



Day-to-night transport in the Martian ionosphere

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The nightside Martian ionosphere is thought to be contributed by day-to-night transport and electron precipitation, of which the former has not been well studied. In this work, we evaluate the role of day-to-night transport based on the total electron content (TEC) measurements made by the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) onboard Mars Express (MEx). This is accomplished by an examination of the variation of nightside TEC in the time domain rather than the traditional solar zenith angle (SZA) domain. Our analyses here, being constrained to the northern hemisphere where the effects of crustal magnetic fields can be neglected, reveal that day-to-night transport serves as the dominant source for the nightside Martian ionosphere from terminator crossing up to time in darkness, TD, of $\approx 5.3 \times 10^3$ s, beyond which it is surpassed by electron precipitation. We also compare the observations with predictions from a simplified time-dependent ionosphere model. We conclude that the solid body rotation of Mars is insufficient to account for the observed depletion of nightside TEC but the data could be reasonably reproduced by the zonal transport model with a zonal electron flow velocity of $\approx 1.9 \text{ km s}^{-1}$. Such a velocity corresponds to a day-to-night electron transport rate of $\approx 2.6 \times 10^{25} \text{ s}^{-1}$, of which the driving force is unclear.