

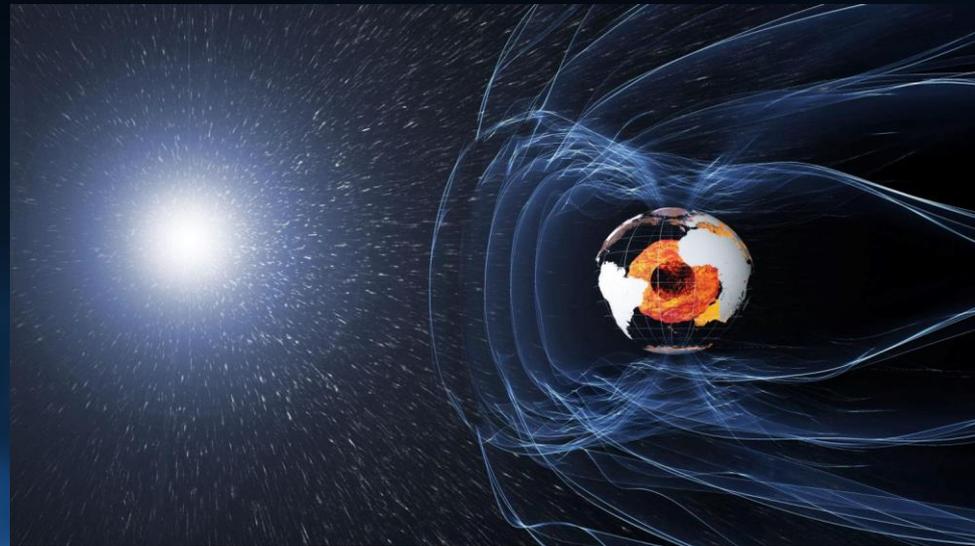
# New Insights on How Energy Passes from Space to Earth

Near Earth space is home to dynamic forces and fast-moving high-energy particles. Dominated by Earth's magnetosphere, this region can trap high-energy particles from both the Sun and interstellar space. Field-aligned currents (i.e., currents carried by particles flowing along the magnetic field lines) are the primary transporters of energy and momentum at the interface between space and Earth's atmosphere. The complex systems of field-aligned currents have been studied since the 1970s but remain poorly understood, particularly on small scales.

New research, supported by the Living With a Star program and just published in the *Journal of Geophysical Research: Space Physics*, presents, for the first time, a comprehensive look at field-aligned currents from small scales under 6 miles to large scales exceeding 150 miles. Using data from the European Space Agency's Swarm satellites and the Advanced Magnetosphere and Planetary Electrodynamics Response Experiment — AMPERE — the scientists were able to observe particle phenomena across a range of distances.

Combining the satellite data with measurements of the solar wind and geomagnetic activity from NASA's Coordinated Data Analysis Web, the researchers were able to study the effect of the solar wind on the transfer of energy, and the resulting space weather behavior.

The results showed a complex interplay between the solar wind and the currents at different scales and locations around Earth. In some locations, large-scale currents dominated energy transfers, whereas in others, energy transfer was primarily determined by smaller scales. The researchers hope to follow up with more detailed case studies and higher resolution models to gain a more wholesome understanding of the driving forces across all scales.



Artist's rendition of Earth's magnetic field lines. Currents of particles flowing on these lines are one of the key ways energy transfers from space to Earth's atmosphere. New research shows that both large and small scale currents can have effects on energy transfer in different areas. Credit: ESA/ATG Medialab