The Main-Ionospheric Trough as an Indicator of Ionosphere-Magnetosphere-Coupling

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ABSTRACT

The mid-latitude electron density trough observed in the topside ionosphere has been shown to be the near-Earth signature of the magnetospheric plasmapause, and thus its behaviour can provide useful information about the magnetospheric dynamics, since its existence is dependent on magnetospherically induced motions. Mid-latitude trough is mainly the night-time phenomenon, which detailed characteristics and features depend on the solar cycle, season, time of the day and many others. The trough is narrow in latitudes but extended in longitudes. The main ionospheric trough features is very dynamic structure. It is well-known fact that the trough structure moves to the lower altitudes both with increasing the level of geomagnetic activity as with increasing the time interval from the local magnetic midnight However the longitude dependence of the main ionospheric structures has been detected still the source of this physical phenomena is not well understood. Using the DEMETER in situ satellite particle and waves measurements, GPS observations collected at IGS/EPN network, and the data retrieved from FORMOSAT-3/COSMIC radio occultation measurements the mid-latitude trough characteristics with regard to the geographic and magnetic longitude at fix local time has been presented. In this presentation, based on the selected number of geomagnetic storms, we analize also the energy deposition in areas adjacent to the structure of the main ionospheric trough. The investigation confirmed the storm-phase dependence of the trough properties.

PLASMA CONDITION DURING MAGNETIC STORM

Geomagnetic storm: 11-13 October 2008:

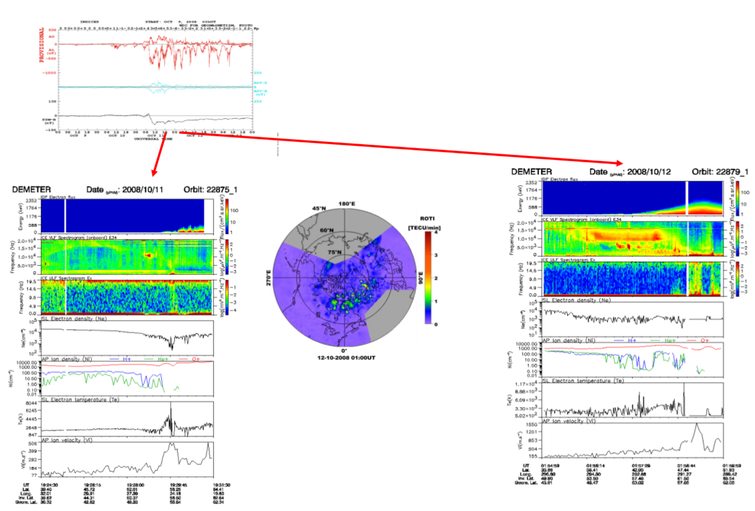


Figure 1: Picture on the right side shows plasma condition for the recovery phase of the magnetic storm. The middle graph presents the auroral oval for that time period.

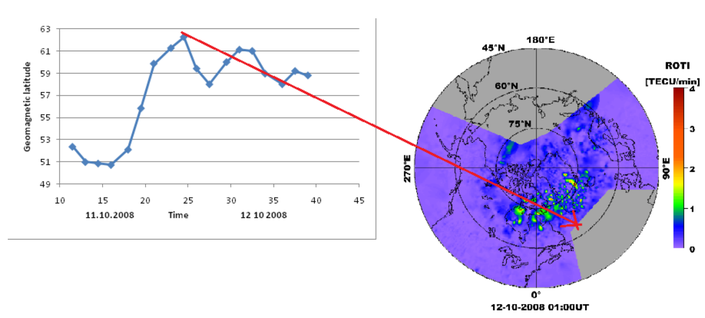
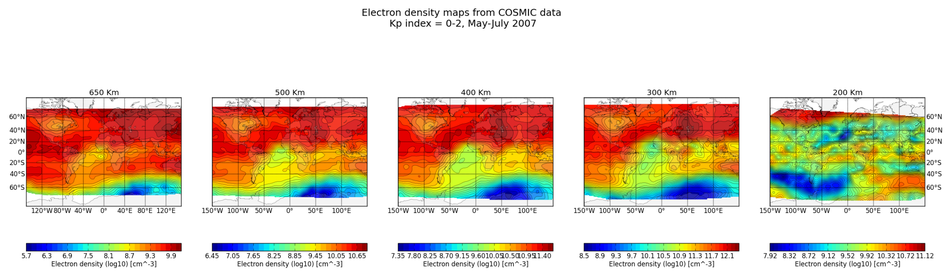


