

# Arctic wildfire (and -related) emissions: Science updates

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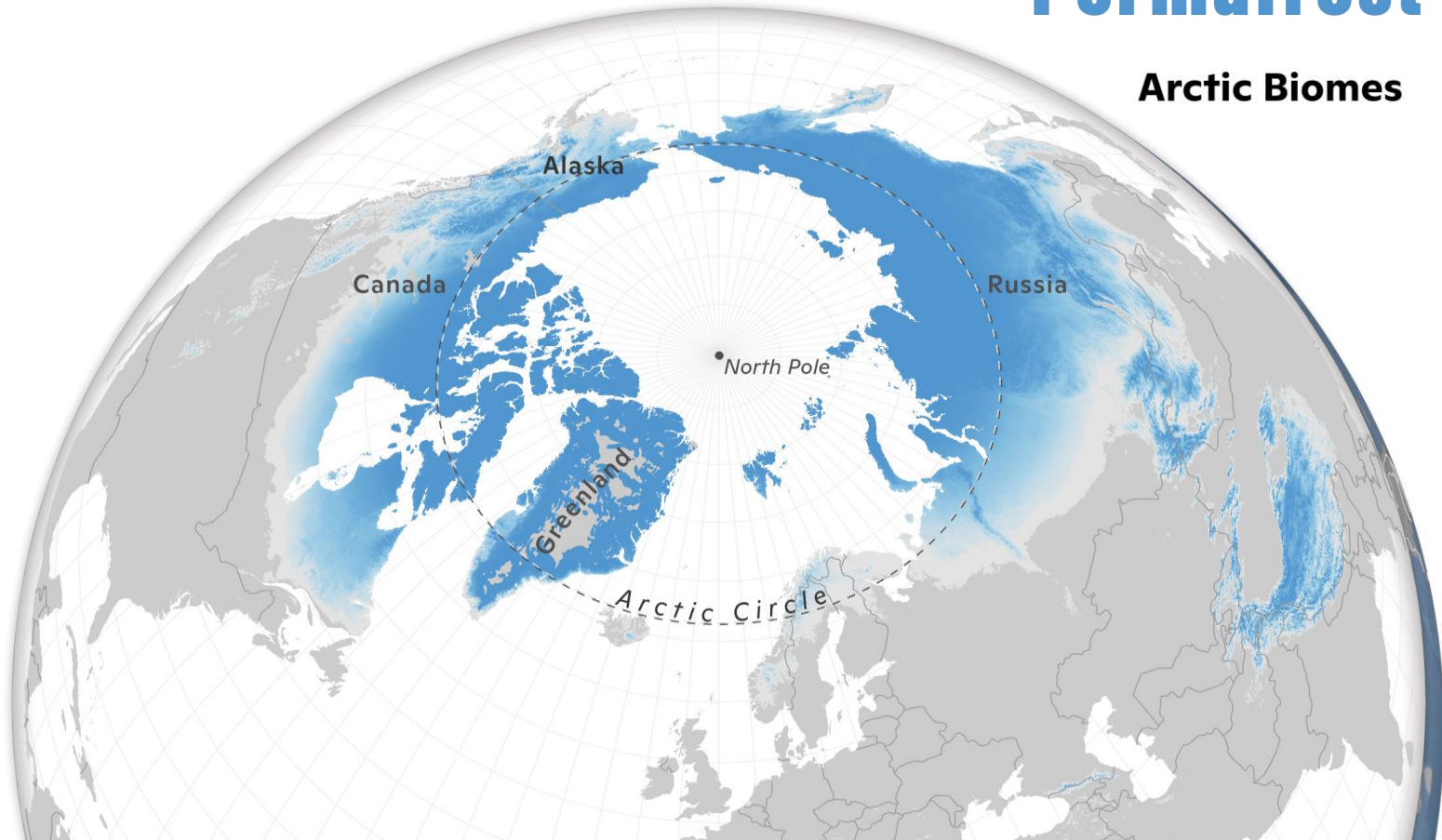


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# Permafrost

## Arctic Biomes



*Credit: Greg Fiske, Woodwell Climate*





**Permafrost**

**1.5 trillion tonnes carbon stored in permafrost soils**



A photograph of a forest with tall, thin trees and dense green foliage. The sky is visible through the canopy, showing a clear blue color. The text "Boreal carbon sink is on par with the tropics!" is overlaid in white, bold font across the center of the image.

