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Oxygen nightglow vertical profiles and horizontal distribution in the Venus upper atmosphere from the VIRTIS-M data

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Abstract

Oxygen ($a^1\Delta_g$) nightglow emission study is the key to understanding of the Venus upper atmosphere chemistry and dynamics. Atomic oxygen produced on the Venus day side as the result of the CO_2 photolysis is transported to the night side via circulation in the lower thermosphere and recombines with production of molecular oxygen in $a^1\Delta_g$ excited state (0.65 – 0.75 % of the O_2 molecules total number [1]). The 1.27 μm airglow emission is produced when O_2 molecules in the excited ($a^1\Delta_g$) state emits a photon and relaxes to its ground ($X^3\Sigma_g$) state.

Using VIRTIS-M limb data cubes the large number of the vertical emission profiles for night side of the northern hemisphere was retrieved. Major characteristics, as altitude of the emission maximum (97.4 ± 2.5 km), a half width of the oxygen layer (7.6 ± 2.2 km) and vertical emission rate (0.52 ± 0.4 MR) was estimated [2]. Analysis of the statistical dependences shows increasing of the profile half width and emission rate with decreasing of the latitude. Increase of the emission rate with increase of the peak altitude is also observed.

Nadir data of VIRTIS-M provide a possibility to make an average horizontal distribution map of the emission rate over a two years period. Viewing angle dependence, reflection from the clouds tops and thermal emission of the lower atmosphere was taken into account. The O_2 emission is strongly variable, an average emission rate for the night side of the southern hemisphere is 1 ± 0.4 MR, however, the values exceeded 4 MR was some times observed. The horizontal distribution of the emission rate indicates more complicated character of circulation than SS-AS: one maximum of emission is observed at low latitudes near midnight (as in the case SS-AS) and the second one is found at around 22^h in the latitude range 20-60 ° S.

References

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