Study of Atmospheric dynamics at the cloud top of Venus deduced from cloud-tracked winds

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We newly developed a newly method of tracking cloud features to derive the wind velocities circumstantially at the cloud top of Venus. Applying the method to the Venus images taken by Galileo in 1990, we identified the spatial structures of atmospheric waves, indicating the accelerations of the atmosphere by the waves.

Many atmospheric waves in Venus have been expected to transport angular momentum upward from the lower atmosphere, resulting in accumulation of the momentum in the upper atmosphere. This transportation and accumulation might be a probably mechanism to maintain the general circulations of Venus, e.g. the 4-day circulation of the atmosphere called the super-rotation.

Various circulation models have been proposed from the results of simulation models. At present, however, any particular mechanisms have not been identified as responsible for the super-rotation due to the lack of observational evidence. Methods of tracking cloud features have been applied to the Venus cloud images taken by Pioneer Venus in the past, and some spatial structures of atmospheric waves, which are thought to be excited by thermal tides or equatorial Kelvin waves, were identified. Same approaches for the derivation of the wind velocities were applied to cloud images obtained by Galileo. However, no one has been successful to derive spatial structures of atmospheric waves because of the limited observation of Galileo, and of lack of technique to derive the spatial structures from few cloud images.

Under these situations, we developed a new method of tracking cloud features combining effective calculation algorithms to derive spatial structures of atmospheric waves more precisely and the accelerations associated with those waves. The results of the analysis of Galileo images show spatial structures of thermal tides in the mean wind velocity distribution, and the equatorial Kelvin wave as a deviation of the observed zonal wind velocity. They indicate that the Kelvin wave-induced acceleration deduced from Galileo's observations in 1990 is larger than the one estimated for the Pioneer Venus in 1980s.