Dynamics of TEC during X-class solar flares

Taurenis D.A. (1), Barabash N.S. (1), Ryakhovskiy I.A. (2)

(1) Federal State Autonomous Educational Institution of Higher Education "Moscow Institute of Physics and Technology (National Research University) Moscow, Russia

(2) Federal State Budgetary Institution of Science Institute of Geosphere Dynamics named after Academician M.A. Sadovsky of the Russian Academy of Sciences, Moscow, Russia

e-mail: taurenis.da@phystech.edu

The current level of development of global navigation satellite systems (GNSS) has made it possible to make significant progress in the study of the ionosphere. To date, the use of GNSS has allowed us to accumulate a large amount of unique experimental data on the structure of the ionosphere – the global distribution of ionization, its daily, seasonal, climatic variations and the total electronic content (PES). The high spatial and temporal resolution of GNSS systems made it possible to conduct studies of fast-flowing processes in the ionosphere caused by various heliogeophysical disturbances (solar flares, magnetic storms, earthquakes, volcanic eruptions, etc.).

The paper presents a comprehensive analysis of the dynamics of the PES during Class X solar flares that occurred in September 2017. An increase in the intensity of X-ray and ultraviolet (UV) radiation observed during chromospheric flares on the Sun causes an immediate increase in the electron concentration in the entire ionosphere. In this study, a methodology was developed to assess the changes in the ionospheric TEC caused by a surge in solar activity. Thanks to the developed algorithm, it became possible to process data from more than 500 observation points located around the world. Using the database of values of the spectral flux of UV radiation of the FISM 2 Flare model, empirical dependences of the change in the ionospheric TEC on the flux of UV radiation in different wavelength ranges were constructed for two flashes on September 6 and 10. Based on the results obtained, the wavelength range was determined, which largely determines the change in the magnitude of the total electron content of the ionosphere during Solar flares. The results of the search for the optimal range were confirmed by the methods of correlation analysis.