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Variation in the Secondary Layer of the Mars Ionosphere

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We investigate variations in the structure of the secondary plasma layer (M1) in the Mars ionosphere that arise from changes in the solar irradiance and the solar zenith angle; we compare to similar variations in the primary (M2) layer of the ionosphere. We analyze the altitude and peak number density of both layers in the Mars Global Surveyor (MGS) dayside electron density profiles. We also employ these observations as new constraints to test a photochemical model of the Mars ionosphere.
We find that the variations in the M1 layer are very similar to those of the M2 layer. The peak electron density of the M1 layer has the same dependence on the solar zenith angle as that of the M2 layer, and is consistent with an ideal Chapman layer. The altitude of the M1 layer rises with increasing solar zenith angle, though more slowly than the M2 layer. Periodic changes in electron density are present a both peaks, which follow changes in the solar irradiance due to the rotation of the sun.
A one-dimensional photochemical model is used to simulate an electron density profile for each day during a six month stretch of MGS observations. The model's ability to reproduce observations depends strongly on the representation of electron temperature. Observations are matched most closely by simulations in which the electron temperature at the peaks remains constant with time.