AQHI Program
Meteorological Services of Canada

Meteorological Service of Canada (MSC)
Environment and Climate Change Canada (ECCC)
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Air Quality Health Index | Cote air santé

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population*	General Population
Low Risk	1 - 3	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate Risk	4 - 6	**Consider** reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	7 - 10	**Reduce or reschedule** strenuous activities outdoors. Children and the elderly should also take it easy.	**Consider** reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	Above 10	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce or reschedule** strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

The Formula

Three pollutants, one number to know!

Weighted sum of local NO_2, O_3, and PM2.5

Simple formula

$AQHI \sim (0.871*NO_2 + 0.537*O_3 + 0.487*PM_{2.5}) / 10.4$

(Robichaud et al, 2016)

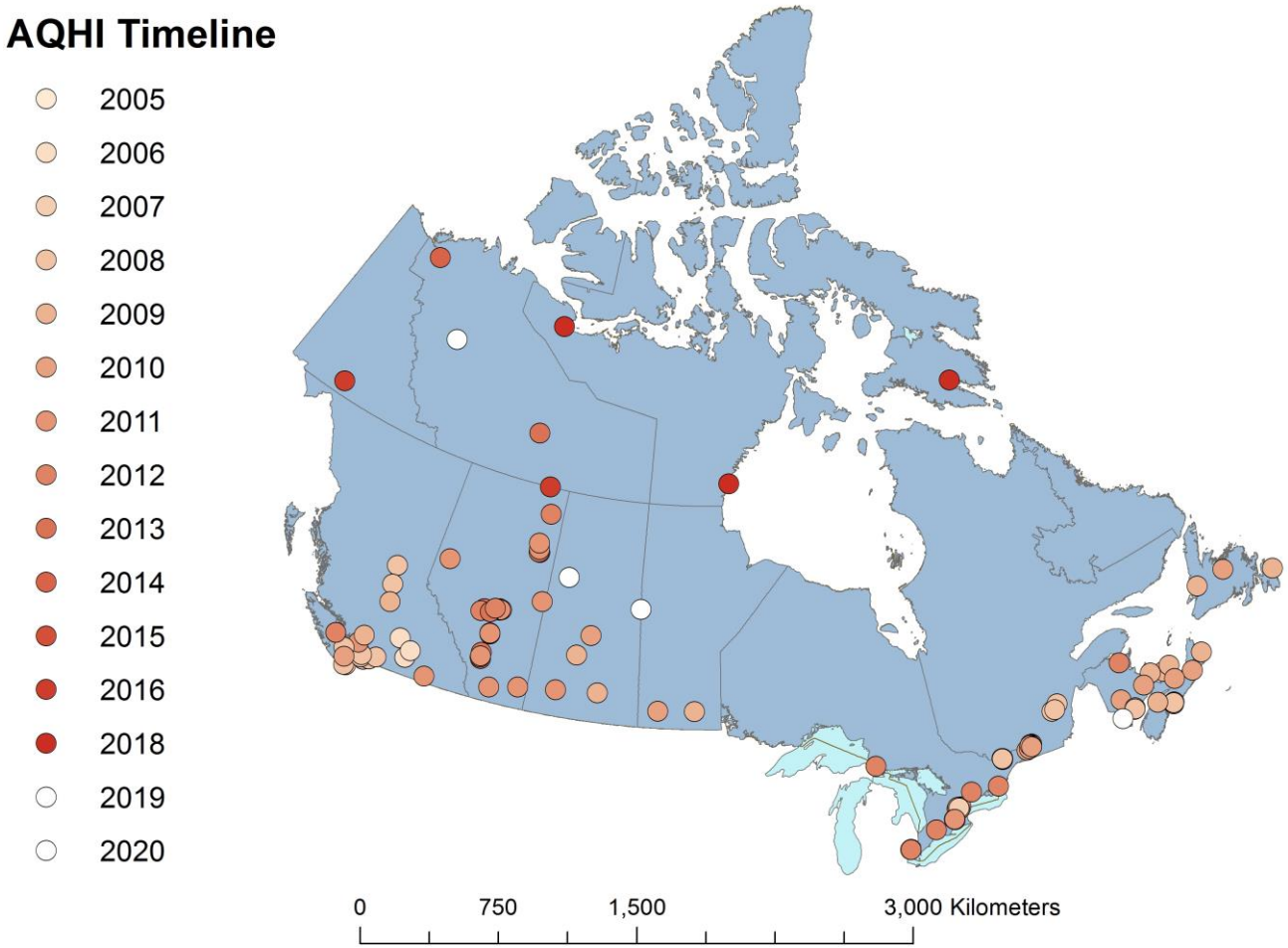
More Sciency formula

$AQHI = 10/10.4*(100*(e^{(0.000871*NO2a)}-1 + e^{(0.000537*O3a)}-1 + e^{(0.000487*PM2.5a)}-1))$

(Steib et al, 2008)

