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Spatial variation of energy conversion at the Earth's magnetopause: Statistics from Cluster observations

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We investigate magnetopause energy conversion in a large statistical data set utilizing Cluster spacecraft observations. We have compiled a database of about 4000 magnetopause crossings from Cluster spacecraft 1 (SC1) measurements during years 2001 - 2008. We have estimated the local energy conversion across the magnetopause for these crossings using Generic Residue Analysis (GRA) and analyzed the spatial distribution of load and generator regions during dayside and lobe reconnection as a function of the IMF magnitude and solar wind dynamic pressure. We found a scatter of the load and the generator regions on the magnetopause surface. Categorizing the crossings into equatorward or tailward of the cusp organizes the load and generators on the surface. During dayside reconnection, equatorward (tailward) of the cusp indicates more load (generator) than generator and is in agreement with theory. During lobe reconnection, we find that a load region dominates both equatorward and tailward of the cusp. We compare the statistics with GUMICS-4 global magnetohydrodynamic simulation results and find that there is a reasonable agreement, although disagreements are also found especially during lobe reconnection. We also investigate the influence of IMF magnitude on the load and generator locations and suggest that the spatial mixing of load and generators is due to rapid movement of the magnetopause surface which in turns moves the locations where load and generator processes appear. The solar wind dynamic pressure controls the magnitude of energy conversion across the magnetopause, and higher dynamic pressures lead to more energy conversion and vice versa.