A New Microphysical Model for Exoplanetary Clouds: Testing against the Observations of Terrestrial and Jovian Clouds.

*Kazumasa Ohno[1], Satoshi Okuzumi[1]

1.Department of Earth and Planetary Science, Graduate School of Science and Technology, Tokyo Institute of Technology

Recent transit surveys have shown that some close-in exoplanets have a featureless transmission spectrum. These planets are commonly thought to have high either an atmosphere with a high molecular weight or an optically thick dust cloud at a high altitude. A realistic exoplanetary cloud model is necessary to understand which interpretation is more likely for each exoplanets. Previous cloud models involve some free parameters whose relationship with the microphysics of the formation and growth of cloud particles is unclear. Furthermore, some models neglect the coalescence of dust cloud particles by assuming that micron-sized dust particles are unable to stick in an updraft.

We have been developed a new exoplanetary cloud model that involves the microphysics of condensation and coalescence (the Meeting of The Japanese Society for Planetary Sciences 2015). Our model produces the vertical distributions of the number and mass densities of cloud particles as a function of the atmospheric updraft velocity, the mixing ratio of the condensing gas at the cloud deck, and the number density of cloud condensation nuclei (CCN).

Here, we test the validity of our model by comparing with the observations of the clouds on the Earth and Jupiter. For terrestrial water clouds, we find that our model plausibly reproduces the cloud optical depth from satellite observations and vertical distributions of the mass and number densities of cloud particles from in situ observations. For Jovian ammonia clouds, our model simultaneously reproduces the particle effective radius, cloud optical depth, and cloud geometric thickness from far-infrared observations by assuming the updraft velocity of 1.2–2 m/s and CCN number density of $\sim 5\times 10^{4}$ m^{-3}. The parameters values assumed for the Jovian clouds are consistent with the Galileo probe observation and with previous 2D simulations of moist convection in the Jovian atmosphere.

Keywords: exoplanet, cloud

