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Comparative temperature retrievals based on VIRTIS/VEX and PMV/VENERA-15 radiation measurements over the northern hemisphere of Venus

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Latitude-dependent temperature profiles were determined from nadir-looking nightside radiation measurements over the northern hemisphere of Venus. Prominent and well-known temperature structures like 'cold collar' and 'hot dipole' have been re-examined.

This work focuses on a comparative temperature retrieval using both recently collected data from VIRTIS on Venus Express and older data from the Russian PMV on VENERA-15 experiments performed in the 1980s. 1370 VIRTIS and 1150 PMV spectra for different latitudes between 0° and 85 °N were investigated. VIRTIS-M-IR data cover the spectral region 1-5 μm, while PMV data involve the 6-36 μm region. The strong CO2 absorption bands located at 4.3 μm (VIRTIS) and 15 μm (PMV) are used to retrieve the thermal structure of the middle atmosphere at altitudes between 50 and 100 km. A similar spectral resolution of both measurement sets in these bands in the order of 10 cm-1 enables direct comparisons of retrieval results. Additional information on Venus lower atmosphere could be extracted from the 2.3 and 1.7 μm emission windows.

The observed high variability of nightside absorption and emission window radiances is due to the combined influence of temperature and cloud opacity changes with latitude and time. When temperature profiles in the middle atmosphere are retrieved from both VIRTIS and PMV measurements, which were performed at a similar geographic location, time-averaged results should be approximately the same. On the one hand, deviations may indicate that the cloud composition and altitude distribution models, which are used in the simulations, are not optimal. On the other hand, retrieval result differences may also point to problems in the data calibration at certain spectral regions. Microphysical parameters of H2SO4 aerosols strongly differ at 4.3 versus 15 μm, and a different chemical aerosol composition would result in different spectral features of microphysical parameters. Changes in these profiles eventually lead to different temperature profiles. The discussion of possible improvements of the cloud model is an important aspect of the present investigation, therefore.