Indian Equatorial Electrojet Model

Source: PIB

Why in News?

Recently, scientists from the **Indian Institute of Geomagnetism (IIG), Navi Mumbai** have developed the **Indian Equatorial Electrojet (IEEJ) Model** to accurately predict the **Equatorial Electrojet** over the Indian sector.

- Ground-based magnetometers at **Tirunelveli station**, near India's southern tip, are used for regular EEJ measurements.

What are the Key Facts About Equatorial Ionospheric Processes?

- **Equatorial Electrojet:** It is a **concentrated, intense electric current** flowing within the **Earth's ionosphere** at the **geomagnetic equator** at a height of around **105-110 km.**
  - India's **southern tip** is close to the Earth's geomagnetic equator where a **strong current exists**.
- **IEEJ Model Capabilities:** It has a **web interface** that allows simulations of EEJ for different dates and **solar activity conditions**.
- **Applications:** The model helps in understanding **equatorial ionospheric processes** and has practical applications in several ways:
  - **Satellite** orbital dynamics
  - **Global Navigation Satellite Systems (GNSS)**-based navigation/positioning
  - Satellite communication links
  - Electrical power grids
  - Transmission lines
  - Oil and gas industry pipelines

Note:

- **The geomagnetic equator** is the **midpoint** between the **magnetic north and south poles**, running around the Earth.
- Unlike the geographic equator, it can **shift and change position** due to variations in the **Earth's magnetic field.**

Ionosphere

- It is **not a distinct layer** like the Troposphere or Stratosphere. Instead, the ionosphere **overlaps** the **mesosphere, thermosphere, and exosphere**.
- It's a very active part of the atmosphere, and it **grows and shrinks** depending on the energy it absorbs from the sun.
  - It is an electrically conducting region capable of **reflecting radio signals** back to Earth.
- The **electrically charged atoms and molecules** that are formed in this way are called **ions,** giving the ionosphere its name.

What is the Division of Atmosphere Based on Thermal and Chemical Composition?

- **Thermal Composition of Atmosphere:**

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ATMOSPHERE AND ITS LAYERS

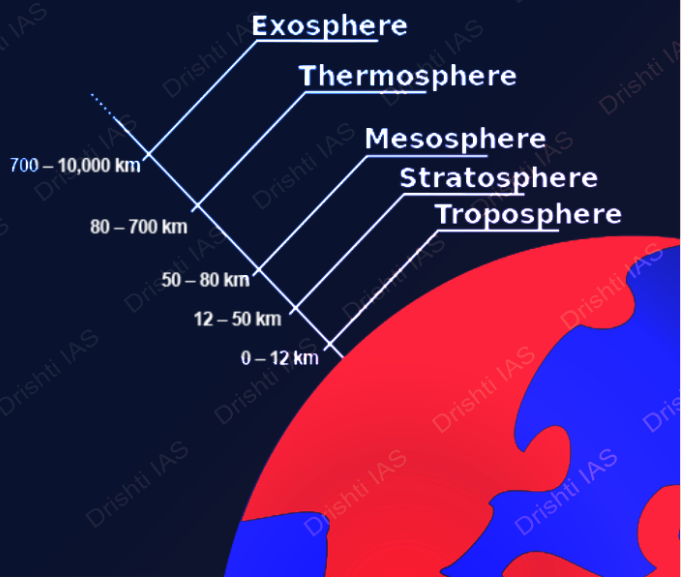
Drishti IAS

ATMOSPHERE

- One of the main components of Earth's interdependent physical system
- It is composed of about 78% nitrogen, 21% oxygen, and 1% other gases

LAYERS

- Troposphere:
  - Extends from Earth's surface upto 12 kilometers
  - The lowest part of the atmosphere- the part we live in
  - Temperature in the troposphere decreases with height
    - The top of the troposphere is called tropopause
  - Densest atmospheric layer
  - Contains about 75% of all of the air in the atmosphere, and 99% of water vapour (which forms clouds and rain)
- Stratosphere:
  - Located between 12 and 50 kilometers above Earth's surface
  - Contains much of the ozone in the atmosphere
    - Ozone molecules in this layer absorb ultraviolet (UV) radiation from the Sun, resulting in an increase in temperature
  - It is nearly cloud- and weather-free
  - It's the highest part of the atmosphere that jet planes can reach
- Mesosphere:
  - Located between about 50 and 80 kilometers above Earth's surface
  - The top of this layer is the coldest place found within the Earth system
  - It forms noctilucent clouds, the highest clouds in Earth's atmosphere
  - Most meteors burn up in this atmospheric layer
  - Sounding rockets and rocket-powered aircraft can reach the mesosphere
- Thermosphere:
  - Located between about 80 and 700 kilometers above Earth's surface
  - Its lowest part contains the ionosphere
  - The temperature of the thermosphere varies between night and day and between the seasons
  - The aurora borealis (northern) and aurora australis (southern) are sometimes seen here
- Exosphere:
  - Located between 700 and 10,000 kilometers above Earth's surface.
  - The highest layer of Earth's atmosphere.
  - There's no weather at all in this layer.
  - Most Earth satellites orbit in this layer.
  - At the bottom of the exosphere is a transition layer called the thermopause.



- **Chemical Composition of Atmosphere:** On the basis of **chemical composition**, the atmosphere is divided into **two broad zones.**
    - **Homosphere:** Homosphere can be defined as the **lowest part** of the Earth's atmosphere. It lies between the heterosphere and the surface of the earth.
        - It is the earth's atmosphere below the altitude of **roughly 90 kms** where there is an **almost-homogenous** composition of **nitrogen (78%), oxygen (21%), argon (10%), carbon dioxide** as well as traces of constituents like **dust particles, aerosols and cloud droplets.**
        - It is divided into the Troposphere, Stratosphere and Mesosphere.
    - **Heterosphere:** The **atmosphere laying beyond the homosphere** is termed as heterosphere. It extends from **90 km to 10,000 km.**
        - The air is **rare** and the **molecules** are **wide apart.** The mixing of the gases is not possible as the **turbulence is not happening there.**
        - It is divided into two main spheres i.e., **thermosphere and exosphere.**

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. Consider the following: (2013)

1. Electromagnetic radiation
2. Geothermal energy
3. Gravitational force
4. Plate movements
5. Rotation of the earth
6. Revolution of the earth

Which of the above are responsible for bringing dynamic changes on the surface of the earth?

(a) 1, 2, 3 and 4 only

(b) 1, 3, 5 and 6 only

(c) 2, 4, 5 and 6 only

(d) 1, 2, 3, 4, 5 and 6

Ans: (d)

Q. A layer in the Earth’s atmosphere called Ionosphere facilitates radio communication. Why? (2011)

1. The presence of ozone cause the reflection of radio waves to Earth.
2. Radio waves have a very long wavelength.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Ans: (d)