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HAIC/HIWC field project: characterizing the high ice water content environment

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High ice water content (IWC) cloud regions in mesoscale convective systems (MCSs) are suspected to cause in-service engine power loss events and air-data probe malfunctions on commercial aircraft. In order to better document this particular environment, a multi-year international HAIC/HIWC (High Altitude Ice Crystals / High Ice Water Content) field project has been designed including two field campaigns. The first campaign was conducted in Darwin in 2014 while the second one took place in Cayenne in May 2015.

The French Falcon 20 research aircraft has been deployed for the two campaigns, with an instrumental payload including an IKP-2 (isokinetic evaporator probe which provides a reference measurement of IWC), a CDP-2 (cloud droplet spectrometer probe measuring particles in the range 2-50 μm), and optical array probes 2D-S (2D-Stereo, 10-1280 μm) and PIP (precipitation imaging probe, 100-6400 μm). 23 flights were performed in Darwin, 18 in Cayenne, all sampling MCSs at different flight levels with temperatures from -10°C to -50°C.

The study presented here focuses on ice crystal size properties related to IWC, thereby analyzing in detail the 2D image data from 2D-S and PIP optical array imaging probes. 2D images recorded with 2D-S and PIP probes were processed in order to produce particle size distributions (PSDs) and median mass diameters (MMDs). Darwin results shows that ice crystals properties are quite different in high IWC areas compared to the surrounding cloud regions. Most of the sampled MCS reveal that the higher the measured IWC, the smaller are the corresponding crystal MMD. This effect is interfering with a temperature trend, whereby colder temperatures are leading to smaller MMD. A preliminary analysis of the Cayenne data seems to be consistent with the above trends.