

Periodicity analysis of Venus' cloud-top temperature measured by Akatsuki LIR

Naoya Kajiwara¹, *Takeshi Imamura¹, Makoto Taguchi², Tetsuya Fukuhara², Toru Kouyama³

1. Graduate School of Frontier Sciences, The University of Tokyo, 2. College of Science, Rikkyo University, 3. National Institute of Advanced Industrial Science and Technology

Planetary-scale waves are thought to play crucial roles in the maintenance of the general circulation of the Venusian atmosphere. However, observational clues are limited, and the nature of such waves is poorly constrained. Here we analyze for the first time the cloud-top temperature field to deduce the periods (frequency) and the spatial structures of planetary-scale waves using LIR image data acquired continuously. Since the systematic (absolute) error in LIR data of around 3 K is larger than the expected amplitudes of the temperature oscillations of around 1 K, the waves are hard to detect by deducing temperature variations with time. In this study, we analyze oscillations of the zonal gradient of the temperature in each image associated with planetary-scale waves. The small random (relative) error in LIR data of 0.3 K enables detection of such small-amplitude waves with this method. Through spectral analyses of the time series of the temperature gradient spanning 142 Earth days from 18 May 2017, distinct oscillations with periods of 3.5 days, 4.9 days and 5.2 days were discovered. All of these modes show almost constant phases along the latitude, indicating that they are planetary-scale waves. Based on the wave period and the latitude dependence of the amplitude, the 3.5-day wave is identified as a Kelvin wave and the 4.9-day and 5.2-day waves seem to be hemispherically-symmetric Rossby waves. The amplitudes of these waves changed with time during the observation period.

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