



Urban surface 'grime' as a tool for low-cost air quality assessment



Sarah A. Styler (and trainees!)

Clean Air Hamilton | April 15, 2024

The PARTICLES lab—McMaster University

(pesticides, art, road dust, traffic, interdisciplinary, combustion, light, equity, surfaces)

Alex

road dust chemistry;
Ti mineral chemistry

Daniel

cloudwater chemistry;
insecticide chemistry

Iris, Steph, and Victor

pollutant transformations in wildfire ash;
surface film chemistry



Laura

non-exhaust emission chemistry; building
custom reactor systems

Kay, Grace, and Mengchan

air quality in museums;
cultural heritage conservation

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Climate change → more (intense) wildfires

PBSO NEWS HOUR



By Matthew Brown, Associated Press

Climate change is causing more wildfires and governments are unprepared, says U.N.

Leave your feedback

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Bazano Feb 22, 2022 11:23 PM EDT

Why Climate Change Makes It Harder to Fight Fire With Fire

Worsening wildfires in recent years have led officials to embrace planned fires to thin forests before disaster strikes. But the warming world is making it tougher to do safely.

Give this article    30

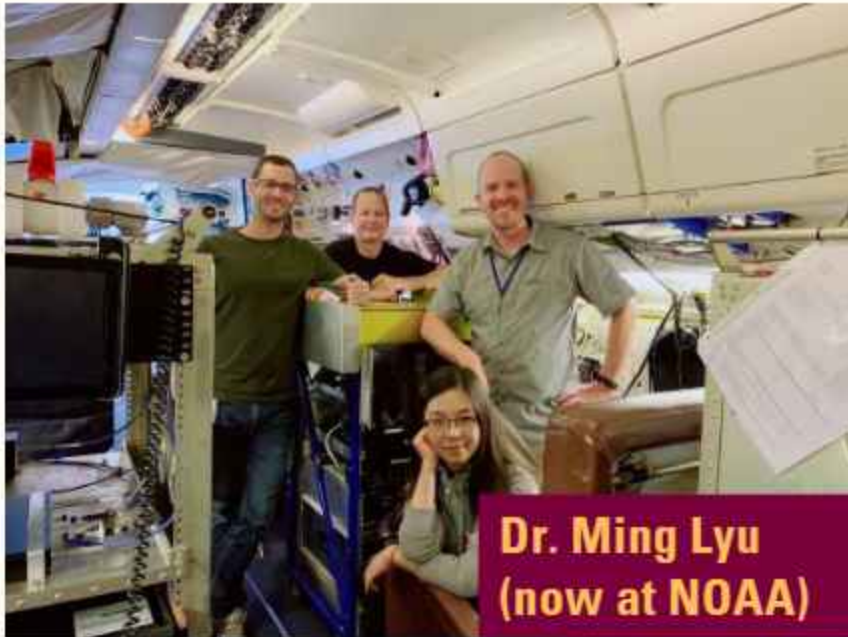


A Modoc National Forest firefighter used a drip torch to ignite a prescribed burn in Alturas, Calif., last year. Max Whitaker for The New York Times

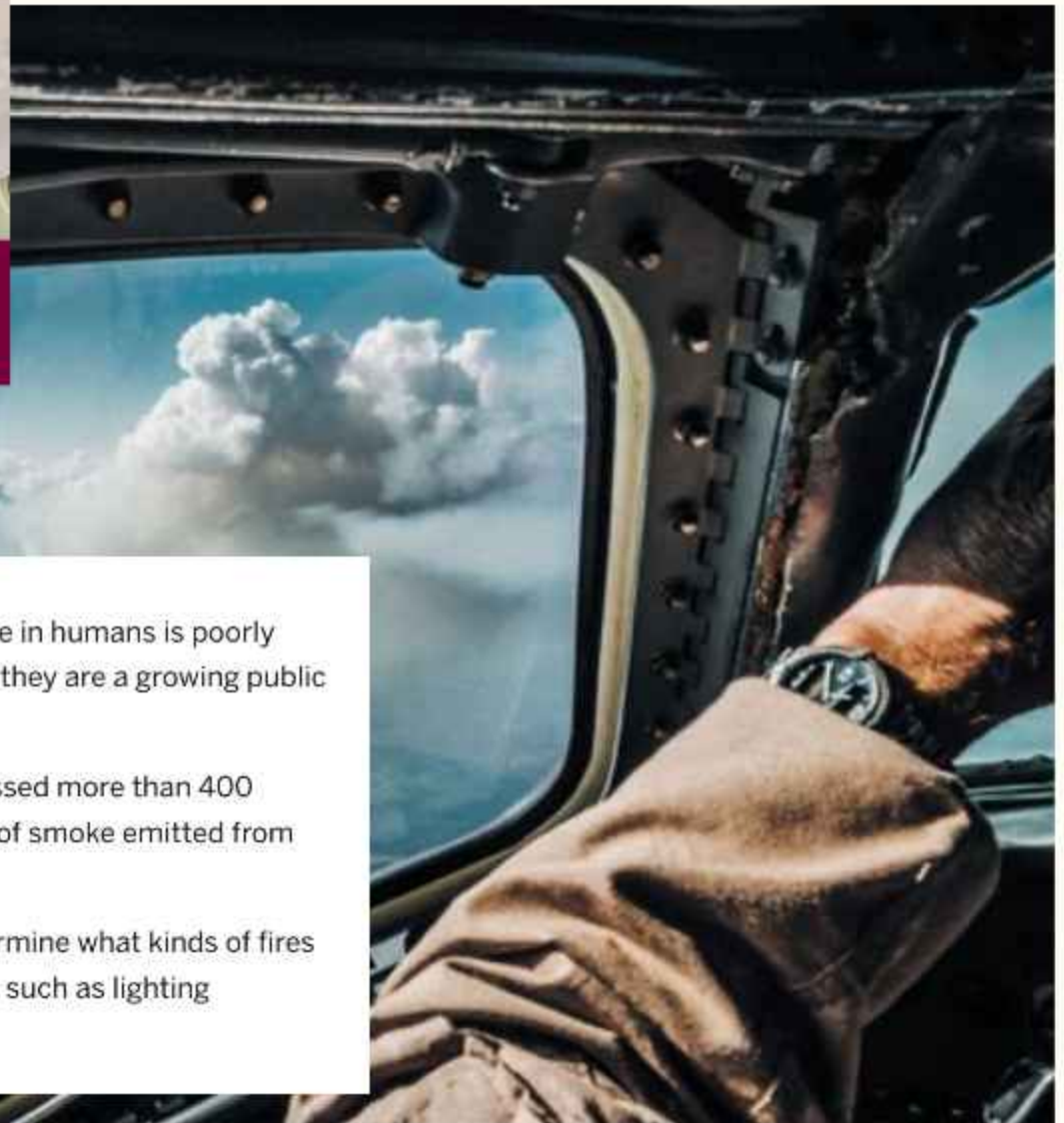
<https://www.pbs.org/newshour/science/climate-change-is-causing-more-wildfires-and-governments-are-unprepared-says-u-n>

