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The Mars Ultraviolet Dayglow Variability: SPICAM Observations and model comparison

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Abstract

The ultraviolet CO Cameron bands and the CO_2^+ doublet dayglow emissions have been observed with the SPICAM spectrometer on board the Mars Express spacecraft [1]. A large set of observations has been obtained at different seasons, latitudes, local times and solar activity levels. We have analysed the variations of the brightness and the altitude of the peak emissions. Focusing on one specific season (LS=[90,180]°), we find that the average peak brightness of the CO Cameron bands is equal to 118 ± 32 kR, with an average peak altitude of 121.1 ± 6.5 km. Similarly, the CO_2^+ emission shows a mean brightness of 21.7 ± 7.2 kR with a peak located at 119.0 ± 6.9 km. We show that the intensity is mainly controlled by the solar zenith angle and by solar activity whereas the peak altitudes appear to be dependent on the local CO_2 density profiles. The observed variation of the brightness with the F10.7 cm proxy is similar to that previously deduced from Mariner 9 observations [2].

We use a set of recent cross sections and solar irradiance and a Monte-Carlo one-dimensional model to calculate the photoelectron energy spectrum. This model is coupled with calculations of the direct solar photon interaction with the Mars atmosphere and outputs are compared with observed SPICAM limb profiles [3]. The neutral atmospheric densities are obtained from the Mars General circulation model [4]. We show that both the altitude and the intensity of the observed emissions provide information on the CO_2 thermospheric variability with latitude and local time.

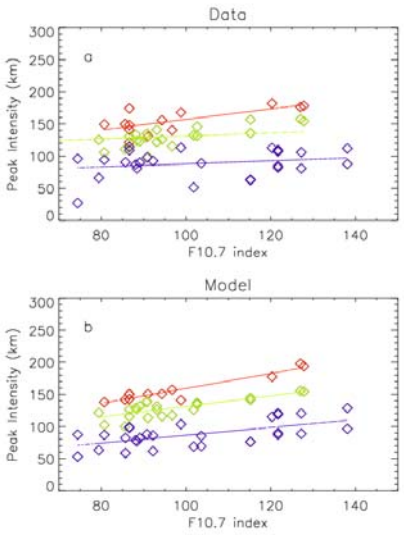

Figure 1: Variation of CO Cameron bands peak brightness as a function of the F10.7 solar index. Each observation is represented by a diamond. Red, green and blue curves correspond to solar zenith angles ranging from 0° to 35°, from 35° to 55° and from 55° to 90° respectively. a: observed values. b: modelled values. The increasing trends on both plots are clearly noticeable although they are more pronounced in the model calculations.

References

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