

Air Quality Research: Indoor and Outdoor Atmospheres



Arthur Chan

University of Toronto

Clean Air Hamilton Presentation

May 13, 2024



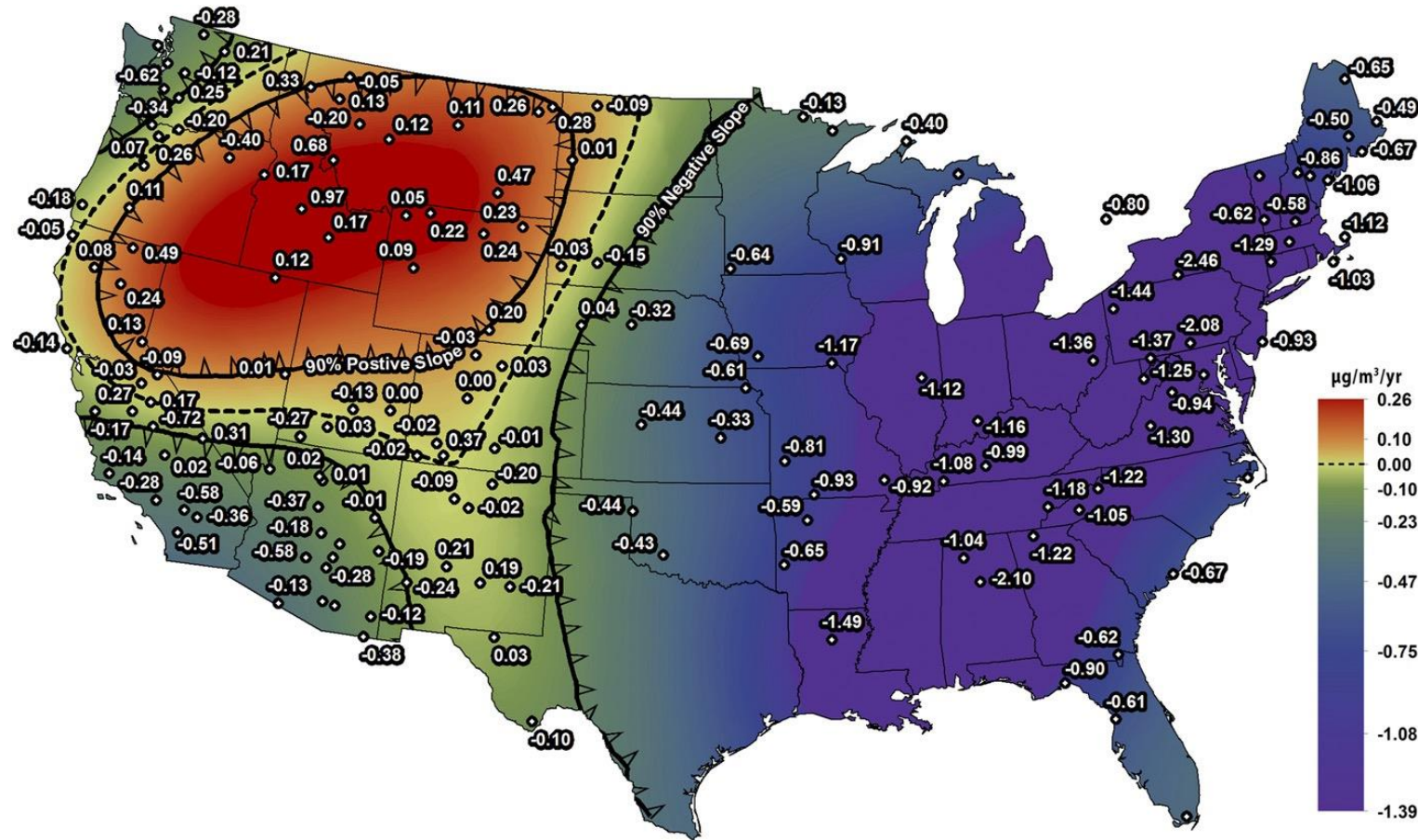
Chemical Engineering & Applied Chemistry
UNIVERSITY OF TORONTO

