あかつき中間赤外カメラによる金星極域大気温度構造の解析

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Investigation of thermal structures in Venus polar regions observed by Akatsuki/LIR

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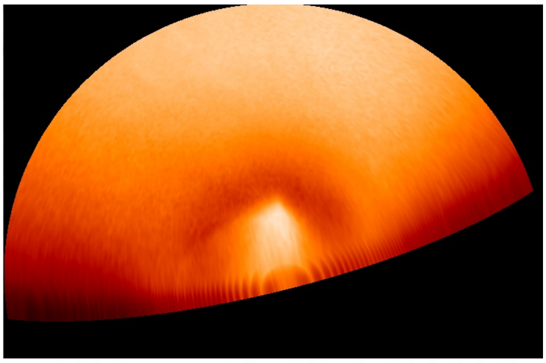
The polar dipole which locates at the center of the polar region shows higher temperature and the polar collars surrounding the polar region shows colder temperature relative to other regions. Infrared observations of Venus by the previous missions revealed these features.

Previous observations show that shapes of the polar dipoles can be characterized by three pattern which have a dipole shape, an elongated oval or a nearly circular structure and that these shapes change with time. [Garate-Lopez et al., 2013] The rotation period of polar dipole is 2.5 Earth days [Piccioni et al., 2007] and 2.8-3.2 Earth days [Schofield et al., 1983] in the south and north polar regions, respectively. It has not been clear that the difference and variability in the rotation period is due to just a temporal variation or influence of solar activity. Temperature of the Venusian atmosphere increases linearly with altitude. It is known that the mean cloud-top altitude decreases from 74 km at the mid-latitudes to 67 km at the high latitudes [Luz et al., 2011]. However, the observation by radio occultation showed that the temperature and altitude are not correlated in the polar region. The polar dipoles and polar collars are attributed to the residual mean meridional circulation (RMMC) enhanced by the thermal tide. In the high latitudes downward advection adiabatically heated by RMMC induces the warm polar dipole, and conversely, in the latitudes equatorward of the polar dipole, upward advection adiabatically cooled by RMMC induces the cold polar collar. [Ando et al., 2015]

The first Japanese Venus orbiter Akatsuki was launched in 2010. The Venus orbit insertion maneuver for Akatsuki in 2010 was failed, however, the second attempt to the Venus orbit insertion in 2015 was successful [Nakamura et al., 2011; 2016]. Akatsuki is a planetary meteorological satellite aiming at understanding the atmosphere dynamics of Venus.

Longwave infrared camera (LIR) observes thermal emission from the Venus cloud top and derives brightness temperature [Fukuhara et al., 2011]. LIR observe both dayside and nightside with an equal quality. Therefore, LIR can get temperature of a hemisphere facing to the spacecraft. Since Venus Express(VEX) was in a polar orbit of which the apoapsis was located at the south pole, VEX was suitable for observing the southern polar region. On the other hand, Akatsuki is in an equatorial orbit, which is suitable for simultaneous observations of both north and south polar regions.

We investigate thermal structure in the polar regions using brightness temperature distributions obtained by LIR. Figure shows an example of brightness temperature distribution derived by LIR. A polar dipole and a polar collar are clearly recognized. LIR has observed Venus sequentially every two hours except for the period while Akatsuki is close to periapsis. Temperature distributions of the polar regions, temporal variation of the shape of polar dipoles, the rotation period of the polar vortex by a cloud tracking method and north-south symmetry of polar phenomenon using brightness temperature distributions will be investigated to clarify the dynamics of Venusian atmosphere. In addition, comparing LIR results with results from other instruments, such as clout top altitudes derived from 2.02 micometer images obtained with a 2-micometer infrared camera (IR2), will provide additional hints for understanding the atmosphere dynamics of Venus polar regions.



An example of a brightness temperature distribution which shows the polar dipole and polar collar