M.S. Defense Announcement
Kristen Van Valkenburg
Wednesday, November 3, 2021, at 1:00 p.m.

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M.S. Defense

November 3, 2022
1:00 p.m. MT

Defense
ATS Large Classroom (101 ATS) or via Zoom

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Susan van den Heever (Adviser)
Steven Rutledge (Co-adviser)
Brenda Dolan
Richard Eykholt (Physics)

Sensitivity of simulated microphysics to the raindrop distribution shape parameter and comparisons with observation

Representation of precipitation microphysics remains a challenge in numerical modeling. Model simulations using two-moment bulk microphysics require a priori choices, such as the rain size distribution shape parameter (nu), which is used to determine the width of the rain drop size distribution (DSD). Selection of nu is often somewhat arbitrary being due, in part, to a lack of observations on which to base such decisions. In this study, the sensitivity of rainfall characteristics to nu is assessed using numerical model simulations and compared with the results obtained from a previously developed observational phase space. A continental deep convection (CD) case and a shallow maritime (MS) case are simulated using bin and bulk microphysical parameterizations. The model results show that accumulated precipitation in the MS case decreases with increasing , while the CD case shows minimal variability. In the CD case, where both warm-, mixed-, and ice-phase microphysical processes are occurring, mixing ratios and number concentrations show a monotonic decrease nu with increasing nu for graupel, while hail shows a monotonic increase with increasing . A rain budget analysis for microphysical processes reveals the MS case shows a shifting balance between evaporation and cloud water collection with changes in , with the changes to evaporation being the predominant influence on the surface precipitation. In the CD there is notable variability in a variety of microphysical processes including feedbacks to ice species. Cloud water collection and evaporation are greatest in the CDn2 simulation. The value of nu greatly impacts contributions to the rain via melting of ice hydrometeors. As the value of nu increases, melting of ice species by collisions with rain decreases, and is near zero in the nu10 simulation. As nu increases, hail melting into rain increases. We will examine the vertical variability of these melting processes. This analysis allows us to gain perspective into how the assumed rain n in bulk microphysics impacts both warm rain processes and feeds back onto mixed-phase and ice-phase processes.

In addition to the bulk parameterization sensitivity tests, both cases are also simulated using a bin microphysics scheme, where nu freely evolves throughout the simulation. We evaluate the breadth of possible nu values predicted in both cases and show the variability of nu values throughout the storm structure. The microphysical processes and rainfall characteristics of the bulk simulations are also evaluated relative to observations using a previously developed 2D phase space of the intercept parameter (logNw) and median drop diameter (D0). In this framework, lower nu values in the bulk

microphysics MS case correspond more closely with observations, while in the CD case higher nu correspond more closely with observations. These findings demonstrate the importance of assumptions constraining rain DSDs in microphysical parameterizations and provide a model-to-observation comparison to help guide a priori choices of nu.

Topic: M.S. Defense: Kristen Van Valkenburg
Time: Nov 3, 2021 01:00 PM Mountain Time (US and Canada)

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