Geophysical Research Abstracts, Vol. 7, 03974, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03974

Seasonal variations of the ionospheric effects of geomagnetic storms: observation and modeling

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We present the results derived from investigating the ionospheric effects of geomagnetic storms observed in the different seasons. Our analysis of the behavior of the ionosphere was based on using the measurements from a network of ionospheric stations located at different latitudes in the longitudinal sector of 90-130˚E. There were considered geomagnetic storms of a different intensity evolving from May, 2003 till March, 2004. During this period there were marked 15 storms, which could be divided into the different season. The morphologic analysis has revealed the following regularities in the ionospheric response to geomagnetic storms over the East-Asia. During the summer storms the disturbances were predominantly negative both at high and middle latitudes. At low latitudes there were marked mainly the positive disturbances. The change-over from negative to positive disturbances was the case at the geomagnetic latitude next to 30˚. In the winter the daytime disturbances were positive during the main phase of the storm at all stations independently of the latitude. During the recovery phase the disturbances were negative in the daytime both at high and middle latitudes. At low latitudes the disturbances were positive both in the daytime and at night throughout storm. During the equinox storms there were observed the negative disturbances during the main and recovery phase both at high and middle latitudes. They were positive at the low latitudes. The alteration of their sign came about 30˚ too. The intensive oscillations of foF2 were observed during the main storm phase of every storm next to equator (Hainan).

The numerical model for ionosphere-plasmasphere coupling that was developed at the ISTP SB RAS, was used to interpret the observational data at high and middle latitudes. Presented results of the model calculations have been obtained owing to correction of the MSIS-86 thermospheric model, which was the opposite in the summer (equinox) and winter conditions. Such neutral composition changes could cause the ionospheric storm to be negative in the summer or to be positive in the winter. The discrepancy between the model and measured values in the evening and night hours at high latitudes was caused by the variations in the auroral fluxes, which were not described with the statistical model, and the processes associated with formation and moving of the main ionospheric trough. The main distinction between calculations and measurements took place during the winter storm in the evening and night hours LT in Irkutsk (the geomagnetic latitude 41˚). This was associated with that the model results were consistent with the situation when plasmasphere over Irkutsk was practically filled and capable to maintain the sufficiently high values Ne after sunset during the storm whereas the actual plasmasphera was not all filled.

This work was done with financial support of the Russian Foundation for Basic Research (grant N grant 02-05-39002) and the Foundation for State Support of Leading Scientific Schools of the Russian Federation (grant NSh-272.2003.5).