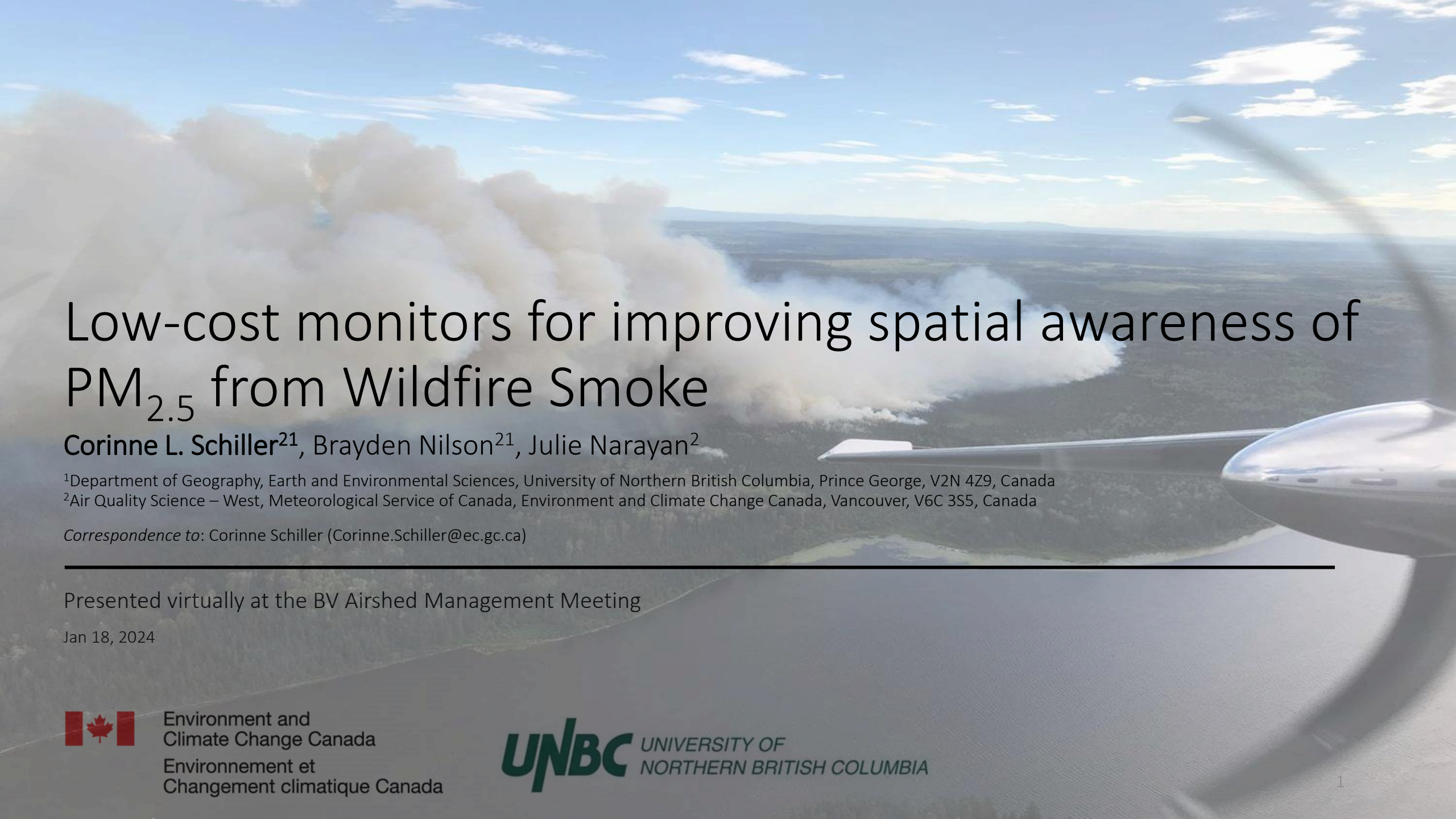

Low-cost monitors for improving spatial awareness of $PM_{2.5}$ from Wildfire Smoke

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Presented virtually at the BV Airshed Management Meeting

Jan 18, 2024

Environment and Climate Change Canada
Environnement et Changement climatique Canada

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

Air Quality Science - MSC

- Focus is Prediction and Services for Air Quality
- Prediction
  - Producing better model results through data ingestion and validation
- Services
  - Provide information about AQ events to public, media, agencies and other departments

Air Quality Science - MSC

3 regional Air Quality Science Units

- West (BC, AB, SK, MB, NU, NT YK)
- Central (ON, QC)
- Atlantic (NB, NL, NS, PE)

National Health and Air Quality Group

- Responsible for AQHI
- Policy related to AQHI

AQSU - West

Head – Keith Jones

Senior Research Scientists

- Corinne Schiller
- Julie Narayan
- Dan McLennan (Acting)

Research Scientists

- Brayden Nilson

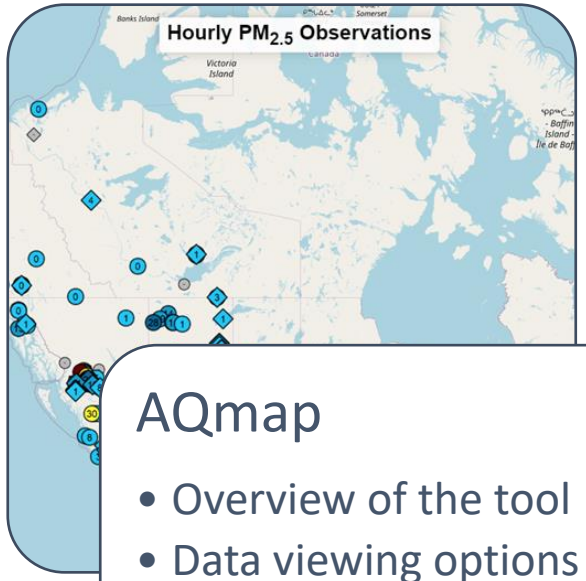
Senior Air Quality Technician

- Chris Nayet

I will provide a overview of the Low Cost Monitors (LCMs) we work with, how you can use our web-tool to view them, and an example of their benefits

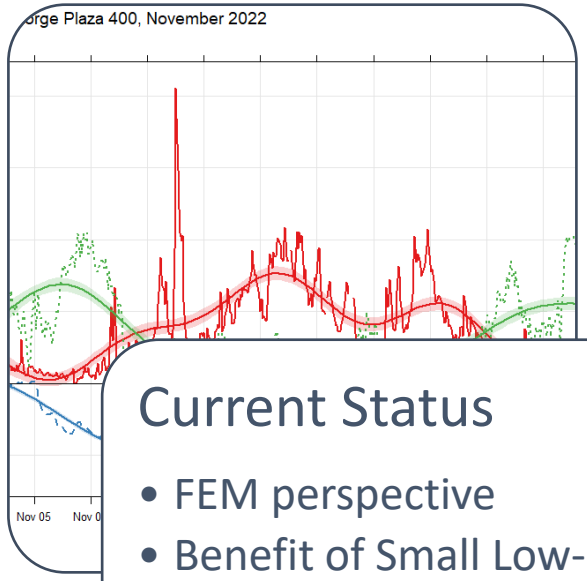
Introduction

- Fine particulate matter ($PM_{2.5}$) monitoring
- Low Cost Monitors (LCMs)
- Comparability of data (FEM vs LCM)