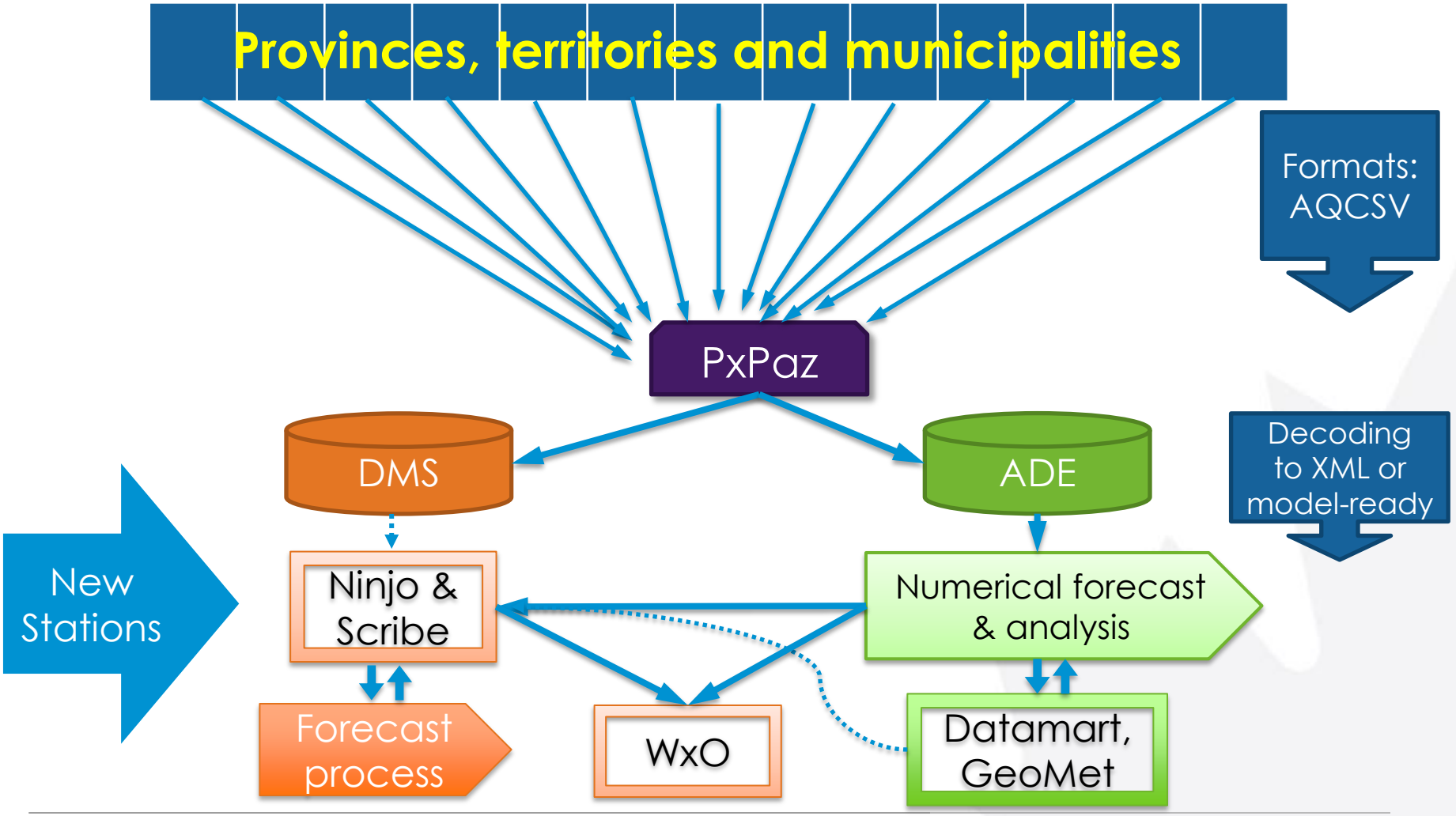
To date, this has reflected the best available science in communities in Canada.

AQHI by Observations



- Use of NAPS stations for Obs
- Available to 80% population
- 111 communities
- 122 AQHI forecasts on WeatherOffice
- AQHI by 2D mapping in 2020-2021

Real Time AQ Data Flow



AQHI Forecast – New 48hr to 72 hr

- Canadian Meteorological Centre (CMC) is responsible for AQ OBS processing and forecast modelling
- MSC Storm Prediction Centre (SPC) operational meteorologist are responsible for AQHI forecasts

- Coordination with P/T partners:
  - AQ data and related issues
  - Forecast/pollutant inquiries
  - Service delivery and forecast/obs dissemination
  - Alert protocols and wildfire events

