Modeling of Sulphur Chemistry in Mars GCM

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Abstract:. The present study discusses the sulphur chemistry in the Martian atmosphere. is one of the major species in the Martian atmosphere along with others CO_2,NO_2 and halogens. The photolysis rate constant (J-value) for SO_2 photo dissociation reaction is calculated using the radiative transfer model. For the model calculations, the wavelength range is set between from 100-198nm.The J-values are calculated from surface upto a height of 80km integrating the actinic flux from wavelength 100-190nm. This work is an approach towards designing a 3-D photochemical model for atmospheric chemistry, which may be useful in analysing the variation of concentration of the molecules at different latitude, longitude and solar zenith angle.

On Earth sulfur dioxide is the most abundant species outgassed by volcanoes, although there is no evidence of active volcanism on Mars today, localized outgassing sources cannot be excluded, and the presence of in the atmosphere might be indicative of such activity. The irreversible loss of SO_2 in Mars occurs mainly through reaction with *OH*, which initiates the following oxidation chain. The end product of the chain sulfuric acid can either condense or trapped in surface of water ice aerosols. The precipitation of solid form of sulfuric acid to the surface is most likely removal process of sulfur in Mars atmosphere.

The 1-D photochemical model considers the distribution of species at a particular location w.r.t to time i.e. the solar zenith angle but the 3-D model would give the rate of change of concentration of any species at any particular latitude , longitude and time of the day. In this work we used the TUV(Tropospheric Ultraviolet Model) model to determine the photolysis rate constant of SO_2 .The radiative transfer model calculations of the actinic flux (quanta cm^-2 s^-1 nm^-1) were used to calculate the photolysis rate constant (J) in s^-1. From our study we have found that the J-values increase with increasing altitude (Fig.01). As we go to higher altitude the intensity of the radiation increases, as a result the chemical bonds break easily, and hence the photo dissociation occurs at a faster rate.

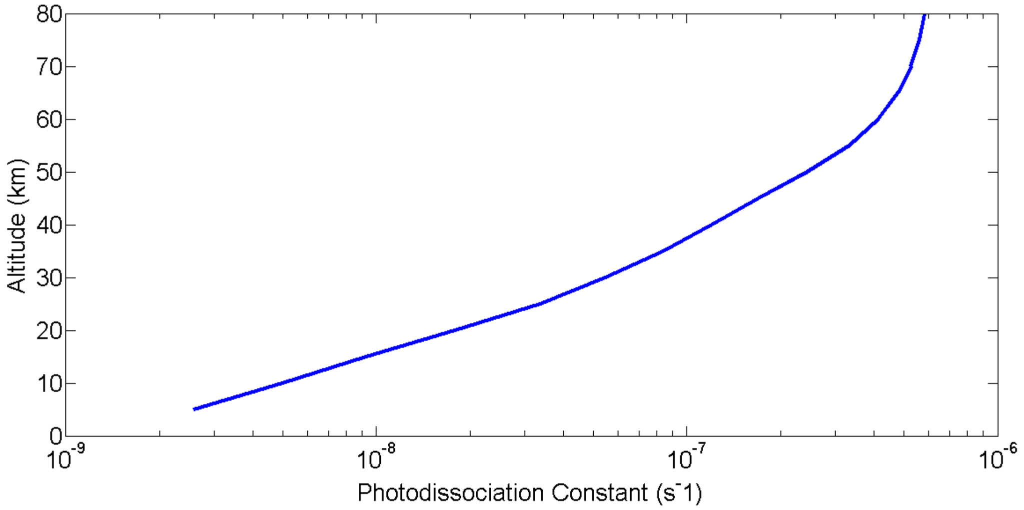

Fig.01 **Photo dissociation constant versus Altitude**

References: [1] Briefs, E. C. G. E. (n.d.). *ECG Environmental Briefs Calculating photolysis rates and estimating photolysis lifetimes*. (1), 0–1.

[2] Liou.K.N.(DEPARTMENT OF ATMOSPHERIC SCIENCES, UNIVERSITY OF CALIFORNIA, L. A., & LOS ANGELES, C. (n.d.). *An Introduction to Atmospheric Radiation Second Edition*.

[3] Wong, A.-S. (2003). Chemical markers of possible hot spots on Mars. *Journal of Geophysical Research*, *108*(E4). https://doi.org/10.1029/2002je002003.