

First two-dimensional observations of overshielding by the SuperDARN Hokkaido radar

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Two-dimensional observations of ionospheric plasma flows possibly caused by overshielding are reported for the first time. The observations were made by the mid-latitude SuperDARN Hokkaido radar in Japan during a major magnetic storm on December 15, 2006. The magnetosphere was exposed continuously to a southward interplanetary magnetic field (IMF) for several hours during the main phase of the storm. Immediately following the subsequent northward turning of the IMF, an anti-sunward plasma flow was observed for about 14 min in the pre-dusk sector at magnetic latitudes of 50-60 deg, reaching a maximum line-of-sight speed of 70-80 m/s. These features are consistent with a simulation of coupling between the ring current and the ionosphere associated with an overshielding condition. Within 1 h of the first observation, a similar anti-sunward flow was observed during a period of southward-oriented IMF. However, the simulation cannot account for the anti-sunward flow in this case. It is suggested that this second overshielding-like condition is attributable to a sudden contraction of the polar cap associated with the substorm, or to a sudden strengthening of the inertial current converted from the abrupt injection of magnetospheric ions.