Long term monitoring of planetary scale temperature variations at the cloud top level of Venus by Akatsuki/LIR observations

*Toru Kouyama[1], Masataka Imai[1], Takeshi Horinouchi[2], Takeshi Imamura[3], Makoto Taguchi[4], Tetsuya Fukuhara[4]

1. National Institute of Advanced Industrial Science and Technology, 2. Hokkaido University, 3. University of Tokyo, 4. Rikkyo University

Since Mariner 10 observation in 1970s, planetary-scale (wavenumber 1) transient waves have been frequently observed at the cloud top level of Venus in both UV albedo and wind speed variations. The typical periods of the wave propagation around Venus are 4-days, which is faster than the super-rotation of Venus at the cloud top, and 5-days, which is slower. Due to the characteristics of their faster or slower propagation speed than the super-rotation, these waves have been considered as Kelvin and Rossby waves. It has been known that the appearances of the Kelvin and Rossby waves are not permanent, and recently it was confirmed that one cycle of increasing and decreasing of a wave amplitude was ~100 days derived from the ultraviolet imager (UVI) onboard Akatsuki (Imai et al., 2019). From these observational evidences, the wave activities are different at different periods, and such variation of wave activity potentially affects the temporal variation of the super-rotation at the cloud level, because these waves can transport atmospheric momentum vertically through their propagation. Therefore, it is worth to confirm typical time scales of the wave life-cycles from observations for assessing temporal variation of atmospheric momentum transportation in Venusian atmosphere.

In this study, we used images obtained by the longwave infrared camera (LIR) onboard Akatsuki from September 2016 to December 2019. The LIR can observe both dayside and night side regions of Venus equally, because the LIR captures thermal emission from the cloud top level of Venus (~70 km). LIR dataset has less observation gaps that is suite for monitoring temporal variations of waves. To extract wave signatures, we performed a periodical analysis with Lomb-Scargle periodgram and used a sliding window method proposed in Imai et al. (2019) in which we set a 40-day window for each analysis. From the result, both 4-day and 5-day wave signatures were confirmed, and their life-times were basically 100 - 200 days. In addition, by averaging the temperature field from the LIR data with a consideration of the 4-day propagation, a horizontal structure of Kelvin-wave like temperature perturbation was also confirmed.

Keywords: Venus, Akatsuki, LIR, Planetary scale waves