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Investigation of winds in Venus mesosphere by digital method using UV images from VMC aboard Venus Express.

Marina Patsaeva (1,2), Igor Khatuntsev (1,2), Nikolai Ignatiev (1,2)

(1) Space Research Institute (IKI), Russian Academy of Sciences, Moscow, Russia, (2) Moscow Institute of Physics and Technology, Dolgoprudnyy, Russia

Investigation of winds at the top cloud layer is important for understanding the global circulation of the Venus atmosphere. The Venus Monitoring Camera (VMC) aboard Venus Express has acquired a huge number of UV (365 nm) images. UV images of top cloud layer are customary to obtain the wind velocity due to their high contrast. Visual estimation of wind velocities is a labor intensive procedure. Authors have developed a digital method to estimate velocities of shifts of cloud details.

The method is based on analysis of correlations between two UV images acquired at different moments. The method takes into account the change of a correlation function due to latitudinal peculiarities of cloud morphology and eliminates image regions which are far from the sub-spacecraft point. The digital method provides with good vector coverage of the Venus day side (9-16 local time) from the equator to high latitudes. The best agreement between the digital and visual methods is observed at low latitudes (below 35S). The discrepancy at higher latitudes is related to complicated cloud morphology, namely domination of streaks, which increases errors in the zonal wind speed. The method is productive for long-scale circulation at the top cloud layer. Sizes of regions for correlation were chosen empirically as a trade-off of sensitivity against noise immunity and varies from 10x7.5 º to 20x10 º depending on grid step.

580 orbits covering ten Venus years have been processed by using the digital method. The database of shift vectors counts about 400000 records. The mean wind speed at low latitudes is about 100 m/s. Wind vector fields were obtained for every orbit. The zonal wind speed in the equatorial region exhibits short-period (about 4.8 days) and long-period variations (long-term trend). Vector field averaged by all orbits show deviations of the main stream up to 5 degrees poleward in the early afternoon (12.5-14.5h) at 45-55S. The mean absolute value of the wind speed increases from 59.38 m/s at 10-12h to 76.46 m/s at 12.5-14.5h at the same latitude interval.