Properties of gravity wave packets detected in radio occultation temperature profiles of the Venus atmosphere

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Gravity waves are thought to play key roles in atmospheric dynamics by carrying momentum in the vertical direction. They induce acceleration or deceleration of the mean wind by depositing momentum on the background atmosphere while dissipating. Such processes should also affect the global structure of the high-speed zonal wind of the Venusian atmosphere. However, since the spatial scales of gravity waves are small and the wave periods are relatively short, it is difficult to capture their spatial structures by observations. Though the meridional distribution of the mean magnitude of short vertical-scale temperature disturbances (Tellmann et al. 2012) and the vertical wavenumber spectrum (Ando et al. 2015) have been investigated, the statistical properties of the wavelength, the amplitude and the vertical extent of the wave packet have not been studied.

Here we analyze temperature profiles obtained from 2016 by the radio occultation experiment in the Venus orbiter mission Akatsuki. Radio occultation is a method to measure the change of the refractive index of the atmosphere as a change of the frequency of the signal received on the ground. At the opportunity when the radio wave transmitted from Akatsuki toward the Earth passes through the planetary atmosphere, the wave is refracted and then reaches the receiving station. We can retrieve the vertical profiles of the pressure and the temperature from each refractive index profile. In the temperature profiles obtained in this way, variations due to various atmospheric disturbances are observed.

To extract spatially-localized temperature disturbances, we applied wavelet analysis to the temperature profiles obtained by radio occultation. Though there have been studies that applied Fourier transform to temperature data, Fourier transform assumes infinitely continuous waves and it is not suitable for extracting spatially localized wave packets. Wavelet analysis is an effective way of obtaining the wavenumbers and the amplitudes of waves in such finite intervals. In this presentation, we report the result of wavelet analysis applied to the temperature data obtained with high vertical resolution by radio holographic method (Imamura et al. 2018). From the obtained results, we report the statistical relationships among wave parameters such as the amplitude, the vertical wavelength and the packet length.