Government of
Northwest Territories

NWT Small Air Quality Sensors

Community Based Air Monitoring Project

Introduction

The Government of the Northwest Territories has added a new type of fine particulate matter ($PM_{2.5}$) monitor to the air quality program. In collaboration with Environment and Climate Change Canada (ECCC), the plan is to enhance the existing monitoring network with several low-cost particulate matter (PM) sensors to increase the spatial coverage of $PM_{2.5}$ monitoring in less populous regions (Figure 1). These sensors will fill in gaps in monitoring during high air pollution events such as when a community is inundated with smoke from wildfires. The concentrations of particulate matter can change quickly during extreme events and real time monitoring within a community will help protect vulnerable populations. A mapping tool has been developed to display the data in real time to the public. This will help managers, health authorities, and concerned citizens make informed decisions during extreme events under changing climate. This citizen science monitoring initiative will provide an opportunity for connecting with communities and working collaboratively to measure air quality across the territory.

Air Quality Sensor

The small air quality sensors or Purple Air (PA) sensors are easy to install, and the data is easily accessible (Figure 2). The sensor measures real-time $PM_{2.5}$ concentrations. Built-in Wi-Fi enables the sensor to transmit data to the map, where it is stored and made available to any smart device. They are low cost, have a small footprint and are easy to use. Full air quality air monitoring stations are extremely costly and complex to operate and are therefore not always practical in smaller and remote communities. A PA sensor costs approximately $500 whereas a $PM_{2.5}$ analyzer used at full air monitoring stations is approximately $25,000.

ECCC Pilot Project

ECCC is currently running a pilot project to use the low-cost PM sensors to augment the existing air quality monitoring across Canada. ECCC national network is not only interested in the data but also interested in how these sensors will perform under extreme winter conditions in the NWT communities. The information from the sensors can be used by forecasters to adjust the

model outputs to better predict concentrations within a region during high PM events such as wildfires. In the future the data may be ingested into models to improve forecasting.

A mapping tool has been developed in collaboration with the University of Northern British Columbia (UNBC) to display the data in real time (Figure 3). The PA sensor data is corrected, using an algorithm developed in collaboration with UNBC, to improve the accuracy of the measurements. The mapping tool also contains various features such as being able to display the current fire locations from NRCan, the firework model output, and fire danger ratings.

ECCC is also developing some automated sensor checks to determine issues and automated reporting for managing agencies. These automated reports can be sent out on a timeline of the users choosing and can include downtime and statistical information regarding concentrations. Expansion of the capabilities of the automated reporting is currently being assessed.

Particulate Matter

Fine Particulate Matter ($PM_{2.5}$) is tiny airborne particles that can be inhaled deep into the lungs. These particles can either be emitted directly by vehicles, industrial facilities, commercial and residential heating (home firewood burning) or natural sources like forest fires or formed indirectly as a result of chemical reactions from other pollutants.

The smaller size of $PM_{2.5}$ allows it to penetrate deep into the lungs and can cause aggravation of asthma, lung or heart disease in people who already suffer from these problems. It can also cause difficulty in breathing in children and the elderly as well as irritation of eyes, throat, skin and nose.

Helping the Community

These sensors will be a valuable tool in that they will provide information to indicate whether air quality is deteriorating during a wildfire event and can help to protect vulnerable populations. Depending on the concentration, these sensors could trigger health- based risk advisories to modify activity, stay indoors, or seek clean air shelters.

Engagement and Deployment Strategy

Building partnerships is the key step in implementing the deployment of the sensors in the territory. The engagement will include working together with Indigenous governments, Indigenous organizations and communities through organizations such as the NWT Association of Communities (NWTAC) and GNWT personnel in each of the 5 major regions of the NWT: Deh Cho, South Slave, North Slave, Sahtu, and Inuvik. The NWTAC and regional personnel will provide recommendations to whether a specific location within a community would be a viable option to set up a sensor.

As part of building partnerships, a kickoff meeting was held with the NWTAC on February 3, 2022 to discuss this community-based monitoring initiative, which received positive feedback and support. The NWTAC recommended to roll the initiative out at Interactive Sessions of the NWTAC 2022 Annual General Meeting and Information Trade Show that is scheduled in

Yellowknife in September 2022. It was also recommended to develop a two-page handout for participants.

Ideal locations within communities that meet requirements of power and Wi-Fi can include:

- Health station
- School
- GNWT office
- Town hall
- Other institution

ECCC will provide PA sensors to the GNWT free of cost. Typically, the sensors are easy to install with instructions provided and does not require a trained technician. Travel costs could be avoided if hosts are able to install the sensors themselves. Hosts will be expected to cover the sensors' power and Wi-Fi costs.