Figure 2: The position of minimum ionospheric trough determined by wave and plasma measurements during geomagnetic storm from 11 till 12 October 2008,(left part), the position of ionospheric irregularities determined by GPS fluctuations measurements integrated during one hour(right side).

SEASONAL BEHAVIOUR

Variations of position of mid-latitude trough are strongly correlated with saesonal changes and insolation. The Northern and the Southern hemisphere trough during local summer is hardly visible and in opposite occurs clear in local winter. We can also observe similar behaviour of trough structure for different altitudes (in range where we expect its presence).



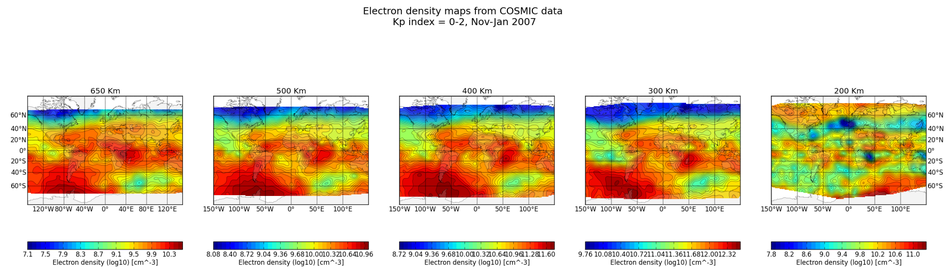


Figure 3: Global maps of electron density distribution in Summer (up) and Winter (down) at different altitudes during geomagnetically quiet conditions. Data taken from COSMIC measurements.

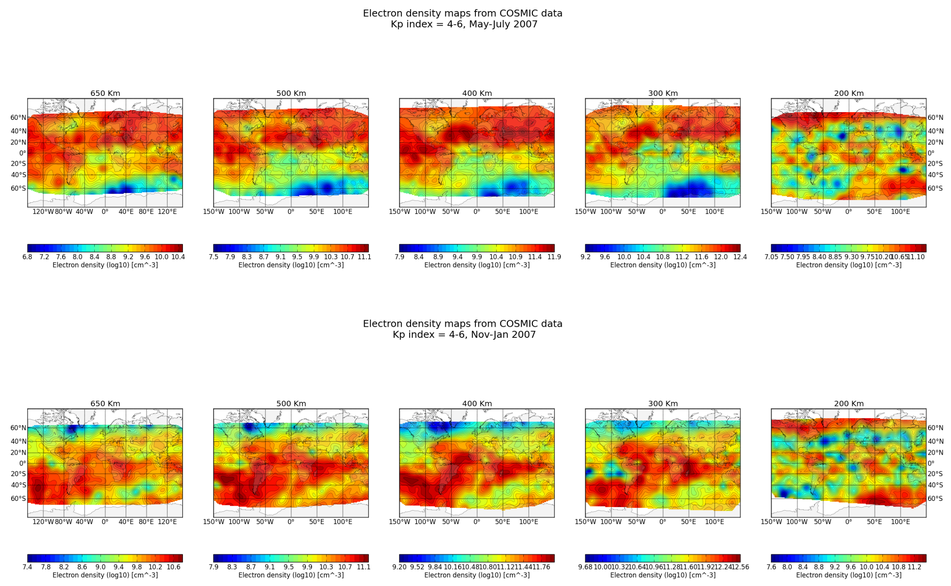


Figure 4: Global maps of electron density distribution in Summer (up) and Winter (down) at different altitudes during geomagnetically disturbed conditions. Data taken from COSMIC measurements.

