OVERSHIELDING AT SUBAURORAL - EQUATORIAL LATITUDES AT THE ONSET OF SUBSTORM

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The dawn-to-dusk convection electric field propagates instantaneously from the polar ionosphere to the equator, and causes the DP2 current system consisting of two-cell current vortices at high latitude and eastward current amplified by the Cowling effect at the dayside geomagnetic equator. Reversed currents have often been observed at subauroral-equatorial latitudes, when the convection electric field reduces its intensity because of northward turning of the IMF. The reversed current has been explained by means of an overshielding electric field due to the Region-2 field-aligned current. In this paper, we show overshielding that initiated at a substorm expansion onset, accompanying an increase in the DP2 currents at auroral latitudes as observed with the IMAGE and Greenland magnetometer arrays. With the SuperDARN observations, we confirmed that sunward plasma flow was enhanced at the afternoon auroral latitude as overshielding occurred and that the reversed current corresponded to an anti-sunward convection flow equatorward of the sunward auroral flow. In addition to the conventional features, the overshielding has new features that the convection electric field increased concurrently and its onset was a few minutes earlier than the onset of the positive bay in the midnight. All these data infer that both the Region-1 and the Region-2 field-aligned currents were intensified at the onset of the substorm, and that the electric field associated with the Region-2 field-aligned currents overcame that of the Region-1 field-aligned currents at mid-equatorial latitudes. The substorm current system (DP1 current) should be modified so as to include the ionospheric currents at the dayside mid - equatorial latitudes.

Overshielding, Region-2 field-aligned current, substorm current

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