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# Air Quality Health Index Program Status and Future Directions

*Prepared for  
NOAA Forecaster Focus Group  
Workshop*

# Implementation Status

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## National

- AQHI reaches 69% of Canadians (goal is 80% by 2016)
  - AQHI forecasts available in all provinces, all EC forecast offices engaged
- Available in 84 locations
- Focus on the North

## International

- Hong Kong implementation of AQHI launched December 2013
- Ireland and UK adopt AQHI messaging
- Ongoing dialogue with US EPA and NOAA
- Ongoing engagement with Mexico and US through the CEC





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# Pan and Para Pan Am Games A Demonstration Opportunity



Pan Am Games July 10–26.  
Parapan Am Games August 7–15.



**TORONTO 2015**  
Pan Am/Parapan Am



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# Pan Am AQHI Service Enhancement



- Addition of 2 AQHI stations (York University and Hanlan’s Point) ... turn on July 2015
- Reporting of AQHI by location (8 locations – 6 in Toronto and 2 in Hamilton)
- Enhancement of forecasting ... 18 1 hour increments for locations and community values
- Smog and Air Health Advisory and Special Air Quality Statements available for Pan Am venues ... locations mapped by proximity to Pan Am venues
- AQHI alerts available through EC-Alert Me



# AQHI by Station and 18 hour Mock-ups

## Pan Am and Parapan Am Games

## Toronto Island - Hanlan's Point - Air Quality Health Index - Next 18 Hours

This table shows a provincial summary of current Air Quality Health Index (AQHI) values. Issued at: 6:00 AM EDT Wednesday 24 June 2015

### Toronto Island - Hanlan's Point

- Location**
- [Hamilton Downtown - and Kelly](#)
  - [Hamilton Mountain - \ and E. 18th](#)
  - [Toronto Downtown - E and Wellesley](#)
  - [Toronto East - Kenne Lawrence](#)
  - [Toronto Island - Hanlan's Point](#)
  - [Toronto North - Yonge Finch](#)
  - [Toronto West - Islington 401](#)
  - [York University - Keele Campus](#)

**Current**

Calculated at: 9:00 AM EDT Thurs

2

1 2

Low Ri (1-3)

**At-Risk Population:**

- Enjoy your usual outdoor act
- [Find out if you are at risk](#)

**Forecast Maximums**

Issued at: 6:00 AM EDT Wednesd

Wednesday

Wednesday night

Thursday

**Who is at risk?**

People with heart and lung conditions are most affected by air pollution.

To find out if you are at risk, consult [the health guide](#), your

Date / Time (EDT)	Value	
25 June 2015		
01:00	3 - Low Risk	
02:00	3 - Low Risk	
03:00	3 - Low Risk	
04:00	2 - Low Risk	
05:00	2 - Low Risk	
06:00	2 - Low Risk	
07:00	2 - Low Risk	
08:00	3 - Low Risk	
09:00	2 - Low Risk	
10:00	2 - Low Risk	
11:00	2 - Low Risk	
12:00	2 - Low Risk	
13:00	2 - Low Risk	
14:00	2 - Low Risk	
15:00	2 - Low Risk	

**Did you know...?**

Ten seconds of idling can use more fuel than turning off the engine and restarting it.

2. Forecast issued at: 6:



Environment Canada

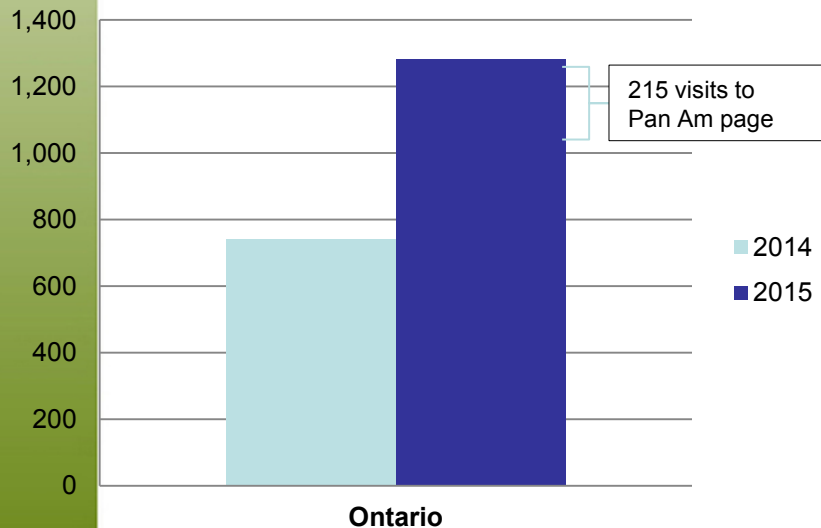
Environment Canada



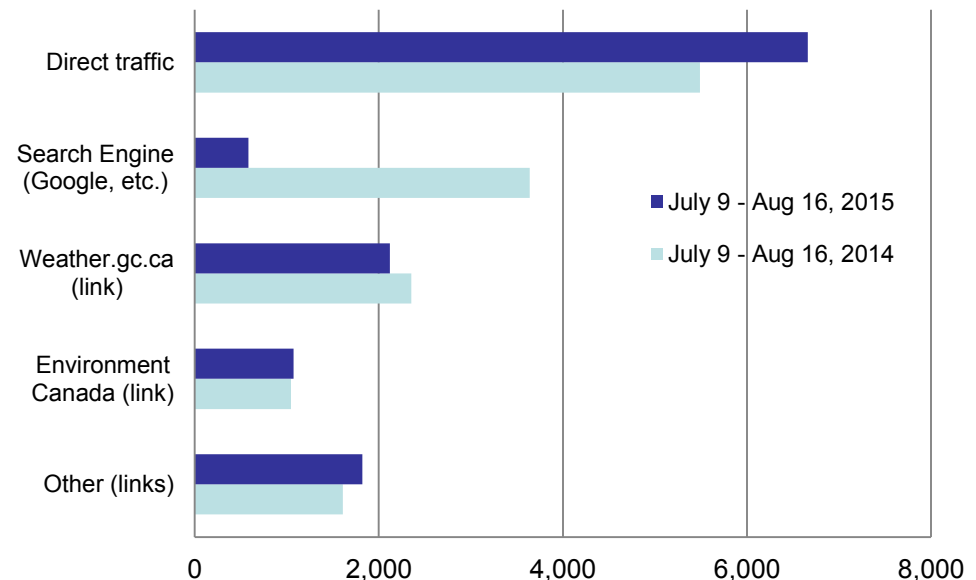
# AQHI Websites during Pan Am (AirHealth.ca)

- Visits almost doubled to the Ontario map pages ( The maps provide access to the AQHI values and are the most heavily used part of the site.)
- Most visitors found the website by typing in the URL, or using a bookmark (i.e. “direct traffic”), rather than using a link from another website.
- The increase was likely caused by the Pan Am activities, the launch of AQHI throughout Ontario, and the inclusion of the website in Ontario AQ advisories (three advisories issued during the Games)

### Visits to Ontario map page on Airhealth.ca



### How they reached Airhealth.ca



# Canadian Air Quality Forecast Systems

- **RAQDPS (Regional Air Quality Deterministic Prediction System)**
  - GEM-MACH
  - Emissions & boundary conditions
  - Statistical model (UMOS-AQ)
  - Products
  - Regional Deterministic Air Quality Analysis (RDAQA)
- **FireWork (RAQDPS with wildfire emissions)**
  - Emissions
  - Statistical model (UMOS-AQ)
  - Specialized Products
  - Regional Deterministic Air Quality Analysis connected to FireWork (RDAQA-FW)
- Experimental AQ system versions (ex: GEM-MACH on 2.5km for PanAm games)
- **VAQUM (Verification of Air Quality Models) System**





# RAQDPS: Components

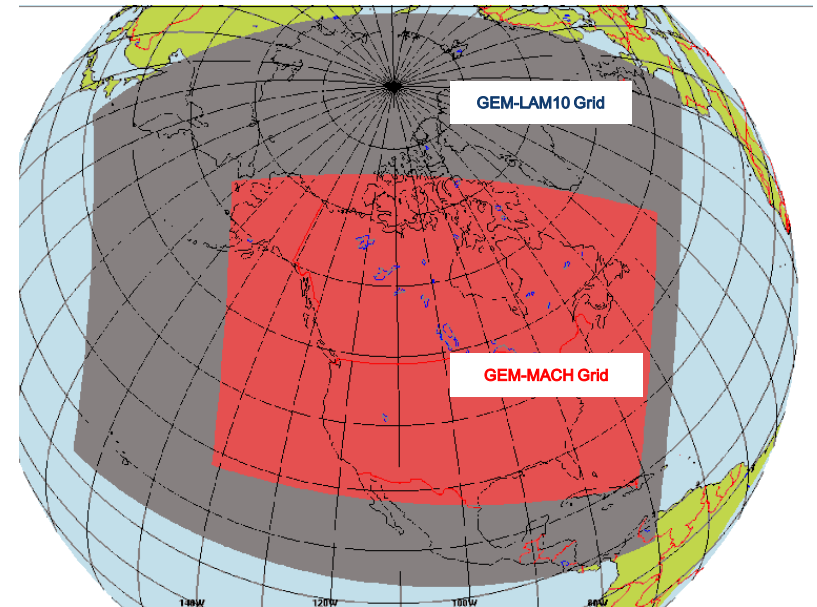
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RAQDPS = Regional Air Quality  
Deterministic Prediction System



