Temperature in the Venusian mesosphere observed by mid-infrared heterodyne spectrometer in 2018

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Extensive observations of the Venusian mesosphere have been performed by Venus Express (VEX) during 2006 - 2014 (e.g., Patzold et al., 2007; Mahieux et al., 2015). In terminators above 100 km in altitude, the thermal structure was reached common understandings by the comparisons between observations by the Solar Occultation at Infrared (SOIR) onboard VEX and numerical simulations by general circulation models (GCMs) . However, the temperature profiles in the altitude region of 85 - 100 km are not reproduced by GCMs, and the discrepancies have not been properly interpreted (Bougher et al., 2015; Gilli et al., 2017). Additional observational constraint for GCMs are needed to advance the understanding of the Venusian mesospheric thermal structure. In this paper, we will report the initial results of our challenge to this topic by obtaining temperature profiles in the mesosphere and its temporal and latitudinal variations utilizing the Mid-Infrared Laser Heterodyne Instrument, MILAHI (Nakagawa et al., 2016), developed by Tohoku University.

Temperature profiles in the altitude region of 70 - 100 km in the nightside are retrieved from CO_2 absorption spectra in 10 micron band. The absorption feature is formed by absorption of the thermal radiation emitted in the altitude close to the cloud top. MILAHI can resolve the spectra with the resolving power of 10^7 owing to the implementation of a CO_2 laser in 10 micron band (30 THz) as a local oscillator with a frequency stability of lower than 1 MHz. This spectral resolution has a potential to derive the temperature profiles with an accuracy of 10 K.

The observations were executed on 11 - 13, 19, and 20 November 2018 by using the Tohoku University 60 cm telescope (T60) located at the summit of Mt. Haleakala in Maui, Hawaii. Apparent diameter of Venus changed between 55.4 and 49.4 arcsec versus the spatial resolution of 4 arcsec by MILAHI with T60 in the wavelength of 10 micron. CO_2 absorption spectra were obtained at the equator on 11 - 13 Nov, 33N degrees on 19 Nov, and 33S degrees on 20 Nov at the evening terminator (local time of 20 h) with integration times of 80 - 105 minutes. In current tentative results, relative temperature differences are investigated by analyzing the day-to-day and latitudinal changes in relative intensity and line shape. The relative intensities on 11 and 12 Nov are similar level while that on 13 Nov is lower. This means that the temperature above the cloud top decreased on 13 Nov. The CO_2 absorption core at 33N degrees is sharper than that at 33S degrees. This can be interpreted as temperature in high altitude around 90 - 100 km at 33N degrees is lower. In presentation, we will show quantitative results in comparison with previous the radio occultation experiments by Akatsuki.