# Super plasma fountain, $F_3$ layer and ionospheric storms during prompt penetration electric field events

# Nanan Balan[1]; Kazuo Shiokawa[2]; Yuichi Otsuka[2]; Mamoru Yamamoto[3]; Shigeto Watanabe[4]

[1] STEL, Nagoya Univ.; [2] STELAB, Nagoya Univ.; [3] RISH, Kyoto Univ.; [4] Dep. of Cosmosciences, Hokkaido Univ

The equatorial plasma fountain, $F_3$ layer and ionospheric storms during daytime eastward prompt penetration electric field (PPEF) events are presented using a physics based model and data. The data obtained using the super double geomagnetic storms of 07-11 November 2004 include the east-west electric field measured by Jicamarca IS radar, electron density (Ne) profiles measured by Jicamarca and Shigaraki IS radars, peak electron density (Nmax) and total electron content (TEC) measured by world ionosonde and GPS-TEC networks including GEONET, and 630 nm intensity measured by OMTI. The model calculations are carried out using the Sheffield University Plasmasphere Ionosphere Model (SUPIM).

The data show strong $F_3$ layer quickly ascending to the topside ionosphere with large density depletions around the equator, and strong positive ionospheric storms (in Ne, Nmax, GPS-TEC and 630 nm intensity) at mid latitudes in Japan-Australian longitude during the first super storm (08 November). Similar ionospheric changes are observed in American longitude during the second super storm (09 November) though the ionospheric storms at mid latitudes were weak. These observations indicate the rapid development of super plasma fountain due to strong longitude dependent daytime eastward PPEFs during the main phase of both super storms. Such strong PPEF was in deed measured by the Jicamarca IS radar during the second super storm (09 November).

The model results confirm the rapid development of super plasma fountain, strong $F_3$ layer with depletion around the equator, and poleward movement of equatorial ionization anomaly (EIA) crests during daytime eastward PPEF events both in the presence and absence of neutral wind. However, the EIA crests become stronger than normal only in the presence of an equatorward neutral wind that reduces (or stops) downward plasma velocity component due to diffusion and raises the ionosphere to high altitudes of reduced chemical loss. The results suggest that the presence of an equatorward neutral wind is required to produce strong positive ionospheric storms during daytime eastward PPEF events. The equatorward neutral wind need not be a storm-time wind though stronger wind can lead to stronger ionospheric storms.