# GEM-MACH, Operational Version (v1.5.4)

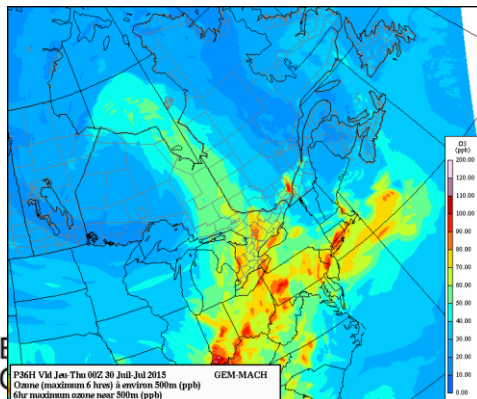
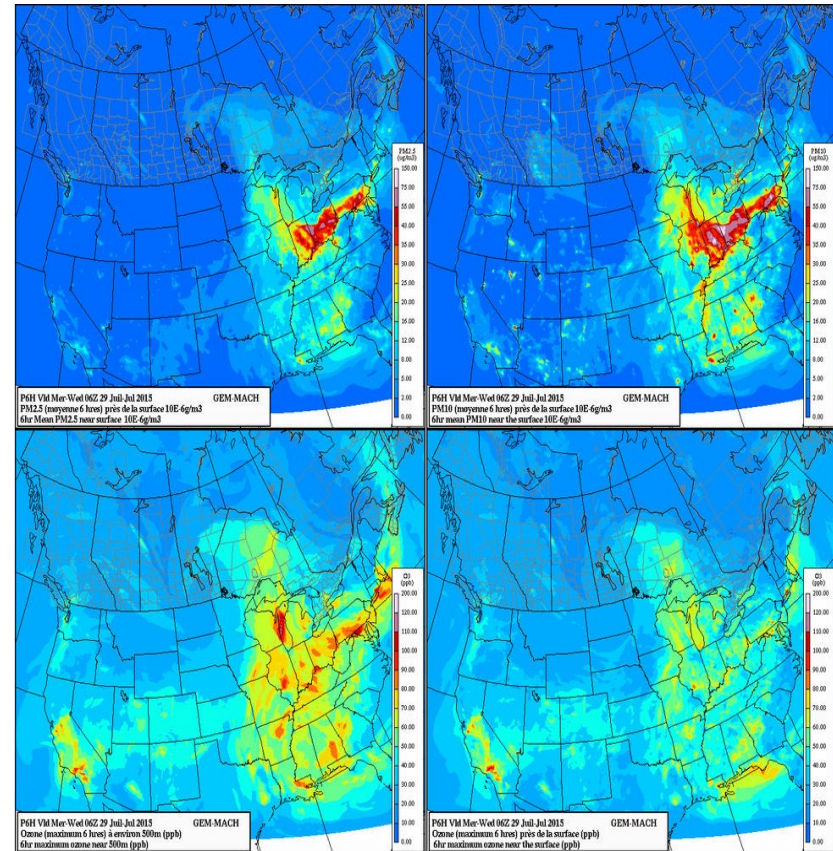
- GEM-MACH is EC's operational AQ model. Here are some essential characteristics:
  - limited-area (LAM) configuration with co-located grid points with operational met-only **GEM**, which supplies initial conditions and lateral boundary conditions for **GEM-MACH**
  - 10-km horizontal grid spacing, 80 vertical levels to 0.1 hPa
  - One-way coupling (meteorology affects chemistry)
  - 2-bin sectional representation of PM size distribution (i.e., 0-2.5 and 2.5-10  $\mu\text{m}$ ) with 8 chemical PM components



- Full process representation of oxidant and aerosol chemistry:
  - gas-, aqueous- & heterogeneous chemistry mechanisms
  - aerosol dynamics
  - dry and wet deposition (including in- and below-cloud scavenging)

# Overview of the Canadian AQ Forecast Program – Model Charts

- Maximum **ozone** near the surface, at 50m and 500m over a 6-hour interval
- **PM<sub>2.5</sub>/PM<sub>10</sub>** near the surface - 6-hour mean
- **4-panel maps** (PM<sub>2.5</sub>, PM<sub>10</sub>, O<sub>3</sub> near the surface, O<sub>3</sub> at 500 metres)
- Products are available over:
  - Eastern Canada; Western Canada and North America



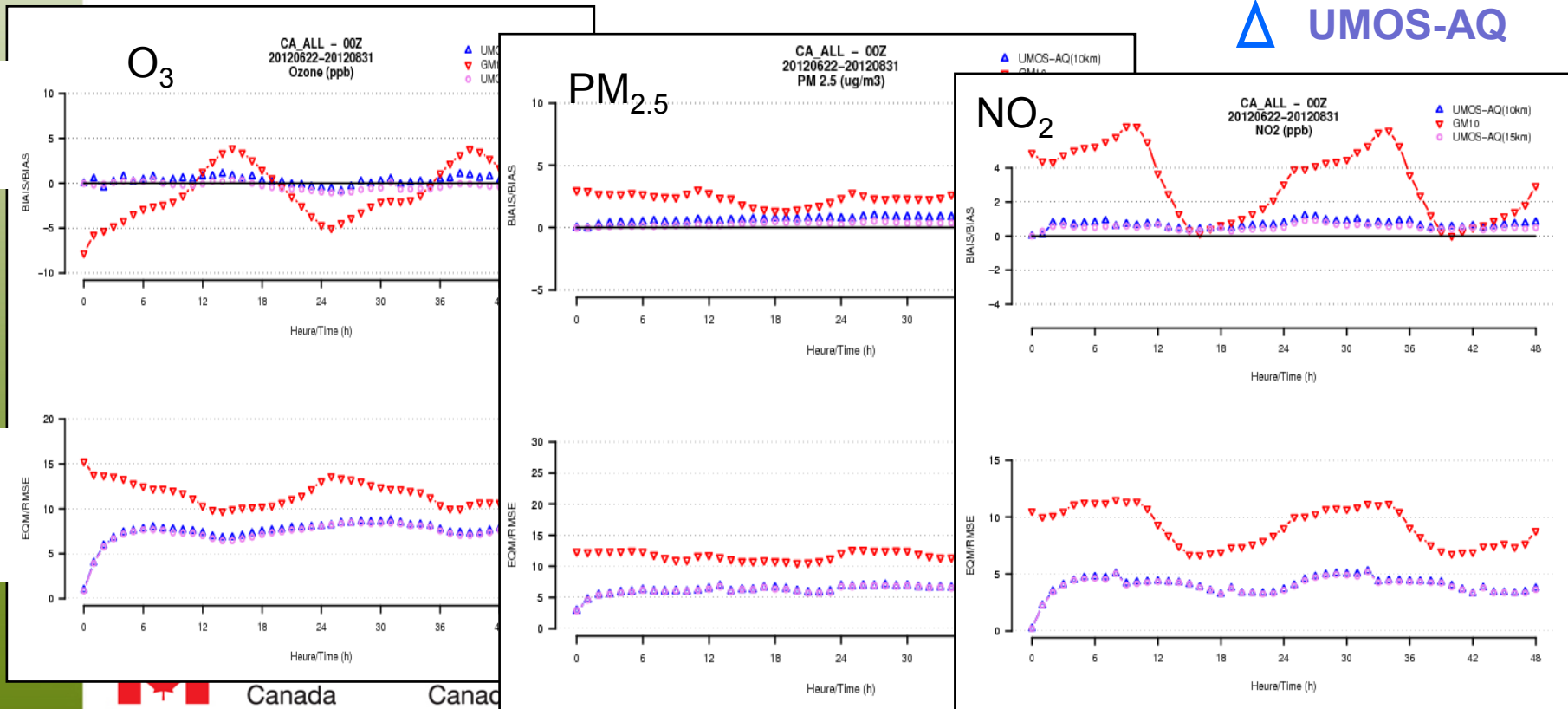
# Statistical Model: UMOS-AQ

- Operational Post-processing applied to GEM-MACH raw model output
- **Reduces model bias and model error at point locations with AQ monitors** through through multi-variate linear regression approach
  - Applied to meteorological variables since 2000
  - Adapted for air quality variables ( $O_3$ ,  $NO_2$ ,  $PM_{2.5}$ ) in 2010
  - Equations are recalculated four times a month

