Effects of microphysical processes on the precipitation spectrum in a strongly forced environment

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This study investigates the effects of microphysical processes on the precipitation spectrum in a strongly forced environment using a vector vorticity cloud-resolving model (VVM). Experiments are performed under imposed advective cooling and moistening with two microphysics parameterizations: predicted particle properties scheme (P3) and Lin scheme (VVM-Lin). Even though the domain-averaged precipitation is similar in two experiments, P3 exhibits stronger extreme precipitation in the spectrum compared with VVM-Lin. Changes in convective structures are responsible for such a difference. Using the isentropic analyses, we identify that in P3, stronger convective updrafts take place in the high regime where air parcels rarely reach. This is caused by additional condensate heating in P3. Through defining convective core clouds, the relation between the convective structure on the isentropic diagram and the extreme precipitation can be identified. The shifts toward extreme intensity in both object-based precipitation spectrum suggest that the microphysical processes have significant impacts on the extreme precipitation by the convective core clouds. The treatment of microphysics has significant impacts on the convective structures and then alter the probability of extreme events under the strongly forced environment. Impacts of microphysical processes on convective aggregation will also be discussed.

Keywords: cloud-resolving model, microphysics, extreme precipitation