AQmap

- Overview of the tool
- Data viewing options
- History

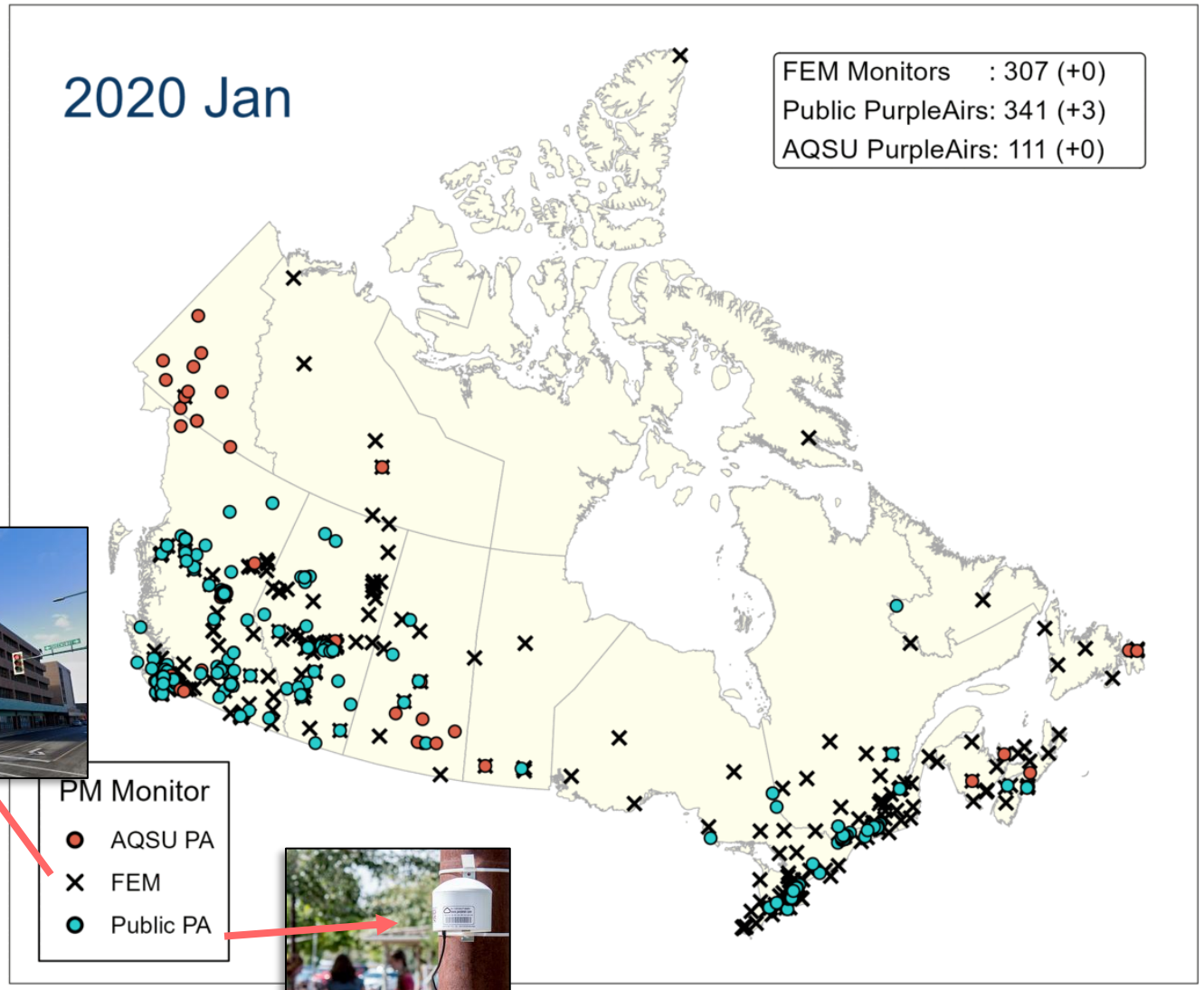


Current Status

- FEM perspective
- Benefit of Small Low-Cost PM Monitors

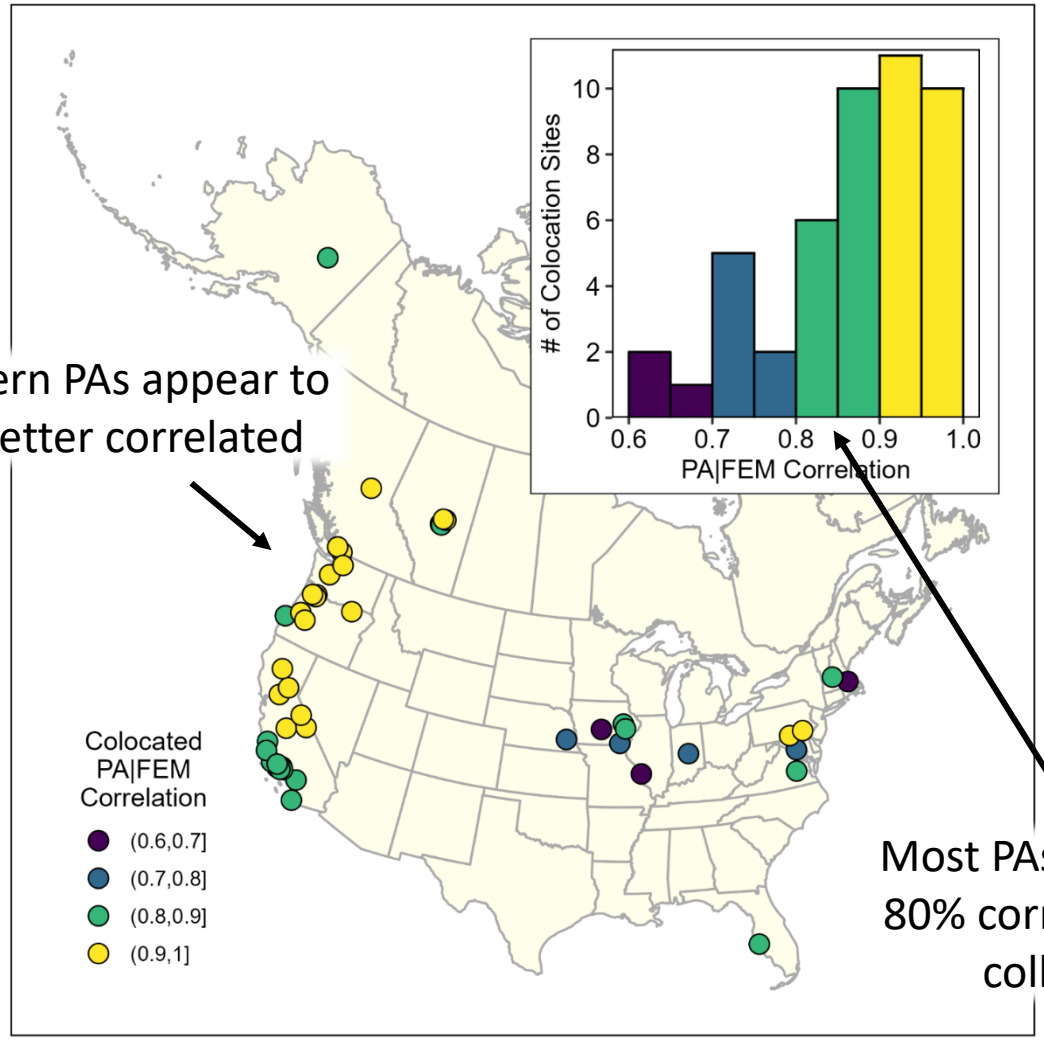
$PM_{2.5}$ is measured on an hourly basis using a network of regulatory (FEM) monitors. LCMs can provide higher-density data at a lower cost

FEM monitor - **~300 in Canada**
(Met One BAM 1020)



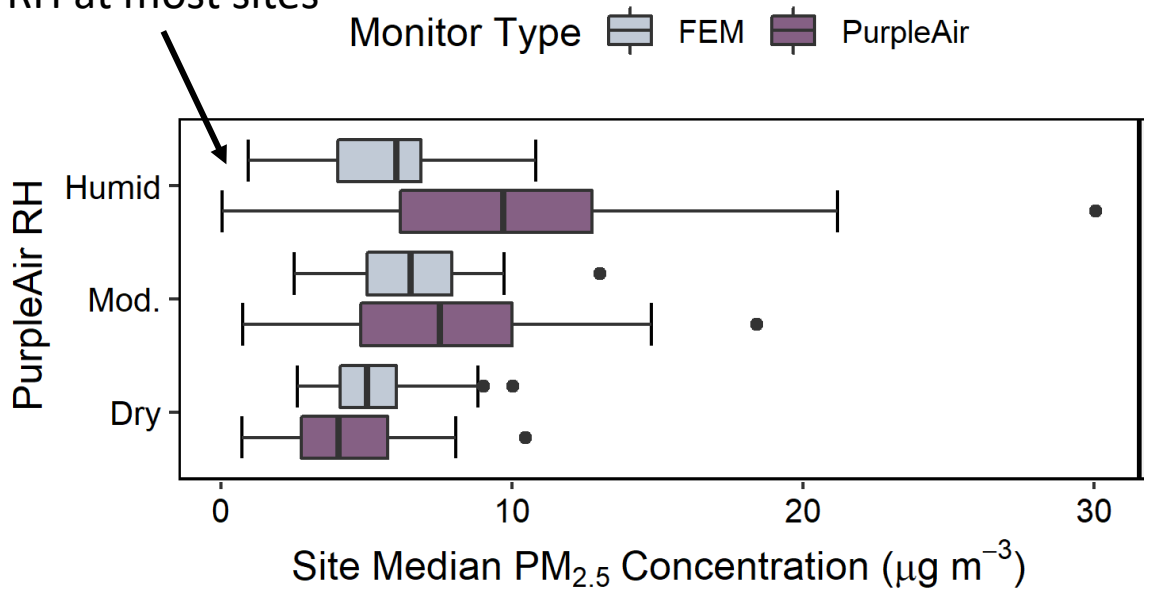
PurpleAir LCM - **~1300 in Canada**
(2x Plantower PMS5003)

The PurpleAir LCMs correlate well with regulatory FEM monitors, but tend to be biased high as humidity levels increase



Most PAs were more than 80% correlated with their collocated FEM

Bias increased with RH at most sites



Based on data up until the end of 2020 (See Nilson et al., 2022)

Our recent publication developed a general-use bias correction for the PA monitors in CAN/USA which significantly improves the PA data

Atmos. Meas. Tech., 15, 3315–3328, 2022
https://doi.org/10.5194/amt-15-3315-2022
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Atmospheric Measurement Techniques

