Installation of X-Band Radar

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Why in News?

Recently, the **Ministry of Earth Sciences** approved an **X-band radar** to be installed in Kerala's Wayanad district after devastating floods and landslides.

What are Key Facts About X-Band Radars?

- **About Radar:** Radar is a device that uses **radio waves** to **detect and locate objects** by measuring the **reflection of the waves.**
  - Radar stands for **radio detection and ranging.**
- **Working of Radar:** The radar device comprises a **transmitter** that emits a signal aimed at an object whose characteristics are to be ascertained (e.g., **cloud in meteorology**).
  - A part of the emitted signal is **echoed** by the object back to the device, where a **receiver** tracks and analyses it.
- **Applications in Meteorology: Doppler radars (weather radar)** reveal how fast a **cloud is moving** and in which **direction** based on the cloud's relative motion changes the **frequency** of the radiation striking it.
  - A **Pulse-Doppler radar** can measure the **intensity** of rainfall by emitting radiation in **pulses** and tracking how often they're reflected to the receiver.
  - Doppler effect is the **change in frequency of sound waves** as their source moves towards and away from a listener.
  - Doppler radars rely on **Rayleigh scattering** in which light or other **electromagnetic radiation** is scattered by particles much smaller than the **wavelength** of the light.
  - Modern Doppler radars can monitor weather conditions and anticipate **new wind patterns, the formation of storms**, etc.
- **X-Band Radar:** An X-band radar is radar that emits radiation in the **X-band** of the electromagnetic spectrum **(8-12 GHz)** corresponding to wavelengths of around **2-4 cm** (this is in the **microwave part** of the spectrum.)
  - It uses radiation of **lower wavelengths** to observe smaller particles like **rain droplets or fog.**
  - The smaller wavelengths allow the radar to produce images of **higher resolution** but X-band radars have a relatively **shorter range.**
- **Role of X-Band Radar in Wayanad:** It will monitor **soil particle movements**, assisting in the issuance of **landslide warnings.**
  - It will conduct **high temporal sampling**, allowing for rapid detection of changes in particle movement over brief periods.

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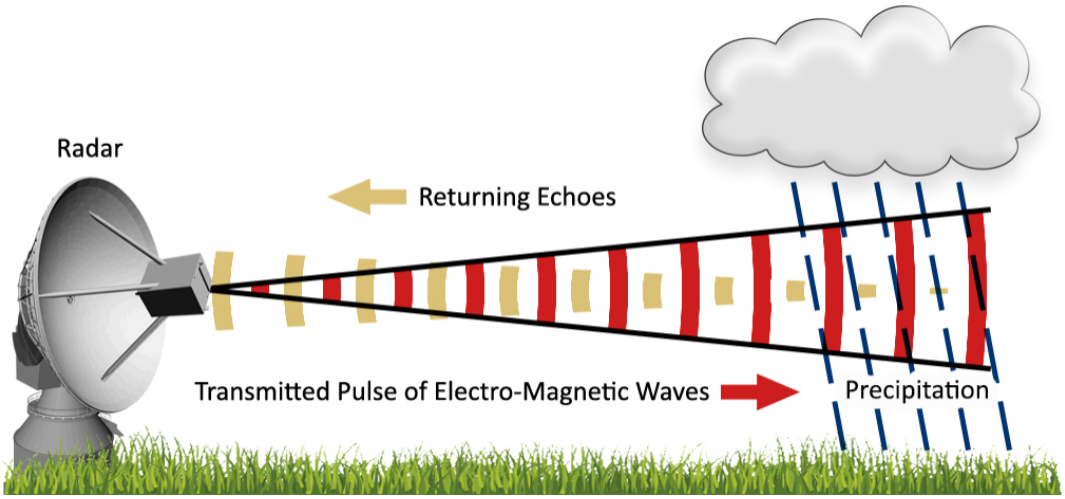

How many radars does India have?

- **Historical Context:** The **India Meteorological Department (IMD)** began using radar for weather in the early 1950s.
  - In **1970,** it installed the first **indigenously designed** X-band storm detection radar in **New Delhi**. By **1996**, IMD upgraded 10 outdated X-band radars to **digital versions.**
- **Types of Radar Network:** In its X-band radar network, India has both **wind-finding and storm-detecting radars**, and some with **dual capabilities.**
  - India also uses **S-band radars** **(2-4 GHz)** for long-range detection.
  - The first **S-band cyclone detection radar** was installed in **Visakhapatnam in 1970** and the first **locally made variant** was commissioned in **Mumbai in 1980.**
- **Recent Initiatives:** As of September 2024, India plans to install **56 additional Doppler radars**, part of the Rs 2,000-crore **Mission Mausam** initiative aimed at enhancing meteorological infrastructure by **2026**.
  - The government is also in the process of acquiring and installing **10 X-band Doppler radars** in northeastern states and Himachal Pradesh's **Lahaul and Spiti district.**
  - A **C-band radar (4-8 GHz)** with an observational range of 250 km will be installed in **Mangaluru.**

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

Q.Consider the following phenomena: (2013)

1. Size of the sun at dusk
2. Colour of the sun at dawn
3. Moon being visible at dawn
4. Twinkle of stars in the sky
5. Polestar being visible in the sky

Which of the above are optical illusions?

(a) 1, 2 and 3

(b) 3, 4 and 5

(c) 1, 2 and 4

(d) 2, 3 and 5

Ans: (c)