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Large scale atmospheric waves in the Venus mesosphere as seen by the VeRa Radio Science instrument on Venus Express

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Abstract

Atmospheric waves on almost all spatial scales have been observed in the Venus atmosphere in various atmospheric regions. They play a crucial role in the redistribution of energy, momentum, and atmospheric constituent and are thought to be involved in the development and maintenance of the atmospheric superrotation.

1. The VeRa Radio Science Experiment

The Venus Express Radio-Science Experiment VeRa investigates the Venus neutral atmosphere and ionosphere in Earth occultation geometry using the spacecraft radio subsystem at two coherent frequencies, X-band (8.4 GHz) and S-band (2.3 GHz). Radial profiles of neutral number density, derived over the altitude range 40–90 km, are then converted to vertical profiles of temperature and pressure, assuming hydrostatic equilibrium [1,2].

These profiles cover a wide range of latitudes and local times, enabling us to study atmospheric wave phenomena at different spatial scales in the mesosphere and troposphere [3,4]. Some of the recent occultation seasons provided the opportunity to observe the same latitude and local time range during consecutive orbits. These data give valuable insight into zonal motions at different latitudes and altitudes.

2. Large scale atmospheric waves

A pronounced local time dependency of the Venus atmosphere is found in the mesosphere at different altitude levels. Wave-2 structures dominate the low latitude range in the upper mesosphere while the higher latitudes show a strong wave-1 at the top of the cloud layer structure [e.g. 5].

Kelvin wave structures at the top of the cloud layer correlated with the superrotating background atmosphere are also existent in the low latitude range at the top of the cloud layer (~65 km) [6].

The VeRa observations will be brought in context with other independent atmospheric observations investigating wave-1 and wave-2 structures in the upper and lower mesosphere at different latitudes.

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