SEGREGATING CHAIN AGGREGATES USING IN-SITU CLOUD PARTICLE PROPERTIES OBSERVED IN WINTER STORMS

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In-situ evidence of electrically induced aggregation of cloud ice and/or frozen droplets has primarily been observed in mid- to upper-level clouds of summertime storms. These aggregates, distinguished by their elongated, quasi-linear structure, are specifically termed as chain aggregates. Further insights into chain aggregate formation come from cloud chamber experiments, revealing that chain aggregation is temperature-dependent and is enhanced in an electric field exceeding approximately 60 kV m^{-1}. However, various complexities arise when connecting the experiments to in-situ observations. While there is a belief in the significance of electric fields for chain aggregate formation, the precise locations, and the mechanisms for chain aggregation within storms remain poorly understood. This lack of understanding poses a challenge in parameterizing the processes involved in the formation of chain aggregates in cloud models, thereby contributing to inaccuracies in cloud radiative transfer properties.

During the recent IMPACTS field campaign, airborne microphysical (imaging) probes observed chain aggregates—consisting of ice crystals and frozen droplets—across multiple research flights in the mid-to-upper levels of nor'easter and extra-tropical winter storms. To address the challenges associated with manually classifying chain aggregates across numerous flights for training dataset application, we employ an automated classification scheme. This scheme utilizes morphological particle properties derived from straightforward image processing techniques, offering an efficient approach to quantifying and identifying chain aggregate occurrences and understanding their impact on corresponding 'satellite-simulating' ER-2 radar/lidar observations. Our analysis, centered on extracting individual particle properties, aims to utilize common chain aggregate properties to segregate/extract them from the overall particle population, undergoing assessment across multiple IMPACTS flights. Moreover, this method is applied to in-situ probes with higher sampling frequencies across multiple flights to establish an accurate chain aggregate concentration scheme, relating it with ER-2 radar/lidar measurements.