GRAPES-3 Muon Telescope

Prelims: *Current events of national and international importance | Science and Technology*

Why in News?

Recently, A study proved that ground-based space particle counters can now track Earth's weather and solar storms in real-time, making climate and space research much stronger.

Key Details	
GRAPES - 3 Observatory	Cosmic-Ray Observatory
GRAPES-3 Muon Telescope	World's largest tracking ***Muon telescope.***
Operated by	Tata Institute of Fundamental Research (TIFR)
Location	Ooty, Tamil Nadu
Commissioned in	2000
Research team	India and Japan

GRAPES-3 (Gamma Ray Astronomy at PeV EnergieS) Observatory

- A high-altitude observatory tracks ***cosmic muons*** (particles formed when cosmic rays hit the atmosphere).
- Scientists measure how changes in upper-atmosphere temperature and the Sun's magnetic field affect the number of muons (tiny particles) that reach Earth's surface
- It has counted billions daily to study the upper atmosphere and the Sun's magnetic field, making it a unique ground tool for *climate and solar weather monitoring.*

Positive Observation – Atmosphere Link

- Shows a direct link between upper-atmosphere temperature and muon counts.

- Warmer atmosphere, it expands outward resulting in fewer low-energy muons reaching ground.
- Therefore, *lower muons mean a warmer upper atmosphere, i.e. Muon count directly reflects temperature changes.*

Negative Observation – Solar Magnetic Field Link

- Shows an *inverse link between Sun's magnetic field and muon counts.*
- *Stronger solar field blocks more cosmic rays,* so only fewer muons detected.
- So, *a stronger solar magnetic shield means low muon counts, i.e. Muon counts inversely reflects solar magnetic strength.*

Neutral Observation – Stable Baseline

- Scientists applied Fast Fourier Transform (FFT) and repititive algorithms to separate signals.
- Seasonal and solar cycle effects are filtered out using mathematical tools.

Reference

Researchmatters | Grapes-3

