Studies Towards the Understanding of Ice Microphysics in Mixed-Phase Clouds

Gijs de Boer, T. Hashino, G.J. Tripoli, and E.W. Eloranta
The University of Wisconsin – Madison

The correct parameterization of ice microphysics in mixed-phase cloud situations remains a formidable challenge. Work being completed at the University of Wisconsin – Madison aims to better our understanding of these complex systems in order to better simulate their presence in both cloud-resolving and global scale models. Observationally, algorithms designed using data from the University of Wisconsin Arctic High Spectral Resolution Lidar (AHSRL), in combination with a NOAA Millimeter Cloud Radar (MMCR) continually retrieve cloud properties such as phase, particle effective size, number density, cloud base height, cloud thickness and water content. To date, this combination has provided over a year of observations from a high-latitude location. This information, along with data from a ground based radiometer, interferometer, radiosonde launches, and other aerosol and microphysical probes combine to form a climatological dataset of parameters having to do with the existence of boundary layer mixed-phase clouds. This dataset is utilized as a source of information as well as a source of validation for simulations of mixed-phase cloud scenarios. A numerical study is being completed using the University of Wisconsin Non-Hydrostatic Modeling System (UW-NMS), along with its new microphysical module, the Advanced Microphysical Prediction System (AMPS). The Spectral Habitat Ice Prediction System (SHIPS) handles the ice microphysics in AMPS, predicting quantities such as a-axis length, c-axis length, dendritic axis length, irregular polycrystal length, bullet rossette length, circumscribed volume, soluble aerosol mass, insoluble aerosol mass, mass produced by riming process, mass produced by melting, mass produced by vapor deposition. These quantities allow for the formation and growth of any type of ice particle. Using this unique framework, this study is aiming to understand the frequently observed longevity of the unstable mixed-phase situation, and the proper handling of ice initiation and growth in this environment. Results from simulations as well as examples of observations will be presented and discussed.