



Geomagnetic Storm

Why in News?

Recently, Elon Musk's [Starlink](#) has **lost dozens of satellites** that were caught in a geomagnetic storm a day after they were launched.

- The satellites were **designed to burn up on reentry into the Earth's atmosphere**, and did not create [debris in space](#).
- However, the loss of 40 satellites — most of a launch batch — in a single solar event has been **described as “unheard of” and “huge”**.

What is Starlink?

- Starlink is a **SpaceX project** to build a broadband network with a cluster of orbiting spacecraft that could eventually number thousands.
- The **Starlink satellites carry Hall thrusters**, which use electricity and krypton gas to generate an impulse, to manoeuvre in orbit, maintain altitude and guide the spacecraft back into the atmosphere at the end of their mission.
- The Starlink network is **one of several ongoing efforts** to start beaming data signals from space.

What is a Geomagnetic Storm?

- Solar Storms occur during the **release of magnetic energy** associated with [sunspots](#) ('dark' regions on the Sun that are cooler than the surrounding photosphere - the lowest layer of the solar atmosphere), and can last for a few minutes or hours.
- A geomagnetic storm is a **major disturbance of Earth's magnetosphere** that occurs when there is a very **efficient exchange of energy from the solar wind into the space environment** surrounding Earth.
 - The magnetosphere **shields our home planet from harmful solar and cosmic particle radiation**, as well as erosion of the atmosphere by the solar wind - the constant flow of charged particles streaming off the Sun.
- These storms **result from variations in the solar wind** that produce major changes in the currents, plasmas, and fields in Earth's magnetosphere.
 - The solar wind conditions that are effective for creating geomagnetic storms are sustained (for several to many hours) periods of high-speed solar wind, and most importantly, a southward directed solar wind magnetic field (opposite the direction of Earth's field) at the dayside of the magnetosphere.
 - This **condition is effective for transferring energy** from the solar wind into Earth's magnetosphere.
- The largest storms that result from these conditions are associated with solar [Coronal Mass Ejections \(CMEs\)](#) where a billion tons or so of plasma from the sun, with its embedded magnetic field, arrives at Earth.
 - CMEs are large ejections of plasma and magnetic fields that **originate from the Sun's**

corona (outermost layer).

How does it Affect Earth?

- **Can Impact Space Weather:**
 - Not all solar flares reach Earth, but solar flares/storms, **Solar Energetic Particles (SEPs)**, high-speed solar winds, and **Coronal Mass Ejections (CMEs)** that come close can impact space weather in **near-Earth space and the upper atmosphere**.
- **Can Hit Operations of Space-Dependent Services:**
 - Solar storms can hit operations of space-dependent services like [Global Positioning Systems \(GPS\)](#), radio, and satellite communications. Aircraft flights, power grids, and space exploration programmes are vulnerable.
- **Can Potentially Create Disturbances in the Magnetosphere:**
 - **Coronal Mass Ejections (CMEs)** with ejectiles loaded with matter travelling at millions of miles an hour, **can potentially create disturbances in the magnetosphere**, the protective shield surrounding the Earth.
 - Astronauts on spacewalks face health risks from possible exposure to solar radiation outside the Earth's protective atmosphere.

How are Solar Storms Predicted?

- Solar physicists and other scientists use **computer models to predict solar storms** and solar activities in general.
 - Current models are **capable of predicting a storm's time of arrival** and its speed.
 - But the storm's structure or orientation still cannot be predicted.
- Certain orientations of the magnetic field **can produce a more intense response** from the magnetosphere, and trigger more intense magnetic storms.
 - With the **increasing global dependence on satellites** for almost every activity, **there is a need for better space weather forecasts** and more effective ways to protect satellites.

[Source: IE](#)

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