A New Attempt to Understand the Cosmic Ray-Cloud Connection with Super-Droplet Cloud Microphysics Model

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The correlation between galactic cosmic ray (GCR) flux and the anomalies of low cloud, which has been first found by Svensmark and Friis-Christensen in 1997, strongly suggests that the solar activity might influence Earth's climate through the ionization effect on the cloud formation mechanism. However, it is not yet well understood how the ionization due to GCR affects the nucleation of aerosol as well as the activation of cloud condensation nuclei. Furthermore, it is also still unclear how the cloud anomalies associated with GCR might make an impact on global climate change. In order to resolve the vitally important problems, our understanding of the linkage between cloud microphysics and climate has to be more progressed.

Recently, we have developed a new simulation model of cloud microphysics, named Super-Droplet Method (SDM) [1]. Since SDM is a particle-based cloud model, which can easily handle the detail processes of sedimentation, condensation, stochastic coalescence, and even chemical reaction in cloud droplets, it will be a powerful tool for revealing the ionization effects on the cloud microphysics. In this talk, we will briefly explain the basic property of SDM, and demonstrate the performance of SDM by presenting the simulation results of cloud formation. Based on them, we are proposing a new research attempt, in which the advanced multiscale simulation incorporating both the microphysical processes and the macroscopic fluid dynamics should be applied for the study of the GCR-cloud connection.

[1] Super-Droplet Method for the Numerical Simulation of Clouds and Precipitation: a Particle-Based Microphysics Model Coupled with Non-hydrostatic Model, S-I. Shima, K.Kusano, A.Kawano, T.Sugiyama, and S. Kawahara: submitted to J. Atmos. Sci.