

## EISCAT observations of unusual flows in the morning sector associated with weak substorm activity

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**Abstract.** A discussion is given of plasma flows in the dawn and nightside high-latitude ionospheric regions during substorms occurring on a contracted auroral oval, as observed using the EISCAT CP-4-A experiment. Supporting data from the PACE radar, Greenland magnetometer chain, SAMNET magnetometers and geostationary satellites are compared to the EISCAT observations. On 4 October 1989 a weak substorm with initial expansion phase onset signatures at 0030 UT, resulted in the convection reversal boundary observed by EISCAT (at  $\sim 0415$  MLT) contracting rapidly poleward, causing a band of elevated ionospheric ion temperatures and a localised plasma density depletion. This polar cap contraction event is shown to be associated with various substorm signatures; Pi2 pulsations at mid-latitudes, magnetic bays in the midnight sector and particle injections at geosynchronous orbit. A similar event was observed on the following day around 0230 UT ( $\sim 0515$  MLT) with the unusual and significant difference that two convection reversals were observed, both contracting poleward. We show that this feature is not an ionospheric signature of two active reconnection neutral lines as predicted by the near-Earth neutral model before the plasmoid is "pinched off", and present two alternative explanations in terms of (1) viscous and lobe circulation cells and (2) polar cap contraction during northward IMF. The voltage associated with the anti-sunward flow between the reversals reaches a maximum of 13 kV during the substorm expansion phase. This suggests it to be associated with the polar cap contraction and caused by the reconnection of open flux in the geomagnetic tail which has mimicked "viscous-like" momentum transfer across the magnetopause.

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