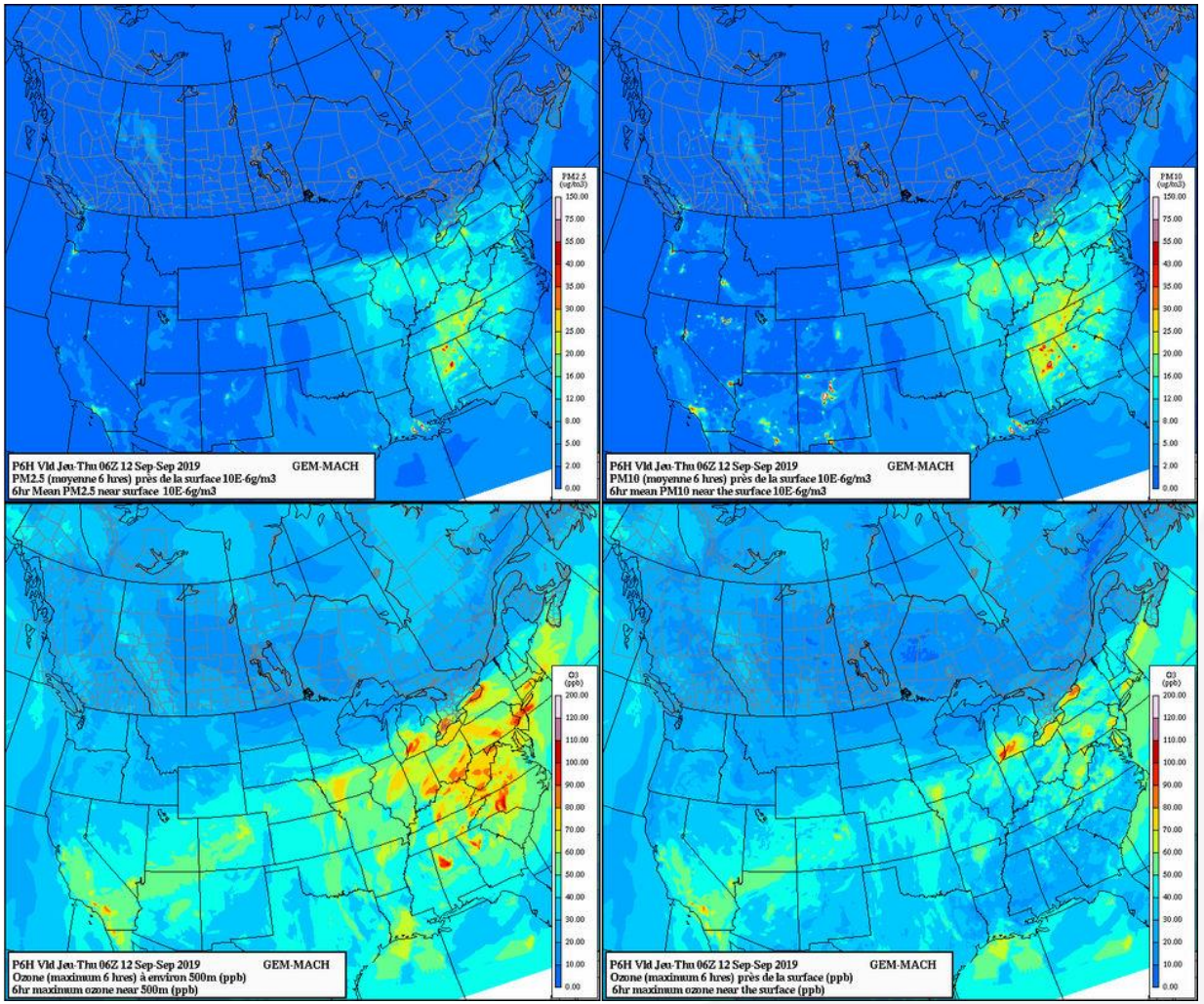
<u>6am forecast</u>
-Today (6am -6pm)
-Tonight (6pm – 6am)
-Tomorrow (6am – 6pm)
-Tomorrow Night (6pm – 6 am)
-Day 3 (6am – 6 pm)

<u>5pm forecast</u>
-Tonight (5pm – 6am)
-Tomorrow (6am – 6pm)
-Tomorrow Night (6pm – 6am)
-Day 3 (6am – 6 pm)
-**Day 3 Night (6pm – 6 am) Option 2**

Forecast products

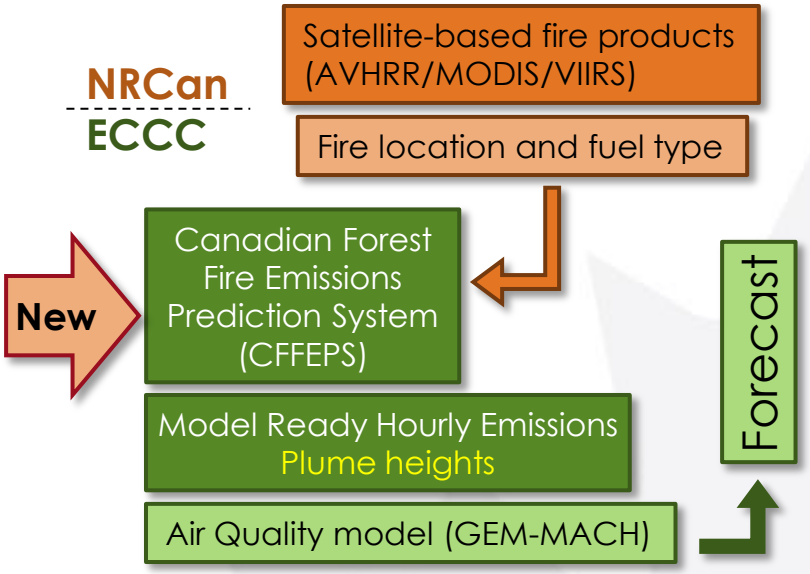
Regional Air Quality Deterministic Prediction System (RAQDPS)

