

Geomagnetic storm

February 11, 2022

In news— Recently, SpaceX has lost dozens of satellites after they were hit by a geomagnetic storm a day after launch.

About geomagnetic storm-

- **A geomagnetic storm, also known as a magnetic storm, is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave** and/or cloud of magnetic field that interacts with the Earth's magnetic field.
- **Such solar "storms" are caused by powerful explosions on the sun's surface**, which spit out plasma and magnetic fields that can hit the Earth.
- A geomagnetic storm occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth.
- 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 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.
- 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.
- Another solar wind disturbance that creates conditions favorable to geomagnetic storms is a **high-speed solar wind stream (HSS)**.
- **HSSs plow into the slower solar wind in front and create co-rotating interaction regions**, or CIRs.

- These regions are often related to geomagnetic storms that while less intense than CME storms, often can deposit more energy in Earth's magnetosphere over a longer interval.
- Storms also **result in intense currents in the magnetosphere, changes in the radiation belts, and changes in the ionosphere**, including heating the ionosphere and upper atmosphere region called the thermosphere.
- **A measure of this current, the disturbance storm time (Dst) index, has been** used historically to characterize the size of a geomagnetic storm.
- In addition, there are currents produced in the magnetosphere that follow the magnetic field, called field-aligned currents, and these connect to intense currents in the auroral ionosphere.
- These auroral currents, called the **auroral electrojets, also produce large magnetic disturbances.**
- While the storms create beautiful aurora, they also **can disrupt navigation systems such as the Global Navigation Satellite System (GNSS)** and create harmful geomagnetic induced currents (GICs) in the power grid and pipelines.

Geomagnetic storm predictions by CESS-

- According to the Center of Excellence in Space Sciences (CESS) under the Indian Institute of Space Education and Research, a filament eruption was observed on the Sun south of the disk center on February 6, 2022.
- The eruption was recorded by the Solar and Heliospheric Observatory (SOHO) mission's Large Angle and Spectrometric Coronagraph (LASCO).
- SOHO is a joint mission by NASA and the European Space Agency launched in 1995 to study the Sun.
- It routinely identifies the coronal mass ejections.