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Sae Aizawa, Nicolas André, Moa Persson, Ronan Modolo, Jim Raines,
François Leblanc, Jean-Yves Chaufray, Quentin Nénon

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Escape and precipitation of planetary ions at Mercury under different solar wind conditions

Sae Aizawa et al.

The escape and precipitation of planetary ions at Mercury under different solar wind conditions have been examined using a global hybrid simulation. The combination of Mercury's weak intrinsic magnetic field and solar wind conditions at Mercury's location results in the formation of a relatively small magnetosphere compared to that of Earth. Its magnetosphere is strongly compressed and may disappear when solar wind conditions are extreme. Under these circumstances, the solar wind can directly interact with its exosphere and surface and the escape of planetary ions is expected to be enhanced. By focusing on the dynamic pressure and interplanetary magnetic field dependence, three different solar wind conditions are used in this study. Under the extreme solar wind planetary protons shows the highest escape rates while planetary sodium ions show the smallest, indicating that the distribution of sodium ions around the planet is controlled by the size of the magnetosphere. As the Larmor radius of planetary sodium ions is larger than that of planetary protons, they cannot escape and instead precipitate onto surface during extreme solar wind conditions, when the dayside magnetosphere is well compressed. Precipitation maps of three components (solar wind protons, planetary protons, and planetary sodium ions) show that the flux from planetary plasmas is sometimes higher than solar wind plasmas, suggesting that the precipitation of planetary plasmas should be considered for the space weathering of Mercury's surface.

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