Topside Ionospheric Reconstruction

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Why in News?

Recently, researchers have developed a novel approach to reconstruct the topside ionosphere over the Indian region.

- **Ionosphere –** Ionized part of Earth's upper atmosphere (60–1000 km).
- It influences radio wave propagation, high frequency communication, GPS and ***NAVIC*** signals of LEO satellites.
- **Low Earth Orbit (LEO) Satellites –** They operate between 160 km – 2,000 km above the Earth and it ***requires accurate electron density data.***

Importance of Electron Density Data
• **Assumption –** Conventional models assume constant *topside scale height.* • **Uneven electron density –** Near the geomagnetic equator (India's region), electron density changes unevenly due to complex magnetic field and solar effects. • **Result –** Using a constant value miscalculates signals, leading to GPS, NAVIC, and satellite errors. *Topside (400–1000 km) is the ionosphere's upper region; scale height shows how fast electron density thins with altitude.*

New Methodology – Topside ionospheric reconstruction method

- **Developed by –** Indian Institute of Geomagnetism (IIG) and Department of Science and Technology (DST)
- **Integration –** Combines data from *COSMIC radio occultation data* (altitudinal scale height variation) with *ionosonde bottom-side profiles.*
- **Output –** More realistic electron density profiles up to 1000 km.
- **Validation –** Correlation with the Swarm satellite in-situ electron density confirms robustness.
- **Result –** Provides region-specific estimates of topside scale height

gradient, especially over the geomagnetic equator.

- **Significance –** Improves reliability of communication, navigation, and remote sensing.
- Supports India's satellite programmes, GPS/NAVIC accuracy, defence communication and space weather prediction

Reference

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