Stationary wavy features and Banded structures at Venusian cloud top extracted by averaging multiple LIR images

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Venus' cloud-top temperature distribution is now continuously mapped by LIR (Long-wave Infrared camera) mounted on the Venus orbiter Akatsuki. Fukuhara et al. (2017) analyzed LIR data and reported the existence of bow-shaped structures extending over 10,000 km in the north-south direction. The features are fixed in position without flowing with the super-rotation and appear above highlands with altitudes higher than 3 km. It was suggested based on a comparison with numerical simulations that the features are gravity waves generated by near-surface flows impinging on mountains. Kouyama et al. (2017) observed stationary features over 4 Venus days and revealed that the features tend to occur in the local afternoon. Gravity waves, whose restoring force is buoyancy, transport horizontal momentum in the vertical direction and accelerate or decelerate the background wind when they dissipate. Therefore, stationary gravity waves influence the general circulation of the atmosphere. In order to estimate the influence, it is essential to reveal the spatial and temporal distributions of gravity waves.

In the previous studies using LIR data, only planetary-scale stationary features have been investigated. On the other hand, Peralta et al. (2017) analyzed the data taken by VIRTIS onboard Venus Express, and reported the existence of many small-scale stationary features; however, VIRTIS can observe the night side only, and the observations were confined to the high latitude of the southern hemisphere because of the geometry of the orbit. Therefore, we intend to investigate with a new analysis method the topographical and local time dependency of small-scale, weak stationary features by using LIR data, which can observe all latitude regions at any local time. Though the S/N ratio of LIR is lower than VIRTIS, averaging of multiple images can suppress noises and at the same time emphasize stationary patterns. By using this method, small-scale, stationary wave trains were newly found above relatively-low topographic rises with altitudes of 1-3 km. In addition to stationary features, zonally-elongated banded structures were also found in averaged LIR images. Such structures have once been detected in LIR images taken during Akatsuki's Venus flyby in 2010 (Taguchi et al., 2012); the new analysis confirmed that banded structures are ubiquitous at the cloud top. The orientations of the banded structures are different from those of dark streaks found in ultraviolet images.