Stormtime overshielding electric fields observed by ROCSAT-1

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The dawn-to-dusk convection electric field is an essential cause for driving the geomagnetic storm and for triggering disturbances in low- and equatorial- latitude ionosphere. The electric field is often reversed because of the convection reduction, disturbance dynamo, and substorm expansion. In this study, using the vertical plasma drift velocity measured by the Ionospheric Plasma and Electrodynamics Probe Instrument (IPEI) aboard ROCSAT-1, we examined the overshielding electric field for major geomagnetic storms during the period from 1999 to 2004. The electric field was estimated from the meridional component of the ExB drift velocity by applying the IGRF-2000 model as the ambient magnetic field. We analyzed time variations of the electric fields at different local times in the range of 25-36 degrees in geographic latitude for three storm events that occurred on 06 April, 2000, 06 November, 2001, and 20 November, 2003. During the storm main phase initiated by the SC at 1639UT on 06 April, 2000, IPEI detected the westward electric field with magnitude of 2-3 mV/m in the pre-dawn hours (5-6 LT), while the electric field turned to eastward with magnitude of 5 mV/m during the recovery phase. On the dayside (9-10 LT), the electric fields are eastward with 4 mV/m during the main phase and westward with 3 mV/m during the recovery phase. In the evening hour (19-20 LT), the electric field is eastward with 4-5 mV/m during the main phase and westward with 2 mV/m during the recovery phase. The magnitude of the electric field changed in a significantly different manner at pre-dawn (5-6 LT), afternoon(14-16 LT), evening (18-20 LT) and pre-midnight (22-23LT). The local time features of the electric field indicates that the convection electric field provided by the Region-1 field-aligned currents predominate the main phase, while the recovery phase is predominated by the overshielding electric field provided by the Region-2 field-aligned currents. Furthermore, both the convection and overshielding electric fields manifest the evening anomaly with the electric fields being in the same direction as in the daytime. Similar local time and storm phase tendencies are identified for the other storm events. These results are in good agreement with those obtained from the ground magnetometer data.