



As wildfires scorch the earth, the Arctic biome rejects more carbon

Context: Global Wildfire Crisis & Carbon Emissions

- Escalation of Wildfires Globally:
 - Severe wildfires in 2025 in California (Eaton & Palisades), Texas, Oklahoma, caused massive destruction: over 14,000 structures destroyed, thousands evacuated, and dozens of lives lost. The Eaton Fire alone burned over 16,000 hectares. As per state agency Cal Fire, it was among the most destructive fires in California history.
 - The Japan fire (near Ofunato City) affected nearly **2,900 hectares**, damaged close to 210 buildings, and forced more than 4,200 residents in the area to evacuate. The worst in five decades.
- Wildfire Emissions Data:
 - In January 2025 alone, wildfires emitted 800,000 tonnes of carbon, 4x higher than the same period a decade ago (CAMS (Copernicus Air Monitoring Service) data).
 - Wildfires' radiative power (heat emission) exceeded the 2003–2024 average by an order of magnitude — indicating intensifying heat signatures.

Arctic Boreal Zone (ABZ): From Carbon Sink to Carbon Source

- ABZ's Traditional Role:
 - Comprises tundra, permafrost, wetlands, and boreal forests.
 - Acts as a major carbon sink, historically storing vast carbon in frozen soils and vegetation.
- Transition to Carbon Source:
 - A third of ABZ now emits more carbon than it absorbs.
 - Shift began before 1990, accelerated by wildfires in Eastern Siberia (2003) and Timmins, Canada (2012).
- Study Insights (Nature Climate Change):
 - Analysis from 200 monitoring sites (1990–2020): shows net carbon emission from many Arctic regions.
 - Alaska (44%), Northern Europe (25%), and Siberia (13%) were key carbon-emitting regions.
- Non-Summer Emissions > Summer Uptake:
 - Emissions during non-summer months (Sep–May) now exceed summer (Jun–Aug) carbon absorption.
 - Sign of **long-term seasonal imbalances** in carbon sequestration.

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Feedback Loop: Warming–Wildfire–Carbon Emissions

- Permafrost Thawing:
 - Rising Arctic temperatures accelerate **permafrost melt**, leading to **organic decay** and CO₂ release.
 - Changes in plant types, drier soils, and higher topsoil temperatures worsen the release.
- Vicious Cycle:
 - Wildfires release carbon → Carbon worsens global warming → Warming dries land, increases fire risk → More wildfires.
 - Creates a self-reinforcing feedback loop with potential tipping points for climate systems.

India's Forest Fires & Carbon Emissions

- Fire-Prone States:
 - As per India State of Forest Report (Dec 2024), Uttarakhand, Odisha, and Chhattisgarh topped forest fire incidents.
 - Uttarakhand alone saw **5,315 fires** between Nov 2022 and June 2023.
- Hotspot Trends:
 - Fire hotspot counts declining slightly:
 - 2.23 lakh (2021–22) → 2.03 lakh (2023–24).
- Temperature Rise:
 - IIT-KGP & IITM, Pune: Land temperatures rising:
 - 0.1º-0.3ºC/decade (pre-monsoon);
 - 0.2º–0.4ºC/decade (post-monsoon).
- Heatwaves = Fire Risk:
 - Earlier, slower-moving, longer-lasting heatwaves are **amplifying fire vulnerability**.
 - India emits ~69 million tonnes of CO₂/year from forest fires (Chase India).

Broader Environmental & Policy Implications

- Loss of Carbon Sink Services:
 - ABZ's shift erodes a key natural buffer against global emissions.
 - o Increases dependence on anthropogenic emission cuts and carbon capture technologies.
- Climate Justice Concerns:
 - Countries with **minimal historical emissions**, like India, face climate risks from emissions elsewhere.
 - Highlights the need for global climate finance, adaptation funds, and early-warning systems.

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• Policy Responses Needed:

- Better forest management, fire prevention, and community-based resilience programs.
- In Arctic and elsewhere, international cooperation vital to protect shared global commons.



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