



Environment and  
Climate Change Canada

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# Small Sensor Data Tools for the 2020 Forest Fire Season

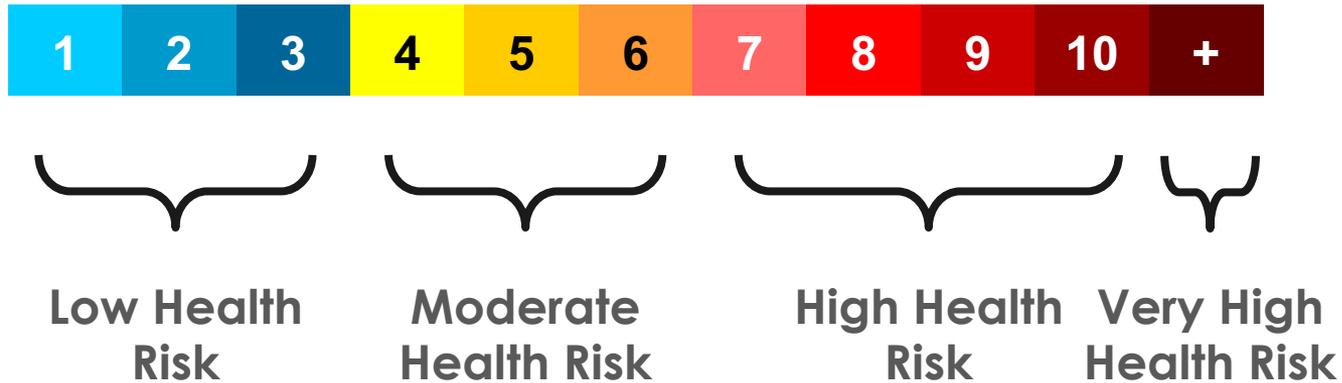
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Change Canada

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NW AIRQUEST



Canada 

# Air Quality Health Index (AQHI)



- Contributions from rolling 3-hour averaged concentrations of:

$$AQHI = \left(\frac{1000}{10.4}\right) \times \left[ \left( e^{0.000537 \times O_3} - 1 \right) + \left( e^{0.000871 \times NO_2} - 1 \right) + \left( e^{0.000487 \times PM_{2.5}} - 1 \right) \right]$$

The equation uses three green rounded rectangular boxes to highlight the pollutant names and their units:  $O_3$  (in ppb),  $NO_2$  (in ppb), and  $PM_{2.5}$  (in  $\mu g/m^3$ ).

(With AQHI values >10 reported as "+")

# AQHI+



- Calculated from 1-hour averaged concentration of  $PM_{2.5}$ :

**$PM_{2.5}$  (in  $\mu\text{g}/\text{m}^3$ )**

$$AQHI+ = \max \left[ \text{ceiling} \left( \frac{PM_{2.5}}{10} \right), 1 \right]$$

(With AQHI values  $>10$  reported as “+”; minimum value is 1)

**Both AQHI and AQHI+ are calculated all the time;  
the AQHI+ value is reported when  $AQHI+ > AQHI$**

# AQHI+ Health Messaging

1-hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Provincial AQHI	AQHI Risk Category	Health Message for People at Higher Risk	Health Message for General Population	Actions to Reduce Wildfire Smoke Exposure
0 – 10	1	Low	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.	Normal air quality in British Columbia
11 – 20	2				
21 – 30	3				
31 – 40	4	Moderate	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms.	No need to modify your usual outdoor activities unless you experience symptoms.	<ul style="list-style-type: none"> <li>• Use a portable air cleaner to reduce smoke in your home</li> <li>• Stay inside with doors and windows closed, but keep cool – being too hot is more risky than breathing smoke for most people</li> <li>• Visit places with cleaner and cooler air, such as libraries, community centres, and shopping malls</li> </ul>
41 – 50	5				
51 – 60	6				
61 – 70	7	High	Reduce or reschedule strenuous activity outdoors.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms.	<ul style="list-style-type: none"> <li>• Visit places with cleaner and cooler air, such as libraries, community centres, and shopping malls</li> </ul>
71 – 80	8				
81 – 90	9				
91 – 100	10				
101+	10+	Very High	Avoid strenuous activities outdoors.	Reduce or reschedule strenuous activity outdoors, especially if you experience symptoms.	<ul style="list-style-type: none"> <li>• Consider relocating to an area with less smoke</li> <li>• If you cannot access cleaner air, consider using a well-fitted N95 respirator</li> </ul>

Yao, J., Stieb, D. M., Taylor, E., & Henderson, S. B. (2019). Assessment of the Air Quality Health Index (AQHI) and four alternate AQHI-Plus amendments for wildfire seasons in British Columbia. *Canadian Journal of Public Health*.

