

# Clearing the Air: Air Quality Health Index Application, Limitations, Challenges

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AQHI Management Committee 2001 - present



# Objectives

- Introduce the National AQHI vision, background and progress
- Discuss the characteristics and functionality of the AQHI
- Discuss learnings of the pilot projects
  - limitations
  - challenges
- Present next steps in the National and BC context



# Vision for an Improved AQI

- **Best indicator of current and forecasted levels of health risk attributable to common air pollutants**
- **Public would be aware of and trust the information and be able to use it to protect themselves or those in their care**
- **Contribute to the public's understanding of air pollution health effects and actions to limit the effects**



# Vision for an Improved AQI

An improved AQI would be characterized by:

- **Transparent, updated and trusted**
- **National in character and coverage while accommodating regional flexibility**
- **Health-science based**
- **Communications tool (developed to inform as a basis for action)**
- **Simplified**
- **Current**
- **\*Include relevant pollutants**
- **\*Flexible**
- **\*Uniform**

\* added since 2002



# PM and Ozone usually drive the AQI

- Currently under the AQI formulation

- Ozone – national

80 ppb ozone (1hr. av.) = 50

## PM at various jurisdictional values.

Quebec/Montreal

35 ug/m<sup>3</sup> PM<sub>2.5</sub> (3hr. av.) = 50

Ontario

45 ug/m<sup>3</sup> PM<sub>2.5</sub> (3hr. av.) = 50

Alberta

80 ug/m<sup>3</sup> PM<sub>2.5</sub> (1hr. av.) = 50

British Columbia/GVRD

50 ug/m<sup>3</sup> PM<sub>10</sub> (24hr. av.) = 50

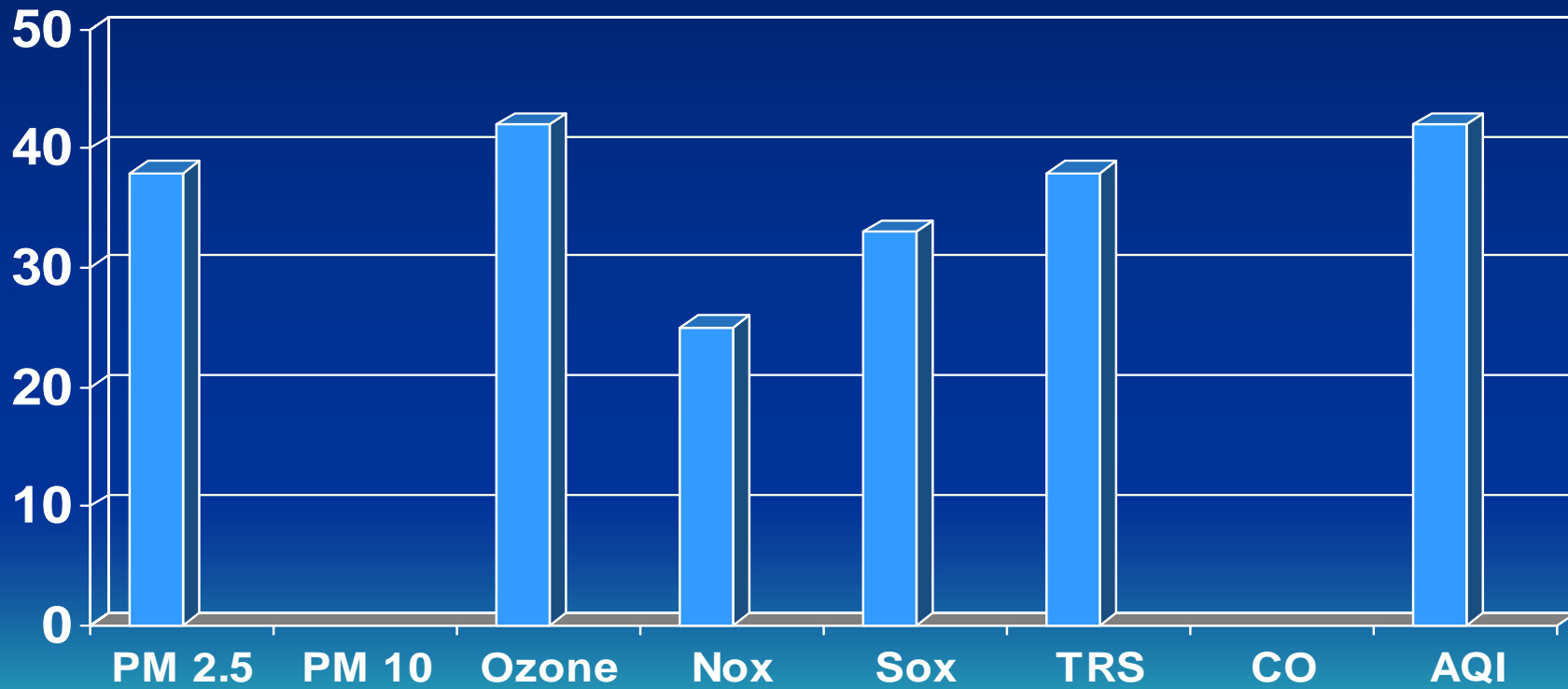
Atlantic Provinces, Man. & Sask are all examining Quebec formula

- Jurisdictions currently reporting daily AQIs with PM<sub>2.5</sub> included, Montreal, Quebec, Ontario and Alberta.
- BC reports based on PM<sub>10</sub>



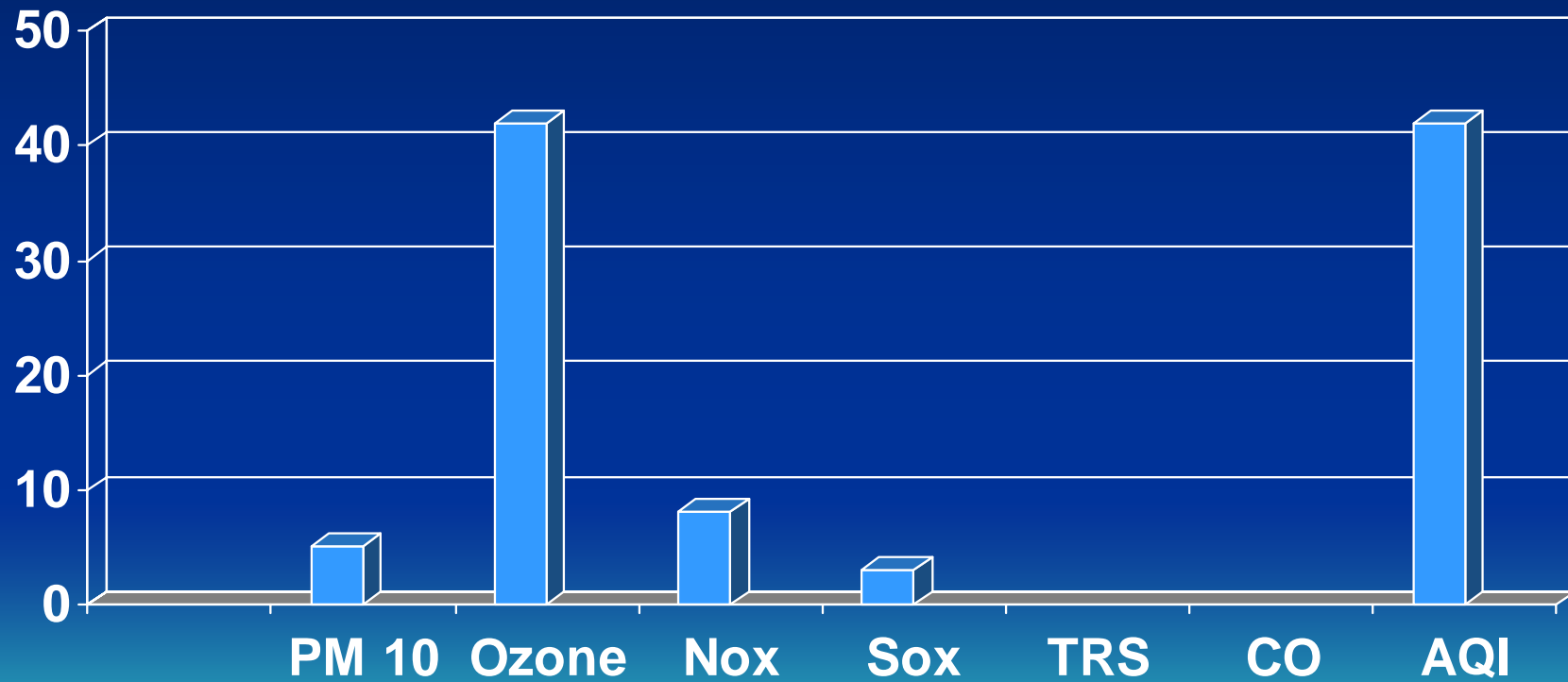
# Example 1

## Dirttown



# Example 2

## Cleantown



# Development of AQUI Numeric Scale Using Historical Data

Mortality risk coefficients from epidemiological studies

Air pollution, mortality data for multiple cities, for reference period 1998-2000



Multiply mortality risk coefficients by daily air pollution concentrations = percent change in mortality



Create distribution of days according to percent change in mortality



Adjust values to 0-10 scale



Multiple health risk coefficients by daily air pollution concentrations, adjust to 0-10 scale; value > 10 means it exceeds all values in 1998 – 2000 reference period \*