▽ GEM-MACH  
△ UMOS-AQ

BIAS

RMSE

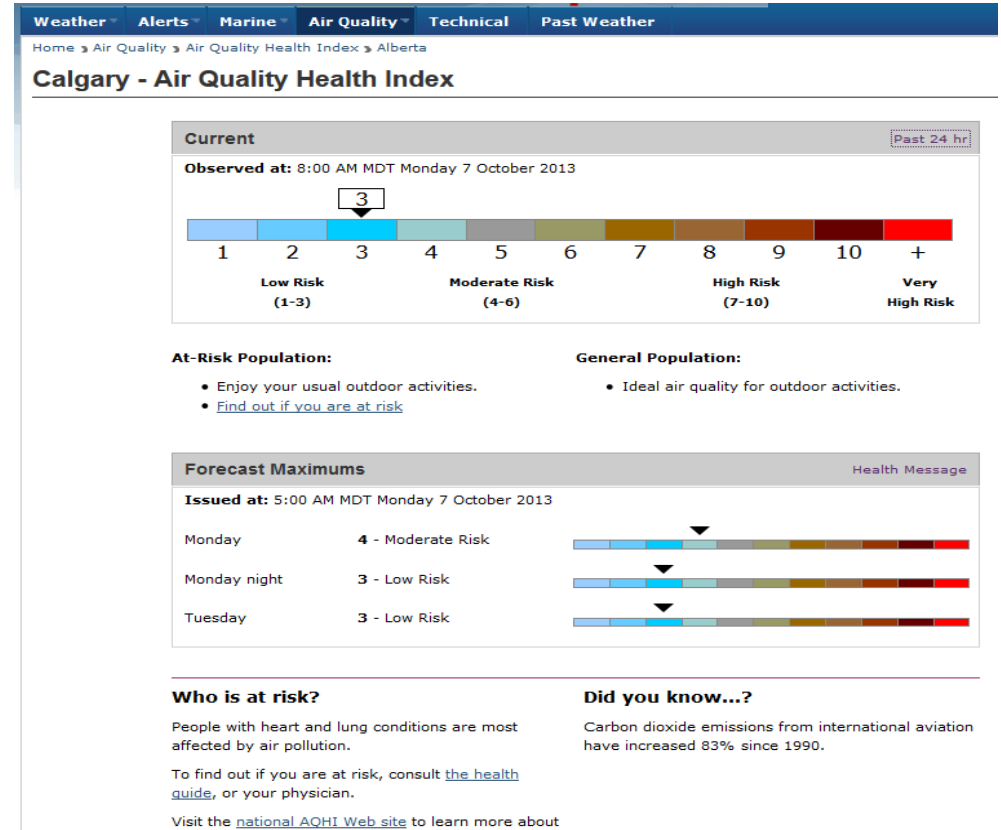


# Products: Air Quality Health Index

Used for public forecasts:

- Multi-pollutant index
- Triggers warnings

$$AQHI_{2.5} = \frac{10}{10.4} * \left[ 100 * \left( \left( e^{0.000871 * NO_2} - 1 \right) + \left( e^{0.000537 * O_3} - 1 \right) + \left( e^{0.000487 * PM_{2.5}} - 1 \right) \right) \right]$$



*Different messaging for at-risk population vs. general population*



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# Products: Forecaster Tools

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- Air quality forecast is prepared for each AQHI community
- Forecasters examine time series of
  - Recent observations
  - Hourly forecasts for the 3 AQHI pollutants ( $O_3$ ,  $PM_{2.5}$ ,  $NO_2$ ), with a 3h running average
    - *From UMOS-AQ*
  - Resulting AQHI
- Additional products are made available to forecasters
  - Internal website with all monitoring sites observations & forecasts
  - Allow investigation of special situations (smoke episode, trans-boundary pollution advection, wildfire smoke dispersion, etc).





# Products: AQHI Forecaster Resource Site

Section des Applications en Modélisation de la Qualité de l'Air (SAMQA)  
Air Quality Modeling Applications Section (AQMAS)

AQHI Resources > Pacific and Yukon 2015-07-29 00 UTC

In case of problems, refer to this document | Français

## Forecast Report

Select month

- Castlegar (JCAAC)
  - Castlegar Zinio Park (103502)
- Central Fraser Valley (JABNO)
  - Abbotsford Airport (101005)
  - Central Abbotsford (101003)
- Central Okanagan (JAFUV) & South Okanagan (JBHUG)
  - Kelowna College (100701)
- Comox (JCJYZ) & Courtenay (JAHUY)
  - Courtenay Elementary School (107100)
- Duncan (JBBWA)
  - Duncan Cairnsmore (104803)
- Eastern Fraser Valley (JCVCC)
  - Chilliwack Airport (101101)
  - Hope Airport (101491)
- Kamloops (JAFNW)
  - Kamloops Federal Building (100491)
- Metro Vancouver - NE (JBXHZ)
  - Coquitlam (100135)
  - Meale Ridge (101501)
  - Pitt Meadows (101202)
  - Rocky R. Park (100111)
- Metro Vancouver - NW (JDATF)
  - Burnaby South (100119)
  - Kensington Park (100110)
  - Kitsilano (100118)
  - Mehon Park (100132)
- Metro Vancouver - SE (JAZBU)
  - Lansey Central (101301)
  - Surrey East (100127)
- Metro Vancouver - SW (JBRBK)
  - North Delta (100125)

## Active Notices

No active notices available

Notice Archive

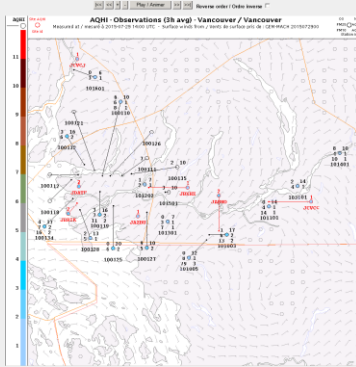
## Surface Field Maps

### GEM-MACH

- NO<sub>2</sub>
- O<sub>3</sub>
- PM<sub>10</sub>
- PM<sub>2.5</sub>
- AQHI<sub>2.5</sub>
- AQHI<sub>10</sub>

### Objective Analysis

- AQHI
- NO
- NO<sub>2</sub>
- O<sub>3</sub>
- PM<sub>10</sub>
- PM<sub>2.5</sub>
- SO<sub>2</sub>



Observation type: Hourly observations Species: AQHI Domain: All locations Location type: Communities Submit

24-hour summary table for (AQHI) generated on: Wednesday July 29 14:55:56 (All times in UTC)

Community	CGNDB	2015-07-29														Current Forecast	Max Obs										
		15	16	17	18	19	20	21	22	23	00	01	02	03	04			05	06	07	08	09	10	11	12	13	14
Castlegar	JCAAC	0.4	0.5	0.5	0.5	3.3	3.6	3.7	1.5	1.5	1.5	1.5	1.4	1.3	1.1	1.0	0.9	0.9	0.9	0.7	0.7	0.6	0.6	0.6	0.5	2	3.7
Central Fraser Valley	JABNO	1.4	1.6	1.6	1.7	1.7	1.7	1.7	1.8	1.9	2.0	2.1	2.1	2.0	1.8	1.8	1.8	2.0	2.1	2.1	2.1	1.9	1.9	1.7	1.5	3	2.1
Central Okanagan	JAFUV	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.8	2.0	2.0	2.0	2.0	1.9	1.9	1.6	1.4	1.3	1.3	1.3	1.2	1.2	1.2	2	2.0
Comox	JCJYZ	0.2	0.2	1.2	1.8	1.7	1.5	1.4	1.4	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.3	1.0	0.8	0.7	0.6	0.6	0.5	2	1.8	
Courtenay	JAHUY	0.2	0.2	1.2	1.8	1.7	1.5	1.4	1.4	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.3	1.0	0.8	0.7	0.6	0.6	0.5	2	1.8	
Duncan	JBBWA	0.7	0.7	0.9	1.1	1.4	1.5	1.7	1.8	2.1	2.3	2.5	2.5	2.3	2.0	1.8	1.6	1.6	1.3	1.0	0.9	0.8	0.7	0.6	0.6	3	2.5
Eastern Fraser Valley	JCVCC	1.2	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2	2.1	2.1	2.0	2.0	1.9	1.9	1.7	1.6	1.4	1.3	3	2.2
Kamloops	JAFNW	1.7	1.8	1.8	1.9	1.8	1.9	1.9	1.9	2.0	2.1	2.1	2.1	2.0	2.0	2.0	1.9	1.8	1.6	1.5	1.4	1.4	1.4	1.5	3	2.1	
Metro Vancouver - NE	JBXHZ	0.8	1.0	1.2	1.5	1.7	1.9	2.0	2.3	2.5	2.7	2.8	2.7	2.5	2.3	2.2	2.1	2.0	1.7	1.5	1.4	1.2	1.2	1.1	1.0	3	2.8
Metro Vancouver - NW	JDATF	1.4	1.5	1.6	1.8	2.0	2.2	2.3	2.4	2.4	2.4	2.4	2.4	2.3	2.2	2.2	2.2	2.1	2.1	2.0	1.9	1.8	1.7	1.6	1.7	3	2.4
Metro Vancouver - SE	JAZBU	1.0	1.1	1.3	1.4	1.5	1.7	1.9	2.1	2.3	2.4	2.4	2.3	2.1	1.9	1.9	2.0	2.1	1.9	1.7	1.6	1.4	1.2	1.1	1.1	3	2.4
Metro Vancouver - SW	JBRBK	1.6	1.6	1.6	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.0	2.0	2.3	2.4	2.5	2.4	2.3	2.2	2.0	1.8	1.6	1.6	1.6	1.6	2	2.5
Nanaimo / Parksville	JAGAL	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.9	2	1.7		
North Okanagan	JBDAP	1.2	1.2	1.3	1.4	1.6	1.7	2.0	2.0	2.0	2.2	2.2	2.1	2.0	2.0	1.8	1.6	1.4	1.2	1.1	1.1	1.0	1.0	1.0	2	2.2	
Prince George	JBLVS	1.4	1.6	1.7	1.8	1.8	1.8	1.8	—	—	—	—	—	—	—	2.2	2.1	1.9	1.8	1.8	1.6	1.5	1.4	1.5	1.5	2	2.2
Quesnel	JBNTS	0.8	1.1	1.2	1.2	1.1	1.0	1.1	1.3	1.4	1.5	1.6	1.6	1.4	1.1	0.9	0.7	0.6	0.5	0.4	0.4	0.3	0.4	0.3	0.6	2	1.6
South Okanagan	JBHUG	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.8	2.0	2.0	2.0	2.0	1.9	1.9	1.6	1.4	1.3	1.3	1.2	1.2	1.2	1.2	2	2.0	
Squamish	JCVJ	0.5	0.6	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.2	2.3	2.4	2.3	2.2	2.0	1.7	1.4	1.2	0.9	0.7	0.6	0.6	2	2.0	
Victoria / Saanich	JBOBQ	0.9	0.9	1.0	1.1	1.3	1.7	1.8	2.0	2.0	2.0	1.6	1.3	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.8	3	2.0	
WestShore	JBLXS	1.1	1.2	1.2	1.4	1.6	1.7	1.9	2.1	2.1	2.1	2.0	1.7	1.5	1.4	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.9	0.9	2	2.1	
Whistler	JCHI	0.5	0.7	0.9	1.1	1.2	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.4	1.3	1.1	1.0	0.9	0.7	0.6	0.5	0.5	2	1.6	
Williams Lake	JBTMB	0.9	1.0	0.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1.4

