Our Planet

3D Global Hybrid Simulations of Earth's Magnetosphere

Science Mission Directorate

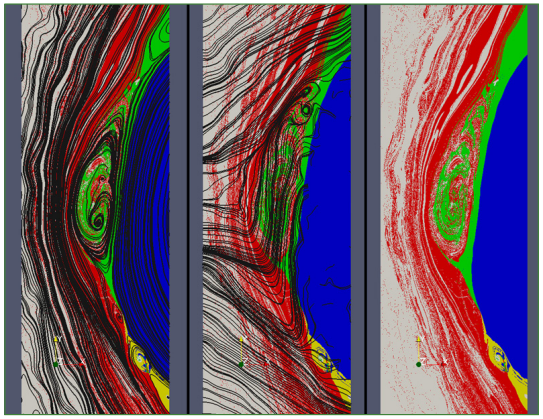
As the global reliance on technology has increased, so has our exposure to the dangers of solar storms. The term "space weather" has been coined to describe the conditions in space that affect the Earth and its technological systems.

Our research in space weather focuses on 3D global hybrid simulations of the Earth's magnetosphere—long considered the "holy grail" in space physics. Using our advanced hybrid code, we have performed one of the largest 3D simulations to date, using 25 thousand cores on NASA's Pleiades supercomputer.

These simulations are, for the first time, enabling a glimpse of the global magnetosphere while capturing the full ion kinetic effects. Our initial problem targets reconnection at the dayside magnetopause. Initial results have yielded key discoveries regarding the formation of flux ropes at the magnetopause.

Global hybrid simulations generate massive datasets. A single run for this data-intensive computing application can generate over 200 terabytes of data. In order to extract physics from these data, we run algorithms on a large number of Pleiades' cores in a pre-visualization stage. The results are then made available for scientific visualization.

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Left panel shows the magnetic field lines; middle panel shows the formation of a vortex in the flow generated by the passage of a flux rope; right panel shows the contours of density. *Burlen Loring, Homa Karimabadi, University of California, San Diego/SciberQuest*