Venus surface from the VMC night side imaging

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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 μm 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 μm result in that even at maximum exposure of 30 s the measured signal does not exceed ~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 (+/- ~40 degrees). 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, constant lapse rate of -8.1 K/km. Comparison of model images with VMC once give us maps of relative emissivity. For calculations we assumed emissivity value 0.8 for basaltic planes.

Obtained results for region that covers Chimana-mana tessera, part of Hinemoa planitia and part of Beta regio show that emissivity of tesserae is 20% lower than emissivity of planitia. Besides on correlation diagram between surface altitude and emissivity there are two clusters that correspond to tesserae and plain regions.