- **4-panel maps (PM2.5, PM10, O3 near the surface, O3 near 500 metres)‡**
- **Available in Eastern, Western and North American layers**
- **00 UTC and 12 UTC at intervals**
  - T+06
  - T+12
  - T+18
  - T+24
  - T+30
  - T+36
  - T+42
  - T+48



FireWork System: Air Quality forecast + wildland fire smoke

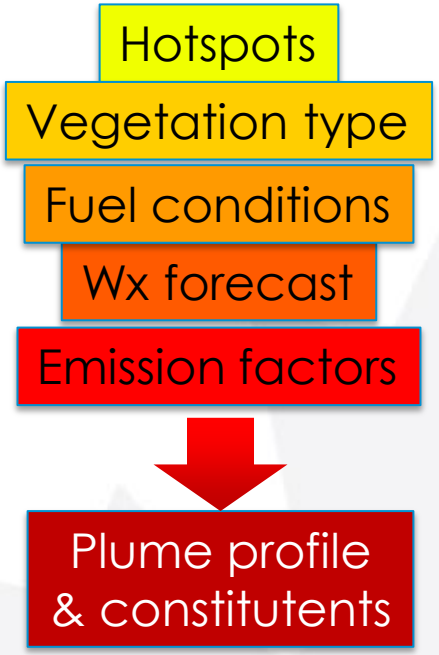
- Operational AQ forecast model (RAQDPS) with inclusion of the near-real-time wildfire emissions
- Relies on input from NRCan's CWFIS system
  - Fire location and fuel type
- FireWork:
  - 2-day forecast, refreshed twice daily (initiated at 00 UTC and 12 UTC)
  - Operated from April to October
- Additional products
  - Alternate AQHI forecast based on FireWork
  - $PM_{2.5}/PM_{10}$ maps and animations isolating the contribution of fires
  - Total column $PM_{2.5}/PM_{10}$ sums
  - Other specialized products available upon request



Fire emissions:
Canadian Forest Fire Emissions Prediction System(CFFEPS)

Developed jointly by the Canadian Forest Service (CFS) and ECCC

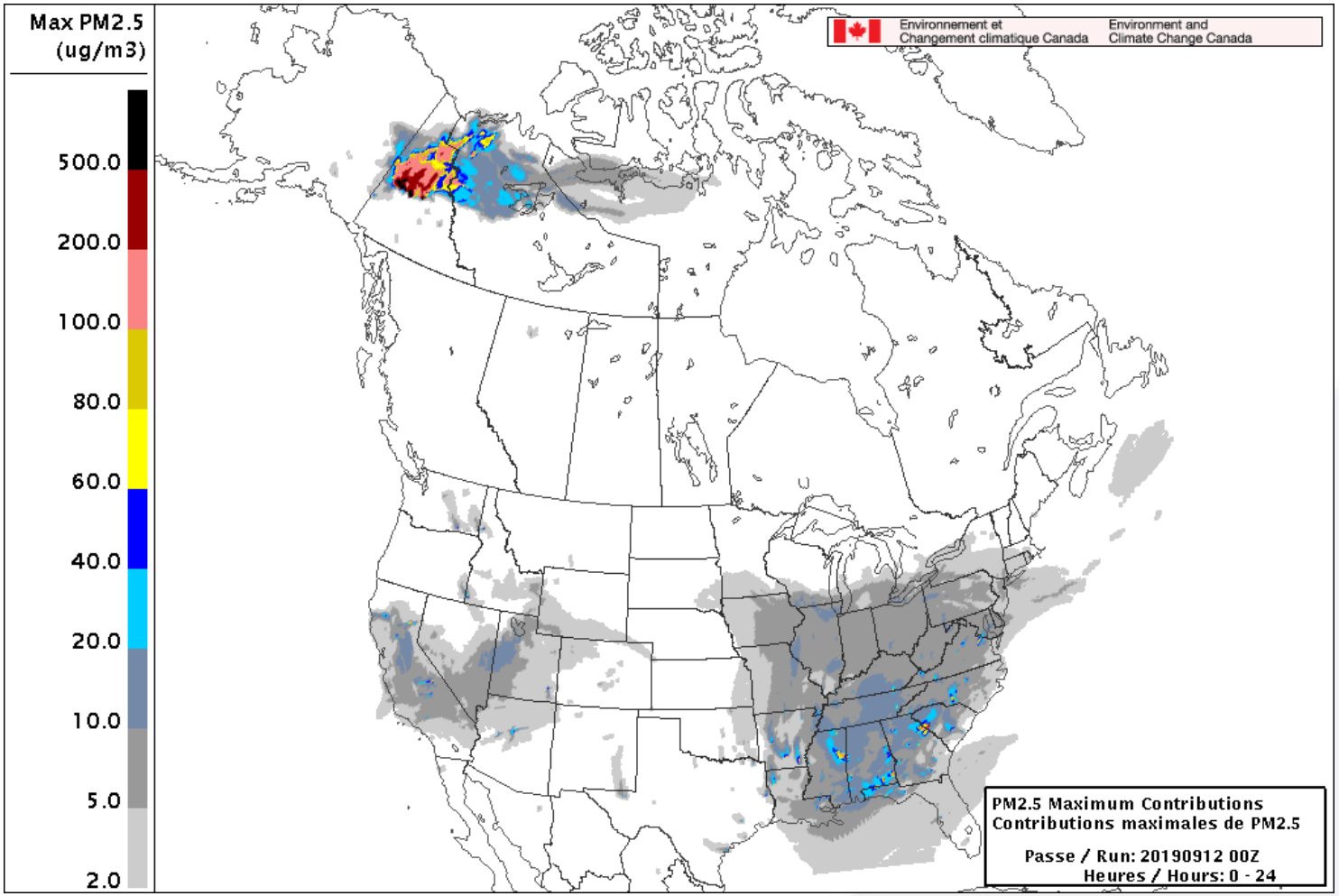
- Fire size:
  - Depends on region and fuel type
- Plume injection height:
  - Based on fire energy thermodynamics
- Temporal resolution of emissions:
  - Adjusted hourly using forecasted GEM meteorology
- Emission factors:
  - Updated by fire type - extensible to fuel type dependence
- Speciation:
  - Different profiles for flaming and smoldering emissions



