Power spectrum analysis using UV images by VMC on board Venus express

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In Venusian atmosphere, there are waves with various scales and they compose turbulence. According to the classical turbulence theory, power spectral intensity at the wavenumber k is expressed as follows: P(k)=$C_k k^{-n}$. In this equation, the index -n corresponds to the slope in the logarithmic plot and characterizes the power spectrum. Enstrophy and energy cascade between the turbulence would occur in the case of n=3 and 5/3, respectively. Earlier studies have derived the power spectra of the turbulence from the Venusian cloud images obtained by earlier spacecrafts in the low latitude. However, the details of the power spectrum in the high latitude have been unknown well. Venus Express, which is the spacecraft launched in 2005, is in the polar elliptical orbit and observing the polar region in the South hemisphere.

In this study, we obtained power spectra from the cloud brightness distribution of the UV images at the cloud top by Venus Monitoring Camera (VMC) on board Venus Express and compared the slope of the spectra with the predicted value from the classical turbulence theory. The obtained spectra show that the slope in the longer wavelength region is steeper than that in the shorter wavelength region. The result suggests that the energy and enstrophy of the turbulence flows to the larger and smaller turbulence, respectively. The obtained slope doesn't completely agree with k^{-3} and $k^{-5/3}$. The slope has temporal and latitudinal variations, while the slope obtained from the terrestrial turbulence is constant in all latitudes. The difference suggests that there is no fixed flow of the energy and enstrophy, unlike the terrestrial turbulence.

We will analyze other data and closely discuss energy and enstrophy flows. Also, we will investigate how turbulence changes as time passes.