Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12300, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12300
EGU General Assembly 2008

Evolution of Particle Size Distribution and Ice Crystal Habit

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This paper discusses impacts of ice crystal habits and aggregation efficiency models on the evolution of Particle Size Distributions (PSDs). Aggregation process of ice particles is the one of the most important processes that grows particle to precipitation size in stratiform clouds. Therefore, better understanding of the process is crucial, for example, to estimate life time of stratiform clouds, precipitation rate, and impacts of anthropogenic aerosols on orographic precipitation.

The authors developed a new microphysical scheme called Spectral Habit Ice Prediction System (SHIPS), which is aimed to retain growth history of ice particles in a 3D Eulerian dynamic model. For collection process, this model predicts a circumscribing volume (or maximum dimension) of ice particles by solving a stochastic collection equation with particle property variables. In a box model setup, the aggregation simulation was tested for five habits: plates, columnar crystals, dendrites, and columnar, planar, and irregular polycrystals starting from pristine crystals. The results show good agreements with empirical relationships between mass, maximum dimension, and density. The simulations indicate the importance of decreasing density with mass in the aggregation process.

Full microphysical simulations were performed in an idealized 2D simulation of an orographic snow storm during IMPROVE-2 campaign. The predicted PSD reproduces the observed relationship between the parameters of an exponential PSD in aggregation dominated clouds. Further comparison of simulations with different aggregation efficiency models and sensitivity tests of growth parameters for aggregation process will be given in the presentation. Possible directions to improve models for aggrega-

tion process will be discussed.