## Observation Maps

AQHI	Hourly
British Columbia	British Columbia
Vancouver	Vancouver

## Tools

- 24-hour observation summaries
- Monitoring of incoming air quality observations (Not operational)
- Troubleshooting Guide: Procedures for SPCs

## AQHI observation availability for the last 6 months

Site / Month	2015-02	2015-03	2015-04	2015-05	2015-06	2015-07
Castlegar	75%	68%	90%	90%	81%	97%
Central Fraser Valley	99%	95%	99%	97%	98%	98%
Central Okanagan & South Okanagan	32%	88%	88%	90%	86%	86%
Comox & Courtenay	77%	90%	89%	73%	85%	97%
Duncan	77%	94%	87%	95%	85%	96%
Eastern Fraser Valley	99%	95%	99%	98%	96%	98%
Kamloops	80%	91%	87%	85%	80%	89%
Metro Vancouver - NE	99%	95%	99%	93%	99%	98%
Metro Vancouver - NW	99%	95%	99%	97%	99%	98%
Metro Vancouver - SE	99%	95%	99%	97%	99%	98%
Metro Vancouver - SW	99%	95%	99%	97%	99%	98%
Nanaimo / Parksville	79%	84%	89%	78%	82%	96%
North Okanagan	68%	68%	89%	95%	84%	97%
Prince George	79%	87%	86%	91%	79%	94%
Quesnel	80%	88%	29%	68%	79%	97%
Squamish	80%	96%	90%	95%	80%	97%
Victoria / Saanich	73%	95%	90%	93%	85%	97%
WestShore	80%	91%	81%	94%	84%	95%
Whistler	74%	82%	89%	73%	86%	97%
Williams Lake	81%	77%	0%	32%	86%	81%

The target for minimum availability of the AQHI at any site is at least 85%

Good availability >= 95%  
Poor 85% <= availability < 95%  
Insufficient availability < 85%

# OA: Objective Analysis for Surface Pollutants

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- Operational as of February 2013, called RDAQA
- Blends model forecasts with surface observations from Canadian regional networks and the U.S. EPA's AIRNow observation network
  - Using an optimal interpolation approach
  - Knowledge of the errors of model and observation data is applied to weight each input accordingly
- Products available hourly (2x = early and late analyses):
  - Available for : **PM<sub>2.5</sub>, O<sub>3</sub>, NO<sub>2</sub>, NO, SO<sub>2</sub>, PM<sub>10</sub> and AQHI**
  - Analyses are not yet used to initialize GEM-MACH
    - Tests have been made, applying a correlation factor to spread information at the surface into the vertical dimension
    - Results show an improvement in the short-term forecast

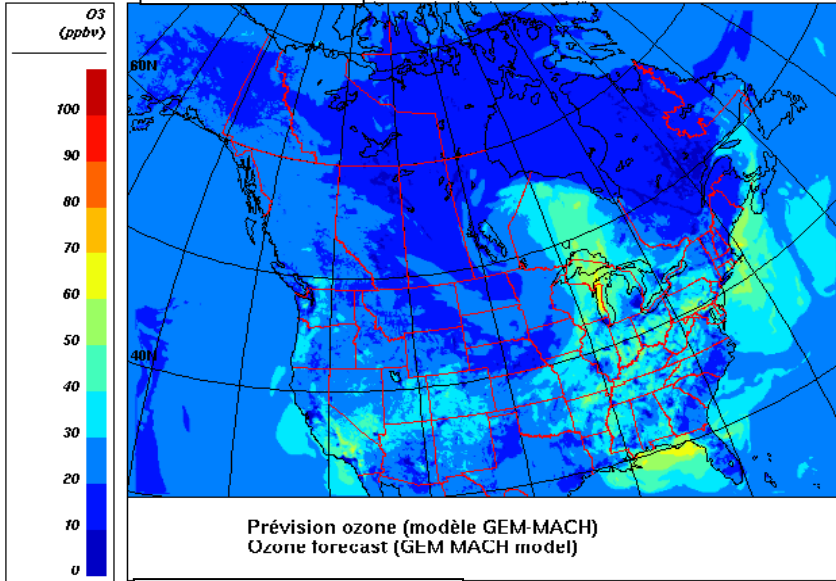




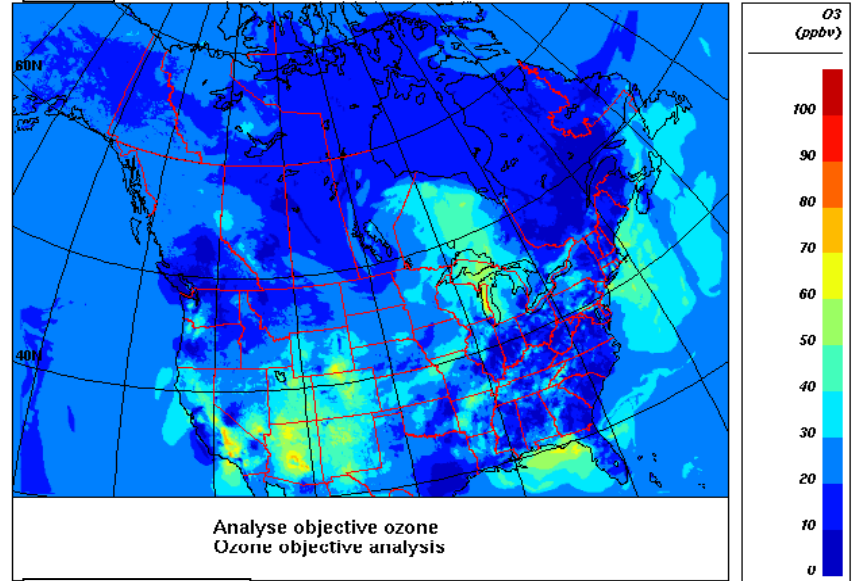
# Example of 4-Panel OA Summary for Wed. July 29, 2015, 08 UTC

Mercredi 29 Juillet 2015 à 08:00Z / Wednesday July 29 2015 at 08:00Z  
Late Analysis

