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Estimation of a quantitative approach for Venus surface data extraction from VIRTIS measurements using topographical variations

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The analysis of Venus' night side thermal emission in the NIR transparency windows measured by the VIRTIS instrument offers a unique possibility to extract information about the planetary surface. Many of these windows, however, are masked by far line wing absorptions of deep atmosphere constituents. Detailed radiative transfer calculations that include appropriate spectroscopic databases and line profiles as well as multiple scattering effects between planetary surface and overlying gas layers are necessary to remove atmospheric influences on the measured spectrum.

The present approach is based on the following selection of VIRTIS-M data: orbits 146-151 (September 2006; case 1, nadir pointing, see Titov et al., 2006), latitude range 10˚S-80˚N, longitude range 333-341˚. This selection covers surface altitude variations of about 8 km. It contains the Ishtar Terra region at 75˚N. A comparison of data in different spectral regions measured over different geographical regions of Venus shows a clear dependence of leaked radiation on topographical features. Differences are observed not only in the surface windows (1.0-1.18 μm), but also in the deep atmosphere windows (1.3, 1.74, 2.3 μm). The radiances and the brightness temperatures decrease with increasing altitude due to a reduced contribution of hot layers. At 1.05 μm, an altitude change of 8 km results in a temperature change of 50 K. Moreover, strong 4.3 μm spectral structure variations are observed that correspond to early Venera-15 mid IR measurements over different latitudes (e.g. hot dipole, cold collar).

A proper analysis of altitude-dependent radiance features in different spectral bands

offers a great chance to distinguish between atmospheric and surface contribution and to extract surface properties like temperature and mineralogical composition.