



# Atmospheric Mercury Monitoring in Canada

## CARA Mercury Monitoring:

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## Collaborators:

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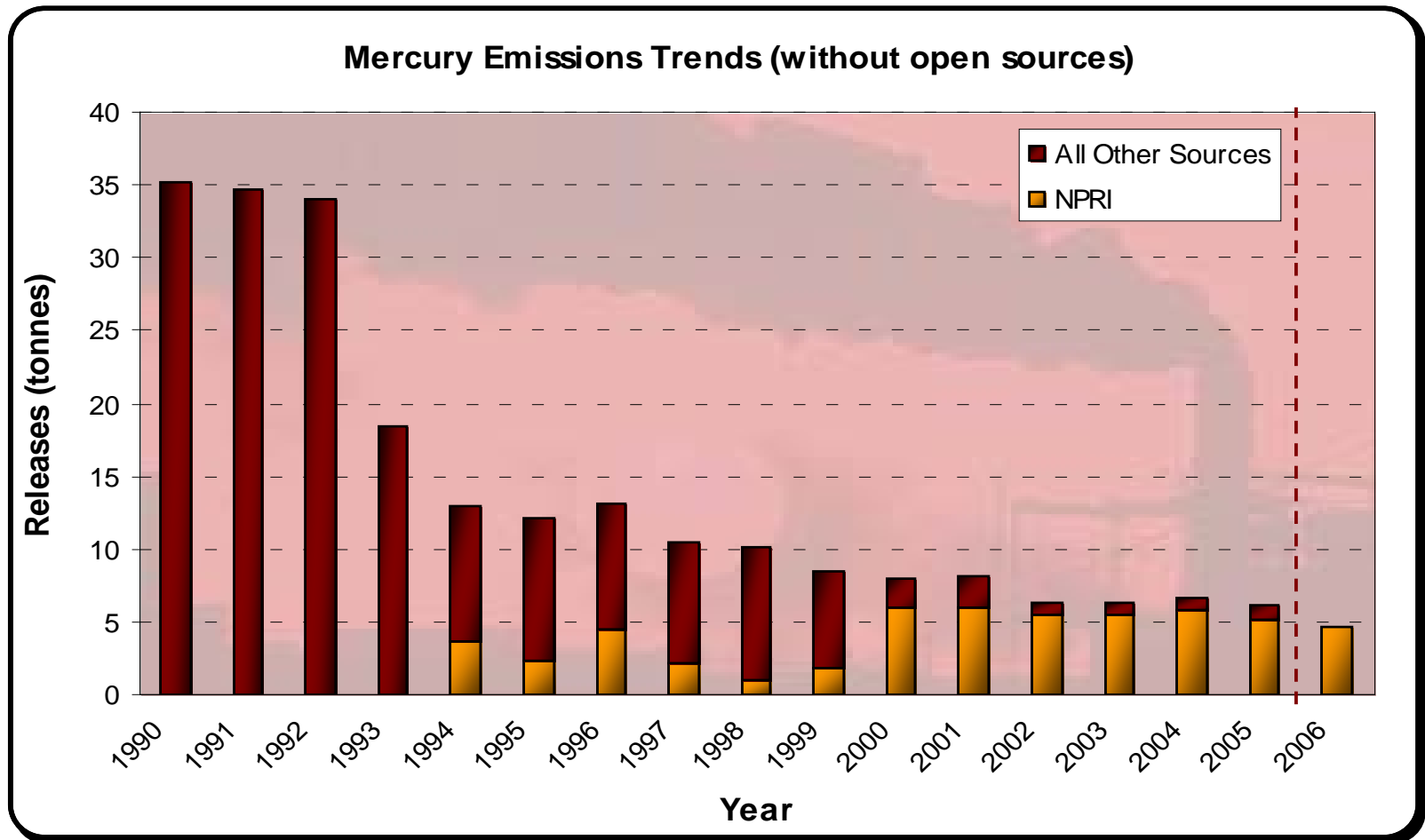
# Why is mercury a concern in Canada?

