Topside-plasmasphere electron density profiles model by using AIS ionosonde measurements and calibrates GPS TEC data

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The Upper Atmosphere Physics group at INGV (Istituto Nazionale di Geofisica e Vulcanologia) developed Autoscala, a computer program for automatic scaling of the critical frequency foF2 and other ionospheric parameters derived from ionograms. Autoscala includes a routine that automatically estimates the electron density profile below F layer peak height hmF2, by adjusting the parameters of a model according to the recorded ionogram [Scotto (2009)]. By integrating this profile we can estimate bottom-side total electron content (bTEC). By means of a calibration technique [Ciraolo et al. (2007)], we are able to obtain calibrated vertical TEC (vTEC) values from GPS measurements over a receiver station. This method permits to estimate biases of the received signal due to transmitter-receiver hardware configuration. These biases must be eliminated from the GPS data in order to calibrate the experimental slant total electron content (sTEC) along the satellite-receiver line-of-sight (LoS). The difference between vTEC and bottom-side TEC (bTEC) permits to evaluate electron content of the topside ionospheric region (tTEC). Starting from tTEC, bottom-side parameters (foF2, hmF2, scale height at hmF2) obtained by ionosonde and O+ - H+ transition level, we can solve a system of equations based on different ionospheric profiler (Chapman, sech-squared and exponential) the solution of which provides ion scale height [Stankov et al. (2003)]. This last factor is sufficient to establish the vertical distribution of electrons in topside and plasmasphere regions.
Obtained vertical profiles could be used to develop a new model for real time estimation of TEC and topside electron density distribution.

References:
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