VARIATION OF THE TROUGH MINIMUM POSITION

Figure 5 presents electron density and electron temperature registration along the DEMETER orbit during on of the geomagnetic storms in January 2005. As the storm develops one can observed that the location of the minimu density moves towards lower latitudes. That confirms that the magnetosphere is the subject of the compression during disturbance.

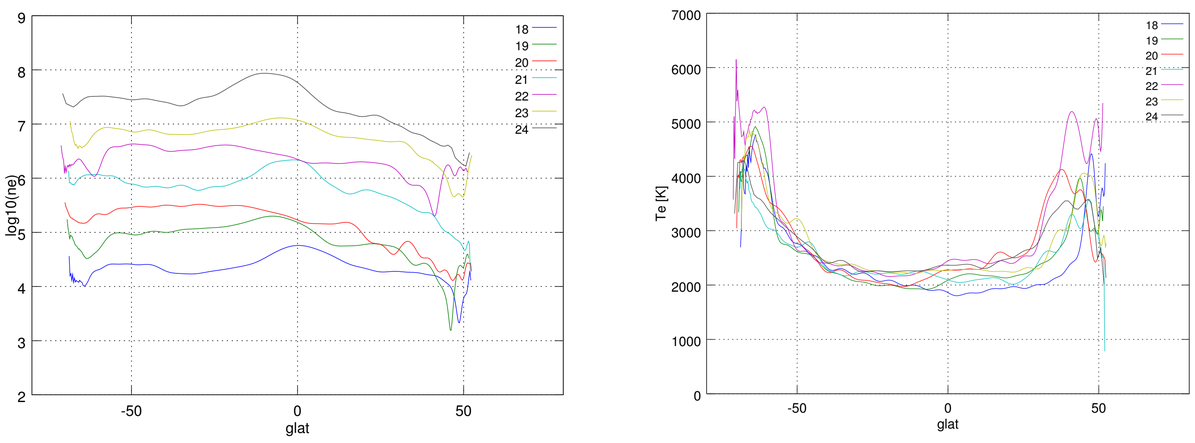


Figure 5: Electron density distribution (left) and electron temperature (right) during geomagnetic storm in January 2005 at selected longitudinal location. Data obtained from ISL experiment onboard DEMETER.

We have also analysed what is the relation between the geomagnetic condition (here, Fig. 6, by means of the Kp index) and the position of the trough.

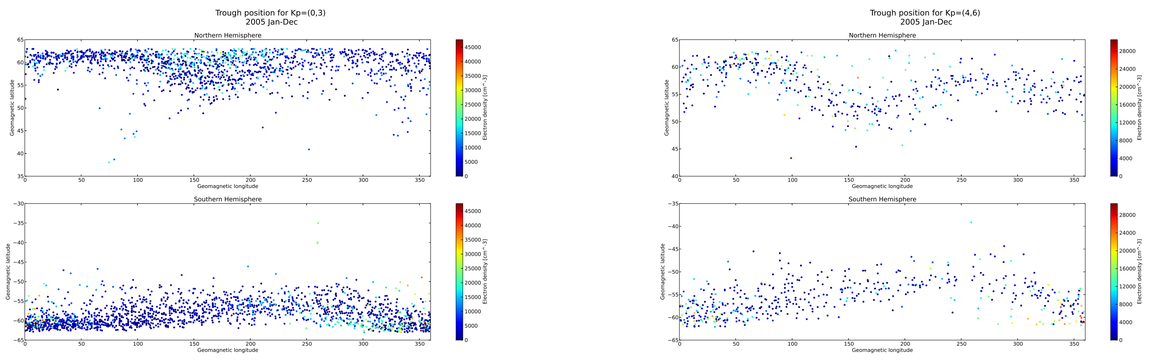


Figure 6: Position of the trough minimum (for northern and southern hemisphere separately) with regard to the Kp index.

ACKNOWLEDGEMENTS

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