VOL. 99 • NO. 7 • JULY 2018

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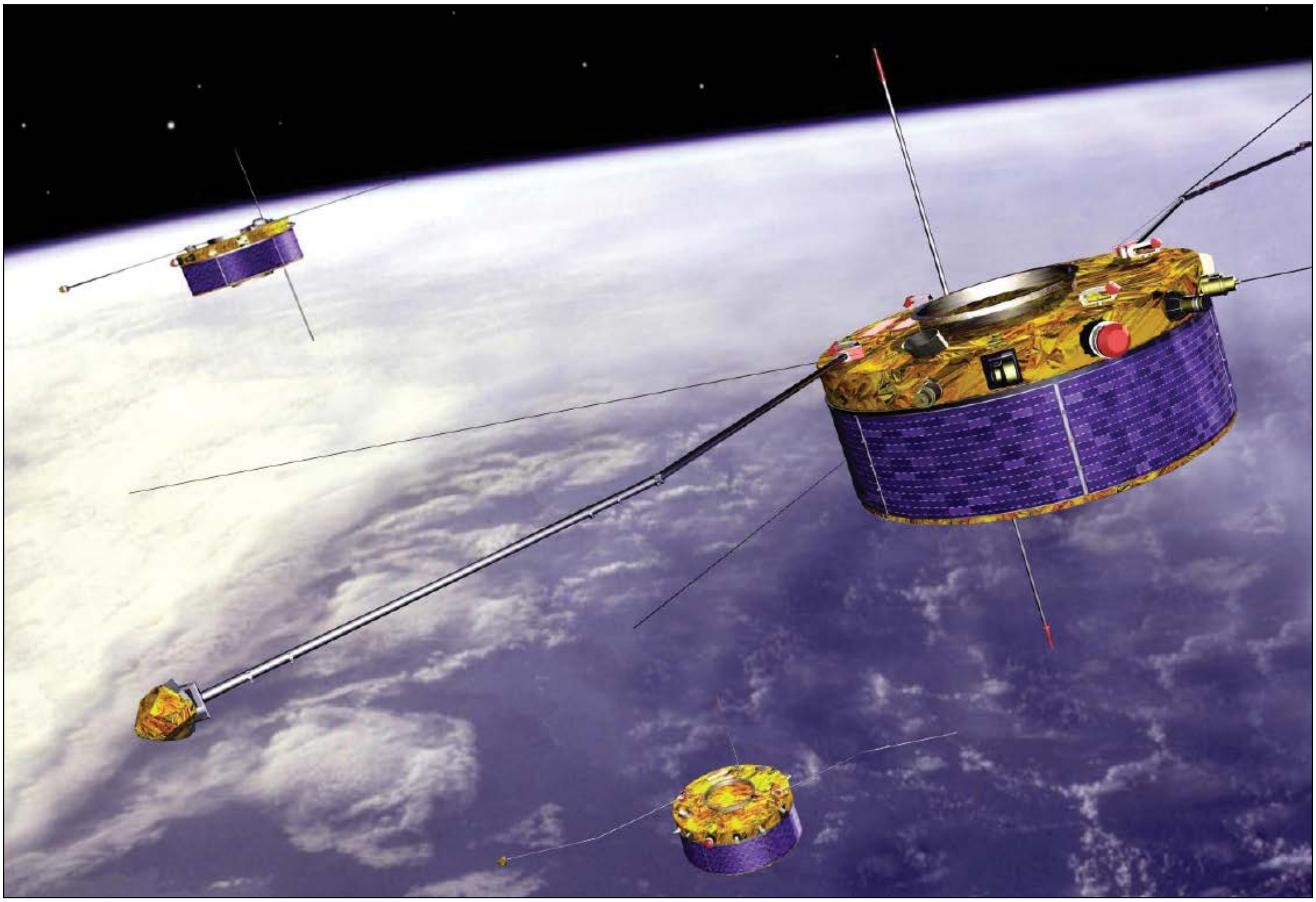
How Space Storms Affect the Satellite Superhighway



Artist's rendering of the Cluster spacecraft. Credit: NASA

Some 36,000 kilometers above Earth, more than 400 commercial, telecommunication, and weather satellites dance in geosynchronous orbit, circling the planet at precisely the same rate that it turns. This so-called satellite superhighway is occasionally whipped by solar wind and fluctuating magnetic fields, a chaotic environment that can damage and interfere with the spacecraft. Now a new 3-D mathematical model of the magnetic environment in the region could help researchers predict how storms affect the geosynchronous magnetic environment.

The researchers' previous attempt to model the solar wind's impact on the geosynchronous magnetic field was conducted more than 25 years ago and did not account for space storms that occur when solar particles slam into Earth's protective magnetosphere. It also used data from only a single satellite, which limited the model's ability to capture the complex dynamics in this zone.

In their new study, *Andreeva and Tsyganenko* used radial basis functions—a numerical methodology to crunch data from multiple satellites, including Time History of Events and Macroscale Interactions during Substorms (THEMIS), Polar, Cluster, and the Van Allen Probes. This computational approach takes into account all major sources of the geomagnetic field, such as the ring and tail currents that result from the solar wind flow around Earth's magnetosphere.

Previously, the team had shown that this approach can accurately model the magnetic field in a given region, including its disturbance by space weather. In their new study, the researchers took into account both the current state of the solar wind and the interplanetary magnetic field—the Sun's magnetic field that gets carried into space—and their previous history. They found that the radial basis function model performed better than earlier attempts to model the region, and they validated it using two separate data sets. Yet they were not able to fully model variations related to substorms, the violent and brief electromagnetic disturbances that cause auroras. The authors note that this is a major stumbling block that will have to be addressed in future research. (*Space Weather,* https://doi.org/10.1002/2017SW001684, 2018)

—Emily Underwood, Freelance Writer