Research areas

- Wildfires and air quality:
 - Fort McMurray fires (2016)
 - Toxicity of wildfire smoke
- Cannabis: thirdhand smoke exposure
- Emissions from consumer products, nanoplastics, food cooking
- Atmospheric reactions

WILDFIRES AND AIR QUALITY

Motivation: Wildfires are a major source of air pollutants



McClure and Jaffe, PNAS, 2018

Why study house dust after fire?

- Concerns about **long term** exposures from house dust

Fort McMurray wildfire: Arsenic found in ash, delaying re-entry for 2,000 residents

CTV News, May 30, 2016

Tests reveal toxic levels of contaminants in Fort Mac soil and ash

JUSTIN GIOVANNETTI

FORT McMURRAY, ALTA. — The Globe and Mail

Published Tuesday, Jun. 07, 2016 9:45PM EDT

Last updated Tuesday, Jun. 07, 2016 9:51PM EDT

Tom Moore has lived through the situation Fort McMurray is about to face. He's the manager of Slave Lake's landfill. More than 400 buildings were destroyed in that city during wildfires in 2011 – about 2,400 have been lost in Fort McMurray.

The landfill in Slave Lake received about 14 tonnes of debris from each burnt structure. That contaminated debris and soil is now entombed in clay.

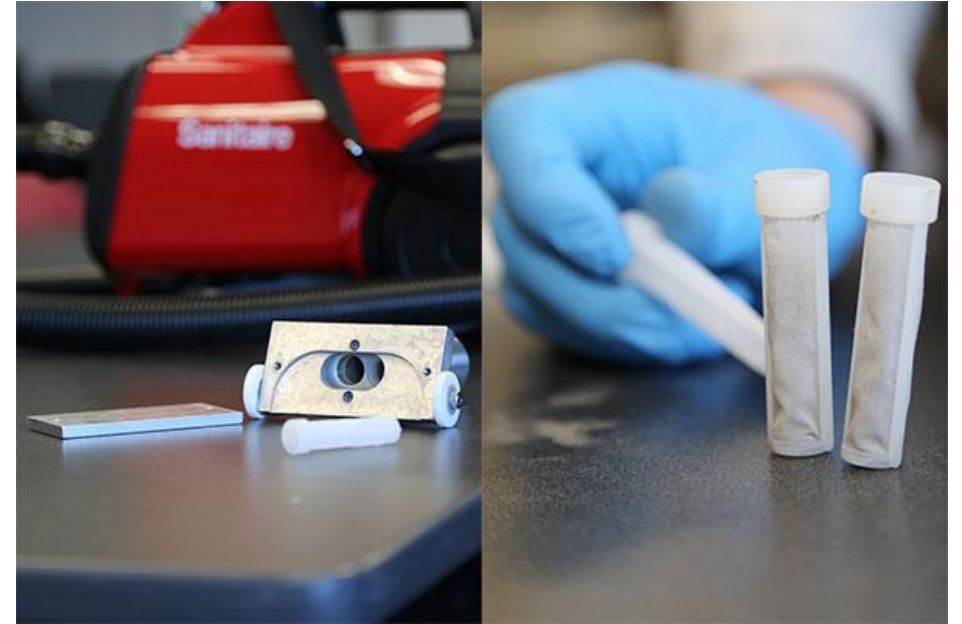
Five years after the fire, the town has only recently started detecting heavy metals reaching the bottom of the landfill.

"This is a challenge that'll last years," Mr. Moore said.

