

Continent-Wide R1/R2 Current System and Ohmic Losses by Broad Dipolarization-Injection Fronts

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Abstract

We employ Magnetospheric Multiscale, Geostationary Operational Environmental and Los Alamos National Laboratory satellites, as well as the ground magnetometer networks over Greenland and North America to study a substorm on 9 August 2016 between 9 and 10 UT. We found that during the substorm two earthward flows, whose dipolarization-injection fronts exceeded 6.5 and 4 Earth's radii (RE) in YGSM, impinged and rebounded from Earth's dipolar field lines at $L = 6-7$ downtail, where L is the McIlwain number. The impingements and rebounds ended with a substorm current system of downward R1 and upward R2 currents which grew to azimuthally cover the whole North American continent. At the fronts, regions of enhanced negative $\mathbf{j} \cdot \mathbf{E}$ were formed and peaked toward the end of the impingements. These regions appeared to be conjugate with eastward moving aurora (along the growth phase arc and together with eastward drifting energetic electrons at geosynchronous equatorial orbit), which manifests ionospheric Ohmic losses.

