Field-aligned currents during an intense substorm as estimated by the KRM method.

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By using global auroral images and geomagnetic variations during an intense substorm, the spatial distribution of field-aligned currents (FACs) relative to auroras is studied . To derive FACs, we first estimated the ionospheric Hall and Pedersen conductances from ultraviolet images taken by the Polar satellite. We then used the Kamide-Richmond-Matsushita (KRM) method, which is a magnetogram-inversion modeling algorithm to specify the earth's polar ionosphere. KRM assumes Ohm's law for the ionosphere and obtain various ionospheric parameters including FACs, using the ionospheric conductances and ground magnetic field perturbations as inputs. It is believed that upward FACs are normally co-located with discrete auroras in the poleward half of auroral bulges during substorms. Upward FACs were located, however, in the equatorward half of a bulge during the expansion phase of an isolated substorm which started at 0724 UT, January 12, 1997. Downward FACs were located in the poleward half and near the eastward edge of the bulge. The electric filed was dominantly south-westward inside the bulge. These results indicate that the spatial gradient of conductance is more important for the FACs to grow such that the centers of bright auroras and FACs were shifted.