<https://doi.org/10.17269/s41997-019-00237-w>

# Traditional Air Quality Monitoring

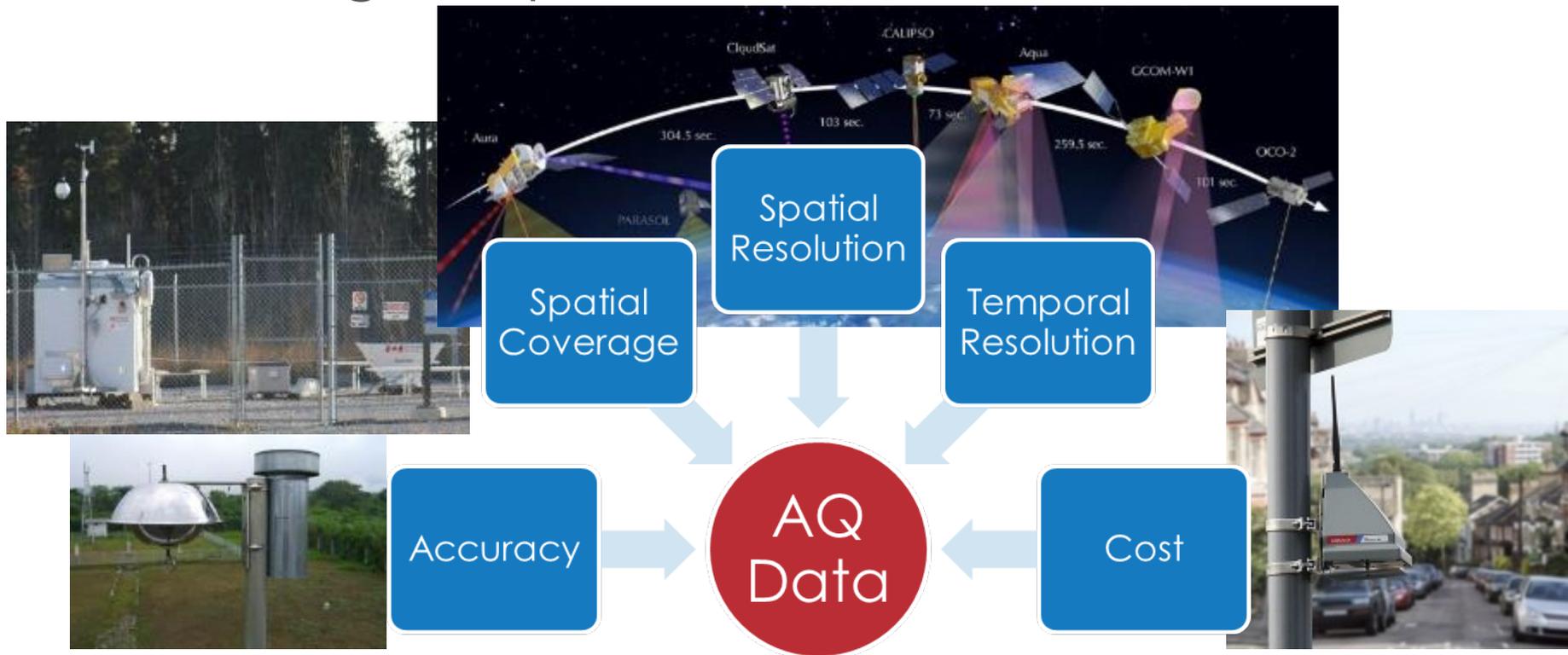


National Air Pollutant Survey (NAPS)



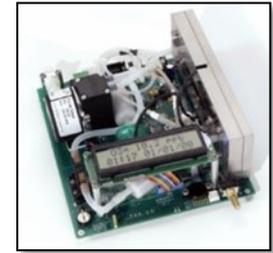
# New Air Quality Monitoring Methods

- Emerging technologies in small air quality sensors can augment existing technologies to reach higher spatial resolution in real-time.