\* Application to current data to calculate index value



# Step 1

- take from Burnett et al. 2000 the slope relating each of the 5 pollutants to mortality

From 2002 Workshop – Details have changed

**TABLE 8.** Percentage Increase in Daily Filtered Nonaccidental Deaths Associated With Increases in Daily Filtered Air Pollution Concentrations in Single and Multiple Pollutant Model Specifications, Controlling for Weather Variables

| Pollutant <sup>a</sup><br>(units)         | Mean<br>concentration | Single-pollutant<br>model | Multiple-pollutant models |                 |
|---|-----------------------|---------------------------|---------------------------|-----------------|
|   |                       |                           | Model I                   | Model II        |
| PM <sub>10</sub> (µg/m <sup>3</sup> )     | 25.9                  | 1.9 (2.8) <sup>b</sup>    | NA <sup>d</sup>           | NA              |
| PM <sub>2.5</sub> (µg/m <sup>3</sup> )    | 13.3                  | 1.6 (3.1)                 | 1.0 (2.9)                 | NA              |
| PM <sub>10-2.5</sub> (µg/m <sup>3</sup> ) | 12.6                  | 0.9 (1.4)                 | 0.6 (1.6)                 | NA              |
| O <sub>3</sub> (ppb)                      | 31                    | 3.4 (2.6)                 | 1.6 (3.4)                 | 2.0 (3.2)       |
| NO <sub>2</sub> (ppb)                     | 22                    | 3.9 (3.0)                 | 1.1 (3.2)                 | 1.2 (2.7)       |
| SO <sub>2</sub> (ppb)                     | 4.7                   | 1.1 (1.6)                 | 0.7 (2.1)                 | NA <sup>c</sup> |
| CO (ppm)                                  | 0.9                   | 2.1 (2.1)                 | 0.7 (1.9)                 | 0.7 (1.7)       |
| SO <sub>4</sub> (µg/m <sup>3</sup> )      | 2.6                   | 1.2 (3.5)                 | NA                        | 1.3 (3.5)       |
| Zn (µg/m <sup>3</sup> )                   | 0.0258                | 0.8 (2.4)                 | NA                        | 0.8 (2.1)       |
| Ni (µg/m <sup>3</sup> )                   | 0.0016                | 0.7 (1.8)                 | NA                        | 0.8 (1.9)       |
| Fe (µg/m <sup>3</sup> )                   | 0.0812                | 1.2 (2.3)                 | NA                        | 0.8 (1.8)       |

B

A

A ÷ B

|                 | CO           | NO2          | O3           | SO2          | PM2.5        |
|-----------------|--------------|--------------|--------------|--------------|--------------|
| <b>Slopes</b> → | <b>0.778</b> | <b>0.050</b> | <b>0.052</b> | <b>0.149</b> | <b>0.075</b> |

\* just slightly more complicated than shown

- Step 2 - calculate the number or percent of deaths attributable to the five pollutants on each day between 1986 and 1996 in each of the seven cities

From 2002 Workshop –  
Details have changed

|          |       |       |       |       |       |
|----------|-------|-------|-------|-------|-------|
|          | CO    | NO2   | O3    | SO2   | PM2.5 |
| Slopes → | 0.778 | 0.050 | 0.052 | 0.149 | 0.075 |

\*just slightly more complicated than shown

| City        | Deaths/day | Day      | Pollutant Concentration |     |    |     |       |
|-------------|------------|----------|-------------------------|-----|----|-----|-------|
|             |            |          | CO                      | NO2 | O3 | SO2 | PM2.5 |
| Vancouver   | 22.1       | 1-Jan-86 | 1.1                     | 20  | 27 | 5.1 | 12.7  |
| Calgary     | 8.5        | 1-Jan-86 | 1.0                     | 26  | 34 | 3.7 | 10.3  |
| Winnipeg    | 12.6       | 1-Jan-86 | 0.6                     | 15  | 31 | 1.2 | 9.5   |
| Windsor     | 4.5        | 1-Jan-86 | 0.9                     | 26  | 36 | 7.3 | 17.7  |
| Toronto     | 46.5       | 1-Jan-86 | 1.0                     | 25  | 36 | 5.0 | 15.4  |
| Ottawa-Hull | 11.7       | 1-Jan-86 | 0.8                     | 20  | 28 | 3.8 | 11.6  |
| Montreal    | 38.8       | 1-Jan-86 | 0.6                     | 22  | 28 | 5.6 | 15.0  |

=

| %Change Mortality |     |     |     |       | TOTAL |
|-------------------|-----|-----|-----|-------|-------|
| CO                | NO2 | O3  | SO2 | PM2.5 |       |
| 0.9               | 1.0 | 1.4 | 0.8 | 1.0   | 5.0   |
| 0.8               | 1.3 | 1.8 | 0.6 | 0.8   | 5.2   |
| 0.5               | 0.8 | 1.6 | 0.2 | 0.7   | 3.7   |
| 0.7               | 1.3 | 1.9 | 1.1 | 1.3   | 6.3   |
| 0.8               | 1.3 | 1.9 | 0.7 | 1.2   | 5.8   |
| 0.6               | 1.0 | 1.4 | 0.6 | 0.9   | 4.5   |
| 0.5               | 1.1 | 1.4 | 0.8 | 1.1   | 5.0   |

WEIGHTED AVERAGE → 5.1

- Step 3 – average the percent values from step 2 across all available cities, weighted by the average number of deaths per day in each city

|        |   |       |       |       |       |       |
|--------|---|-------|-------|-------|-------|-------|
|        |   | CO    | NO2   | O3    | SO2   | PM2.5 |
| Slopes | → | 0.778 | 0.050 | 0.052 | 0.149 | 0.075 |

X

| City        | Deaths/day | Day      | Pollutant Concentration |     |    |     |       |
|-------------|------------|----------|-------------------------|-----|----|-----|-------|
|             |            |          | CO                      | NO2 | O3 | SO2 | PM2.5 |
| Vancouver   | 22.1       | 1-Jan-86 | 1.1                     | 20  | 27 | 5.1 | 12.7  |
| Calgary     | 8.5        | 1-Jan-86 | 1.0                     | 26  | 34 | 3.7 | 10.3  |
| Winnipeg    | 12.6       | 1-Jan-86 | 0.6                     | 15  | 31 | 1.2 | 9.5   |
| Windsor     | 4.5        | 1-Jan-86 | 0.9                     | 26  | 36 | 7.3 | 17.7  |
| Toronto     | 46.5       | 1-Jan-86 | 1.0                     | 25  | 36 | 5.0 | 15.4  |
| Ottawa-Hull | 11.7       | 1-Jan-86 | 0.8                     | 20  | 28 | 3.8 | 11.6  |
| Montreal    | 38.8       | 1-Jan-86 | 0.6                     | 22  | 28 | 5.6 | 15.0  |

=

| %Change Mortality |     |     |     |       | TOTAL |
|-------------------|-----|-----|-----|-------|-------|
| CO                | NO2 | O3  | SO2 | PM2.5 |       |
| 0.9               | 1.0 | 1.4 | 0.8 | 1.0   | 5.0   |
| 0.8               | 1.3 | 1.8 | 0.6 | 0.8   | 5.2   |
| 0.5               | 0.8 | 1.6 | 0.2 | 0.7   | 3.7   |
| 0.7               | 1.3 | 1.9 | 1.1 | 1.3   | 6.3   |
| 0.8               | 1.3 | 1.9 | 0.7 | 1.2   | 5.8   |
| 0.6               | 1.0 | 1.4 | 0.6 | 0.9   | 4.5   |
| 0.5               | 1.1 | 1.4 | 0.8 | 1.1   | 5.0   |

From 2002  
Workshop – Details  
have changed

WEIGHTED AVERAGE---> 5.1

(x 0.907)-----> 4.7

**Step 4** - convert these values into a 0 to 10 scale, by multiplying by  $10/11.03=0.907$

|        |   |       |       |       |       |       |
|--------|---|-------|-------|-------|-------|-------|
|        |   | CO    | NO2   | O3    | SO2   | PM2.5 |
| Slopes | → | 0.778 | 0.050 | 0.052 | 0.149 | 0.075 |

X

| City      | Deaths/day | Day      | Pollutant Concentration |     |    |     |       |
|-----------|------------|----------|-------------------------|-----|----|-----|-------|
|           |            |          | CO                      | NO2 | O3 | SO2 | PM2.5 |
| Vancouver | 22.1       | 5-May-02 | 1.1                     | 20  | 27 | 5.1 | 12.7  |

=

| % Change Mortality |     |    |     |       | TOTAL |
|--------------------|-----|----|-----|-------|-------|
| CO                 | NO2 | O3 | SO2 | PM2.5 |       |
|                    |     |    |     |       | 5.0   |

|           |        |     |
|-----------|--------|-----|
| (x 0.907) | -----> | 4.5 |
|-----------|--------|-----|

**Step 5** - Repeat calculation for any other time, place - this is the index value

From 2002 Workshop –  
Details have changed

# Step 6

- Apply conversion factor for using 3 hour monitoring data instead of 24 hour monitoring data



