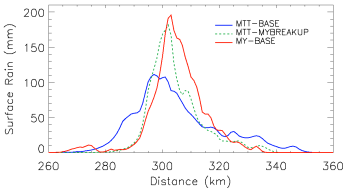
# Microphysics Complexity in Squall Line Simulations

## Research Highlight

As high-resolution climate models have increasingly moved towards an explicit representation of convection, the research spotlight shifts towards the parameterization of cloud microphysics in deep convection. Over the past decade or so, these parameterizations have rapidly gained complexity. With this increase in complexity also comes an increased computational burden, so it is important to understand the level of complexity that is needed for the computationally expensive high-resolution climate simulations.

Department of Energy scientists at Brookhaven National Laboratory and collaborators performed sensitivity simulations of an idealized two-dimensional squall line with the Weather Research and Forecasting model (WRF). They showed that there is a benefit to using two prognostic variables (two-moment schemes) to describe the size distribution evolution of **all** hydrometeors in the model. Adding hydrometeor types (e.g., by adding hail to a scheme containing rain, snow, and graupel) seemed less beneficial, since a large sensitivity was introduced to an arbitrary (and an a priori unknown) threshold to convert graupel into hail. Most importantly, it was shown that two equally complex microphysics schemes (Milbrandt and Yau 2005 [MY] and Morrison et al. 2009 [MTT]) still behave very differently in terms of surface precipitation and moist processes aloft. These differences could be entirely related to different treatment of collisional raindrop breakup and depositional growth.

Over the past years, the focus in microphysics modeling often has been on the role of size distribution assumptions in state-of-the-art schemes, but this study has identified that an equally large variability is associated with processes such the ice initiation, growth processes, and the breakup of raindrops.




Sensitivity of surface precipitation to drop breakup parameterization. The spatial distribution over a two-dimensional domain of accumulated surface precipitation for a full time integration of 5 hours are given for the Morrison et al. (2009) scheme (MTT-BASE), the Milbrandt and Yau (2005) scheme (MY-BASE), and a hybrid scheme (MTT-MYBREAKUP) that is identical to MTT-BASE except that the MY raindrop breakup parameterization was used.

### Reference(s)

Van Weverberg K, AM Vogelmann, H Morrison, and JA Milbrandt. 2012. "Sensitivity of idealized squall-line simulations to the level of complexity used in two-moment bulk microphysics schemes." Monthly Weather Review, 140(6), doi:10.1175/MWR-D-11-00120.1.

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### Working Group(s)

Cloud Life Cycle