**Boreal carbon sink is on par with the tropics!**

*Tagesson et al. (2020) Nature Ecol. Evol.  
Watts et al. (2023) Global Change Biology*





Aleut

Yup'ik

Koryak

Sugpiaq

Chukchi

DENE

EVENKI

Gwich'in

Iñupiat

Inuvialuit

Even

Dehcho

INUIT

ARCTIC  
OCEAN

NENET

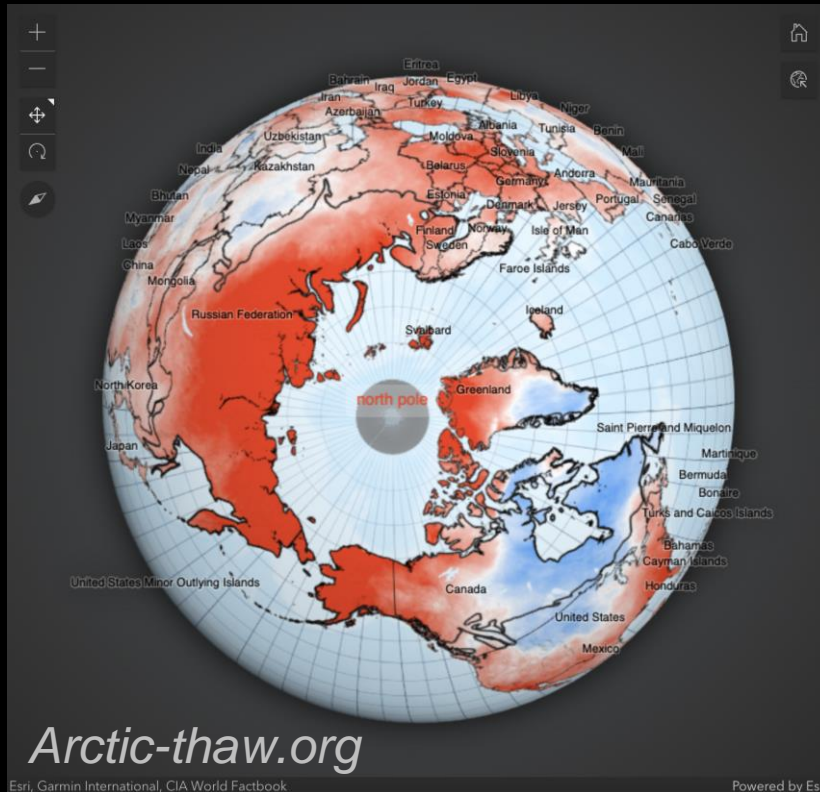
Nunavimmiut

Kalaalit

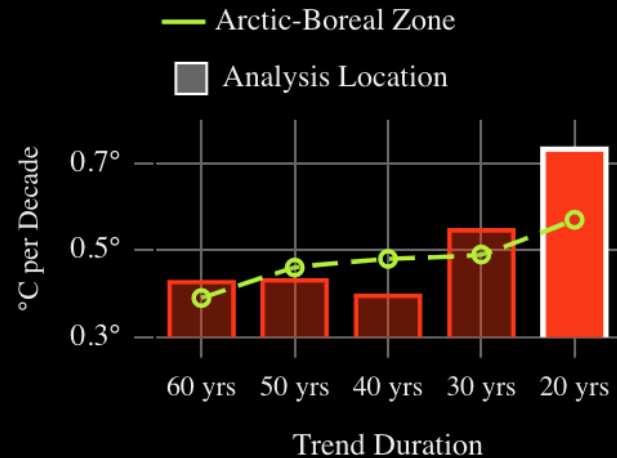
Sámi

Khanty-Mansi

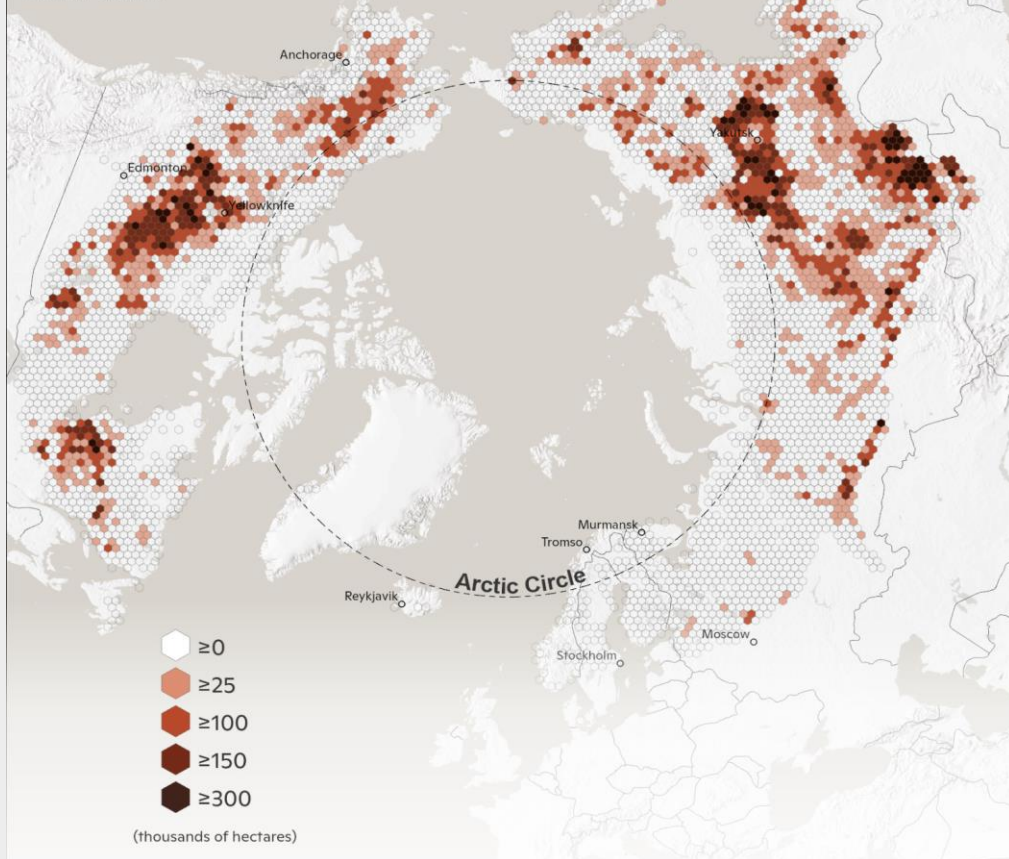
