

## Stationary waves and slow cloud features challenge Venus's night side superrotation

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The atmosphere of Venus rotates with velocities that at the cloud tops (65-70 km above surface) can be sixty times faster than the underlying surface, a phenomenon known as superrotation that continues to puzzle atmospheric scientists after decades of research. Whereas on Venus's dayside the cloud top motions are well determined, the night side circulation remains poorly studied except for the polar region. Here, we report first global measurements of the night side circulation of Venus at the upper cloud level from the tracking of individual features in thermal emission images at 3.8 and 5.0 microns during 2006-2008 (Venus Express/VIRTIS) and 2015 (IRTf/SpEx). Contrarily to the dayside motions dominated by mean super-rotating winds ranging -120 to -90 m/s at this altitude, night side motions are far more variable, revealing well-contrasted features moving at similar velocities than the day side features, stationary wave patterns with zonal speeds ranging from -10 to +10 m/s and a complex mixture of cloud-like features with apparent motions ranging from -80 to -40 m/s. These results defy the paradigm of an ubiquitous steady day and night stable superrotation at this altitude level and decades of numerical efforts to explain Venus's General Circulation.

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