# 3-D thermal structure of the Venus atmosphere obtained by Akatsuki/LIR

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Brightness temperature of the Venus disk obtained by Longwave Infrared Camera (LIR) onboard Akatsuki shows clear limb darkening in the low and middle latitudes. Limb darkening is an apparent temperature decrease from the center to the limb of the Venus disk. It is caused by increase of the altitude sensed by LIR as an emission angle, which is a zenith angle of direction of emission from the Venus atmosphere to the sensor, increases and a negative lapse rate of the atmosphere. In higher latitudes limb brightening is observed, because an inversion layer exists at the cloud-top altitudes. In other words a profile of limb brightness reflects vertical distributions of atmospheric temperature and optical thickness of cloud particles. Taylor et al. [1980] presented local time dependence of limb darkening using brightness temperature data obtained by the Pioneer Venus orbiter, but did not mention its physical mechanism. In this study horizontal distributions of brightness temperature obtained by LIR when Akatsuki was in the altitude range from 60,000 to 100,000 km during the period from October 19, 2016 to October 2, 2018 were analyzed to investigate the vertical structure of brightness temperature distribution above the cloud-tops based on the emission angle dependence of the sensing altitude. We used LIR data obtained with an observation mode in which 32 successive images are acquired with an interval of two seconds. Each brightness temperature image with 328 x 248 pixels was divided into 3280 x 2480 sub-pixels, and 32 successive images were accumulated after precise adjustment of the Venus disk position to improve S/N. Then average brightness temperatures were derived as a function of the emission angle for 24 local time zones and 18 zonal belts with a latitudinal width of 10 degrees within plus or minus 85 degrees. Emission angles are converted to sensing altitudes by a radiative transfer calculation with nominal temperature and cloud particle distributions composed of the past Venus observations [Sato et al., 2014]. Thus, we derived a local time-altitude cross section of the brightness temperature deviation above the cloud-tops. In the equator region it shows a clear semidiurnal tide of which the phase shifts upstream as the altitude increases. The maximum positive temperature deviation appears around 10 and 21 LT at the bottom of the sensing altitudes. It is suggested that the thermal tide is generated deep in the cloud deck by solar heating and propagates upward. Ando et al. [2018] indicated that the phase of the semidiurnal tide inclines in the altitude range from 70 to 85 km by a general circulation model, and estimated a vertical wavelength of the semidiurnal tide in the altitude range from 75 to 85 km to be 10-15 km. A vertical wavelength will be also derived from our observation result by the same way, and will be compared with the simulation result to evaluate the background wind field. In the higher latitudes an inversion layer is identified in a local time-altitude cross section of the brightness temperature deviation corresponding to the cold polar collar.