2. Mapping Lightning Across India

Prelims: Geography- Climatology

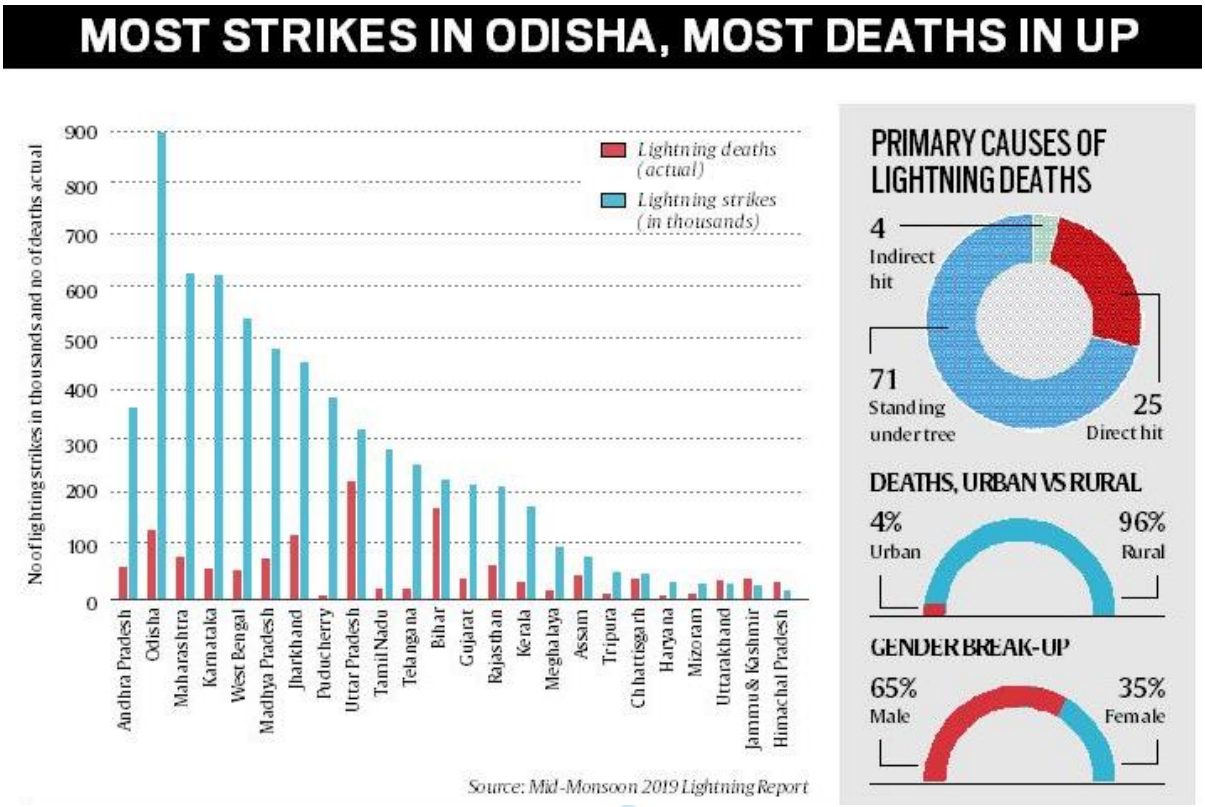
Mains: GS-I- Important Geophysical Phenomena such as Earthquakes, Tsunami, Volcanic Activity, Cyclone Etc.,

Why in News?

- For the first time, a report has mapped lightning strikes across the country, and the lives they have claimed. It is a first-of-its-kind report on lightning incidents which has been **prepared by Climate Resilient Observing Systems Promotion Council (CROPC)**, a non-profit organisation that works closely with India Meteorological Department (IMD).

