Model Reveals How Plasma from Superstorms Affects Near-Earth Space

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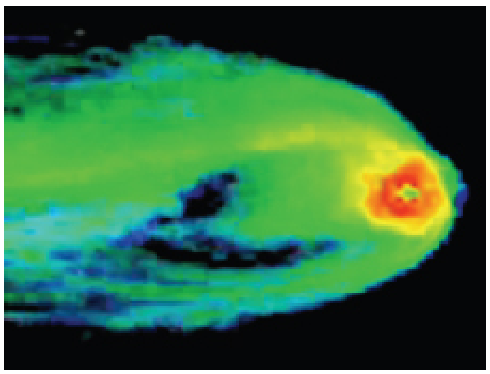

This computer-generated image shows a view of Earth's inner magnetosphere during a superstorm. Credit: NASA/ Mei-Ching Fok and Thomas E. Moore.

NASA scientists have uncovered new details about how plasma from superstorms interact with Earth's magnetosphere.

"The surprising result of this model is that the magnetosphere's main phase pressure is dominated by energetic protons from the plasmasphere, rather than from the solar wind," says Mei-Ching Fok, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Md. Fok and her team will present their findings on May 29 at the American Geophysical Union conference in Ft. Lauderdale, Fl.

Violent activity on the sun, such as a solar flare, can produce a monster superstorm that releases plasma into the solar wind. Large flares often result in an ejection of material from the solar corona, called a coronal mass ejection (CME). A CME can spew billions of tons of plasma away from the sun and toward Earth at speeds faster than 1.5 million mph. The plasma affects Earth and the vicinity surrounding Earth dominated by its magnetic field, called the magnetosphere.

As plasma from a superstorm interacts with Earth's magnetosphere, it can trigger spectacular displays of the Northern Lights, called auroras, interfere with communications between satellites and airplanes traveling near the North Pole, and interrupt global positioning systems and our power grid.

Fok and her team used their global ion kinetic model to evaluate contributions to magnetospheric pressure from the solar wind, polar wind, auroral wind, and plasmaspheric wind. Their model, which simulates sources of superstorm plasmas, found that energetic protons from the plasmasphere dominate the magnetosphere's main phase pressure. Until now, scientists thought energetic protons from the solar wind most affected the magnetosphere.

The inner region of Earth's magnetosphere contains a low-density mixture of hot and cold plasmas, which include the ring current, the plasmasphere, and the radiation belt.

The plasmasphere is a donut-shaped region of the inner magnetosphere. During space storms, the plasmasphere is squashed and pressurized by the solar wind, forming a long tail called the plasmaspheric plume. The plume particles are picked up and further energized by the solar wind. When they re-enter the magnetosphere, they supply the majority of energetic protons that affect the magnetosphere's main phase pressure during a superstorm event.

Simulating the sources of superstorm plasmas will help to better understand superstorms and pave the way to predicting their impact on Earth. The details uncovered in the team's model provide a new piece of the Sun-Earth puzzle.

For more information about how plasma interacts with the inner magnetosphere: mcf.gsfc.nasa.gov/Fok/PUA1911.pdf

Source: NASA

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