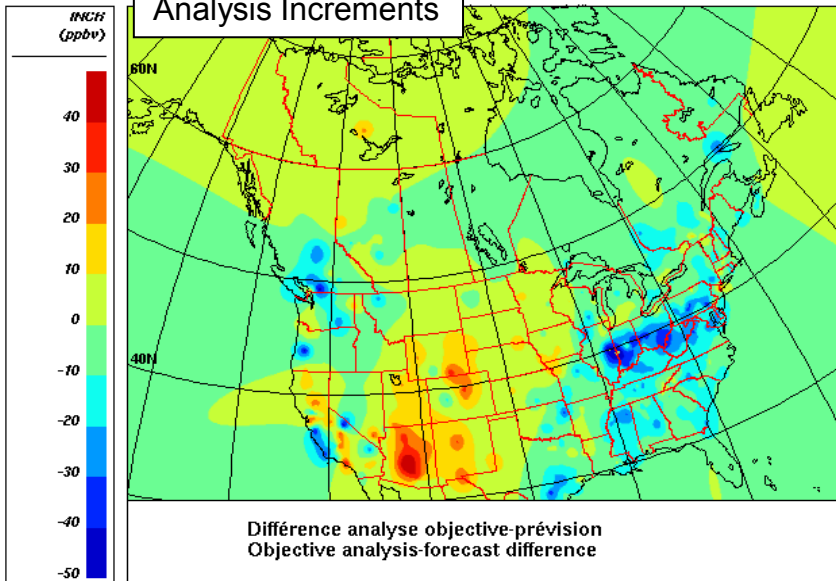
### GEM-MACH



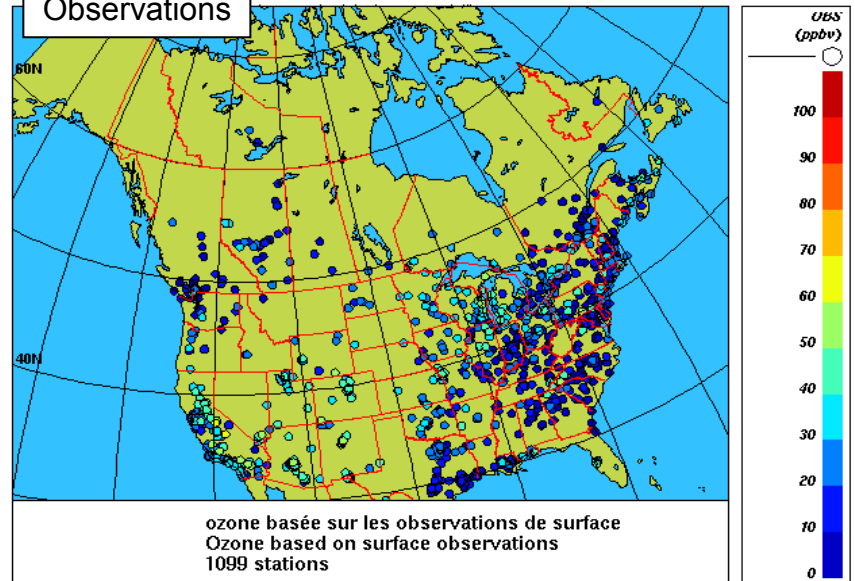
### OA



### Analysis Increments



### Observations



# FireWork System

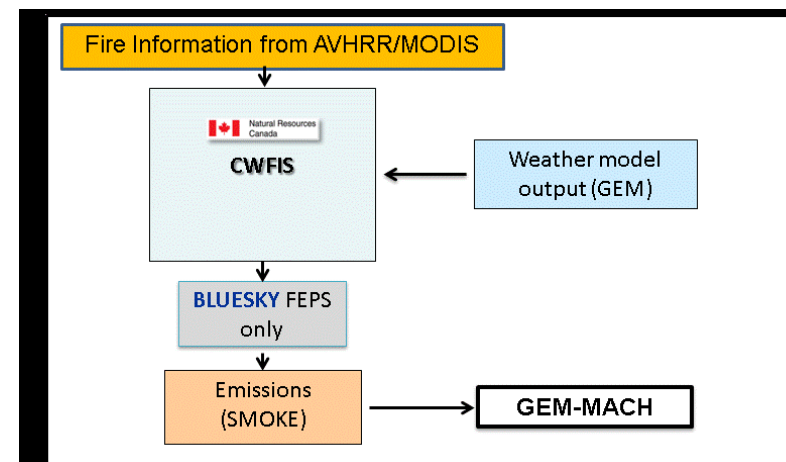


- FireWork has the same configuration as GEM-MACH, the operational AQ model. The only difference is the inclusion of the near-real-time wildfire emissions

- FireWork:
  - Run twice daily (initiated at 00 UTC and 12 UTC)
  - Available at approximately at the same time as the operational model

- Additional products
  - Alternate AQHI based on FireWork
  - PM<sub>2.5</sub>/PM<sub>10</sub> maps and animations based on difference fields (FireWork – GEM-MACH) to isolate plumes
  - Total column PM<sub>2.5</sub>/PM<sub>10</sub> sums
  - Other specialized products available upon request

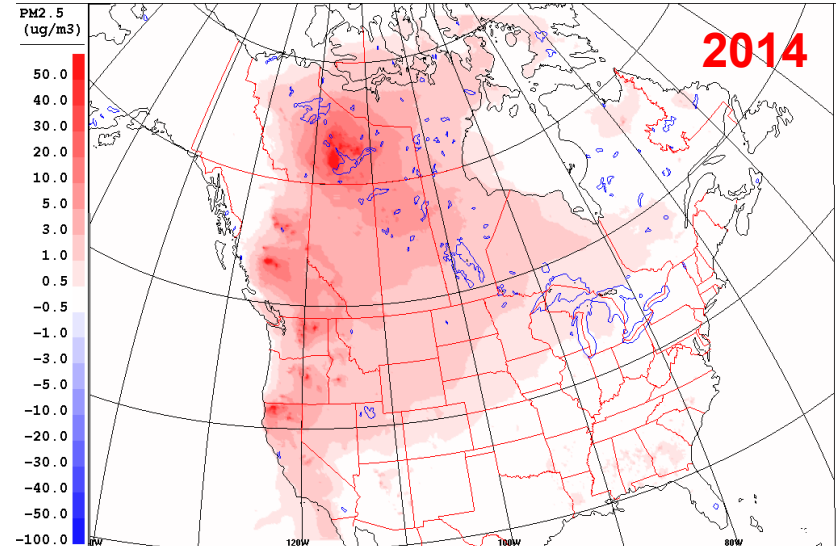
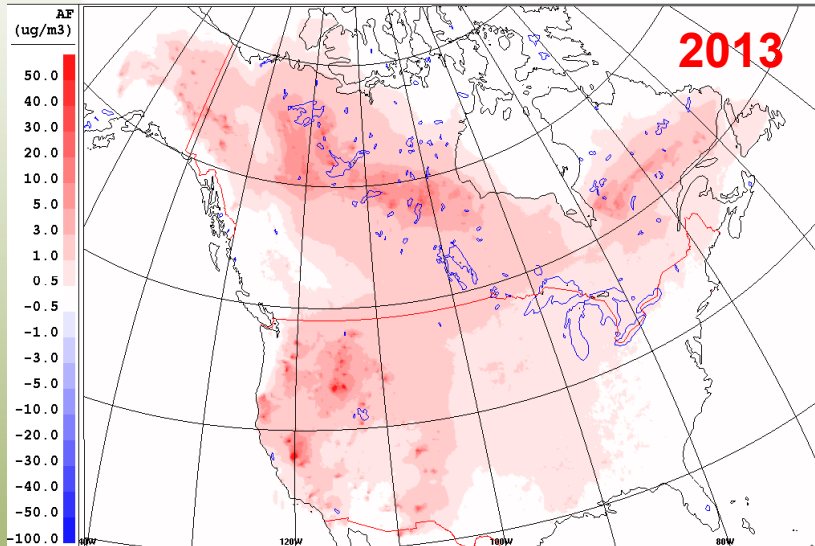
## WildFire Emissions Data



# Why are Wildfire Emissions Important?

Wildfire emissions contribution to average summertime  $PM_{2.5}$  concentrations