# Small sensors

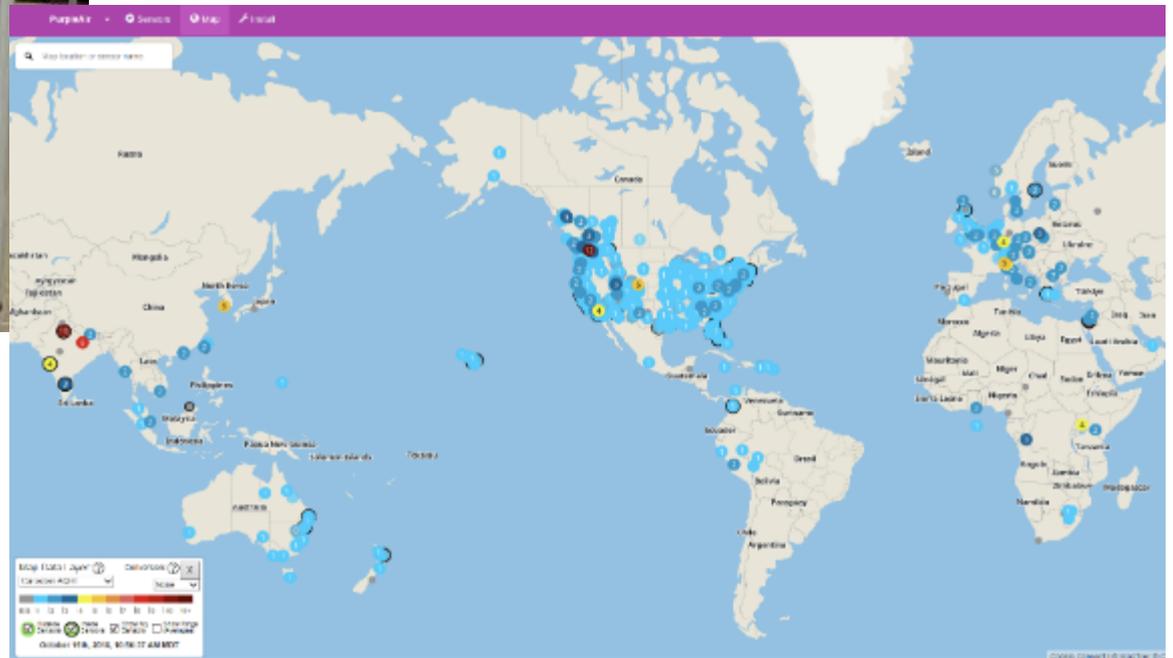
- 2B (O<sub>3</sub> only)
- Aeroqual AQY
- SCI-608
- Vaisala AQT
- PurpleAir (PM only)
- AQ Egg
- Sensit RAMP



