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Data-Model Comparisons of Photoelectron Flux Intensities on the Strong Crustal Field Lines at Mars

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This study quantifies the factors controlling photoelectron fluxes on strong crustal field lines in the Martian ionosphere. Using data from Mars Global Surveyor's Magnetometer and Electron Reflectometer instruments, dayside electron populations near the strong crustal fields in the southern hemisphere are analyzed versus various controlling parameters. These parameters include a Mars F10.7 proxy, a solar wind pressure proxy, local solar zenith angle, magnetic elevation angle, magnetic field strength. It was found that solar EUV radiation (corrected for solar zenith angle and the Mars-Sun distance) has the strongest influence on the photoelectron fluxes, and during different time periods this radiation has a stronger influence than at others times. Second, fluxes show a slight enhancement when the magnetic elevation angle is near zero degrees (horizontal field lines). Finally, other parameters, such as pressure and magnetic field strength, seem to have no major influence. These measurement-based results are then compared against numerical modeling flux intensities to quantify the physical mechanisms behind the observed relationships. The numerical code used for this study is our superthermal electron transport model, which solves for the electric distribution function along a magnetic field line. The code includes the influence of a variable magnetic field strength, pitch angle scattering and mirror trapping, and collisional energy cascading. The influence of solar EUV flux, atmospheric composition, solar wind dynamic pressure, and the local magnetic field are systematically investigated with this code to understand why some of these parameters have a strong influence on photoelectron flux intensity while others do not.