

Multi-spacecraft measurements of magnetospheric substorms and their implications for the near-Earth neutral line model

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The magnetospheric community has long sought the capability to view the substorm system in a global way and concurrently to probe the microphysical details of key physical regions. This objective has now been substantially realized with the combination of the CLUSTER constellation and global magnetospheric imaging missions. With the addition of ACE, POLAR, and various geostationary orbit spacecraft, there is an ability to apply both global and local observational principles. Recent examples serve to illustrate the observational power of these new tools. Using tail crossing events in 2001-2002, CLUSTER observed clear substorm sequences of events in the mid-magnetotail region ($X \sim 19R_E$). In this presentation we focus on global substorm onset events in August 2002. CLUSTER data reveal microphysical details while other spacecraft show the global, macroscopic context. We have used the Lyon-Fedder-Mobarry MHD simulation code to numerically model particular events. The observations and model comparisons lead to improved understandings of 3-dimensional magnetospheric substorm processes. Analysis shows global features consistent with the present-day near-Earth neutral line (NENL) model of substorm dynamics, but the specific details reveal previously unappreciated aspects of magnetic reconnection and particle acceleration near the neutral line.