ATMOSPHERIC ABUNDANCES RETRIEVED FROM IUVS/MAVEN STELLAR OCCULTATIONS.

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Introduction

We present CO_2, O_2, and O_3 profiles observed with the Imaging Ultraviolet Spectrograph (IUVS) on the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission. The density profiles are derived from stellar occultations in the FUV and the MUV wavelength range (*Jakosky et al.*, 2015; *McClintock et al.*, 2014). The FUV channel is sensitive to CO_2 and O_2 while the MUV channel is sensitive to CO_2, O_3, and clouds and aerosols. FUV occultations can also detect high altitude clouds. Altitudes between around 90 km and 150 km are covered with the FUV channel and from around 30 km up to 90 km with the MUV channel. After calculating the transmission spectrum we apply a spectral inversion using the Levenberg-Marquardt least squares fitting algorithm to get the best fit. The line-of-sight column densities are inverted to determine local number densities using the Tikhonov regularization scheme. A detailed description of stellar occultations executed with the IUVS instrument and the applied pipeline to retrieve the number densities can be found in (*Gröller et al.*, 2015) and (*Sandel et al.*, 2015).

CO_2 and O_2 Number Densities

Figure 1 shows the variability with solar longitude of the CO_2 and O_2 number densities (upper and middle panel) and the O_2 mixing ratio (lower panel) at an altitude of 120 km. Each color represent a different stellar occultation campaign and the gray circles in the upper panel show the CO_2 number densities from stellar occultations executed with SPICAM onboard Mars Express (*Forget et al.*, 2009). The CO_2 number densities inferred from IUVS stellar occultations show the same L_S dependency as those from SPICAM, however, the average CO_2 number density seems to be slightly lower. The O_2 number densities show s similar L_S variation as the CO_2. Though the O_2 mixing ratio shows a high variability with values between 2 and 7×10^{-3}, the mean value is constant with solar longitude.

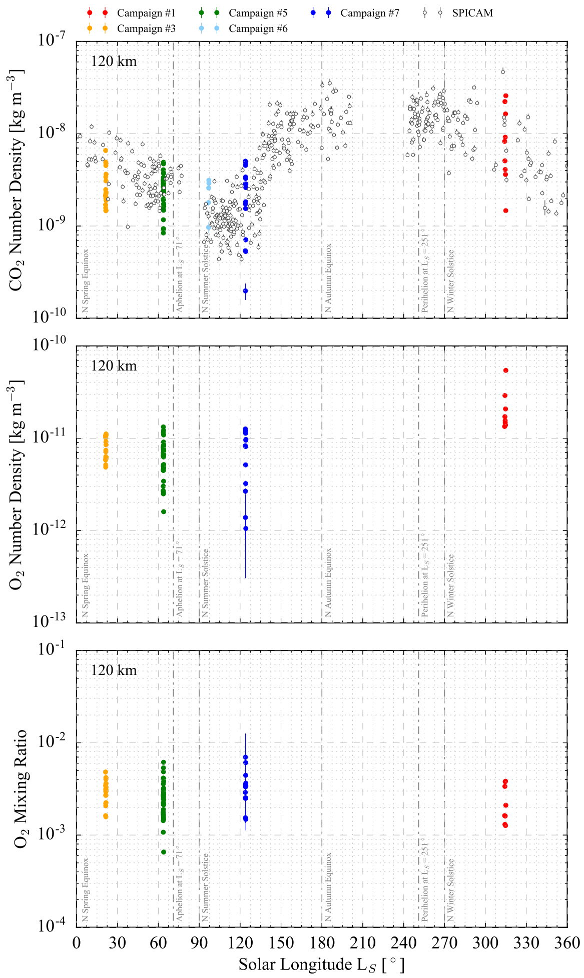

Figure 1: Solar longitude dependency of the retrieved CO_2 and O_2 number density and the O_2 mixing ratio at an altitude of 120 km. Each color represent a single stellar occultation campaign. In addition, the CO_2 number densities from SPICAM/MEX stellar occultations shown in *Forget et al.* (2009) are included as gray circles in the upper panel.

