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A spectral habit ice prediction system: Test simulations of orographic precipitation

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Over the past 18 months, we have developed a new Eularian explicit ice microphysics scheme that is designed to eliminate many of the shortcomings encountered with the traditional Kessler/Lin and Orville approach to ice microphysics. The basis for the new scheme is to simulate the evolution of 5 components of crystal mass (a, c and dendritic axis and cloud and rain rime) rather than assumed ice habit (ie snow, pristine crystals, dendrites, plates) based on local and current conditions. In this way, arbitrary and unphysical discontinuous conversions between ice categories that dramatically affect the simulation of radiative transfer and the ability to assimilate radiation observations, do not need to be made as they are with the old paradigm. In addition to the continuous habit formation, the new scheme incorporates a piecewise continuous distribution matched at the boundaries of a number of mass bins ranging from a few to 50 or more depending on the resources dedicated to the problem. This would imply from 10 to several hundred predictive variables. The latter would could be prohibitive in three-dimensions. However, the microphysics of a 3D simulation typically occupy only a small part of the total 3d domain, typically not exceeding 1% of the grid volume. While implementing this technique into the 3D University of Wisconsin Nonhydrostatic Modeling System, we have taken advantage of this property allowing this scheme to be nearly as economical as those based on the old paradigm. Tests of this new scheme applied to an orographic cloud will be compared to results using the old scheme. At issue will be the ability to simulate habit development from basic principles, and the economy of using such a sophisticated scheme.