Forecast products

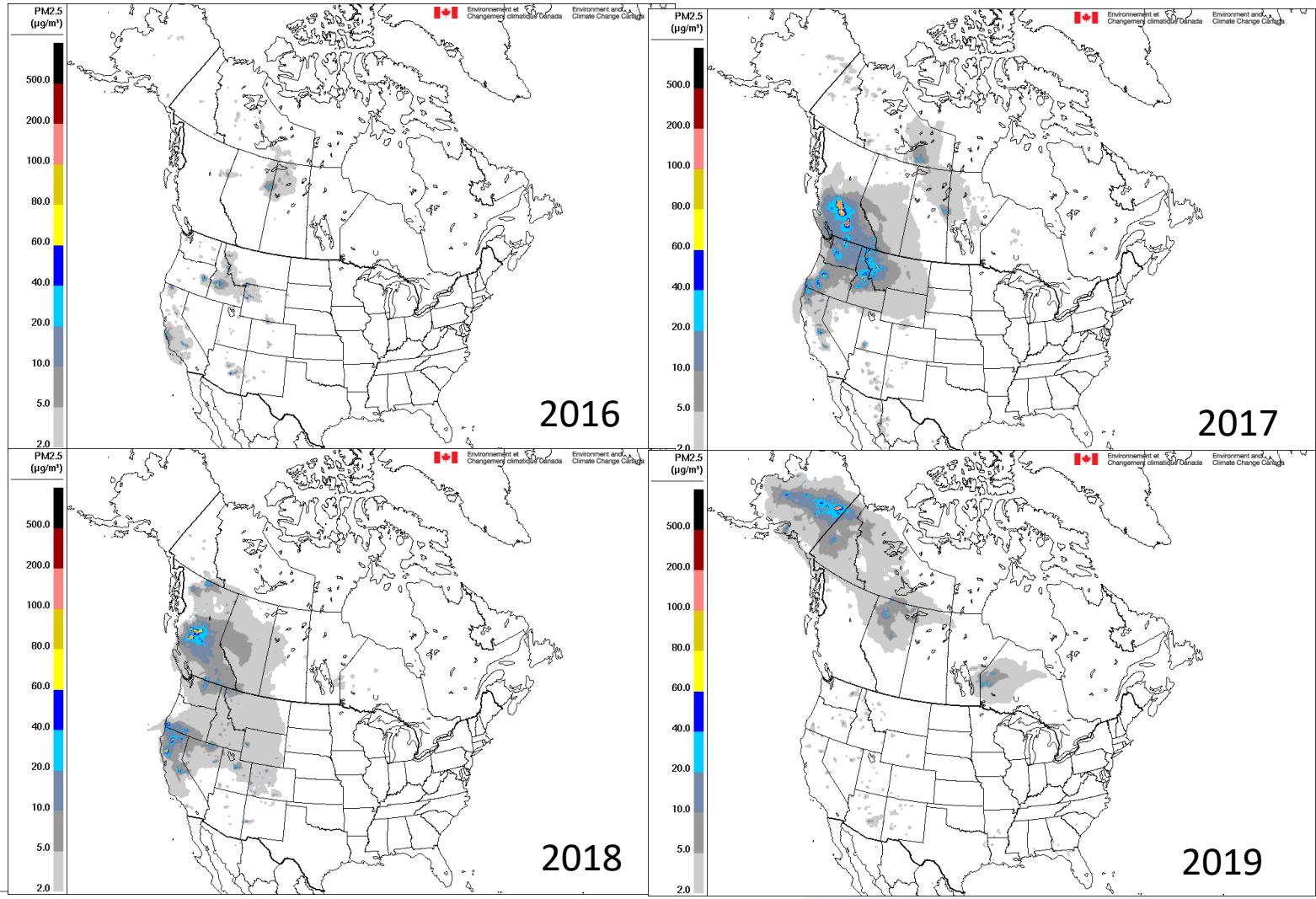
Firework (April to late October)

