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Martian dust properties through NOMAD UVIS-LNO nadir datasets' investigation: analysis update

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Abstract

In this work we present an update on the analysis described in [15,21], focused on the characterization of Martian dust microphysical properties through the investigation of the TGO/NOMAD [1] UVIS and LNO channels' combined nadir data. These observations cover ultraviolet-visible and near-infrared wavelengths respectively, an extended range that allows constraining the dust densities and sizes. Spatially and temporally coincident data are analysed through the MITRA radiative transfer (RT) tool [2,3,4,16].

Being the spectral surface albedo a key element in the RT simulations, we define a method to derive it by exploiting MEx/OMEGA data. As a by-product of this analysis, we plan to obtain a global Mars surface albedo map covering visual (VIS) and near-infrared (NIR) wavelengths.

- Introduction

Airborne dust drives the Red Planet's thermal structure and climate [6,7,8,9,10], the distribution and circulation of atmospheric gases and has a role in triggering water ice clouds formation [5,17]. These mechanisms are affected by dust composition, abundance and microphysics. The investigation of NOMAD UVIS and LNO nadir data, can provide significant information on the properties of the integrated dust column down to the surface, hence contributing in our understanding of the evolution of Mars' atmosphere.

- Instrument and observations

Among NOMAD's three spectrometers [1], UVIS and LNO channels can observe in nadir geometry in the ultraviolet-visible (UV-VIS, 0.2 – 0.65 μm) and NIR (2.2 – 3.8 μm) ranges respectively. Therefore, if combined, they allow retrieving the dust microphysical properties in the whole

atmospheric integrated column. We consider observations encompassing from the second half of Martian Year (MY) 34 to the first half of MY37, an extended interval within which dust global and seasonal trends can be analyzed.

- Method

UVIS data are exploited down to 0.36 μm, matching the lower wavelength of the surface albedo spectra ingested in the RT model. These are obtained by processing MEx/OMEGA data with a modified version of the SAS technique [14], nominally correcting the spectral shape from the gases and aerosols contribution. We modify the method in order to determine if the observations can be considered as aerosols-free, hence avoiding biases deriving from the assumed aerosols properties in the original correction. As far as LNO is concerned, only spectral orders from 168 to 202 are adopted [15,21], since they cover a wavelength range (2.20 - 2.55 μm) that is approximately devoid of strong absorption lines, hence allowing a reliable estimation of the spectral continuum. This way, no gases correction is required in our modified SAS.

The retrievals are performed through MITRA tool, deriving the temperature-pressures profiles from [11] and considering dust optical constants from [12,13]. A benchmarking with the ones recently published in [19] is also foreseen.

Summary

This study presents an update of the method described in [15,21], focused on retrieving Martian dust microphysical properties from NOMAD UVIS and LNO nadir observations. We updated the method for deriving the spectral surface albedo in order to reduce eventual biases introduced in the original correction.

We plan to analyze all spatially and temporally coincident UVIS and LNO observations, in order to track the evolution of dust properties in different MYs and verify how they compare to those retrieved at high altitude with NOMAD SO channel's data [20].

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