

Day-night contrast of the atmospheric circulation at the cloud top of Venus revealed by Akatsuki LIR

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In spite of the importance of elucidating the atmospheric circulation of Venus from the viewpoint of planetary meteorology, winds at the cloud top of Venus have been measured predominantly on the dayside. Prominent poleward drifts have been observed with dayside cloud tracking and interpreted to be caused by thermal tides and a Hadley circulation; however, the lack of nightside measurements over broad latitudes has prevented the unambiguous characterization of these components. Here, we obtain cloud-tracked winds at all local times for the first time using thermal infrared images taken by LIR onboard the Venus orbiter Akatsuki. To suppress the random noise and topography-related stationary features present in the original images, we applied a moving average in the time domain in a coordinate system that rotates with the superrotating background atmosphere, thereby highlighting drifting cloud patterns. The occurrence of prominent equatorward flows was found on the nightside, resulting in null meridional velocities when these are zonally averaged. The velocity structure of the thermal tides were unambiguously determined for the first time. The semidiurnal tide was found to have an amplitude large enough to contribute to the maintenance of the atmospheric superrotation. The weakness of the mean meridional flow at the cloud top implies that the poleward branch of the Hadley circulation exists above the cloud top and the equatorward branch in the clouds. The LIR data, combined with the analysis method developed in this paper, would enable characterization of various types of atmospheric motions including waves and the mean flow with emphasis on the localtime dependence.

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