Development and evaluation of correction models for a low-cost fine particulate matter monitor

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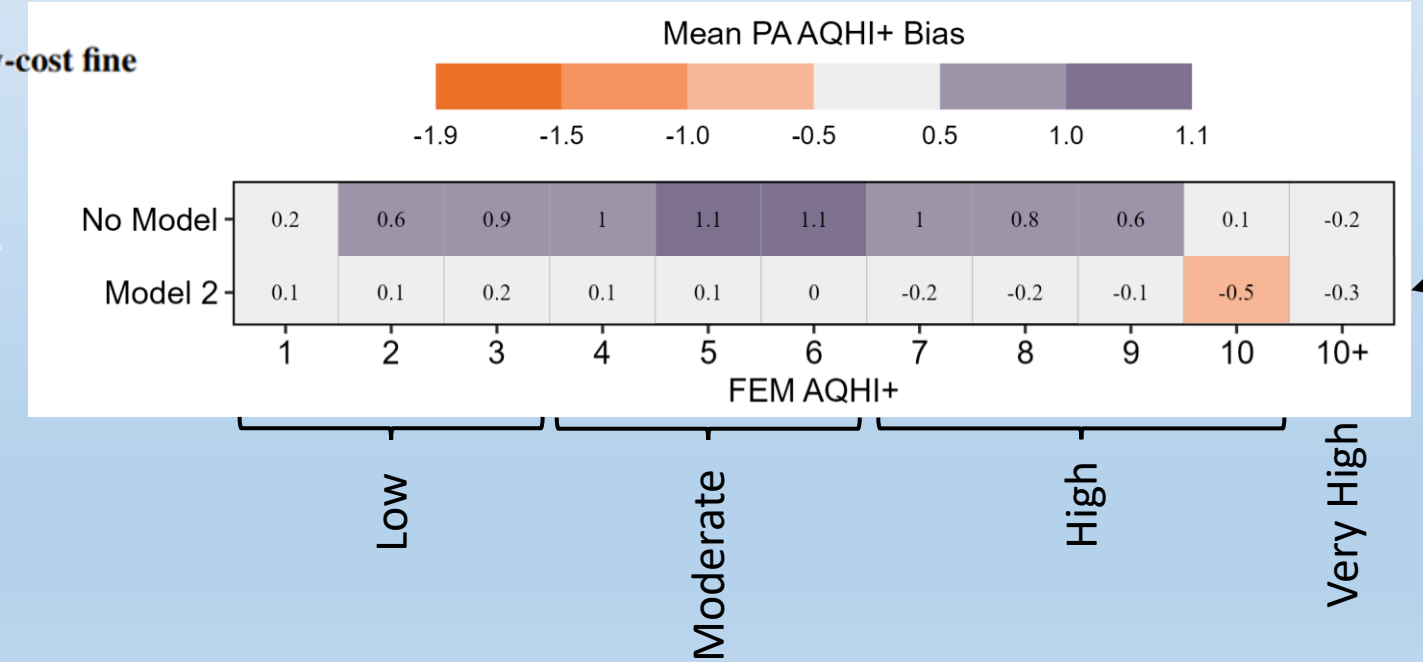
[2]Air Quality Science – West, Meteorological Service of Canada, Environment and Climate Change Canada, Vancouver, V6C 3S5, Canada

Correspondence: Brayden Nilson (brayden.nilson@ec.gc.ca)

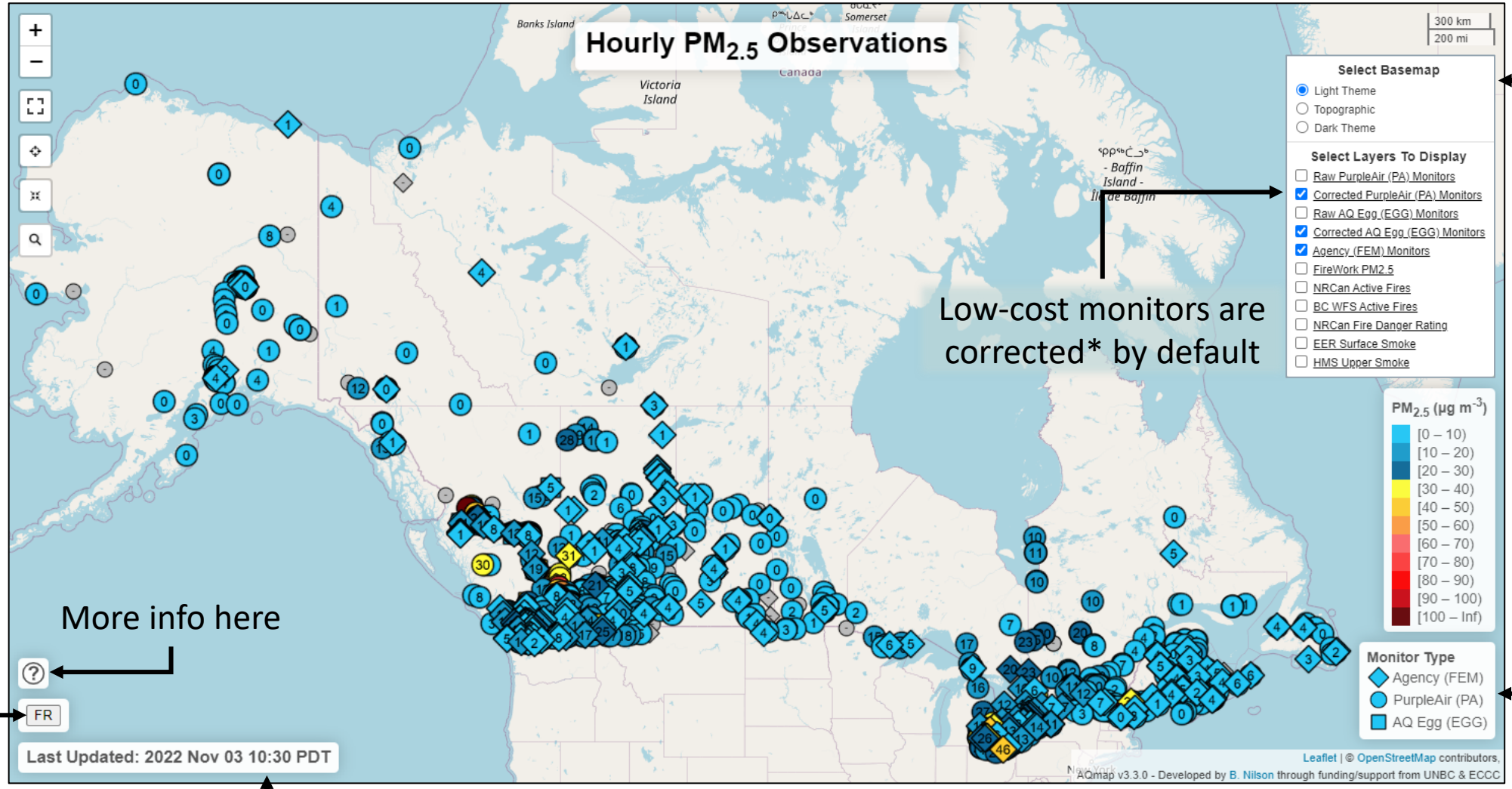
Received: 15 December 2021 – Discussion started: 18 January 2022
Revised: 16 April 2022 – Accepted: 27 April 2022 – Published: 3 June 2022

Our correction brings PA obs to within half of an AQHI+ unit (~5 µg m^{-3}) from collocated FEMs (on average)



We developed "AQmap" to display real-time $PM_{2.5}$ in Canada from both FEMs and LCMs