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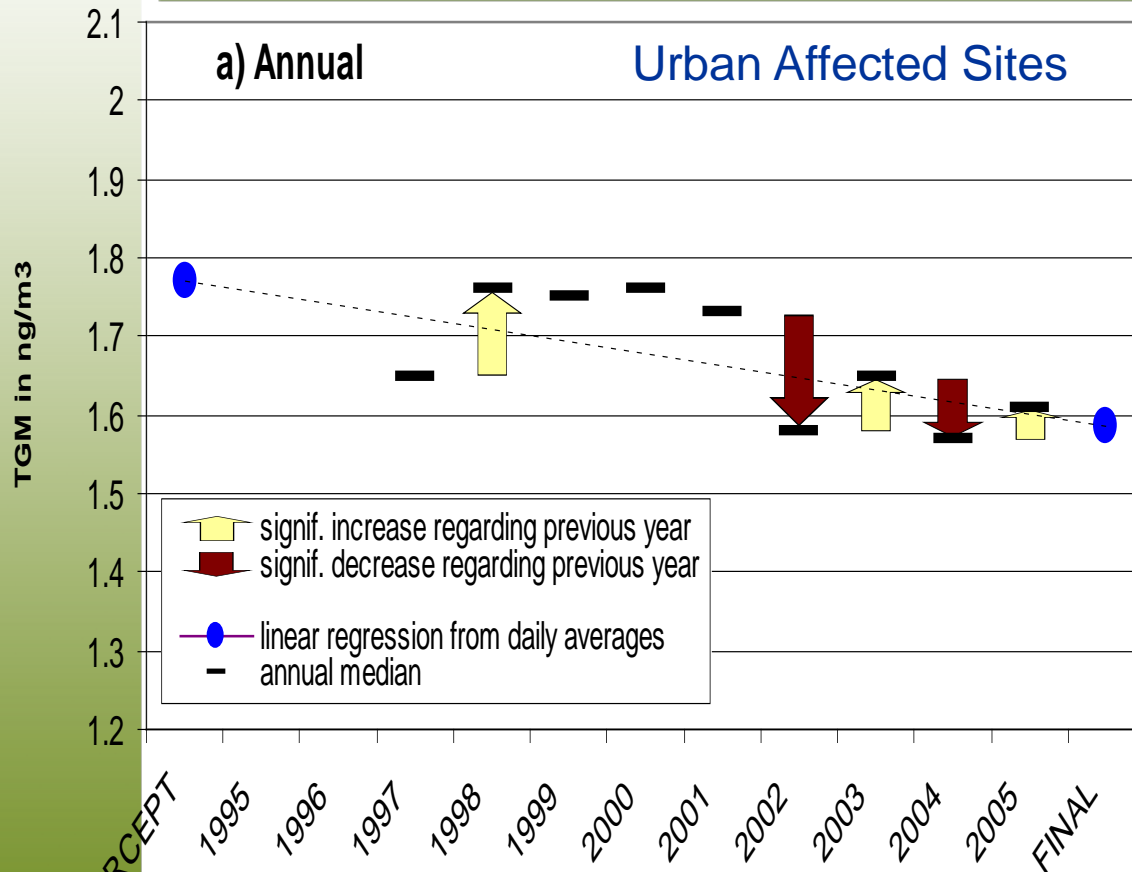
- Mercury is toxic to humans and biota at levels found in the Canadian environment
  - Indigenous populations in several areas of the Arctic have blood mercury levels that exceed U.S. and Canadian established guidelines
  - Mercury is causing reproductive problems in wildlife at sites in Canada
- Mercury is the primary trigger of human fish consumption advisories in Canada
- Aboriginal peoples, especially those in the Arctic, are particularly vulnerable to mercury exposure due to high consumption levels of fish and marine animals
- Mercury levels are increasing in the arctic environment and, thus, potentially increasing risk to arctic peoples and wildlife
- Mercury is readily transported long distances, hence, global emissions impact levels of mercury in Canada
- Foreign emissions of mercury are increasing in some areas of the globe
- The role of climate change in exacerbating this risk is uncertain



# What are the trends in Canadian anthropogenic emissions of mercury to air?



# What are the recent trends in atmospheric levels of mercury in Canada?



- Mercury concentrations in the Canadian atmosphere have decreased significantly (~10%) from 1997 to 2005.
- Decreases correspond with decreasing trends in mercury in precipitation as observed by co-located MDN stations.

Temme et al. (2007) Atmos. Env., 41, 135-153.

