



Approaches to Modelling Mars' Ionosphere Using Same-Day Observations from Both Hemispheres

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Abstract

A 1-D model of the Martian ionosphere is developed that can utilize flexible input conditions for specific dates and locations at Mars. These include: (1) neutral densities and exospheric temperatures from the Mars Climate Database (MCD), (2) Solar2000 solar irradiance daily input scaled to the location of Mars, (3) parametrization of plasma temperatures with respect to neutral temperatures, as guided by Viking measurements, (4) a solar zenith angle dependent secondary ionization parametrization, and (5) published cross-sections. Ion composition profiles are computed using photo-chemistry and plasma diffusion to generate electron density profiles. The model is validated by comparisons to same day radio occultation observations made in late 2004 by Mars Global Surveyor (MGS) in the northern hemisphere and Mars Express (MEX) in the southern hemisphere. We use these data sets to tune the MCD and to constrain parameterizations (3) and (4). The modeled profiles compare favorably to MGS and MEX measured data sets below ~200 km, specifically at the photo-chemically dominated M1 and M2 layers. Plasma and magnetic field parameters are analyzed to study the expected divergence between modeled profiles and measured ones as plasma diffusion and H₂ chemistry become increasingly important in the top-side ionosphere.