

ISRO's Aditya-L1 decodes the Impact of a Powerful Solar Storm on Earth's Invisible Magnetic Shield

Space weather refers to conditions in space caused by transient activity on the Sun, such as solar plasma eruptions, which can affect satellites, communication and navigation services, and power grid infrastructure on Earth. During such strong space weather events, Earth's magnetic shield can be significantly disturbed. Scientists and research students from the Indian Space Research Organisation (ISRO), using observations from the *Aditya-L1* mission along with data from other international space missions, have published a breakthrough study in the *Astrophysical Journal* (DOI 10.3847/1538-4357/ae1974, December 2025) that investigated a powerful solar storm that impacted Earth during October 2024. The storm was caused by a massive eruption of solar plasma material from the Sun. The study revealed that the most severe effects occurred during the impact of the turbulent region of the solar storm, which was identified with the help of *Aditya-L1* observations.

This turbulent region strongly compressed Earth's magnetic field, pushing it unusually close to the Earth and briefly exposing some satellites in geostationary orbit to harsh space conditions. This phenomenon occurs only during severe space weather events. During the turbulent phase of the storm, currents in the auroral region (high latitudes) super intensified, potentially heating the Earth's upper atmosphere and causing enhanced atmospheric escape. The finding of this study shows further importance of understanding of space weather phenomena and their real time assessments to safeguard the critical space assets.

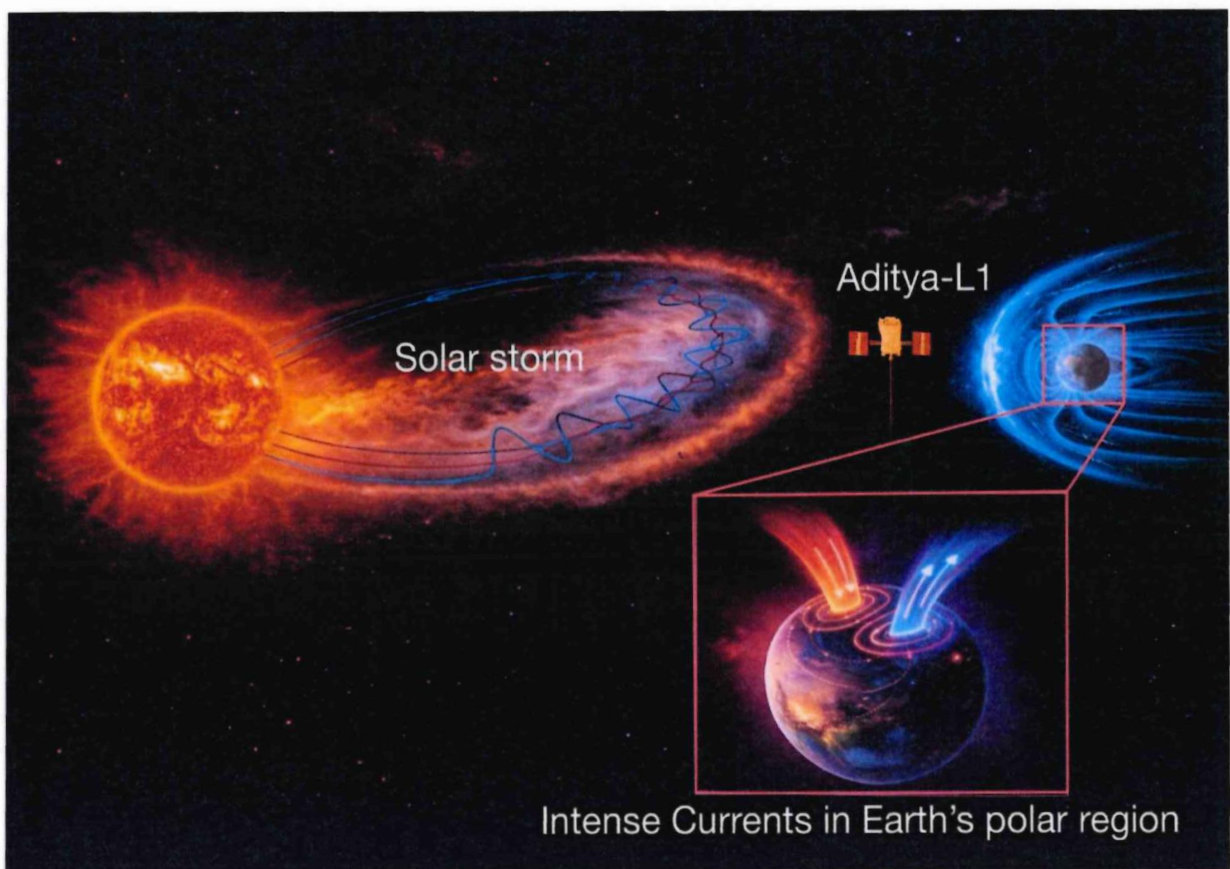


Figure: The figure shows an artistic impression of the solar storm and its interaction with Earth's magnetosphere. The Earth's magnetosphere acts as an invisible shield that protects us from harmful charged particles coming from the Sun. Aditya-L1 observed the structure of solar storm and helped in the assessments of its impact on Earth's environment along with data collected by other spacecraft around Earth. The figure graphically illustrate the super-intensification of electric currents around Earth's polar regions (auroral region)

due to the impact of turbulent front of the solar storm. The image is for visualization purposes and not drawn to scale.

Reference: Thampi, S. V., Bhaskar, A., Venugopal, I., Biswas, S., & Yadav, V. K. (2025). Extreme Geoeffectiveness by the Turbulent Sheath of the ICME of the 2024 October Space Weather Event. *The Astrophysical Journal*, 995(2), 226. <https://doi.org/10.3847/1538-4357/ae1974>