K$_{dp}$ signatures of precipitating clouds as a proxy for vertical velocity and possible use in precipitation nowcasting

Renzo Bechini and V. Chandrasekar – Colorado State University, Fort Collins, CO

Abstract

Vertical motions play a central role in the formation of precipitation, for both warm and cold rain processes. Radar retrieval of the vertical component of the wind field by means of multiple Doppler techniques is in general only feasible when the vertical velocity is of the same order of the horizontal components (shallow and deep convection) and is limited to a portion of the overlapping area. More often the vertical motions are considerably weaker than the horizontal counterpart and Doppler retrievals are not viable due to large uncertainties. The potential of radar polarimetry for microphysical retrievals is well established. The identifiable microphysical species and processes are often directly related to the cloud dynamics, specifically to the vertical component of the wind field. This study aims at investigating the potential of polarimetric signatures of microphysical processes related to updraft regions. Notable examples are the vertical columns of Z$_{dr}$ in convective storms and the enhanced K$_{dp}$ values observed in the ice region of stratiform precipitating systems. The latter observations are considered in this work, through a comparison of co-located C-band K$_{dp}$ estimates and X-band vertical pointing Doppler measurements in Italy. The K$_{dp}$ signatures may be used to estimate the IWC or as a proxy for vertical velocity for assimilation in numerical models.

Conclusions

- Marked K$_{dp}$ signatures in stratiform precipitation around -15°C level are observed at both C- and X-band
- The coincident K$_{dp}$ estimates (scanning C-band radar) and vertical pointing Doppler measurements (X-band) support the hypothesis of ice crystal growth by vapor deposition, enhanced by weak updraft.
- K$_{dp}$ measurements may allow improvement of the Ice Water Content estimates and provide better input for numerical model assimilation

References