

## Dynamics of the Venus atmospheric superrotation

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The atmospheric superrotation of Venus is one of the most remarkable phenomena in the planetary meteorology. We constructed a nonlinear dynamical model on the spherical geometry to investigate a generation mechanism of the Venus atmospheric superrotation. By using the solar heating without its mean zonal component, it was found that the atmospheric superrotation extending from the ground to 80 km was generated. The vertical distributions of the mean zonal flow obtained in our numerical experiments were similar to the observations. Velocity of the mean zonal wind in the equatorial region reached about 60-100 m/s near the cloud top level. The linear theories presented by Fels and Lindzen (1974) and Takagi and Matsuda (2006) suggest that the atmospheric superrotation obtained in the present study is generated and maintained by the momentum transport associated with the thermal (semidiurnal) tides. The downward transport of zonal momentum associated with the downward propagating semidiurnal tide excited in the cloud layer induces the mean zonal flow opposite to the Venus rotation in the lowest layer adjacent to the ground. Surface friction acting on this counter flow provides the atmosphere with the net angular momentum required for the atmospheric superrotation from the solid part of Venus (Takagi and Matsuda, 2007).

However, since the zonal mean component of the solar heating is excluded in the present study, the mean meridional circulation which is an important component of the Venus atmospheric general circulation is not taken into account. It should be examined that the mechanism proposed in this study can work to generate the superrotation in the real Venus atmosphere. It is also noted that the radiative process in the Venus atmosphere with enormous optical depth cannot be correctly represented by a linear Newtonian cooling scheme. In order to simulate and understand the Venus atmospheric superrotation better, we are working on a new radiative scheme suitable for the Venus atmosphere which can be incorporated into the present dynamical model.