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The 1.27 µm oxygen nightglow in the Venus atmosphere from the VIRTIS-M data

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Abstract

Oxygen $O_2(a^1\Delta_g)$ nightglow emission study is a key for understanding the Venus upper atmosphere chemistry and dynamics. Atomic oxygen is produced on the Venus day side as a result of the CO_2 photolysis by solar EUV. It is carried from the day to the night side by the subsolar to antisolar (SS-AS) circulation where the oxygen atoms recombine, producing the molecular oxygen in the $a^1\Delta_g$ excited state. The 1.27 µm airglow is produced due to emission of the exited O_2 molecules which relax to the ground ($X^3\Sigma_g$) level.

1. Nadir data analysis

To obtain the O_2 emission rate from the nadir VIRTIS-M data, the thermal emission of the lower atmosphere, reflection from the clouds tops and viewing angle dependence were taken into account. The average emission rate for the night side of the southern hemisphere was found to be 0.35 MR, however the airglow emission rates larger than 6 MR were observed in some areas. The O_2 emission rate map, averaged over two years of observations in the coordinates "local time – latitude" showed that at latitudes < 20°S, the circulation has the SS-AS character, which is typical for the thermosphere. At higher latitudes the maximum emission is observed before midnight and deep minimum – after midnight. The influence of the retrograde zonal superrotation was not identified in the southern hemisphere. A comparison with the map of the horizontal wind, obtained from the observed motion of the O_2 emission features shows that maximum emission correlates with the minimum of horizontal wind speed where also the direction of wind changes, which indicates the descending of atmospheric flux in these areas. Minimum emission after midnight correlates with high horizontal wind speed.

2. Limb data analysis

Using VIRTIS-M limb data cubes the large number of the vertical emission profiles for the night side of the northern hemisphere was retrieved. The obtained data were used to get the main characteristics of emission, such as the altitude of maximum (97 ± 3 km), half width of the emitting layer (8 ± 3 km) and emission rate (0.45 ± 0.36 MR). Analysis of the statistical dependences reveals the increasing of the profile half width and the emission rate with the decreasing of latitude. It indicates the importance of SS-AS circulation at low latitudes. At latitudes < 50N the maximum emission is shifted to 1h of local time, which may indicate the existence of zonal superrotation at low latitudes in the Northern hemisphere. Limb profiles with the double emission maxima are observed, similar to those found in the Earth atmosphere on the night side although the O_2 airglow is 10 km lower there.

3. Figures

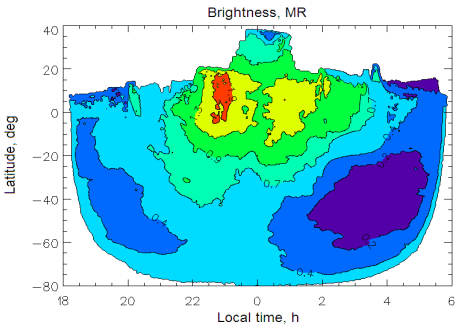

Figure 1: Oxygen (1.27 µm) airglow brightness distribution on the Venus night side.