The Integrated Atmospheric Deposition Network

Great Lakes Binational Toxics Strategy (GLBTS)
B(a)P / HCB Workgroup Meeting
December 12, 2007

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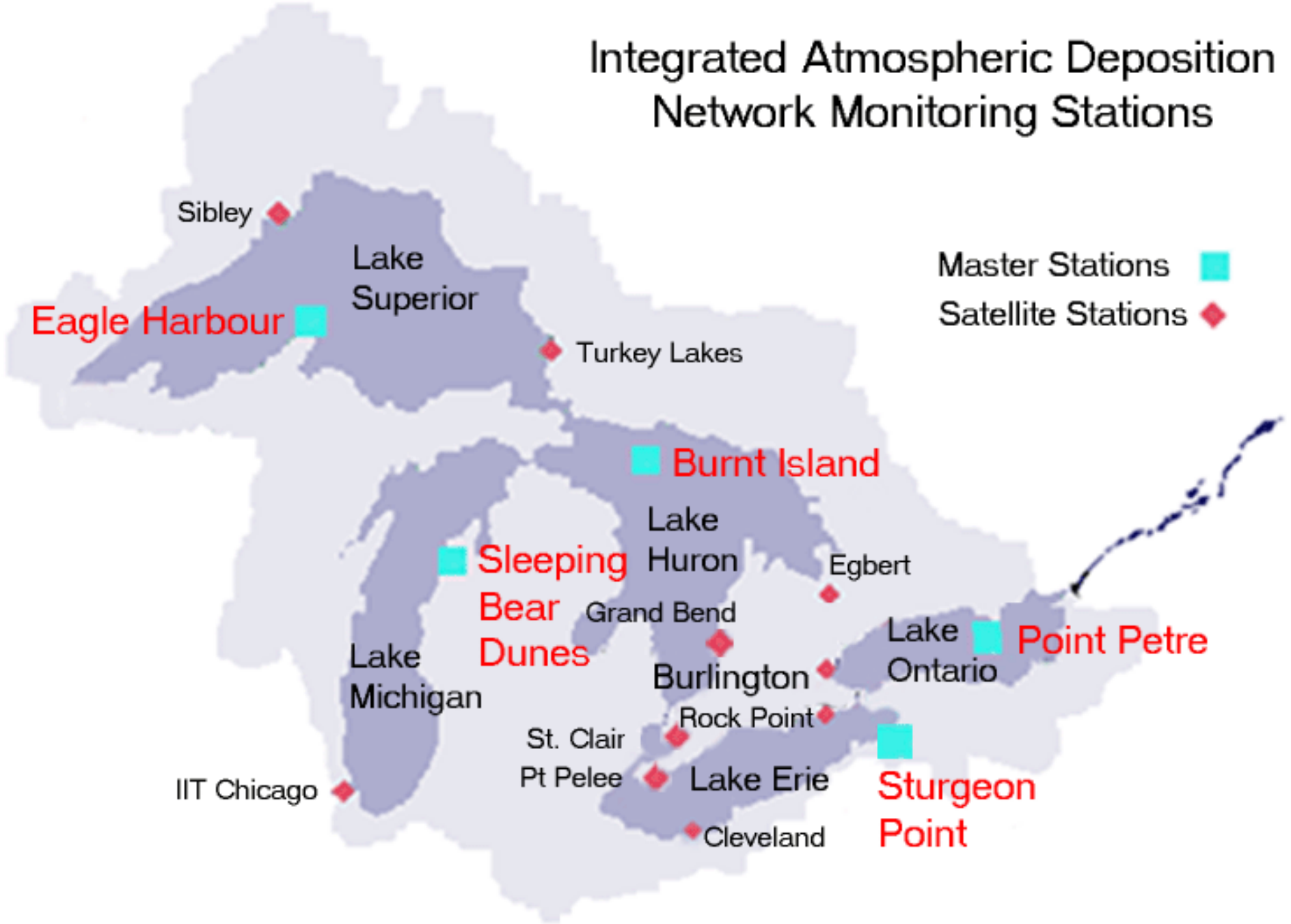
U.S. Environmental Protection Agency

Acknowledgements

- Most data slides from Ron Hites, Ilora Basu, Marta Venier, Lingyan Zhu, Eunha Hoh, and Ping “Sunny” Sun of Indiana University (IADN grantee)
- Binational IADN Steering Committee
- Tom Dann of Environment Canada for NAPS data
- And of course Melissa Hulting

