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Sensitivity analysis of various microphysics schemes in a community NWP model

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It is well known that microphysics schemes used in NWP models have a great sensitivity to the uncertainties in the parameterizations of aerosol loading and microphysical processes that control the size evolution of hydrometeors. It is relatively less revealed in the literature that various MP schemes are sensitive to these parameterization uncertainties quite differently. The differences in the sensitivity between various MP schemes makes it difficult to determine which of the schemes is better physically based than the others. In this presentation, we use the widely-used WRF model to illustrate the differences in the response to these parameterization uncertainties. In particular, we will reveal the root cause for the lack of solutions to reduce the differences: inadequate theoretical understanding and observational evaluation. We have also found that the differences in the response to these parameterization uncertainties between the schemes are also related to the differences in the implementation of the interaction between aerosol loading and aerosol-dependent microphysical processes. We will show that these differences have an impact on how much precipitation is produced, where it falls, and the vertical distribution of hydrometeors. A pathway forward to alleviate the differences based on the theory of population dynamics will be provided and discussed.