

Stormtime substorm electric fields at middle-equatorial latitudes as observed with HF Doppler sounders and magnetometers

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The HF Doppler sounders (HFDs) in Prague (49.4 degrees magnetic latitude) and Japan (29.2 mlat) detected prompt penetration electric fields at middle and low latitudes during the main and recovery phases of the storm on 22-23 June, 2015. The main phase started immediately after the storm sudden commencement (SC) at 1833 UT and reached a minimum SYM-H of -139 nT at 2016 UT. The Cluster 2 and THEMIS spacecraft detected the PI-, MI-electric field and succeeding intense convection electric field for 70 minutes in the dawn- and day-side magnetosphere, respectively. The electric field was eastward in Prague (2000 MLT) and westward in Japan (0330 MLT). The main phase electric field intensified the equatorial electrojets (EEJ) on both the day and nightsides as detected by the magnetometers at Huancayo in South America (1330MLT), Guam in the western Pacific and Tirunelveli in India (2330MLT). The sudden northward turning of the interplanetary magnetic field caused a decrease in intensity of electric fields in the magnetosphere and the EEJs over 20 min from 1950 UT. Immediately afterwards, the HFDs detected strong eastward electric fields on the nightside with the intensity of 9.9 mV/m at Idate (0500 MLT) and 14.8 mV/m at Prague (2130 MLT) while the auroral electrojet intensified on the night side at Dixon (01 MLT). The opposite polarity of the electric field indicates that the overshielding occurred. The overshielding electric field was confirmed with the anti-sunward plasma flows in the afternoon at latitudes equatorward of the expanded sunward dusk convection cell as detected by the Blackstone SuperDARN radar. All the features of the recovery phase overshielding are consistent with those of the isolated substorm overshielding (Hashimoto et al., 2017) except that the intensity is anomalously strong. We suggest that the stormtime substorms provide strong overshielding electric field penetrating to the middle-equatorial latitudes on the nightside as well as on the dayside.

Keywords: stormtime substorm, ionospheric electric field, mid-latitude ionosphere, equatorial electrojet, magnetospheric convection electric field, HF Doppler sounder