Included in Issue: Summer 2023

In Case You Missed It

Arrival of Canadian wildfire smoke and a look at the changing arctic from above

By Sarah Petters

Recent Air Quality Alerts Related to Wildfires in Canada

If you live on the east coast, you will have noticed the uptick in air quality alerts related to wildfires burning as far away as western Canada. In fact, this spring a large swath of North America has experienced the effect of widespread fires in Canada, including areas of Alberta and British Columbia.

Intermittently since mid-May this year, parts of the Midwest, Northeast, and the Eastern Seaboard have been immersed for days at a time in plumes of smoke brought with the polar jet stream from Canadian wildfires. The daily Air Quality Index has reached Code Yellow, Code Orange, and even Code Red levels in these areas, prompting states to issue air quality alerts. The poor air quality affected scheduled activities in major metropolitan areas including Chicago, New York, and Philadelphia.

In the News

Major wildfire and air quality events were reported by various news outlets in early May, early June, and mid-July:

Date	Area highlighted in report	News source and link
May 8, 2023	Alberta and British Columbia	NASA
May 11, 2023	Northeast and Mid-Atlantic	Washington Post
June 6, 2023	Charlotte, NC	Queen City News
June 7, 2023	Triangle area of North Carolina	WRAL
June 8, 2023	Northeastern US	New York Times
June 8, 2023	Northeast, Midwest and South	Miami Herald
June 28, 2023	New York	CNBC
July 18, 2023	North Carolina and Georgia	New York Times

An Active Year for Wildfires in Canada

The Canadian Interagency Forest Fire Centre, which reports on current and historical Canadian fires, shows that although the size and frequency of wildfires varies significantly from year to year, wildfires in 2023 have already resulted in almost 11 million hectares of burned area. The second and third most active fire years since 1980 were 1989 and 1995, with 6 million and 7 million hectares of burned area, respectively.

These statistics cover the entire year or year-to-date; for reference, the Camp Fire (2018) burned 0.062 million hectares over a period of two weeks (fire.ca.gov; CNBC 2018), and the 2017 fires in Portugal burned in total 0.54 million hectares in two major events, each lasting a few days and involving hundreds of individual fires (Ramos et al. 2023).

Here are some areas for comparison:

	Area in million hectares	**Source**
Canadian wildfires so far in 2023	11.0	Canadian Interagency Forest Fire Centre (CIFFC)
Canadian wildfires last year (2022)	1.5	CIFFC
Canadian wildfires in 1995	7.1	CIFFC
Canadian wildfires in 1989	5.9	CIFFC
The Camp Fire, two weeks in 2018	0.062	fire.ca.gov; CNBC 2018
Fires in Portugal, June & October 2017	0.54	Ramos et al. 2023
Area of Alberta	66.1	organic search
Area of Butte County (Camp Fire)	0.43	organic search
Area of Portugal	9.2	organic search

Changes in the Boreal Forests and Tundra

Alberta and British Columbia are predominantly boreal forest. The boreal forests serve as a carbon sink, but now as aboveground biomass is removed and ecosystems change, the uptake of carbon by these forests could slow and reverse. As boreal forests become warmer and drier, they become vulnerable to wildfires that burn larger areas and penetrate deeper into the soil.

Further north, tundra regions extend from the North Slope of Alaska southward across the Northwest Territories of Canada towards Hudson Bay. The arctic tundra soil is rich in biomass, and the release of that carbon by fires or increased biological activity accelerates warming as the region becomes warmer and drier.

Maps of burned areas are important in calculating wildfire emissions, and can be drawn using satellite retrievals, GPS-based boundaries, aerial footage, and even historical records. Satellite-based burned area maps are often used to estimate carbon release by wildfires, but usually for boreal forest and not for tundra.

A Look at Arctic Wildfires from ABoVE

The Arctic Boreal Vulnerability Experiment (**ABoVE**, https://above.nasa.gov/) is entering its third and final phase after ten years of field-based and remote sensing data collection across a large swath of western Canda and Alaska. The campaign documents and analyses changing carbon dynamics, wildfire and insect disturbances, hydrology, wetlands, permafrost, and vegetation.

Much of the measurement activity has focused on ecosystems and wetlands. Carbon loss from these

ecosystems translates directly to gas and aerosol emissions, and this is where the news from ABoVE may be most interesting to AAAR readers. Publications from ABoVE are available here and calls for AGU 2023 abstracts are posted here.

Recent publications

Potter et al. (2023) present a high-resolution (500 m) burned-area map for Alaska and Canada from 2001 to 2019, using MODIS 500 m retrievals and Landsat 30 m imagery. They then used machine learning to estimate burn depth, which impacts both emissions and the health of the ecosystem, and to calculate carbon emissions for the entire ABoVE domain.

Moubarak et al. (2023) used ground-based measurements of burn depth and ecosystem properties in concert with Landsat retrievals to estimate burned area and carbon emissions from the burning tundra in Alaska. The authors convert the loss of organic matter to gas and aerosol emissions and use these emissions to model the radiative forcing of the tundra wildfire.

Further Reading

The ABoVE Field Campaign (above.nasa.gov)

Potter, S., Cooperdock, S., Veraverbeke, S., Walker, X., Mack, M.C., Goetz, S.J., Baltzer, J., Bourgeau-Chavez, L., Burrell, A., Dieleman, C., French, N., Hantson, S., Hoy, E.E., Jenkins, L., Johnstone, J.F., Kane, E.S., Natali, S.M., Randerson, J.T., Turetsky, M.R., Whitman, E., Wiggins, E., and Rogers, B.M. (2023). Burned area and carbon emissions across northwestern boreal North America from 2001–2019. *Biogeosciences* 20 (13).

Moubarak, M., Sistla, S., Potter, S., Natali, S.M., and Rogers, B.M. (2023). Carbon emissions and radiative forcings from tundra wildfires in the Yukon–Kuskokwim River Delta, Alaska. *Biogeosciences* 20 (8).

Wang, J.A., Baccini, A., Farina, M., Randerson, J.T., and Friedl, M.A. (2021). Disturbance suppresses the aboveground carbon sink in North American boreal forests. *Nature Climate Change* 11 (5).

Akagi, S.K., Yokelson, R.J., Wiedinmyer, C., Alvarado, M.J., Reid, J.S., Karl, T., Crounse, J.D., and Wennberg, P.O. (2011). Emission factors for open and domestic biomass burning for use in atmospheric models. *Atmospheric Chemistry and Physics* 11 (9).

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