Surface Temperature Variation from VIRTIS Imaging

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The 1.02 micron wavelength thermal emission of the night side of Venus is strongly anti-correlated to the elevation of the surface because surface temperature is strongly controlled with elevation. Due to the thick atmosphere the temporal and horizontal variation of temperature is small.

The VIRTIS instrument on Venus Express mapping the thermal emission therefore gives evidence to the orientation of Venus starting in 2006. The Magellan mission provided a global topography data set recorded between 1990 and 1992. Comparison of these two data sets reveals a consistent deviation in longitude indicating a rotation of the planet not fully described by the body fixed coordinate system. The deviation and time between the two missions fits to a period of rotation of Venus of 243.023±0.003 days. This value agrees well with pre-Magellan estimates but is significantly different from the value of 243.0185 days recommended by the International Astronomical Union and adopted for the coordinate referencing of the Venus Express mission.

A good alignment of altimetry and thermal emission imaging is required for retrieval of near infrared surface emissivity. The altimetry is used to calculate surface temperature which dominates the emerging thermal radiation. Reflections between surface and atmosphere furthermore reduce the influence of surface emissivity in the high emissivity range. Still it is possible to isolate the signal of emissivity given sufficiently accurate altimetry. There are indications that the Magellan altimetry is biased in some areas of strong tectonic deformation with lateral topography scales smaller than the altimetry posting. VIRTIS thermal emission imaging of these areas is roughly consistent with this supposed bias.

As exogenous surface temperature variations are small or well described by topography, the radiation from endogenous heat sources is detectable when above a treshold determined by instrumental noise and data processing uncertainty. So far no clear signal of an endogenous heat source was identified. Modelling of the magnitude and frequency distribution of active volcanism and its associated thermal radiation signatures is in progress. Once finished, a comparison with the distribution of the detection limit in space and time will allow us to determine an upper bound for the current rate of volcanism on Venus. The accuracy of this upper bound is increasing as Venus Express accumulates data.