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Ground-based GNSS-derived TEC data assimilation into NeQuick

B. Nava* (1), D. Themens (2,3), A. Kashcheyev (2), and A. McCaffrey (2)
(1) The Abdus Salam International Centre for Theoretical Physics; e-mail: bnava@ictp.it
(2) University of New Brunswick, Fredericton, Canada, e-mail: david.themens@unb.ca; akashche@unb.ca; a.mccaffrey@unb.ca
(3) Space Environment and Radio Engineering (SERENE) Group, University of Birmingham, Birmingham, UK

In the present work, the results obtained by the implementation of the Best Linear Unbiased Estimator (BLUE) [1] algorithm to assimilate ground-based GNSS-derived Total Electron Content (TEC) data in the NeQuick [2] ionospheric electron density model (considered as a background) are presented. TEC data for the days 15 and 16 July 2017 from about 300 receivers located in the European region have been assimilated. Manually scaled ionosphere peak parameter values obtained at one-hour time interval from Athens, Chilton, Dourbes, Fairford, Julisruh, Moscow, Pruhonice, Rome, Roquetes, San Vito and Tromso ionosondes have been considered as reference measurements for the validation of the assimilation procedure. As far as the geomagnetic activity is concerned, the 15th corresponds to a quiet period, while the 16th can be considered slightly disturbed (with the Dst index reaching a minimum of -72 nT). Being an uncommon circumstance, it is worth noting that the day 16 features a positive ionospheric storm and a Tongue of Ionization (TOI), resulting in an enhancement in peak electron density by a factor of two with respect to the day 15 and an increase in peak electron density height by as much as 100 km. The analysis results, based on the relative frequency distribution of the differences between the retrieved and the corresponding experimental peak parameter values, indicate the effectiveness of the proposed data assimilation method, especially during the geomagnetically disturbed day. Indeed, considering all the ionosondes, for the day 15, the average, standard deviation, maximum and minimum error in the reconstructed foF2, the critical frequency F2 ionospheric layer, are -0.16, 0.45, 0.92, -1.80 MHz respectively; the analogous errors for the NeQuick model, used as a background, are 0.42, 0.50, 2.73, -0.65 MHz. The same kind of statistics for the day 16 are -0.01, 0.55, 1.62, -1.41 MHz for the assimilative model and -0.18, 1.11, 2.43, -3.59 MHz for the background model.

References

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