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Global Modeling and Future Explorations of Atmospheric Escape Processes

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Satellite observations have revealed that atmospheric escape to space is common to planets. Not only for the long-term evolution of planetary environments but also for magnetospheric dynamics it may represent important factors. Mars as a non-magnetized planet is thought to have lost huge amounts of water and greenhouse gases, since morphological analysis of the martian surface indicates that large bodies of liquid water were probably present on the surface at its primitive epochs. Atmospheric escape to space is regarded as a possible process which has removed a few to 30 m GEL of H2O and 0.1 to several bars of CO2 from Mars over the last 3.5-4 Gyr. On the other hand, ions escaping from a magnetized planet can affect the magnetospheric dynamics: O+ ions escaping from the Earth's ionosphere have been shown to circulate in the magnetosphere and even dominate the ring current region during intense magnetic storms, while other ionospheric ions such as N+ contribute with a ratio as high as N+/O+$\sim$0.5. Despite the importance of atmospheric escape, global modeling that considers numbers of ion species (including C+, CO+, CO2+, O+ and N+) has not been done. We have developed a self-consistent global magnetosphere model with an ionosphere included. We will present possible impacts of the escaping ions/neutrals on planetary environments as well as the magnetospheric dynamics. We will also present our targets of observations for future space missions.