<https://www.nytimes.com/2022/05/05/climate/wildfires-prescribed-burn.html>

Wildfire air quality impacts



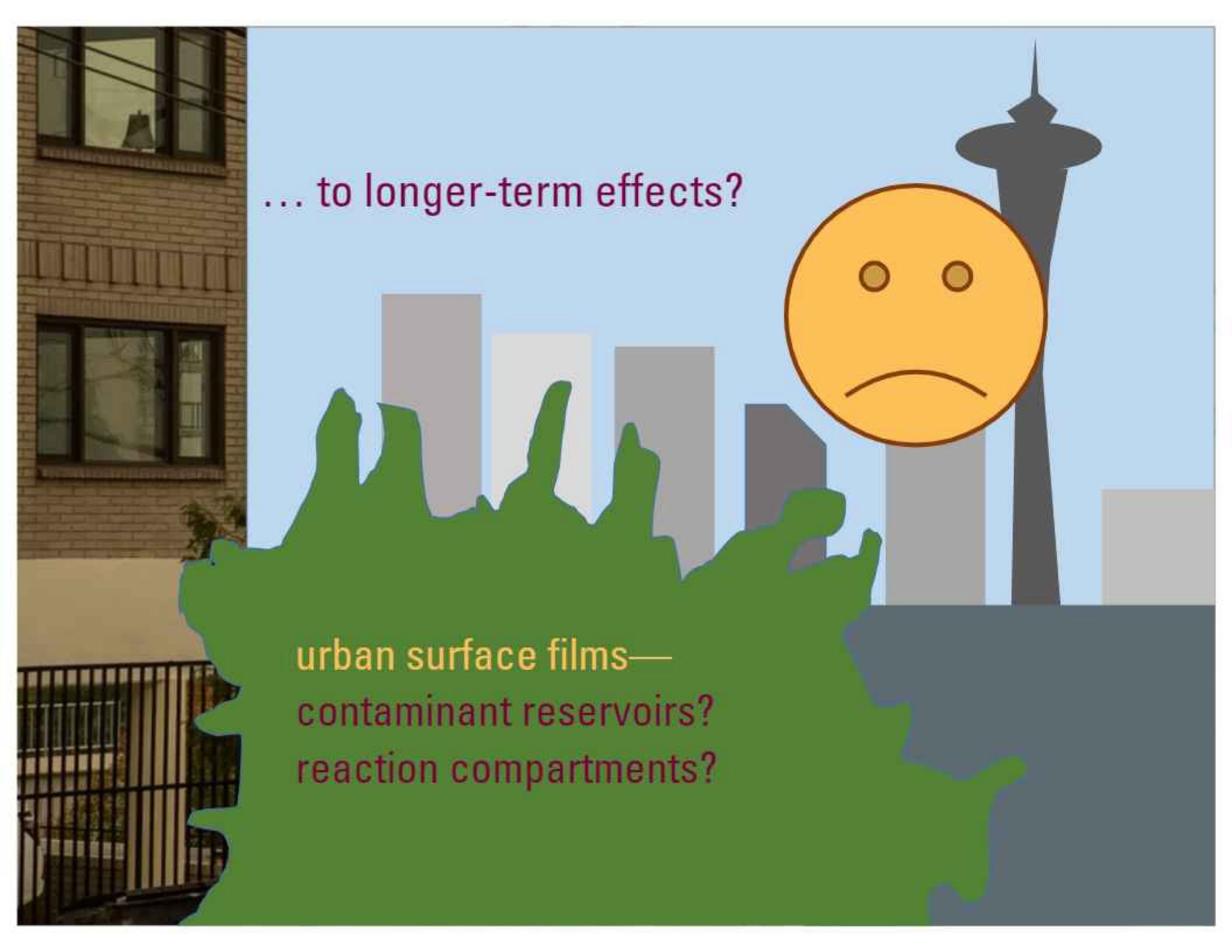
**Dr. Ming Lyu
(now at NOAA)**



- **The acute and chronic effects of wildfire** smoke exposure in humans is poorly understood. As wildfires intensify and occur in new places, they are a growing public health threat.
- **An unprecedented project led by NOAA and NASA** amassed more than 400 scientists to investigate the precise chemical composition of smoke emitted from biomass burns and how it changes over time.
- **Data collected during the aerial campaign** will help determine what kinds of fires are most harmful. This could inform how fire management, such as lighting prescribed burns, is regulated and practiced.

From "short-term"
air quality impacts ...





... to longer-term effects?

urban surface films—
contaminant reservoirs?
reaction compartments?

Autumn 2021—pilot surface film sampling campaign



Autumn 2021—pilot surface film sampling campaign

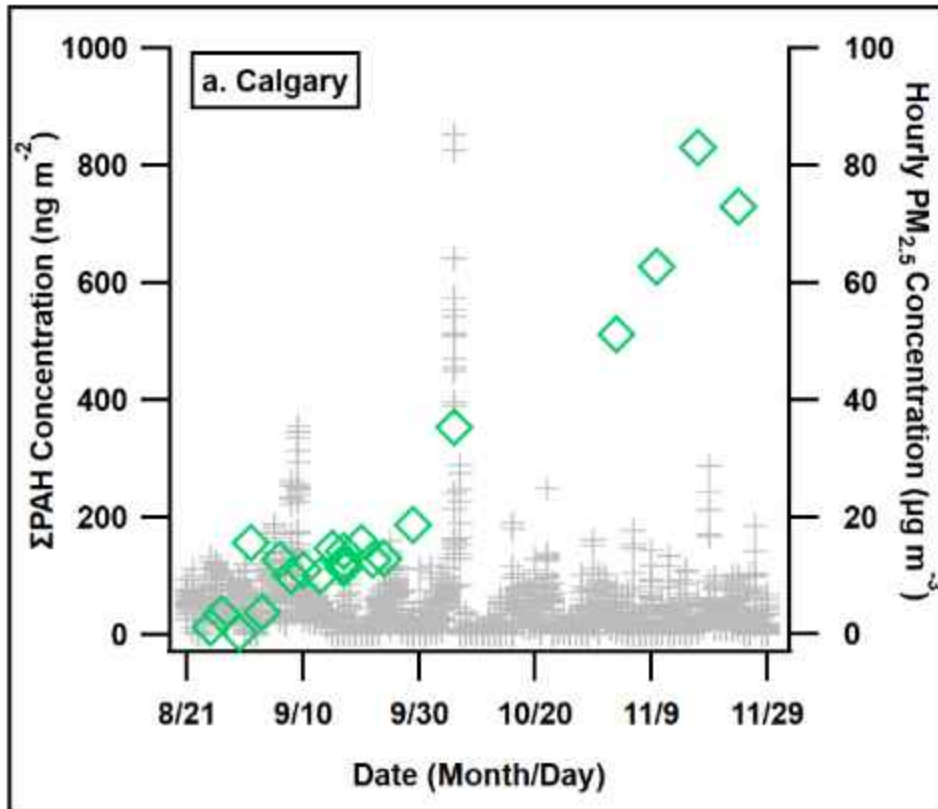


Calgary, Alberta
(Laura's family's house)



