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Probing the Mars-Solar Wind Interaction With Numerical Modeling of High-Altitude Photoelectrons

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The Electron Spectrometer (ELS) instrument of the ASPERA-3 package on the Mars Express satellite has observed photoelectron energy spectra up to apoapsis. The characteristic photoelectron shape of the spectrum is sometimes seen well above the ionosphere in the evening sector across a wide range of near-equatorial latitudes. Two numerical models are used to analyze the characteristics of these high-altitude photoelectrons. The first is a global, multi-species MHD code that produces a 3-d representation of the magnetic field and bulk plasma values around Mars. It is used here to examine the possibility of magnetic connectivity between the high-altitude flanks and the dayside ionosphere. It is found that some field lines do indeed have connection between the dayside ionosphere and the magnetosheath flanks and magnetotail, and this location provides information about the Mars-solar wind interaction. The second model is a kinetic electron transport model that calculates the electron velocity space distribution along a non-uniform magnetic field line. It is used here to simulate the high-altitude electron velocity-space distribution for comparison with the ELS measurements. It is found that there are systematic features in the electron distribution that also provide information about the Mars-solar wind interaction.