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Venusian wind velocity distributions in middle-to-high latitude regions derived from the UV/IR images observed by Venus

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We tried to derive the wind velocity distribution in the southern high latitude regions of Venus using the UV images taken by the Venus Monitoring Camera (VMC) on Venus Express (VEX). We focused on the longitudinal distributions of wind velocity, and found a possible correlation between the distributions of cloud-top temperature and meridional wind.

The UV images of Venus has contrasting distributions. They have been thought to show the distributions of unknown UV absorber which exists in the altitude of approximately 70km around the cloud top where the wind vectors have been estimated by tracking the cloud motions.

In addition, we can estimate the cloud top temperature from the brightness images in the mid-infrared region. The atmospheric vortices on both polar regions have been observed, and the vortices are made of two parts; one is high temperature regions near the pole called ”polar dipole”, and the other is low temperature regions called ”polar collar” outside of the dipole. The dipoles have a structure with the wave-number of two and rotate with the period of 2 to 2.5 days. The collars have a crescent structure with the wave-number of one and the phase fixed to the local time.

It is suggested that there is a correlation between the distributions of temperature and wind velocity. For example, the adiabatic heating due to a descending flow has been pointed out as a possible cause of the dipole. Indeed, poleward meridional winds have been found at the limbs of the vortices by observations in the UV region [Sanchez-Lavega et al., 2008; Moissl et al., 2009].

In this study, we aimed to derive the wind velocity distribution by tracking UV cloud images in middle-to-high latitude taken by VMC, and examine the correlation between the longitudinal distribution of temperature seen in the IR region and wind velocity seen in the UV region.

We adopted the cloud tracking method developed by Kouyama et al. (2009) for the detection of wind fields in high latitude regions. We modified this method to achieve the cloud tracking in high latitude regions where the tracking was hard. We got the result of wind velocity consistent with Kouyama et al. (2009) in middle-to-low latitude.

To get the wind velocity fields with respect to the dipole, we need to define a coordinate system fixed in the dipole. We fitted an ellipse to the dipole in mid-IR region and derived the distribution of wind velocity on the basis of its long axis. We analyzed data obtained from 5 orbits. The results show that there is no clear longitudinal distribution for zonal wind. In contrast, we found the structure which can be approximated to the zonal wavenumber of two in the meridional wind velocity. It suggests that we can approximate the streamline of wind by a dipole-like ellipse.

However, there is a difference in the longitudinal phase between the dipole in temperature and meridional wind structure. In addition, there is a significant variation in the phase difference with a period of as short as about 1 day. This result suggests that the longitudinal structure of the dipole is not made by wind steadily, and we need to consider the possibility that the dipole is made by another factors such as the wave phenomena. We need some additional analyses mainly to track the time variation of the phase difference.

Keywords: Venus, Polar vortex, Wind velocity, Longitudinal distrubition, Venus Express, Venus Monitoring Camera