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Wavelet analysis of gravity waves on Venus using radio occultation temperature profiles

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Atmospheric gravity waves are thought to play crucial roles in transporting momentum and energy in planetary atmospheres. They are frequently observed as localized quasi-monochromatic wave packets in cloud images, while the vertical structures of the wave packets have not been investigated. The wavelengths and the packet lengths should reflect the generation processes of the respective wave packets. Though wave packets are thought to propagate independently, they are superposed on each other to induce an unstable field. The statistical characteristics of wave packets need to be known to understand the roles of the waves in the development of the atmospheric structure.

We study the characteristics of gravity wave packets in Venus's atmosphere using high vertical resolution temperature profiles obtained by Venus Express and Akatsuki radio occultation experiments with radio holographic methods (Imamura et al. 2018). Localized disturbances are extracted by applying wavelet transform to the vertical temperature distributions. The analysis showed that (1) wave packets having different wavelengths are overlapped with each other, (2) each wave packet typically includes <3 cycles, (3) waves with vertical wavelengths of ~1 km are frequently seen,(4) individual wave packets are hardly saturating in isolation, while saturation occurs as a result of superposition of wave packets, and (4) short-vertical wavelength waves are more frequently observed at lower altitudes.