Forest Fires and Carbon Balance

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Forest Fires and Carbon Balance: A Climate Emergency

Context:

In recent months, multiple states in the United States have simultaneously experienced tornadoes, wildfires, and dust storms. These are not isolated weather events but are part of a larger global pattern of increasing climate-related disasters. Among them, **wildfires have emerged as a critical concern**, affecting ecosystems, human health, and the planet's carbon balance.

Global Trends in Wildfire Incidents

- Forest fires are becoming increasingly widespread across continents.
- The area affected by wildfires has **increased by about 5.4% annually since 2001**.
- In **2023**, nearly **12 million hectares** of tree cover were lost due to wildfires.

Country-specific data:

- **United States**: Forest fires have severely impacted homes and ecosystems in **Texas, Oklahoma, Los Angeles, and California**.
- **Japan**: Witnessed its **largest forest fire in three decades**, burning over **5,200 acres** near **Ofunato** in the north.
- **India**: As per the **India State of Forest Report 2024**, **Uttarakhand, Odisha, and Chhattisgarh** recorded the most wildfire incidents.
    - **Uttarakhand alone** experienced **5,315 forest fires** between **November 2022 and June 2023**.

Causes Behind the Rise in Wildfires

1. **Rising Land Temperatures**
    - According to the Indian Institute of Tropical Meteorology, India's land surface temperature is rising steadily:
        - **0.1°C–0.3°C per decade** during the **pre-monsoon season**
        - **0.2°C–0.4°C per decade** during the **post-monsoon season**
2. **Increased Heatwaves**
    - Heatwaves are occurring earlier in the year, lasting longer, and moving more slowly.
    - Combined with prolonged dry spells, they make forests more vulnerable to fires.
3. **Climate Change**
    - Contributes to drier and hotter conditions, increasing the frequency and severity of wildfires globally.
4. **Spontaneous Combustion**
    - Under extreme heat, organic materials like dry leaves or grass may ignite naturally.
5. **Agricultural Practices**
    - Slash-and-burn methods used in farming can unintentionally spark large-scale fires.
6. **Lightning Strikes**
    - Natural cause of wildfires during dry seasons when vegetation is highly flammable.

Impact of Wildfires on Earth's Carbon Balance

1. **Radiative Power**
    - The radiative intensity of recent wildfires has been **ten times higher** than the average recorded between **2003 and 2024**.
2. **Carbon Emissions**
    - According to the **Copernicus Air Monitoring Service**, wildfires released **800,000 tonnes of carbon** in **January 2025 alone**.
    - **India's forest fires** emit approximately **69 million tonnes of carbon dioxide every year**.
3. **Destruction of Carbon Sinks**
    - Forests, wetlands, and permafrost that once acted as **carbon sinks** are being destroyed, reducing their ability to absorb CO_2 and increasing atmospheric carbon levels.

Definitions:

- **Carbon Sink**: A natural system that absorbs more carbon than it releases. Examples include forests, oceans, and soil.
- **Carbon Source**: A system or activity that releases more carbon than it absorbs. Examples include wildfires and fossil fuel combustion.

Arctic Boreal Zone (ABZ): A Region of Concern

- The **Arctic Boreal Zone**, the world's **largest land-based biome**, includes tundra, wetlands, and coniferous forests.
- Wildfires have transformed **more than 30% of the ABZ** from a carbon sink into a carbon source.

Regional contributions to new carbon emissions in ABZ:

- **Alaska**: 44 percent
- **Northern Europe**: 25 percent
- **Siberia**: 13 percent

Thawing of Permafrost:

- Wildfires are accelerating the thawing of permafrost.
- This process:
    - Dries the soil
    - Raises the temperature of the topsoil
    - Alters vegetation cover
    - Releases trapped organic carbon into the atmosphere

What Lies Ahead: Strategy and Recommendations

1. **Long-Term Urban and Regional Planning**
    - Cities and regions must adopt scientific, climate-resilient strategies to reduce wildfire vulnerability.
2. **Protection of Carbon Sinks**
    - Prioritise the conservation of forests, wetlands, and permafrost zones to maintain Earth's natural carbon balance.
3. **Global Collaboration**
    - International cooperation is essential to address the transboundary impacts of wildfires and climate change.

4. **Addressing the Root Causes**

    - Urgent efforts are needed to reduce greenhouse gas emissions, prevent deforestation, and promote sustainable land use practices.