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Spatial and temporal variations of particle sizes in the upper clouds of Venus from the VMC/VEx data

Oksana Shalygina (1), Elena Petrova (2), and Wojciech J. Markiewicz (1)

(1) Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany, (2) Space Research Institute, Russian Academy of Sciences, Moscow, Russia

From 2006 to 2014 the Venus Express spacecraft successfully operated in orbit around Venus. A large amount of wide-angle images of the planet was acquired with the Venus Monitoring Camera (VMC) in four narrow spectral bands centered at 0.365 (UV), 0.513 (VIS), 0.965 (NIR1), and 1.01 (NIR2) micron [1, 2]. With the VMC, full glory on the upper cloud deck of Venus was imaged for the first time [1]. In this work we analyze a whole set of the VMC data obtained in UV, VIS, and NIR1 channels and compare the phase profiles of brightness measured at phase angles less than 40° to the singe-scattering phase functions of particles of different sizes. From the angular position of the glory features, the dominant size of scattering particles and their refractive index have been retrieved, and their spatial (in latitude) and temporal (in local time, LST) variations have been analyzed. We presented the measured phase profiles in two ways: they were built for individual images and for individual small regions observed in series of successive images. The analysis of the data of both types has yielded the consistent results, and they are in general agreement with our estimates of the sizes and refractive index of cloud particles earlier obtained from the phase-function analysis of the VMC data [1–3]. The presently retrieved radii of cloud particles average approximately 1.0 – 1.2 μm (with peaks to 1.4 μm) and demonstrate a variable pattern versus latitude and LST. The decrease of particle sizes at high latitudes (down to 0.6 μm) earlier observed in the NIR1 and partly UV data has been definitely confirmed in the analysis of the data of all three channels considered. The obtained values of the refractive index are more or less uniformly distributed over the covered latitude and LST ranges, and most of them are higher than those of concentrated sulfuric acid solution expected. This confirms our previous result obtained only for the NIR1 spectral range, and now we may state that the cases of a relatively high real part of the refractive index are often observed for the 1-μm mode of cloud particles on Venus. Consequently, an additional component with a high value of the refractive index is required to be present in the cloud droplets. We suppose that this material can be ferric chloride or sulfur; both are also candidates for the so-called unknown UV absorber in the upper clouds of Venus.

References

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