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IONOSPHERIC MODELING DURING GEOMAGNETIC STORM FOR SPACE WEATHER APPLICATION

Abstract

The ionosphere is that part of the upper atmosphere, where free electrons occur in sufficient density, which has an influence on the propagation of radio frequency electromagnetic waves. The ionospheric study is well investigated by using different instruments such as ionosondes, riometers, incoherent radars, GPS receivers, and other similar techniques. This paper focuses on the critical frequency of the F2 layer (foF2) measured by ionosondes. The ionosphere is important for the propagation of radio wave signals. It is also important because satellite signal delays are determined by the state of the ionosphere. To optimize the use of communication applications, it is essential to understand the drivers of ionospheric storms and accurately predict the propagation conditions especially during disturbed days. In this paper, the modeling of the ionospheric foF2 variability during geomagnetic storms will be presented using neural network (NN) and linear regression (LR) techniques. The concluded results will lead to the generation of a new valuable product, to model the complex ionospheric changes during disturbed periods, in an operational space weather monitoring and forecasting environment. The foF2 data during the geomagnetic storm for the period 1996–2014 from Grahamstown ($33.3^oS, 26.5^oE$), South Africa ionosonde station was used in modeling. The modeling performance of both NN and LR was found to be comparable during selected storm periods. In addition, the performance during two significant geomagnetic storms (28 October–1 November 2003 and 6–12 November 2004) were demonstrated. Both models were capable of capturing the ionospheric foF2 responses during these storms, which have been demonstrated to be challenging storms to model in previous studies. Although some improvement is required to refine the accuracy of the models, especially for short term responses, the results reveal that the NN and LR models give adequate agreement with observational data in identifying the resulting ionospheric response as a result of geomagnetic storms.