10/15/2009



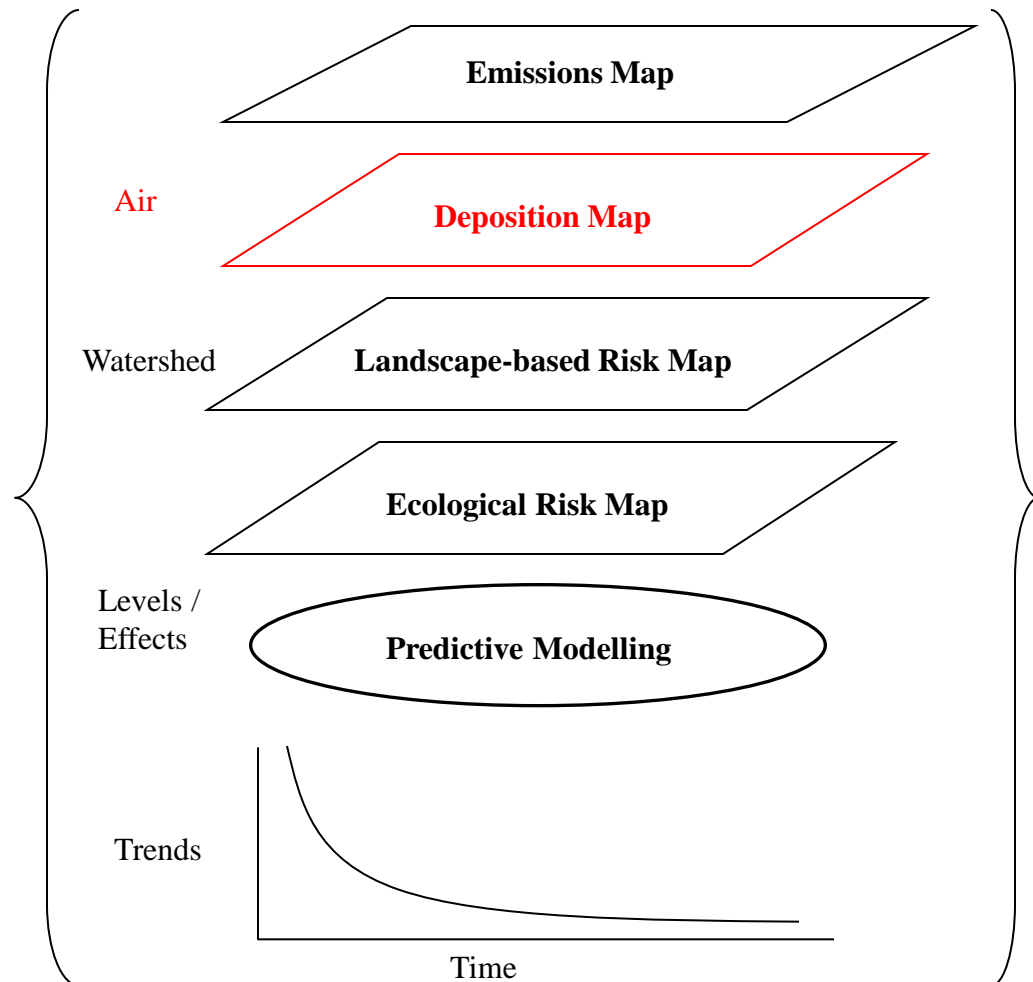
Environment  
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Canada

# Canadian Clean Air Regulatory Agenda (CARA)

- Reduce emissions of SO<sub>x</sub>, NO<sub>x</sub>, VOCs, GHGs and **Mercury**.
- Regulation of **industrial sectors**
- Implementation requires **research, monitoring, modelling** and **assessment**.
- Timeline is 2007-2011.