https://aqmap.ca/aqmap/



Low-cost monitors are corrected* by default

Extra smoke-related layers

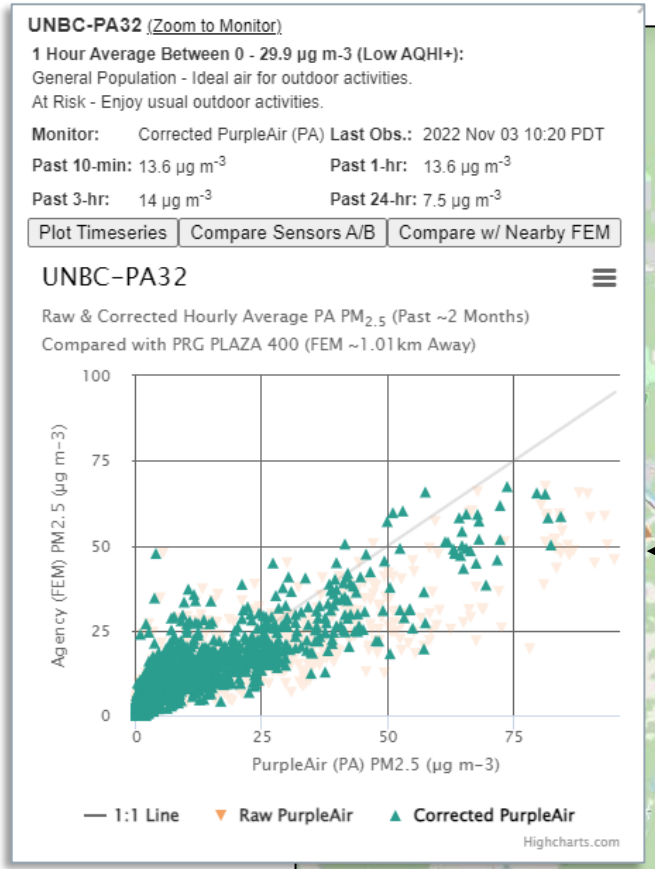
Regulatory AND low-cost monitors

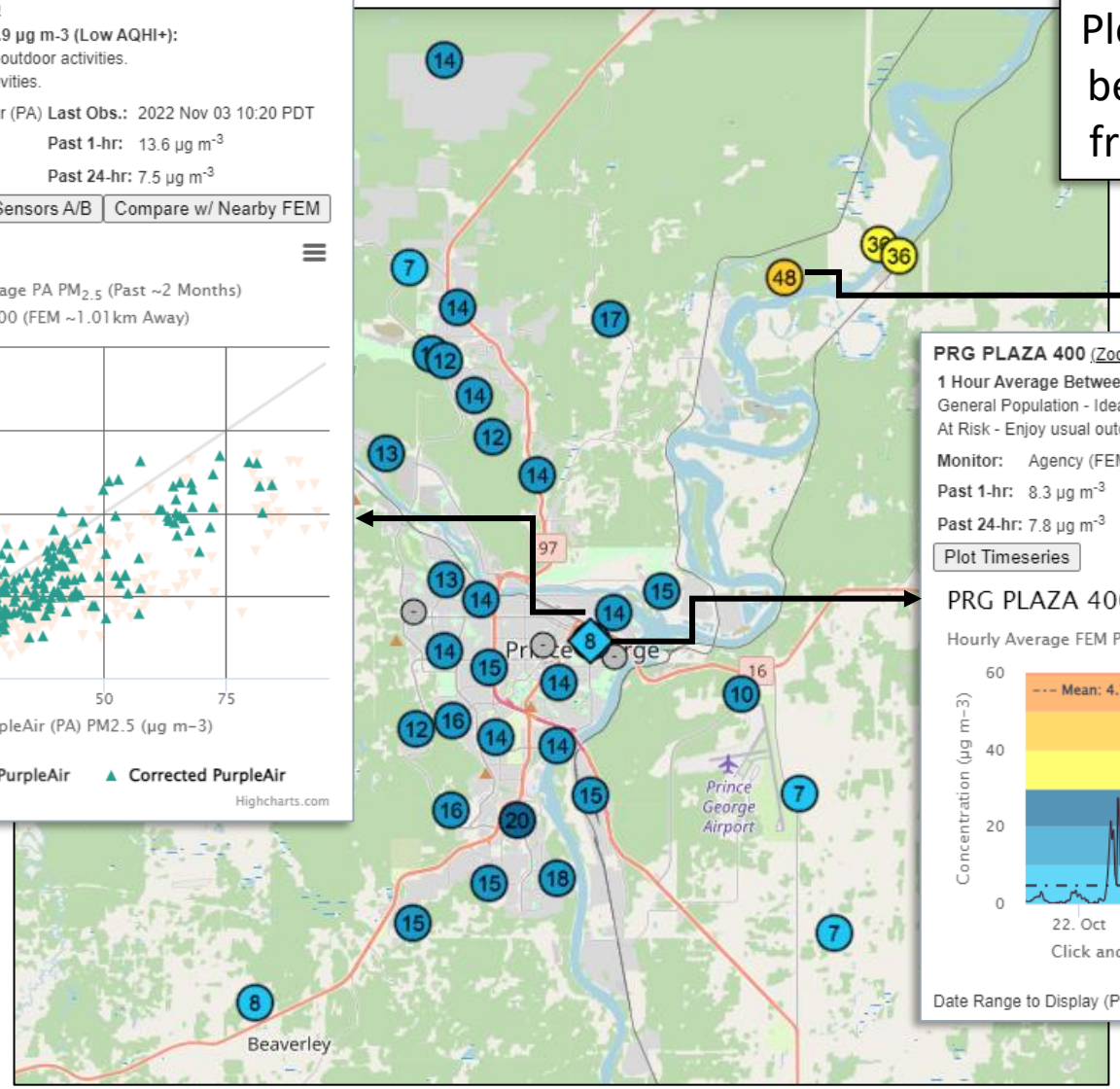
French version available

More info here

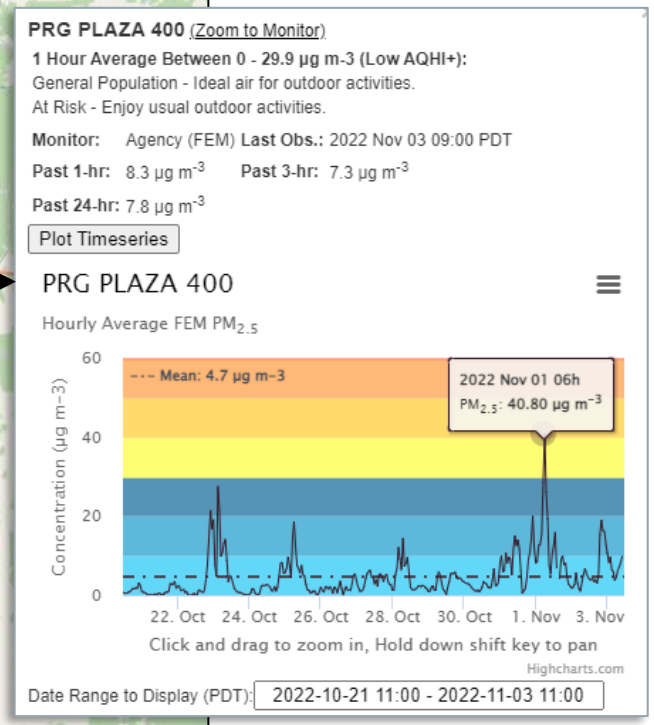
Updated every 10 minutes

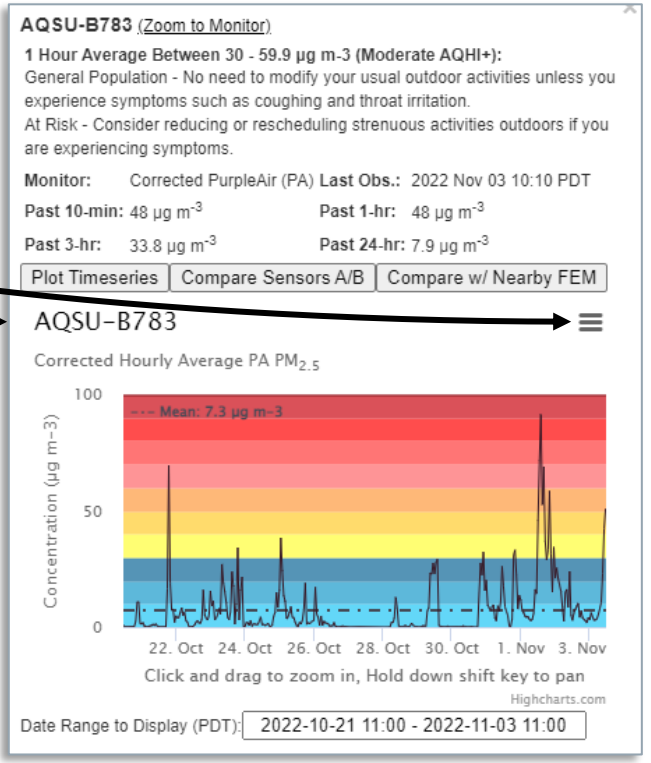
Anyone can use this tool to see areas currently impacted by high $PM_{2.5}$





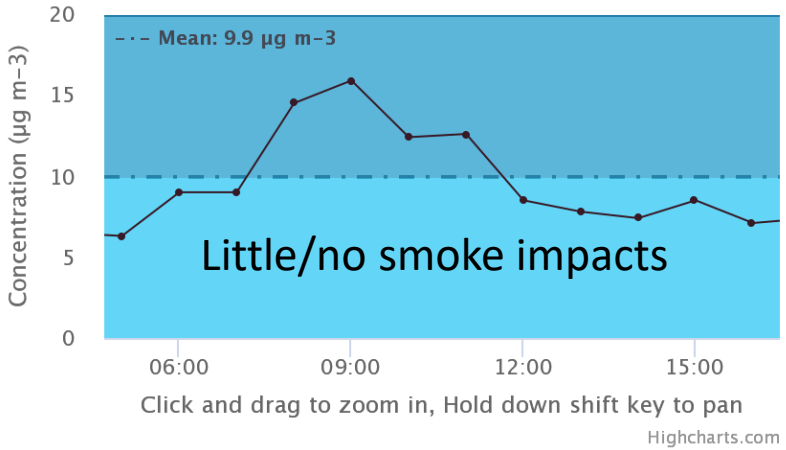
Plotted data can be downloaded from this menu



