Effects of ion-ion collisions on vertical CO_2^+ profiles in Martian ionosphere under magnetic field penetration: Multi-fluid MHD

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The escape of the planetary atmosphere is an important phenomenon related to evolution of the atmosphere, and numerical simulations are an effective method to understand the global atmospheric escape processes. The escape of CO_2^+ from Mars observed by Mars Express is presumed that the origin of CO_2^+ escape flux is result of the ionospheric outflow. In this process, the escape of massive amounts of CO_2^+ requires relatively high density of CO_2^+ at high altitude ionosphere. Ionospheric model developed by Fox and Hac [2010] presumed chemical reaction and velocity difference for each ion fluxes in ionosphere to reproduce the density disturbance of CO_2^+ in high altitude ionosphere. This result suggests velocity difference is important to reproduce the high CO_2^+ density in high altitude ionosphere. Multi-fluid MHD, it is the model allows ion fluxes to take individual velocities, has developed Najib et al,. [JGR, 2011], but the model has not include the effects of the collisions between ions. In our previous research, we developed Multi-fluid MHD and reproduced Martian ionosphere. To investigate effects of collisions, we conducted 5 cases of the simulation. Case1: Multi-fluid MHD includes electron-neutral and ion-ion collisions, Case2: Multi-fluid MHD without electron-neutral collision, Case3: Multi-fluid MHD without ion-ion collisions. Case4: Multi-fluid MHD without electron-neutral and ion-ion collisions. Case5: Multi-fluid MHD. From this previous study, we obtained the effects of velocity differences between ion fluxes and collision for CO_2^+ vertical density distribution. Our recent study is the effect of solar wind magnetic field on Martian ionosphere using under developing Multi-fluid model. Mars has no intrinsic magnetic field. So that, solar wind magnetic field penetrates into Martian ionosphere when the solar wind magnetic field is in active state. When solar wind magnetic field penetrates, Martian ionosphere is contracted, and ion-fluids are accelerated by magnetic field. Our Multi-fluid MHD code can describe individual velocity of ion fluxes, ion-ion collisions, electron-neutral collision, and effects of magnetic field for ion fluxes with different speeds. In this presentation, we report the dependence of ionospheric condition on magnetic field strength and ion velocity in the upper boundary.

Keywords: Mars, Ionosphere, Multi-Fluid MHD

