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Solar Wind Control of Electron Densities in the Ionosphere of Mars

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At Mars, the solar wind interacts directly with the planet's extended atmosphere and ionosphere to form an induced magnetic barrier that deflects the solar wind around the planet. Through this interaction, the solar wind deposits energy and momentum into the ionosphere resulting in plasma heating, acceleration, and escape. Consequently, the global structure and dynamics of the ionosphere are thought to be affected by the conditions that prevail in the upstream solar wind. Observational studies detailing these effects, however, have been limited owing to the lack of concurrent observations of the ionosphere and upstream solar wind. We present results from a statistical analysis in which we studied these effects using ionospheric electron density measurements from the MARSIS (Mars Advanced Radar for Subsurface and Ionosphere Sounding) Radar on Mars Express, and upstream solar wind measurements from instruments on MAVEN (Mars Atmosphere and Volatile EvolutioN). Our results show that, during times of high solar wind dynamic pressure, the plasma scale height in the topside ionosphere is reduced and electron densities in the nightside ionosphere are enhanced. The analysis also reveals that there is an asymmetry in the ionosphere with respect to the direction of the solar wind $-V \times B$ motional electric field.