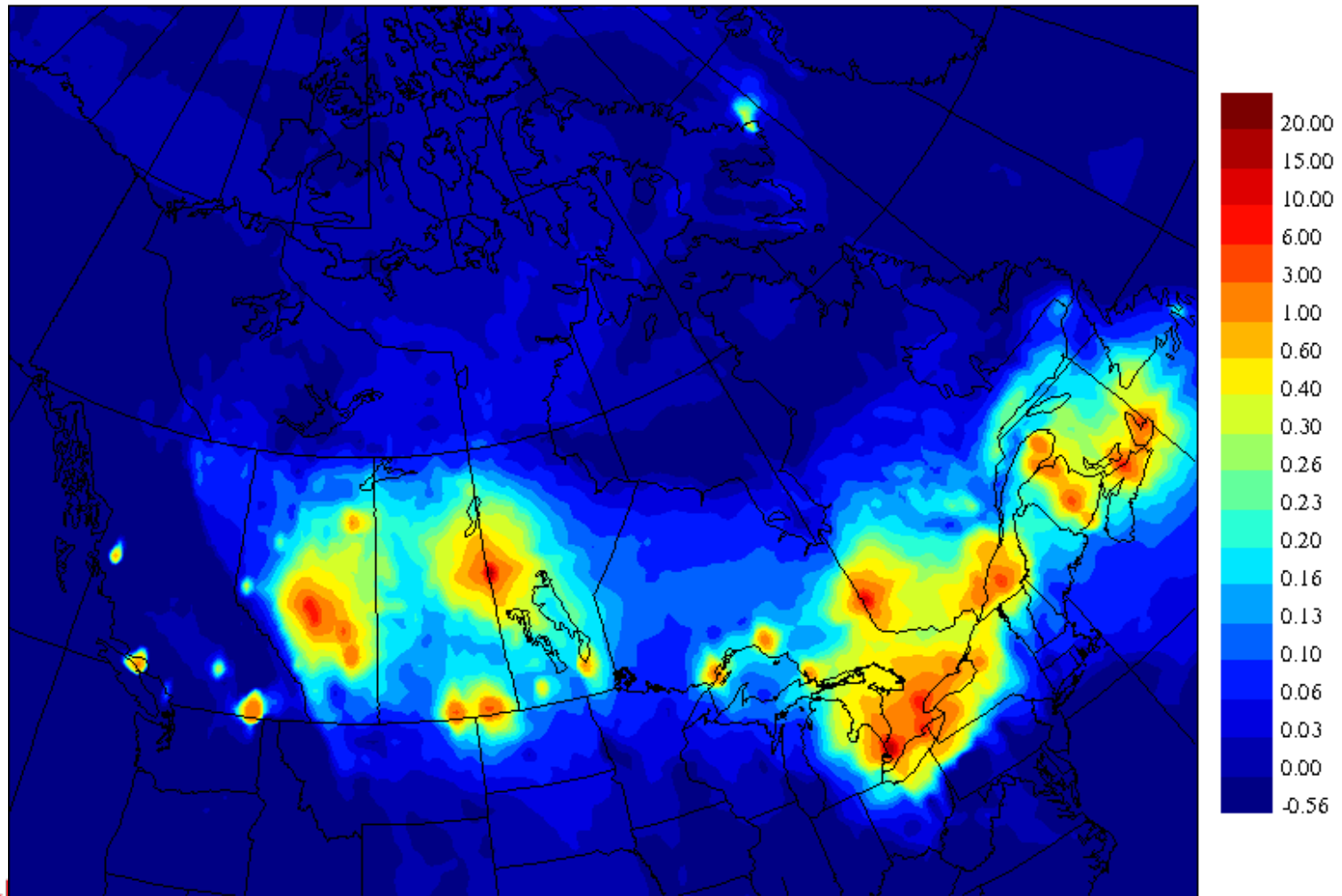


# Atmospheric Mercury Measurements

- Total Gaseous Mercury (TGM) or Gaseous Elemental Mercury (GEM):
  - In-situ continuous monitor, 5 min., ~1.5 ng/m<sup>3</sup>
- Mercury in precipitation:
  - precipitation collector, weekly sample, 5-15 ng/L.
  - US Mercury Deposition Network or sent to Canadian laboratory.
  - Methyl Mercury analyses at some sites.
- Mercury Speciation:
  - In-situ, research-grade system, 2-3 hours.
  - Gaseous Elemental Mercury
  - Particulate Mercury, pg/m<sup>3</sup>
  - Reactive Gaseous Mercury (RGM) or Gaseous Oxidized Mercury (GOM), pg/m<sup>3</sup>
  - Research into methodology improvements.