Integrated Atmospheric Deposition Network (IADN)

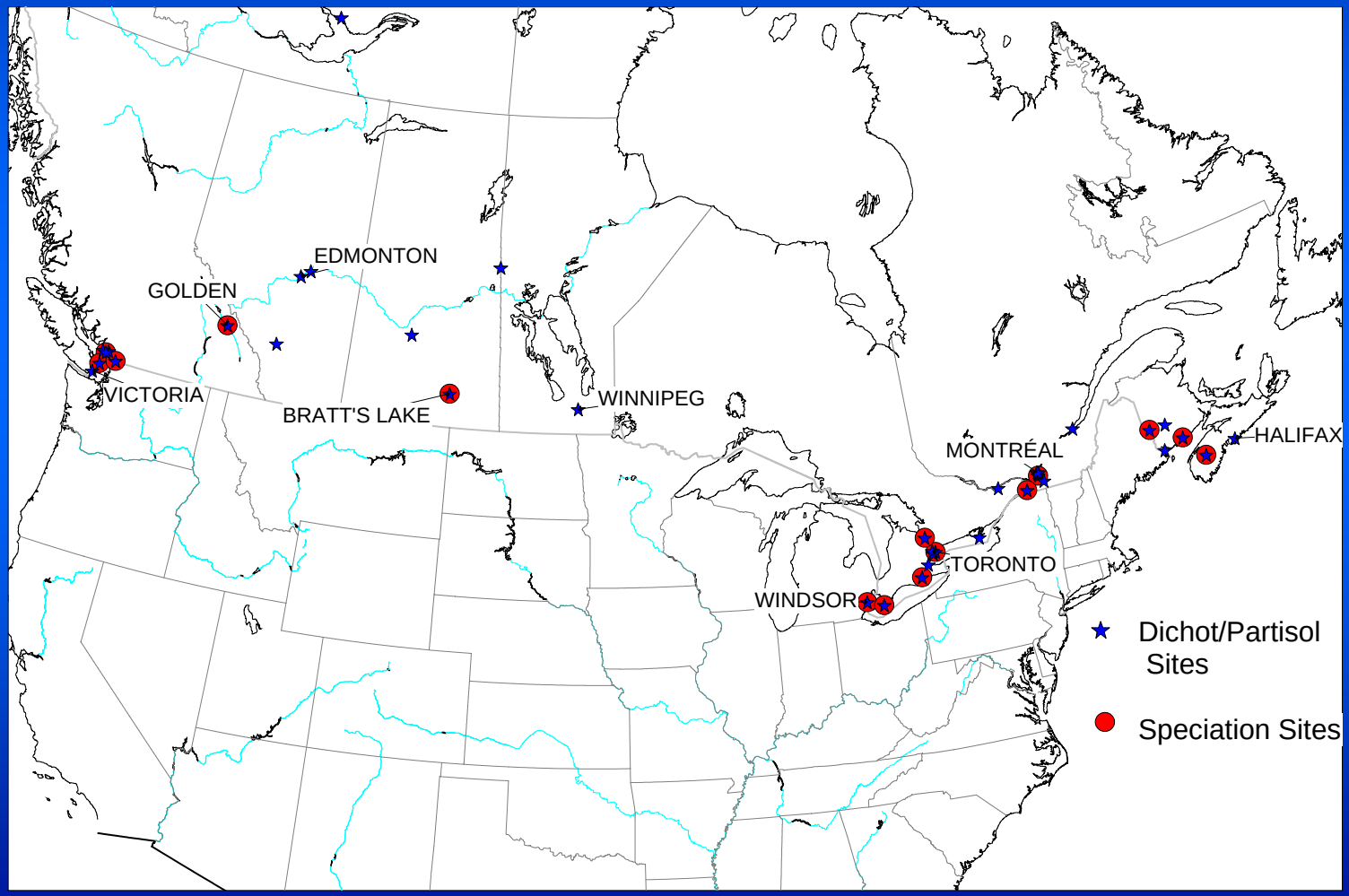
- Joint EPA-Environment Canada project
  - Grantee is Ron Hites at Indiana University
- In operation since 1990 (GLWQA and CAAA of 1990)
- Measure PBTs in air and precipitation at 15 sites around the Great Lakes (U.S. runs five)
- Goals:
  - Determine atmospheric loadings
  - Look at trends in concentrations
  - Use data to measure progress


