Testing a 3D ionosphere model during 2001 solar maximum period

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The ionospheric refraction error is currently the most prominent error source in GPS measurements. To date, all ionosphere models that have been developed are essentially two-dimensional in nature so they are unable to fully characterize the ionosphere field. In this paper, a three-dimensional (3D) ionosphere model is described based on the tomography approach. Such a 3D model could provide a full dimensional description of the ionosphere field and outperform the 2D models in terms of modeling accuracy. The model performance was tested using data acquired during the 2001 solar maximum from 15 IGS stations. The geomagnetic Kp index value reached to 9 during the period and significant ionosphere variations were observed. The proposed model has been used to perform short-term (120 seconds) ionospheric TEC predictions and it was assessed through a comparison to directly GPS-inferred TEC values. The results indicated that the accuracy of the short-term vertical TEC predictions was about 6 TECU over a 24-hour period and the accuracy would be further improved if the prediction interval were shorter. The prediction computations have been implemented in a near real-time (NRT) mode so it meets the WAAS's ionosphere message update interval requirement (5 minutes). The obtainable accuracy of the vertical TEC prediction using the proposed model also satisfies the WAAS's ionospheric correction accuracy requirement of about 1.5 m for the Category (CAT) I precision approach in aircraft navigation.