micro Rain Radar [6], Parsivel disdrometer and NOAA S-band, UHF radar profilers [5], which were installed in Southern Great Plains Central Facility.

References

[1] Atlas, D. et al., (1973) Doppler radar characteristics of precipitation at vertical incidence, Rev. Geophys., 11.
[2] Adirosi E. et al.(2016) Improvement of vertical profiles of raindrop size distribution from micro rain radar using 2D video disdrometer measurements , Atmo. Res. 169
[3] Tridon, F. et al. (2015) Dual-frequency radar Doppler spectral retrieval of rain drop size distributions and entangled dynamics variables, J. Geophys. Res. Atmos., 120
[4] Jensen M. P. et al. (2016) The midlatitude continental convective clouds experiment (MC3E), BAMS
[5] Williams, C. R.(2012) Vertical air motion retrieved from dual-frequency profiler observations, J Atmos OceanTech. 29
[6] Petersen W. A. et al. (2012) GPM ground validation NASA micro rain radar.