Full Station Monitors vs Purple Air Sensors

Federal Equivalent Method (FEM) monitors are the standardized regulatory monitoring equipment that are installed at full stations. Networks of FEM monitors require technical knowledge and consistent maintenance to ensure they collect accurate data. PA sensors are a smaller, no maintenance and less expensive alternative to use in remote or underserviced area. With the use of a standardized correction factor, they offer an alternative to measure outdoor air quality in smaller and less accessible communities and fill gaps in the monitoring network. PAs respond and perform well in extreme events such as wildfire smoke.

The GNWT operates FEM air quality monitoring stations as part of the NAPS program. There are currently five air quality monitoring stations in the NWT- Yellowknife, Inuvik, Norman Wells, Fort Smith, and Fort Simpson. As of February 2022, as part of pilot testing under extreme cold conditions, the GNWT has deployed three PA sensors in Yellowknife (Figure 2 and Figure 4).

The PA network will measure air quality at additional locations in the territory. The PA sensors are different from GNWT monitoring stations and cannot be used to assess if air pollution levels are within legal limits. They provide other important information, such as current air quality or particulate matter at a specific location and can take the necessary actions to protect health. Air quality data from PA sensors can also be used to understand general trends in air quality and in localized areas where there are no air quality monitoring stations.

Figure 1. Potential Purple Air Monitoring Locations in the NWT
(Initial Draft - locations subject to change, meeting the siting criteria)

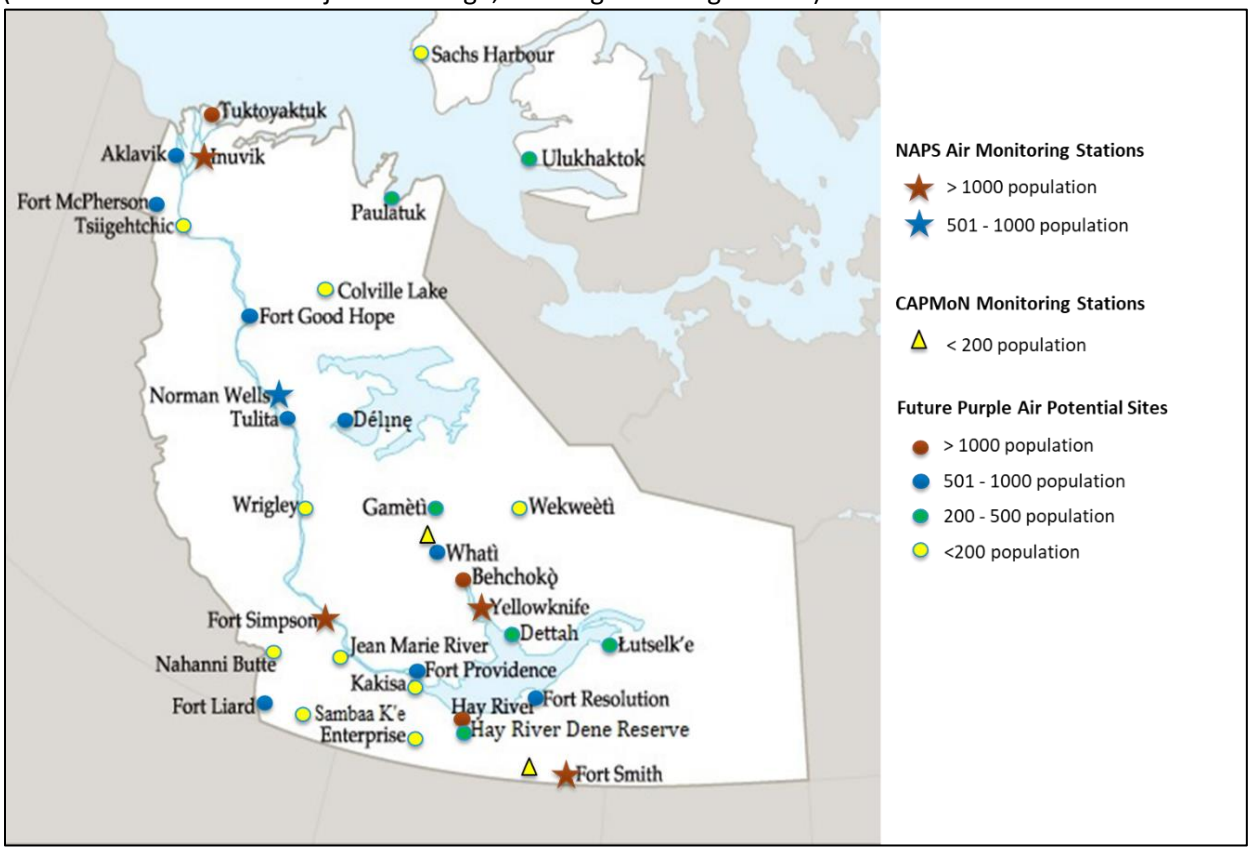

Table 1. The NWT Population Estimates by Community

Community	2021
Northwest Territories	**45,504**
Beaufort Delta Region	**6,846**
Aklavik	684
Fort McPherson	737
Inuvik	3,303
Paulatuk	311
Sachs Harbour	109
Tsiigehtchic	190
Tuktoyaktuk	1023
Ulukhaktok	489
Dehcho Region	**3,365**
Fort Liard	558
Fort Providence	753
Fort Simpson	1,214