# Dastoor et al: Modelled Total Annual Mercury Deposition in Canada from Canadian Point Sources.

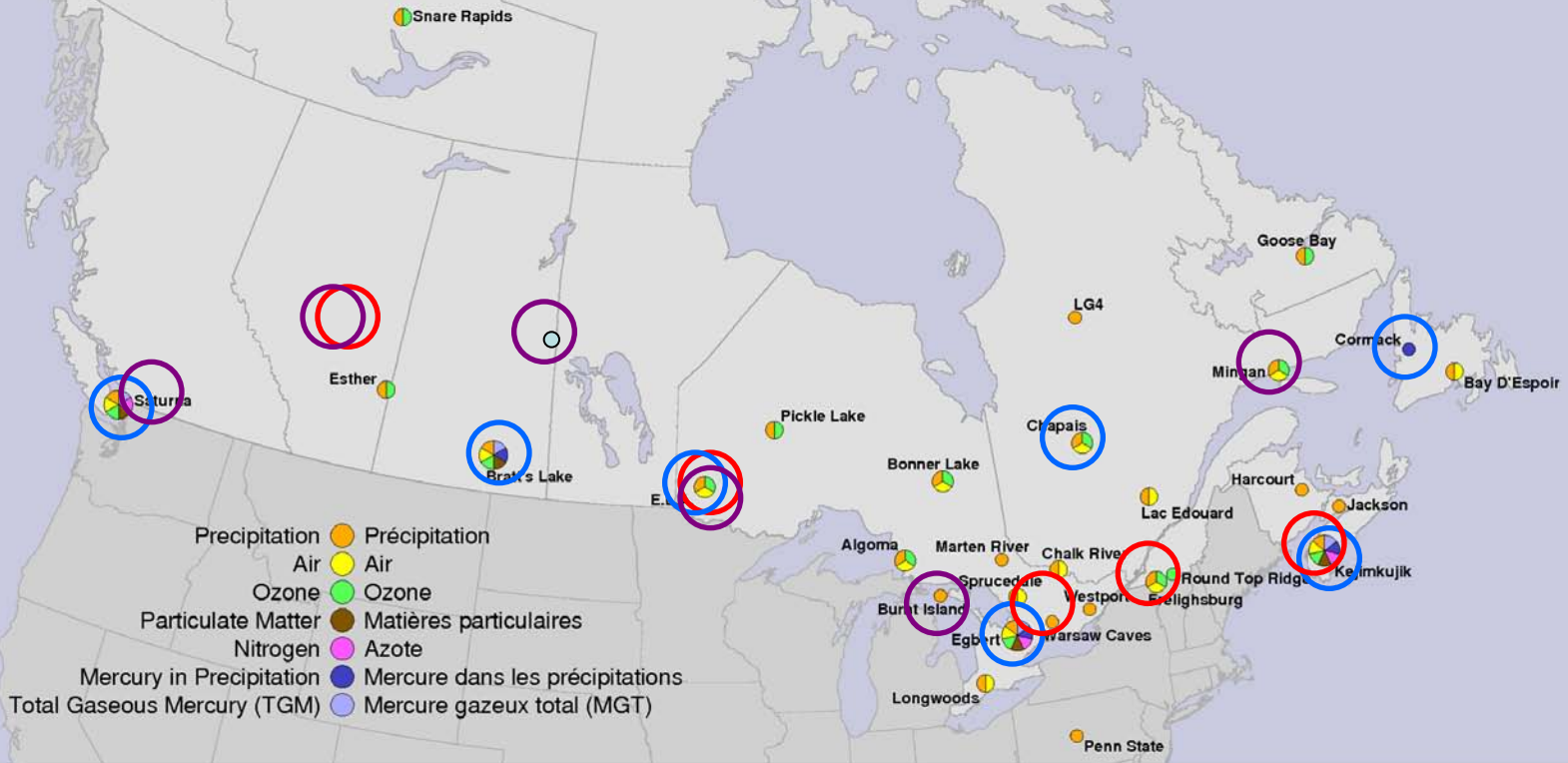




The Canadian Air and Precipitation Monitoring Network  
Réseau canadien d'échantillonnage des précipitations et de l'air

2009

- CAPMoN (GEM and/or Precip (MDN))
- Speciation (GEM, RGM, pHg)
- Other GEM or Precip



Precipitation	<span style="color: orange;">●</span>	Précipitation
Air	<span style="color: yellow;">●</span>	Air
Ozone	<span style="color: green;">●</span>	Ozone
Particulate Matter	<span style="color: brown;">●</span>	Matières particulaires
Nitrogen	<span style="color: pink;">●</span>	Azote
Mercury in Precipitation	<span style="color: blue;">●</span>	Mercuré dans les précipitations
Total Gaseous Mercury (TGM)	<span style="color: lightblue;">●</span>	Mercuré gazeux total (MGT)



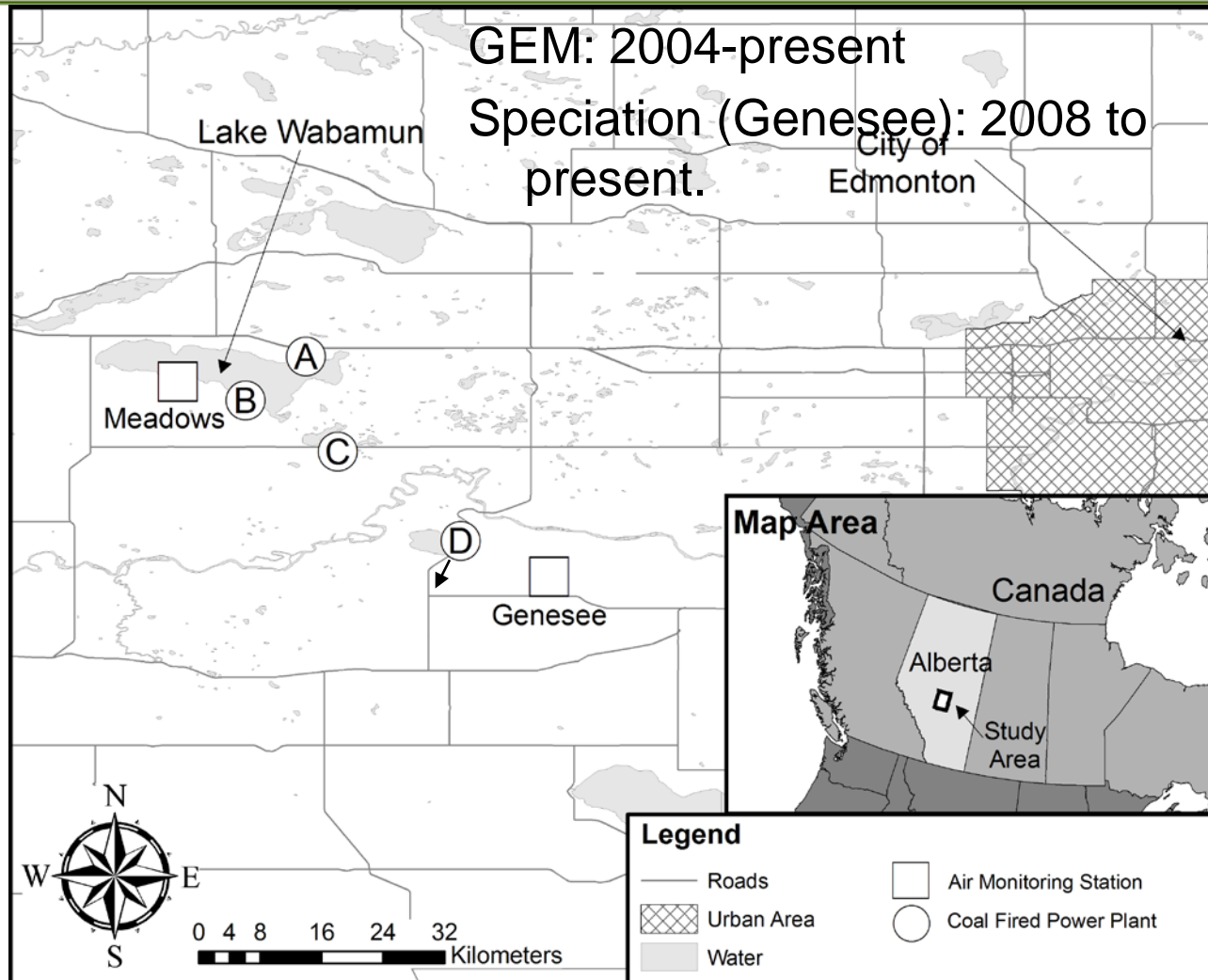
# Eastern Canada: Kejimikujik National Park