Hamilton, Ontario
(chez moi)

One wildfire smoke event contributes > 20% of overall PAH loadings in Calgary grime



WEATHER

Sask. wildfire smoke prompts air quality advisory for Calgary



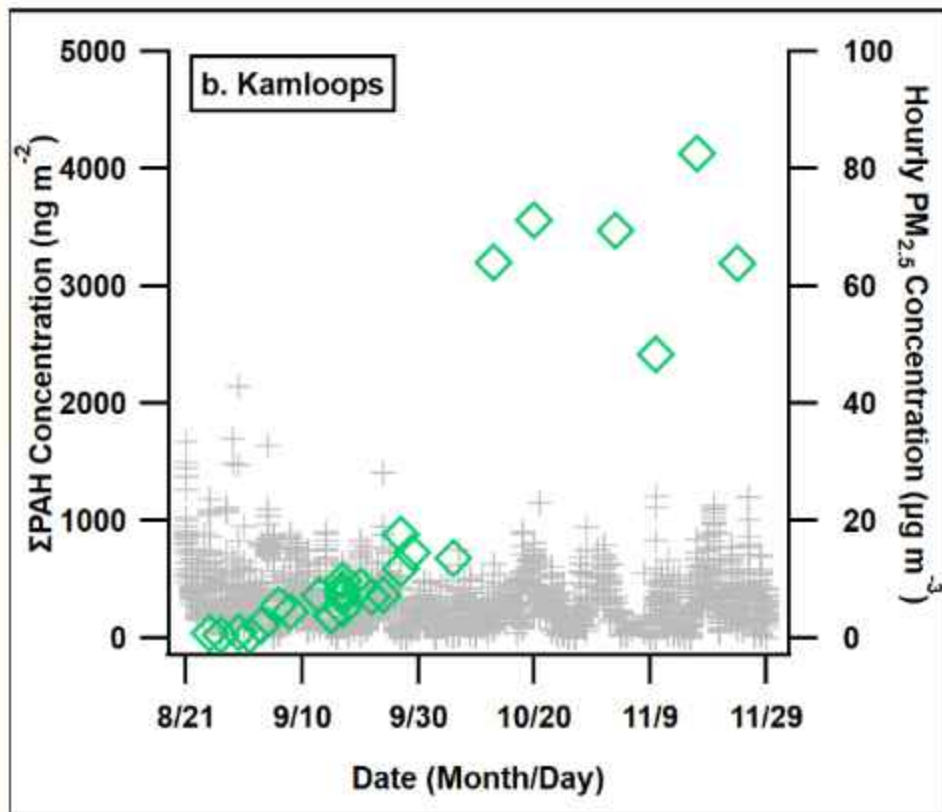
By Kaylen Small • Global News

Posted October 6, 2021 9:57 pm • Updated October 7, 2021 1:31 am • 1 min read



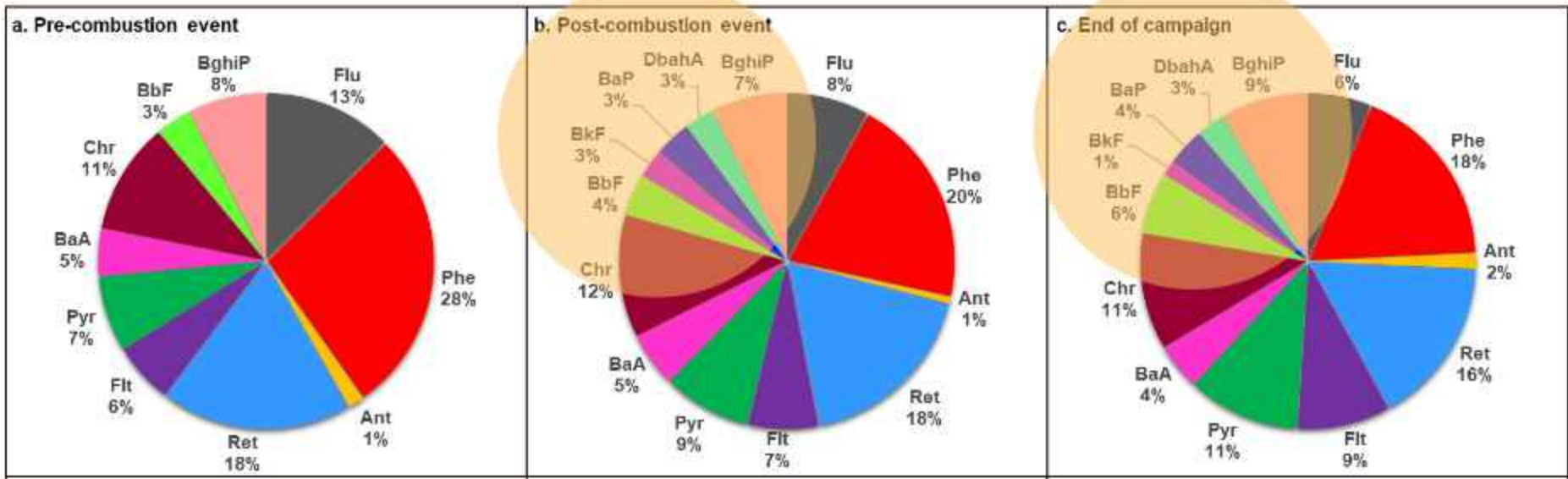
A smoky Calgary is pictured on Wednesday, Oct. 6, 2021. Global News

