磁気嵐によって引き起こされた中低緯度電離圏におけるプラズマ輸送

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Storm-induced plasma transport in the low to mid-latitude ionosphere

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Geomagnetic disturbances on 7 to 12 November 2004 were quite severe and the maximum excursion of Dst reached approximately -400 nT. Associated with successive magnetic storms during this period, unusual ionospheric phenomena have been reported all over the world. In this study, however, we will limit the discussion to the observations at the West Pacific longitudes.

After sunset on 8 November, ionospheric total electron content (TEC) was rapidly increased in a short time, from 18 TEC unit at 1830 JST to 76 TEC unit at 2030 JST (JST=UT+9 hr), over Hokkaido, northern Japan. The evening extreme TEC enhancement was first interpreted as a low-latitude part of a storm enhanced density (SED) [Maruyama, Geophys. Res. Lett., 2006] that is an ionospheric signature of plasmaspheric tails. However, the center of the TEC enhanced region observed was well within the plasmasphere as an L-value of approximately 1.5. The westward drift velocity of the plasma measured by the DMSP satellite was at 250 m/s in the Earth frame, half the velocity of the solar terminator, which means that the density enhanced region moved toward midnight sector. Thus the observed TEC enhancement must be a separate phenomenon from SEDs originally defined as density-enhanced cold plasma entrained in the sunward convection within the plasmasphere boundary layer, even if there exists any connection with SEDs. In this regards, there seems to be some confusion in the usage of the term "SEDs" in the past literature.

Another unusual event was observed on 10 November, also after sunset: Low to mid-latitude ionosphere was highly structured [e.g., Nishioka et al., J. Geophys. Res., 2009] and intense range type spread F was observed across Japan. The apparent movement of the irregularities was from north to south [Sahai et al., J. Geophys. Res., 2009]. Also TEC was largely enhanced after sunset, from 15 TEC unit at 1830 JST to 45 TEC unit at 2030 JST. There have been many reports on the characteristic of the irregularities on this night, but nothing on the density enhancement after sunset.

There exist many similarities, except for the association of intense density irregularities, between the events on two nights. We will revisit the early November 2004 storm period and propose a unified physical mechanism of the disturbances on the two nights, which also might be applied to the other similar events reported by Foster and Coster [J. Atmos. Solar-Terr. Phys, 2007].