# AQHI Formulation (latest revision)

AQHI =

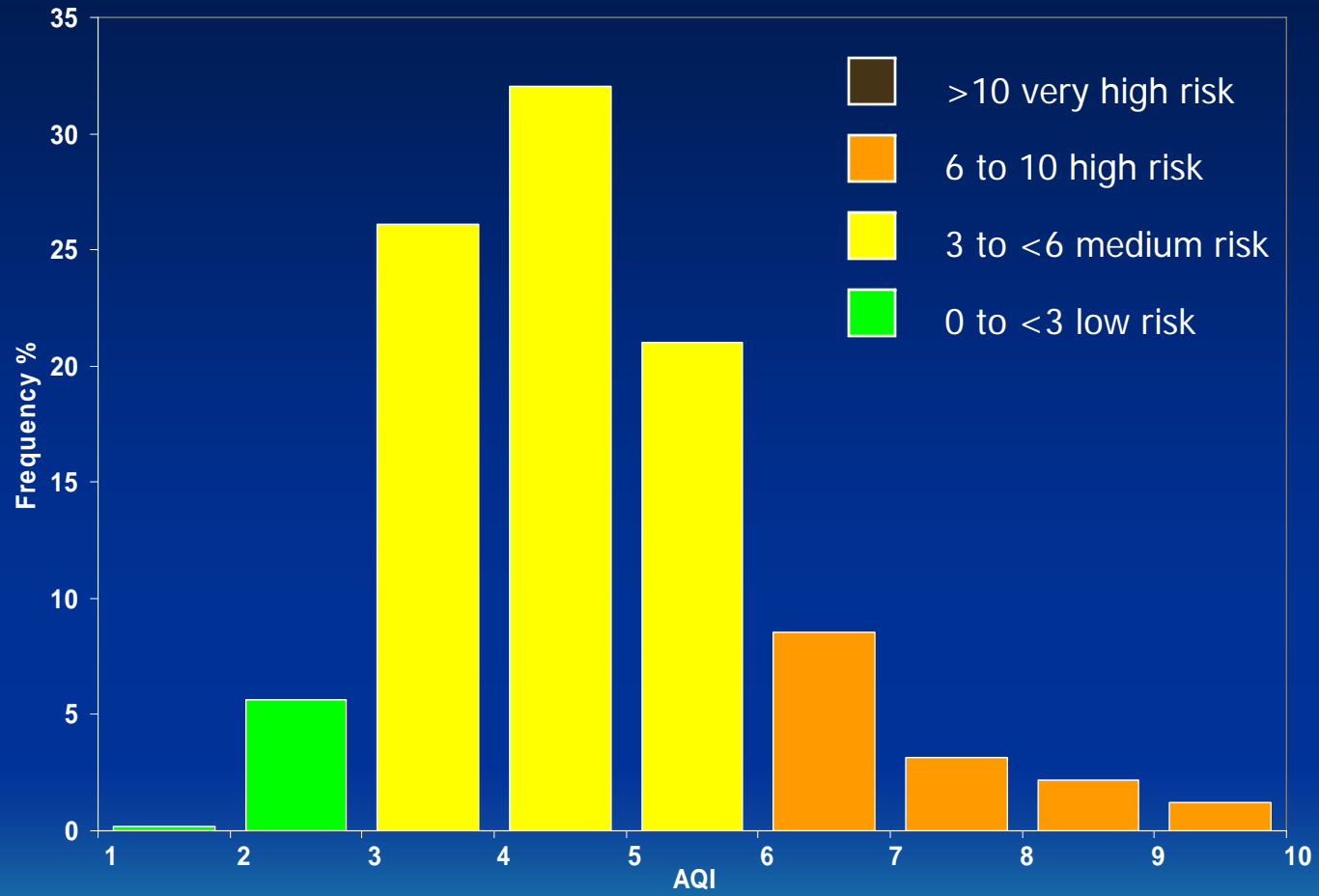
$(10/10.4)*100*((\exp(0.000537*(O_3)))-1)$