Difference: FireWork – GEM-MACH



## Edmonton Example

Bad air quality due to wildfires - August 19<sup>th</sup> 2010



Grant MacEwan  
University



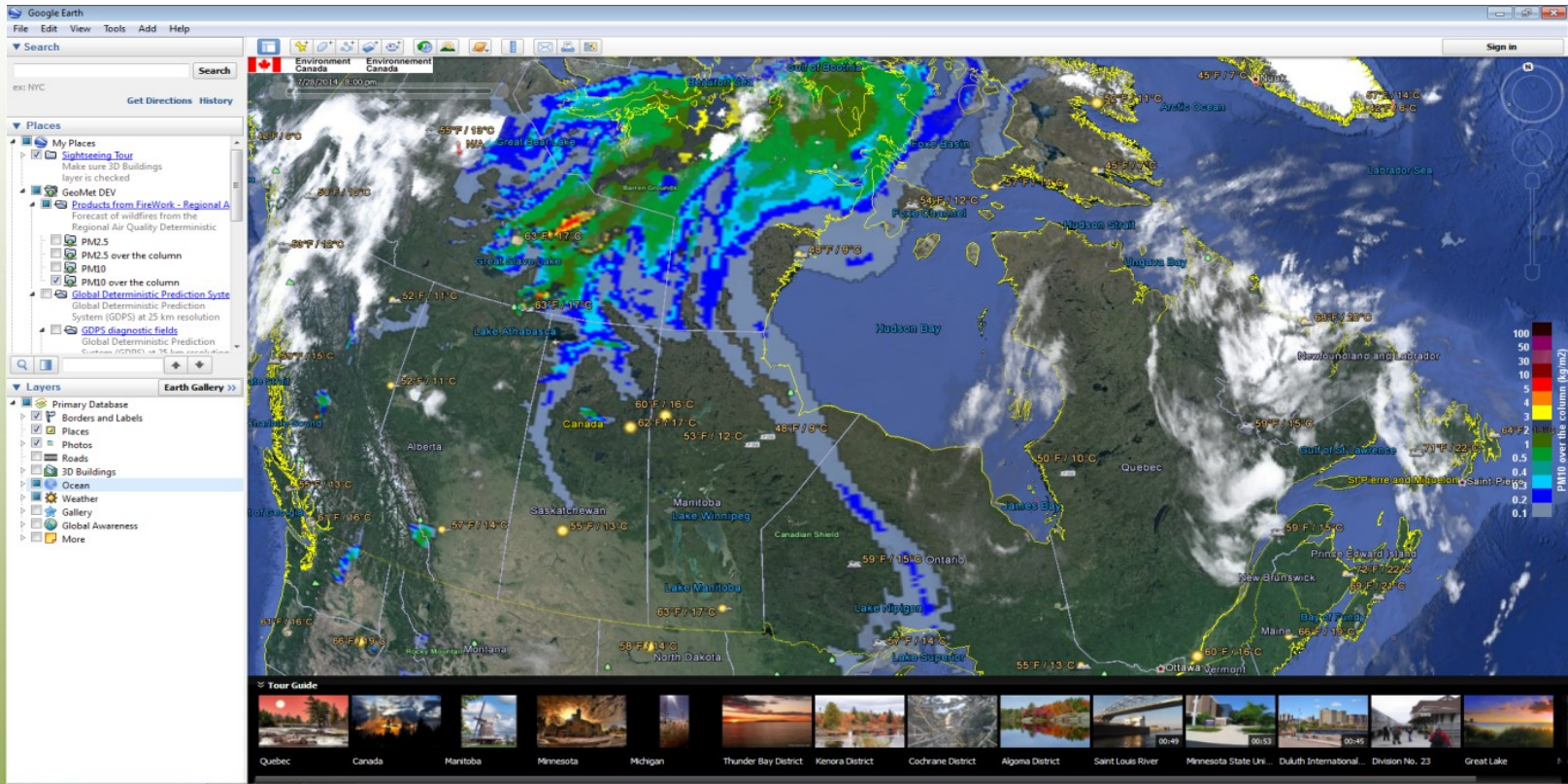
Grant MacEwan  
University

Observed hourly  $PM_{2.5}$  up to  $250 \mu\text{g}/\text{m}^3$





# FireWork forecasts available as WMS/KML layers



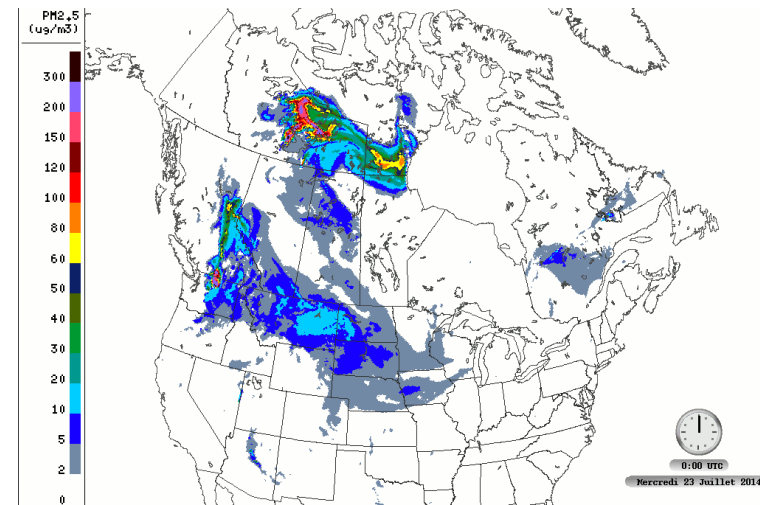
**AQHI FireWork external web page:** <http://collaboration.cmc.ec.gc.ca/cmc/air/FireWork-GEMMACH>

Date de la passe / Run date : 2015-07-30 00:00:00

- Carte des points chauds / Maps of the hotspots
- Sorties PM<sub>2.5</sub> de FireWork-GEMMACH en format geotiff pour l'Alberta et la Colombie Britannique  
FireWork-GEMMACH PM<sub>2.5</sub> output in geotiff format for Alberta and British Columbia
- PM<sub>2.5</sub> à la surface attribués aux émissions de feux de forêt  
Surface level PM<sub>2.5</sub> attributed to forest fire emissions
  - o Animation en un seul fichier  
Single file animation
  - o Moyenne sur 24 heures  
Average over 24 hours
  - o Somme sur 24 heures  
Sum over 24 hours
- PM<sub>2.5</sub> sur toute la colonne attribués aux émissions de feux de forêt  
Total vertical column PM<sub>2.5</sub> attributed to forest fire emissions
  - o Animation en un seul fichier  
Single file animation
- UMO5-AQ/MIST + PM<sub>2.5</sub> à la surface attribués aux émissions de feux de forêt  
UMOS-AQ/MIST + Surface level PM<sub>2.5</sub> attributed to forest fire emissions
- Analyse objective de PM<sub>2.5</sub> issue de FireWork-GEMMACH  
PM<sub>2.5</sub> objective analysis from FireWork-GEMMACH
- PM<sub>10</sub> à la surface attribués aux émissions de feux de forêt

# Summary of FireWork Experience

- Environment Canada developed the capability of including wildfire emissions into air quality forecasts
- FireWork is primarily designed to support meteorologists in issuing AQ forecast and advisories
- EC is willing to share products from FireWork with governmental agencies dealing with wildland fire management
- Based on 2013/2014/2015 FireWork results, we have seen :
  - A significant improvement of  $PM_{2.5}$  forecasts
  - That FireWork is capable of forecasting long range pollution transport from wildfires



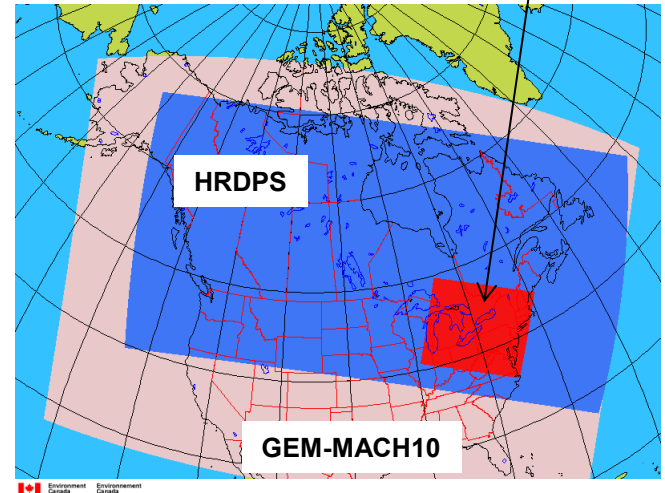
# Fine-Scale AQ Systems: GEM-MACH on 2.5-km Grid for 2015 Toronto PanAm Games

GEM-MACH run at 2.5 km run (June to August 2015) by EC Operations for PanAm games:

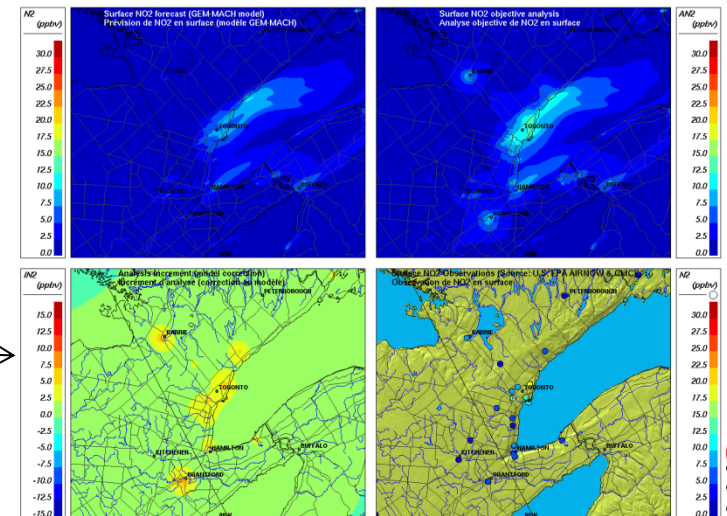
- HRDPS - used as pilot model for meteorology
- GEM-MACH10 - used as pilot model for chemistry

## Products:

GEM-MACH2.5



Jeu 30 Juillet 2015 à 13:00Z / Thursday July 30 2015 at 13:00Z (PANAM GAMES PROJECT)



Forecast Report

Active Notices: No active notices available

Surface Field Maps: GEM-MACH (NO2, O3, PM10, PM2.5, AQHI2.5, AQHI)

Observation Maps: AQHI Hourly (Toronto, Ontario)

Tools: 24-hour observation summaries, Monitoring of incoming air quality observations, Troubleshooting Guide, QA Tools - PanAm Games Dashboard

AQHI observation availability for the last 6 months

Site / Month	2015-02	2015-03	2015-04	2015-05	2015-06	2015-07
Barrie	95%	82%	95%	95%	95%	100%
Brampton	95%	95%	95%	95%	95%	100%
Burlington	95%	95%	95%	95%	95%	95%
Dorset	95%	95%	95%	95%	95%	95%
Hamilton	95%	95%	95%	95%	95%	100%
Hamilton Downtown - Elgin and Kelly	95%	84%	95%	95%	95%	95%
Hamilton Mountain - Vickers and E. 10th	97%	84%	84%	85%	85%	90%
Kingston	95%	95%	95%	95%	95%	100%
London	95%	84%	95%	95%	95%	95%
Mississauga	95%	82%	95%	95%	95%	94%
Newmarket	95%	84%	95%	95%	95%	95%
Oakville	95%	95%	95%	95%	95%	95%
Oshawa	95%	95%	95%	95%	95%	95%
Ottawa & Gatineau	95%	95%	100%	95%	95%	100%
Peterborough	95%	95%	84%	95%	95%	95%
Sault Ste. Marie	97%	95%	95%	95%	95%	95%
St. Catharines	95%	95%	82%	95%	95%	95%
Toronto	95%	95%	95%	95%	95%	100%
Toronto Downtown - Bay and Wellesley	95%	95%	95%	95%	95%	100%
Toronto East - Kennedy and Lawrence	95%	95%	95%	95%	95%	100%
Toronto Island - Hatten's Point	95%	95%	95%	95%	95%	100%
Toronto North - Yonge and Finch	95%	84%	95%	95%	95%	100%
Toronto West - Islington and 401	95%	84%	95%	95%	95%	100%
Windsor	95%	95%	95%	95%	95%	100%
York University - Keele Campus	97%	95%	95%	95%	95%	100%

Legend: Good availability >= 95%, Fair 85% <= availability < 95%, Poor availability < 85%

