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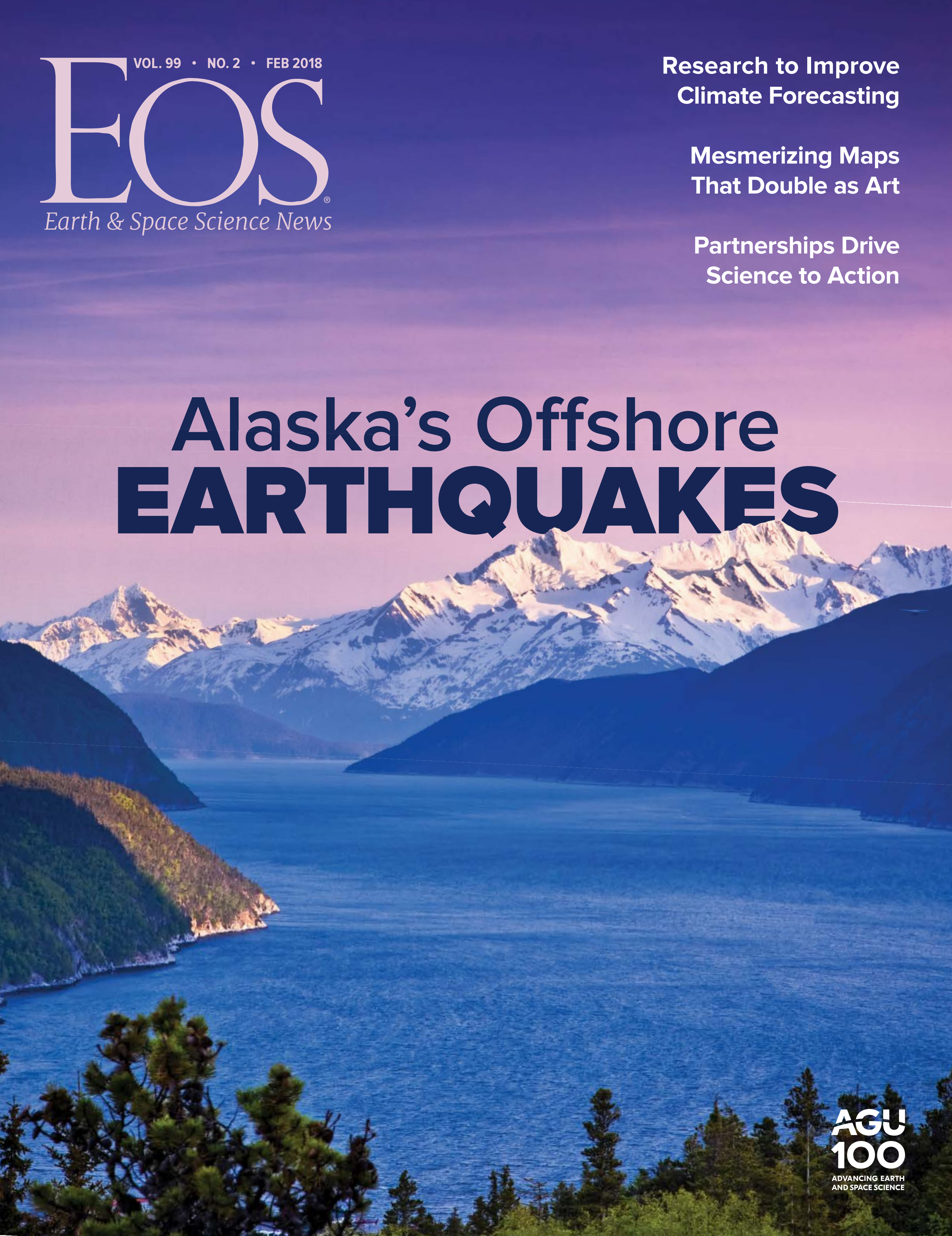
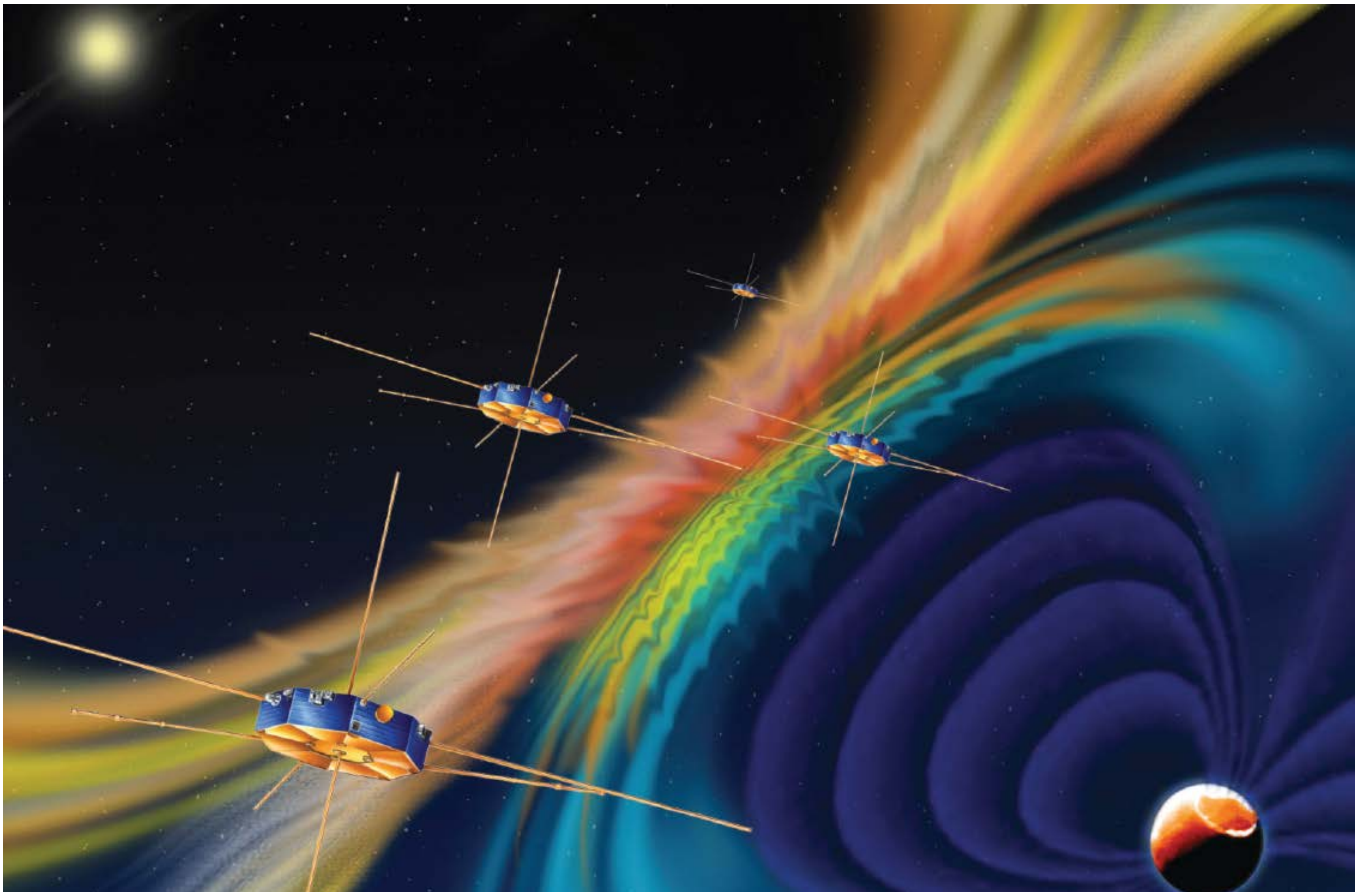


