

Study of the mid-latitude responses to the extreme geomagnetic storms for solar cycle-23

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We present the results from analyzing the experimental data measured by ground-based instruments for 1998 - 2005. Instrumental complex consists of the Irkutsk incoherent scatter radar (52.9°N, 103.3°E), multiposition chirp ionosonde of oblique-incidence sounding and two digisonde DPS-4 located at Irkutsk (52.4°N, 104.3°E) and Norilsk (69°N, 88°E). Chirp ionosonde includes the receiver near p. Tory (51.7°N, 103.1°E) and three transmitters located near Irkutsk IS radar, at Norilsk and at Magadan (60°N, 150.7°E). That instrumental complex let us to research the ionosphere characteristics over extensive Russia region from subpolar to middle latitudes into longitudinal sector 90⁰-150⁰E. Coordinated experiments were carried out using NOAA Space Environment Center Solar-Geophysical forecast received by Internet (<http://sec.noaa.gov/today.html>). Therefore we could observed the ionosphere responses to the most extreme geomagnetic storms for Solar Cycle-23: on 25 September 1998, on 15-16 July 2000, on 17-20 April 2002, on 29-31 October 2003 and 9-12 November 2004.

Common script of the ionospheric disturbance development was observed for aforementioned storms. The auroral oval and ionospheric trough displaced in the direction of middle latitudes significantly. During the nighttime the equatorial boundary of the auroral oval reached ~46°N (invariant latitude). The Irkutsk IS radar during that period recorded long-lasting coherent echoes from ionospheric E-layer irregularities generated near the oval boundary. Negative disturbances of electron density (~60-80%), diffusive auroral kind Es – layer and a generation of a broad spectrum of irregularities and wave-like disturbances in the ionosphere over most of the region were recorded. Negative disturbances of electron density over Irkutsk were accompanied by a substantial rise of electron (~80%) and ion (~70%) temperatures.

So, mid-latitude ionosphere over the north-east region of Russia had assumed a properties of the polar ionosphere for the extreme geomagnetic storms of Solar Cycle-23.