



The role of F-layer peak parameters on the uncertainties in estimating ionospheric electron density profiles and Total Electron Content (TEC) over the low latitudes

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Since the low latitude ionosphere is characterized by vibrant electrodynamic processes, it is essential to accurately model the ionospheric Total Electron Content (TEC) to arrive at accurate estimates of range delays on the trans-ionospheric radio signals. Ionospheric models such as the International Reference Ionosphere (IRI) and NeQuick2 derive TEC by integrating the empirically constructed vertical electron density profiles. This involves the estimation of F-layer peak density (N_mF_2), peak height (h_mF_2), profile thickness and shape parameters in the bottom side and topside ionospheres followed by fitting of suitable polynomials. Any uncertainty in deriving the above parameters significantly hinders the accuracy of modelled electron density profiles and thereby the TEC. In this effect, the impact of deviations in the estimation of F-layer peak parameters through empirically constructed formulations on the construction of vertical electron density profiles and TEC in the International Reference Ionosphere (IRI) model is explored over the Indian equatorial and low latitude sectors. Significant deviations are observed in the modelled h_mF_2 , especially in the post sunset hours during which the Pre-Reversal Enhancement (PRE) in the zonal electric field occurs over the magnetic equator. The contributions of different height models in IRI towards uncertainties in modelled TEC is evaluated using digisonde observations. A systematic analysis on the variability of topside electron density profiles with respect to the modifications in the various empirical parameters revealed larger deviations in the modelled outputs over the low latitudes. Results from the data assimilation analysis on the improvements in ionospheric electron density profiles and TEC with respect to modifications in the F-layer peak parameters will be discussed.