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Nightglows in the upper atmosphere of Venus as observed by VIRTIS on Venus Express

G. Piccioni (1), P. Drossart (2), A. Migliorini (1), and the VIRTIS-Venus Express team

(1) IASF-INAF, via del Fosso del Cavaliere, 100, 00133 Rome, Italy, (2) Obs de Paris-Meudon, 5, Place J. Janssen, 92195, Meudon, France. (giuseppe.piccioni@iasf-roma.inaf.it, +39 06 4993 4445)

Abstract

After more than 3 years from the Venus orbit insertion, the Visible and InfraRed Thermal Imaging Spectrometer (VIRTIS) [1,2] on board the ESA Venus Express mission provided, and is currently providing, an extended data set very valuable to study Venus from the surface up to the thermosphere in long term. The VIRTIS instrument consists of two channels: VIRTIS-M, an imaging spectrometer with moderate spectral resolution in the range from 0.25 to 5 µm and VIRTIS-H, a high spectral resolution spectrometer in the range from 2 to 5 µm co-aligned with the field of view of –M. The spectral sampling of VIRTIS-M is 2 nm from 0.25 to 1 µm and 10 nm from 1 to 5 µm while for VIRTIS-H it is about 2 nm.

The oxygen nightglow is a very important mean to study the dynamics and chemistry of the upper atmosphere. The most intense nightglow emission is observed at 1.27 um and it is due to the (0-0) transition [3,4], figure 1. By using both limb and nadir views, we can get the 3-dimensional structure of the emission.

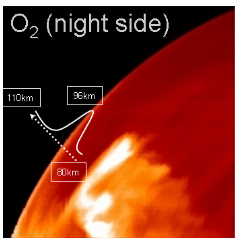

Figure 1: Oxygen nightglow at 1.27 µm.

The peak altitude of the limb profile is typically found at 96-97 km, with a maximum emission at low latitudes and near the antisolar point. The nadir measurements confirm the same behaviour and the global mean map of the oxygen nightglow shows an almost perfect symmetry of the SS to AS circulation, with a maximum of the emission rate in the antisolar region of about 1.2 MR. The apparent motion of the tracked emission features show very complex but with a sign of a mean zonal speed of about + 50 m/s, and thus opposite to the atmospheric super-rotation [5].

The hydroxyl nightglow has been recently discovered on Venus at 2.8 (1-0 transition) and 1.46 (2-0 transition) µm [6], figure 2. It peaks a couple of km lower than the oxygen. The most probable mechanism is the Bates-Nicolet from the combination of H and O_3 as from the extension of the terrestrial case, so that OH nightglow could be an important tracer for these two chemical species.

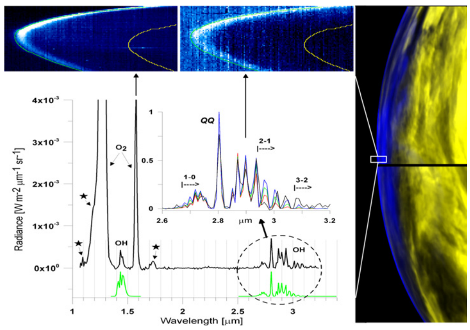

Figure 2: Hydroxyl nightglow at 1.46 and 2.8 µm.

More recently, the NO infrared nightglow emission at 1.224 µm has also been observed for the first time in the VIRTIS spectra [7].

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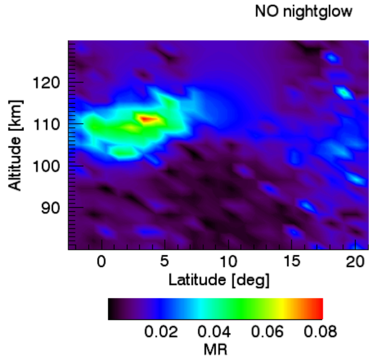

Figure 3: Nitric oxide nightglow at 1.224 μm.

The NO nightglow typically peaks at about 110 km altitude, figure 3, and thus the relative difference in altitude with the oxygen and hydroxyl nightglows provides important information about the dynamics at different levels in the Venus upper atmosphere.

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Additional Information

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