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2000 Earth days around Venus: imaging with Venus Monitoring Camera on Venus Express

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Abstract

By the time of this meeting the Venus Express spacecraft (VEX) should have completed more than 2000, 24 hour orbits around Venus. The Venus Monitoring Camera (VMC) on has been observing the upper cloud layer in four filters in visible spectral range. On average VMC takes nearly two hundred images per day. VEX has a highly elliptical orbit allowing for global as well as close up views with resolution down to 200 meter per pixel. We will review some of the highlights of the results obtained from this enormous data set.

1. Introduction

The VMC is a CCD camera with four channels in the UV, visible and near IR, with centre wavelengths at 365, 513, 965 and 1010 nanometers respectively. The VMC UV wavelength corresponds to the spectral feature of a, so far unidentified, absorber. In particular this subset of the VMC data shows great variety of morphologies. On global scales these include equatorial belts, bright polar bands and polar caps. The observed small scale features change their appearance from mottled clouds and convective cells at low latitudes to streaky patterns at middle and high latitudes. The large scale features are observed to evolve on time scales as short as hours to days.

2. Global Morphology

Figure 1 shows a relatively typical UV VMC image of the southern dayside hemisphere. Such images are taken nearly every day. The sub-solar equatorial region has a mottled appearance usually interpreted as convective region. In this particular orbit 458 this convective region extends to about 30º S. At higher latitudes flow becomes more laminar showing streaky clouds of the so called mid latitude bands. The general flow appears to be towards the pole (from right to left in the image) and resembles a vortex. The pole itself is clearly marked with a dark band.

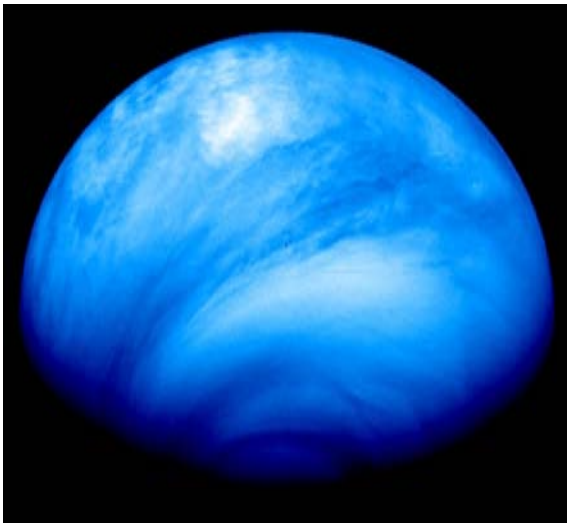

Figure 1: Global, false color, UV view of mostly southern hemisphere in orbit 458. Equator is near the top, Southern polar region at the bottom centre.

3. Wind speeds

Time sequences of global views such as shown in figure 1 have been used extensively to track clouds and hence to obtain wind speed vectors. Figure 2 shows results of such efforts. 90 orbits were processed resulting in 30000 wind speed vectors. The time span covered is 1346 earth days. It must be emphasized that figure 4 shows average values. The actual variation of zonal winds can be as much as ±50 m/s.

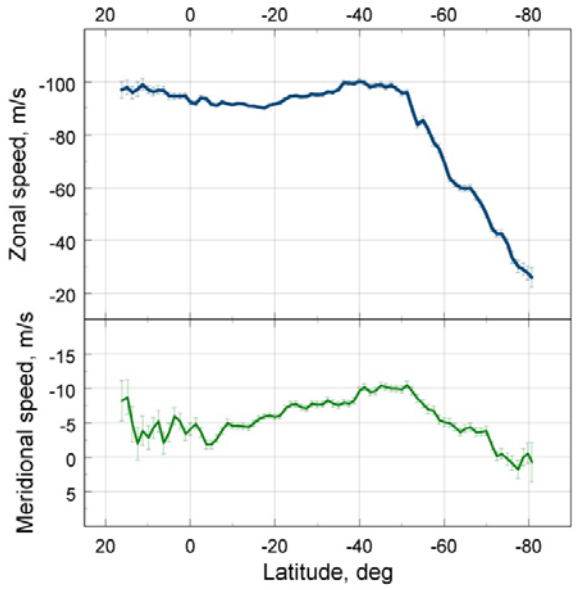

Figure 2: Average wind speeds obtained from tracking cloud features in VMC data.

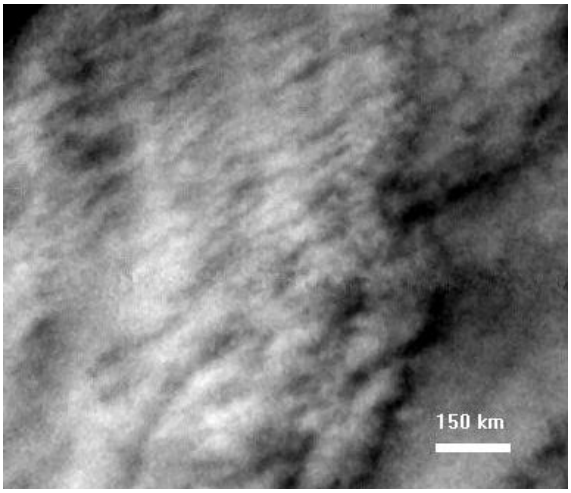

Figure 3: Convective region centered on equator.

5. Venus tropics and waves

As the VEX spacecraft comes closer to the planet we no longer monitor cloud motion and rather quickly fly over them. During this pericentre passage it is possible to make dayside mosaics of the clouds as well as night side mosaics of the surface.

The pericentre passage allows for the highest resolution images. Some of the most interesting ones are found in the equatorial convective region. An example is shown in figure 3. The scales of the convective cells go down to few tens of kilometers and are significantly smaller than observed previously. This may have implications for the thickness of the convective zone itself and hence provide clues for understanding the difficult problem of vertical transport of energy and momentum.

In near polar regions, usually above 50º latitude, we see many waves. Figure 4 shows one example in UV. These are most likely gravity waves and are visible in all four VMC channels. The large waves crossing the full field of view have an average wavelength of 15 km. They are always accompanied by small waves (seen in the upper part of figure 4) with an average wavelength of 3 km. Because of the VEX orbit we can only detect these waves in the northern hemisphere but there is no reason to preclude them in the south. It is also likely that they are global phenomena but only in higher latitude VMC resolution is high enough to detect them.

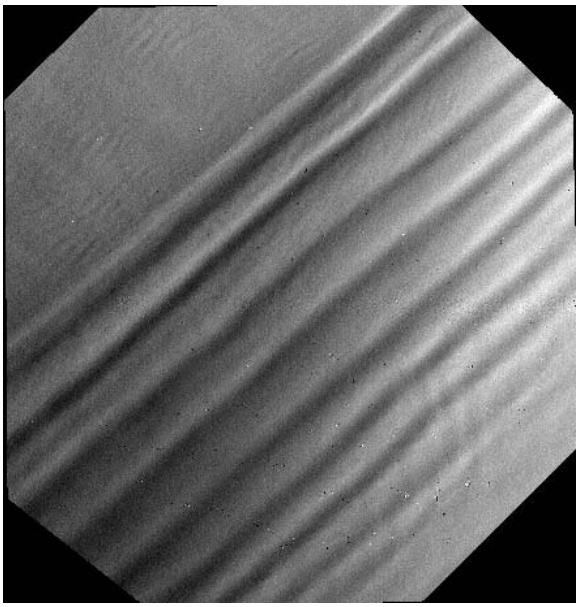

Figure 4: UV image of high latitude waves.