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Coupling between magnetospheric interfaces and evening discrete aurora through field-aligned currents

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Current continuity in the auroral circuit involves closure of the current generated in the magnetosphere through field-aligned currents and the perpendicular, Pedersen and Hall, currents in the ionosphere. The current-voltage relation (CVR) between field-aligned current density ($j_{||}$) and the field-aligned potential drop ($\Delta\Phi$) is generally obtained from a kinetic treatment of the adiabatic motion of particles in a mirroring magnetic field and a field-aligned electric field. We investigate the coupling between a magnetospheric structure, described by a Vlasov equilibrium solution, and the evening polar ionosphere. The model solves the current continuity equation neglecting the divergence of the Hall currents. We obtain narrow channels of precipitating accelerated magnetospheric electrons and ionospheric ions that are accelerated upward, intense upward field-aligned currents, and regions of enhanced Pedersen conductance, all the ingredients for discrete auroral arcs. Model results are compared with data from a conjunction between Cluster (above the acceleration region) and DMSP (intersecting Region 1 field-aligned currents and an auroral arc) from April 28, 2001, reported by Vaivads et al.(2003). Model results and experimental data suggest that the generator of the auroral arc observed by DMSP may be located at the interface between the PSBL with the lobe or at higher altitudes, at the inner edge of the LLBL. The model estimation of the field-aligned current density, flux of precipitating energy and spatial scales of the arc are in agreement with observations suggesting that Cluster and DMSP provide evidence for auroral electron acceleration by a quasi-stationary field-aligned potential drop.