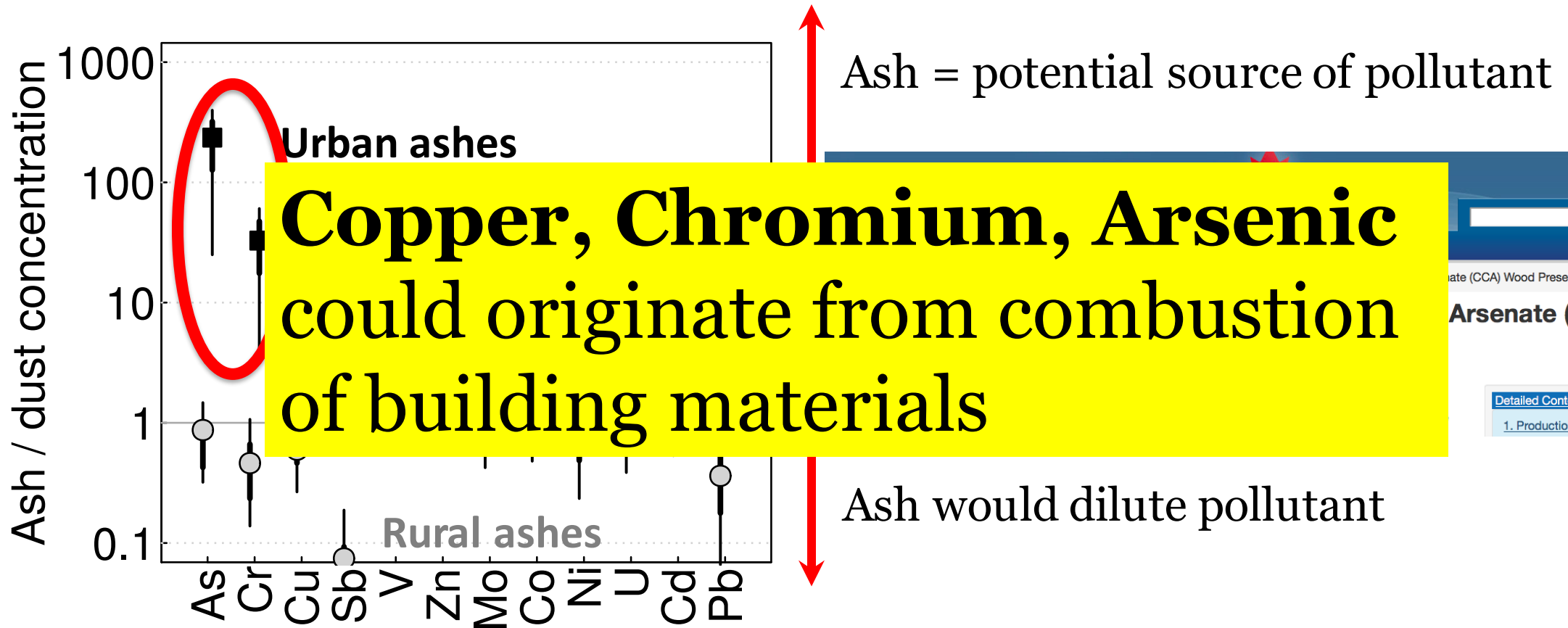


House Dust Sampling in Fort McMurray

- Vacuum house dust (bedroom, basement, door way)
- 125 homes in Fort McMurray



