Complex Greenhouse Gas dynamics in the Central Himalayas

Prelims - *Current events of National & International importance and General issues on Environmental ecology, Biodiversity & climate change*

Why in News?

Recently, scientists revealed the data on Greenhouse Gas (GHG) emissions around the Himalayan region.

- **Data gathered by** - Aryabhatta Research Institute of Observational Sciences (ARIES), an autonomous research institute under the Department of Science & Technology (DST).
- **Data collection site -** High-altitude research site in Nainital for over 5 years.
- **Key findings -** Greenhouse gas concentrations in the Central Himalayas are generally higher than those at other remote background sites.
- However, these levels remain lower than those typically found in urban and semi-urban settings.
- **Contributing Factors -** Natural processes and human activities together shape greenhouse gases.
- **Key Green-house gases** - Carbon dioxide (CO_2) and methane (CH_4), and carbon monoxide (CO) in the Central Himalayan region.
- **Daily Variations -** Carbon dioxide reaches its lowest levels during daylight hours due to active photosynthesis.
- Methane and carbon monoxide tend to peak during the day as mountain winds transport pollutants upward from lower elevations.
- **Seasonal Variations -** Carbon dioxide concentrations rise in spring, coinciding with increased biomass burning and limited vegetation cover.
- Methane levels are highest in autumn, likely linked to agricultural activities such as rice cultivation.
- Carbon monoxide peaks in late spring, suggesting a strong influence from regional pollution transport during this period.
- **Long-term trends** – The trends point to a steady rise in both carbon dioxide (2.66 ppm per year) and methane (9.53 ppb per year).
- These trends are even higher than those at ***Mauna Loa (a background site),*** underscoring the growing impact of anthropogenic emissions in the region.
- In contrast, carbon monoxide shows a gradual decline (3.15 ppb per year), possibly reflecting improvements in combustion efficiency or changes in regional emission sources.
- **Significance -** These comprehensive, high-resolution observations provide an essential baseline for validating satellite data, refining emissions inventories and

improving atmospheric models.
- To disentangle the effects of biospheric uptake, regional emissions, and complex meteorological patterns that shape the region's air quality and climate.

Reference

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