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Using multi-wavelength instruments to investigate the microphysical structure of deep convective cores

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Due to the large natural variability of its microphysical properties, %(size, shape, density)

the characterisation of solid precipitation is a longstanding problem. Since in situ observations are unavailable in severe convective systems, innovative remote sensing retrievals are needed to extend our understanding of such systems. This study presents a novel technique able to retrieve the density, mass and effective diameter of graupel and hail in severe convection through the combination of airborne microwave remote sensing instruments.

The retrieval is applied to measure solid precipitation properties within two convective cells observed on May 24th 2014 over North Carolina during the IPHEx campaign by the NASA ER-2 instrument suite. Between 30 and 40 degrees of freedom of signal are associated with the measurements, which is insufficient to provide full microphysics profiling. The measurements have the largest impact on the retrieval of ice particle sizes, followed by ice water contents. Ice densities are mainly driven by a priori assumptions, though low relative errors in ice densities suggest that, in extensive regions of the convective system, only particles with densities larger than 0.4 g/cm3 are compatible with the observations. This is in agreement with reports of large hail on the ground and with hydrometeor classification derived from ground-based polarimetric radars observations.

This work confirms that multiple scattering generated by large ice hydrometeors in deep convection is relevant for airborne radar systems already at Ku band. A fortiori, multiple scattering will play a pivotal role in such conditions also for Ku-band space-borne radars (e.g., the GPM Dual Precipitation Radar).