Climate effects of aerosol-cloud interaction investigated by a global cloud-resolving model.

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Current general circulation models (GCMs) suffer from the uncertainty in representing aerosol-cloud interaction (ACI) because the relevant processes such as cloud microphysics occur at scales much smaller than typically resolved by a GCM grid. Such deficiencies in GCMs have prevented us from understanding the quantitative contribution of ACI to climate.

In this regard, the global cloud-resolving model coupled with the aerosol transport module, NICAM-SPRINTARS, is expected to represent ACI realistically with its explicit cloud dynamics and microphysics on the global scale. Previous studies investigated ACI by NICAM-SPRINTARS with 1-moment cloud microphysics and showed that aerosol effects on cloud water content is well-represented in the model consistent with satellite observations, as opposed to GCMs. The 1-moment scheme, however, is constrained in representing ACI because some important processes for ACI are not incorporated.

The purpose of the study is to reveal key processes for ACI in NICAM-SPRINTARS with 2-moment cloud microphysics scheme that predicts number and mass concentrations of hydrometeors to better represent ACI. Specifically, we compare the model with 1-moment and 2-moment schemes against satellite observations on the global scale to evaluate how different degrees of freedom in representing cloud microphysics influence ACI. The analysis is intended to isolate the aerosol effects on cloud from contamination of other factors such as meteorological impact and wet scavenging process to clarify quantitative contributions of microphysical processes to ACI. In particular, wet scavenging process is found to significantly contribute to the aerosol-cloud correlation, possiblyresulting an error in estimating the aerosol effects on cloud.

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