One 'hyper-local' combustion event dominates PAH loadings in Kamloops grime

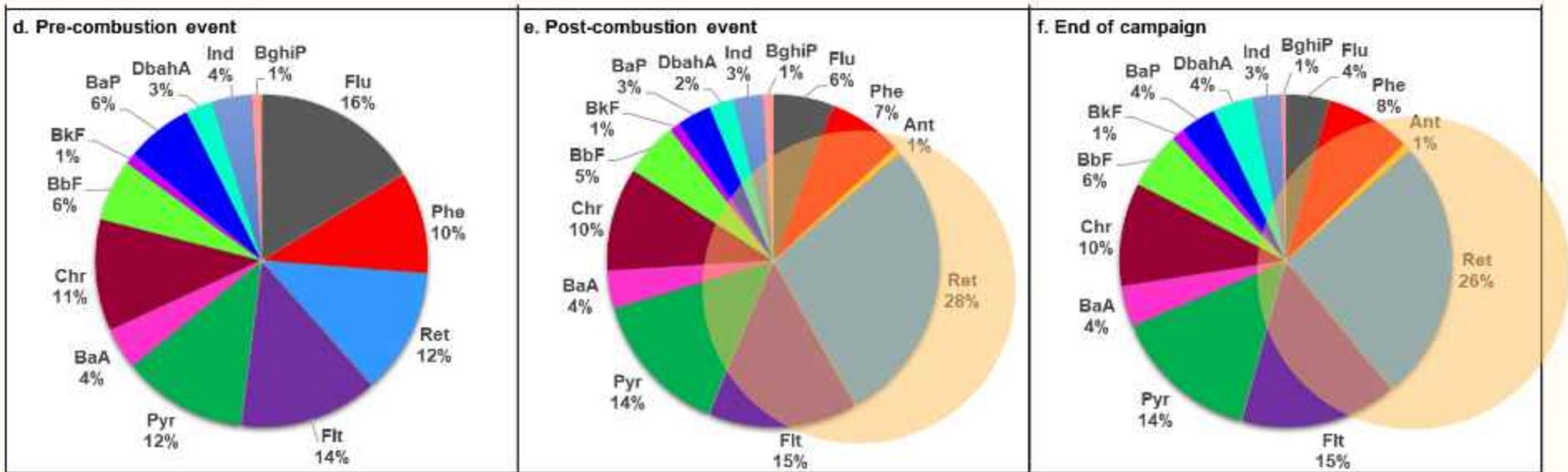


PM_{2.5} data shows no evidence of event!

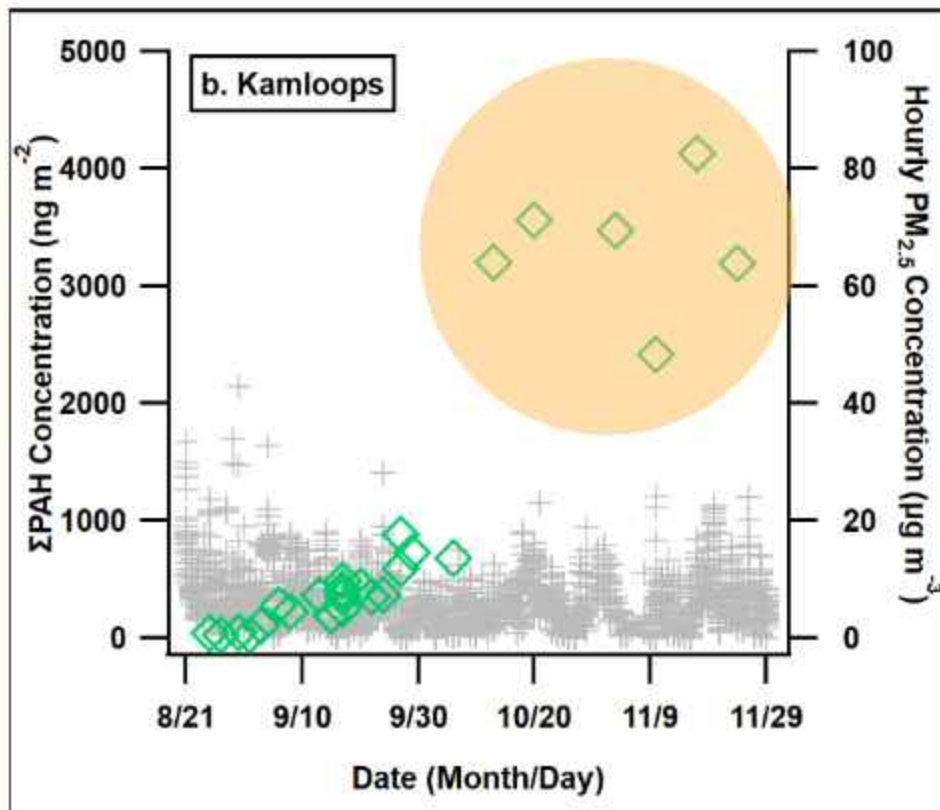
Smoke events precipitate changes in PAH congener profiles



Smoke events precipitate changes in PAH congener profiles

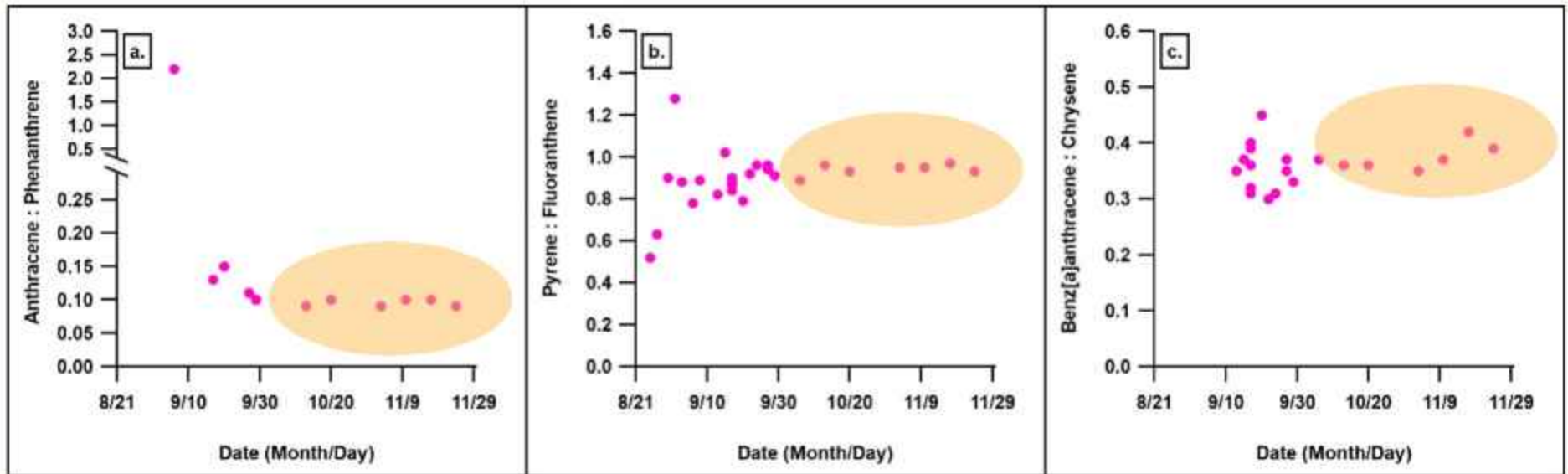


Are PAH 'shielded' from oxidation by the grime matrix?



