金星探査機「あかつき」によって観測された中緯度帯雲頂構造

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Cloud-top structure in the middle latitudes observed by the Venus orbiter Akatsuki

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Venus is covered with thick sulfuric acid clouds floating at 40-70 km altitudes. The cloud particles scatter sunlight and shine brightly. In the visible region, light reflected by the clouds are poorly absorbed and almost uniformly distributed over the dayside disk except for a geometrical effect. However, in the infrared region, we observe thermal structures such as streaks aligning from the mid-latitude to the pole, the cold collars and polar vortices in the polar regions. On the other hand, in the ultraviolet region, we observe Y-shaped structures in the low-latitude region and the streak structures like those seen in the infrared region.

The five cameras onboard the Venus orbiter Akatsuki can capture radiation from multiple altitudes using the difference of the atmospheric transmittance at their peculiar wavelengths, and light up the 3-D structure and dynamics of the Venus atmosphere. Among the cameras, the Longwave Infrared Camera (LIR) detects thermal emission from the cloud top in a wavelength region 8-12 um to map the cloud-top temperature (Fukuhara et al., 2011) and Ultraviolet Imager (UVI) is designed to map the ultraviolet contrast at 283 nm and 365 nm for observing SO2 and un unknown absorber, respectively (Yamazaki et al., 2018).

Both LIR and UVI observed the streak structures, but unlike previous observations (Titov et al., 2008), the brightness temperature and ultraviolet brightness of the streak structures show a positive correlation.

Since Akatsuki orbits in a plane close to the equatorial plane, it is difficult to determine what shape the streak structures and cold collars found in the middle and high latitudes have. Therefore, we projected images centered on the North pole or the South pole (Kouyama et al., 2017). Furthermore, we calculated the average value of thermal images and created polar maps of temperature deviations. As a result, in images obtained by LIR, we found that the streak structure may start from the latitude of 60 degree around noon to the polar region in the afternoon and that the cold collar appears at latitudes of 60-80 degree in the morning.

In addition, we analyzed frequency characteristics in the local time domain at each latitude in order to investigate the local time dependency. As a result, in the images obtained by LIR, we found that a wavenumber 2 component is dominant in the equatorial region and that a wavenumber 1 component is dominant in the middle- and high-latitudes where the streak structure and the cold collar are observed.

In the presentation, we present the comparison between the results of these analysis and numerical simulations, and discuss the dynamics of the atmospheric structures of Venus' cloud-top in the middle-latitude region.