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Titov, D.V.

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Venus atmospheric dynamics: digging into the Venus Express observations

Dmitrij Titov[1]

[1]**Leiden Observatory**

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Dynamics of the Venus atmosphere is still one of unsolved fundamental problems in the planetary physics. ESA's Venus Express collected the longest imaging time series of the planet in several wavelengths from UV to near-IR. It was later amended by JAXA's Akatsiki observations thus providing the longest (~24 Venus years) almost uninterrupted monitoring. The imaging allowed wind tracking at different levels within the cloud deck thus enabling significant progress in characterization of the mean atmospheric circulation. The analysis revealed variabilities including changes with altitude, latitude, local solar time as well as influence of the surface topography and long term 12.5 years periodicity.

The images also provided morphological evidences of dynamical processes at the cloud level. UV dark low latitudes are dominated by convective mixing that brings UV absorbers up from depth, while bright uniform clouds at middle-to-high latitudes are typical for the regions with suppresses vertical mixing. This feature correlates with the drastic increase of the total cloud opacity poleward from ~60° latitude that likely indicates presence of a dynamical mixing barrier here. Similarity of the global UV cloud morphology at the cloud top (~70 km) and that in the deep cloud (50-55 km) observed in the near-IR on the night side suggests similar morphology shaping processes throughout the cloud deck. Venus Express observed gravity waves poleward of 65°N concentrated at the edges of Ishtar Terra likely indicating generation by interaction with the surface.

Venus Express performed about 800 radio occultations providing precise measurements of the atmospheric temperature structure and static stability parameter in the altitude range 40-90 km. The Richardson number latitude-altitude field derived from the wind and temperature measurements suggests convection in the cloud and stable mesosphere above it with the convective layer extending to greater depth at high latitudes. The talk will provide a summary of the Venus Express observations related to the atmospheric dynamics and give an outlook for further analysis of these data.