



Geomagnetic Storm

Why in News?

Recently, Earth has been hit by a powerful **Geomagnetic Storm**, having a severity grade of G4 according to the US National Ocean and Atmospheric Administration (NOAA).

- Severity grade of G4, which is the second-highest grade possible, can potentially cause **widespread voltage control problems for power grids**. It can also cause protection systems to mistakenly trip key electric assets of the grid.

Notes: NOAA ranks geomagnetic **storms on a scale running from G1**, which could cause an increase in auroral activity around the poles and minor fluctuations in power supplies, up to G5, which includes extreme cases like the **Carrington Event — a colossal solar storm that occurred September 1859**, which disrupted telegraph services all over the world and triggered auroras so bright and powerful that they were visible as far south as the Bahamas.

What is a Geomagnetic Storm?

- A geomagnetic storm **refers to the disruptions to the Earth's magnetic field** caused by solar emissions.
- When a **Coronal Mass Ejection (CME)** or a high-speed solar stream reaches our planet, it **slams into the magnetosphere**.
 - The Earth's magnetosphere is created by its magnetic fields and it usually **protects us from the particles emitted** by the Sun.
- When a CME or a high-speed stream arrives at Earth, it peels open the planet's magnetosphere, kind of like an onion. This allows energetic **solar wind particles to stream down and hit our atmosphere over the poles**.
- Solar weather events like this can also supercharge **auroras**, sometimes making them **visible in places where they wouldn't have been otherwise**.

What are the Implications of Such a Storm?

- **Space Weather:**
 - Not all solar flares reach Earth, but solar flares/storms, Solar Energetic Particles (SEPs), high-speed solar winds, and CMEs that come close can impact space weather in near-Earth space and the upper atmosphere.
- **Problems for Spacecraft Operations:**
 - Solar storms can hit operations of space-dependent services like **Global Positioning Systems (GPS)**, radio, and satellite communications. Aircraft flights and space exploration programmes are vulnerable.
- **Disturbances in the Magnetosphere:**
 - It 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.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. If a major solar storm (solar flare) reaches the Earth, which of the following are the possible effects on the Earth?

1. GPS and navigation systems could fail.
2. Tsunamis could occur at equatorial regions.
3. Power grids could be damaged.
4. Intense auroras could occur over much of the Earth.
5. Forest fires could take place over much of the planet.
6. Orbits of the satellites could be disturbed.
7. Shortwave radio communication of the aircraft flying over polar regions could be interrupted.

Select the correct answer using the code given below:

- (a)** 1, 2, 4 and 5 only
- (b)** 2, 3, 5, 6 and 7 only
- (c)** 1, 3, 4, 6 and 7 only
- (d)** 1, 2, 3, 4, 5, 6 and 7

Ans: (c)

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