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Specific findings on ice crystal microphysical properties from in-situ observation

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This study focuses on microphysical properties of ice particles populating high ice water content areas in Mesoscale Convective Systems (MCS). These clouds have been extensively sampled during the High Altitude Ice Crystal - High Ice Water Content international projects (HAIC-HIWC, Dezitter et al. 2013, Strapp et al. 2015) with the objective of characterizing ice particle properties such as size distribution, radar reflectivity and ice water content. The in-situ data collected during these campaigns at different temperature levels and in different type of MCS (oceanic, continental) make the HAIC-HIWC data set a unique opportunity to study ice particle microphysical properties. Recently, a new approach to retrieve ice particle mass from in-situ measurements has been developed: a forward model that relates ice particles' mass to Particle Size Distribution (PSD) and Ice Water Content (IWC) is formulated as a linear system of equations and the retrieval process consists in solving the inverse problem with numerical optimization tools (Coutris et al. 2016). In this study, this new method is applied to HAIC-HIWC data set and main outcomes are discussed. First, the method is compared to a classical power-law based method using data from one single flight performed in Darwin area on February, 7th 2014. The observed differences in retrieved quantities such as ice particle mass, ice water content or median mass diameter, highlight the potential benefit of abandoning the power law simplistic assumption. The method is then applied to data measured at different cloud temperatures ranging from -40°C to -10°C during several flights of both Darwin 2014 and Cayenne 2015 campaigns. Specific findings about ice microphysical properties such as variations of effective density with particle size and the influence of cloud temperature on particle effective density are presented.