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Equatorial counterelectrojets during geomagnetic storms and their possible dynamos in the magnetosphere

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The convection electric field and Region-1 field-aligned currents (R1 FACs) are generated by the solar wind dynamo and are conveyed by the shear Alfven waves to the polar ionosphere, extending near-instantaneously to low latitude by means of the Earth-ionosphere waveguide. The transmitted electric field drives the DP2 currents at mid-equatorial latitudes with enhancement in amplitude at the dayside equator (EEJ). The convection electric field further extends to the inner magnetosphere and generates the ring current. The partial ring current would work as a dynamo for the overshielding electric field responsible for the equatorial counterelectrojet (CEJ) when the convection electric field reduces its intensity. The convection reduction has been a major cause of the overshielding, but our recent studies [Hashimoto et al., 2011] show that the substorm works as a dynamo for the overshielding electric field even under the steady southward IMF. In this case, the substorm intensifies both the R1 and R2 FACs, but the R2 FACs are strong enough to cause the overshielding. In this paper we show that the CEJ occurs during both the main and recovery phases of the storm and attempt to identify the dynamo for the CEJs. Using solar wind and ground-based data, we suggest that the stormtime CEJ is caused by the northward turning of the IMF, sudden decrease in the solar wind density, and the substorm expansion. It is to be noted that the substorm overshielding plays a crucial role in the generation of the electric field at subauroral latitude responsible for the high speed auroral plasma flow and SAPS.

Keywords: geomagnetic storm, substorm, overshielding, equatorial counterelectrojet, Region-2 field-aligned current