

Frequent appearance of large stationary gravity waves in Venus atmosphere

*Toru Kouyama¹, Takeshi Imamura², Makoto Taguchi³, Tetsuya Fukuhara³, Takao M. Sato⁴, George HASHIMOTO⁵, Masahiko Futaguchi⁶, Naomoto Iwagami⁷, Makoto Suzuki⁴, Munetaka UENO⁸, Mitsuteru Sato⁹, Seiko Takagi¹⁰, Takehiko Satoh⁴, Masato Nakamura⁴

1. National Institute of Advanced Industrial Science and Technology, 2. University of Tokyo, 3. Rikkyo University, 4. Japan Aerospace Exploration Agency, 5. Okayama University, 6. Toho University, 7. Senshu University, 8. Kobe University, 9. Tohoku University, 10. Tokai University

The first observation just after Akatsuki's Venus orbiter re-insertion (VOI-R) on December 7, 2015, showed a mysterious large scale feature expanding ~10,000 km from south to north in Venus disk, called a "bow shaped feature" which had been never seen before, clearly in Longwave Infrared Camera (LIR) images and in also Ultraviolet Imager (UVI) images though faintly. Fukuhara et al (2017) revealed the thermal feature seen in LIR had stayed almost the same location centered at the Equator and 90°E for at least five days, and the location was just above Aphrodite Terra region. The temperature amplitude of the feature reached more than 1 K, which was the largest amplitude seen at the observation. They also demonstrated the feature can be caused by a turbulence enhanced at 10 km altitude which may be related to mountains via mountain waves or other mechanisms, though the mechanism in which a disturbance can survive to propagate from the mountain level (~3km) to 10 km has not been clear. For more than one Earth year observation of Akatsuki since the VOI-R, the huge stationary gravity wave features have frequently confirmed in LIR images. Almost every timing when a high altitude mountain is in afternoon region of Venus, a huge stationary wave pattern appears and becomes more clear when the mountain approaches the evening terminator (i.e. local time = 18 hours). The wave features have been confirmed above not only Aphrodite Terra region, but also Maat Mon, Thea Mon, and other mountain peak locations. On the other hand, when the high mountains were located around morning, the large features have not been observed (disappeared), indicating the local time dependency of the appearance. Especially for Maat Mon, which locates nearby the Equator and 200°E region, we confirmed that the large-scale feature clearly appeared every one solar day of Venus (= ~117 Earth days), and the feature shape was almost same in every appearance. These evidences suggest existence of "daily" phenomena in Venus atmosphere. The observation results from LIR support a high altitude mountain in Venus can cause the stationary large scale features. The local time dependency indicates solar heating or solar fixed atmospheric may cause the large scale features.

Keywords: Venus, Gravity waves, Akatsuki, LIR