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A Study of Microphysical Parameterizations and Simulated Tropical Cyclone Development

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This presentation highlights major results from an idealized tropical cyclone case study in which the Weather Research and Forecasting (WRF) model was used to compare and evaluate three bulk microphysics parameterization (MP) schemes with various degrees of complexity: the Ferrier single-moment 3-category, the WRF single-moment 6-category (WSM6) and the Thompson double-moment 6-category formulations. We first compare the sensitivity of the WRF-simulated intensification of an idealized tropical cyclone to the three MP schemes. We then compare the heating profiles and hydrometeor distributions from the three schemes. We further diagnose the source and sink terms of all the hydrometeor budgets. Results from this diagnosis indicate that the major differences in the production of hydrometeors in these schemes are more in the spectral definition of individual hydrometeor categories and spectral-dependent microphysical processes, such as accretion growth and sedimentation, than the differences between the single- and double-moment formulations. Differences in the assumed pathways to the production of frozen hydrometeors also significantly contribute to the differences among these schemes. This study demonstrates that hydrometeor budget analysis is an effective tool for MP scheme comparison and evaluation studies, allowing better understanding of actual assumed pathways to cloud and precipitation production in these schemes and their associated uncertainties.