South Atlantic Anomaly

Why in News

Recently, the **Swarm constellation of satellites** of the **European Space Agency (ESA)** has updated the development of **South Atlantic Anomaly (SAA).**

- The South Atlantic Anomaly signifies **weakening of the Earth's magnetic field** between **Africa and South America.**
  - However, it has been observed that the present dip in intensity of the Earth's magnetic field is **within the normal fluctuation levels.**

Swarm Constellation Mission

- Swarm is European Space Agency's **first** constellation of satellites for **Earth observation.**
- It consists of three satellites designed to identify and precisely measure the **different magnetic signals** that **make up Earth's magnetic field.**
- The mission is operated by ESA's European Space Operations Centre (ESOC), in **Germany,** via the primary ground station in **Kiruna, Sweden.**

Earth's Magnetic Field

- **Description:**
  - Earth's magnetic field, or the geomagnetic field, is the magnetic field that extends from the Earth's interior out into space exerting a force on the charged particles emanating from the Space including Sun.
  - The earth's south magnetic pole is actually near the North Pole and the magnetic north pole is near the South Pole. This is why a compass magnet's north pole actually points north (Since opposite poles attract each other).

- **Reasons for Presence:**
  - The magnetic field of the Earth is due to the **metallic and liquid outer core** of the planet.
  - The outer core of the planet is like a **giant dynamo.** The **rotation of the Earth** creates **movements inside the liquid outer core** which gives rise to the geomagnetic field.
- **Significance:**
  - It creates electric currents that generate and change our electromagnetic field.
  - The Northern Lights in the Polar Regions are caused by the magnetic field of Earth – the energy particles emitted by the Sun are channelled by the Earth's magnetic field towards the poles, where they interact with the atmosphere to create the **aurora borealis.**
  - The Earth's magnetic field also plays an important role in **protecting the planet from solar winds and cosmic radiation that are harmful.**

Key Points

- **Intensification of SAA (Weakening of Magnetic Field):**
  - Scientists have discovered that Earth's magnetic field has **lost** around **9%** of its strength over the **last 200 years.**
  - Further, the strength of the field has **dropped** from around **24,000 nanoteslas to about 22,000 nanoteslas** between **1970 and 2020.**
  - It has also observed an **intensified weakening** of magnetic fields in the **southwest of Africa.** The **eastern minimum** of the South Atlantic Anomaly has appeared over the last decade and has been **developing vigorously.** This scenario indicates that the South Atlantic Anomaly **could split** into **two separate low points.**
- **Significance of SAA:**
  - It has been speculated that the current weakening of the field is a **sign of the pole reversal of the earth–** in which the north and south magnetic poles may switch places.
    - Pole reversal is not an uncommon event and it takes place every 250,000 years. Last it had happened 7.8 lakh years ago.
  - Additionally, the SAA is expected to help to understand the **processes in Earth's core** and future developments in the earth's interior.

- **Implications:**
  - At **surface level,** the South Atlantic Anomaly presents **no cause for alarm.** It means that people won't feel the change even if the pole shift happens.
  - However, **satellites and other spacecraft flying through the area** are more likely to experience **technical malfunctions.** The weaker magnetic field in this region may force charged particles to penetrate the altitudes of low-Earth orbit satellites.
  - It may also affect the **navigation-mapping, telecommunication and satellite systems** which rely on the geomagnetic field. Therefore, computers, mobile phones and other devices could also face difficulties.

Way Forward

- Earth's magnetic field is often visualised as a powerful dipolar bar magnet at the centre of the planet, tilted at **around 11° to the axis of rotation.** However, the growth of the South Atlantic Anomaly indicates that the processes involved in **generating the field are far more complex.**
- The magnetic field observations from the Swarm satellite are also expected to provide the new insights into the scarcely understood processes of Earth's interior.

Source:BL