RETRIEVALS OF OZONE AT THE TERMINATOR OF MARS FROM SPICAM/MEX SOLAR OCCULTATIONS

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Introduction: The martian atmosphere at the day-night terminator is a region of great interest characterized by gradients of density and temperature, driven by differences in the solar illumination, and by sharp transitions in the chemical regime. Ozone, in particular, displays rapid changes due to photolysis across the terminator [1]. Nowadays, most of the retrieval algorithms for solar and stellar occultations rely on the assumption of a spherically symmetrical atmosphere. In order to handle concentration gradients along the line of sight it is necessary to improve the retrieval scheme used to analyse occultation observations.

Observations: SPICAM (SPectroscopie pour l'Investigation des Caractéristiques Atmosphériques de Mars), on board the ESA's spacecraft Mars Express, is a remote sensing spectrometer observing in the ultraviolet (118–320 nm) and in the near infrared (1–17 μm) [2]. In the solar occultation mode, the UV sensor is particularly well suited to measure the vertical profiles of O_3 and aerosols of the martian atmosphere [3]. Figure 1 displays transmission spectra obtained at different altitudes for the observation 00633A02.

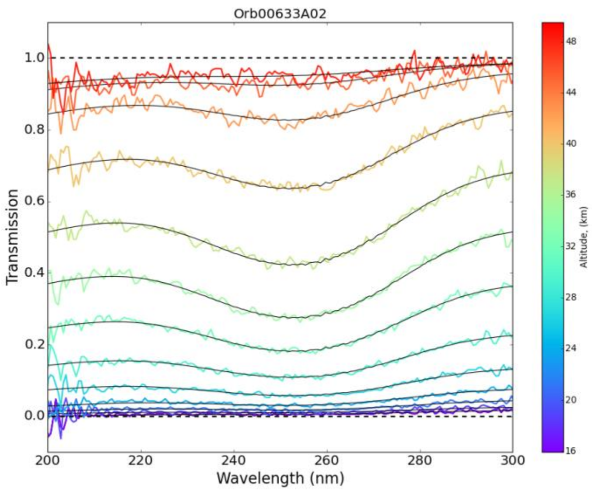

Figure 1: Example of SPICAM transmission spectra at different altitudes: (blue) low altitudes; (red) high altitudes.

The signal below 200 nm has a poor S/N ratio due to the low emission of the Sun at those wavelengths. The ozone absorption band (Hartley band) is clearly visible around 250 nm

Retrieval technique: SPICAM-UV spectra are simulated using the line-by-line radiative transfer code ASIMUT-ALVL developed at IASB-BIRA [4]. ASIMUT has been modified in order to take into account the atmospheric composition and structure at the day-night terminator. Three different gradients along the line of sight (LOS) can be considered: temperature, total density gradients and the variations of the concentration of specific species. As input for ASIMUT, we used gradients predicted by a 1D model with high temporal resolution [5] driven by the 3D GEM-Mars v4 Global Circulation Model (GCM) [6,7]. Figures 2 show examples of ozone density profiles obtained around the terminator by the GEM-Mars.

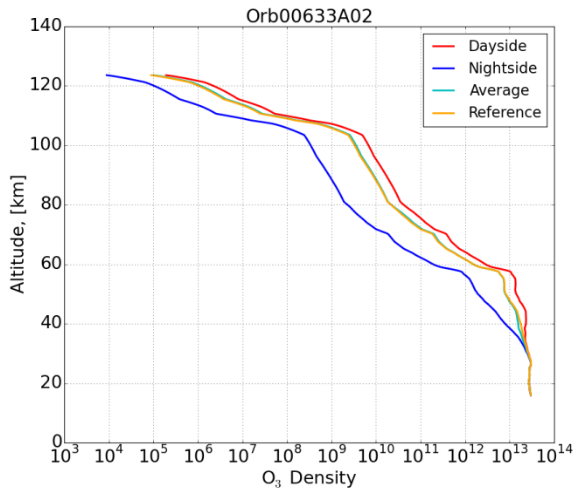

Figure 2: Ozone density profiles obtained by GEM-Mars around the terminator.

Preliminary results: As preliminary test, we applied the ASIMUT improved retrieval scheme to five SPICAM-UV solar occultations, focusing on ozone (O_3). As first step, we retrieved O_3 profiles without taking in account gradients and we obtained results in agreement with previous studies. Then, we tested the effects of temperature and ozone density gradients on the retrieval of ozone. Temperature gradients did not show any impact on the ozone retrieval. On the contrary, when ozone gradients were taken into account, the retrieved ozone profiles were lower compared to retrievals without gradients, even if differences were within the error bars. This effect will be analysed more in detail.

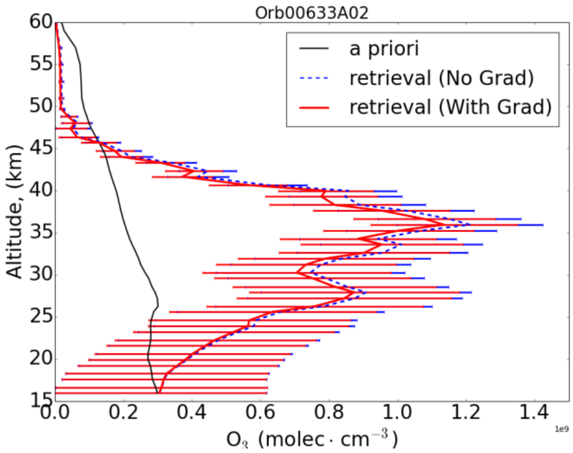

Figure 3: Retrieved ozone profiles. (Blue) retrieval obtained assuming no gradients at the terminator; (Red) retrieval obtained assuming a ozone gradient; (Black) a priori profile.

Summary and conclusions: We will extend our analysis to the first martian year (MY27) of SPICAM-UV solar occultation data. The main objective is to investigate fully the impact of these gradients on ozone retrievals. We will compare our retrievals with those from a similar study carried out at LATMOS within the UPWARDS project (see abstract Määttänen et al., this conference). Results of this study will then be used for the analysis of the data expected from the NOMAD instrument on the ExoMars 2016 Trace Gas Orbiter.

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