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MODELING OF EQUATORIAL AND LOW LATITUDE IONOSPHERE FOR COMMUNICATION AND NAVIGATIONAL APPLICATIONS

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Abstract: Ionospheric Modeling is important for both scientific and practical applications. Since the largest variability occurs in the ionospheric F-region and for HF communication and other applications it would be suffice to model the changes in the F-region parameters of the ionosphere. Ionospheric Electron Content (IEC) is another parameter useful for the determination of phase path, group delay, dispersion, refraction and Faraday polarization rotation of trans- ionospheric signals. In the present study, two HF prediction models for short and long term and one IEC model are developed for equatorial and low latitude ionosphere. Short term HF prediction model is based on Multiple Regression Analysis (MRA) for the dependence of F- region parameters namely foF2 and M(3000)F2, on solar 2800 MHz flux (F10), and geomagnetic index Ap whereas for long term prediction, Second Degree (SD) coefficients are generated by fitting monthly median foF2 and M(3000)F2 with corresponding 12 monthly mean sunspot numbers (R12) using data over three solar cycles. For generating MRA coefficients, daily foF2, M(3000)F2 values for each hour, obtained from Delhi (28.6ºN, 77.1ºE) digital ionosonde for about half a solar cycle are used. MRA coefficients, separately for quiet (Ap<25) and disturbed (Ap>25) periods, for foF2 and M(3000)F2, are obtained for every month over 24 UT times using daily F10 and Ap values. Whereas SD coefficients are obtained each month at all local times for all the 14 stations covering a geographic latitude range from about 0 to 45º N. Similar to SD model, IEC model is also developed using monthly median foF2 and hmF2 values for each hours for all the 14 stations which are feed into IRI 2000 model to calculate respective IEC values for two altitudes namely 1000km and 2000km. Then second degree coefficients, separately for above two altitudes, are obtained for each month at all local times for all the 14 stations. In this way once appropriate coefficients for each hour for all the twelve months are obtained, they are used by the computer based MRA, SD and IEC

models, to predict ionospheric hourly foF2, hmF2 and IEC values for a given inputs such as month, F10, Ap and R12 as the case may be. Predicted model values calculated on short and long term basis, are then compared with the observed data and also with those obtained using IRI-2001 model. From the comparative studies, it is observed that MRA and SD models show better agreement with observations as compared to the IRI model for both long as well as short term basis and among the two; the MRA model provides best agreement with the observed ones even during the magnetic storm periods. The SD model on the other hand, which is based on monthly median values, useful for providing long-term predictions for HF communication applications. IEC model predicted results are also gives better agreement with the observed one as compared with those obtained from IRI 2000 model.