+  $((\exp(0.000487*(PM_{2.5})))-1)$

+  $((\exp(0.000871*(NO_2)))-1)$

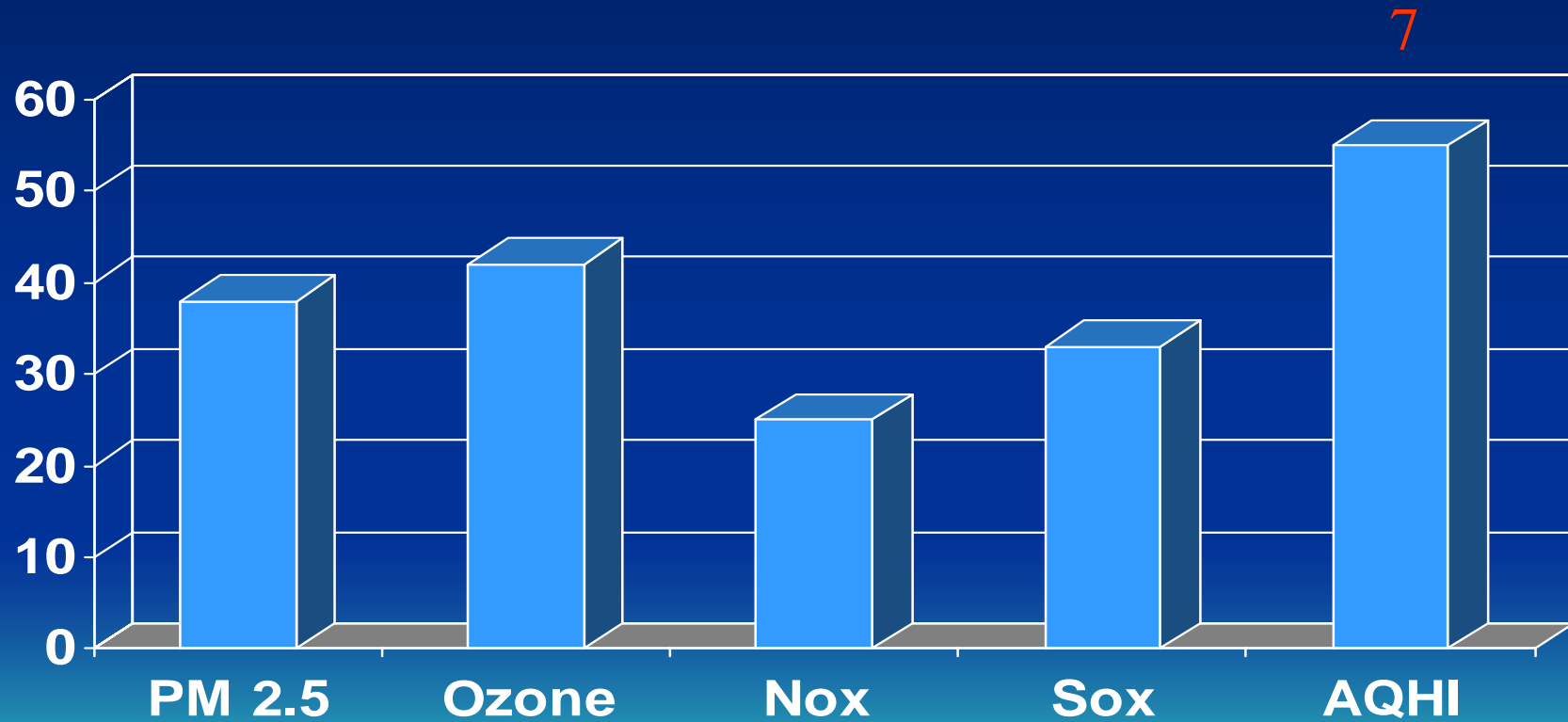


## Frequency of days in AQI categories



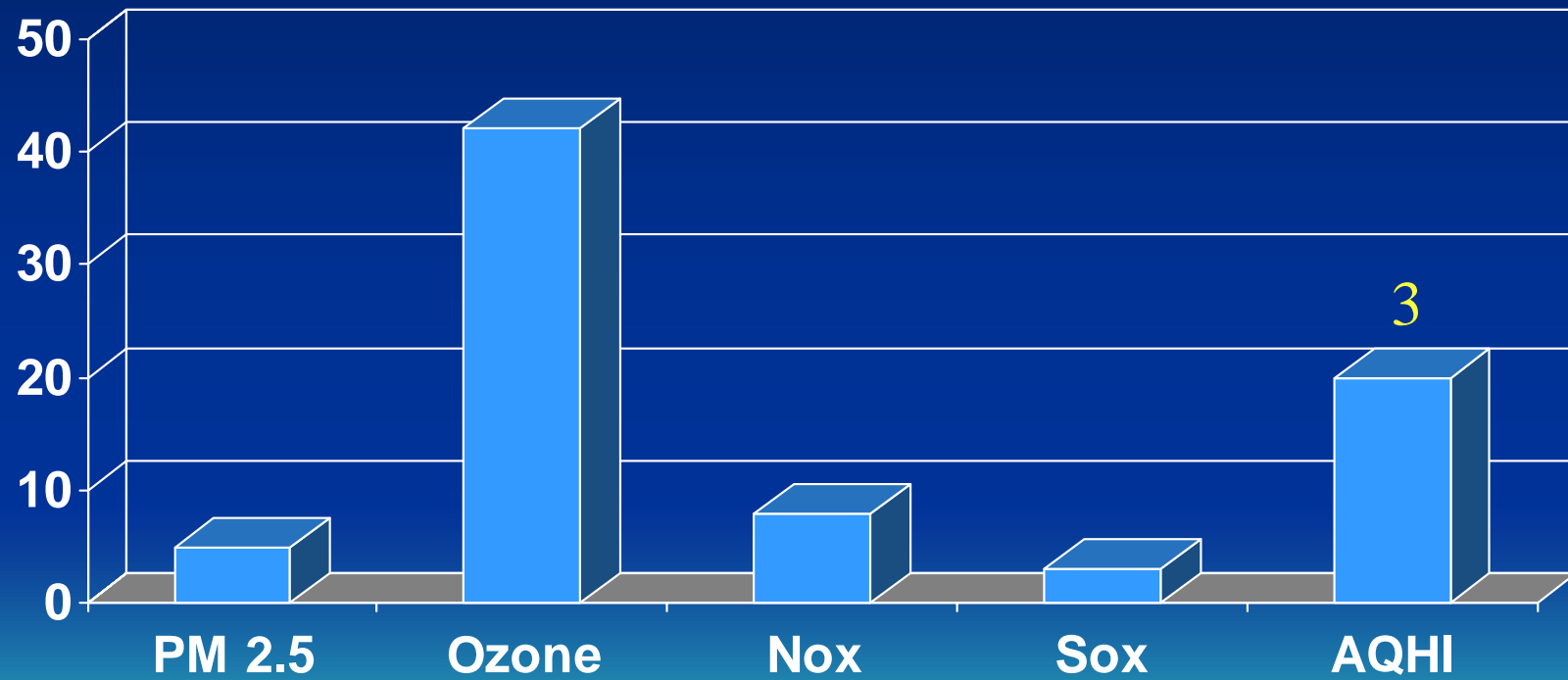
# Example 1

## Dirrtown



# Example 2

## Cleantown



# 2005-06 Pilots

- 2005 – Thompson-Okanagan
- 2006
  - BC communities
  - BC Kamloops variation
  - Nova Scotia high risk users



# Pilot questions

- Can we do it?
- Is it used?
- Is it liked?
- Is there any suggestion people are doing things differently because of info?



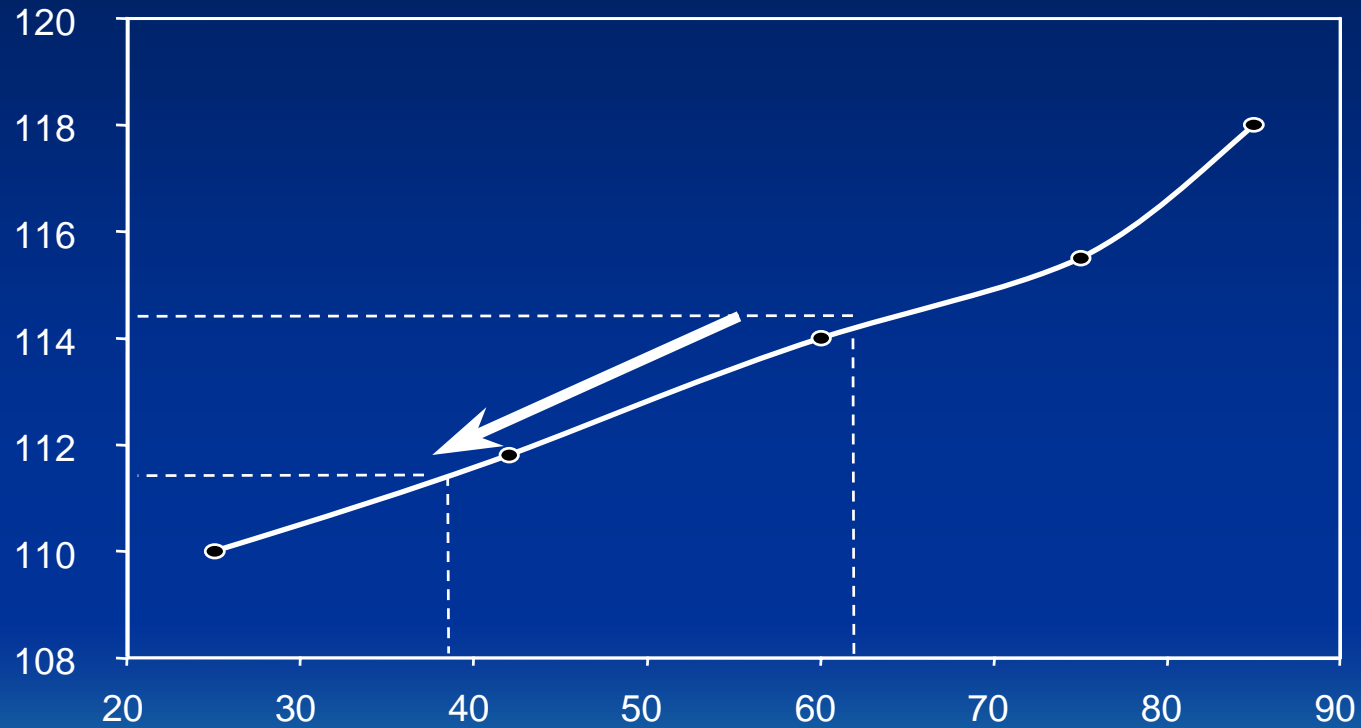
# Basic Principles

- There is no safe level of contaminants in the air
- There is a linear relationship between poorer air quality and poorer health outcomes
- Irrespective of the perceived quality of our air, we should try to make it better



# Relationship between air quality and mortality as a health outcome

Mortality (% relative to background)



Air quality index units



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[Forecast](#)

[Air & Health](#)

[About the Pilot](#)

[What Do You Think?](#)

[Media & Inquiries](#)

## Air Play is a new way to help you protect your health.

This website is part of a **Pilot Project** to test public acceptance of the world's first air quality index that directly ties air quality to health risk. It is designed to help you make decisions on how to best manage and protect your health.

We hope you will visit this site often and tell us what you think -- so that your opinion may influence the launch of a new national approach for communicating the air quality and how it may affect your health.



*This Pilot Project covers the Thompson and Okanagan valleys of British Columbia using monitoring data collected in Kamloops, Vernon, Kelowna and Osoyoos*

This pilot website is brought to you in partnership by Interior Health and the BC Ministry of Environment.

# www.airplaytoday.org

Design by Koch Ink - Powered by SiteCMP™ - web content management made easy by IdeaLEVER Solutions

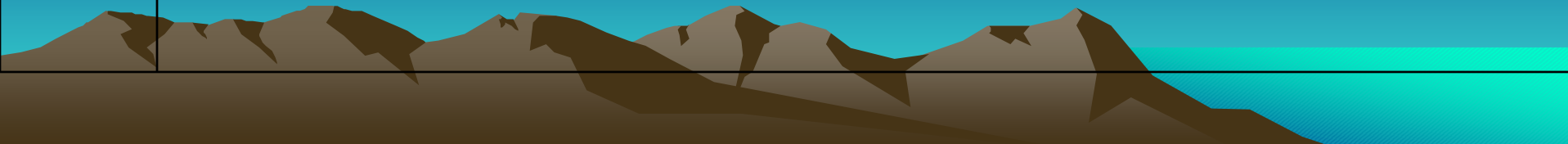
# Communicating Messages

- Bank of health messages that have been focus tested
- Bank of general information messages that have been tested



| •Air Quality Index Level of Risk | •Numerical Value | •Accompanying Health Message for At-Risk Population   | •Accompanying Health Message for General Population   |
|----------------------------------|------------------|---|---|
| •Low Risk                        | •0–3             | <ul style="list-style-type: none"> <li>•Enjoy your usual outdoor activities.</li> <li>•Follow your doctor’s advice for exercise.</li> </ul>   | •Ideal conditions for outdoor activities such as sports, biking or walking.   |
| •Moderate Risk                   | •4–6             | <ul style="list-style-type: none"> <li>•If you have heart or breathing problems, and experience symptoms, consider reducing physical exertion outdoors or reschedule activities to times when the index is lower.</li> <li>•Follow your doctor’s usual advice about managing your condition.</li> </ul>   | •No need to modify your usual outdoor activities.   |
| •High Risk                       | •7–10            | <ul style="list-style-type: none"> <li>•Children, the elderly and people with heart or breathing problems should reduce or reschedule physical exertion outdoors to periods when the index is lower, especially if they experience symptoms.</li> <li>•If you have heart or breathing problems, follow your doctor’s usual advice about managing your condition.</li> </ul> | •Anyone experiencing discomfort such as coughing or throat irritation should consider reducing or rescheduling strenuous outdoor activities to periods when the index is lower. |
| •Very High Risk                  | •Above<br>•10    | <ul style="list-style-type: none"> <li>•Children, the elderly and people with heart or breathing problems should avoid physical exertion outdoors.</li> <li>•If you have heart or breathing problems, follow your doctor’s usual advice about managing your condition.</li> </ul>   | •Everyone should consider reducing or rescheduling outdoor activities to periods when the index is lower, especially if they experience symptoms.                               |