Integrated Atmospheric Deposition
Network Monitoring Stations
Master Stations
Satellite Stations
Sibley
Lake
Superior
Eagle Harbour
Turkey Lakes
Burnt Island
Lake
Huron
Sleeping
Bear
Dunes
Egbert
Grand Bend
Lake
Michigan
Lake
Ontario
Point Petre
Burlington
Rock Point
St. Clair
Pt Pelee
Lake Erie
Sturgeon
Point
IIT Chicago
Cleveland

National Air Pollution Surveillance (NAPS) Program

- The NAPS program is a cooperative federal-provincial-territorial network of over 800 ambient air quality monitoring instruments across Canada, mostly in urban centres.
- Substances measured:
  - PAH
  - PCDD/PCDF
  - Hexachlorobenzene (HCB)
  - Pentachlorophenol (PCP)
  - Octachlorostyrene (OCS)
  - Nitro-PAH - C13 to C22, 24 species including dinitropyrenes
  - Dioxin like PCBs
  - Metals - Hg, Cd, Pb
  - VOC - 1,4-dichlorobenzene
- http://www.etc-cte.ec.gc.ca/NAPS/

NAPS locations

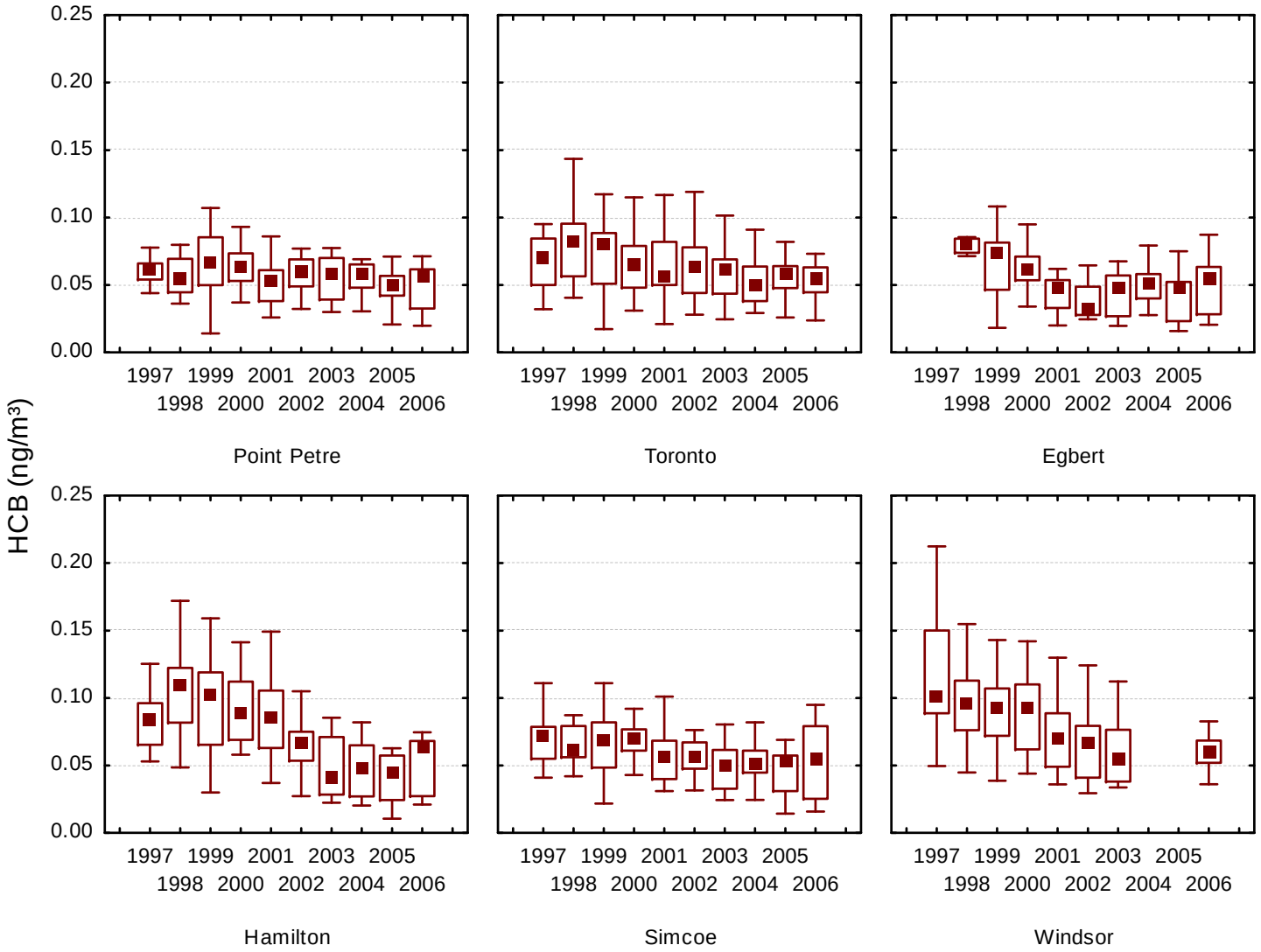


Why air?

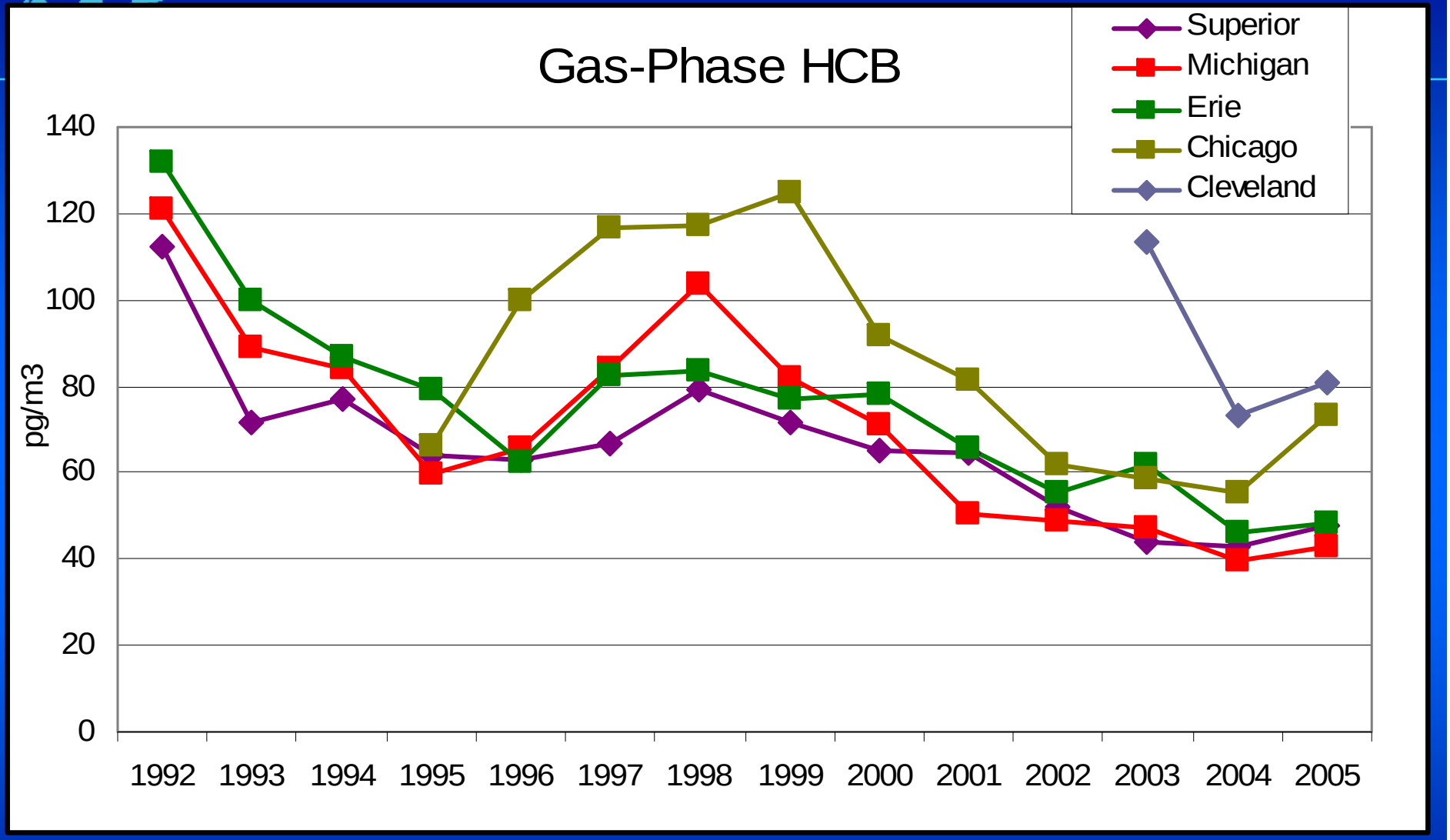
- Primary pathway for input to the Lakes
- Air concentrations respond rapidly to changes in emissions


