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Martian Atmosphere CO Vertical Profiles: Results from the First Year of TGO/NOMAD Science Operations

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Nadir and Occultation for Mars Discovery (NOMAD) onboard ExoMars Trace Gas Orbiter (TGO) started the science measurements on 21 April 2018. We present results on the retrievals vertical profiles for several species in the Martian atmosphere from the first year measurements of the TGO/NOMAD. In particular, we present our progress on retrieving CO vertical profiles.

NOMAD Instrument

NOMAD, the "Nadir and Occultation for Mars Discovery" spectrometer suite [1], is part of the payload of the ExoMars Trace Gas Orbiter mission 2016. The instrument will conduct a spectroscopic survey of Mars' atmosphere in the UV, visible and IR wavelengths covering the 0.2-0.65 and 2.3-4.3μm spectral ranges. NOMAD is composed of three channels: a solar occulation channel (SO) operating in the IR, a limb and nadir channel (LNO) also operating in the IR, and an ultraviolet/visible channel (UVIS) that can perform all observation modes. The spectral resolutions of SO and LNO is a significant improvement on previous infrared surveys of Mars (λ/dλ~15000). Both SO and LNO consist of an acousto-optic tunable filter (AOTF) in combination with an echelle grating. Several spectral ranges are measured simultaneously at a high spectral resolution, allowing for the study of different molecular species. The design of the three channels is fully described in [2] and [3].

Vertical Profile Retrievals

The vertical sampling rate of the SO channel is typically ~1km, which provided an unprecedented vertical resolution from the surface up to ~200km. ExoMars TGO has a ~2 hour orbital period, and the SO channel operates on ~50% of the potential occultations, which leads to great monitoring of the climatology. The calibration of SO is a collaborative exercise with retrievals, but inherits many of the techniques used for the SOIR/VEX instrument described in [4]. The retrievals are performed using the software ASIMUT developed at BIRA-IASB [5], which can use Optimal Estimation Method [6] among other algorithms to retrieved atmospheric profiles.

Discussion and Results

Carbon Monoxide is a non-condensable species playing a major role in the photochemical cycle of CO_2. Local and seasonal variations are expected and will give valuable constraints for the dynamical processes in the Martian atmosphere. The 2-0 band of CO centered at 2.4μm is positioned in the SO orders 186-192 (4200-4350cm^{-1}). It is easily measurable in transmittances up to ~110km. In the figure above, we show that we have good observational coverage. In this presentation, we will talk about how we retrieve abundances from spectral absorption features, and try to isolate climatological effects from observational geometry.

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