

Morphology of Venusian upper clouds as seen by thermal infrared emission

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In order to investigate thermal and cloud structures at the cloud-top altitudes of Venus we have analyzed temperature distributions obtained by the Longwave Infrared Camera (LIR) onboard the Japanese Venus orbiter Akatsuki. Thermal structures are roughly categorized into three characteristic patterns: bow-shaped, zonal, and cell-like structures. Figure a shows an example of a brightness temperature distribution at the Venus cloud-tops obtained on July 23, 2016. A bow-shaped stationary structure centered on the equator is prominent, stretching to both polar regions. Irregular structures in various scales exist around it. This structure was observed for three weeks above a highland of surface topography when it was around the evening terminator. The brightness temperature distribution is compared with UV images at the wavelengths of 283 nm and 365 nm obtained by the Ultraviolet Imager at almost same time. In the UV images the stationary bow-shaped structures are sometimes identified at the same location where the bow-shape structures are found in the infrared images, but they are mostly very unclear. It is found that the equatorial part of the bow-shaped structure corresponds to the region of cell-like clouds which are common features in the dayside lower latitudes in the UV images. In the high latitudes zonal structures often appear in both thermal and UV images. Figure b shows a brightness temperature distribution in the southern high latitudes obtained on June 20, 2016. The zonal structures seen in the thermal infrared extend from the polar region in the west to the lower latitudes in the east similar to those previously known in the UV images. A low temperature zonal structure seems to connect with a polar collar, and a high temperature zonal structure is associated with the equatorial boundary of the low temperature zonal structure. Fine structures of cloud-top temperature are detected in the images obtained by a close-up observation while Akatsuki passes periapsis. Cell-like thermal structures with a horizontal scale of ~100 km are found in the low latitudes for the first time, though they are so faint as close to the detection limit of LIR. It is suggested that the low temperature regions of these structures correspond to the upwelling regions where temperature decreases due to adiabatic cooling. The dark regions in the UV images are also thought to be the upwelling regions where UV absorber-rich air is supplied from the lower atmosphere. Relationship between the cell-like structures seen in infrared and UV are being carefully studied.