Burning urban materials vs. biomass



Canada

Search

ate (CCA) Wood Preservation Facilities

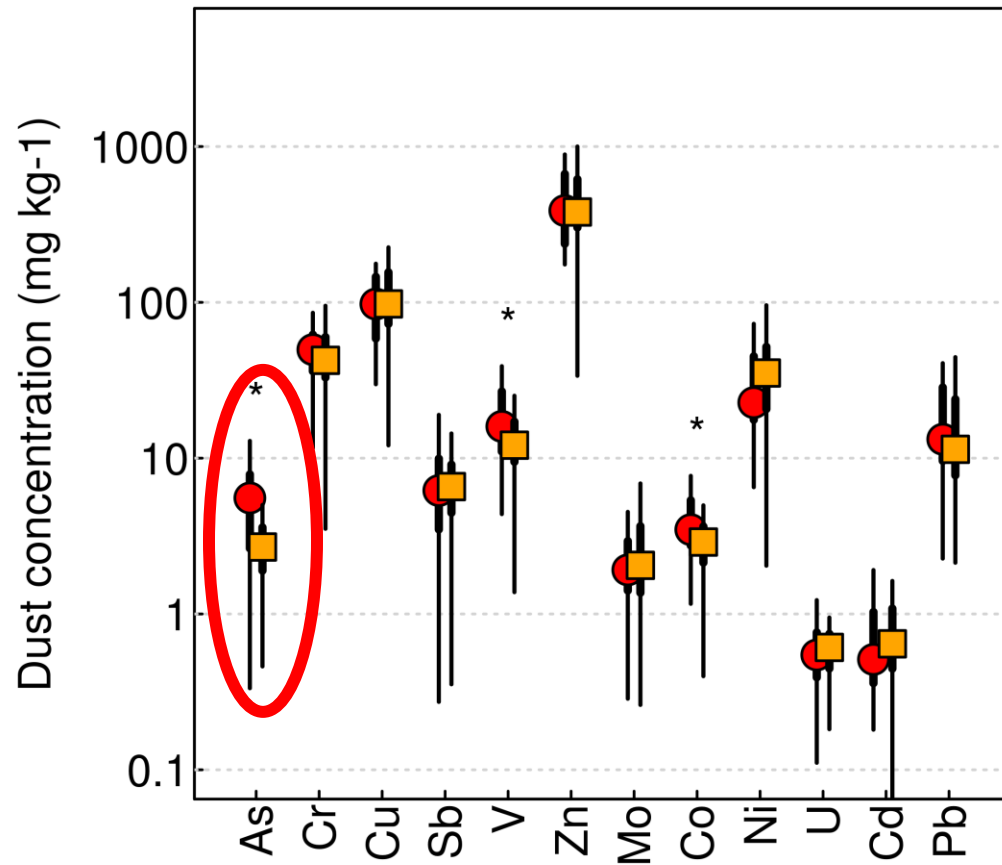
Arsenate (CCA)

