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Analysis of ice crystals occuring in the upper high levels of tropical mesoscale convective systems

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Title : Analysis of ice crystals occurring in the upper high levels of tropical mesoscale convective systems

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Abstract :

In 2010 several test flights were performed in tropical marine meso-scale convective systems at flight levels between 10.5 and 10.8 km. Ice crystals were observed with a high speed CDD camera (image pixel resolution: 15 μm, time resolution 0.007 s) hereafter called the Airbus nephelometer. In-cloud observations were not restricted to the stratiform regions of the MCS but also convective cores were intensely sampled. High number concentrations of ice crystals (N > 1000 L^{-1}) and IWC of more than 4 $g.m^{-3}$ could be observed.

The main objective of our study is the retrieval of the ice water mass from ice particle number distribution and crystal habits, both observed by the Airbus nephelometer.

The shape of ice particles was supposed to correspond to the form of oblate spheroids. A statistical study of the aspect ratio of crystal images was performed comparing two different geometrical approaches for the aspect ratio of their semi axis. One uses the ratio of minimum to maximum length, the other is based on the aspect ratio which best fits the crystal image.

Different regions of the MCS present different mean aspect ratios measured at small scale (200 m). Variations of the aspect ratio seem to be associated with different nucleation and growth histories for the crystals. For regions with 'young' ice crystals, an anti-correlation between the aspect ratio and ice number concentration was observed. This observation is compared with the results obtained from simple diffusional growth modeling. To better quantify the characteristics of high concentrations of small ice crystal MCS regions, we propose to use the size distribution of the mean aspect ratio (from 100 μm to 1 mm), to distinguish quite different behaviors for 'young' and 'mature' convective regions.