PAH clearly 'stick around' ...
is there **any evidence**
of degradation?

No evidence of post-deposition PAH degradation



Why does all of this matter?

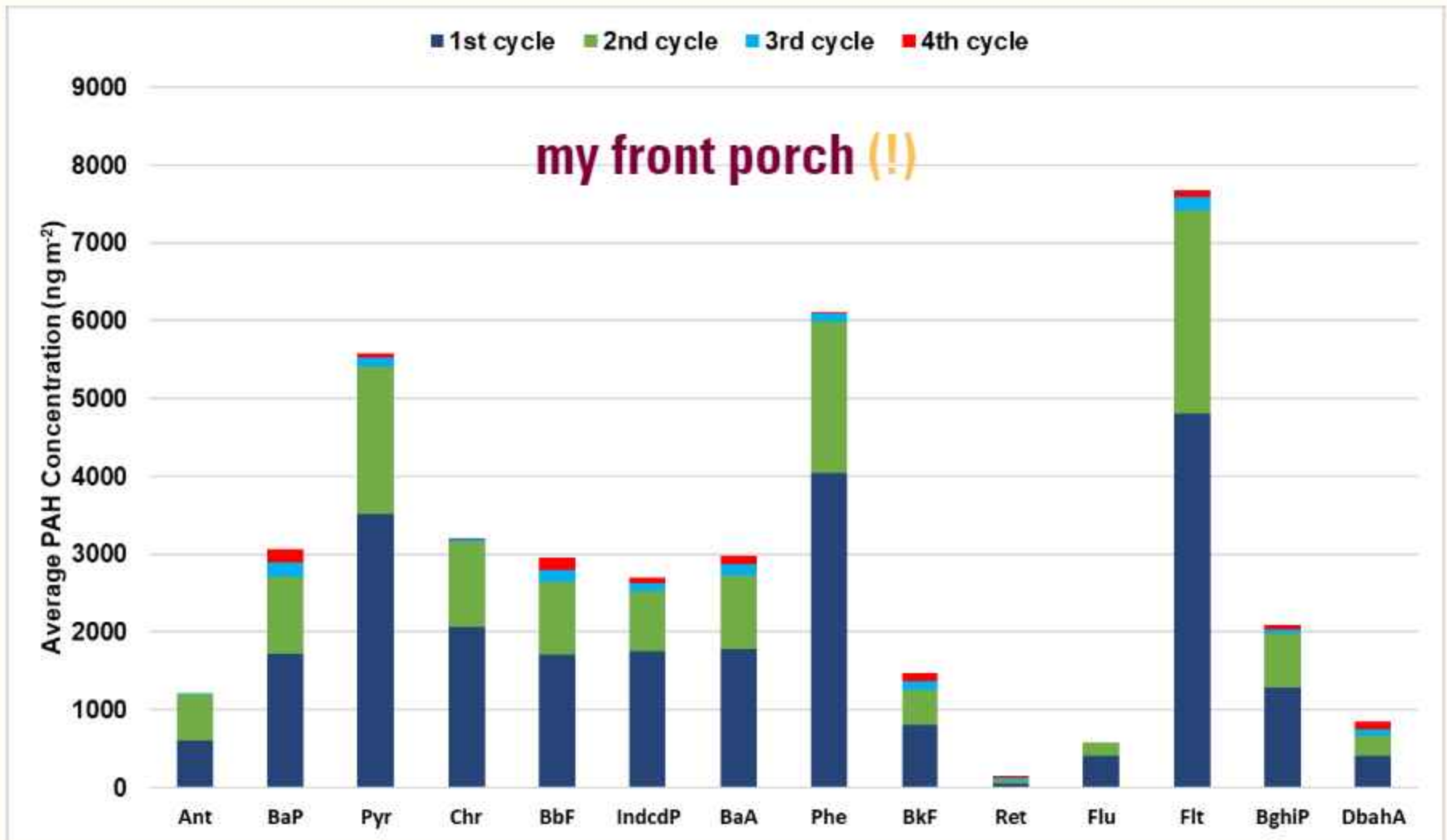
- episodic wildfire smoke events likely dominate grime composition in smoke-affected areas
- small-scale urban combustion activities are important!
- pollutant burden from smoke incursions can be long-lasting → pulsed pollutant delivery via stormwater runoff
- grime analysis can capture short-term events 'missed' by less frequent speciated measurements (*e.g.*, NAPS)

Summer 2022—ON-FIRE

(Observing North American Films Influenced by Regional Emissions from fires; naming credit to Dr. Jennifer Murphy)



Why does all of this matter ... in Hamilton?



