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Simulation study of global climate variation depending on cloud droplet size

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Since it was pointed out that the variation in galactic cosmic-ray intensity and the change in low-cloud amount are well correlated with each other, effects of cosmic rays on global environment have been discussed. Particularly a hypothesis that a higher intensity of galactic cosmic rays cools the global climate by enhancing nucleation of cloud particles through atmospheric ionization has attracted attention. According to this hypothesis, it is likely that the averaged size of cloud droplets becomes smaller as the galactic cosmic ray flux is increased, because the increase of number of cloud condensation nuclei may reduce the size of droplet when a constant amount of liquid water is present in the cloud. Then the earth albedo increases, and the earth surface temperature becomes cold as a result. The purpose of this study is to investigate the influence of the diameter of the cloud droplet gives to the earth surface temperature using a coupled atmosphere-ocean general circulation model. As a result, it is shown that the temperature decreased about three degrees in ten years when the diameter of the cloud droplet is halved, while the temperature increased about three degrees in ten years when the diameter of the cloud droplet is doubled. Interestingly, the cloud amount does not uniformly increase but it decreases in some regions when the diameter of the cloud droplet is halved. Also, the amount of the cloud does not always increase in the region where the temperature largely decreased. Based on the simulation results, we quantitatively discuss the detailed mechanism how the temperature changes when the radius of the cloud droplet is changed.

Keywords: cloud droplet, cloud amount, galactic cosmic-ray