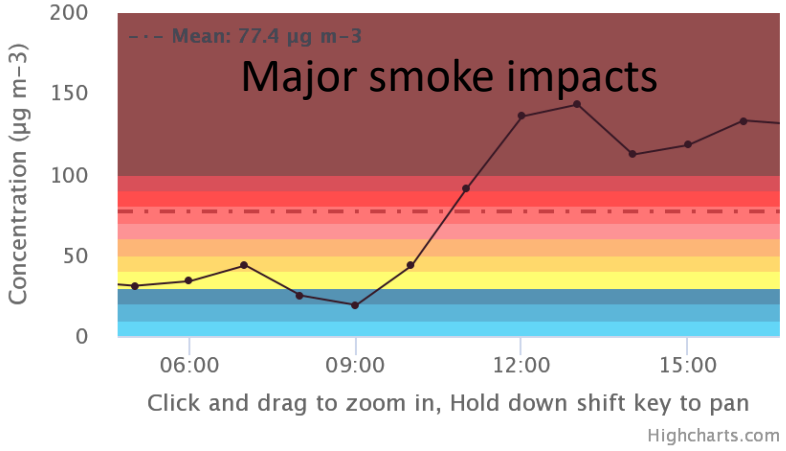


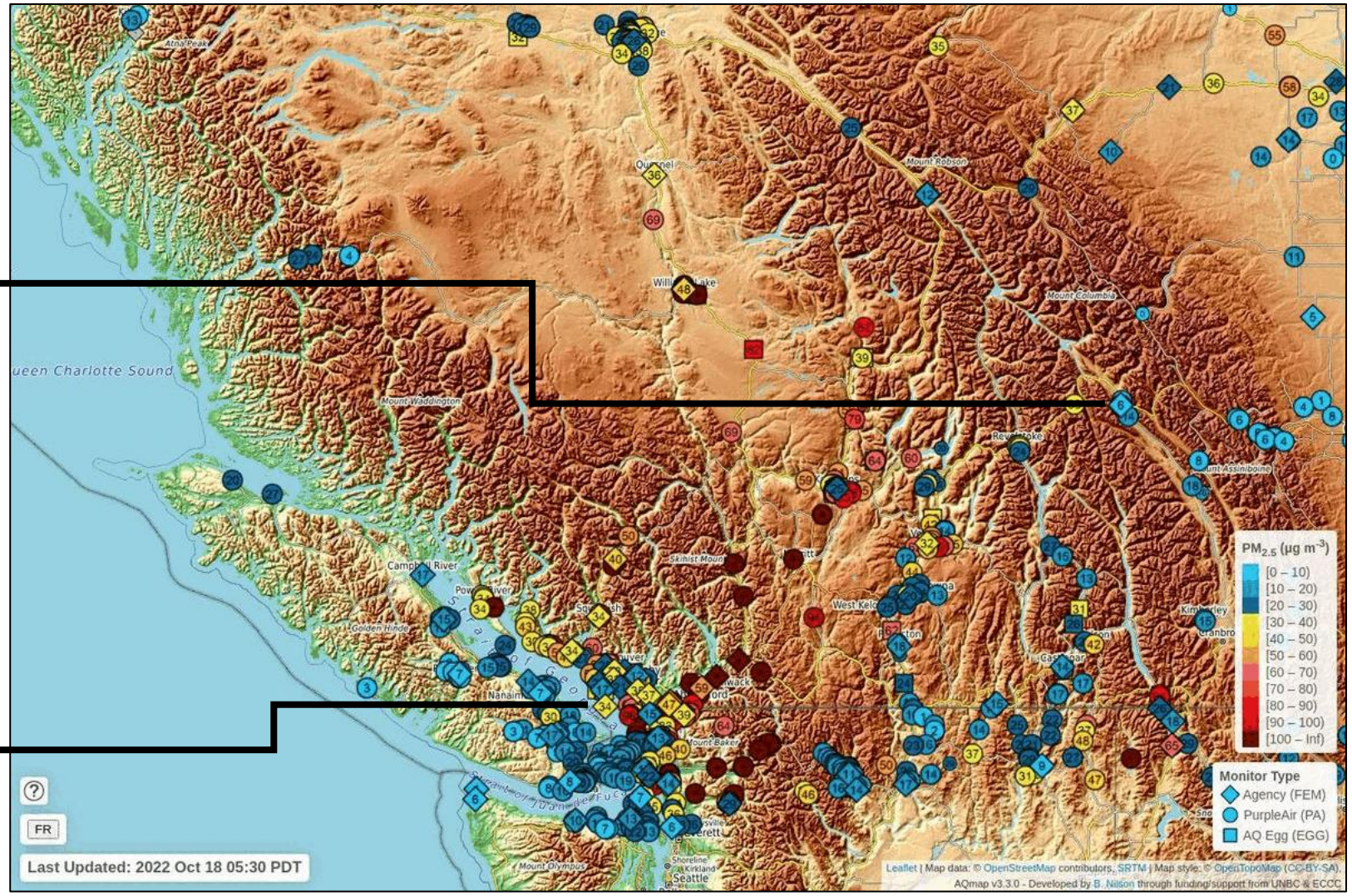
AQmap is especially useful for locating surface smoke from wildfires

