Evaluating the magnetic and plasma flux transport in the plasma sheet during geomagnetic storms using MMS

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Abstract

During geomagnetic storms, the nightside of Earth's magnetosphere is highly disturbed, and several phenomena of various scales co-exist, affecting each other's dynamics. Enhanced convection along with particle injections influences the development of ring current during storm times. At the same time, mesoscale structures such as bursty bulk flows (BBFs) and dipolarization fronts are known to contribute significantly to the transport of plasma and magnetic flux in the plasma sheet, but their role specifically during storms remains poorly understood.

In this work, we evaluate the magnetic and plasma flux transport occurring in the plasma sheet region by using measurements from NASA's Magnetosphere Multiscale (MMS) mission. Due to the recent magnetotail campaigns, MMS contains a plethora of measurements from the plasma sheet region, allowing statistical investigation to be conducted. Specifically, from hundreds of geomagnetic storms during the MMS era, we classified about 200,000 data points (4.5 sec resolution) from the Fast Plasma Investigator (FPI) indicating MMS presence in the plasma sheet during disturbed geomagnetic periods.

The statistical analysis focuses on examining how different properties describing convection in the plasma sheet change over the different phases of storms (main and recovery) and over different ranges of distance from the Earth. Finally, we compare our results with previous efforts from other missions, and we examine whether there are instrumental limitations that can affect the statistical results by using different instruments from MMS with variable time resolution and energy range.