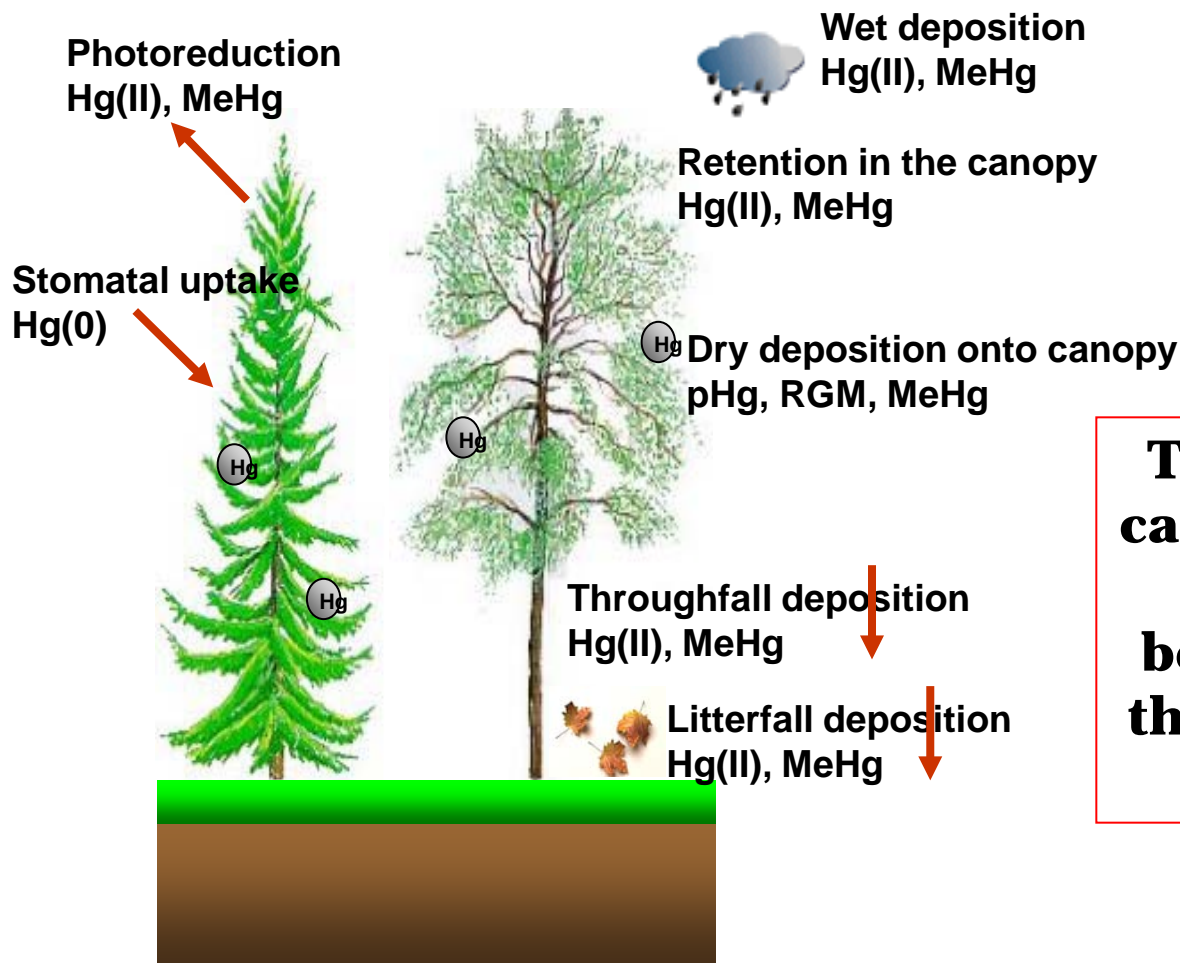
- Historical site for GEM (CAPMoN), MDN (NADP- NS01)
- Speciation: Jan. 2009-
- Site audit August 2009 (Mark Olsen - USGS)



