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Carbon Dioxide and Temperature Profile Retrievals from NOMAD SO Channel on board ExoMars TGO

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Introduction

NOMAD (Nadir and Occultation for MArs Discovery) [1, 2] is one of the four instruments on-board the ExoMars Trace Gas Orbiter (TGO). It consists of three spectrometers, SO (Solar Occultation), LNO (Limb, Nadir and Occultation) and UVIS. The SO channel started to make solar occultation measurements on April 21, 2018. It has regularly performed solar occultation measurements of the atmosphere of Mars.

The NOMAD SO Channel

The SO channel is dedicated to solar occultation measurements: SO sounds both night side and day side of the terminator of Mars. SO is a copy of the SOIR instrument [3] that operated successfully during the entire Venus Express mission. It is an infrared spectrometer working in the 2.2 to 4.3 µm spectral range (2325-4545 cm^{-1}) with a spectral resolution around 0.15 cm^{-1}. The instrument is composed of an echelle grating in a near Littrow configuration, and an Acousto-Optical Tunable Filter (AOTF) for the diffraction order selection [4]. TGO is on a quasi-circular orbit at around 400 km of altitude. During a solar occultation, SO scans six diffraction orders each second. Most of these diffraction orders span a spectral range containing carbon dioxide lines. The tangent altitudes where carbon dioxide profiles are retrieved depend on the lines intensity and aerosols presence. The highest altitude bounds are limited by overly weak lines with respect to the signal to noise ratio. The lowest altitudes are limited by either line saturation or dust presence. The later varies mainly with respect to the season and latitude. The different intensities of carbon dioxide lines amongst the diffraction orders allows a coverage of all altitudes below 200 km.

Profile Retrievals

ASIMUT-ALVL [5], the radiative transfer program developed at BIRA-IASB, is the program used to retrieve profiles of species from NOMAD spectra. ASIMUT-ALVL is based on the Optimal Estimation Method [6] and includes the analytical calculation of the Jacobians [6]. From carbon dioxide vertical profiles, temperature profiles are derived using the hydrostatic equation and the ideal gas law, similar to the work that was accomplished for the SOIR instrument spectra [7].

The preliminary results of retrieved carbon dioxide and temperature vertical profiles from the SO channel will be presented, discussed, and compared to the results obtained by other instruments as well as models.

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