Detailed Contents

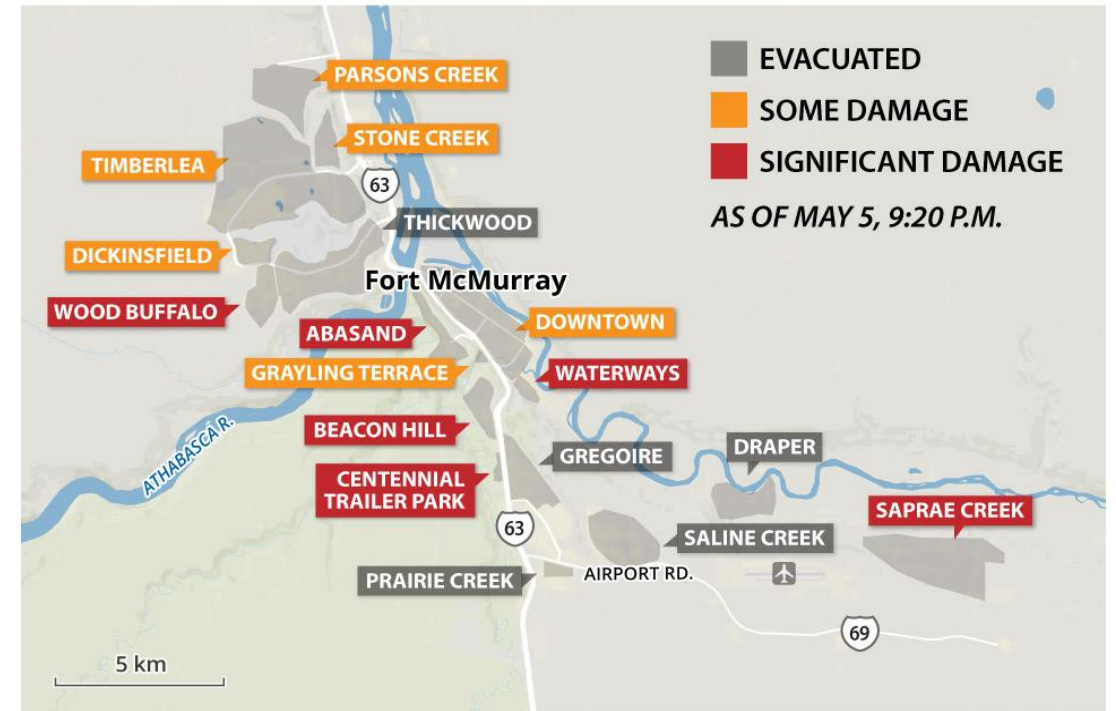
1. Production and Use

In house dust: Arsenic detected at higher levels in more fire-impacted neighbourhoods

+73% As in most affected areas



FORT MCMURRAY NEIGHBOURHOODS



SOURCE: MAPBOX, OPENSTREETMAP: REGIONAL MUNICIPALITY OF WOOD BUFFALO THE CANADIAN PRESS

Only small differences between neighborhoods in Fort McMurray

Summary

- One major wildfire event (2016 Fort McMurray wildfire) has little long-term impact on indoor house dust
 - Arsenic was elevated due to wood treatment in building materials
 - Indoor dust resembled outdoor soil and indoor sources (e.g. human activities)

New project in studying wildfire smoke

- This summer:

Home Team

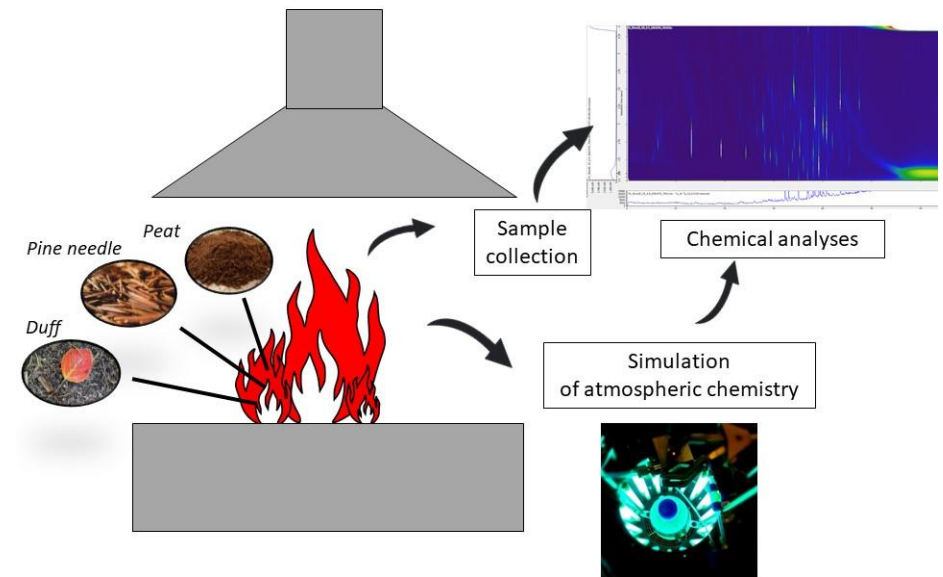
Biomass Burning in Canada

Addressing Climate and Air Quality Impacts

UNIVERSITY OF ALBERTA DALHOUSIE UNIVERSITY Université de Montréal UNIVERSITY OF TORONTO

A new research network focused on atmospheric impacts of biomass burning, using a combination of new measurements and modeling activities.

