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Evaluation of the capability of ExoMars-TGO NOMAD infrared nadir channel for water ice clouds detection on Mars

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The Nadir and Occultation for Mars Discovery (NOMAD) is one of the four instruments on board the 2016 ExoMars Trace Gas Orbiter. The instrument is a suite of three spectrometers, mainly designed to study minor atmospheric species at high spectral resolution (A.C. Vandaele et al., 2015; E. Neefs et al., 2015). Nevertheless, Oliva et al. (2022) demonstrated the capability of NOMAD infrared nadir channel to investigate surface ice composition in the 2.3 – 2.6 μm wavelength range. Ice signatures have been also observed at mid/equatorial latitudes suggesting, after analysis, the first detection of CO_2 ice clouds through the study of the narrow 2.35 μm absorption band.

In this work, we also use observations of the NOMAD infrared LNO channel in order to evaluate its capability to detect H_2O ice clouds. We present a technique taking advantage of the 2.7 μm strong ice absorption band. For this study, we select LNO spectral orders 167, 168, 169 and combine them to derive a spectral index for H_2O ice detection, namely the Frost and Clouds Index (FCI). The acquisition of data during Mars Year 34 and 35 (March 2018 to February 2021) allows us to construct seasonal maps for H_2O ice clouds. The results appear in agreement with previous studies focused on Mars Express SPICAM/UV and OMEGA data analysis (Willame et al., 2017; Olsen et al., 2021). FCI is sensitive to the Polar Hood clouds, although the full structure is not detected. Moreover, detections in the Aphelion Cloud Belt (ACB) are limited. This is consistent with previous OMEGA spectrometer observations (Olsen et al, 2021) showing different physical properties between the two main Martian atmospheric structures and making the ACB less detectable in the infrared. We hence derive the LNO channel sensitivity limit for these clouds detection.

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