# The Permafrost Region is At Risk – Warming >3x Faster Than Elsewhere on Earth



## Air Temperature Trends



## Cumulative Burned Area of the Arctic Boreal Zone 2004-2024



Map from Woodwell's Boreal Fire team: Brendan Rogers, Greg Fiske, et al.

# Climate Change is Increasing **Wildfires**

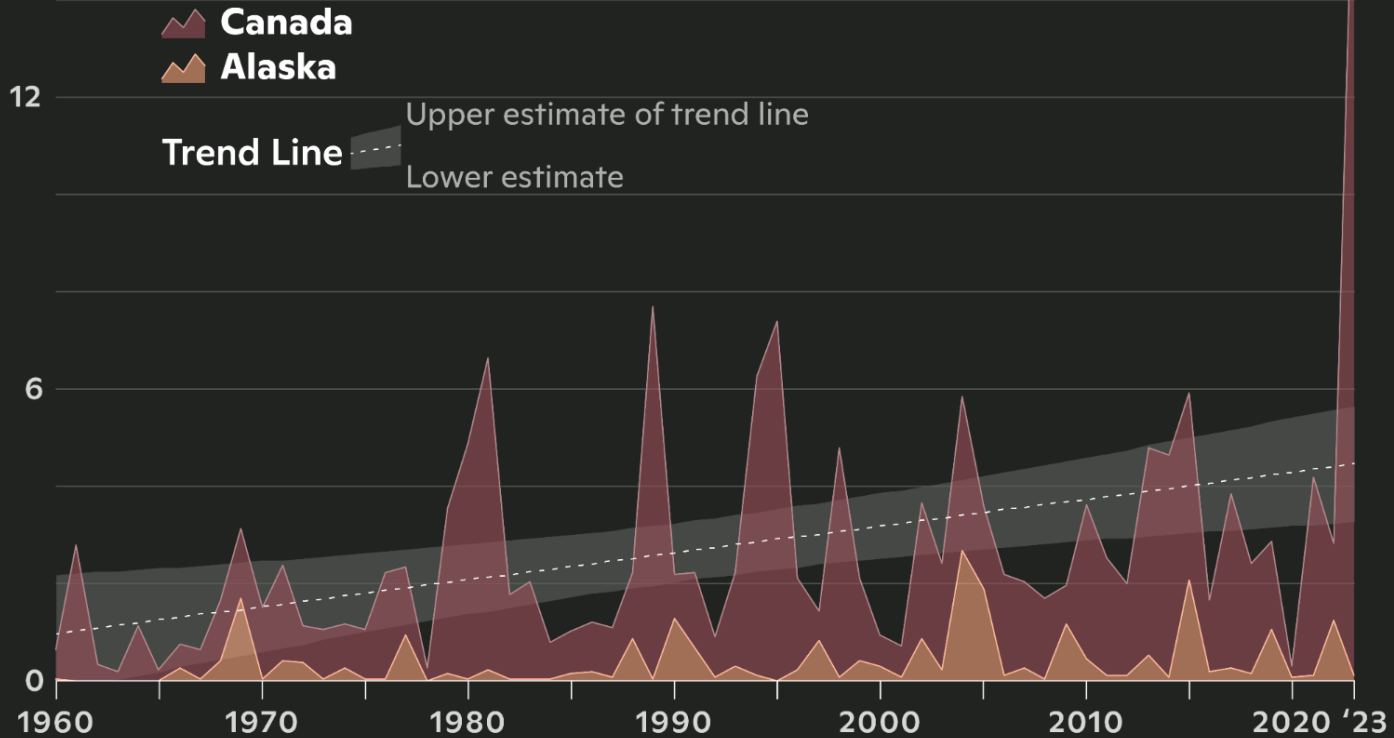
- Burn area has doubled since 1960s
- Observations confirm more severe and frequent fires in the region