Hay River Dene Reserve	338
Jean Marie River	86
Kakisa	36
Nahanni Butte	101
Sambaa K'e (Trout Lake)	98
Wrigley	122
Sahtu Region	**2,668**
Colville Lake	159
Délı̨nę	627
Fort Good Hope	601
Norman Wells	768
Tulita	513
South Slave Region	**7,427**
Enterprise	116
Fort Resolution	548
Fort Smith	2,579
Hay River	3,823
Łutselk'e	335
Tłı̨chǫ Region	**2,901**
Behchokǫ̀	1,952
Gamètì	280
Wekweètì	150
Whatì	519
Yellowknife Region	**22,297**
Detah	226
Yellowknife	21,775

Notes:
1. Source: NWT Bureau of Statistics.

Figure 2. Purple Air Sensor (Dimensions: 3.5 in x 3.5 in x 5 in)

Air Station, 49th St and 52nd Ave, Yellowknife

Air Station, 49th St and 52nd Ave, Yellowknife

57th St, Yellowknife

Figure 3. Map Displaying Real-Time $PM_{2.5}$ Monitoring Results

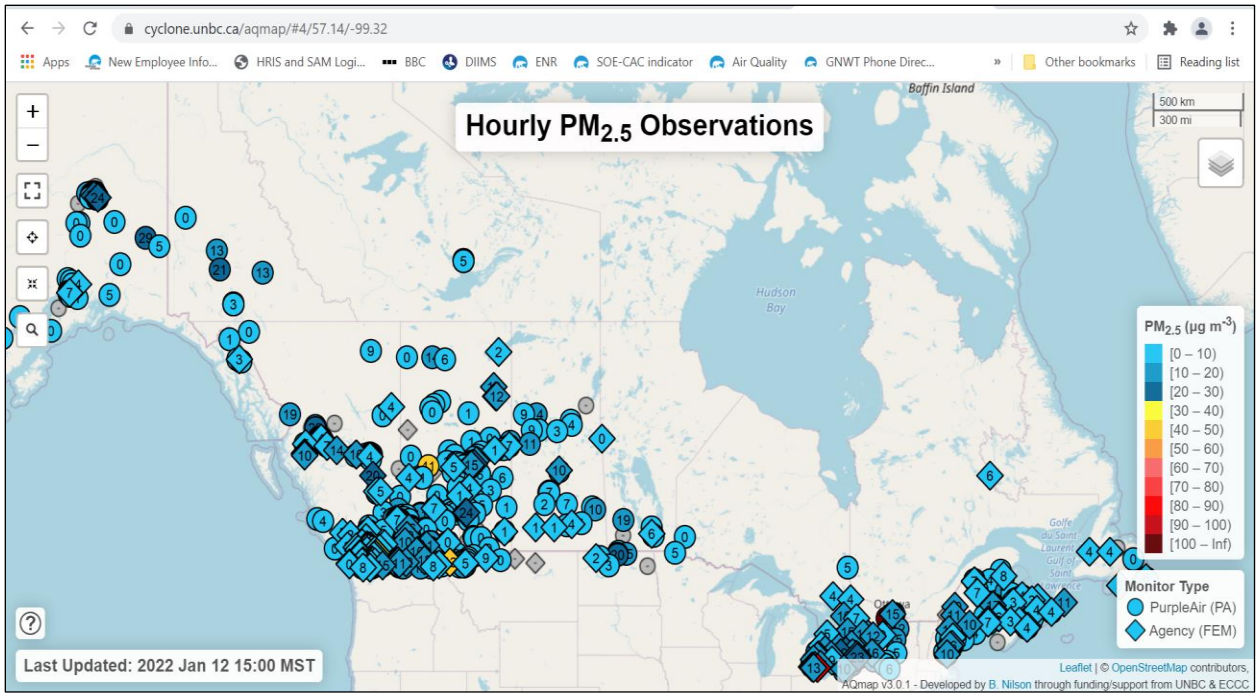

Figure 4. Yellowknife Map with Real-Time Purple Air Results (Pilot Testing)