Plasma Sheet Magnetic Flux Transport During Geomagnetic Storms

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What is the science question?

How is global convection in the plasma sheet changing during geomagnetic storms ? How is the elevated storm time convection electric field realized throughout the magnetotail?

What were your findings?

We performed a large-scale statistical analysis of millions of data points from *in-situ* observations by the MMS and Geotail missions during quiet times and geomagnetic storms. We found that particles transport more magnetic flux due to the elevated electric field. We further noted a significant difference between the dawn (morning) and dusk (evening) sectors on the nightside of the near-Earth space environment. Relatively to quiet times, during storm times, plasma moves faster (V is higher) on the dawn side, while the magnetic field is stronger and more dipolar (Bz is higher) on the dusk side.

What was the impact?

While It was known that the convection electric field is elevated during geomagnetic storms, the precise profile of this elevation was impossible to map in 2D due to a lack of sufficient measurements. By using both MMS and Geotail, we were able, for the first time, to see the profiles of the convection electric field, magnetic field, and plasma flow across the entire plasma sheet region during geomagnetic storms. Our findings suggest that plasma movement and energy buildup during storms are more complex than previously thought. The energy buildup on the dusk side pushes plasma movement more toward the dawn side. Understanding these details helps us better predict the impacts of geomagnetic storms on Earth's space environment.

Why does it matter to non-scientists?

Strong solar activity creates major disruptions of Earth's magnetic field known as geomagnetic storms. These major disturbances of near-Earth space can impact essential technologies like GPS systems and power grids. A better understanding of geomagnetic storms can improve our ability to protect our technology and infrastructure on Earth.

Published in Geophysical Research Letters (GRL), September 2024 https://doi.org/10.1029/2024GL110839

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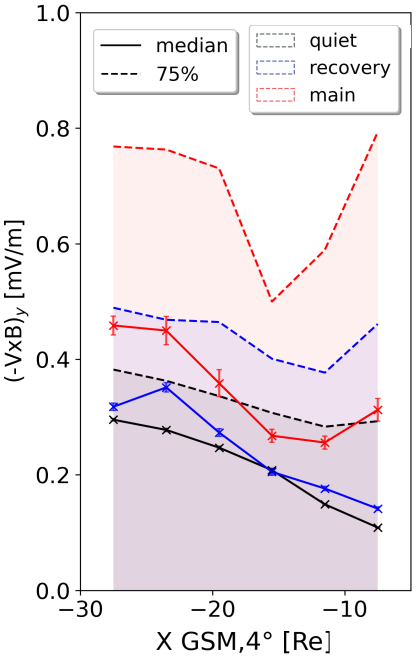
This research was supported by the NASA DRIVE Science Center for Geospace Storms (CGS) under award 80NSSC22M0163



Statistics from plasma sheet measurements showing the convection electric field and how is systematically higher during geomagnetic storms.