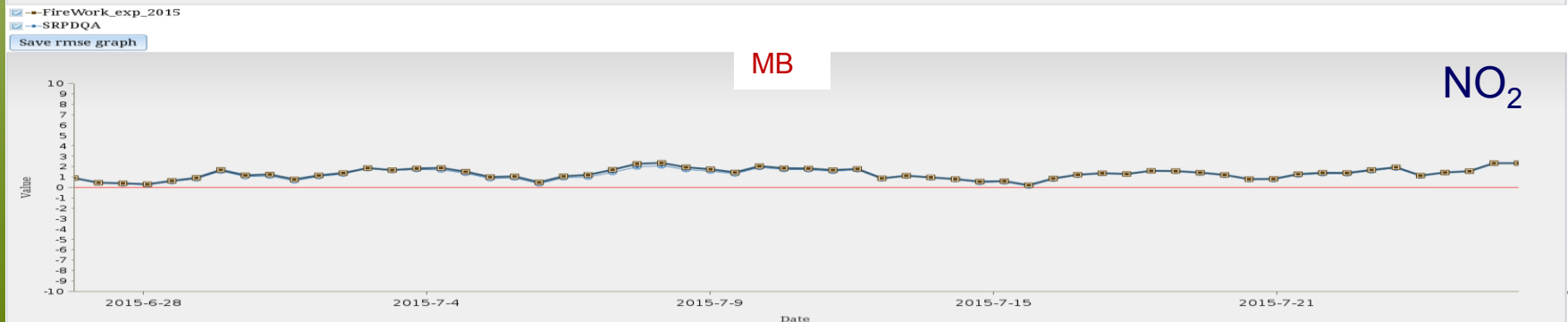
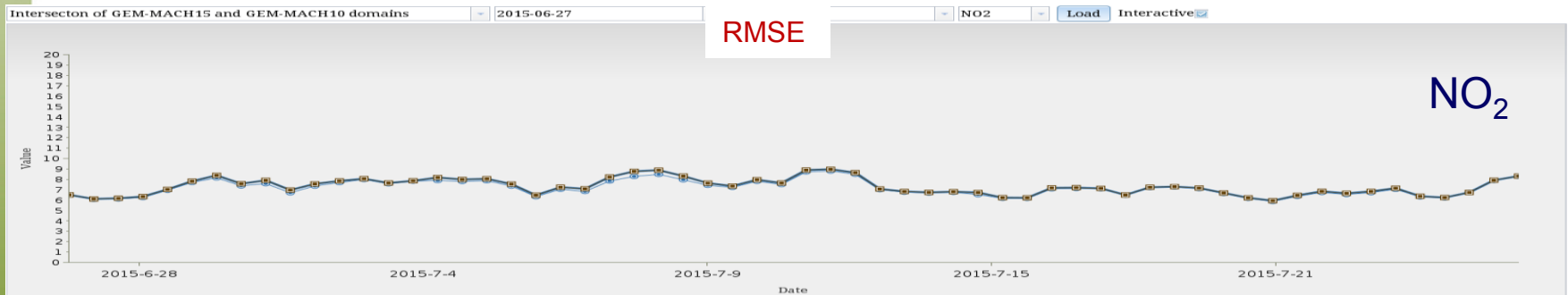


Environment Canada

Environnement Canada

# VAQUM: v erification for Air Q Uality M odels

- Designed a PostGIS database to store AQ observations and corresponding model outputs
  - Can ingest both real time and QC'ed historical datasets
  - Allows to production of various statistics & categorical scores
  - About **1730 stations** (265 CAN, 1465 USA)
  - Collecting data since 2007
- Essential tool to assess the impact of model updates
- Also used to monitor the performance of the operational system



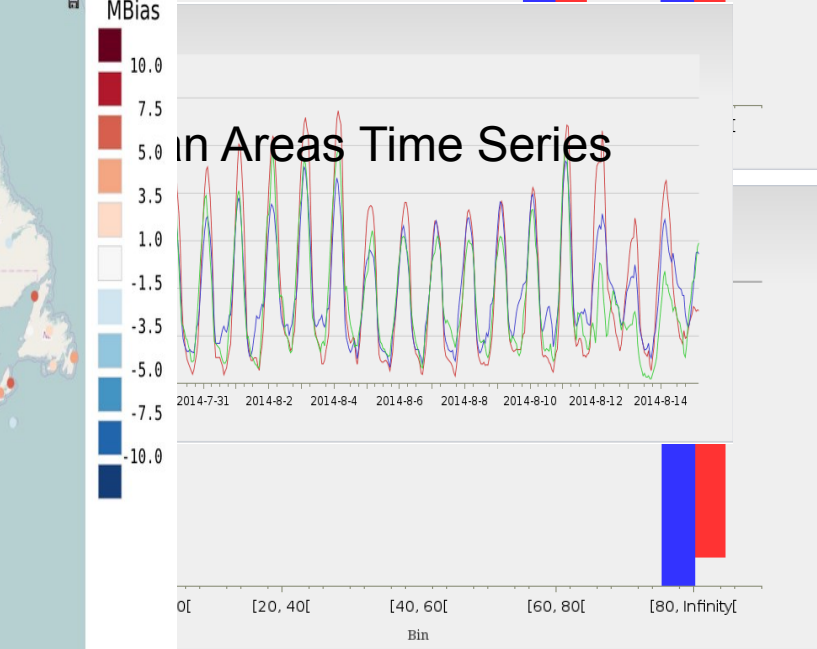
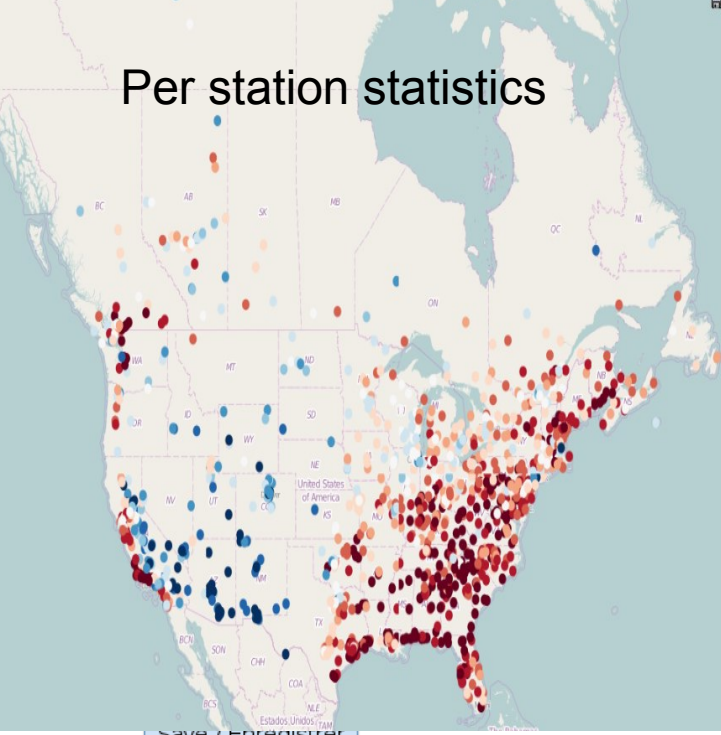
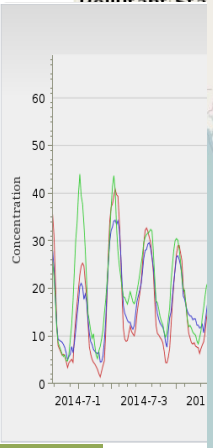


# VAQUM Products

BOOTSTRAPPING		Domaine Complet		Canada		Ouest du Canada		Est du Canada	
Polluant	Statistique	Base	Test	Base	Test	Base	Test	Base	Test

**NO<sub>2</sub> Daily Maximums Statistics**

Region	CAN	ECAN	EUSA	C
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Environment Canada

Environnement Canada



# Short-term Planned Updates of the Canadian AQ Forecast Program

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- RAQDPS

- 1) Piloting by [global model](#)
- 2) **72h forecasts**
- 3) New, [improved GEM](#) version, with mass conservation of tracers
- 4) Updated emissions inventories for Canada, U.S. and Mexico
- 5) Expansion of AQHI program
- 6) Introduction of AQHI+ values in some provinces

- FireWork

- a. Same as 1-4 for RAQDPS
- b. [Status change](#) from experimental to operational or parallel
- c. [Improved plume-rise algorithm](#) applied to wildfire smoke dispersion
- d. Improved wildfire emissions estimates



# Possible Future Directions

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- Updated or new AQ process representations
- Improved chemical lateral boundary conditions from global GEM-MACH
- Chemical data assimilation to initialize GEM-MACH?
- Benefits of higher-resolution deterministic AQ systems?
  - Tested for 2.5 km for PanAm Games
- Ensemble AQ systems?
- Activating AQ feedbacks to meteorology? (longest term)



# AQMAS Team

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# Post-Processing (AQHI)

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## UMOS-AQ

- Operational Supported (since July 2010)
- Based on linear statistical methods
- Adaptive methods for season and model transitions

