GC2024-STP063

Identification of spatial area that gives main contribution to positive storm-time response in high-latitude regional electron content

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Based on the Global Self-Consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP), the response of the regional ionospheric electron content (REC) was calculated for an isolated “reference” geomagnetic storm. The reference storm was obtained by superposing epochs for the AE index with key moments corresponding to the AE maximum. The GSM TIP simulation was carried out for four seasons (autumn/spring equinox and summer/winter solstice) and for four variants of AE maximum times: 00 UT, 06 UT, 12 UT and 18 UT. The model REC response was compared with the observed reference REC response, which was calculated using the following scheme: (1) calculation of REC from total electron content maps; (2) calculation of REC disturbances (dREC) as deviations of observed values from the 27-day moving average REC value and (3) calculation of the reference REC response by averaging dREC using the method of superimposed epochs with key moments corresponding to the maximum of the AE index. In this work, the response of regional electron content at high latitudes for the northern and southern hemispheres is investigated. The best model/data agreement was provided by the option when the time of maximum of the AE index corresponded to 18 UT. A significant (>40%) positive response of the high-latitude REC was revealed on days 1-2 of a geomagnetic storm in local winter months. The mechanisms of formation of high-latitude REC disturbances are considered. The altitudinal and latitudinal regions that make the main contribution to the positive response of the high-latitude REC are identified. A similar study was carried out for the geomagnetic storm on March 17, 2015.

The work was supported by Saint Petersburg State University (project ID 116234986).