Sampling in Hamilton to date

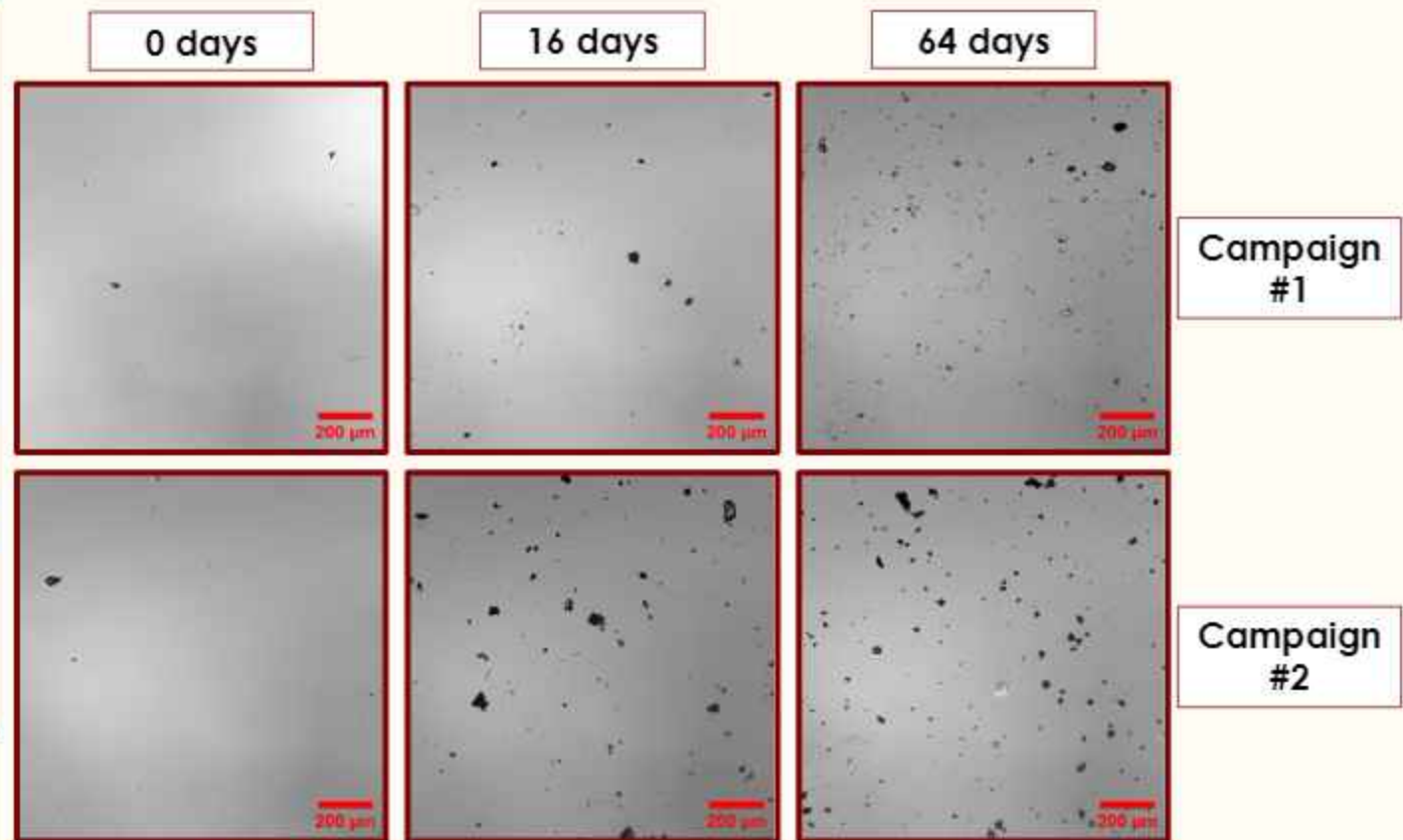


Surface soiling as a function of time



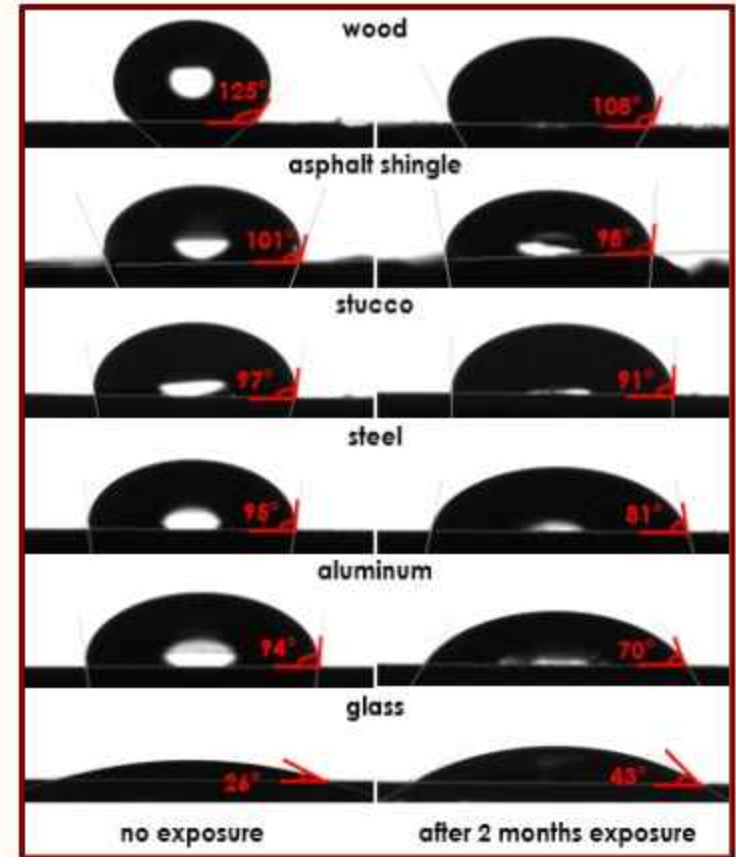
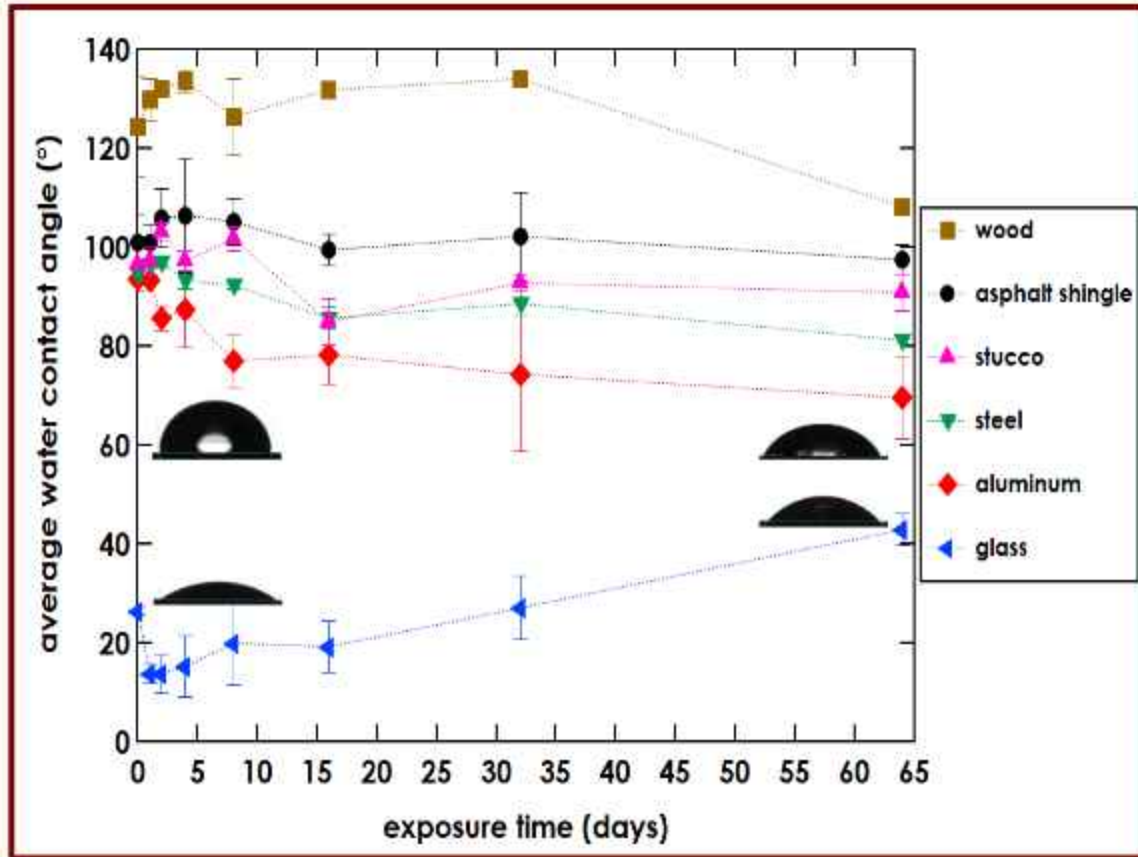
Olympus Upright
Widefield Microscope
+
ImageJ software