- Average and Maximum PM2.5
- Available at 00 UTC and 12 UTC
- 00 to 24 hours and 24 to 48 hours



Firework compilation of results

2016 to 2019



AQ Alerting Programs

Partner specific

- **Ontario**, Smog and Air Health Advisory for AQHI 7 or more (incl. AQHI+)
- **Northwest Territories**, Air Quality Advisory for AQHI 7 or more (incl. AQHI+)
- **British Columbia** Advisories issued by province, Disseminated by ECCC via Special AQ Statement (SAQS)
- **Alberta**, New partnership for advisories, ECCC to issue SAQS for routine and non-routine events based on AQHI 7 or more (incl. AQHI+) and regional events of concern
- **Québec,** Smog Warning based on AQI
  - O_3 (82 ppb) for at least 3 consecutive hours
  - $PM_{2.5}$ (35 μ/m^3) 3 hour rolling average

- Special Air Quality Statements (SAQS) issued by Storm Prediction Centres (SPC) are used for smoke events and at partner request

Single Pollutant Exceedance – AQHI+

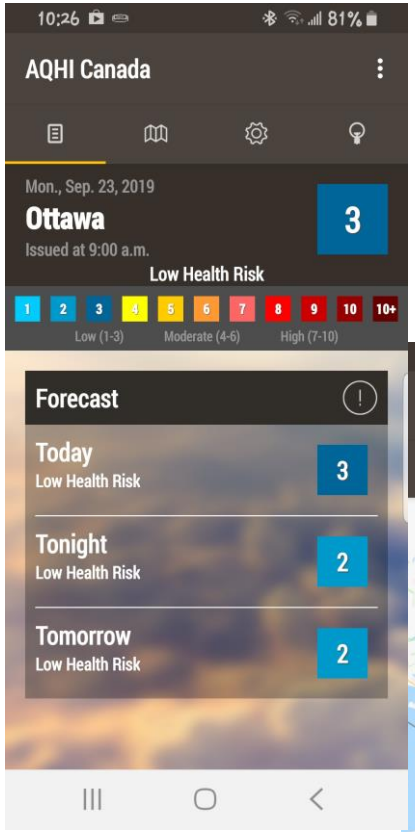
- Supports heath protection communications, i.e. forest fire smoke circumstances
- AQHI+ is based on I hour average – instead of reg AQHI 3 hr average. (more responsive, *risk of bad data*)
- Monitoring of data quality by AQHI partners and Storm Prediction Centre (SPC) Meteorologist
- **Alberta, NWT**, BC and Ontario have identified the pollutant cut-point **i.e. PM2.5 is 80.5 µg/m3 (Next slide for more info)**
- Exceedance event bumps the AQHI observation and forecast to the high risk
- AQHI remains at high risk until pollutant drops below threshold

AQHI+ Pollutant Thresholds

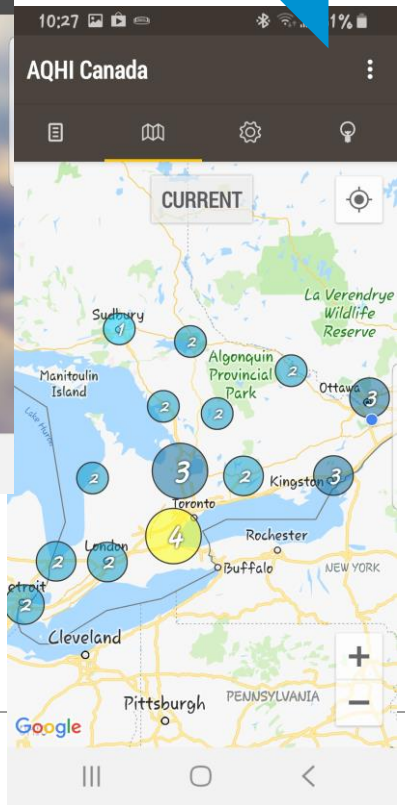
P/T	NO2 ppb	O3 ppb	PM2.5 ug/m3	CO ppb	SO2 ppb	*Calc
NL	*	*	*			1hr&3hr
PE	*	*	*			1hr&3hr
NS	*	*	*			1hr&3hr
NB	*	*	*			1hr&3hr
QC	*	*	*			1hr&3hr
ON	201*	81*	*	30500	251	1hr&3hr
MB	*	*	*			1hr&3hr
SK	*	*	*			1hr&3hr
AB	159.5*	82.5*	80.5*	13500	185 (Pilot 35)	1hr&3hr
BC	*	*	Pilot PM2.5 for Wildfire Smoke PM2.5/10			1hr&3hr
YK	*	*	*			1hr&3hr
NT	*	*	80.5*			1hr&3hr
NU	*	*	*			1hr&3hr

