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Geographic distribution of zonal wind and UV albedo at cloud top level from VMC camera on Venus Express: Influence of Venus topography through stationary gravity waves vertical propagation.

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UV images (at 365 nm) of Venus cloud top collected with VMC camera on board Venus Express allowed to derive a large number of wind measurements at altitude 67±2 km from tracking of cloud features in the period 2006-2012. Both manual (45,600) and digital (391,600) individual wind measurements over 127 orbits were analyzed showing various patterns with latitude and local time. A new longitude-latitude geographic map of the zonal wind shows a conspicuous region of strongly decreased zonal wind, a remarkable feature that was unknown up to now. While the average zonal wind near equator (from 5°S to 15°s) is -100.9 m/s in the longitude range 200-330°, it reaches -83.4 m/s in the range 60-100°, a difference of 17.5 m/s.
When compared to the altimetry map of Venus, it is found that the zonal wind pattern is well correlated with the underlying relief in the region of Aphrodite Terra, with a downstream shift of about 30° (∼3,200 km). We interpret this pattern as the result of stationary gravity waves produced at ground level by the up lift of air when the horizontal wind encounters a mountain slope. These waves can propagate up to cloud top level, break there and transfer their momentum to the zonal flow. A similar phenomenon is known to operate on Earth with an influence on mesospheric winds. The LMD-GCM for Venus was run with or without topography, with and without a parameterization of gravity waves and does not display such an observed change of velocity near equator.
The cloud albedo map at 365 nm varies also in longitude and latitude. We speculate that it might be the result of increased vertical mixing associated to wave breaking, and decreased abundance of the UV absorber which makes the contrast in images. The impact of these new findings on current super rotation theories remains to be assessed.
This work was triggered by the presence of a conspicuous peak at 117 days in a time series of wind measurements. This is the length of the solar day as seen at the ground of Venus. Since VMC measurements are done preferably in a local time window centred on the sub-solar point, any parameter having a geographic longitude dependence will show a peak at 117 days.