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Effects of the solar X-ray and EUV radiation on the Martian ionosphere

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Because the solar X-ray and EUV radiation affects the Earth and planetary ionospheres, it should play a major role in the evolutions of planetary atmospheres. Many researchers have studied escape of O atoms from the Martian atmosphere in various solar activities. The escape fluxes have been calculated taking into account escape processes of ion pick up, sputtering, and dissociative recombination of O2+. During periods of young solar age, the escape flux due to each process should depend on activities of the young Sun that would emit strong X-ray and EUV radiation. Recently, observations by Mars Global Surveyor (MGS) indicated that the Martian ionosphere varied significantly in association with enhancement of the solar X-ray and EUV flux during a solar flare. Moreover, Mars Express (MEX) first observed the increase in the heavy ion outflow flux from the Martian atmosphere. We can easily estimate the escape flux of O atoms due to dissociative recombination of O2+ when we assume that the energetic O atoms produced near the exobase would escape from the Martian atmosphere. The enhancement of the solar X-ray and EUV flux would cause increase in the O escape flux by 20% during a big solar flare event. Some astronomical studies showed that the young sun would have quite active periods when the strong X-ray and EUV radiation was emitted from the stars and big flares occurred at frequent intervals. Therefore, it is very important to estimate response of varying and escaping flux to solar flares in study of escape of the Martian atmospheres, especially, in study of evolving the Martian atmosphere.
In this study, we update a photochemical model of the Martian ionosphere, which was developed at Tohoku University. The ionization rate are calculated by using a spectrum model of the solar X-ray and EUV radiation, although the old version of the model did not include the ionization by the solar X-ray and XUV radiation. We investigate responses of the Martian ionosphere to enhancement of the solar X-ray and EUV radiation, e.g. during a solar flare. This model will make it possible to investigate the responses of the Martian ionosphere to intense X-ray and EUV radiations from the young sun. The effects of the solar X-ray and EUV radiation on the evolution of the Martian atmosphere will be discussed in the future.