Highlights of The Report:

- According to the report lightning strikes have caused at least 1,311 deaths in the four-month period between April and July this year. UP accounted for 224 of these deaths, followed by Bihar (170), Odisha (129) and Jharkhand (118).
- It counted 65.55 lakh lightning strikes in India during this four-month period, of which 23.53 lakh (36 per cent) happened to be cloud-to-ground lightning, the kind that reaches the Earth. The other 41.04 lakh (64 per cent) were in-cloud lightning, which remains confined to the clouds in which it was formed.
- Odisha recorded over 9 lakh incidents of lightning (both kinds), the maximum for any state but fewer deaths than Uttar Pradesh, which had 3.2 lakh incidents.
- Between 2,000 and 2,500 people are estimated as killed every year in lightning strikes in the country.
- Observations confirm that the Chhotanagpur plateau, which is the confluence of Jharkhand, Odisha, part of Chhattisgarh and West Bengal and is inhabited by tribals, is the most lightning-prone area.
- The area is electrostatically and thermodynamically charged, resulting in lightning. East Singhbhum has the highest number of lightning strikes — more than 2 lakhs — compared to any other district in India.
- These areas are predominantly inhabited by tribals who need to be relocated to safer spaces, else their population will go extinct.



Significance of The Report:

- The report is part of an effort to create a database that can help develop an early warning system for lightning, spread awareness, and prevent deaths.
- It is possible to predict, 30-40 minutes in advance, when a lightning strike heads towards Earth.
- The prediction is made possible through study and monitoring of the in-cloud lightning strikes.
- Timely dissemination of this information can save several lives.
- After carrying out a pilot project in 16 states, the IMD has begun providing lightning forecasts and warnings through mobile text messages from this year.
- However, this is not yet available in all regions, and there isn't enough awareness as yet on the kinds of action that need to be taken after an alert.

Connection Between Lightning and Climate Change:

- It has been found that areas prone to heatwaves were also prone to lightning.
- Pollution increases aerosols in the atmosphere, which in turn increases lightning.
- There have been at least two or three instances of lightning strikes without rainfall, killing persons in Jharkhand.

How Is Lightning Formed?

- Lightning is a very **rapid and massive discharge of electricity in the atmosphere**. Some of it is directed towards the Earth.

- It is a **result of the difference in electrical charge between the top and bottom of a cloud**. The lightning-generating clouds are typically **about 10-12 km in height**, **with their base about 1-2 km from the Earth's surface**. The temperatures at the top range from -35°C to -45°C.
- As water vapour moves upwards in the cloud, it condenses into water due to decreasing temperatures. A huge amount of heat is generated in the process, pushing the water molecules further up. As they move to temperatures below zero, droplets change into small ice crystals.
- As they continue upwards, they gather mass, until they become so heavy that they start descending. It leads to a system where smaller ice crystals move upwards while larger ones come down. The resulting collisions trigger release of electrons, in a process very similar to the generation of electric sparks. The moving free electrons cause more collisions and more electrons; a chain reaction is formed.
- The process results in a situation in which the top layer of the cloud gets positively charged while the middle layer is negatively charged. The electrical potential difference between the two layers is huge, of the order of billions of volts. In little time, a huge current, of the order of lakhs to millions of amperes, starts to flow between the layers.
- It produces heat, leading to the heating of the air column between the two layers of cloud. It is because of this heat that the air column looks red during lightning. The heated air column expands and produces shock waves that result in thunder sounds.

How Does Lightning Strike Earth?

- **The Earth is a good conductor of electricity. While electrically neutral, it is relatively positively charged compared to the middle layer of the cloud.** As a result, an estimated 20-25 per cent of the current flow gets directed towards the Earth. It is this current flow that results in damage to life and property.
- **Lightning has a greater probability of striking raised objects on the ground,** such as trees or buildings. Once they are sufficiently near the ground, about 80-100 m from the surface, they even tend to redirect their course to hit the taller objects. This is because travelling through air, which is a bad conductor of electricity, the electrons try to find a better conductor and also the shortest route to the relatively positively charged Earth's surface.
- Thousands of thunderstorms occur over India every year. One thunderstorm can involve more than 100 lightning strikes.