Photo: Scotty Creek fire, NWT, Canada  
(Oliver Sonnentag)

18 million hectares burned

over 17.7 million  
hectares burned  
in 2023

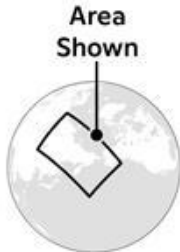
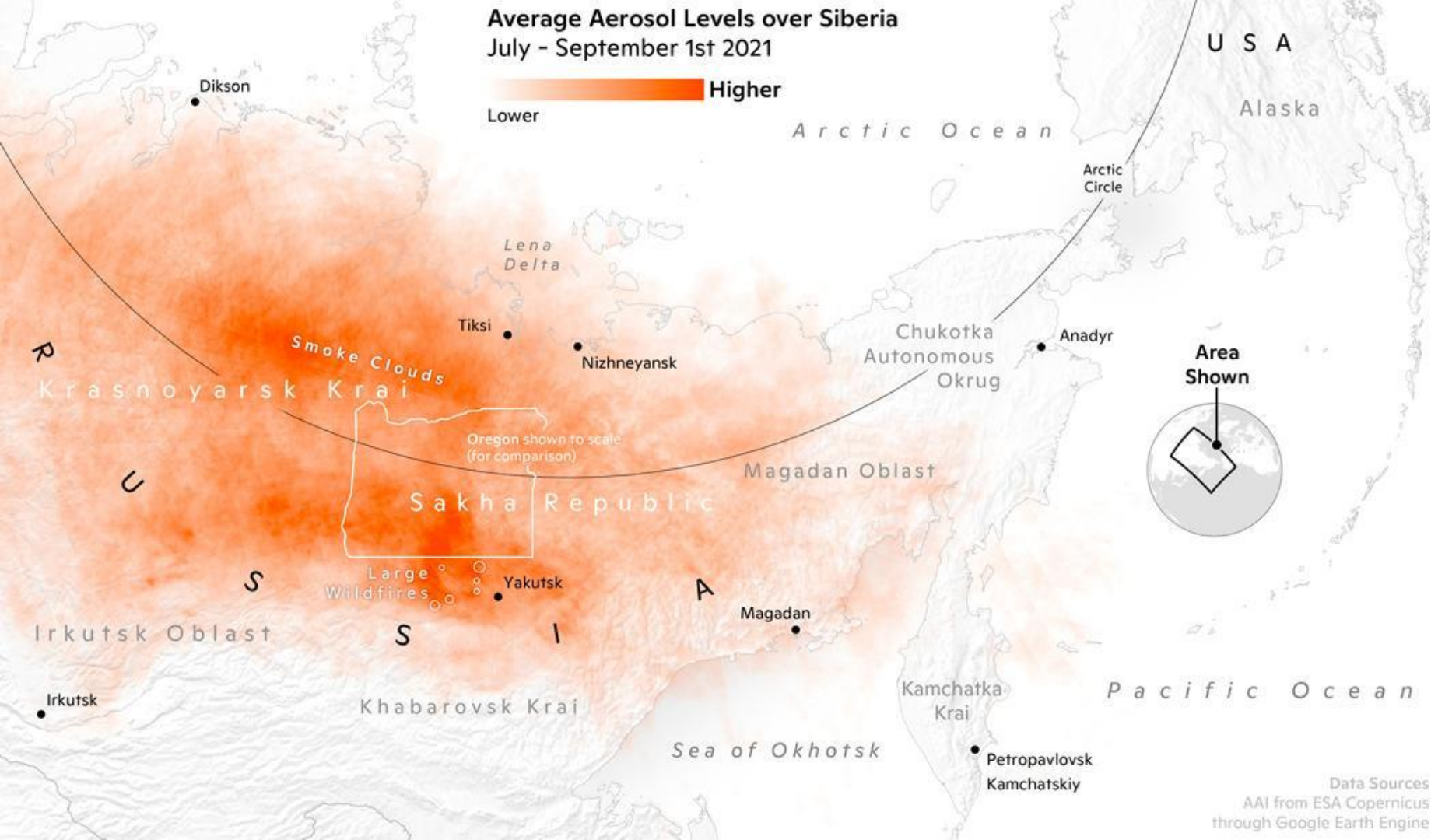


