Geophysical Research Abstracts
Vol. 13, EGU2011-8705, 2011
EGU General Assembly 2011

Multiple Spacecraft Study of the Impact of Turbulence on Reconnection Rates

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Magnetic turbulence and secondary island formation have reemerged as possible explanations for fast reconnection. Recent three-dimensional simulations reveal the formation of secondary islands that serve to shorten the current sheet and increase the accelerating electric field, while both simulations and observations witness electron holes whose collapse energizes electrons. However, few data studies have explicitly investigated the effect of turbulence and islands on the reconnection rate. We present a more comprehensive analysis of the effect of turbulence and islands on reconnection rates observed in space. Our approach takes advantage of multiple spacecraft to find the location of the spacecraft relative to the inflow and the outflow, to estimate the reconnection electric field, to indicate the presence and size of islands, and to determine wave vectors indicating turbulence. A superposed epoch analysis provides independent estimates of spatial scales and a reconnection electric field. We apply k-filtering and a new method adopted from seismological analyses to identify the wavevectors. From several case studies of reconnection events, we obtain preliminary estimates of the spectral scaling law, identify wave modes, and present a method for finding the reconnection electric field associated with the wave modes.