Influence of seasonal changes on the mid-latitude trough properties

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INTRODUCTION

The mid-latitude ionospheric trough is a depleted region of ionospheric plasma observed in the topside ionosphere. Its behavior can provide useful information about the magnetospheric dynamics, since its existence is sensitive to magnetospherically induced motions. Mid-latitude trough is mainly a night-time phenomenon. Both, its general features and detailed characteristics strongly depend on the level of geomagnetic disturbances, time of the day, season, and the solar cycle, among others. Data used for the analysis comes from the FORMOSAT-3/COSMIC mission. It's a joint U.S-Taiwanese project consisting of six microsatellites which uses radio occultation method to obtain informations about meteorological conditions in the Earths atmosphere

SEASONAL CHANGES

We can observe that trough structure is most visible during the local winter on both hemispheres (Fig 1. the bluish color around 60-65 latitude), because of the shorter time when ionosphere is sunlit. There are regions where MIT exists during almost whole year and where is most visible under favorable conditions. For the northern hemisphere trough can be easily observed for winter solstice months, i.e. from November till January. On the contrary for mentioned time period structure on the southern hemisphere is visible for some longitudes only which is also affected by occurence of the so called Weddell Sea anomaly. During May-July period we observe the opposite situation.

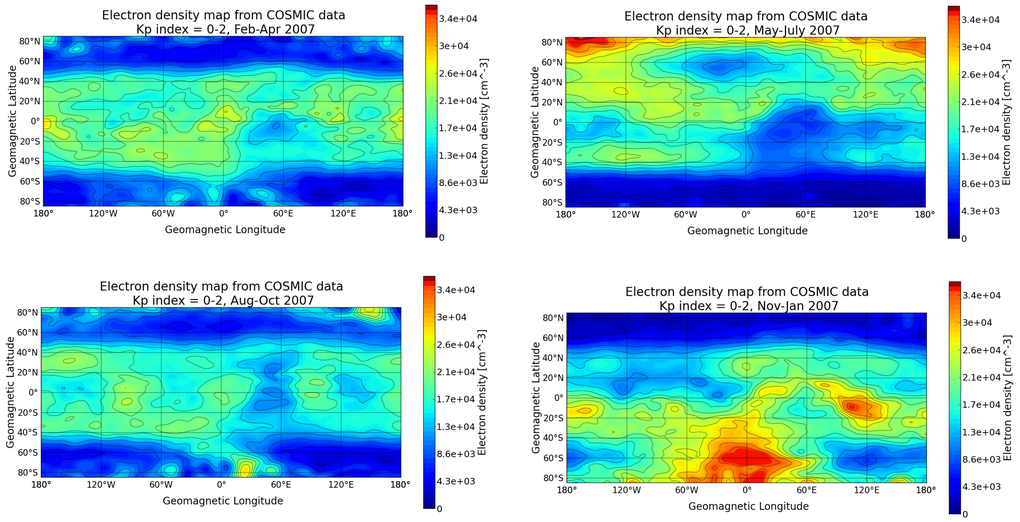

Figure 1: Maps of seasonal changes in electron density derived from COSMIC data for K_p index between 0-2 range in 2007.

THE TROUGH POSITION DURING NIGHT-TIME

The main ionspheric trough is mostly the night-time phenomenon strongly dependet on absence of sunlit in stagnation regions, which provide siutable condition for plasma decay due to recombination. The figure 2 shows data for 2-hour night periods around spring equinox. We can see that in general trough appears not for all longitude ranges. In some regions it is visible during whole night and for some it doesn't appear at all. There are regions were clearly visible trough develop only after midnight. The signature of movment of trough position toward equator also can be observed. In Figure 3 the night time evolution of the electron density for selected longitudes is presented. The northern trough for both longitude regions (around 65 latitude) is shown to move equatorward closer to the local midnight. For the southern case the similar trough behaviour is better distinguishable for the case of 120 longitude.

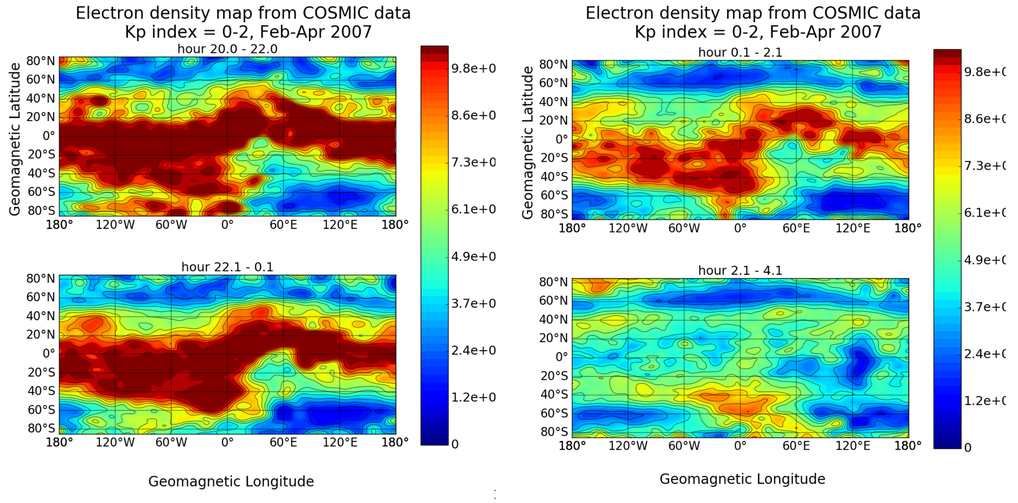

Figure 2: Maps of electron density for different night time periods derived from FORMOSAT-3/COSMIC data for K_p index 0-2, February-April, 2007.

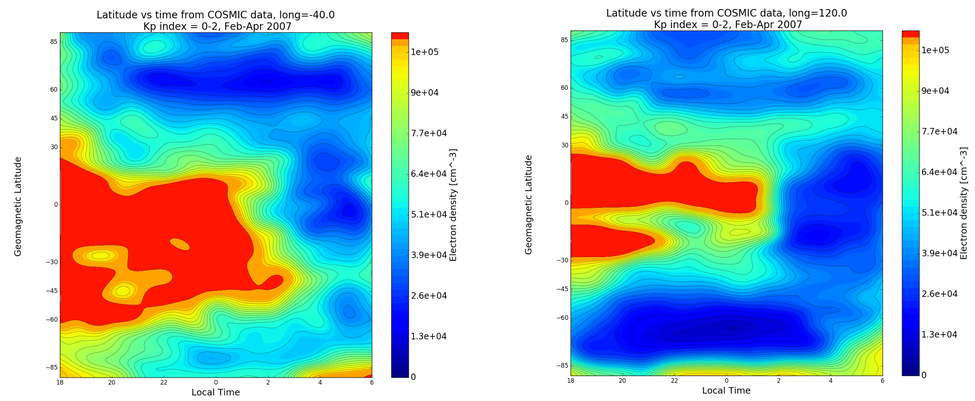

Figure 3: Maps of electron density during the night time period vs latitude for two selected longitudes (-40, 120) derived from FORMOSAT-3/COSMIC data for K_p index 0-2, Feb-Apr, 2007.

SUMMARY

The occurencce and position of mid-latitude trough are strongly correlated with seasonal, night time changes and insolation. Local winter is for both hemispheres the period when the structure appears to be the deepest and well developed, while during local summer it becomes hardly visible and much weaker. The southern hemisphere trough structure appears as a deeper and better visible even during the local summer, however during local winter it occurs only outside the region where the Weddell Sea anomaly is observed.