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Multispacecraft and simulation study of dayside reconnection using the response of the cusp to variable IMF conditions

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Particles entering the polar cusps reflect fundamental properties of the large-scale topology and dynamics of the reconnection of the interplanetary magnetic field (IMF) with the geomagnetic field. In particular, discrete structures in the energy-latitude dispersion of precipitating particles are observed frequently by spacecraft as they cross the polar cusps. These observations indicate that significant spatial and temporal changes in the merging process occur at the dayside magnetopause as it interacts with IMF discontinuities. We use multispacecraft observations of the cusp's response to fast rotations of the IMF and the results of numerical simulations to determine the large-scale topology and dynamics of the merging region at the dayside magnetopause. This study is based on consecutive crossings of the northern mid-altitude cusp by the Cluster satellites and uses global magnetohydrodynamic simulations together with time-dependent large-scale kinetic computations. Comparisons between energy-latitude ion dispersion patterns computed from the simulations and Cluster measurements indicate that the occurrence of unsteady large-scale structures is related to the spatial variation of the reconnection region as IMF discontinuities interact with the magnetopause.