Data: Alaska Interagency Coordination Center; Canadian Wildland Fire Information System; Kasischke, E. S., et al. (2002). <https://doi.org/10.1071/WF02023>; Stocks, B. J., et al. (2003). <https://doi.org/10.1029/2001JD000484>



# Average Aerosol Levels over Siberia July - September 1st 2021

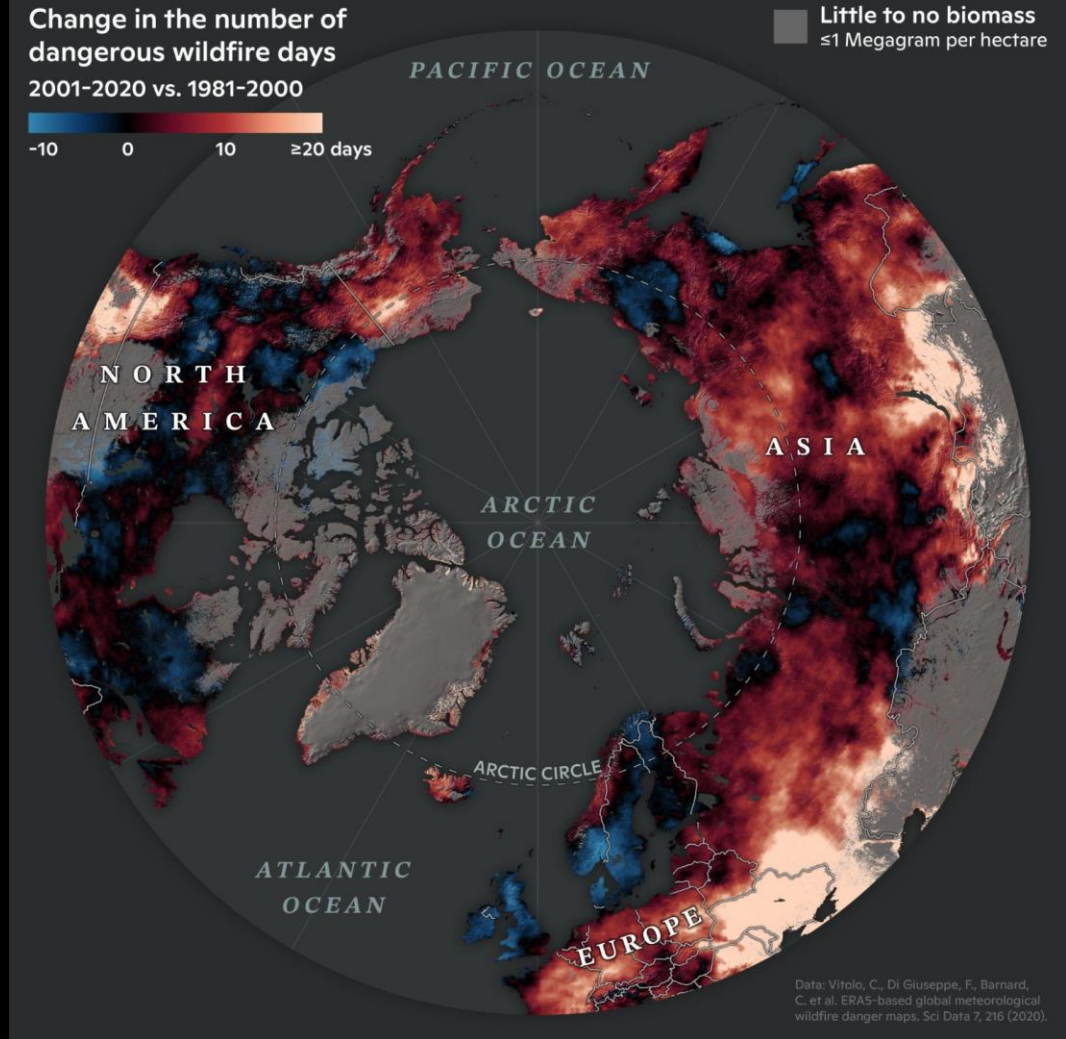
Lower  Higher



Data Sources  
AAI from ESA Copernicus  
through Google Earth Engine

# Wildfire Sources

- Reduced snowpack
  - Drier/warmer conditions
  - Increased lightning strikes
- 