GOLDEN HOSPITAL HELIPAD



TSAWWASSEN

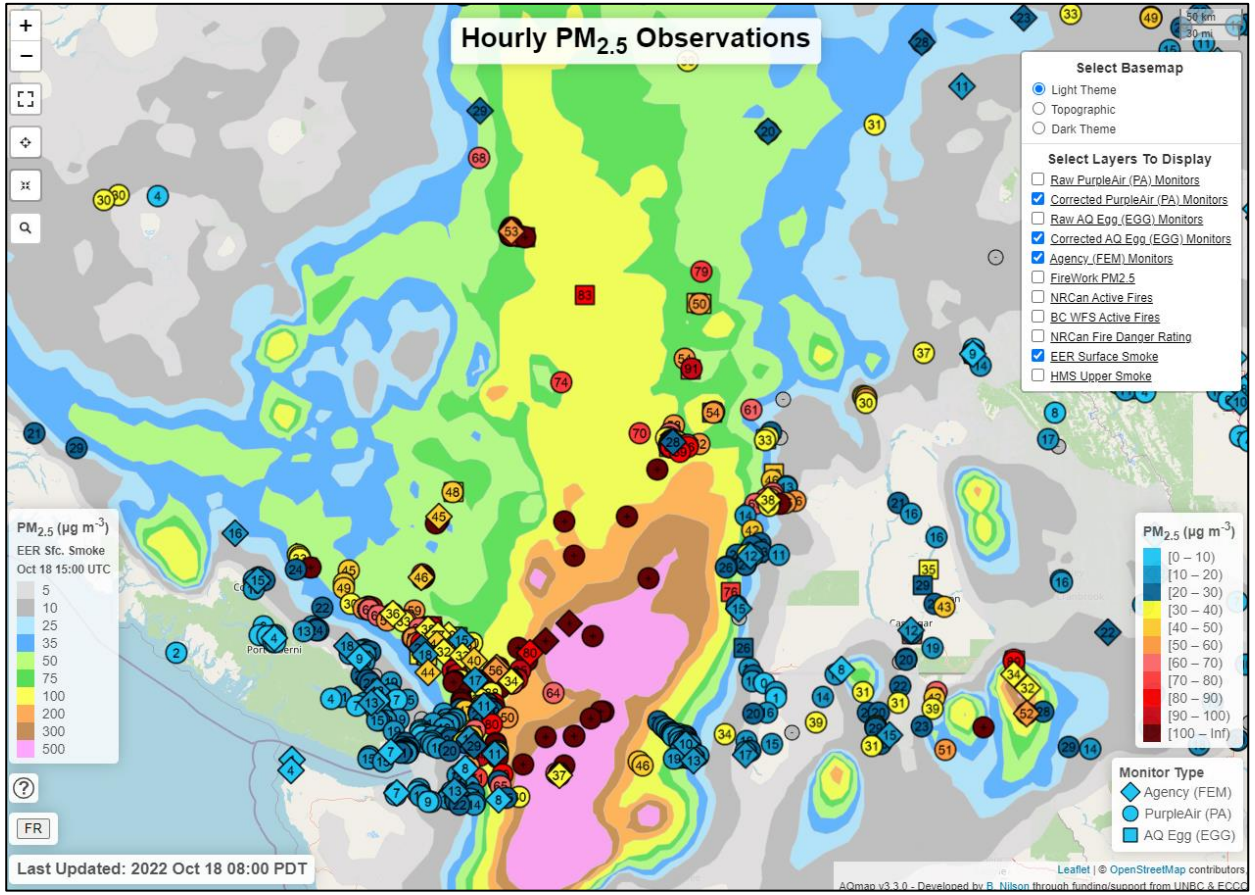




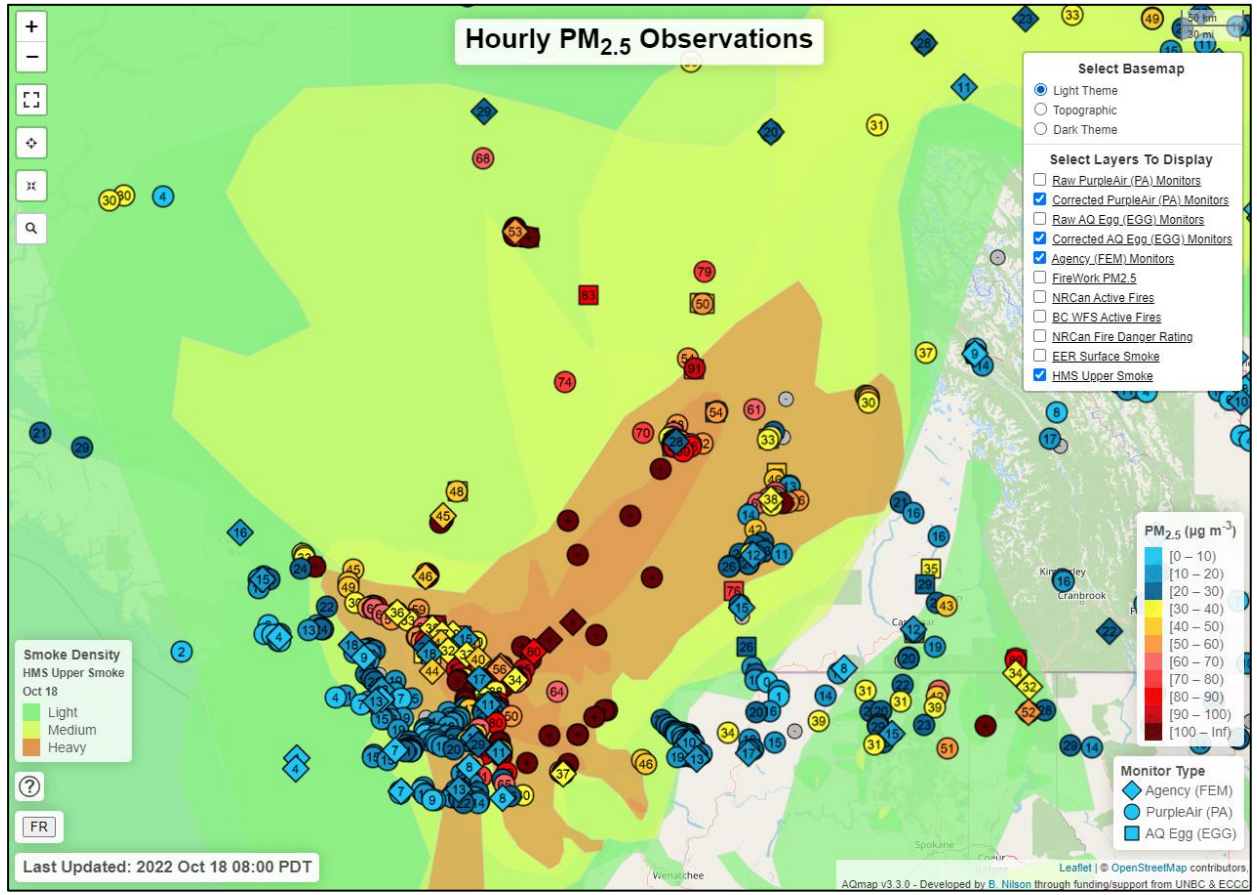
Oct 18, 2022 5:30 – 16:30 (PDT)

Additional data layers can be used to improve spatial awareness during wildfire smoke events

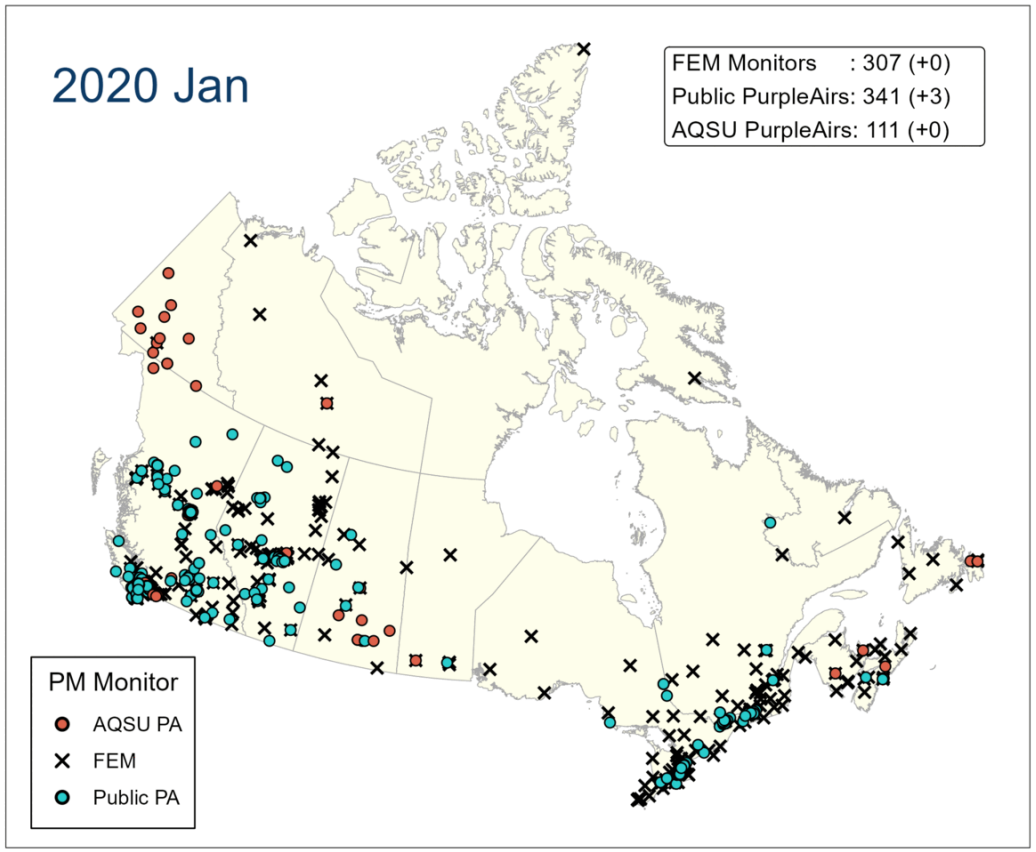
EER Dispersion Model Surface Smoke Simulation
(where a model thinks smoke from wildfires is on the surface)



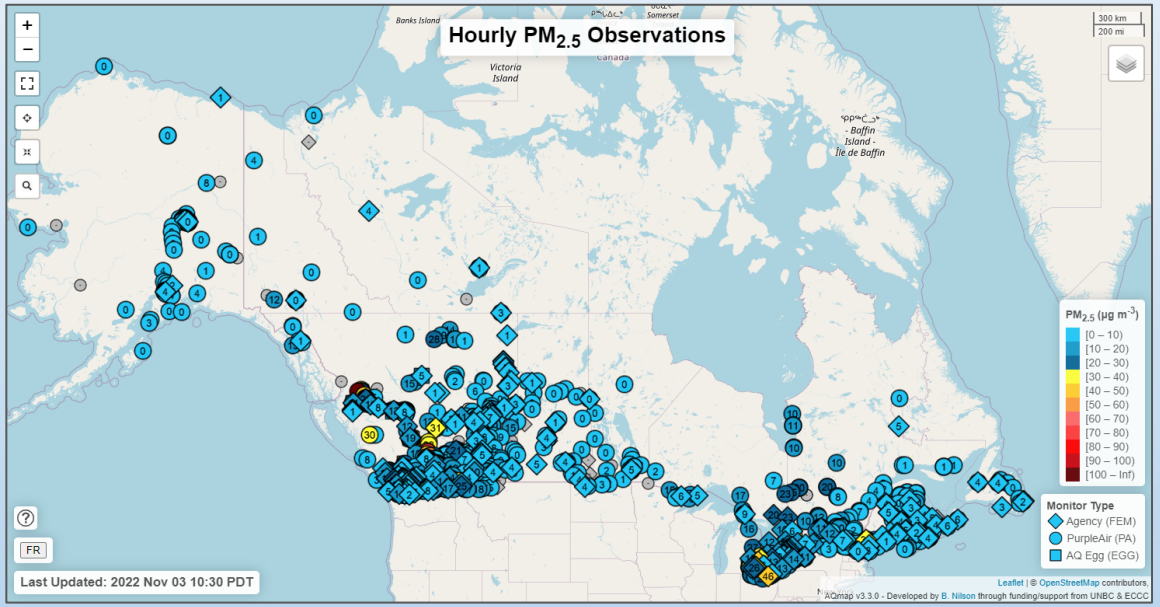
HMS Hand Drawn Smoke Density from Satellite Analyst
(where an expert thinks smoke is present, surface or not)



