Geophysical Research Abstracts
Vol. 17, EGU2015-9820, 2015
EGU General Assembly 2015

Variability of mass-size relationships in tropical Mesoscale Convective Systems

Emmanuel Fontaine (1), Delphine Leroy (1), Julien Delanoë (2), Régis Dupuy (1), Lyle Lilie (3), Walter Strapp (4), Alain Protat (5), and Alfons Schwarzenböeck (1)

(1) Université Blaise Pascal, Laboratoire de Météorologie Physique, Aubière, France, (2) Laboratoire Atmosphère, Milieux et Observations Spatiales, UVSQ, Guyancourt, France, (3) Science Engineering Associates Inc., Mansfield Center, USA, (4) Met Analytics Inc., Aurora, Canada, (5) Center for AustralianWeather and Climate Research, Melbourne Australia

The mass of individual ice hydrometeors in Mesoscale Convective Systems (MCS) has been investigated in the past using different methods in order to retrieve power law type mass-size relationships m(D) with m = α D$\hat{}\beta$. This study focuses on the variability of mass-size relationships in different types of MCS. Three types of tropical MCS were sampled during different airborne campaigns: (i) continental MCS during the West African monsoon (Megha-Tropique 2010), (ii) oceanic MCS over the Indian Ocean (Megha-Tropique 2011), and (iii) coastal MCS during the North-Australian monsoon (HAIC-HIWC).
Mass-size relationships of ice hydrometeors are derived from a combined analysis of particle images from 2D-array probes and associated reflectivity factors measured with a Doppler cloud radar (94GHz) on the same research aircraft. A theoretical study of numerous hydrometeor shapes simulated in 3D and arbitrarily projected on a 2D plan allowed to constrain the exponent β of the m(D) relationship as a function of the derived surface-diameter relationship S(D), which is likewise written as a power law. Since S(D) always can be determined for real data from 2D optical array probes or other particle imagers, the evolution of the m(D) exponent β can be calculated along the flight trajectory. Then the pre-factor α of m(D) is constrained from theoretical simulations of the radar reflectivity factor matching the measured reflectivity factor along the aircraft trajectory. Finally, the Condensed Water Content (CWC) is deduced from measured particle size distributions (PSD) and retrieved m(D) relationships along the flight trajectory.
Solely for the HAIC-HIWC campaign (North Australian Monsoon) a bulk reference measurement (IKP instrument) of high CWC could be performed in order to compare with the above described CWC deduced from ice hydrometeor images and reflectivity factors. Both CWC are coherent.
Mean profiles of m(D) coefficients, PSD, and CWC are calculated as a function of the temperature. For the three types of MCS, it is shown that the variability of m(D) coefficients is correlated with the variability of the temperature and that the mass of ice hydrometeors for a given size decreases with decreasing temperature.
Finally, the vertical variability of m(D) and PSD will be further differentiated, when separating the dataset horizontally with respect to the convective core of the MCS using the definition of a convective index.