Climatologic prediction of ionospheric thickness parameter (B0) and peak height (hmF2), and forecasting disturbances of hmF2 for IRI

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Taking the advantage of the worldwide network of Digisondes providing suitable datasets and sharing it through the Global Ionospheric Radio Observatory (GIRO), it is possible analyzing changes in electron density height distribution for both quiet and disturbed conditions making possible studies of the global ionosphere at climatological and meteorological time-scales. We have used such data set to obtain an analytical formulation for predicting the climatological behavior of some ionospheric key parameters in support to the International Reference Ionosphere (IRI) model aiming at improving the current IRI prediction at global scale, and to obtain an analytical formulation to forecast disturbances in the density peak height (hmF2) caused during intense geomagnetic storms at mid-latitudes.

Spherical Harmonic analysis technique has been used for globally modeling purposes to predict quiet conditions. Models for bottom-side B0 and B1 parameters of IRI, for hmF2 and for equivalent scale height (Hm) have been developed. Each SH model has been parameterized according to the observed time-space pattern of each ionospheric parameter and has been bounded to the solar activity. These empirical models improve, in average, the prediction of B0, B1 and hmF2 by 40%, 20% and 10% respectively with respect to previous IRI versions (hmF2 is improved by more than 30% at high and low latitudes). IRI has adopted the SH empirical models for B0 and B1 as additional options in the current version (IRI 2012) and has proposed the SH model for hmF2 to be included into next releases. The analytical model for Hm could be useful to estimate information for the topside profile formulation.

Gaussian functions have been applied to analytically forecast the disturbed pattern of hmF2 during intense geomagnetic storms (ΔhmF2) at mid-latitudes, which coefficients are bounded to the local-time, season and to the conditions of the interplanetary magnetic field. Combining the prediction model of hmF2 for quiet conditions and the disturbance model ΔhmF2 it is possible to build a tool that successfully forecast hmF2 at mid-latitudes in near-real-time. Moreover, assimilating real-time data to adapt the models with the available measurements using the IRTAM technique (Galkin et al., *Radio Science*, **47**, 2012, RS0L07) may lead to new application of the IRI extensions for providing new insights into the temporal and spatial space weather domain.