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Multispectral analysis of the Martian dayglow from UVIS-NOMAD on board TGO

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The NOMAD instrument currently in orbit around Mars on board ESA's ExoMars Trace Gas Orbiter (TGO) includes UVIS, a UV-visible spectrograph covering the spectral range 200-700 nm. This instrument has two channels, one for solar occultation and a nadir channel essentially designed to analyse solar backscattered radiation. Since April 2019, the TGO spacecraft is occasionally tilted so that the nadir channel is pointed toward the Martian limb to observe the planetary airglow. A first success was the discovery of the forbidden oxygen green line at 557.7 nm that is ubiquitous in all UVIS limb dayside observations. This emission gives its characteristic colour to the terrestrial polar aurora but had never been observed before in the airglow of other planetary atmospheres. This emission is excited by the interaction between solar radiation and CO₂ and shows a mean intensity peak near 80 km. More recently, the much weaker OI 630-nm emission has been detected following co-addition of several hundreds of UVIS spectra. It is much weaker than the green line, as a consequence of collisional deactivation of the long-lived O(¹D) excited state. Both oxygen dayglow emissions have been successfully modelled. Molecular transitions are also identified in the UVIS ultraviolet spectrum, including the CO Cameron bands, the CO₂⁺ ultraviolet doublet at 298-299 nm and the Fox-Duffendack-Baker (FDB) bands. They originate from the lower thermosphere near 120 km.

The seasonal-latitudinal evolution of the 557.7-nm emission will be described and compared with model simulations for the conditions of the observations. Simultaneous observations of dayglow emissions originating from different altitude will be available over a full Martian year. Coupled with model simulations, they provide constraints on the changing structure and composition of the Martian lower thermosphere, a region difficult to probe otherwise.