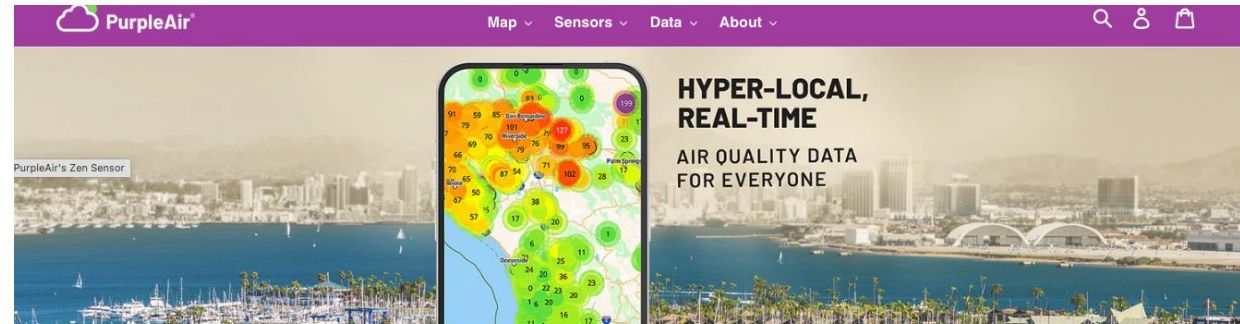
Funded in part by the Government of Canada's Environmental Damages Fund, Biomass Burning in Canada (BBCan) intends to unite university scientists with many Canadian government partners to enable more comprehensive and accurate assessments of biomass burning (BB) atmospheric impacts and



www.bbcan.net

Natural Resources Canada,
Edmonton, Alberta

This summer: evaluating air quality in public spaces during wildfire events



PurpleAir makes sensors that empower Community Scientists who collect hyper-local air quality data and share it with the public.

OUR SENSORS

Three PurpleAir sensors are displayed in a row. Each sensor is shown next to a smartphone displaying the PurpleAir app interface. The Flex sensor is a white, cylindrical device with a blue sensor array. The Touch Indoor sensor is a white, rounded rectangular device with a green sensor array. The Zen sensor is a white, cylindrical device with a green sensor array. A red diagonal banner with the text "NEW PRODUCT" is overlaid on the Touch Indoor and Zen sensors. A gift icon with a red "1" is located in the bottom left corner of the Flex sensor's product image.

PurpleAir Flex Air Quality Monitor
\$289.00

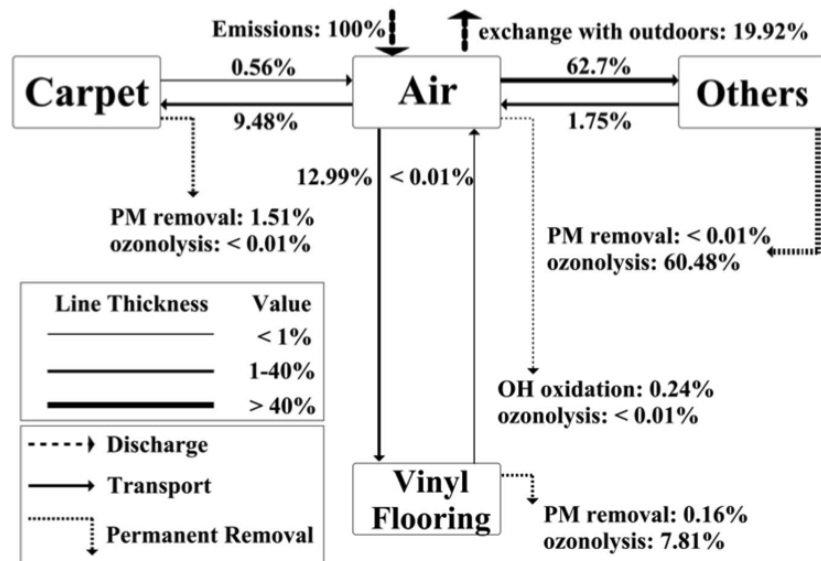
PurpleAir Touch Indoor Air Quality Monitor

