CO^+ first-negative band emission: A tracer for CO in the Martian upper atmosphere

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Abstract:

Carbon monoxide is an important minor species in the Martian upper atmosphere which primarily produced via photodissociation of CO_2. The study of CO distribution and its variation is essential to understand the stability of CO_2 in the Mars. We have developed a photochemical model to study the excitation processes of CO^+ first-negative band emission ($B^2\Sigma^+ \rightarrow X^2\Sigma^+$) in the upper atmosphere of Mars. The number density profiles of CO_2 and CO from different models have been used to study the sensitivity of the calculated limb intensity of this band emission. On increasing the input CO density (by a factor of 3 and 20 for Mars Climate Database[1] and Fox (2004)[2] models, respectively), the modelled CO^+ first-negative limb intensity profile is found to be consistent with the observation of Imaging Ultraviolet Spectrograph (IUVS) on-board Mars Atmosphere and Volatile EvolutioN (MAVEN) satellite[3]. In this case, the intensity of CO^+ first-negative band is significantly determined by the photoionization of CO and the role of dissociative excitation of CO_2 is negligible for the altitudes above 150 km. By comparing the modelled limb intensity profile with IUVS/MAVEN observation, we also constrain the upper limit for the photodissociative excitation cross section of CO_2 producing $CO^+(B^2\Sigma^+ \rightarrow X^2\Sigma^+)$ as about 5 x 10^{-19} cm^2 in the wavelength band 165–365 Å, which has not been reported in the literature. The solar photon flux around the wavelength 303.78 Å is the important source of CO^+ first-negative band emission via photoionization and electron impact ionization of CO and CO_2. Since CO is the significant contributor to this band emission, we suggest that the observed band emission intensity can be used to retrieve CO neutral density in the Martian upper atmosphere for the altitudes above 150 km.

References:

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