Weather and Health Portfolio for the 2015 Pan and Para Pan Am Games

Approach, Legacy & Lessons Learned

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Context

• Opportunity presented in December 2012 to contribute to the MSC Pan Am Agenda

• Weather and health portfolio was an umbrella for a range of activities encompassing areas of interest to partners
  – Combination of deliberate planning, adapting initiatives of interest to clients and opportunism
  – “what can we do to position the program for the future”

• Involvement in MSC Pan Am Working Group Activity (Science, Prediction and Services and Monitoring)
Why a Weather and Health Partnership

• Working with health partners allows the MSC to:
  – to acquire legitimacy and support in issuing health-related warnings
  – better understand their decision-making processes and their unique nature
  – Impact capabilities and capacity for longer term collaboration

• Leverage efficiencies of expertise and investment in weather forecasting, data management and warnings dissemination

• Pan Am is a demonstration opportunity to show what we all do best and how we collectively contribute to the goal of enhanced public safety
Weather and Health Portfolio

• Showcase of MSC Weather and Health Portfolio

  1. Service enhancement (existing services)
     ▪ Operational
     ▪ Reliance on the OSPC/Service for delivery of enhanced service

  2. Demonstration projects
     ▪ Catalyst for showcasing partnerships, expertise and technology of relevance to setting future directions
     ▪ Integrate/exploit other EC program directions
     ▪ Not operational
     ▪ Public Health as the primary client (Education as a secondary)
     ▪ Look for legacy opportunities but not at the expense of expectations for continuance post-Fall 2015
     ▪ No or minimal impact on the operations of the OSPC

  3. Evaluation
## Pan Am Weather And Health Portfolio

<table>
<thead>
<tr>
<th>Theme</th>
<th>Activity</th>
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</table>
| **Air Quality**    | Increase number of AQHI locations and provision of hourly forecasting for all locations and communities  
Enhancing AQHI model resolution (GEM-MACH 2.5 km)  
Firework: forest fire smoke modeling maps  
Air Sensors for Chemicals in the Environment (AirSENCE)  
Near Roadside Monitoring Study  
Web-based mapping for traffic related air pollution and route planning  
AQHI implementation in Ontario ... Pan Am driven |
| **Heat**           | Multi-parameter weather monitoring network (mesonet)  
Urban-scale heat, humidity and stress indices predictions  
Urban Heat Island/Population vulnerability mapping  
Implementation of new health-based-criteria for Heat Warnings |
| **UV**             | Enhanced and geospatially presented UV forecasts  
Investigation of cost-effective, real-time UV monitors  
Pilot warning with health stakeholders |
| **West Nile Virus**| Weather prediction to improve modelling estimates of risk |
| **Education**      | OAGEE Pan Am Summer Institute on Weather and Health |
| **Dissemination**  | Weather Active - Heat and AQ smart phone application  
Weather.GC.CA, EC Alert Me WISDOM |
| **Decision Support**| Heat Warning and Information System Service Scenario Exercise  
Weather health Information System for Decision Optimization Management (WISDOM) |
Partners/Collaborators

• Internally
  – Central (Ontario and Quebec), Pan Am Secretariat and AQ & Health Signature Project Team
  – S&T (AQRD, AQMAS, RPN, NAPS, etc…)
• The Province of Ontario
  – Ministry of Environment and Climate Change, Ministry of Health and Long-Term Care and Public Health Ontario
• Health Canada (Climate Change and Health and Air Health Affects)
• 10 Public Health Unit in the Pan Am Games area
  – Toronto and KFL&A Public Health in particular
• University of Toronto, York University, Waterloo University
• Toronto District School Board and ESRI Education
• Ontario Association of Geographers and Environmental Educators
• Ontario Sun Safety Working Group
Pan Am AQHI Service

- Implementation of the AQHI for Games
- 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

This table shows a provincial summary of current Air Quality Health Index (AQHI) levels.

