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One of the goals of the ESA and Roscosmos Exomars Trace Gas Orbiter (TGO) is the exploitation of the two solar occultation instruments NOMAD [1] and ACS [2] to characterize the thermal structure of the Martian atmosphere with unprecendented vertical resolution, and from the ground up to the thermosphere. Specifically for the upper atmosphere this is a unique opportunity [3] and we present here an on-going effort to retrieve CO2 abundance and temperature profiles simultaneously from each of these instruments and to combine them for a mutual validation and for obtaining a most complete mapping from the TGO orbit.

We developed a retrieval suite common for both instruments, comprising: (a) a cleaning/pre-processing module to build vertical profiles of calibrated transmittances which computes and correct for residual calibration and instrumental effects like spectral shifts, bending of the continuum and variations in the instrument line shape; (b) a state-of-the-art retrieval scheme designed originally for Earth atmospheric remote sensing [4,5,6] and applied to Mars [7], in order to derive simultaneous density and temperature profiles allowing for hydrostatic adjustments during the internal iteration.

Recently the first application of this retrieval scheme focused on measurements by the NOMAD SO channel at altitudes below 100 km, and for the first year of TGO operations, from April 2018 to March 2019 (second half or “perihelion” season of MY34), and revealed very interesting results [8]. The thermal structure is strongly affected by the MY34 global dust storm at all altitudes, a cold mesosphere (in comparison to global climate models) was found during the post-GDS period, and wavy structures at mesospheric altitudes in the morning terminator seem to reveal very strong thermal tides at low-mid latitudes.

In this presentation we also focus on the Martian troposphere and mesosphere and build upon the above mentioned work during the 1st year of TGO by extending the study to a full Mars year and adding retrievals from ACS MIR channel. Both NOMAD/SO and ACS/MIR channels observe the strong CO2 ro-vibrational band at 2.7 micron in the same spectral region with some differences in spectral resolution and noise level, in addition to very differnet instrument characteristics, which are included in our retrieval approach. In obth cases we use calibrated atmospheric transmittances to tackle three targets, CO2 density, temperature, and dust loading, in a simultaneous global-fit inversion, including contaminant species like H2O. The contamination by aerosol can severely limit the ability to sound low tangent altitudes with both instruments, when the gas absorption lines become hidden within the aerosol continuum. But also these measurements permit a good characterization of aerosol properties [9]. Propagation of measurement noise, tunning of regularization, and computation of averaging kernels are performed with the same code and the comparison of the retrieval performance is a first step towards a common validation between these two instruments, considering that a complete correlation is not possible since the two instruments' individual solar occulation scans are non-coincident in time and space. Our results will be discussed and compared to paralell retrieval efforts by other teams within the NOMAD and ACS consortia using the same datasets [10, 11, 12]. We will also compare them with specific runs of the LMD-Mars GCM (see also a companion presentation in this conference on this specific topic [13]). One of the important applications of our inversion is to supply true-field and a.priori inputs for the inversion of trace species from collocated NOMAD spectra, as we are doing for water vapour [14] and carbon monoxide [15].

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