[JJ] Evening Poster | P (Space and Planetary Sciences) | P-CG Complex & General

[P-CG23]Planetary Magnetosphere, Ionosphere, and Atmosphere

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Exploration of Moon, Venus, Mars, Mercury, Jupiter, Saturn, and beyond together with rapid developments of numerical simulations provides us new view of planetary environment. This session collects general contributions of new findings about planetary magnetosphere, ionosphere, and atmosphere. New methodology and technology development studies for future explorations are also welcome. In order to put the common knowledge at different planets into perspective, this session aims to facilitate discussions on comparative planetary environments.

[PCG23-P09]Numerical Modeling of Moist Convection in Jovian Planets in the case of high abundances of condensable species

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The condensation of chemical species of high molecular mass such as water, ammonia, and methane is thought to occurs in the hydrogen-helium atmospheres of Jovian planets. However, the characteristics of moist convection associated with these species remains to be clarified. In particular, the structure of moist convection and characteristics of vertical heat transportation are important issues to be understood in the case of high abundances of condensable species because the negative buoyancy caused by the condensation of condensable species inhibits moist convection (Guillot, 1995). Based on theories of Solar System formation, the abundances of condensable species in Saturn's, Uranus', and Neptune's atmospheres are higher than those in Jupiter's atmosphere. The abundances of condensable species in these planets are also beyond the convection inhibitation threshold of Guillot (1995). In the previous studies using cloud resolution model, Nakajima et al. (1998) perform some numerical simulations in order to discuss the convection inhibitation caused by the above-mentioned effects of molecular weight. However, Nakajima et al. (1998) uses temperature and pressure condition predicted in Jupiter's atmosphere, and consider the water condensation only. In addition, the abundance of water used in their calculations does not significantly exceed the threshold. In the present research, we perform two-dimensional calculations of moist convection and demonstrate dependencies of possible structure of moist convection on the abundances of condensable species in the atmospheres of the Jovian planets.

The basic equation of the model is based on quasi-compressible system (Klemp and Wilhelmson, 1978). The cloud microphysics is implemented by using the terrestrial warm rain bulk parameterization that is used in Nakajima et al. (2000). We simplify the radiative process, instead of calculating it by the use of a radiative transfer model. The model atmosphere is subject to an externally given body cooling that is a substitute for radiative cooling in the upper cloud layer. The body cooling rate is set to be -1 K/day which is 100 times larger than that observed in Jupiter's atmosphere in order to save the CPU time required to achieve

statistically steady states of the model atmosphere. The domain extends 1024 km in the horizontal direction. The vertical domains are 300 km, 600 km, and 800 km for the cases of Jupiter, Saturn, and Uranus, respectively. The spatial resolution is 2 km in both the horizontal and the vertical directions. The abundance of each condensable gas is set to be 1, 3, 10, and 30 times solar abundance.

In our poster, we will discuss the emergence of vigorous cumulonimbus clouds developed from the water lifting condensation level to the tropopause in each case, and demonstrate the heat budget obtained from our calculations.