$PM_{2.5}$ monitoring in Canada (FEMs and LCMs)



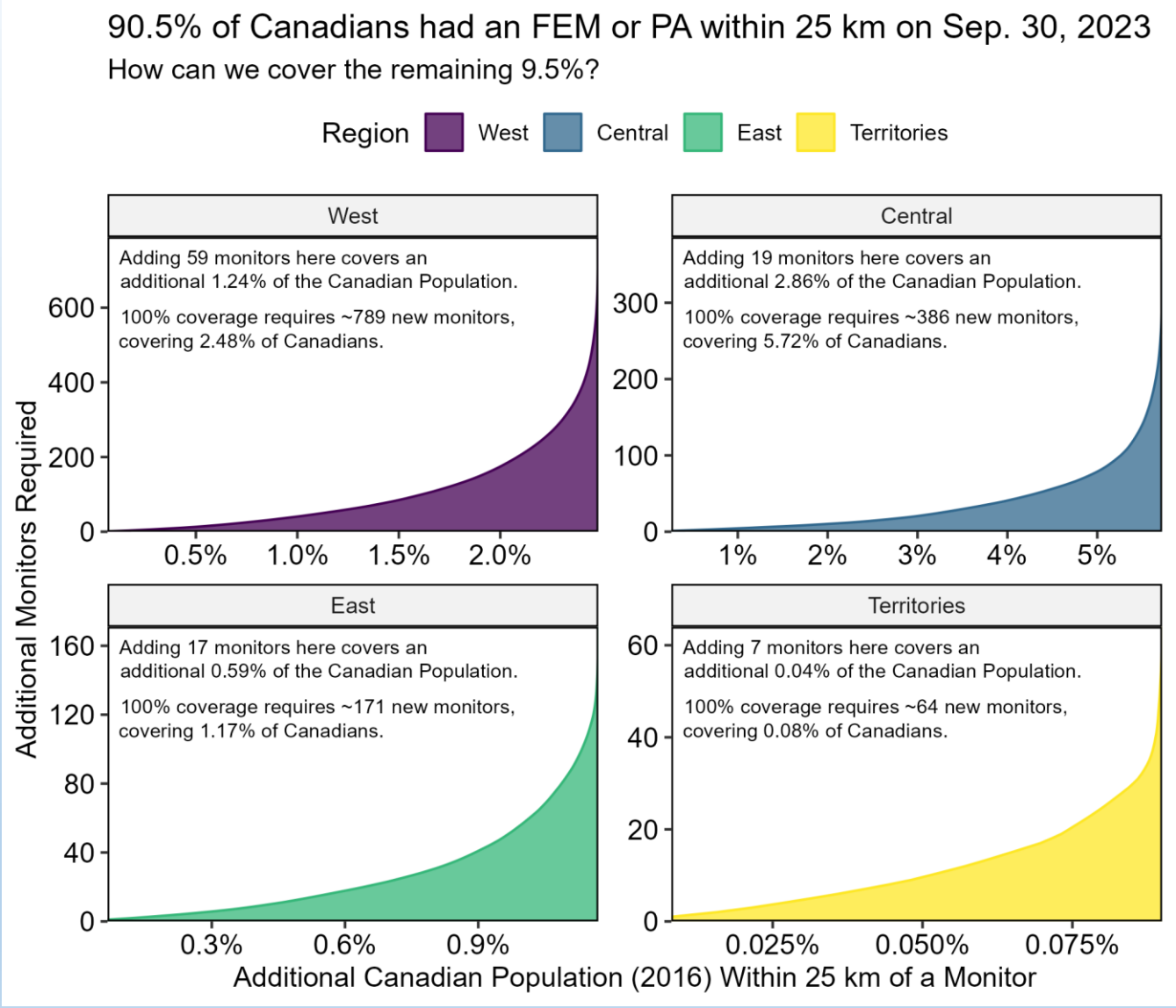
Usefulness of AQmap https://aqmap.ca/aqmap/



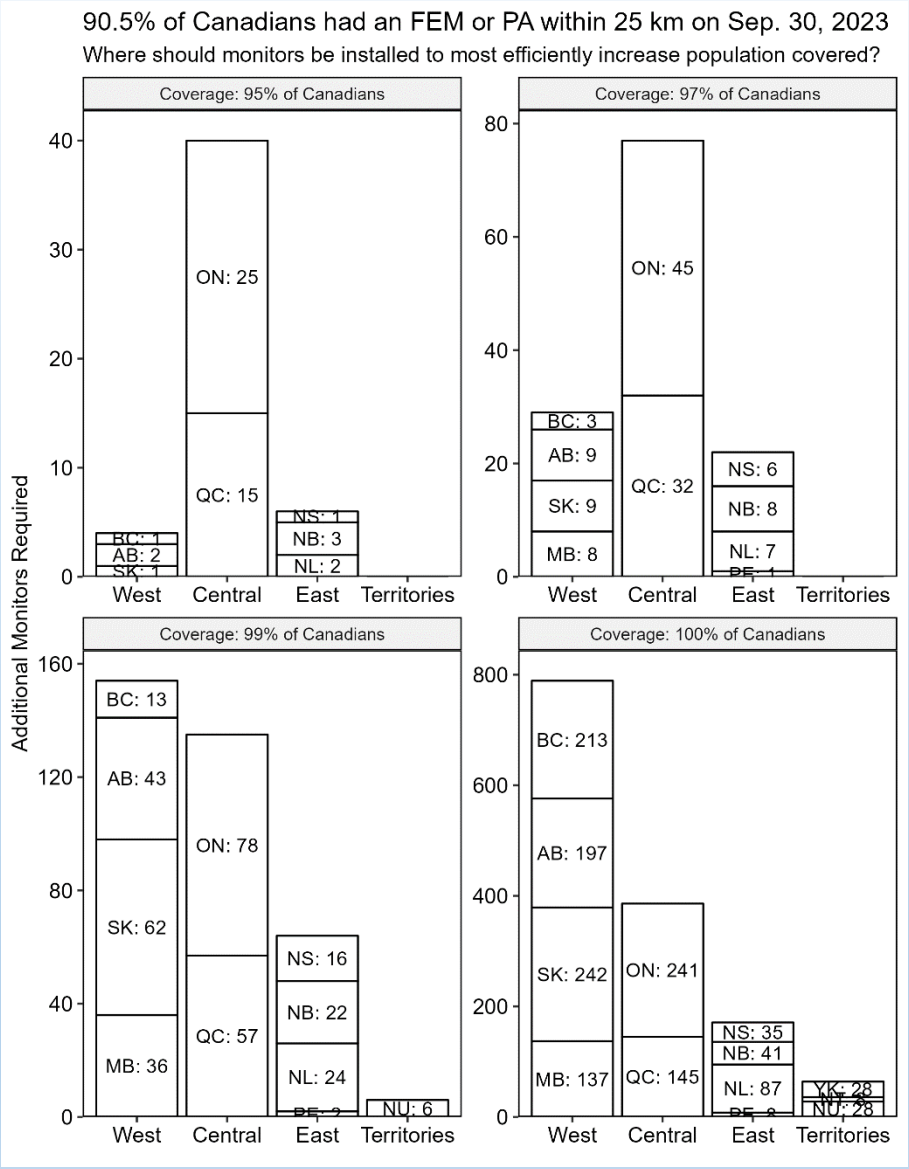
Current Status of LCM Pilot Project

- With NAPS FEM network alone ~ 80% of the population of Canada was within 25 km of a PM monitor
- Including the LCM ~90% of the population of Canada is within 25 km of PM monitor
- Sept 30, 2023 – 306 FEM monitors, 1349 PA LCM (28.2% from ECCC)
- Forecast Zone Coverage Canada – FEM 27%, FEM & LCM 39%
- Forecast Zone Coverage West – FEM 24%, FEM & LCM 41%