<table>
<thead>
<tr>
<th>Location</th>
<th>Current</th>
<th>At-Risk Population</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Enjoy your usual outdoor act</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Find out if you are at risk</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Date / Time (EDT)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 June 2015</td>
<td></td>
</tr>
<tr>
<td>01:00</td>
<td>3 - Low Risk</td>
</tr>
<tr>
<td>02:00</td>
<td>3 - Low Risk</td>
</tr>
<tr>
<td>03:00</td>
<td>3 - Low Risk</td>
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<tr>
<td>04:00</td>
<td>2 - Low Risk</td>
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<tr>
<td>05:00</td>
<td>2 - Low Risk</td>
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<tr>
<td>06:00</td>
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<td>07:00</td>
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<tr>
<td>08:00</td>
<td>3 - Low Risk</td>
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<tr>
<td>09:00</td>
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<tr>
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<tr>
<td>11:00</td>
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<td>12:00</td>
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<td>13:00</td>
<td>2 - Low Risk</td>
</tr>
<tr>
<td>14:00</td>
<td>2 - Low Risk</td>
</tr>
<tr>
<td>15:00</td>
<td>2 - Low Risk</td>
</tr>
</tbody>
</table>

**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 Canada.

**Did you know...?**

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

- Working with Health Canada, the province of Ontario and 36 Public Health Units to harmonize heat warnings and communications in Ontario
- Ontario Service and OSPC support Implementation around Pan Am 2015 with provincial rollout for Spring 2016
- Early notification, SWS (first event), Warning and De-escalation of Warnings

<table>
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<tr>
<th>Heat Warning Region</th>
<th>Condition</th>
<th>Duration</th>
</tr>
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</table>
| Region 1            | *\(T_{\text{max}} \geq 31^\circ\text{C}\) and \(T_{\text{min}} \geq 21^\circ\text{C}\)  
                    | OR \(\text{Humidex} \geq 42\)                     | 2+ days  |
| Region 2            | \(T_{\text{max}} \geq 31^\circ\text{C}\) and \(T_{\text{min}} \geq 20^\circ\text{C}\)  
                    | OR \(\text{Humidex} \geq 40\)                     | 2+ days  |
| Region 3            | \(T_{\text{max}} \geq 29^\circ\text{C}\) and \(T_{\text{min}} \geq 16^\circ\text{C}\)  
                    | OR \(\text{Humidex} \geq 36\)                     | 2+ days  |
AirSENCE (Air Sensor for Chemicals in the Environment)

- U of Toronto initiative
- Endorsed by the AQHI program in 2012 (part of Allergen Research Program)
- EC investment (2013-2014) investigating small sensor/battery technology
- 5 additional sensors for Pan Am… real-time data AQHI and pollutant data…
- Web accessible
Portable and Low-cost Air Quality Monitoring Device

Figure 1: Box plot comparison of NO\textsubscript{x} measured by AirSENCE and reference instruments beside a major highway and in downtown Toronto.

Figure 2: 1-minute averaged CO measured with AirSENCE and Reference instruments over a typical day in downtown Toronto.

Figure 3: 1-minute averaged NO\textsubscript{x} and O\textsubscript{3} measured by AirSENCE in Beijing at Peking University.

Figure 4: Conditional quantile: the median, 10\textsuperscript{th}, 25\textsuperscript{th}, 75\textsuperscript{th}, and 90\textsuperscript{th} percentile of AirSENCE O\textsubscript{3} and NO\textsubscript{x} values are plotted against reference values. The blue histogram is for reference values and the grey histogram is AirSENCE.
Testing Small UV Sensors

- Four Kipp and Zonen UV sensors were deployed for the Games
- UVA & UVE
- Reporting real-time UV
- Used to validate new UV modeling
Pan Am Games Summer School on Weather and Health

- July 6-10th in Toronto
- 25 teachers (international participation from Hong Kong)
- Jointly organization with the Ontario Association of Geographers and Environmental Educators (OAGEE), ESRI Canada and O
- Air Quality, Heat Health risks, UV with focus on GIS technique
- Follow-up presentations at OAGEE AGM in the Fall 2015
- Day at Downsview (Pan Am Science presentations) and other field trips
- Excellent feedback
WISDOM
Weather and health Information System for
Decision Optimization and Management

- Developed in collaboration with Kingston Frontenac Lennox and Addington Public Health
  - Based on PHIMS (Public Health Information Management System)
- Common Operating Picture – Situational awareness tool for environmental risks related to public health
  - Custom ESRI GIS platform
  - Responsive design
  - Password protected
- Integration of monitoring/prediction with health outcomes
- Provinces interested in health awareness platforms for real-time, static and predictive spatial data
- Integration with EC Alert Me … “the tap on the shoulder”
How does it support decision process?

