Title: Modelling relative total electron content in Europe during storm time using a neural network

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Abstract:

The ionospheric state is constantly changing and can be described by the integrated electron density estimation commonly known as the total electron content (TEC). The estimate of ionospheric TEC during geomagnetic storms can vary significantly compared to the TEC during quiet conditions. Therefore, it is important that ionospheric models also perform well during perturbed or storm conditions. We developed a neural network (NN)-based model that predicts the storm-time TEC relative to the 27-day median prior to the storm events. The network uses the 27-day median TEC, latitude, longitude, universal time, storm time, solar radio flux index F10.7, global storm index SYM-H and geomagnetic activity index Hp30 as input parameters and the output is the relative TEC with respect to the 27-day median. A storm dataset has been used containing the TEC maps from UQRG global ionosphere maps (GIMs) from the years 1998 until 2020 and comprises in total of 398 storm events. The model was tested with unseen data from 33 storm events that occurred during 2015 and 2020 representing a high- and low solar activity year, respectively. The performance of the storm-time model during the storms in the test dataset was compared with the Neustrelitz TEC model (NTCM) and the NN-based quiet time TEC model, both developed at German Aerospace Center (DLR) and the storm-time model outperforms both.