

Overshielding associated with substorm current system

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Convection electric field propagates instantaneously from the polar ionosphere to the equator, and causes the DP2 currents consisting of two-cell current at high latitude and eastward current at the dayside geomagnetic equator during substorm growth phase. Reversed current is often observed at the subauroral -equatorial latitudes, when the convection electric field is reduced by northward turning of the IMF. In this paper, we examine a new type of overshielding that initiated at substorm expansion, accompanying an increase in the convection electric field at auroral latitudes. Using data from IMAGE and INTERMAGNET magnetometer arrays and SuperDARN for five years from 2003 to 2007, 114 overshielding events were chosen. These events were found occurring 1-10 minutes before development of positive bays at mid-latitude on the night side. Furthermore, we found that the overshielding occurred a few minutes before dipolarization of the nighttime magnetosphere for some events. These data infer that both the Region-1 and Region-2 field aligned currents (FACs) are intensified at the onset of the substorm, and that the electric field associated with the Region-2 FACs overcomes that of the Region-1 FACs at mid - equatorial ionosphere. The substorm current system (DP1 current) should be modified so as to include the ionospheric currents at the dayside mid- equatorial latitudes.