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VIRTIS/VEX O_2(a1Δg) nightglow profiles affected by gravity waves action: modeling and results

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Gravity waves (GWs) are mesoscale atmospheric oscillations related to the buoyancy restoring force, which play a key role in the circulation of planetary atmospheres. Their propagation, inducing fluctuation in both temperature and density fields, can also affect the intensity of the airglow emissions. In this work we report on the modelling of O_2(a1Δg) nightglow limb profiles perturbed by the GWs propagation in the Venus atmosphere. O_2(a1Δg) excited molecules arise by the three-body reaction between two atoms of oxygen and carbon dioxide, then they decay at the fundamental state by emitting most of the photons at 1.27 μm or through collisions with CO_2 molecules (quenching). The 1.27 μm emission behavior is analyzed through the data acquired by the VIRTIS (Visible and InfraRed Thermal Imaging Spectrometer) instrument on boards the ESA mission Venus Express (VEX). The high variability observed in the shape of the O_2(a1Δg) nightglow limb profiles between 80 and 120 km, often characterized by the presence of a double peak, implies GWs occurrence at the considered altitudes. In order to model and derive the GWs properties, we apply to Venus a well-known theory used to study terrestrial airglow fluctuations induced by the GWs propagation. The initial O_2(a1Δg) molecules density profile have been assumed to be Gaussian shaped. Unperturbed temperatures and density profiles have been taken from SPICAV data, while the initial atomic oxygen density profile has been derived with the same approach of Gerard et al. [2009]. This study confirms the high variability induced by the waves propagation in the O_2 profiles, as observed in the VIRTIS data.