The effects of planetary waves on the Venusian middle atmospheric dynamics

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From past few observations of the O2 nightglow variation, it is suggested that Super-rotation in the Venusian mesosphere and thermosphere has few-day temporal variation due to dissipating atmospheric waves such as gravity waves and planetary waves. Some researchers have simulated the effects of gravity wave drag on the Venusian atmosphere using limited information about phase speed and time period of gravity waves above the cloud top. However, the few-day variation of Super-rotation couldn't be reproduced in these previous studies. On the other hand, it has been reported that nonlinear interaction between two different primary planetary waves can produce the so-called "difference secondary wave" which has few-day period in the Earth's upper atmosphere. In addition, recent observation showed few-day oscillation of the atmospheric density in the Venusian thermosphere, suggesting that the planetary wave-wave interaction would induce few-day atmospheric oscillation.

In order to investigate the Venusian secondary planetary waves propagating from the cloud level to upper atmosphere and to estimate the wave drag effects on the middle and upper atmosphere, we have developed a numerical model which covers 70-150 km altitude. This model includes nonlinear interactions between Kelvin and Rossby waves observed near the cloud region of Venus. The three-dimensional primitive perturbation equations are solved assuming the background day-night flow, thermal dumping, and some parameters.

In the present study, we will show the upward propagation of the Venusian secondary planetary waves generated at the cloud top. Moreover, we will discuss the possibility of wind acceleration with few-day period by the propagating waves in the middle atmosphere.