# Small Sensors for PM (and AQHI+)

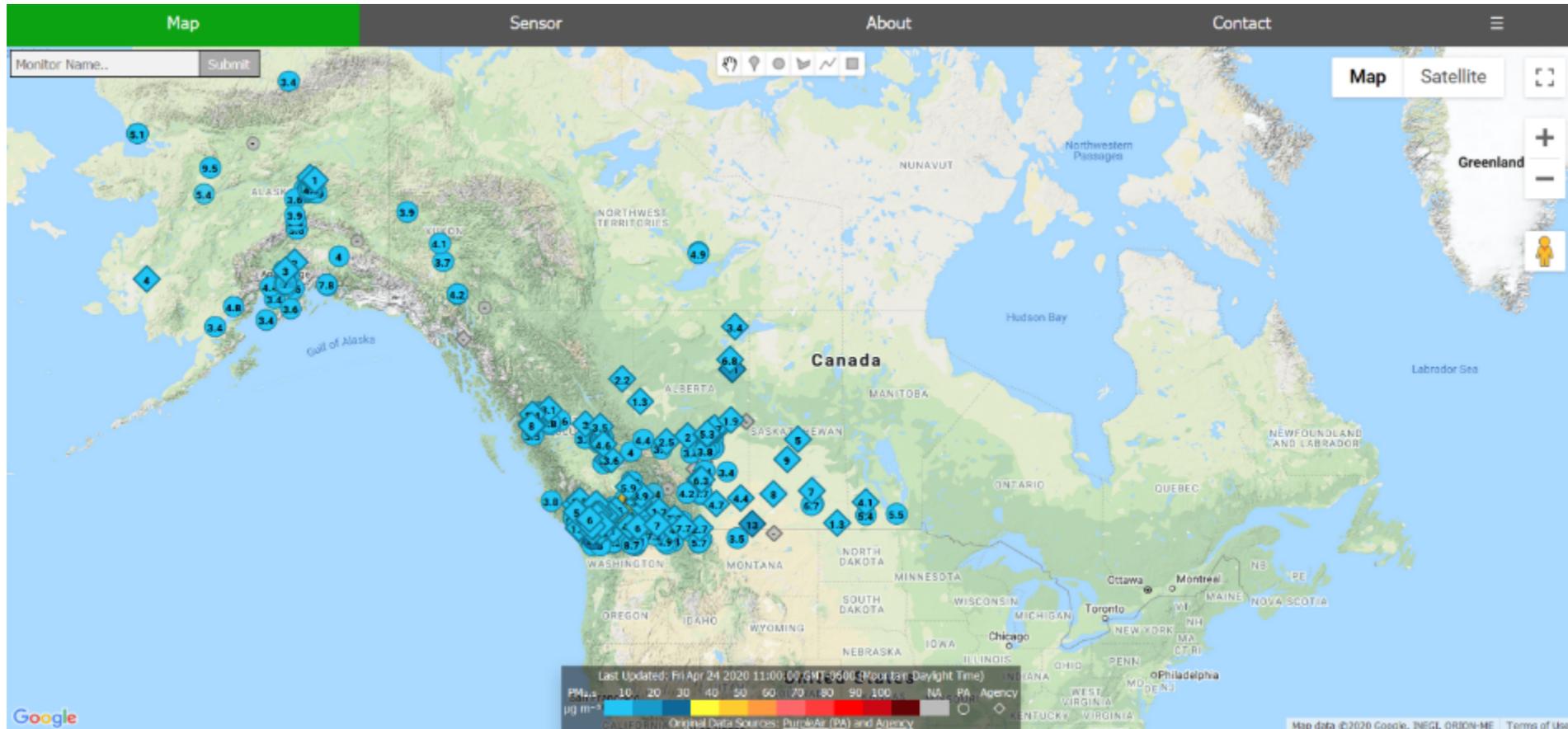


Inexpensive and widely distributed; data are easily available but need to be corrected.