Image retrieved from <https://calm.mcmaster.ca/equipment-3/widefield/>



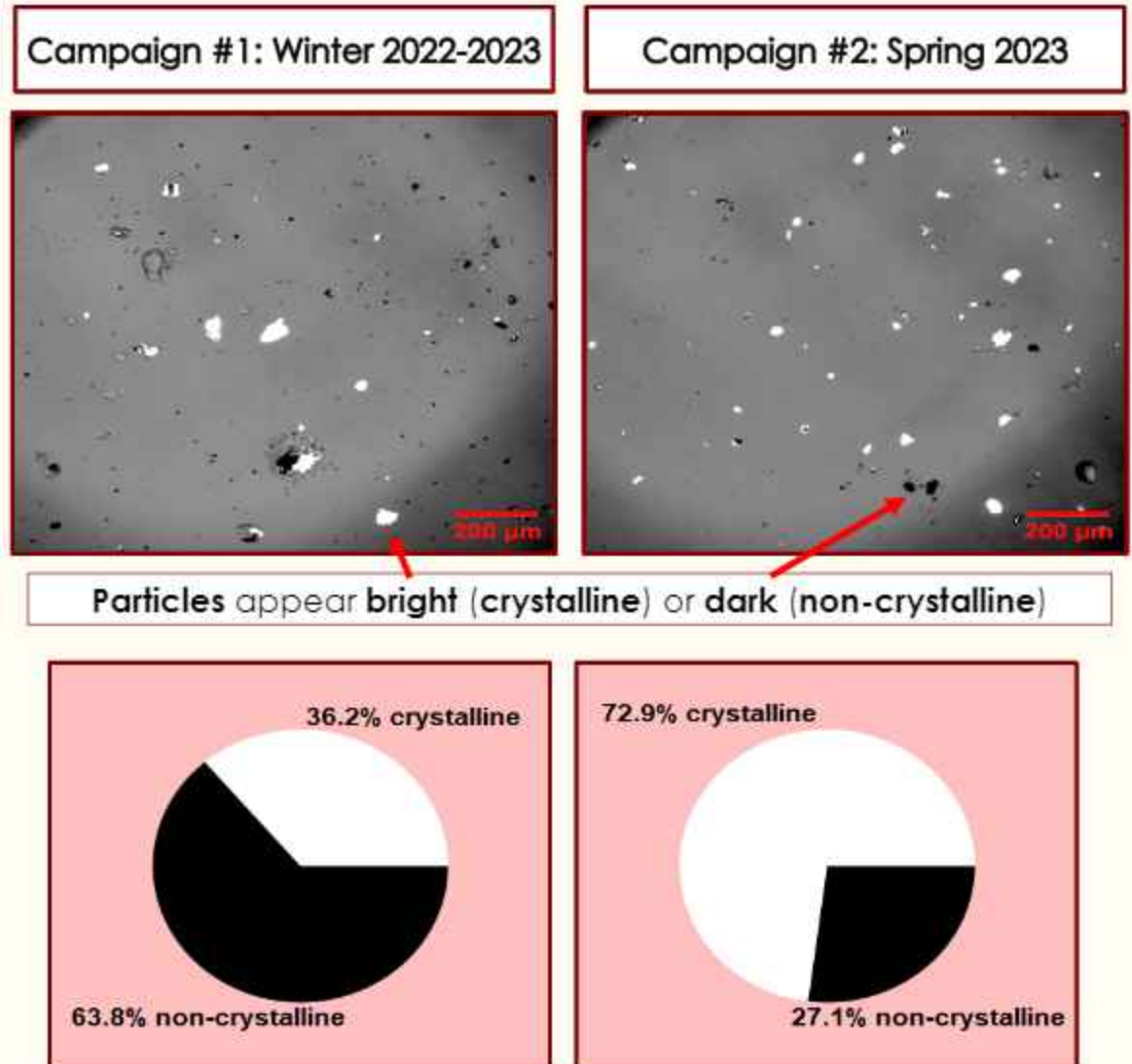
Capture images at various exposure

Physicochemical characterization— contact angle measurements

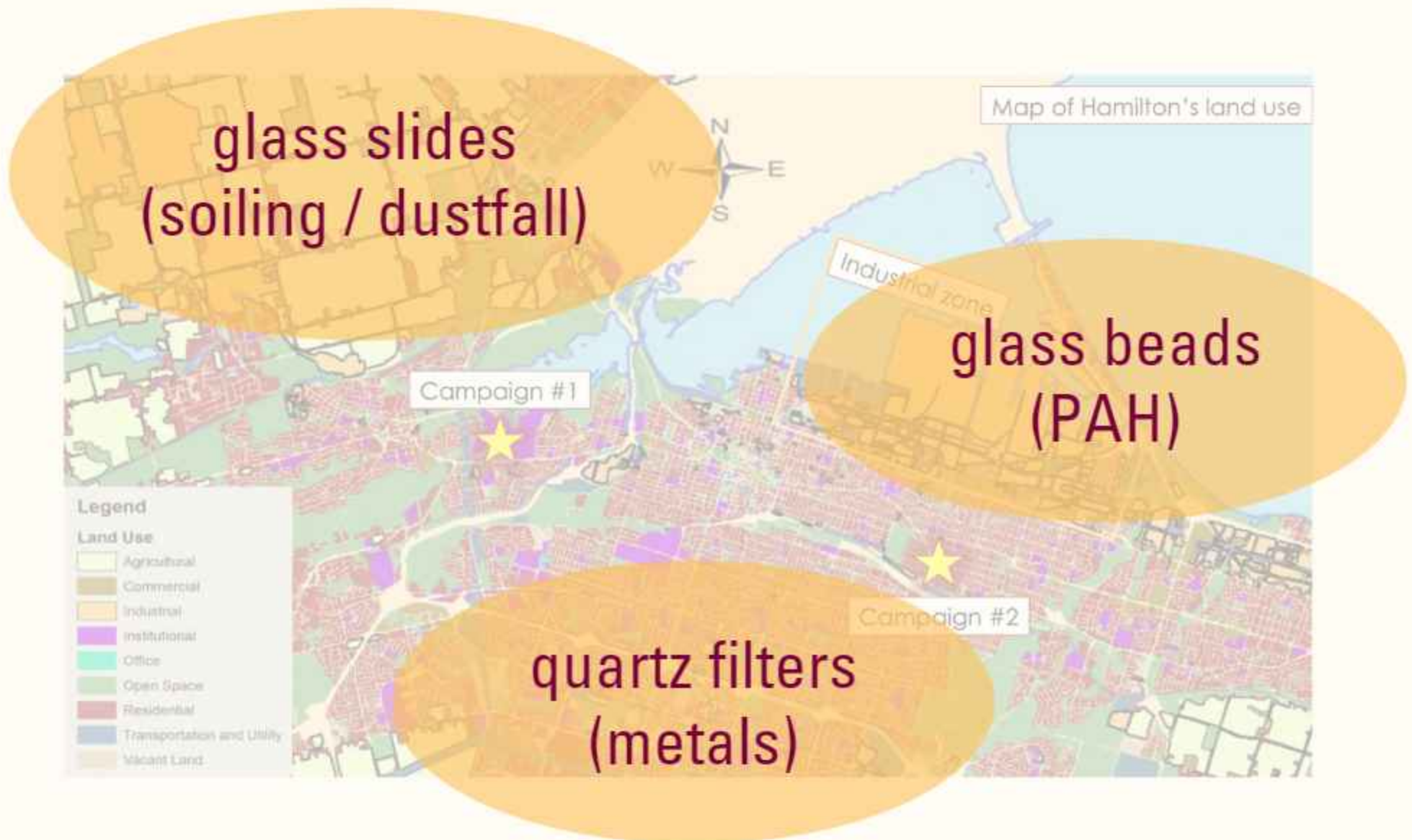


Physicochemical characterization— polarized light microscopy

... influence of
metal dust?



Planned sampling in Hamilton



Planned sampling in Hamilton—funding?

BRIGHTER
WORLD

McMaster
University

Societal Impact Seed Grant

APPLY NOW

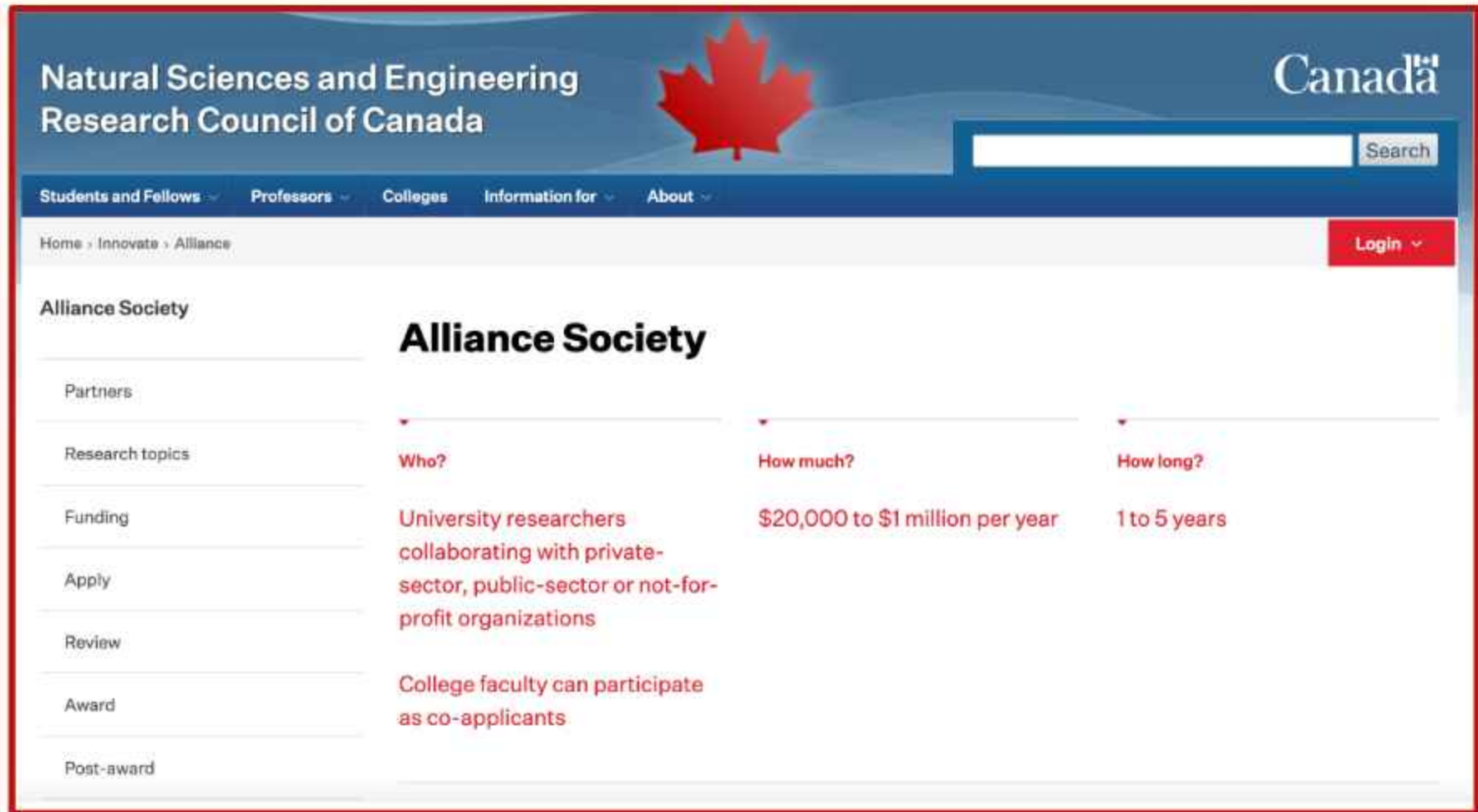
Supports McMaster researchers and their partners in the generation and mobilization of co-created knowledge that helps solve a societal challenge.

Application Deadline: March 10, 2024

 Learn more at research.mcmaster.ca



Planned sampling in Hamilton—funding?



The screenshot shows the website for the Natural Sciences and Engineering Research Council of Canada (NSERC). The header includes the NSERC logo, a search bar, and navigation links for Students and Fellows, Professors, Colleges, Information for, and About. The main content area is titled "Alliance Society" and features a table with details about the funding program.

| | Who? | How much? | How long? |
|-----------------|---|----------------------------------|--------------|
| Partners | | | |
| Research topics | | | |
| Funding | University researchers collaborating with private-sector, public-sector or not-for-profit organizations | \$20,000 to \$1 million per year | 1 to 5 years |
| Apply | | | |
| Review | | | |
| Award | College faculty can participate as co-applicants | | |
| Post-award | | | |

With thanks to ...



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University of Alberta
McMaster University
start-up funding



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