Venus Express observations of longitude variations of zonal wind, UV albedo and H_2O at Venus cloud top level explained by stationary gravity waves.

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I will review some results obtained with Venus Express concerning the atmospheric dynamics at cloud top level and will try to put them in the context of Akatsuki new findings. It seems that underlying topography may play an important role in modulating the general super-rotation through the vertical propagation of stationary gravity waves generated near the surface.

Based on the analysis of UV images (at 365 nm) of Venus cloud top (altitude 67±2 km) collected with VMC (Venus Monitoring Camera) on Venus Express (VEX), it was found that the zonal wind speed south of the equator (from 5˚S to 15˚S) shows a conspicuous variation (from -101 to -83 m/s) with geographic longitude of Venus, correlated with the underlying relief of Aphrodite Terra. 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 the cloud top level, break there and transfer their momentum to the zonal flow.

In the equatorial regions, the UV albedo of clouds at 365 nm and the H_2O mixing ratio at cloud top varies also with longitude, with an anti-correlation: the more H_2O, the darker are the clouds. We argue that these variations may be simply explained by the divergence of the horizontal wind field. In the longitude region (from 60˚ to -10˚) where the horizontal wind speed is increasing in magnitude (stretch), it triggers air upwelling which brings both the UV absorber and H_2O at cloud top level and decreases the albedo, and vice-versa when the wind is decreasing in magnitude (compression). This picture is fully consistent with the classical view of Venus meridional circulation, with upwelling at equator revealed by horizontal air motions away from equator: the longitude effect is only an additional but important modulation of this effect. We argue that H_2O enhancement is the sign of upwelling because the H_2O mixing ratio decreases with altitude, comforting the view that the UV absorber is also brought to cloud top by upwelling.

The full-disk monitoring capabilities of Akatsuki have already revealed new features in the atmosphere of Venus which are certainly related to similar dynamical phenomena.