|                               |  |
|-------------------------------|--|
| <p>Index Reading 0–3</p>      | <p>People with breathing or heart problems should always pay attention to symptoms, even at low index levels. Even low levels of air pollution can have a negative effect on the health of vulnerable people, such as the elderly, children, and people with cardio-respiratory problems.</p> <p>Riding your bike, walking or rollerblading to work is healthy for you and keeps the air clean. A full bus takes 40 to 60 cars off the road.</p>   |
| <p>Index Reading 4–6</p>      | <p>Air pollution can affect your health now and many years from now. Air pollution comes from both local sources (e.g. vehicles, industry, wood smoke) and from far away, carried over hundreds of kilometres. Children inhale more pollution per kilogram of body weight than adults. A full bus takes 40 to 60 cars off the road.</p> <p>Even low levels of air pollution can have a negative effect on the health of vulnerable people, such as the elderly, children, and people with cardio-respiratory problems.</p> <p>People with heart or breathing problems should monitor symptoms as the index reading increases. You can reduce your risk from air pollution by lessening the intensity of your exercise, for example, walking instead of jogging, as well as taking more breaks.</p> <p>You will breathe in less traffic-related pollution by planning routine physical activity, such as running or jogging, away from high traffic areas. If you are spending more time indoors, look for an air conditioned, smoke-free environment.</p>  |
| <p>Index Reading 7–10</p>     | <p>Some types of air pollution can reach high levels even in parks and rural areas. You cannot always see or smell air pollution that is harmful to your health. According to recent research, diabetics may be at an increased risk from air pollution. Even healthy people may have more difficulty breathing on days when the index is high. Air pollution affects everyone’s health in different ways, ranging from minor symptoms, such as throat irritation, to worsening of breathing and heart problems. Negative health effects will increase as air pollution increases.</p> <p>You can reduce your risk from air pollution by lessening the intensity of your exercise, for example, walking instead of jogging, as well as taking more breaks.</p> <p>You will breathe in less traffic-related pollution by planning routine physical activity, such as running or jogging, away from high-traffic areas. People participating in sports or strenuous work outdoors breathe deeply and rapidly, allowing more air pollution to enter their lungs. They may have difficulty breathing when air pollution levels are high, and should take more breaks.</p> <p>If you are spending more time indoors, look for an air conditioned, smoke-free environment.</p> |
| <p>Index Reading Above 10</p> | <p>Even healthy people may have more difficulty breathing on days when the index is very high. Air pollution affects everyone’s health in different ways, ranging from minor symptoms, such as throat irritation, to worsening of breathing and heart problems. Negative health effects will increase as air pollution increases. Seniors, children and people with breathing and heart problems are most affected by air pollution. Negative health effects will increase as air pollution increases. Some types of air pollution can reach high levels even in parks and rural areas. People participating in sports or strenuous work outdoors breathe deeply and rapidly, allowing more air pollution to enter their lungs. They may have difficulty breathing when air pollution levels are high, and should take more breaks. If you are spending more time indoors, look for an air conditioned, smoke-free environment.</p>  |



Is the air quality affecting your health?

Find out at [www.airplaytoday.org](http://www.airplaytoday.org)



airplay▶

Check the air quality to plan your activities today



Is the air quality affecting your health?

Find out at [www.airplaytoday.org](http://www.airplaytoday.org)



Is the air quality affecting your health?  
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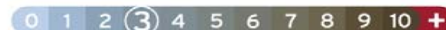
- Home
- Today's Index
- Forecast
- Air & Health
- About the Pilot
- What Do You Think?
- Media & Inquiries

## Kelowna

Print interface | Low Health Risk | fits 4"x 6" page.

### Air Quality Health Index

Moncton, New Brunswick



Currently

Feb. 7, 2006  
8:00 AM EST

**3** Low Health Risk

■ At Risk Population:  
Enjoy normal activities outdoors.

■ General Population:  
Ideal conditions for outdoor activities, biking or walking to work and sports.

#### Forecast

Today

Low Health Risk

Tomorrow

Moderate Health Risk

#### Who is at risk?

People with heart or lung conditions are the most affected by air pollution. For further information on the impacts of air quality on your health, visit [www.3xxx.ca](http://www.3xxx.ca), or contact your local Public Health Office or your doctor.

#### Did you know...

Riding your bike, walking or rollerblading to work is healthy for you and keeps the air clean.

Learn more at [www.airhealthindex.ca](http://www.airhealthindex.ca)

## Check Tomorrow's Forecast

The Air Quality *Health* Index is a scale designed to help you understand what the air quality around you means to your health. Developed by environmental and health professionals, this scale tells you three things;

- a number between 1 and 10 indicating the air quality. The higher the number, the lower the air quality.
- a message beside the number describes the **level of health risk** associated with the index reading.
- health messages customized to each level of air quality for both the general population and **individuals at risk**.

### What do you think?

This Website is part of a Pilot Project to create the first air quality health index of its kind in the world.

**Please tell us what you think** - Your opinion is valuable and your feedback will influence the launch of a new national standard for communicating air quality and health risk.

This pilot website is brought to you in partnership by Interior Health and the BC Ministry of Environment.

# Evaluation

- 2006 Pilot Website Statistics
- over 12,000 web visits
- 133,895 page views
- 1,800 referrals from partner sites
- 975 visits through search engines

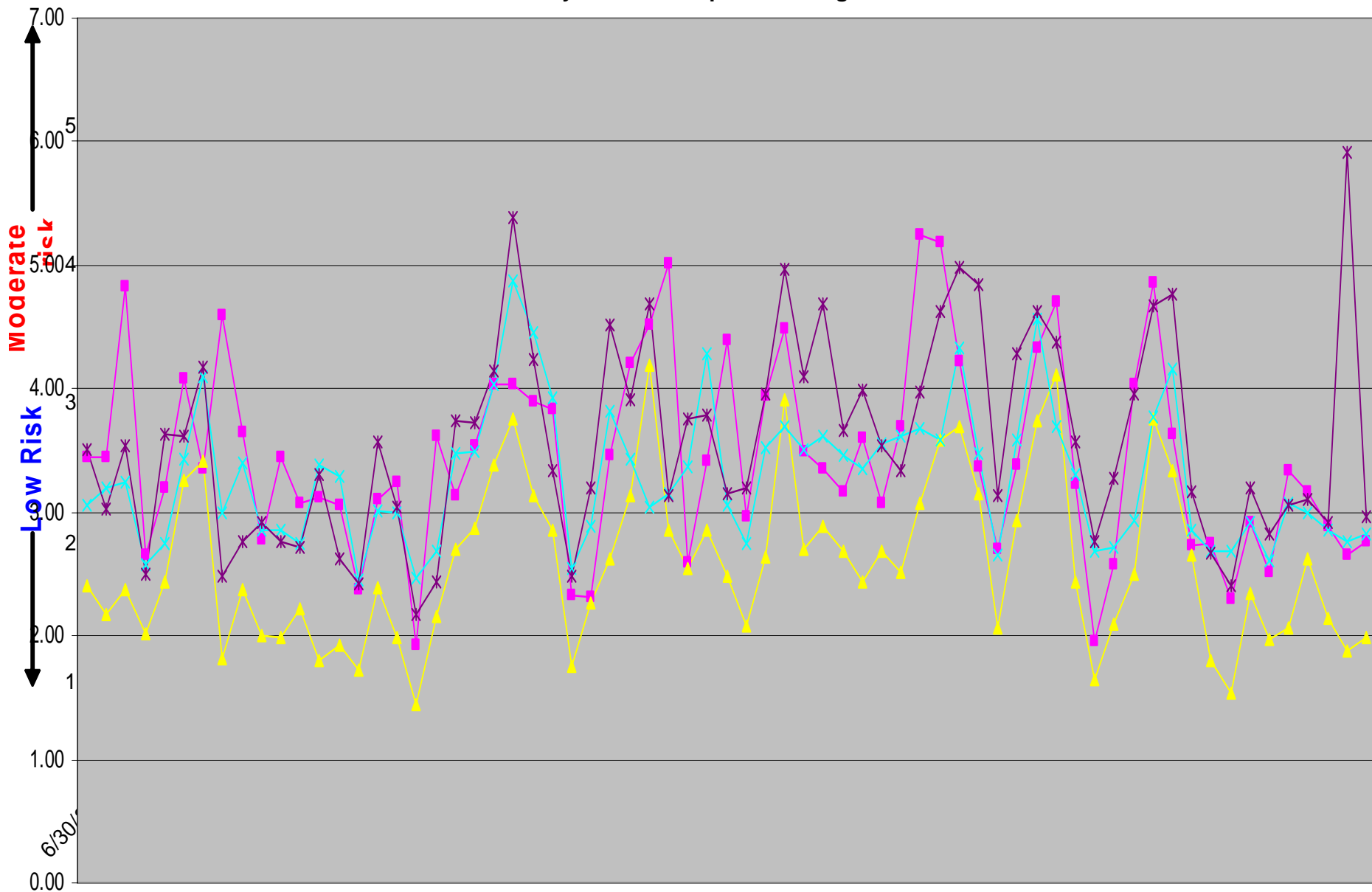


# Evaluation

- 75% rates website good or excellent
- 90% find AQHI clear and useful
- 75% rate AQHI as good or excellent