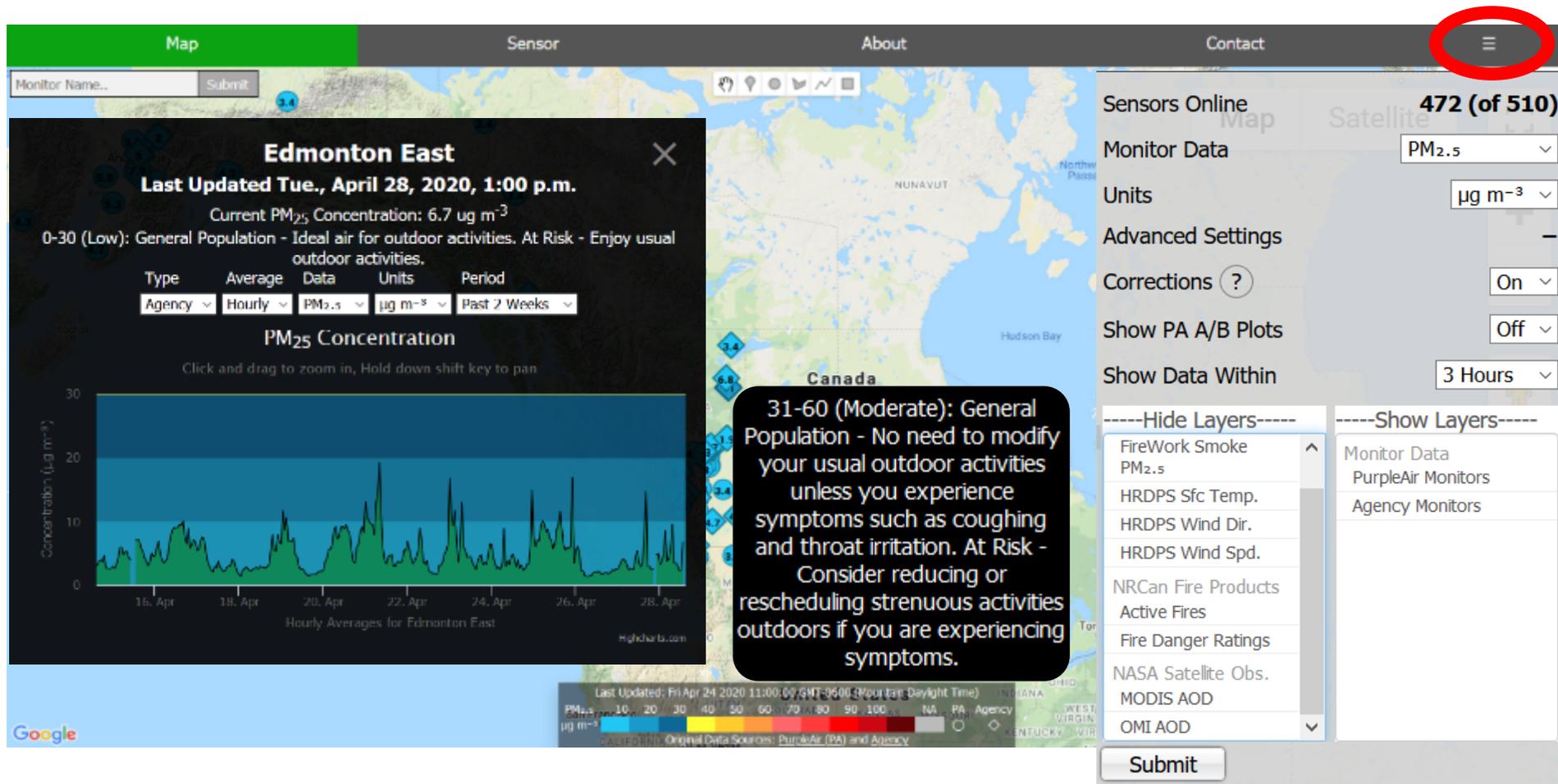
Our collocation tests have shown that corrected data can provide the correct AQHI+ value >95% of the time.