If PM10 samplers are present, PM10 is also calculated for 1hr&3hr

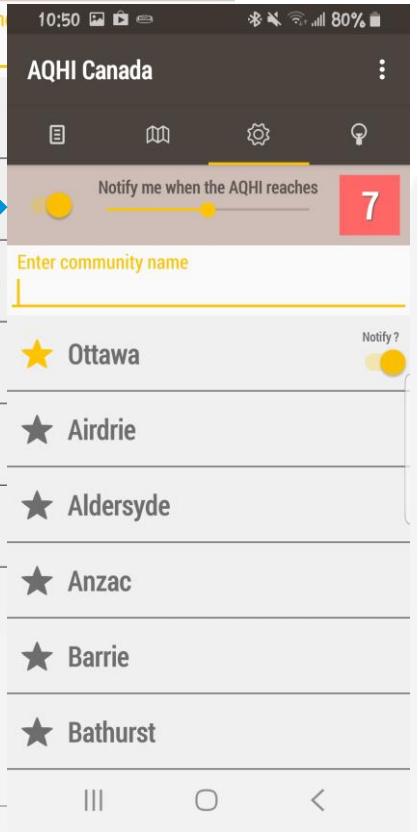
AQHI App, produced with Alberta



- Current and forecasted index
- Map of current observations



Alert for Index number

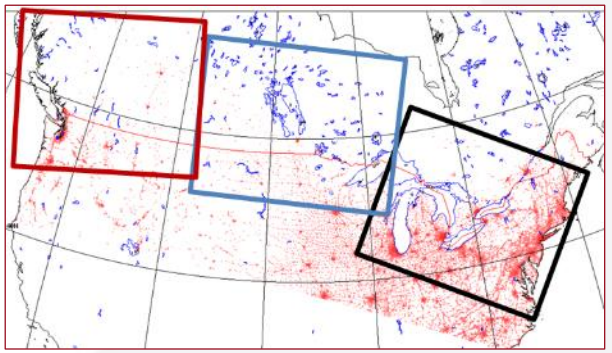


ECCC WeatherCAN App

- Available on Apple App and Google Play store.
- Receive weather alert notifications in your area, as well as in your saved locations, wherever you are in Canada.
- AQHI also available, future enhancements to include UV, Alert me AQHI number, Forecast 2D AQHI by map

In preparation

- New system update planned this summer
  - Major core weather model update to GEM-5
  - Process updates in GEM-MACH (SOA formation from isoprenes, Wx-dependant fugitive dust, etc)
  - **Extension to 72h forecast**
- Day 3 public forecast to be developed by 2020
- 2D products (AQHI by map)
  - Now aligning with MSC's wider effort to deliver weather services by map
  - New target: late 2020 / 2021
- High resolution domains: planning for 2022



