

Structuring of the midlatitude ionosphere associated with storm enhanced density

Takashi Maruyama[1]

[1] NICT

Two severe positive ionospheric storms occurred after sunset in November 2004 were compared. On 8 November, NmF2 and total electron content (TEC) increased by 20 times the quiet level at around 21 LT over northern Japan. During this event, we had a direct overflight of the DMSP F15 satellite in the region of the density enhancement. The DMSP plasma data have shown a large ion drift velocity towards northwest, which suggested that the density enhancement was so-called storm enhanced density (SED), previously reported only in the Northern America. On this night, individual ionogram showed no spread F. The other nighttime positive storm event occurred on 10 November. In this event, NmF2 increased by 5 times the quiet level at 19 LT. The TEC enhancement was significant over central Japan. The DMSP plasma data exhibited northwest ion drift again, and this event was also interpreted as SED. In contrast to the previous event, however, intense range type spread F was observed over stations from Wakkanai to Okinawa throughout the night. DMSP total ion density data showed density biteouts similar to those of plasma bubbles over the magnetic equator.

Previously, two mechanisms are proposed to explain the generation of midlatitude spread F, traveling ionospheric disturbances and Perkins instability. These mechanisms, however, are hard to generate large density biteouts in the topside ionosphere at midlatitudes. On the other hand, Rayleigh-Taylor instability in the equatorial ionosphere creates density biteouts or bubbles, but which are thought to be limited to equatorial to low latitudes. A storm enhanced density plume can be a third mechanism of midlatitude ionospheric irregularities, which carries density biteouts from an equatorial region to midlatitudes. Strong eastward electric fields at the equatorial to low latitudes push the ionosphere into lower midlatitudes, and succeeding poleward electric fields drive it toward west forming a SED/TEC plume. When the SED/TEC plume originates in a sunlit region, we may have no irregularities, like the case on the night of 8 November 2004. However, if it originates in the dark after sunset, the ionosphere may be strongly structured by Rayleigh-Taylor and EXB drift instability and the irregularities are convected into midlatitudes along with the ambient plasma, like the case on the night of 10 November 2004.