

AMPERE observations of the Birkeland currents associated with substorms and comparison with simple electrodynamic modelling

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Abstract

We present observations of the global terrestrial Birkeland field-aligned current (FAC) pattern observed by the Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE) during a sequence of substorms. The observations show that the region 1 and 2 current systems move to lower latitudes during the substorm growth phase and retreat to higher latitudes following substorm expansion phase onset. We interpret these observations within the framework of the expanding/contracting polar cap paradigm. This links expansion of the polar cap and equatorward motion of the auroras and FAC systems to the action of magnetopause reconnection increasing the open magnetic flux content of the magnetosphere.

Magnetotail reconnection subsequently causes a decrease in the open flux content and the auroras and FACs contract polewards. The observed expansion and contraction rates allow us to model the associated magnetic flux transport in the system, a driver of ionospheric convection, and hence its associated electrostatic potential pattern. This allows us in turn to model the FAC magnitudes that are expected for different ionospheric conductances. Good overall agreement is found. Discrepancies, where they exist, provide information on the substorm current wedge FACs, which are not included in our model.