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Quasistatic electric field structures and field-aligned currents in the polar cusp region

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Quasistatic electric field structures in the vicinity of the cusp have been studied using Cluster data.
There are two categories of electric potential structures, S-shaped and U-shaped.
In previous studies in the nightside auroral region, the S-shaped potential was uniquely related to the boundary transition between low density and high density plasma regimes, leading to the conclusion that the electric field profile depends on whether the plasma populations on each side of the boundary can support intense field-aligned and Pedersen currents.
In this study in the dayside cusp this is not the case, and a different explanation has to be sought.
Most electric field structures are associated with the start of the cusp ion dispersion or with injection signatures within the cusp, and the field-aligned currents associated with these structures are found to be consistent with the cusp currents expected for the IMF By polarity at the time.
This indicates that the electric field structures are generated by the cusp current system, or modified by the cusp current system to be consistent with the required currents.
Furthermore, we provide firm evidence for the dayside Region 1 current to be located on open field lines, which have been postulated but to our knowledge heretofore not experimentally verified.