# Western Canada: near coal-fired power plants.



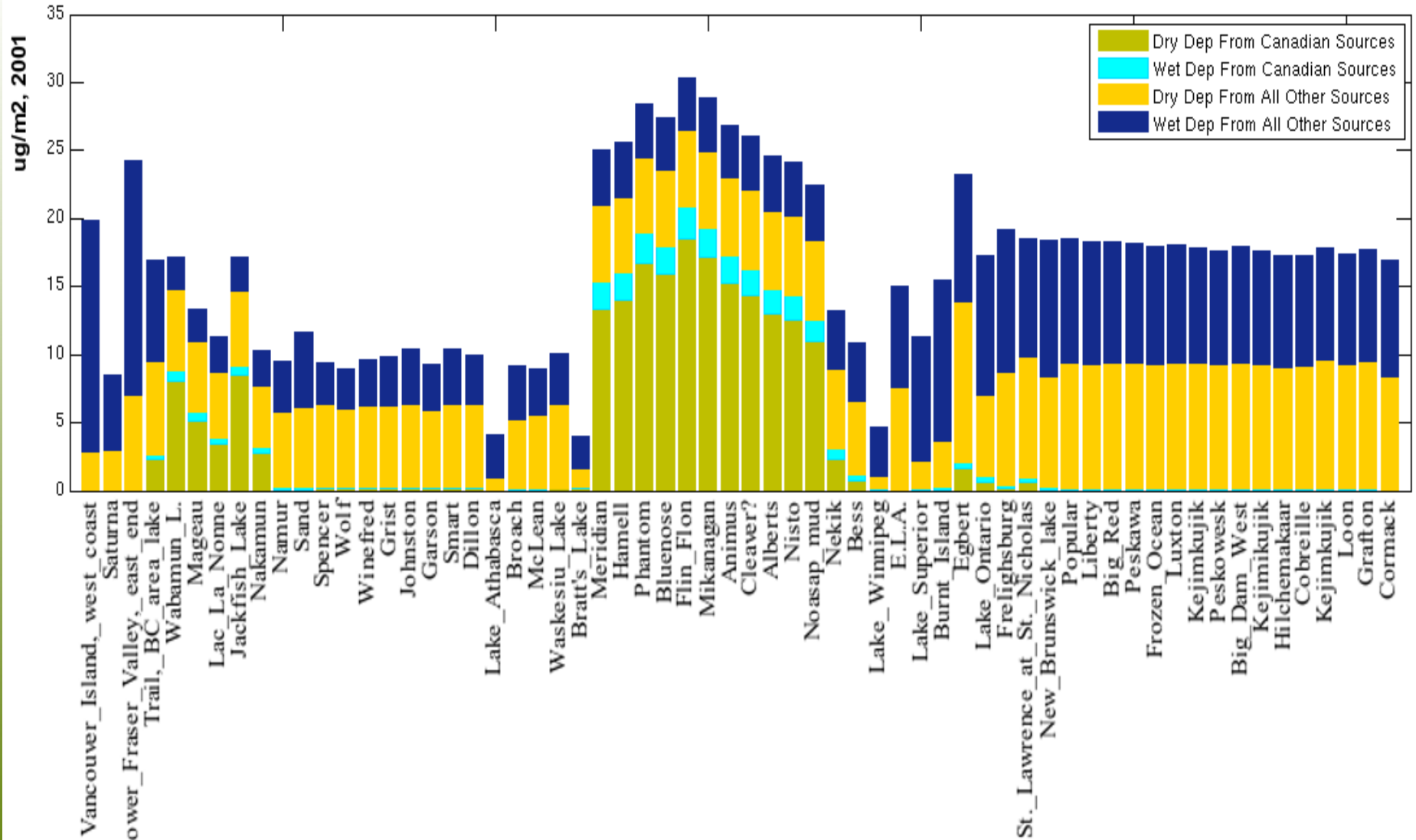
# Experimental Lakes Area Total Deposition: Vince St. Louis and Jenny Graydon (U. of Alberta)



