

Radio holographic analysis of Venus' radio occultation data

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Gravity waves are considered to drive the atmospheric general circulation by vertical transportation of momentum and energy. Gravity wave breaking occurs via local instabilities such as convective instability and shear instability as the amplitude of the wave increases in the course of upward propagation. Turbulence following the gravity wave braking plays an important role in the diffusion of atmospheric substances, momentum, and energy.

Gravity waves with vertical wavelengths from a few tens of meters to kilometers have been observed in the Earth's atmosphere by radiosondes and radars. Also in the atmospheres of other planets, gravity waves are observed by various methods including radio occultation. The radio occultation method relies on the measurement of the frequency shift of the received signal caused by the bending of radio waves in the radial gradient of the refractive index in the atmosphere.

The geometrical optics method has long been used for the analysis of radio occultation data. However, this method cannot disentangle multipath rays and vertical resolution is limited by the size of the Fresnel zone (~1 km). Because of this limitation, only a limited part of the gravity wave spectrum has been covered, and thus the propagation and dissipation mechanisms of the gravity waves in other planets are poorly understood.

Radio holographic methods have been proposed for processing of radio occultation signals in multipath regions and obtaining atmospheric profiles with high resolution. One of them is the Full Spectrum Inversion (FSI), which was recently applied to GPS occultation data of the Earth's atmosphere. By applying this technique to Venus Express radio occultation data, we derived temperature profiles with high vertical resolution. In this presentation, the vertical wave number spectra will be compared among different altitudes, latitudes, and longitudes, and the spatial distribution of unstable layers will be investigated for studying propagation and dissipation of the gravity waves.

Keywords: Venus, Gravity wave, Radio occultation, Radio holographic analysis