**Values:**
1. Feedback based
2. User Centered
3. Comprehensive
4. Well documented
5. Spatially driven

**Vision:** Every Public Healthworker seeing the value in the demonstration data products shown through WISDOM

**Mission:** To be the most cutting edge and user friendly spatial decision environment for Public Health

**Strategy:**
1. Obtain access to the demonstration and operational data users want
2. Make the system intuitive enough that users can make informed decisions on their first use
Data In WISDOM: Focus on the geospatial

- The value of our MSC geomet service can not be understated
- Operational (available to public or used operationally)
  - Real time Heat (temperature, humidity), AQI, AQHI, heat indices, Firework, radar and CMC operational GEM and GEM-MACH 10km
  - Warnings and Special air quality/weather statements
- Socio-economic and psycho-social static data
  - To support interventions with vulnerable populations
- Showcase products (demonstration of capability, etc)
  - Mesonet weather network (60 stations)
  - Urban scale model output of heat stress indices
  - Urban Heat Island and vulnerability mapping
  - High resolution GEM-2.5
  - Real-time UV, new UV forecasting
- PHU infrastructure (e.g., daycares, cooling stations, etc)
AQHI Modeling (2.5km) and AQHI Readings and Forecasting
FireWork: Surface Concentrations of Wildfire Smoke
UV All Sky Model and New Sensors
Urban GEM Temperature (250m) and Mesonet
Historical Record Through FRODO
Heat Vulnerability Mapping
Socio Economic/Population Vulnerability
Evaluation

• Establish baseline understanding of decision making of PHUs
• Focus is on the value of partnerships and service
  – Assessing the value of
    ▪ the service offerings;
    ▪ products available through WISDOM; and
    ▪ the value in spatially presenting forecasts and supporting data
• Surveyed Public Health Units between the Pan and ParaPan Am Games on the heat and use of WISDOM
• Followed with interviews/discussions and formal survey process in the case of heat service
How did we do

• Accomplished every activity within the portfolio
• WISDOM had a 98.5% uptime performance during the Games
  – geomet service reliability improved throughout
• Accomplished our primary goal of enhancing our relationship with health partners in the Games area
• Anecdotal comments on the value of WISDOM and elements of the portfolio varied
  – Larger health units (with resources) found significant value and support for decision making
  – Smaller units were a bit overwhelmed
  – Many unexpected surprises
Pan Am Legacy

- Presentation WWOSC (August 2014)
  - *Managing heat health hazards in a climate of change: Mitigating risks for extreme weather in preparation for the Pan Am Games*

- Presentation - Toronto Public Health Forum (March 2015)
  - *Real-time, predictive mapped weather data: innovations to protect vulnerable people during extreme temperatures*

- Presentations to the AMS Conference (January 2016)
  - *Extreme Temperatures TO2015 Pan Am Games: Heat Stress Impacts*
  - *Heat Health Warning Systems in Canada: Development, Implementation and Assessment*

- Special Session on Weather and Health at CMOS in Fredericton

- In Progress
  - Story Board for Health and Weather Pan Am data – developed with ESRI Education
  - Case Study of the Ontario Harmonized Heat Warning and Information System
Pan Am Emerging Legacy (cont)

• New service offerings for AQHI and Heat Warnings
• Contributions to the Pan Am Legacy Dataset
• Contribution to the MSC Games Report
• Working with researchers on health and AQ studies (Texas Tech, Toronto Public Health, KFLA and U of T)
• Better understanding of weather and health linkages in Ontario schools
• Test-bed to develop and test the revitalization of a UV index program
The Value of the Games

- Externally, by capitalizing on the opportunity of the Games we:
  - Confirmed the power of partnerships
  - Encouraged partners to implement or risk in piloting new services
  - Used as a springboard for the propagation of national service offerings
  - Leveraged resources from other partners
  - Demonstrated to partners cutting edge science/modeling and monitoring
  - Better understood client needs/decision-making
  - Saw the “Knock on effect” … partners collaborating independently
• Internally, development and execution of the Health Portfolio:
  – Allowed us to partner with our colleagues in an overall impressive MSC effort
  – Elevated the profile of a relatively young service
  – Opened the door for subsequent, numerous internal collaborations
  – Allowed us to test some impressive technology as support for possible new service directions
THANK YOU

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