

Numerical calculation of moist convection in Jupiter's atmosphere - A case study with an average cooling vertical profile based on a radiative transfer calculation -

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Active moist convections associated with condensation of H_2O and NH_3 and chemical reaction of NH_4SH are considered to occur in Jupiter's atmosphere. Since it is difficult to observe Jupiter's atmosphere covered with thick clouds by remote sensing, the structure of moist convection remains unclear. We have developed a cloud resolving model that includes cloud microphysical processes of condensation and chemical reactions of multiple components, and have investigated the structure of moist convection realized under Jupiter's atmospheric conditions (Sugiyama et al., 2009, 2011, 2014). Our calculations showed that periods of intense convective activity (active periods) and periods of weak convective activity (quiet periods) appear quasi-periodically. However, the settings of our previous studies were highly idealized. The purpose of this study is to examine the structure of moist convection in Jupiter's atmosphere that are established through a large number of life cycles of convective cloud elements by using the temperature and thermal forcing profiles based on the result of a one-dimensional vertical radiative-convective equilibrium calculation (Takahashi, Hokkaido University Ph. D. thesis, 2018).

The cloud resolving model developed by Sugiyama et al. (2009) is used. The temperature and pressure conditions and the abundances of condensable gases used in our calculation are based on the one-dimensional vertical radiative-convective equilibrium calculation (Takahashi, Hokkaido University Ph. D. thesis, 2018). The computational domain is two-dimensional, 1024 km in the horizontal direction and 300 km in the vertical direction. The resolution is set to 2 km in both the horizontal and vertical directions. One of the major differences between the settings of our calculation and those of Sugiyama et al. (2014) is the temperature profile of the basic state. The temperature profile used in our calculation is stable between 0.4 bar level and the tropopause (0.1 bar level). Another difference is the pressure range in which the model atmosphere is subject to an externally given body cooling that is a substitute for radiative cooling. The body cooling is applied below 0.4 bar level.

In our poster, we will present the characteristics of the structure of moist convection that emerge under more realistic conditions that are based on the one-dimensional vertical radiative-convective equilibrium calculation.

Keywords: planetary atmosphere, moist convection, cloud resolution model