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Martian water vapor vertical profiles from solar occultation measurements by NOMAD onboard TGO/ExoMars: H_2O-Temperature retrievals with the IAA-KOPRA forward model

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NOMAD [1] (*Nadir and Occultation for MArs Discovery*) is a multi-channel spectrometer onboard the ExoMars 2016 Trace Gas Orbiter (TGO), which began its observations in April 2018. The Solar Occultation (SO) channel has a spectral range coverage from 2.3 to 4.3 μm (2320 to 4350 cm^{-1}). An Acousto-Optical Tunable Filter (AOTF) is used to select different spectral windows (with a width that varies from 20 to 35 cm^{-1}) corresponding to the desired diffraction orders to be used during the atmospheric scan. The SO channel has a sample rate of ☐1 s, that allows a vertical sampling of ☐1 km. In order to obtain as much information as possible from the Martian atmosphere, for this study we have analyzed data from diffraction orders 134 (3011-3035 cm^{-1}) and 168 (3775-3805 cm^{-1}), taken simultaneously during different solar occultation scans within the first year of measurements. This combination of diffraction orders allowed us to explore the distribution of the water vapor at atmospheric tangent altitudes from ☐10 km up to about ☐100 km and in different atmospheric conditions, but also to study its spatial and seasonal variability.

Here we present the water vapor vertical profiles of a subset of the solar occultations observed during the first year of TGO/ExoMars, including data taken during the 2018 Global Dust Storm (GDS) and during the 2019 local dust storm. Similar studies have been done by [2] and [3], showing that dust storms allow water vapor to reach higher altitudes in the atmosphere. Also, thanks to this phenomenon, escape of atomic hydrogen has a relevant role in the planetary evolution, as [4] shows. The data presented here have been analyzed with pre-processing and cleaning tools developed entirely at the IAA, and then, have been inverted using a state-of-the-art retrieval scheme [5]. Our method allows us to use consistent temperature profiles during the inversion i.e., obtained from inversion of other diffraction orders' measurements of the same scan (see companion contributions to this conference [6], [7], [8]). This impose the limitation to use a dataset where CO_2 orders and H_2O orders have been observed simultaneously. Also, synthetic spectra have been generated mimicking the NOMAD SO behavior as a first step of a comprehensive error analysis. Preliminary results will also be presented, showing water vapor vertical profiles and estimations of hydrogen escape. Comparisons with results of other groups in the NOMAD team will be shown [9], [10].

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