# External Visualization Tool from UNBC



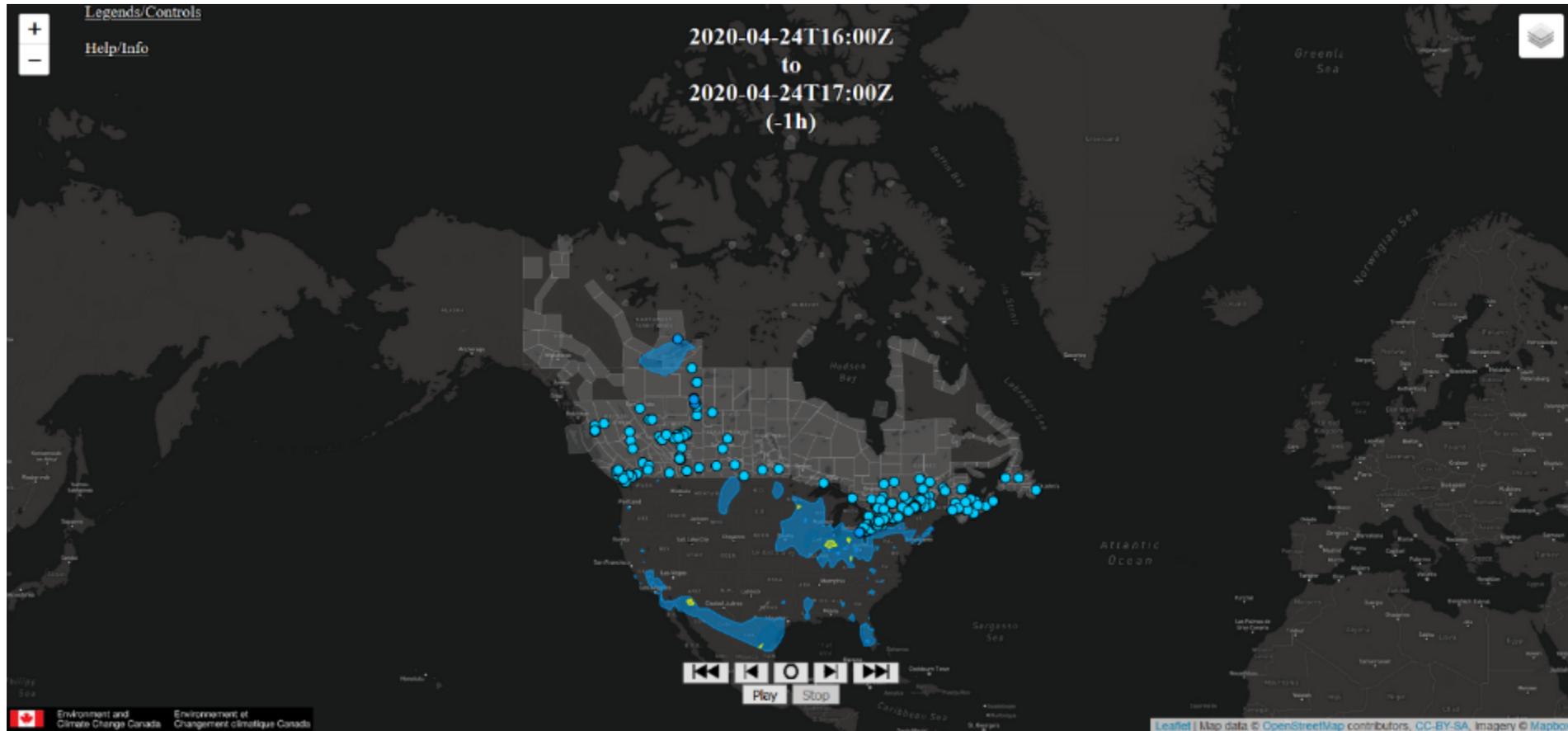
<http://weather.unbc.ca/aqmap>

# External Visualization Tool from UNBC



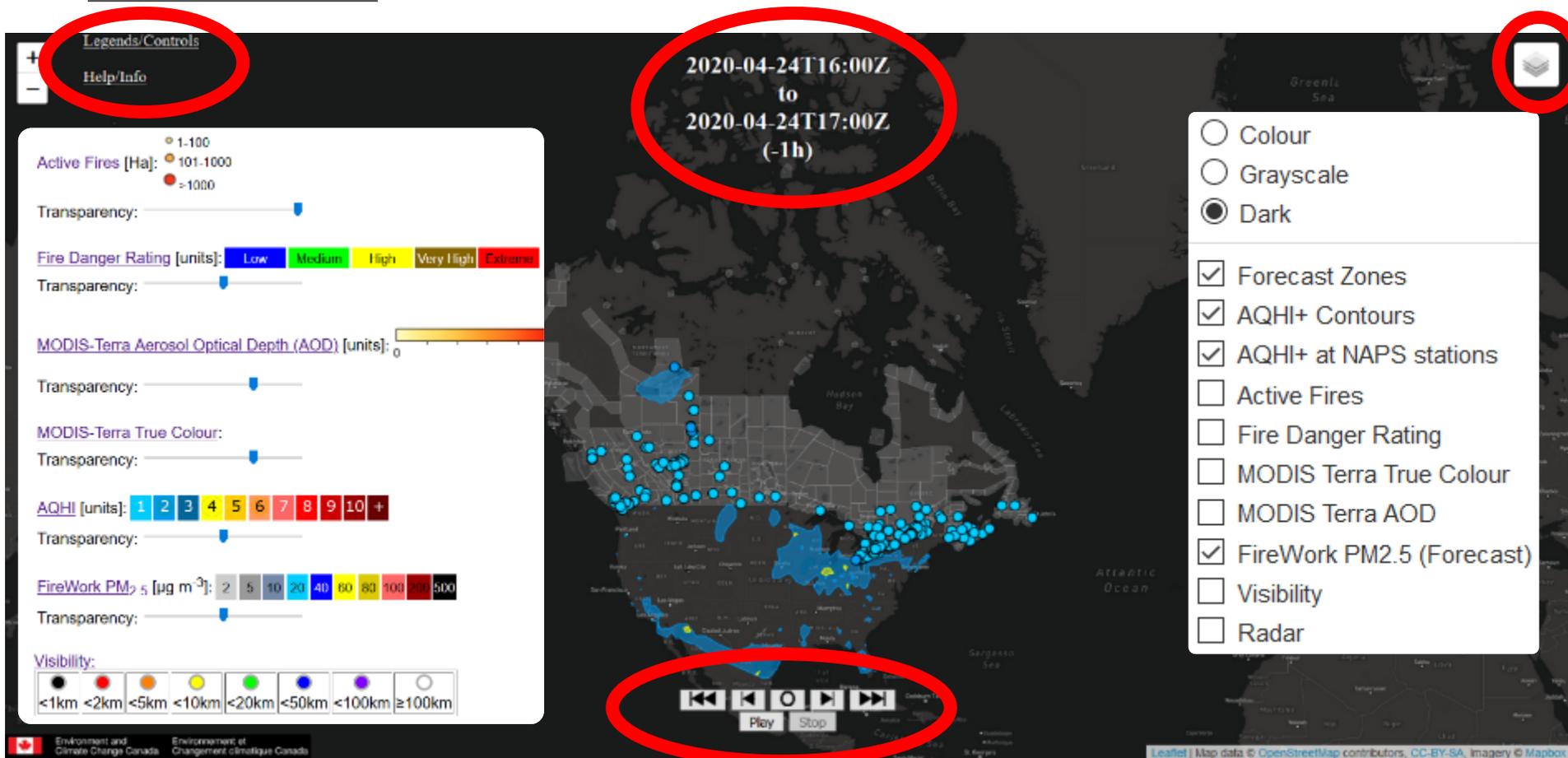
<http://weather.unbc.ca/aqmap>

