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Vertical wavenumber spectra of gravity waves in the Venus atmosphere

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Vertical wavenumber spectra of Venus gravity waves were obtained for the altitude range 65-80 km from temperature profiles acquired by the Venus Express radio occultation experiments and classified in terms of four latitude regions; equatorial region (0-20 degree), middle latitude region (20-50 degree), high latitude region (50-80 degree), polar region (80-90 degree). As a result, the spectra, which cover vertical wavelengths from 1.5 to 15 km, generally show a decline of the spectral density with wavenumber similarly to those obtained in the terrestrial stratosphere and mesosphere. Moreover we compared observed spectrum with the theoretical spectrum of the saturated gravity waves described as Tsuda et al. (1991) and Tsuda and Hocke (2002). In equatorial region, spectral density is lower than those in the other latitude regions by up to one order of magnitude and does not reach the saturation value. This implies that gravity waves are not saturated in the equatorial region. In middle latitude region, logarithmic slope of the spectrum is nearly -4, although its density is near the saturation value. In high latitude and polar region, spectral density is almost consistent with theoretical saturation spectrum, which suggests that gravity wave saturation occurs also in these regions in the Venus atmosphere.

Moreover we calculated the intensity scintillation spectra near the altitude of 70 km from the time development data of the received intensity and classified in terms of four latitude regions as described above. As a result, spectral densities in the high latitude and polar region are 3-4 times as large as in the equatorial and middle latitude regions and Kolmogorov inertial subrange could be seen. This implies that turbulent diffusion associated with the gravity wave breaking occurs in these regions.

Keywords: Venus atmosphere, Gravity wave, Vertical wavenumber