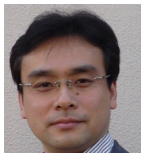
Laboratory of Satellite Climatology



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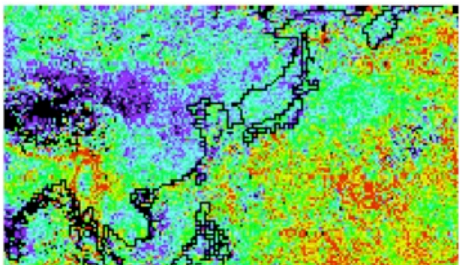
It is widely accepted that global warming is occurring due to anthropogenic carbon dioxide emissions, but how do you react when you hear that the characteristics of clouds and rainfall patterns may change due to anthropogenic activities?

Considerable amounts of aerosols, tiny particles formed from the gases emitted by factories and cars, are suspended in the atmosphere as either solids or liquids. Volcanic ash and dust originating from deserts also contribute to the aerosol content of the atmosphere. Aerosols reflect solar radiation and decrease the Earth's surface temperature due to the associated reduction in incoming solar energy. When water vapor condenses on an aerosol particle, it forms a cloud droplet; therefore, changes in the numbers of aerosol particles can lead to changes in cloud characteristics. When the amount of water vapor is fixed, cloud droplet size decreases along with increasing numbers of aerosol particles.



This figure shows the droplet size of water clouds over Asia (warm colors represent larger values and cold colors represent smaller values). Cloud droplet size over oceans is typically greater than it is over land. Furthermore, droplet size is greater over the remote ocean than it is near the shore. These characteristics arise due to differences in the number of aerosol particles. Generally, air masses over oceans contain fewer aerosols than air masses over land, which are subject to more pollution due to both anthropogenic activities and natural phenomena.

Since raindrops are formed from a collection of cloud droplets, any change in cloud droplet size may influence both the amount and pattern of rainfall. According to a recent study, increased amounts of aerosol particles reduced the amount of rainfall, since the presence of more particles in the atmosphere lead to smaller cloud droplet size; however, the impacts of aerosols on rainfall are much more complicated than we realize.

In our laboratory, the behavior of particles in the atmosphere, including aerosols, clouds, and raindrops, are investigated using satellite data, ground-based data, and numerical meteorological model outputs. In particular, we examine detailed structures from inside the cloud layer that are being obtained from the recently launched, space-borne radar on CloudSat.