

Exploring the existence of ionospheric pre-storm enhancements and their drivers over South Africa

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The paper reports on the investigation of pre-storm enhancements observed over South Africa during the period of 2003 and 2013. The pre-storm enhancements were first reported by (R. P. Kane, Journal of Atmospheric and Terrestrial Physics, **35**, 1973, pp. 1953-1966) and have received relatively little attention. Quiet days (i.e. $Dst \leq -40$ nT and $Kp \leq 3$) prior to 10 strong geomagnetic storms ($Dst \leq -100$ nT) were analyzed and only 3 cases were determined to be possible candidates of pre-storm enhancements. Measurements of the total electron content (TEC) from several ground based GPS receivers and critical frequency of the F2 region (foF2) from two ionosondes co-located with the GPS receivers were used in this study. The criteria used to determine these pre-storm enhancements were based on the ratio of TEC or foF2 measurements compared to their corresponding monthly medians being greater than 45% for TEC or 20% for foF2 a day prior to the onset of the relevant storm. Pre-storm enhancements were observed prior to the storm occurring on 27 September 2011, 01 October 2012 and 17 March 2013. However the results show that these were not the only enhancements observed during the quiet days preceding these storms; similar enhancements were observed up to 6 quiet days prior to the corresponding storm's onset. Most of the observed enhancements occurred during local nighttime and therefore suspected to belong to the typical midlatitude nighttime enhancements. To investigate the physical processes driving these enhancements, we used the Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIE-GCM) open-source version available at the Community Coordinated Modeling Center (CCMC).