AGU 100
ADVANCING EARTH AND SPACE SCIENCE

Jets of Ionospheric Cold Plasma Discovered at the Magnetopause



Artist's conception of the four Magnetospheric Multiscale (MMS) spacecraft investigating magnetic reconnection at the boundary of Earth's magnetosphere. Credit: Southwest Research Institute, CC BY 2.0 (http://bit.ly/ccby2-0)

The Sun and the Earth both produce powerful magnetic fields, and their intersection creates a complex system of physics that determines the space weather experienced by our planet.

The solar wind—a constant stream of charged particles (plasma) emitted from the Sun—collides with Earth's magnetic field, like water flowing around a rock in a river. The collision of the two magnetic fields produces a phenomenon known as magnetic reconnection, in which the field lines of both the planet and its star snap together following the perturbation. The process releases jets of high-energy plasma, which can produce auroras and disrupt communication systems when they collide with Earth's magnetic field.

Scientists believe that plasma from the magnetosheath—the magnetically weak layer of the magnetosphere where Earth's field makes contact with the outflowing solar wind—is the dominant driver of magnetic reconnection. However, a new publication by *Li et al.* shows that "cold" plasma from the planet's ionosphere may play a larger role than previously thought.

The difference between "hot" and cold plasma is a measure of temperature. Researchers have known for some time that hot plasma (in the kiloelectron volt range) from the ionosphere plays a role in reconnection, but the new study shows that cold ions (those originally in just the electron volt range) can also be found flowing out of the ion jets produced by reconnection.

The observation comes from a quartet of NASA satellites named the Magnetospheric Multiscale mission. The spacecraft are designed to fly in a tight formation—as close as 6.5 kilometers apart—and collect data about the magnetic and plasma environment in space. Sensors on board the craft allow the researchers to detect the flow of ions and identify their origins.

On a 1 November 2015 pass through the Earth's magnetopause, the satellites detected a high density of cold plasma coming from the ionosphere at the reconnection site. The discovery is significant because the cold ions can change the physics in the magnetosphere, influencing both the rate and the structure of the reconnection process and thus contributing to how solar storms affect our planet and its environment. (*Journal of Geophysical Research: Space Physics*, https://doi.org/10.1002/2017JA024287, 2017) **—David Shultz, Freelance Writer**