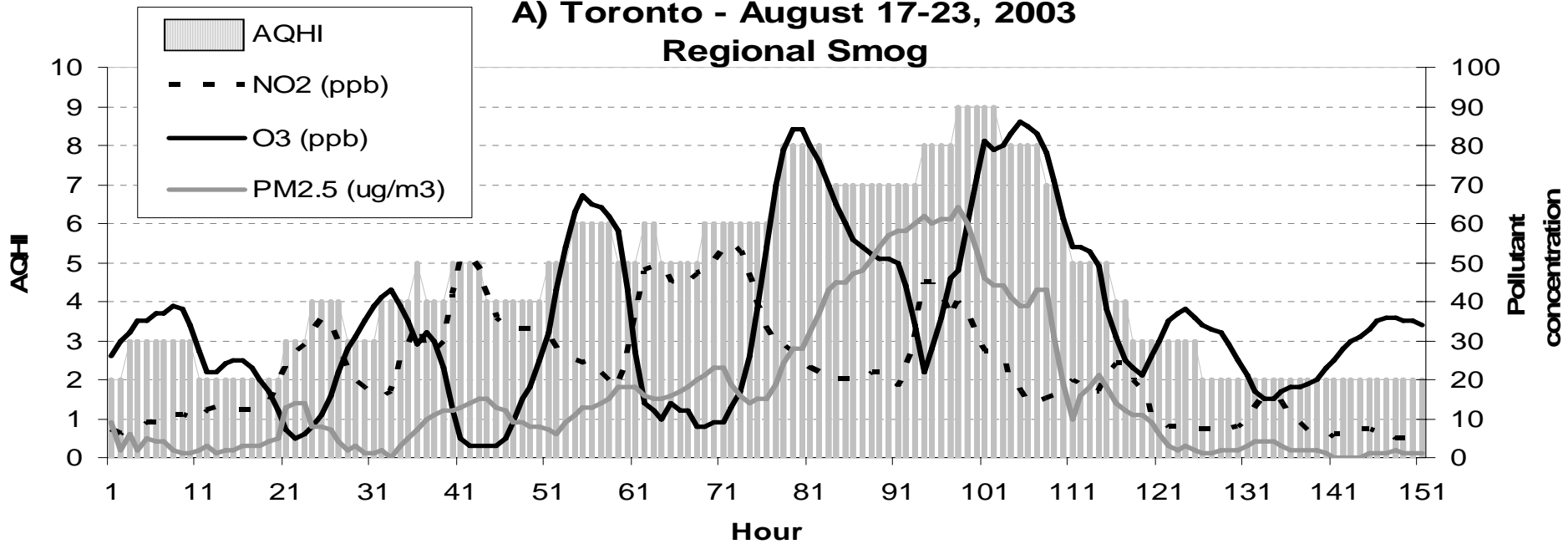


Maximum Daily AQHI - Thompson/Okanagan 2005

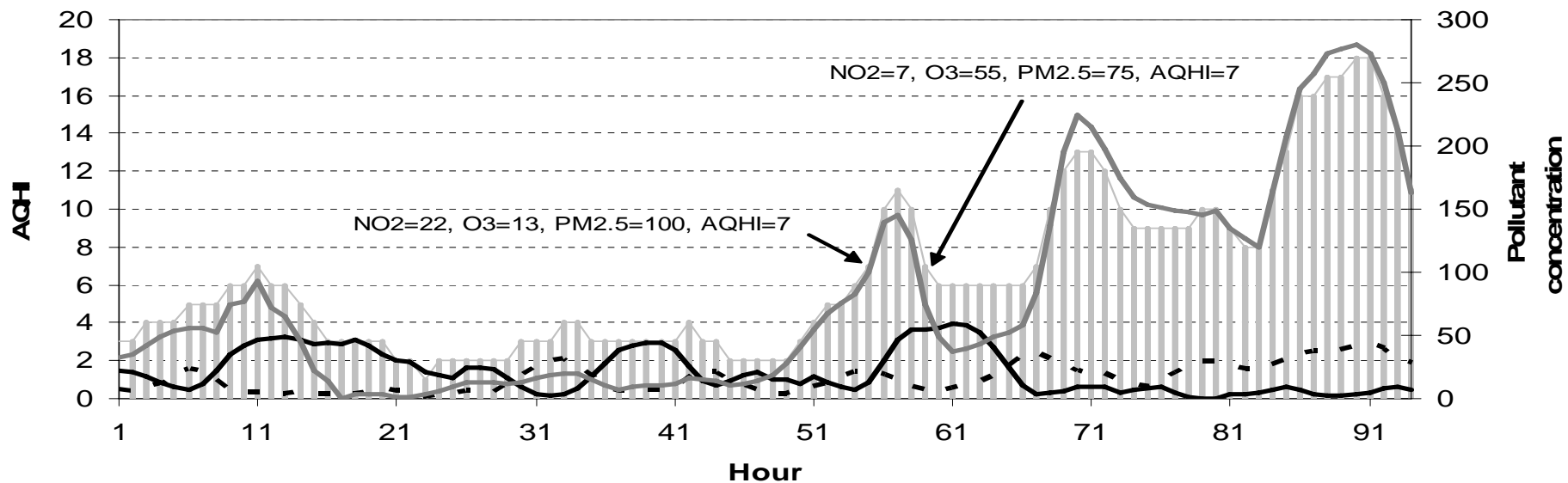


■ Kamloops ▲ Vernon ✖ Osoyoos ✖ Kelowna

### A) Toronto - August 17-23, 2003 Regional Smog



### B) Kelowna - August 18-21, 2003 Forest Fires

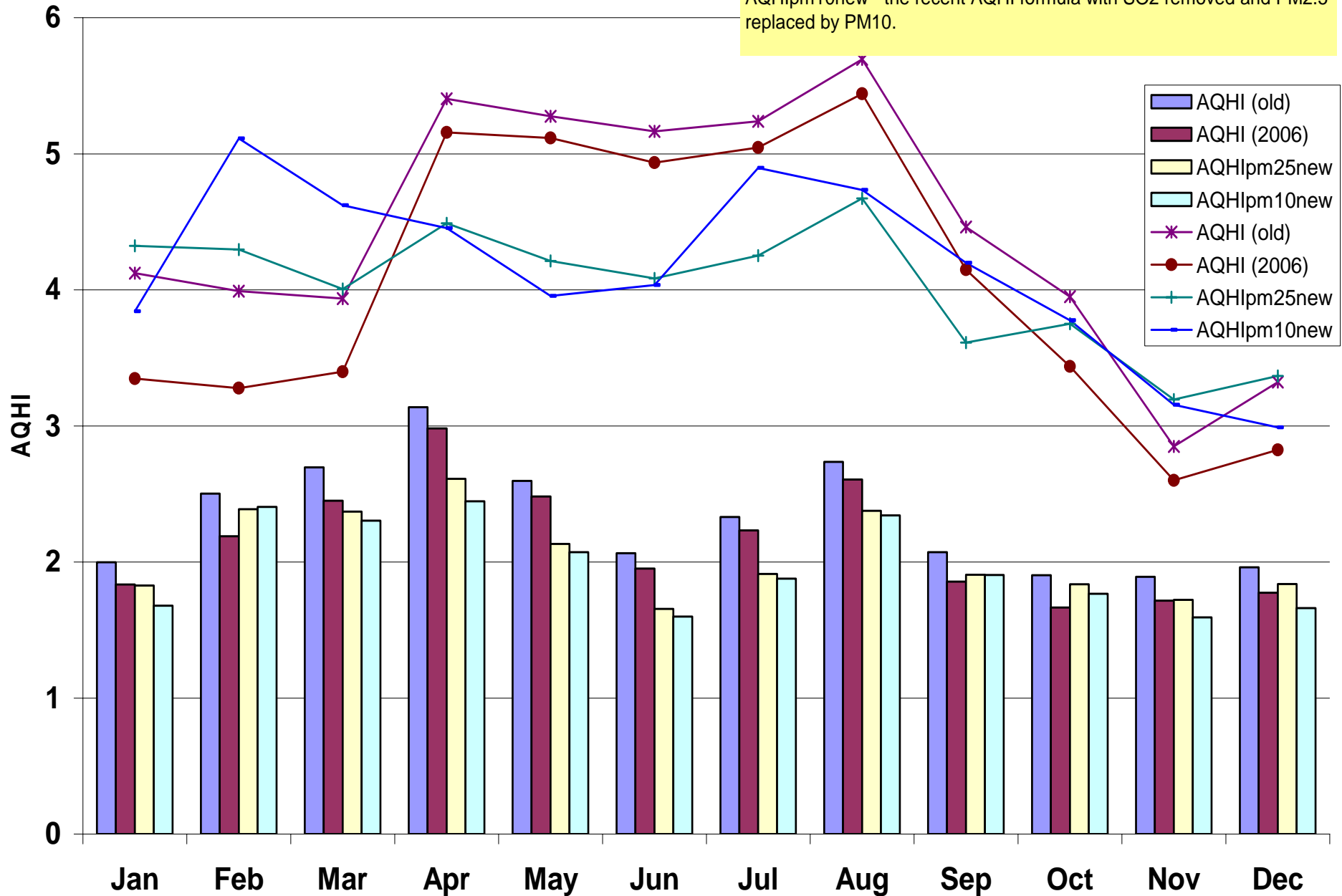


# Kelowna 2005 - Median and Maximum monthly AQHI

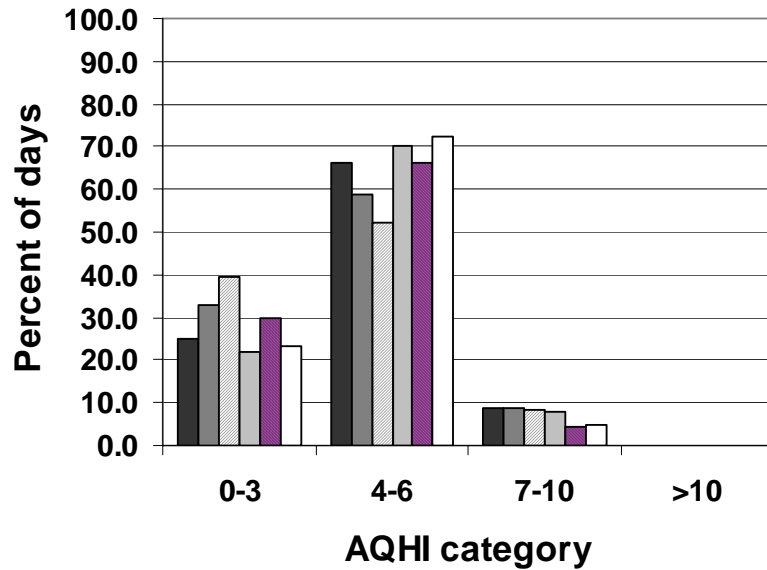
Bars are hourly medians

Lines are hourly maximums

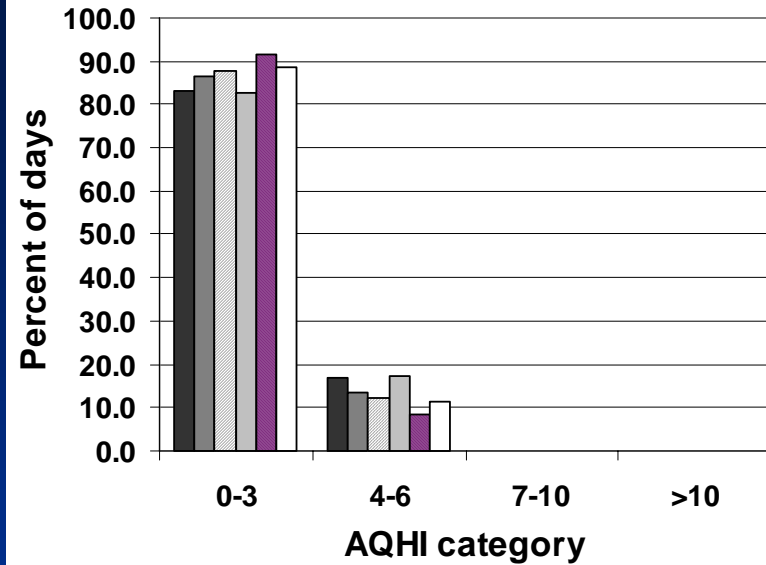
AQHI (old) - the original AQHI that I saw in early 2005  
 AQHI 2006- the AQHI that I first saw in early 2006  
 AQHlpm25new - the recent AQHI formula with SO2 removed.  
 AQHlpm10new - the recent AQHI formula with SO2 removed and PM2.5 replaced by PM10.



