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PCG33-02 Room:202 Time:May 25 09:15-09:30

Atmospheric structure in the cloud-top altitude region of Venus

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The first Japanese Venus orbiter Akatsuki launched in May 2010 is a meteorological satellite which will reveals the 3-D structure of Venusian atmosphere using 5 cameras and a radio occultation experiment onboard. The Longwave Infrared Camera is one of the suite of cameras and measures thermal infrared radiation in the wavelength region of 8-12 um emitted from the cloud-top altitude region around 65 km. Observed data is converted to brightness temperature with absolute temperature accuracy of 3 K and noise-equivalent temperature difference of 0.3 K using an algorism developed by the pre-launch calibration experiment. Akatsuki arrived at Venus on December 7, 2010, but unfortunately the Venus orbit insertion was failed. While Akatsuki was traveling away from Venus, LIR acquired a few Venus images on December 9 and 10. The downloaded image is blurred because of spacecraft attitude change during the image acquisition. A clear image was obtained by precise correction of line-of-sight shift which is calculated from the brightness center position of Venus disk imaged in each intermediate image (Fig.1a).

The obtained brightness temperature maps show cloud-top temperature ranging from 225 to 240 K, the cold collar and dipole in the northern polar region, the limb darkening effect due to difference in optical depth versus zenith angle of line-of-sight, zonal structures and finer structures therein seen in the middle and low latitudes, and temporal variation of them. The observed limb darkening was reconstructed by a fitting calculation using model profiles of cloud optical depth and temperature. The retrieved optical depth exhibits a steep gradient at the upper cloud-top region and is 2-8 km lower in altitude than the initial profile. The brightness temperature map was corrected for the limb darkening effect thus calculated (Fig.1b), and compared with ultraviolet images obtained by the Venus Monitoring Camera (VMC) onboard Venus Express.

VMC observes solar light scattered by the cloud particles, while LIR observes thermal infrared radiation from the cloud particles. The light emitting altitude region is almost same for the UV and infrared images, though the observed hemisphere and local time are different. It is found that bright zonal belts exist in the latitude region of -45 to -55 both in the UV and mid-infrared images. This implies that the higher temperature belt where LIR can see deeper through the upper cloud with thin optical depth is laid in the latitude region where density of UV absorber is thin. The fact that the zonal structure extends for all local time suggests the cloud particles seen in the mid-infrared or the UV absorber can live longer than a few days. The mid-infrared images obtained by LIR show the brightness temperature distribution on the almost whole Venus nightside for the first time, and the information retrieved from the images gives constraint on the atmospheric dynamics and cloud chemistry in the cloud-top altitude region of Venusian atmosphere.

References

Taguchi et al., Icarus, in press, 10.1016/j.icarus.2012.01.024, 2012.

Figure 1. Brightness temperature distributions composited from 32 intermediate images (M=32 and N=32) (a) before and (b) after correction for the limb darkening effect. The illustration in the lower right shows equi-latitude and -longitude lines every 30 degree and the sunlit region of the Venus disk [Taguchi et al., 2012].

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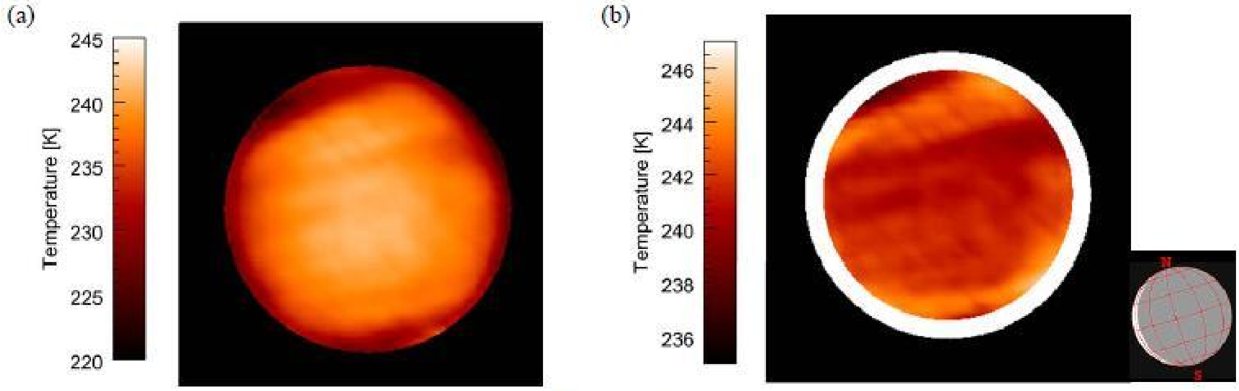

Figure 1