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Toward a holistic modeling of space climate

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How the solar activity affects the terrestrial environment is a crucial issue for the understanding of long-term climate variability. Although several possible mechanisms about the causal relationship between solar activity and the earth's climate have been proposed, the correlative analyses have not been able to discriminate them. In this paper, first, we review the issues of the two different mechanisms, so called ion-induced nucleation effect and near-cloud ion effect, the both of which may affect climate through cloud processes. Second, we will propose a new type of modeling frame-work, which should be developed to clarify the cloud effect as a space climate process. The modeling frame-work consists of several multi-scale models, which are molecular dynamics, monte-carlo model, particle-based cloud model called super-droplet method, and global circulation model (GCM). We also demonstrate how the super droplet model is able to deal with the sensitivity of cloud formation on aerosol density.

Keywords: space climate, model, super droplet method, cloud, cosmic ray, MHD