**The forest canopy can result in up to 8 times more Hg being deposited to the watershed than to open areas**



# Dastoor et al: Modelled Mercury Deposition Across Canada ( $\mu\text{g m}^{-2} \text{y}^{-1}$ ).

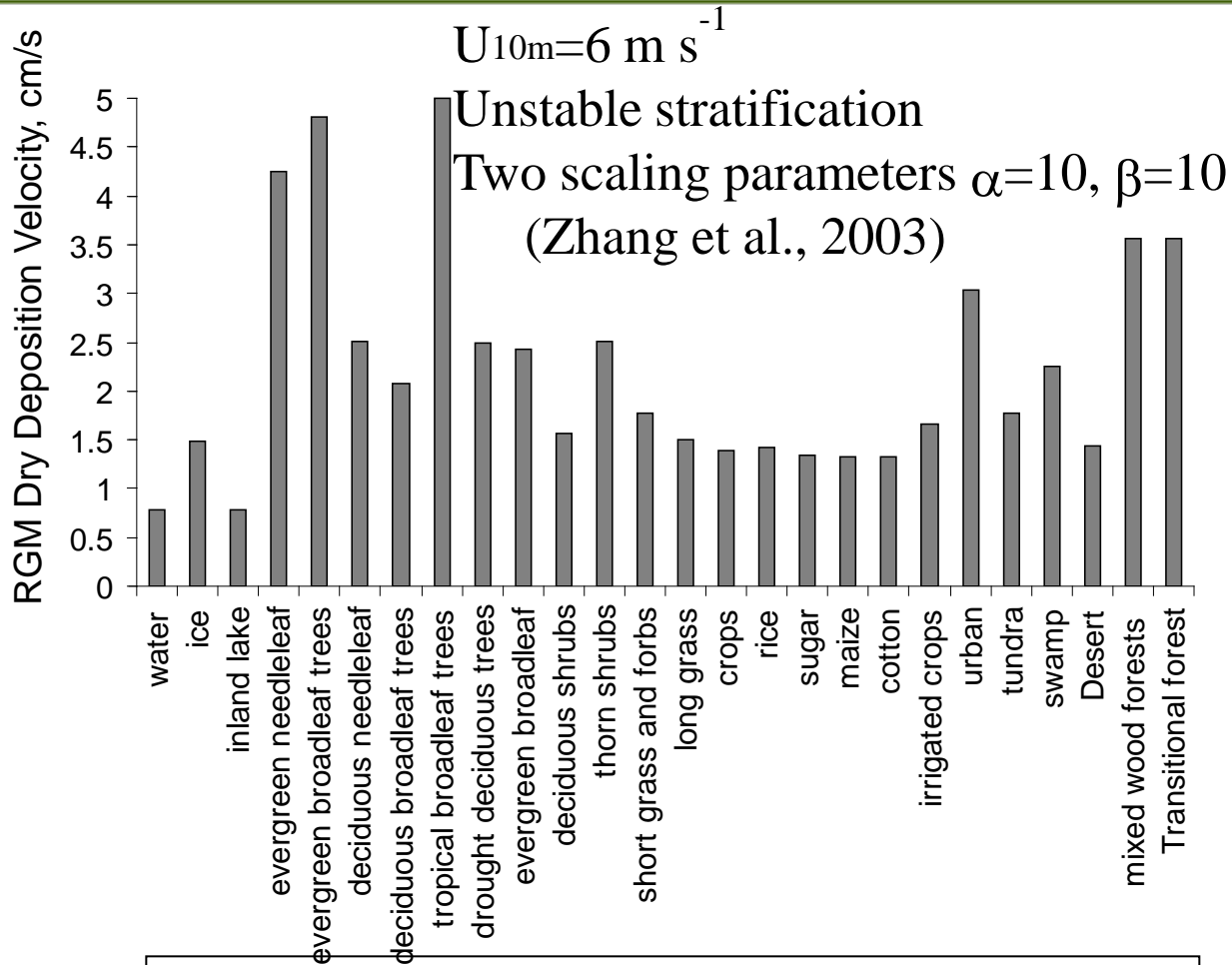


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# R&D: Modelling Dry Deposition of Atmospheric Mercury



Zhang et al. Atmospheric Environment, 2009



# R&D: New Methods for Mercury Speciation, Parisa Ariya et al. (McGill University)

## Gold Nanoparticle Microextraction of RGM:

- Gold preconcentrates RGM through adsorption and amalgamation
- Nanoparticles have high surface area, can be placed on portable fibers, filters and other surfaces.
- Microextraction exposes air stream to small quantity of nanoparticles

Atmospheric Pressure Chemical  
Ionization Tandem Mass Spectrometry  
used to detect mercury species.



# Collaboration with NADP-MDN-AMNet

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- CAPMoN sites part of MDN. Intercomparison sites.
- Canadian scientists participate in the development of SOP and QA/QC protocols used for both Canadian and US NADP-AMNet sites.
- Speciation data QC intercomparison:
  - Compare data quality control handling methods between NADP program and EC's RDMQ module.
  - Year-long data sets from sites have been exchanged with NADP





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