# Consequences of Wildfire

- Public health/smoke inhalation
- Loss of property/infrastructure
- Impacts to local economy and transportation
- Impacts to wildlife and habitat
- Impacts to subsistence living
- Black carbon melting ice
- ...Worsening climate conditions (via forest loss & increased GHG emissions)

**CO<sub>2</sub>**

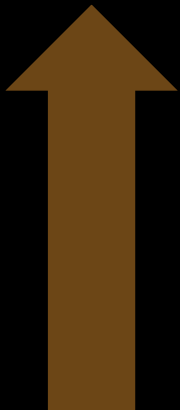


Photo: Scott Rupp

**CH<sub>4</sub>**

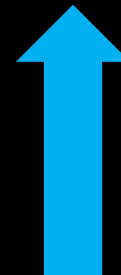


Photo: Merritt Turetsky

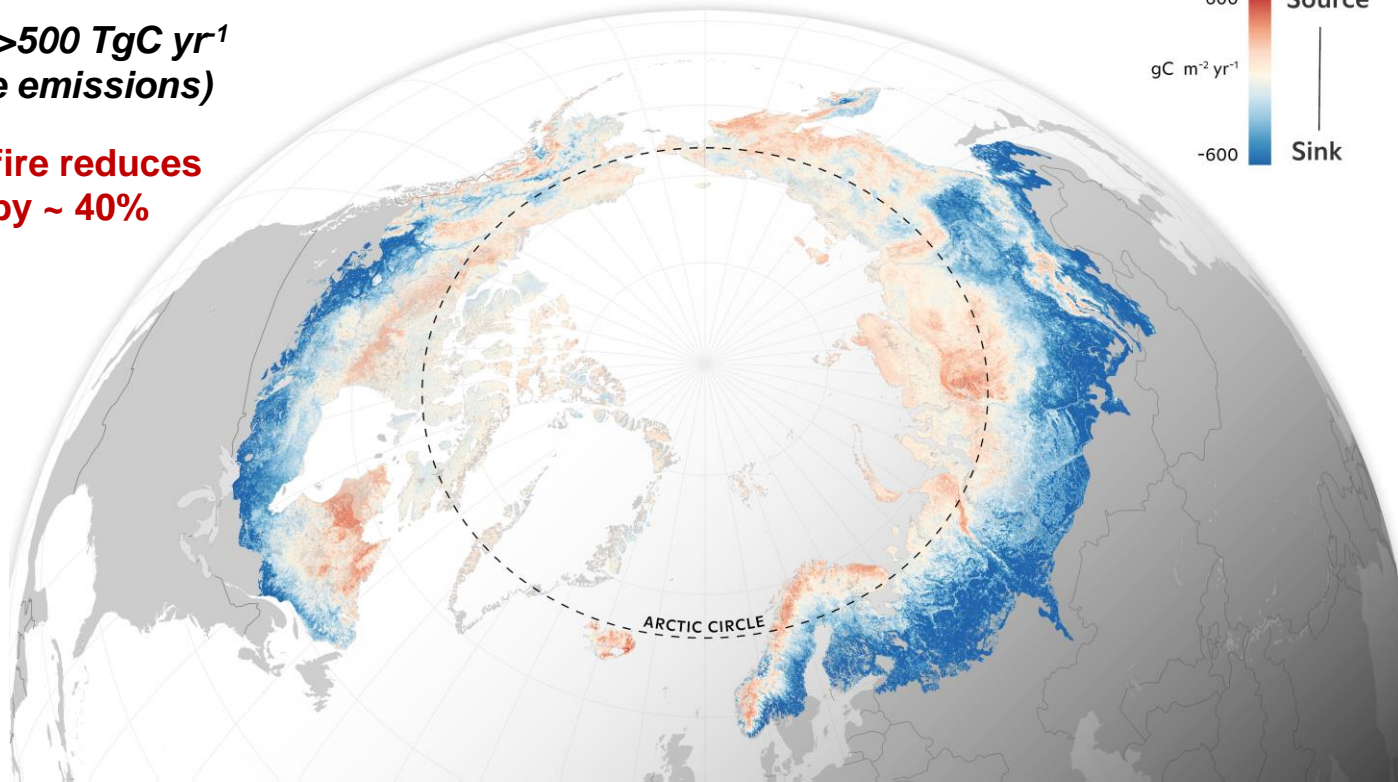
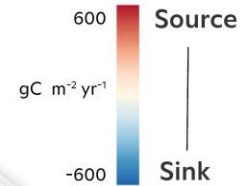