# Internal Visualization Tool for ECCC



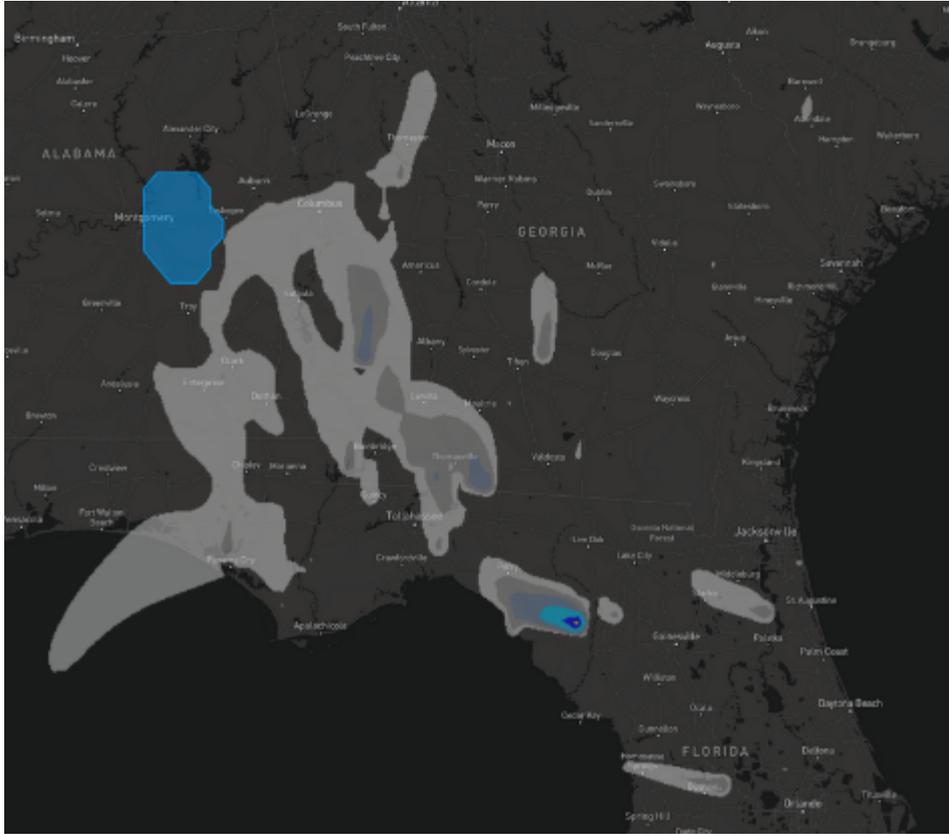
<http://goc-dx.science.gc.ca/~map003/airqualitymap.html>  
(only from within ECCC network)

# Internal Visualization Tool for EC3C



<http://goc-dx.science.gc.ca/~map003/airqualitymap.html>  
(only from within EC3C network)