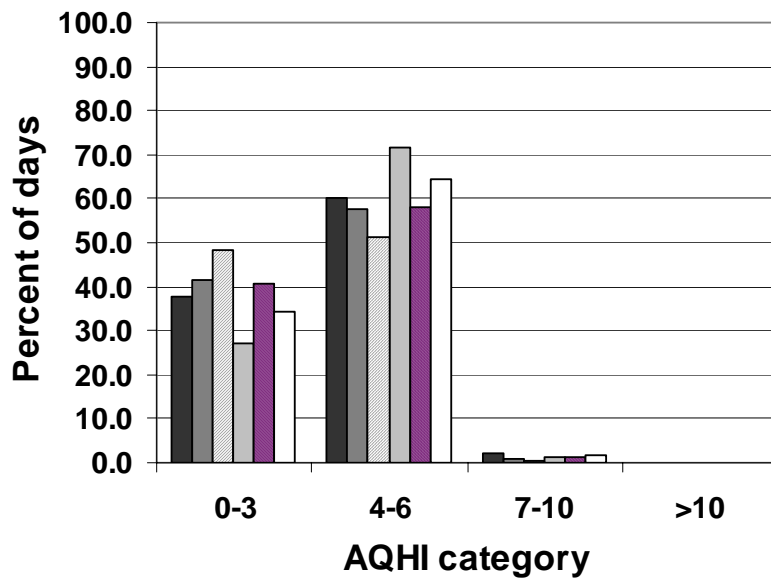
### Toronto



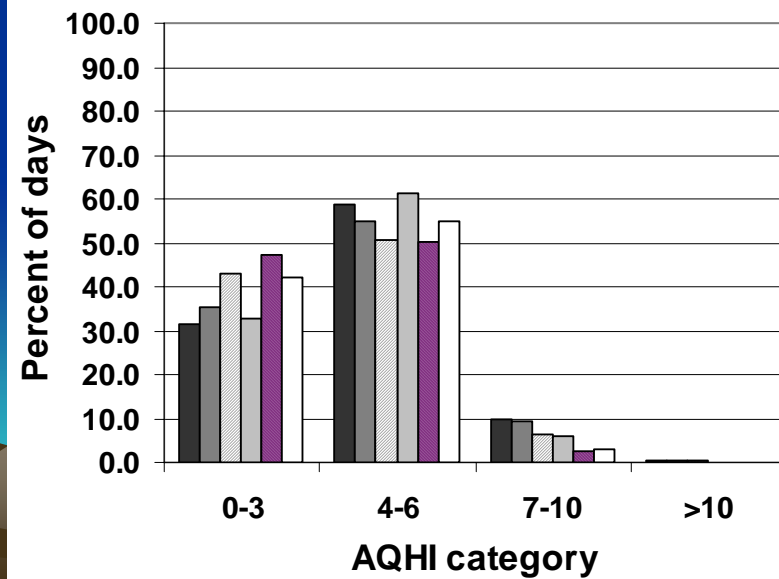
### Vancouver



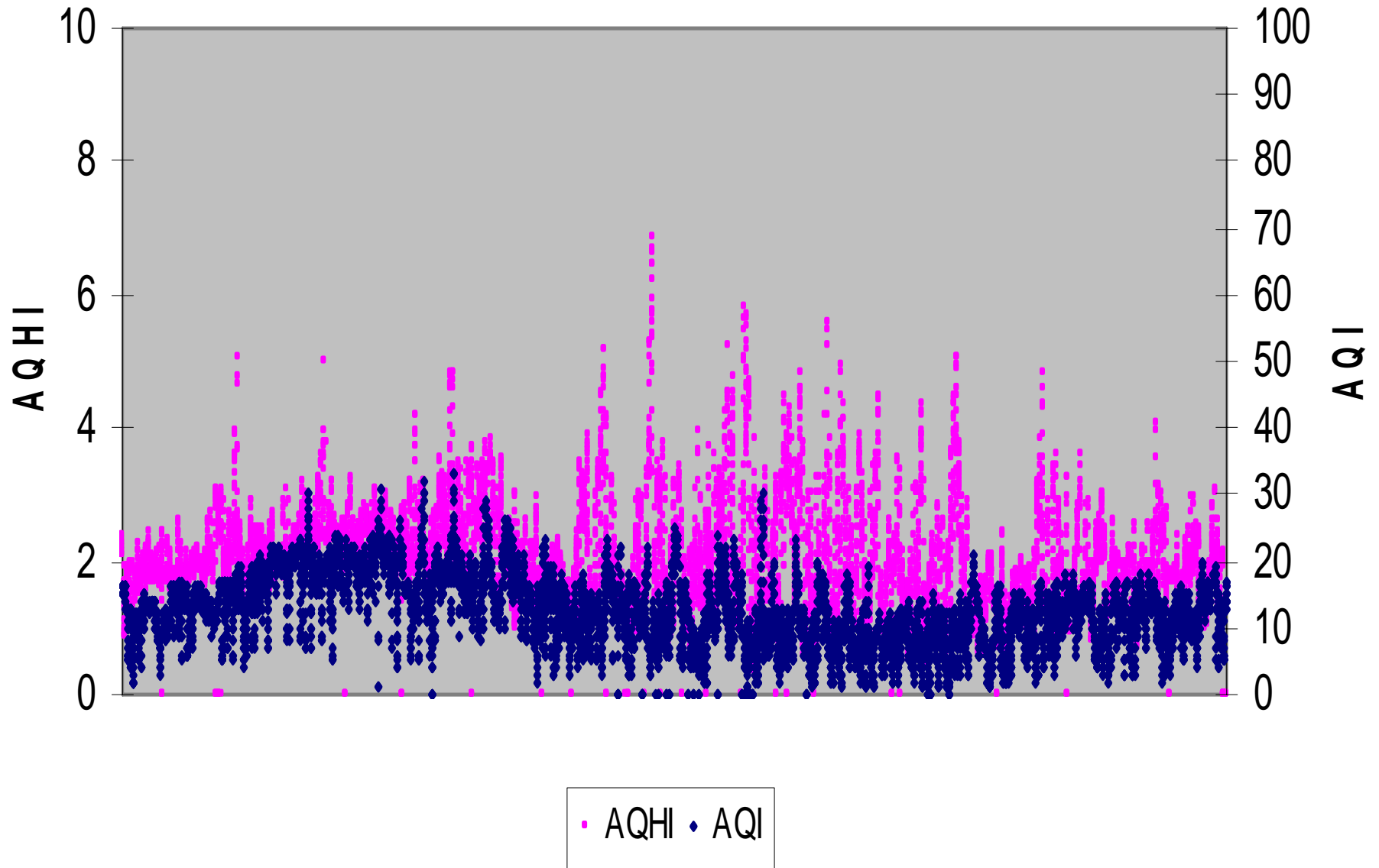
### Calgary



### Hamilton

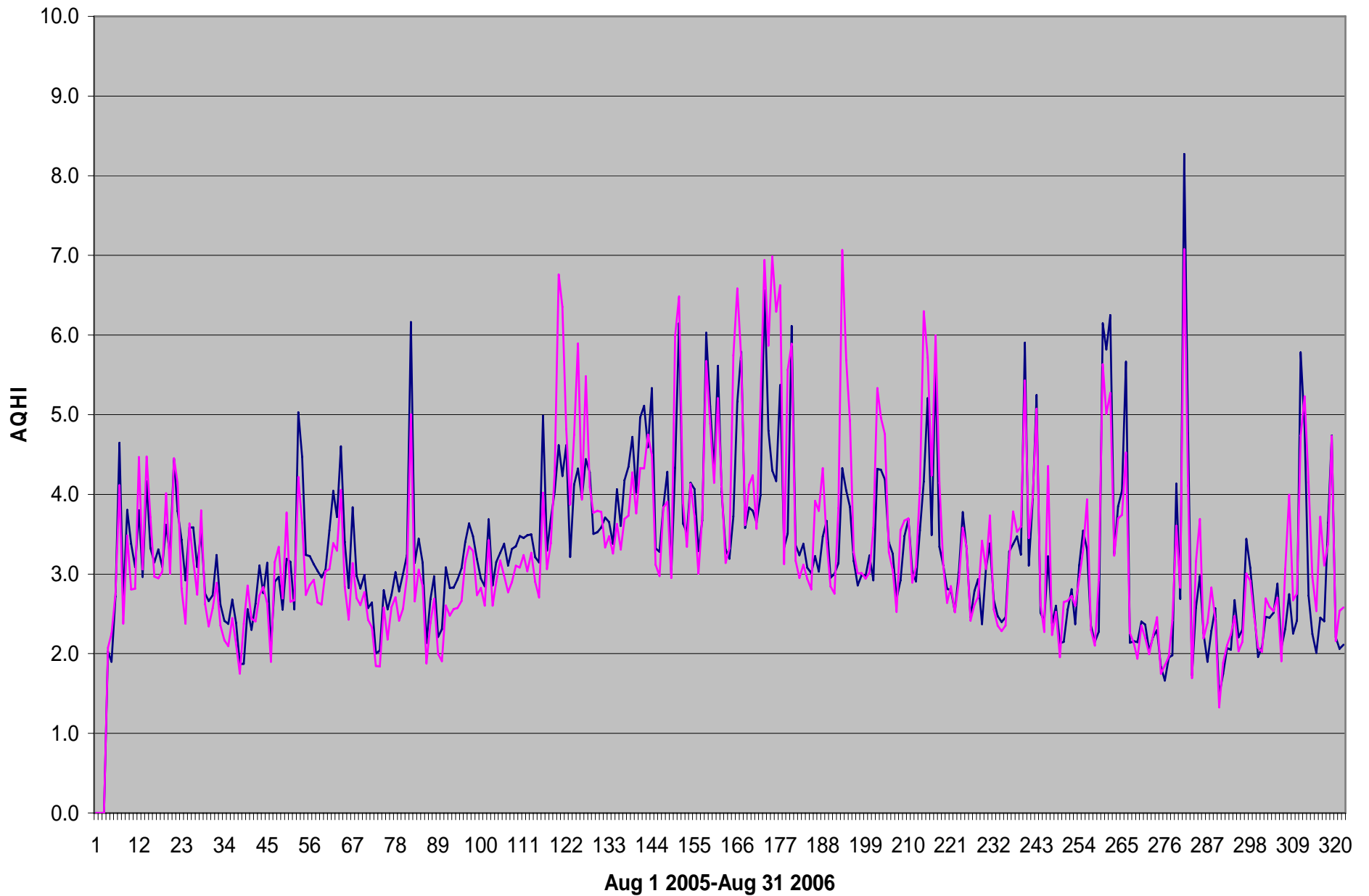


# AQHI vs AQI Hourly Values for Forest Hills Jan-Dec 2005



# Prince George Aug 2005-Aug 2006: New PM2.5 AQHI and New PM10 AQHI-Daily Max

PM10 in mauve, PM2.5 in blue

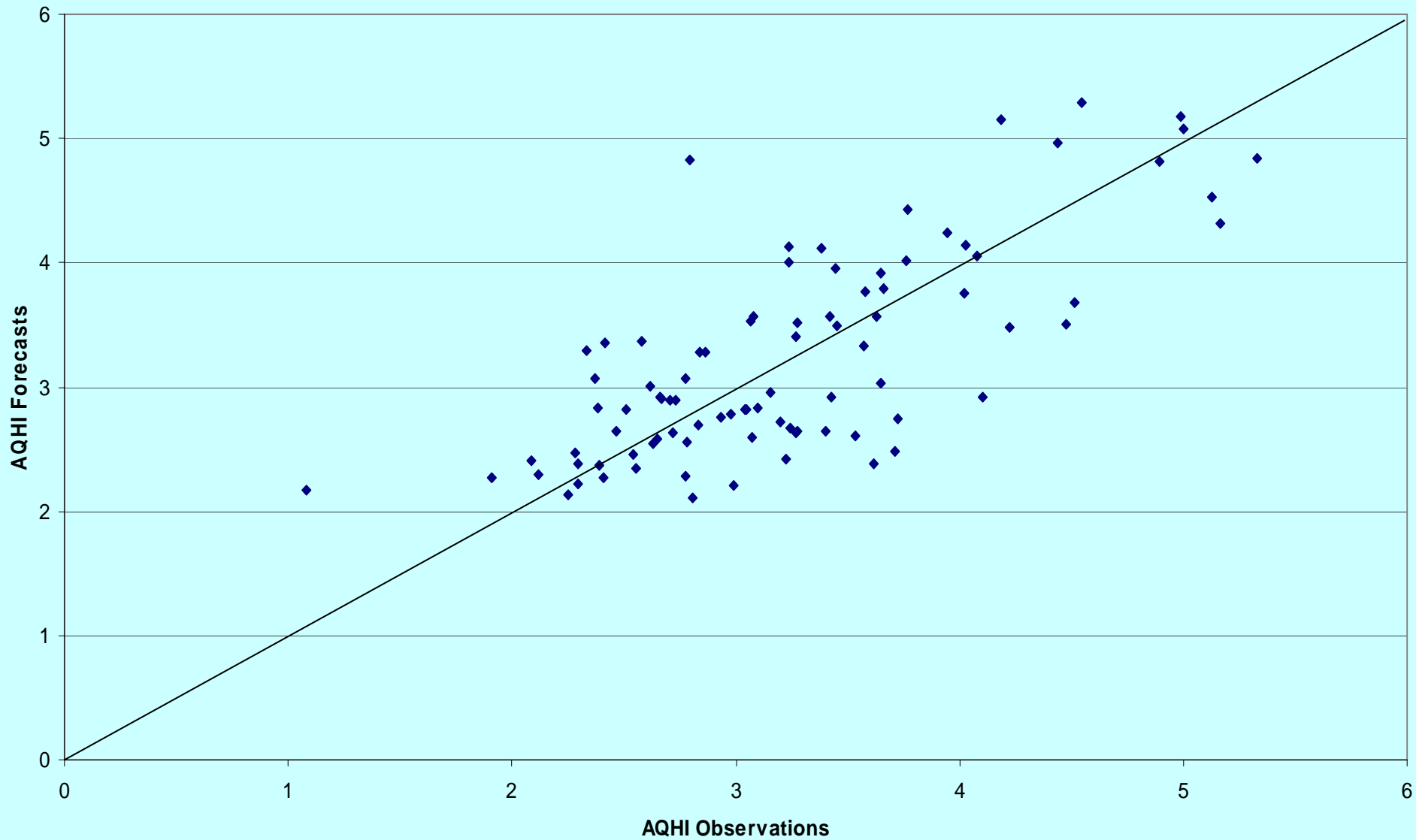


# Forecasting

- In an ideal world, forecasting for 24-48 hours in advance would be needed to increase the utility of the index
- Environment Canada was able to pilot the forecast model with the AQHI pilot



# Kamloops



# Issues to Date

- **Health messages are informative, but need for messaging to health care workers on how to advise patients**
- **Message bank may not be robust enough**
- **Relationship between monitoring requirements using current regulatory structure with new communication tool and index**
- **Buy-in of lots of folks**



# Issues and Limitations

- Monitoring capacity and missing data
  - no monitor
  - short term monitor lapses
- Representiveness of monitoring
  - ie. we know microvariation is a risk, but model is based on macrolevel surveillance



# Major Issue

- The AQHI is not about adding together the risk associated with various different pollutants
- It is about representing and communicating the total health risk in a single index by using available monitoring information



# Next Steps

- “National” pilot, which includes most of BC, Toronto, possibly areas in Quebec, expansion in Atlantic areas
- Integration into EC weather reporting
- Review nationally of “brand” to operate in both official languages
- Communication outreach tool development
- Focus on health care professional messaging on how to use AQHI clinically
- Release of the national “brick” – science document



# BC Next Steps

- To be decided February 27-28



# BC Next Steps - cont



# Public Health roles

- Support implementation activities
- Act as health experts to the pilots
- Encourage HA involvement
- Support media activities with a health face
- Liaise with medical and health communities on health impacts of air quality



# Contact Information (to clear the air)

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