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FORECASTING OF IONOSPHERIC VARIABILITIES OVER EGYPT USING MACHINE LEARNING BASED ON GNSS OBSERVATIONS

Abstract

Ionospheric disturbances and irregularities jeopardize satellites, navigation, and communication. The research into the dynamics and changes that occur both on a regular and occasional basis in the near-Earth space is essential to understand and mitigate the threats on our satellites and communication systems. There is a huge shortage of ground-based ionospheric observations in Egypt and the surrounding countries. In this study, a well-distributed ground-based Global Navigation Satellite Systems (GNSS) network in Egypt was used to compensate for the lack of ionospheric data. One of the physical quantities that can be derived from GNSS observations is the total electron content (TEC) which provides a primary indication of ionospheric variability, and it is crucial to establish an ionospheric TEC prediction model. We investigated the variation of ionospheric TEC derived from observations by the mentioned network for the past five years and we used this data to predict ionospheric TEC over Egypt by a machine learning model based on a deep neural network (DNN). The input parameters for the neural network (NN) model comprise solar and geomagnetic activity parameters. The results were compared to the TEC prediction obtained from the IRI model during the quiet and disturbed periods.