**“Cloud Microphysics: An essential component of GCM for simulation of extreme precipitation”**

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The present study demonstrates that a general circulation model (GCM) requires a full representation of cloud microphysics to simulate the extreme precipitation frequency close to the observation. GCMs with conventional convective parameterizations produce common bias in precipitation frequency: they overestimate light precipitation and underestimate heavy precipitation with respect to observed values. This frequency shift toward light precipitation is attributed here to a lack of consideration of cloud microphysical processes related to heavy precipitation. The budget study of cloud microphysical processes using a cloud-resolving model shows that the melting of graupel and accretion of cloud water by graupel and rainwater are important processes in the generation of heavy precipitation. However, those processes are not expressed explicitly in conventional GCMs with convective parameterizations. In the present study, the cloud microphysics is modified to allow its implementation into a GCM with a horizontal resolution of 50 km. This coarse-resolution GCM with cloud microphysics requires an additional vertical mixing process in the lower troposphere. The newly developed GCM, which includes explicit cloud microphysics and additional vertical mixing, produces more heavy precipitation and less light precipitation than conventional GCMs, thus simulating a precipitation frequency that is closer to the observed.