

## New FASTSAT discoveries paint detailed view of region near Earth

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This artist's concept drawing shows the Fast, Affordable, Science and Technology SATellite (FASTSAT) -- NASA's first microsatellite, which launched on Nov. 19, 2010 and has been collecting data on the dynamic atmosphere surrounding Earth. Credit: NASA

Space around Earth is anything but a barren vacuum. The area seethes with electric and magnetic fields that change constantly. Charged particles flow through, moving energy around, creating electric currents, and producing the aurora. Many of these particles stream in from the solar wind, starting out 93 million miles away on the surface of the sun. But some areas are dominated by particles of a more local source: Earth's atmosphere.

These are the [particles](#) being watched by FASTSAT's Miniature Imager

for Neutral Ionospheric [Atoms](#) and Magnetospheric Electrons (MINI-ME) instrument. For one well-defined event, scientists have compared MINI-ME's observations to those from two other instruments. The event shows a detailed picture of this dynamic region, with a host of interrelated [phenomena](#) -- such as electric current and outflowing particles – occurring together.

"We're seeing structures that are fairly consistent throughout a handful of instruments," says Michael Collier at NASA's Goddard Space Flight Center in Greenbelt, Md., who is the principal investigator for MINI-ME. "We put all of these observations together and it tells a story greater than the sum of its parts."

Unlike the hotter hydrogen coming from the sun, Earth's upper [atmosphere](#) generally supplies cooler oxygen ions that course outward along Earth's [magnetic field](#) lines. This "ion outflow" occurs continuously, but is especially strong during periods when there is more solar activity such as solar flares and coronal mass ejections that burst off the sun and move toward Earth. Such activity drives oxygen ions out of our planet's upper atmosphere, particularly in regions where [aurora](#) displays are strong.

"These ion outflow events are important because they help us understand the space weather environment around Earth," says Goddard's Doug Rowland who is the principal investigator for FASTSAT's Plasma Impedance Spectrum Analyzer, or PISA instrument. "The heavy ions flowing away from Earth can act as a brake, or damper, on incoming energy from the [solar wind](#). The flow also indicates ways in which planets can lose their atmospheres – something that happens slowly on [Earth](#), but more quickly on smaller planets with weaker magnetic fields, like Mars."

MINI-ME has been successfully spotting such outflows since the

instrument first began to collect data in the winter of 2010. The instrument counts ions as it moves through a part of Earth's atmosphere called the ionosphere. This is the region where the particles gain enough speed and energy to overcome Earth's gravity, so it's an ideal place to study the first step in the outflow process.

Late on March 31, 2011, the FASTSAT spacecraft flew through an ion outflow with well-defined areas of increased fast moving, or "energetic," particles.

Simultaneous observations from PISA, which measures the density of material in the atmosphere, also showed that this was a highly structured auroral zone. In addition, the scientists turned to the National Science Foundation's Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE), a mission managed by the Johns Hopkins Applied Physics Laboratory, which measures current flow and magnetic features through a network of instruments placed on commercial satellites owned by Iridium Communications. AMPERE data showed current structures that were also consistent with what is expected for an auroral zone.

"This is just one event," says Collier. "But it helps confirm the idea that the current and ion-outflows are all connected. As we continue to go through the data, there will be many more events to follow. We'd like to be able to pin down the origin of all these mechanisms in the ionosphere."

Over time, data like this will allow scientists to determine where these ions come from, what drives them, and how their intensity varies with incoming solar activity.

Provided by NASA's Goddard Space Flight Center

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