EPSC Abstracts
Vol. 9, EPSC2014-278-1, 2014
European Planetary Science Congress 2014

Study of the nightside Venus upper haze from VIRTIS-M / Venus Express limb observations

D. Gorinov (1,2), N. Ignatiev (1,2), L. Zasova (1,2), G. Piccioni (3) and P. Drossart (4)
(1) Moscow Institute of Physics and Technology, Dolgoprudny, Russia, (2) Institute of Space Research, Moscow, Russia,
(3) Istituto di Astrofisica e Planetologia Spaziali, INAF, Rome, Italy, (4) LESIA, Observatoire de Paris, Paris, France.
(gorinov-dmitry@yandex.ru)

Abstract

This work studies the structure of the aerosol in the upper haze of Venus (75-95 km). According to several nightside limb observations made by VIRTIS (IR imaging spectrometer on-board the Venus Express spacecraft) a haze of particles can sometimes be seen on the planet's limb. These observations are also confirmed by the similar results, gained by SPICAV/SOIR, another experiment on the same mission, operating however in a different geometry. By using the model ARS [2], which simulates the radiative transfer in the venusian atmosphere, we were able to create the intensity profiles and to try to fit them (forward modeling) into the experimental data. As a result of these calculations, a lot of particle parameters were found out, including their size distribution, altitude distribution and number density.

1. Introduction

Nightside limb observations of Venus made by VIRTIS mapping spectrometer onboard Venus Express revealed a thermal emission scattered at the right angle by the upper haze above the cloud tops. This emission comes from the cloud tops in the spectral range of 4-5 microns and from the hot deep subcloud atmosphere and the surface in several spectral transparency windows between 1 and 2.5 microns. De Kok et al. [1] first demonstrated that the spectra of this emission can be used to retrieve the density of the upper haze and estimate its particle size. In particular they obtained vertical profiles of the haze density from the spectra of the thermal emission from the cloud in the interval of 4-5 microns for 4 orbits and two narrow latitudinal bands of 20-30N and 47-50N.

2. Study of the haze

We extend this study to other spectral windows and analyze a wide set of measurements obtained in 2006-2009. We analyzed the vertical profiles of the scattered emission at 1.18, 1.7 and 2.3 μm to retrieve the upper haze density between 75 and 90 km with the vertical resolution of 3 km. A total of 48 orbits and 376 vertical profiles were processed in this work, binned into 5° latitude intervals. In the lower latitudes the retrieved extinction at 85 km is equal to 0.001-0.003 km^{-1} at wavelength of 1.75 μm and the equivalent mode 2 density equals 0.1-0.3 cm^{-3}, which is in agreement with the results by deKok et al. [1] and Wilquet et al. [3] obtained for similar conditions. The upper haze is subjected to a considerable temporal variability, which is difficult to systematize due to very non-uniform limb observation sequence. The variability can be illustrated by the altitude of the apparent limb boundary in the IR limb images: in most cases it is located at altitudes of 79-83 km, being systematically lower at higher latitudes, but sometimes extends up to 89 km. Detached layers are sometimes observed at 75-85 km, hovewer their origin in not yet clear.
These experimental profiles were successfully fitted by the model profiles, using the forward modeling with ARS [2], also including the orbits containing detached layers. However, this was possible only in 1.75 and 2.35 μm spectral windows. When applied to a 1.18 window with the same initial haze parameters, the result would differ, and the model extinction would not coincide with the retrieved experimental one. Such difference between 1.18 μm window and 1.75/2.35 μm windows is the main current problem yet to tackle and is a subject of a further research.

3. Summary and Conclusions

We succeeded in fitting several observed profiles using a model in 1.74 and 2.3 μm windows. The particles' parameters that were used in the corresponding model runs more or less coincide with the SPICAV results. However, in 1.18 μm window the fitting was not possible due to a very low contrast of the observed profiles. This contrast diversity problem can be partially solved by increasing particle radius or number density, but it is not yet clear what can be the mechanism that causes such discrepancy.

Acknowledgements

We would like to thank Moscow Institute of Physics and Technology for supporting this work financially (grant № 11.G34.31.0074). We acknowledge the Program 22 of Presidium RAS and Russian Foundation of Fundamental Research, grant 12-02-01280 for financial support of this work.

References

[1] de Kok R., Irwin P.G.J., Tsang C.C.C., Piccioni G., and Drossart P.: Scattering particles in nightside limb observations of Venus' upper atmosphere by Venus Express VIRTIS, Icarus 211, 51, 2011.

[2] Ignatiev, N. I.; Titov, D. V.; Piccioni, G.; Drossart, P.; Markiewicz, W. J.; Cottini, V.; Roatsch, Th.; Almeida, M.; Manoel, N.: Altimetry of the Venus cloud tops from the Venus Express observations, Journal Geophys. Res., 114, E00B43, 2009

[3] Wilquet V., Fedorova A., Montmessin F., Drummond R., Mahieux A., Vandaele A.C., Villard E., Korablev O., and Bertaux J.-L.: Preliminary characterization of the upper haze by SPICAV/SOIR solar occultation in UV to mid-IR onboard Venus Express, Journal Geophys. Res. 114, E00B42, 2009