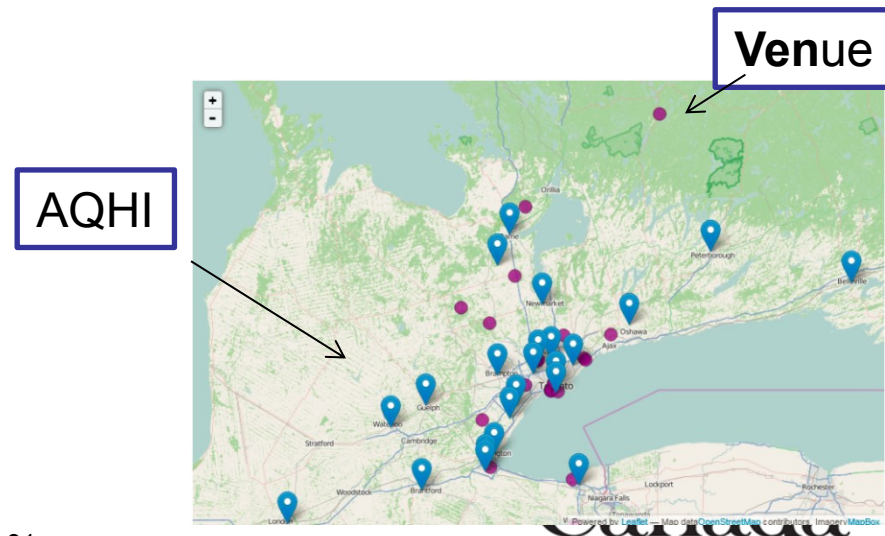
## XM-Tool

- Experimental Products and Infrastructure
- Broad suite of statistical tools and additional predictors
- Alternative statistical methods
- XM\_MLR, RandomForest, and Kalman filter used to support PanAm Games forecasts



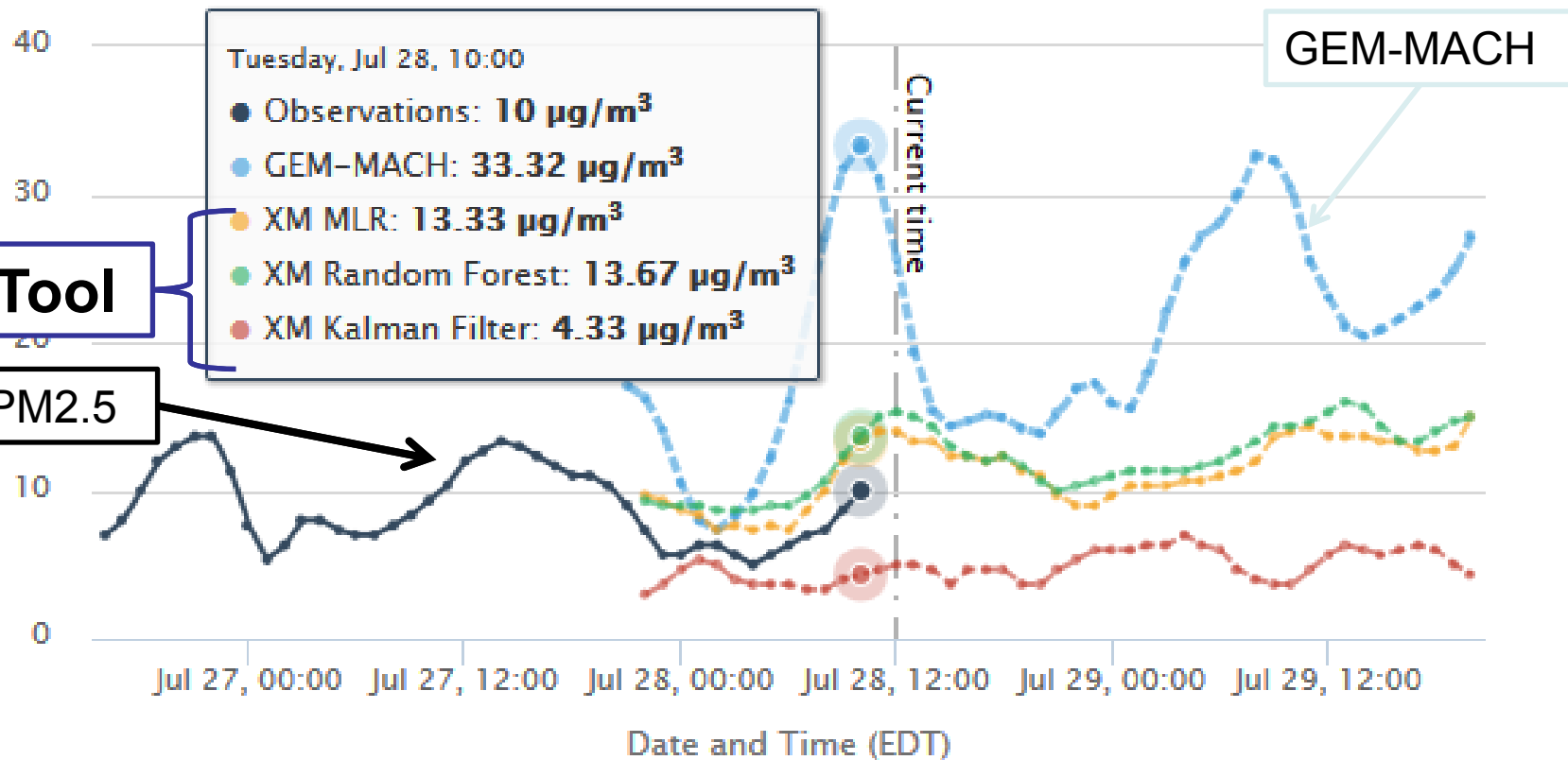
# Pan Am ... XM-Tool Demonstration

- Air Quality Health Index Forecasts for AQHI sites and sport venues
- Forecasts for GM2.5 and GM10km
  - Twice daily
- Three new Post processing techniques to supplement UMOS-AQ from GM 10km
  - xm\_MLR;
  - xm\_RF,
  - xm\_KF

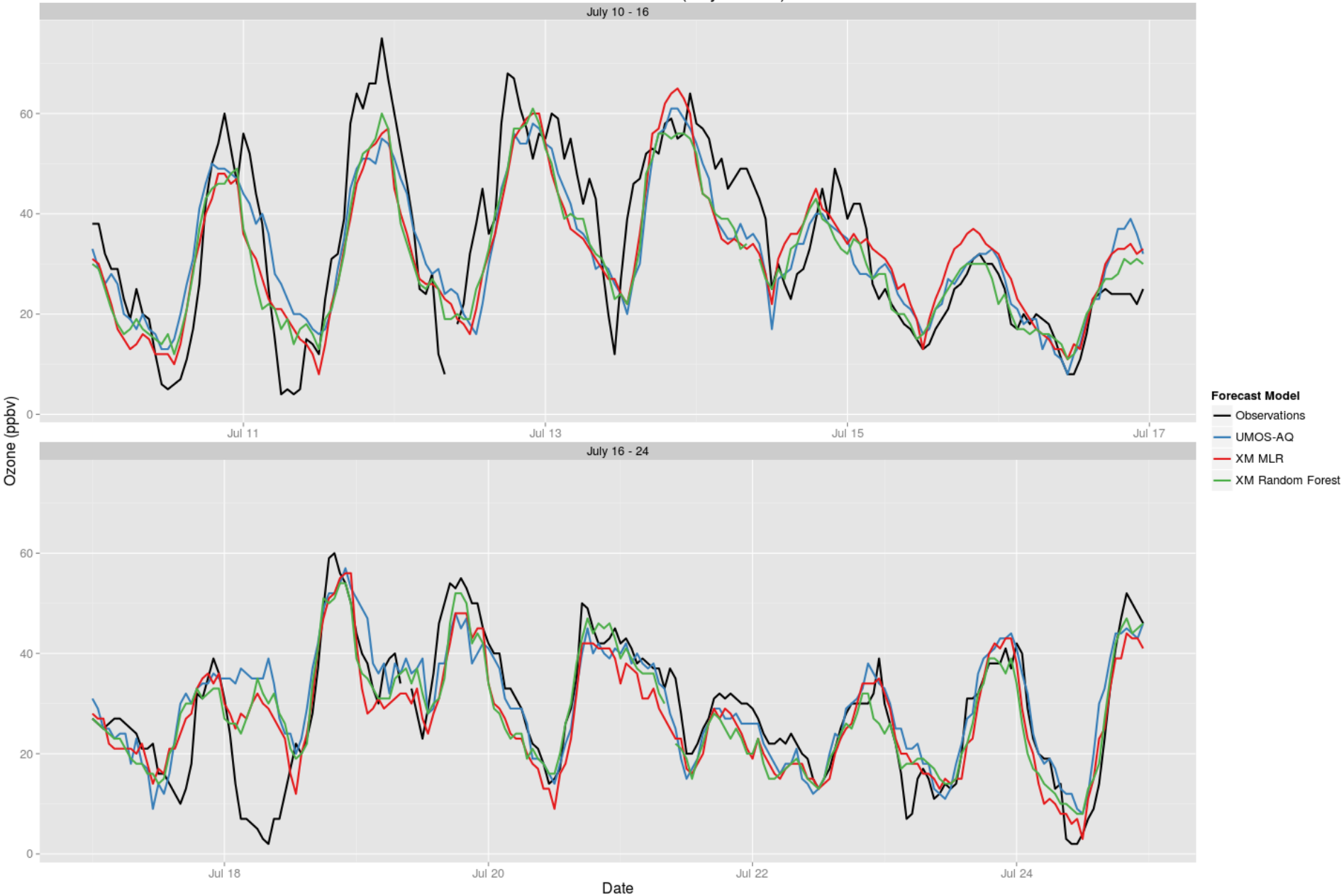


# XM-Tool (2015 PanAm Demo)

## 3-Hour Rolling Mean PM<sub>2.5</sub> Observations and Forecasts



# XM-Tool Pan Am Timeseries (July 10 - 24)





# THANK YOU

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