EPSC Abstracts,
Vol. 2, EPSC2007-A-00224, 2007
European Planetary Science Congress 2007

Effects of thermal tides on the Venus atmospheric superrotation

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A nonlinear dynamical model on the sphere has been constructed to investigate a generation mechanism of the Venus atmospheric superrotation by the thermal tides. By using the solar heating exciting the diurnal and semidiurnal tides, the atmospheric superrotation extending from the ground to 80 km is generated. The vertical distributions of the mean zonal flow obtained in our numerical experiments are similar to the observations. The maximum velocity of the mean zonal flow reaches about 60-100 m/s near the cloud top level. A linear theory proposed by Takagi and Matsuda (2006) suggests that the atmospheric superrotation obtained in the present study is generated and maintained by the momentum transport associated with the thermal tides. Namely, 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 from the solid part of Venus.