PM2.5 Sensors National

http://hpfx.science.gc.ca/~map003/instrumentdashboardmap.html

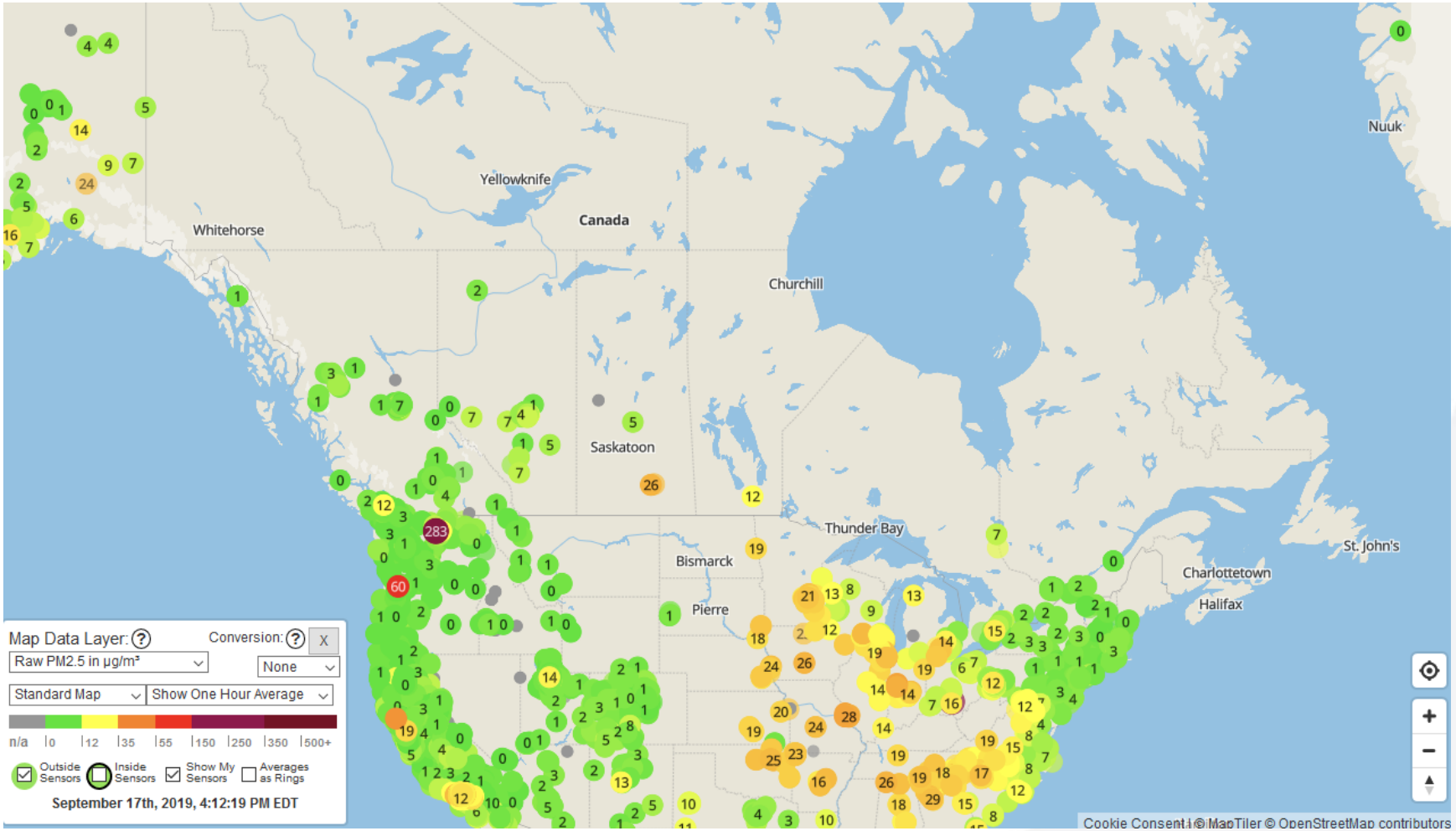
- Pacific and Yukon Region (PYR), Atlantic Region and National Air Pollution Surveillance (Ottawa) testing
- Algorithm developed by Peter Jackson UBC, co-locate and proximity with NAPS monitor for correction
- To improve tools for forecasting wildfire smoke in remote regions
- To detect residential wood smoke during inversions

PM2.5 Sensors Project
Whitehorse, Yukon

- Co-locate with NAPS and WAKM monitors
- Distribution by YK AQ and MHO in residential areas
- Monitor Residential wood smoke and wildfire smoke
- Test efficiency of unit in North, good success in EDM
- Data monitoring and reporting by MSC Science in PYR
- Available in real time

https://www2.purpleair.com/collections/air-quality-sensors/products/purpleair-pa-ii

Purple Air Monitors map



https://www.purpleair.com/map?#3.1/53.39/-99.3

Health and AQ Forecast Services Team

- **Core program team**
  - **Mike Howe – Manager**
  - Kathleen Young – Websites/Social Media (Technical Backup)
  - Danielle Jubainville – Technical Lead (Scribe, Data, Product development)
  - Céline Audette – AQHI Lead (G&C, Evaluation)
  - Melissa MacDonald – Heat Lead (Cold, AQ, Evaluation, Reporting)
  - Philippe Martin – UV Lead (G&C, GIS, Heat backup)
  - *Kasey Thomas – Cold Lead (Admin, Health Board) on assignment*
  - *Sean Perry – Engineering/Science Advancement (on parental leave)*
- **Extended team**
  - Joanne St-Cœur – H&AQ lead DG (Bill Appleby - advisor)
  - Didier Davignon – National Coordinator, Health and Env Forecasts
  - André Giguère and Caroline Presseau – CMC Data Processing
  - **Regional Program Supervisors** - Tracey Talbot (Atl Canada), Sylvain Labrecque (QC), Weiqing Zhang (ON), David Baggley (MB – Prairies, NU), Stephen Vallee (AB – Prairies, NWT), Gregg Walters (BC, YT) with **Forecasters and Warning Preparedness Meteorologists** (WPMs)
  - **MSC Science** (Keith Jones, Corrine Shiller, Andrew Teakles, Lucy Chisolm)

Questions?

THANK YOU
MERCI
GRACIÀS