What would it take to reach most of Canadian Communities

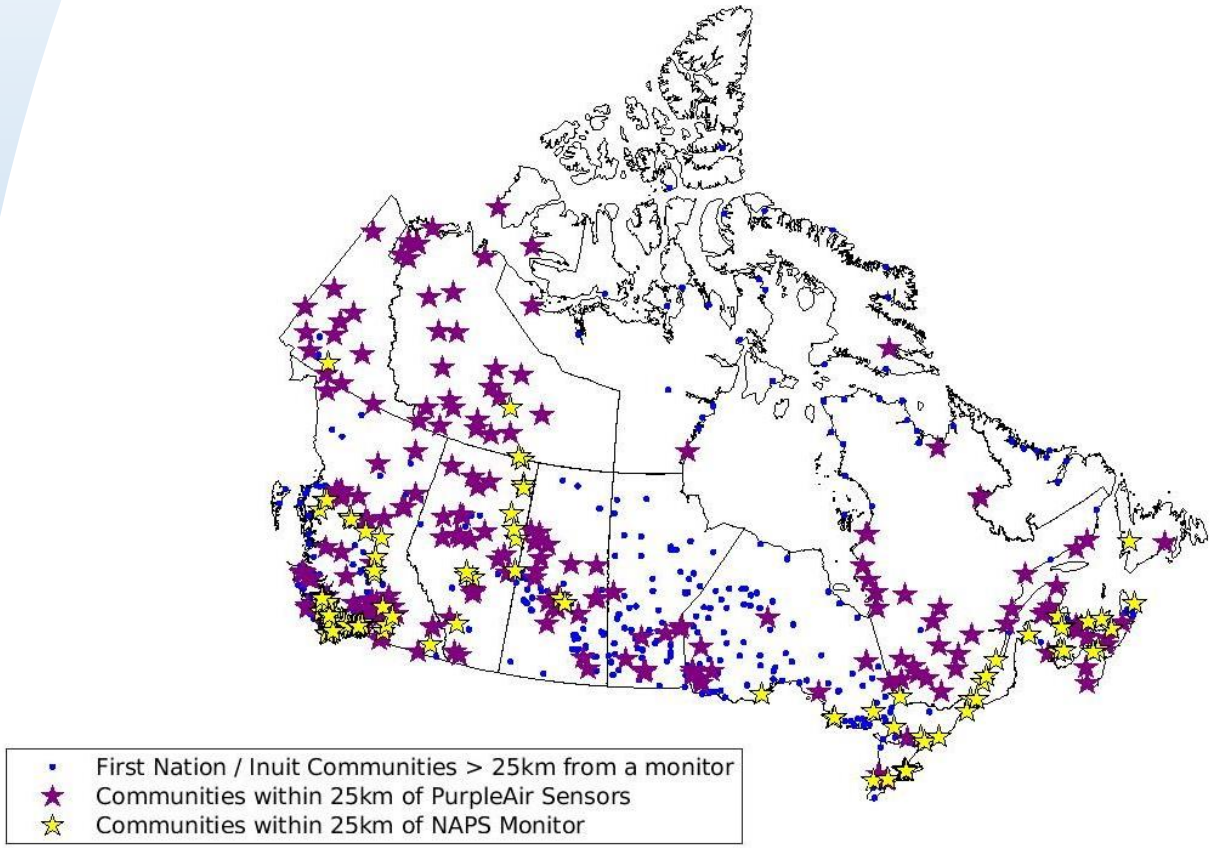


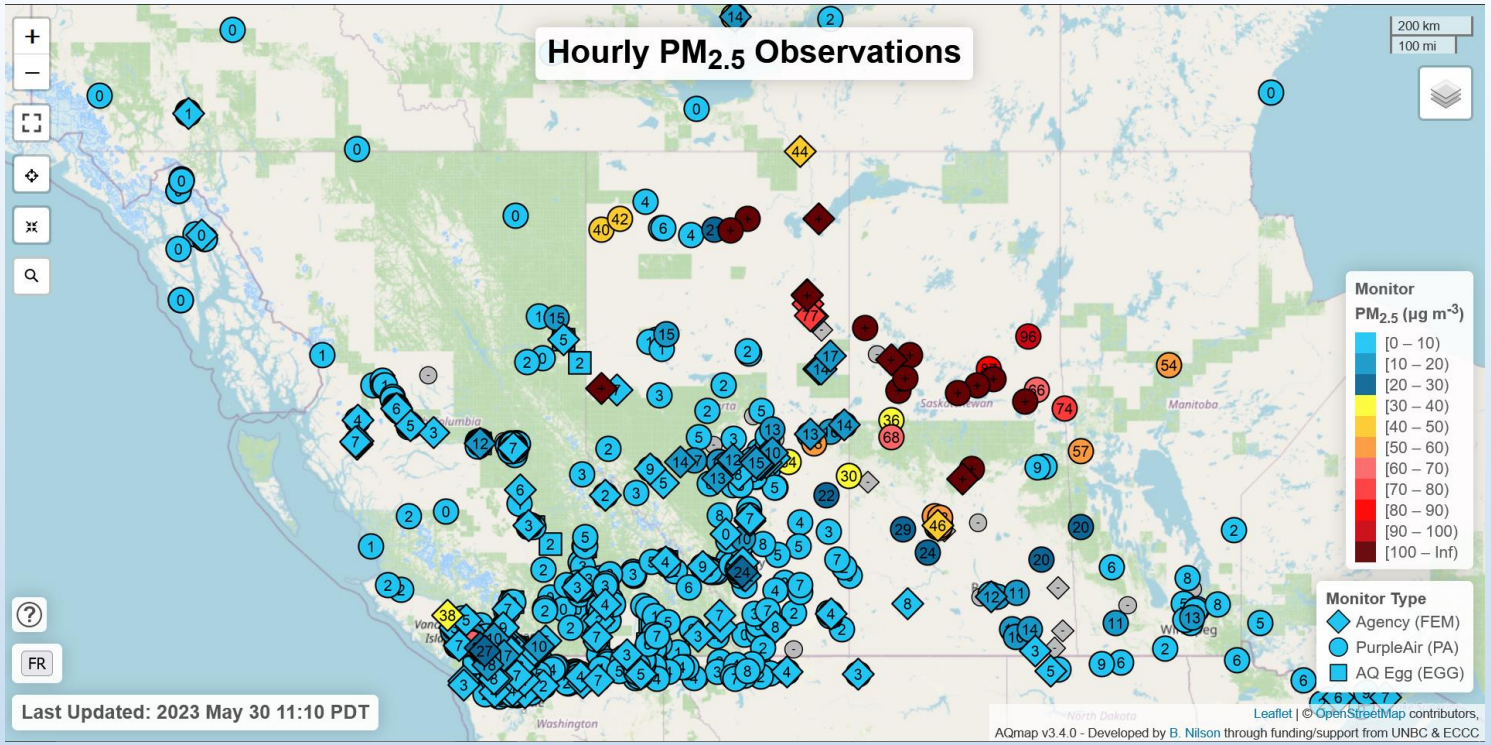
Approximate numbers of LCM required



Indigenous Communities

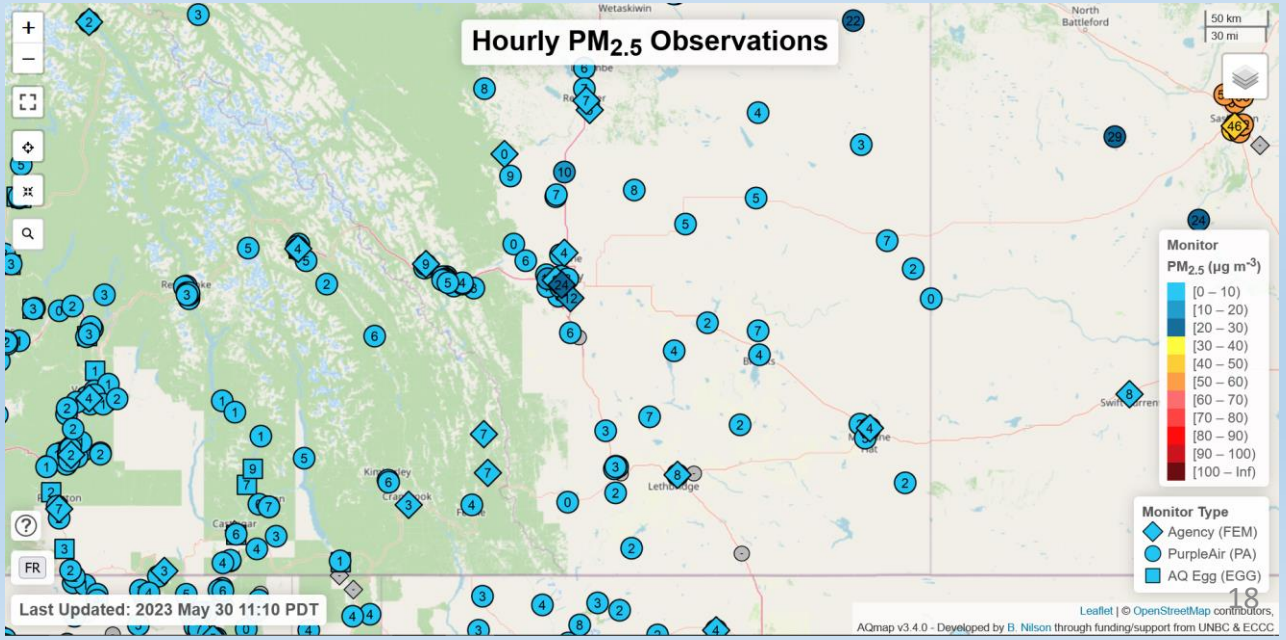
- 690 Inuit and First Nation Communities.
- 20.3% within 25 km of an FEM
- 49% within 25 km of LCM & FEM
- Focused area to improve





Low-Cost PM Sensors Fit For Purpose

- Shows areas of high PM
- Shows similar ranges to the FEM sensors
- Due to lower cost can provide spatial coverage to a larger area
- Shows impacts of high PM events such as forest fires
- Provides information to individuals, communities, and agencies where people live, work and play

Questions?

Corinne.Schiller@ec.gc.ca