PurpleAir Zen Air Quality Monitor
\$299.00

CANNABIS AND INDOOR AIR QUALITY

Cannabis and Air Quality

- Cannabis smoke is much less understood than tobacco smoke → thirdhand smoke concerns
- Computer model to estimate exposure



Main exposure pathway for thirdhand smoke:

- adults: inhalation
- infants: hand-to-mouth transfer

→ Mitigation: ventilation and filtration during smoking

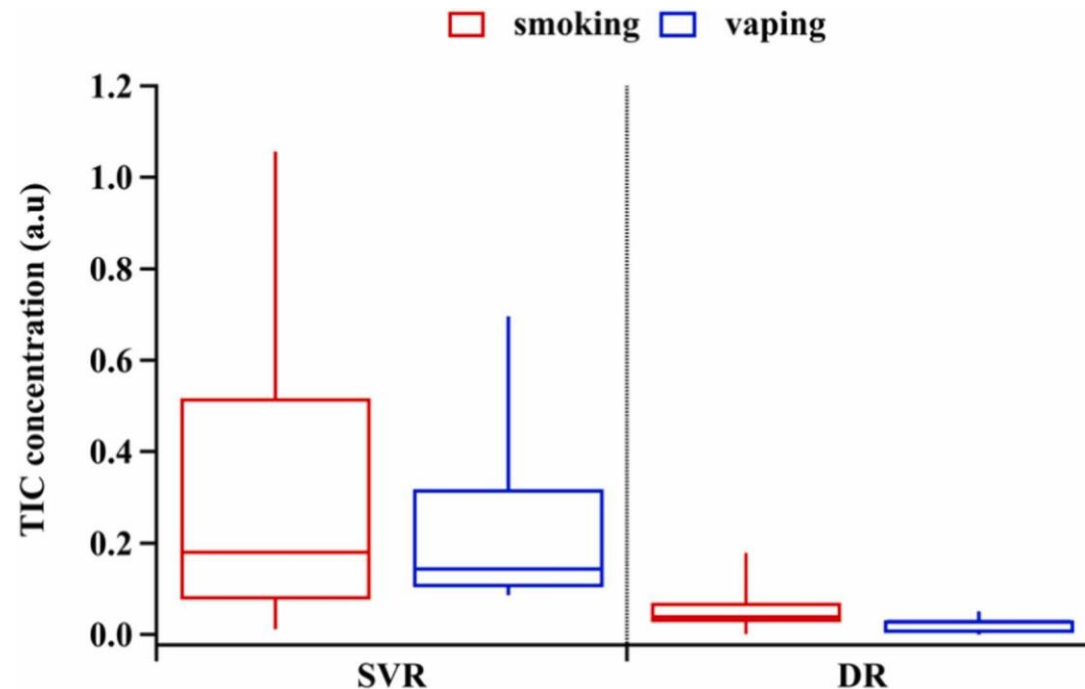
→ Surface cleaning

Measurements of Cannabis Smoking and Vaping

- Performed at Center for Addiction and Mental Health

Smoking / vaping room:
Where participants use cannabis
products for 5-10 minutes

Detox room:
Where participants recover after
their smoking/vaping session



Other works

- Evaluating new policies on volatile organic compound emissions from consumer products
- Food cooking (air fryer vs traditional cooking, impact of cooking oil, impact on outdoor particulate matter)
- Nanoplastics (clothing fiber, tires)

Acknowledgements



Research Group, August 2022

Funding sources:



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada



**CANADA
RESEARCH CHAIRS
CHAIRES DE
RECHERCHE DU
CANADA**



CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada



**CANADIAN
RED CROSS**

ALBERTA INNOVATES