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Periodical wind speed variations at the cloud top deduced from UV cloud images taken by Venus Express

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In this study, by deriving wind speeds and their variations at the cloud top of Venus from cloud images taken by Venus Monitoring Camera (VMC) onboard Venus Express (VEX), we discuss spatial structures of planetary scale atmospheric waves in the Venusian atmosphere. Because VEX has a highly elliptic polar orbit and the footprint of apogee is near the south pole of Venus, VMC has taken many cloud images covering middle and high latitude region of the southern hemisphere of Venus. Applying a cloud tracking method that we have developed in 2008 JPGU meeting to these images, the wind speeds and their variations in middle and high latitude region could be well derived.

From Fourier analysis of wind speed variations derived from 18 days cloud images (January 25 - February 12, 2007), planetary scale 5.5 day period variations were identified in both zonal and meridional wind. The periodic variation of the zonal wind speeds was centered at the equator region and that of meridional was centered at 35 degree of south latitude. Difference between the zonal and meridional initial phases was 90 degrees and both phases were preceding westward at higher latitude. The phase speed of the 5.5-day period variations is slower than that of the super-rotation of Venus atmosphere at the cloud top. The westward preceding structure is consistent with a structure of Rossby waves derived from a numerical simulation (Yamamoto and Takahashi, 1997). These results are also consistent with previous studies of the wind speed and the cloud brightness variations using Pioneer Venus observations (Del Genio and Rossow, 1990; Rossow et al., 1990). Therefore we conclude that the derived 5.5-day variation is a result of the Rossby wave excited in the Venusian atmosphere.

The Rossby waves, which can be excited by the baroclinic instability in Venus atmosphere (Yamamoto and Takahashi, 1997), transport angular momentum from the latitude where these are excited to the higher latitude, and dissipate this instability. In this study, we will discuss transportation of the angular momentum by Rossby waves quantitatively based on the derived parameters from our analysis.

Keywords: Venus, super-rotation, cloud tracking, Venus Express