# Fire Impacts to Permafrost Region C Budgets

**Net sink of >500 TgC yr<sup>-1</sup>  
(without fire emissions)**

**Including fire reduces  
total sink by ~ 40%**

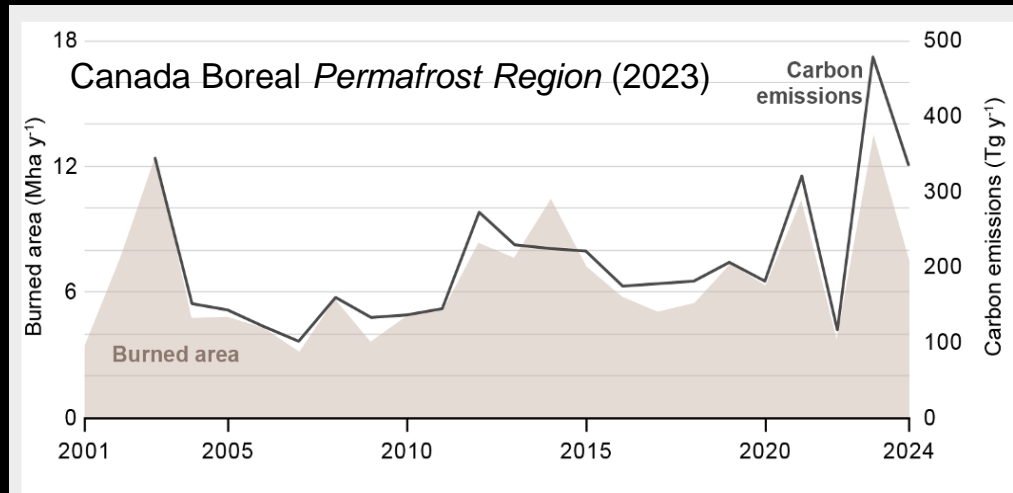
2001-2020 CO<sub>2</sub> Budget



Map: Greg Fiske, Woodwell Climate; Data: Virkkala et al. (2024) In Press @ Nature Climate Change

# Wildfire GHG Emissions

- **Canada (2023): 3x the emissions of all other sectors in Canada combined**
- **Alaska + Canada (2021-2050) estimates: Yearly emissions from 2.6 billion cars**







**Wildfire and wildfire-permafrost emissions are underrepresented in global carbon budgets.**

# Key Limitations to Current Decision Making:

- Most global climate models do not adequately represent permafrost-region wildfire emissions, nor permafrost-wildfire interactions.
- Funding for Arctic fire research and emergency response is not proportional to the climate costs.
- Fire management decisions have not prioritized protecting carbon or permafrost, human health and other values increasingly at risk.
- Arctic Indigenous Knowledge-holders are not adequately centered in decision-making.



# Thanks for your attention.

[permafrost.woodwellclimate.org](http://permafrost.woodwellclimate.org)



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