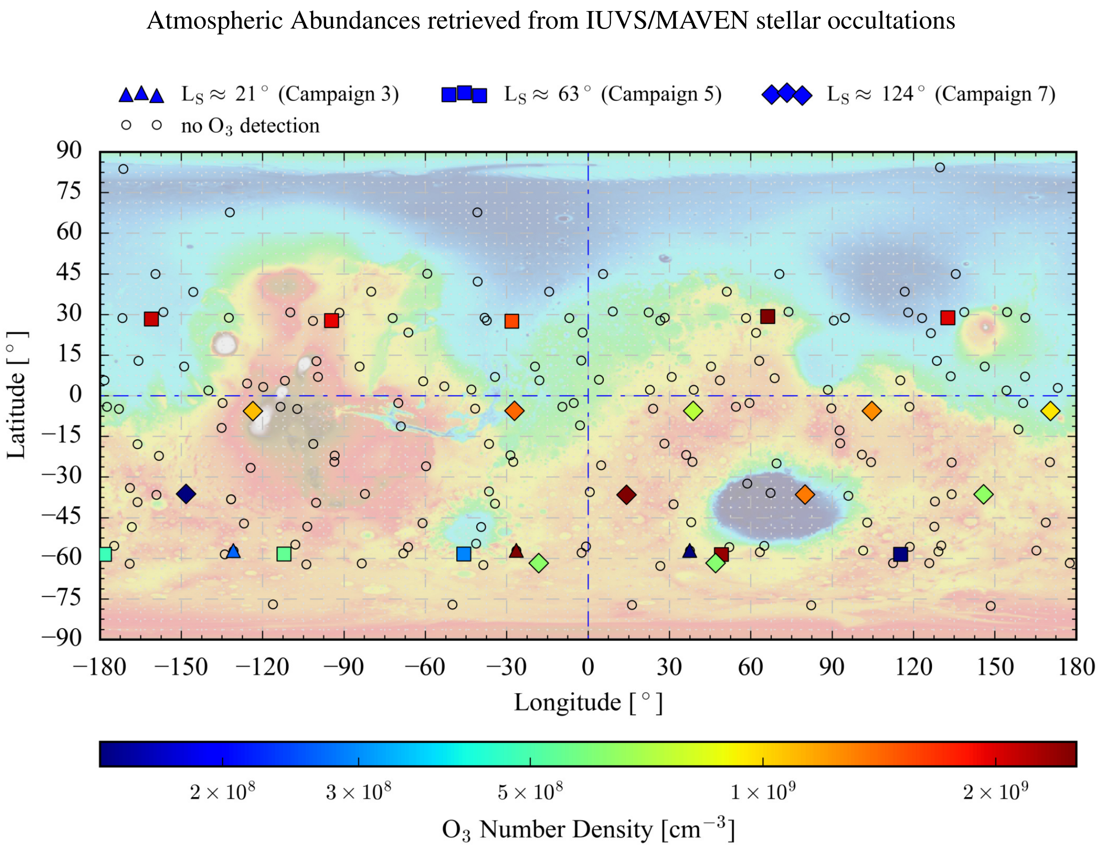

Figure 2: Longitude and latitude distribution of the peak O_3 number densities. The filled triangles, squares, and diamonds are representing the obtained O_3 number densities measured during the stellar occultation campaign 3, 5, and 7, respectively. The empty black circles indicate stellar occultations where no O_3 was observed.

Ozone Number Densities

Ozone shows a very distinctive feature in the MUV wavelength range of the transmission spectrum. If O_3 is present in the atmosphere, the Hartley band, a broad absorption feature centered around 255 nm, can be seen. We detect ozone in 29 occultations from the first 10 campaigns. All 29 occultations are executed during the nighttime between 21:00 and 3:00. Daytime stellar occultations are recorded but they cannot be used for ozone retrievals due to the saturation of the MUV channel.

