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Energy transport of Venusian atmospheric turbulence estimated by the spectral analysis of the VEX/VMC UV images

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In Venusian atmosphere, there are waves with various scales and they compose turbulence. The cloud top (~70km altitude), which can be imaged at ultraviolet wavelength, is in a very distinct phenomena, so called superrotation. Studying the energy flow of turbulence at this altitude is important to find out about the energy transportation structure which regulates Venusian atmospheric dynamics.
According to a classical turbulence theory, power spectral intensity at the wavenumber k is expressed as follows: $P(k)= C_k k^{-n}$. In this equation. 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 by earlier spacecrafts' data. However, the earlier data was obtained in short-term. Venus Monitoring Camera (VMC) onboard Venus Express can observe the polar region at high resolution to take advantage of its elliptical orbit.
In this study, we are aiming at understanding long-term power spectral variation of the cloud brightness distribution using the ultraviolet images in Southern hemisphere by VMC. The spectra obtained show that the slope in the longer wavelength range is steeper than that in the shorter wavelength range. The result suggests that enstrophy and energy cascade are dominant in the longer wavelength range and the shorter wavelength range, respectively. The slope obtained doesn't completely agree with -3 and -5/3. The slope has latitudinal variation, while the slope obtained from the terrestrial turbulence is constant at all latitudes. These difference suggests that there is no stable flow of the energy and enstrophy, unlike the terrestrial turbulence.
In this presentation we discuss the temporal variation of the energy and enstrophy flows. Also, we will consider correlation of the energy transportation at the cloud top with that at the upper and lower layer to find out about the vertical energy flows and its source.

Keywords: Venus, turbulence, spectral analysis, ultraviolet image, cloud top