Recent Study on Aerosols

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

Why in News?

Recently, researchers from various institutions have studied the classification of global aerosol types and radiative effects.

- **Aerosols** – The ***tiny solid or liquid particles*** suspended in the atmosphere play a crucial yet complex role in shaping our planet's climate. They come from both nature and human activities.
- Key examples include fog, dust, and spray mists.
- From desert dust storms to urban emissions and forest fires, these microscopic particles scatter, absorb, and interact with sunlight in different ways, altering the planet's energy balance and affecting weather, clouds, and rainfall.

AEROsol Robotic NETwork (AERONET) – *It is a network of ground-based sun photometers which measure atmospheric aerosol properties. Established in 1993 by NASA and PHOTONS (CNRS / University of Lille)*

Key findings

- Analysed data from 171 ground-based monitoring stations, or AERONET sites, across six continents, spanning over 30 years.
- **7 main aerosol types** were identified
  - Pure dust (PD),
  - Dust-dominated mixtures (DDM),
  - Pollution-dominated mixtures (PDM),
  - Very weakly absorbing (VWA),
  - Weakly absorbing (WA),
  - Moderately absorbing (MA), and
  - Strongly absorbing (SA).
- Strongly absorbing (SA) aerosols produce the highest atmospheric forcing, whereas very weakly absorbing aerosols produce the lowest.

Atmospheric forcing *– Effects and energy fluctuations from the atmosphere such as wind stress, heat exchange, and precipitation—that drive dynamics in underlying systems like oceans, ice sheets, or land surfaces.*

- **South Asia** – Largely affected by dust mixed with pollution or dust-dominated mixtures (DDM), which produces the *highest Aerosol Radiative Forcing (ARF)* and atmospheric heating rates.
- **North Africa** – Pure dust (PD) aerosols dominance,
- **Europe & North America** – Urban and industrial regions are characterised by less-absorbing aerosols, VWA, WA, and MA aerosols.
- **Tropical regions** – Prone to biomass burning, are dominated by strongly absorbing (SA) aerosols.

- **Impacts on climate & Energy**
- **Strongly absorbing aerosols** – Those rich in black carbon, contribute significantly to atmospheric heating, with the potential to disrupt regional weather patterns and cloud formation.
- **Weakly absorbing aerosols** – Those have a relatively minor impact on the atmosphere, primarily reflecting sunlight into space and cooling the surface.
- **Significance** – Accurately identifying aerosol types is crucial for developing more reliable retrieval algorithms and assessing the impacts of air pollution on human health and ecosystems.

Reference

PIB | Study related to aerosols and its radioactive effects