

The Equivalent Slab Thickness of Mars' Ionosphere

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Abstract

The integral with height of an electron density profile, called the ionospheric total electron content (TEC), is dominated by plasma near the height of maximum electron density (N_{\max}). The ratio $\tau = \text{TEC}/N_{\max}$ has a unit of distance, representing the thickness of a slab of plasma of uniform density (N_{\max}) with the same TEC. At Earth, the parameter τ has been found to vary far less than either N_{\max} or TEC, and thus models of τ can be used to generate values of TEC or N_{\max} when only one is observed. For an ionospheric layer dominated by photo-chemical processes, τ has also been related to the scale height of the neutral gas ($H = kT/mg$) that is ionized by sunlight.

The MARSIS radio science package on the Mars Express satellite has produced large independent data sets of TEC and N_{\max} . We have used them to form slab thickness patterns versus phase of the solar cycle and solar zenith angle. The overall sample average for daytime ($\text{SZA} < 90^\circ$) conditions is $\langle \tau \rangle_{\text{day}} = 71 \pm 21$ km, and for SZA between $90^\circ - 100^\circ$, $\langle \tau \rangle_{\text{terminator}} = 55 \pm 25$ km. We will report on the possible use of τ patterns to infer characteristics of the martian ionosphere and thermosphere.

