Local least squares estimation of auroral field-aligned currents

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Auroral field-aligned currents control the exchange of energy between the polar ionosphere and distant magnetospheric regions. This paper discusses a class of multi-point array analysis methods for auroral field-aligned currents as measured by the constellation of Swarm satellites. We pursue a local linear least squares approach based on a few measurements around a reference point. The resulting estimators are compared with non-local counterparts and also with local analysis methods based on finite differences. Implementation, errors, caveats, and further practical issues are addressed. A second category of methods deals with the geometrical characterization of weakly time-dependent current systems on multiple spatial scales using along-track measurements of individual spacecraft. Selected auroral crossings of the Swarm satellites are used to illustrate and to contrast the various techniques.