Sujet/Subject:

A new approach for parameterizing microphysics based on prediction of ice particle properties

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The treatment of cloud and precipitation microphysics remains a key uncertainty in cloud, weather, and climate models. There is particular sensitivity of forecasts to representation of the various types of ice particles that occur in the atmosphere (pristine ice, snow, rimed snow, graupel, hail, etc.). To address this problem, a new approach is proposed that differs substantially from the standard approach of partitioning ice into different categories with pre-defined properties such as bulk density and fallspeed. In the new approach, ice particle properties are predicted and evolve locally in time and space by prognosing four ice variables (number mixing ratio, vapor deposition mass mixing ratio, rime mass mixing ratio, rime volume mixing ratio). This allows the full range of ice particle types to be represented by a single ice category. Thus, the new approach avoids the need for conversion rates and thresholds between different ice categories, which are poorly constrained and often unphysical, used by the standard approach.

A bulk scheme based on the new approach has been developed and implemented into the Weather Research and Forecasting model (WRF). The new scheme is tested in WRF at high-resolution “convection-permitting” scales over a wide range of conditions including winter orographic precipitation and different types of convective storms. Despite the simplicity of the new scheme, i.e., use of a single ice category, its prediction of ice particle properties produces realistic simulation of meteorological phenomena at a reduced computational cost relative to most current schemes.