Geophysical Research Abstracts
Vol. 13, EGU2011-554, 2011
EGU General Assembly 2011

Synthetic images of Venus surface based on VMC images

Eugene Shalygin (1), Alexander Basilevsky (1,2), Dmirti Titov (1), and Wojciech J. Markiewicz (1)

(1) Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany, (2) Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow, Russia

The Venus Monitoring Camera (VMC) is a part of the Venus Express payload. It takes images in four channels, one of which centered at 1.01 micron registers the night side thermal emission from the planet surface. On the night side VMC maps thermal emission of the surface in the $1.01\mu m$ spectral transparency “window”. These measurements are at the limit of instrument capability. Faintness of the surface emission and low efficiency of the CCD detector at $1.01\mu m$ result in that even at maximum exposure of 30 s the measured signal does not exceed $\approx$ 200 digital units (DNs) which is 3% of the CCD full well. The second difficulty of the surface observations results from the solar stray light. In order to cope with this problem VMC observes the night side when the spacecraft is in eclipse. This limits the observations to low latitudes ($\pm\approx 40^{\circ}$). Formal spatial resolution of these images taken from the working distances (2000–8000 km) is 1 to 5 km, but because the surface radiation on its way to the camera passes through the dense scattering atmosphere and cloud layer, the actual spatial resolution is about 50 km.

Thermal emission of the surface is the only source of radiation on the Venus night side. The radiation intensity depends on the surface temperature thus giving a hope to register the ongoing volcanic eruptions. Also the radiation intensity depends on the emissivity of the surface material, which is a function of a number of parameters including surface texture in micron to millimeter scale and mineralogical composition.

To calculate synthetic VMC images we used the Magellan topography derived from Magellan Radar Altimeter, Monte-Carlo based simulations of light scattering to get blurring function and atmosphere reflectance/transmittance for two streams approximation and DISORT calculations for gaseous absorption. We used the vertical structure of clouds and their optical properties from VIRA. The topography data were converted into the maps of temperature assuming thermal equilibrium with the atmosphere. Comparison of model images with VMC once give us maps of relative emissivity.

We analyzed four couples of two base model parameters: temperature lapse rate: -8.1 (adiabatic) and -5.6 K/km (to compare with VIRTIS) and emissivity of basaltic plains (0.8 and 0.58). Obtained results for region that covers Chimana-mana tesserae, part of Hinemoa planitia and part of Beta regio show that emissivity of tesserae and emissivity of planitia are statistically unequal (emissivity of tesserae is 10% higher) in models with temperature lapse rate -8.1 K/km. Besides on correlation diagram between surface altitude and emissivity there are two clusters that correspond to tesserae and plain regions. Top of Tuulikki volcano also shows different emissivity comparing to surrounding plains in models with temperature lapse rate -8.1 K/km. If these differences caused by weathering, then they can be results of stronger winds at higher altitudes which removed smallest dust particles from surface. For models with temperature lapse rate -5.6K/km the tesserae’s emissivity appears to be a bit lower than emissivity of plains (same as in VIRTIS results), but difference is inside the range of statistical errors.