# How is ECCC using these tools?

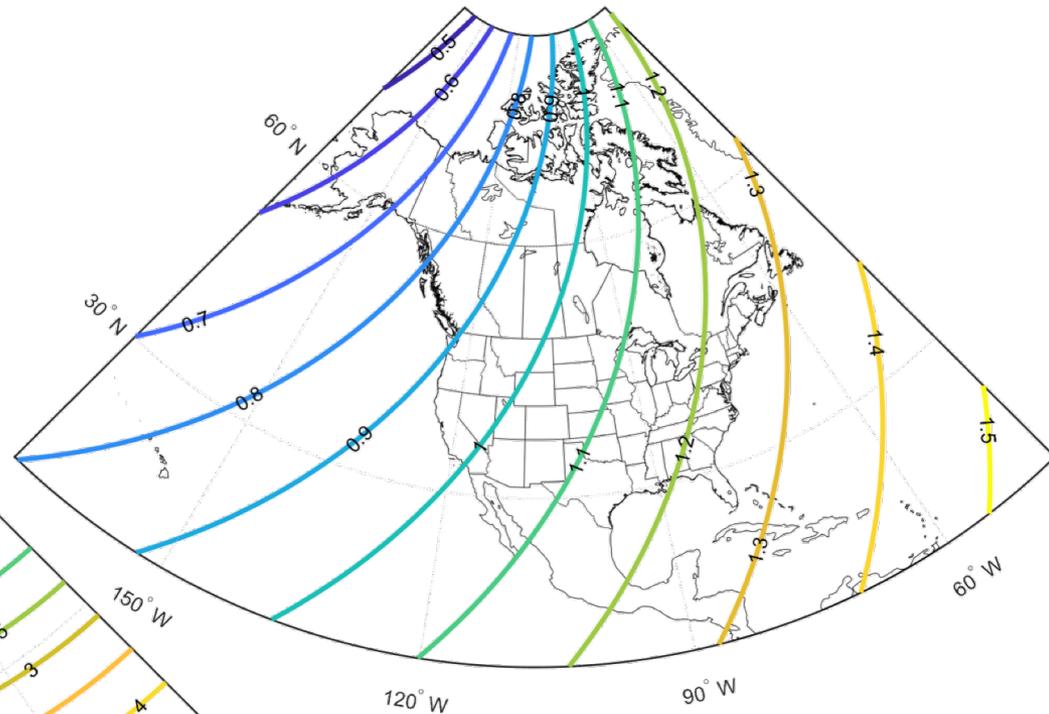


- Real-time validation of FireWork model output for operational forecasters.
- Real-time data visualization for services staff responding to media or emergency operations inquiries.
- Encouraging partner agencies to take advantage of UNBC map product to see their sensor data in a Canadian context with appropriate AQHI health messaging.

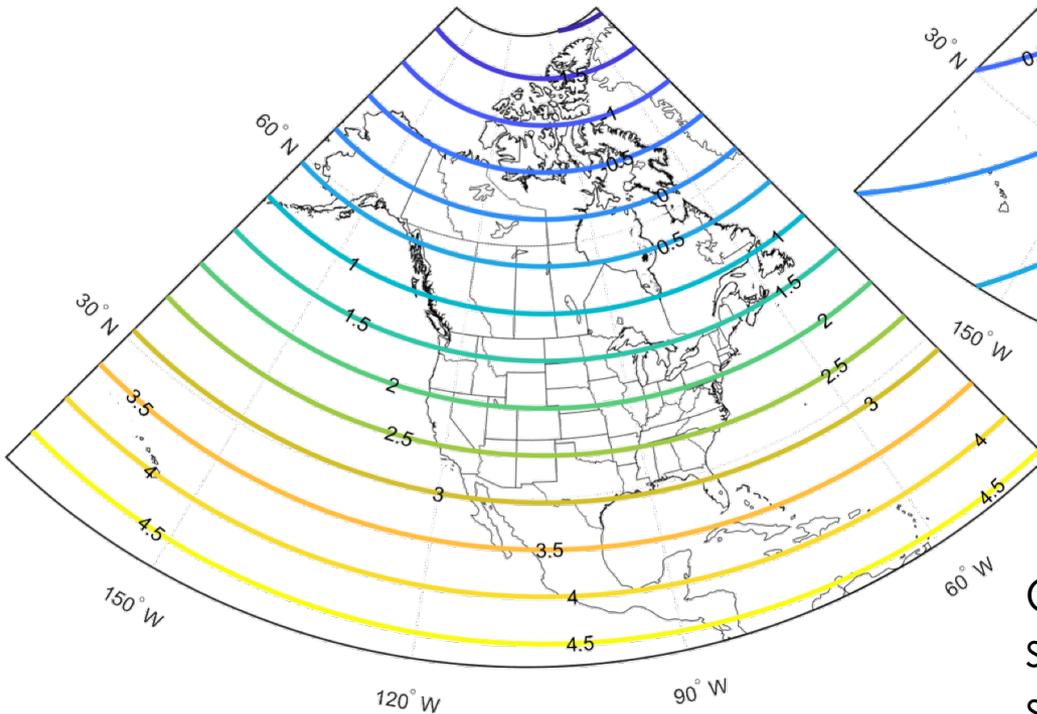
*As an example, FireWork model predicts smoke impacts over southeastern US in this case, but surface observation data show an increase in AQHI+ at a different region in Alabama.*

# Regional Correction Algorithm

Slope



Intercept



Corrections could also factor in seasonal, meteorological, and PM size and composition dependencies

# Questions? Contact us!

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