The geographic distribution of the retrieved ozone profiles are shown in Figure 2. The filled triangles, squares, and diamonds represents the maximum O_3 number densities measured during stellar occultation campaign 3, 5, and 7, respectively. These three campaigns are separated by 3 to 4 Earth months and thus each campaign represent a different season on Mars; campaign 3 ($L_S \approx 21°$) was executed during early spring in the Northern hemisphere (NH), campaign 5 ($L_S \approx 63°$) during late spring in the Northern hemisphere, and campaign 7 ($L_S \approx 124°$) during mid summer in the Northern hemisphere. The empty black circles indicate stellar occultations where a MUV transmission spectrum was recorded but no O_3 was observed. During the NH mid summer, ozone number densities up to $\sim 10^9$ cm^{-3} were detected near the equator. Ozone abundances up to 3×10^9 cm^{-3} have been observed around 30°N during the NH late spring season. Nighttime occultations at a latitude of around 60°S have been executed in all three campaigns and show a variability of more than an order of magnitude (1×10^8 cm^{-3} to 3×10^9 cm^{-3}).

The altitude dependent ozone density profiles for all 29 occultations are shown in Figure 3. One group of O_3 profiles shows a peak of $\sim 2 \times 10^9$ cm^{-3} around an altitude of 40 km and a second group shows a slightly smaller peak centered at $\sim$ 30 km. The ozone profiles at higher altitudes are recorded during campaign 5 at $L_S \approx 63°$ (late spring) whereas the group of profiles at around 30 km are observed during campaign 7 at $L_S \approx 124°$ (mid summer). O_3 density profiles for different occultation geometries are shown in *Lebonnois et al.* (2006) measured with the UV spectrometer of the SPICAM instrument onboard the European Mars Express mission. Their profiles show an ozone peak with values ranging from 2 to 9×10^9 cm^{-3} at altitudes between 30

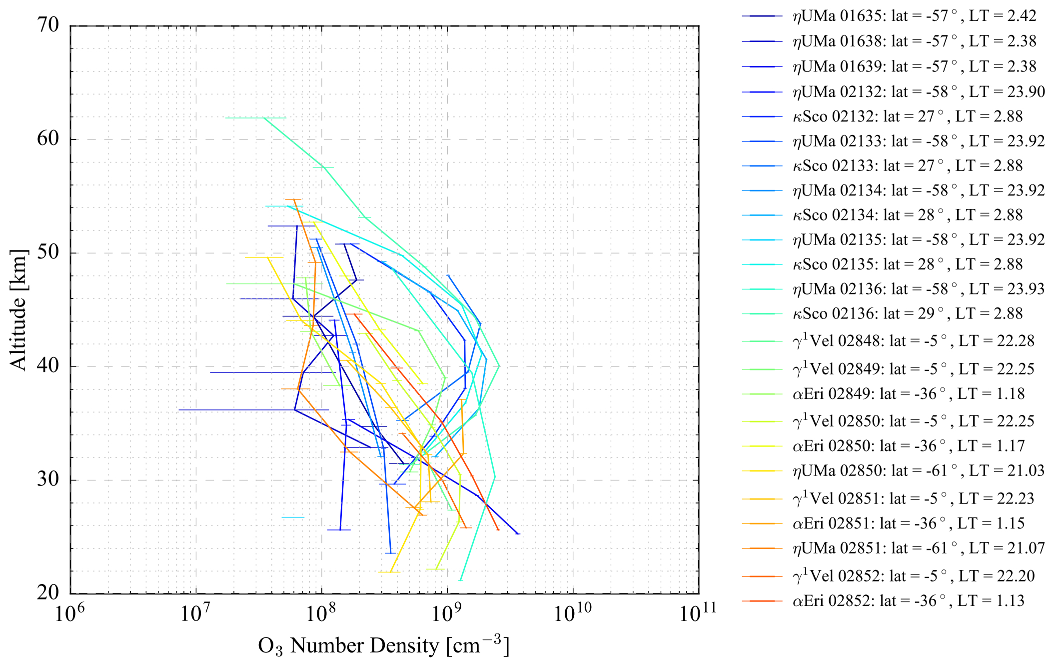

Figure 3: Ozone density profiles for all 29 stellar occultations.

and 40 km. Though their altitudes are in agreement, the peak values are up to a factor of five higher than the one obtained from the IUVS instrument.

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