HCB

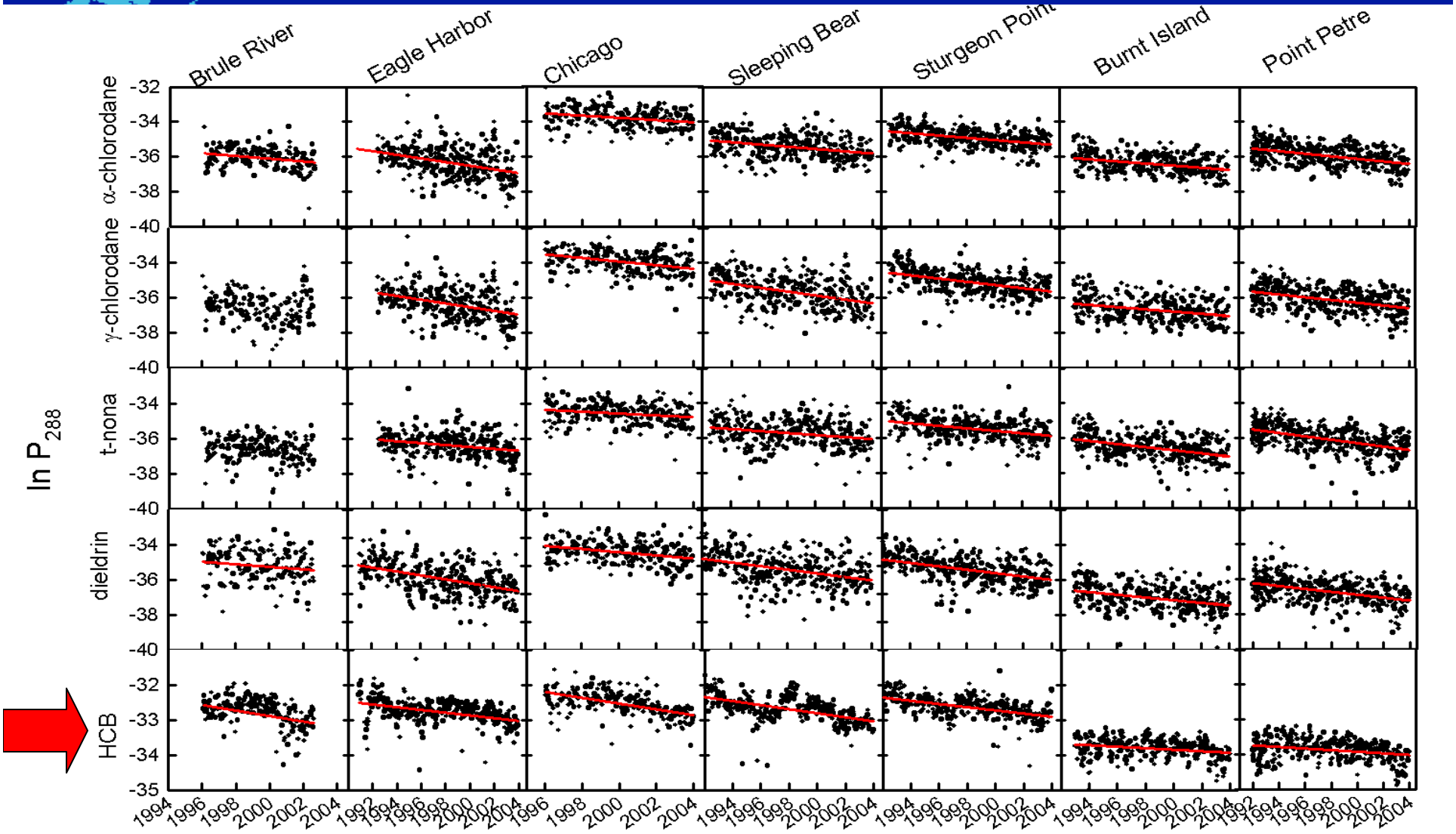
Slow decrease in HCB



Annual Variation in Hexachlorobenzene Concentrations (ng/m3) at Ontario Sites (1997-2006)

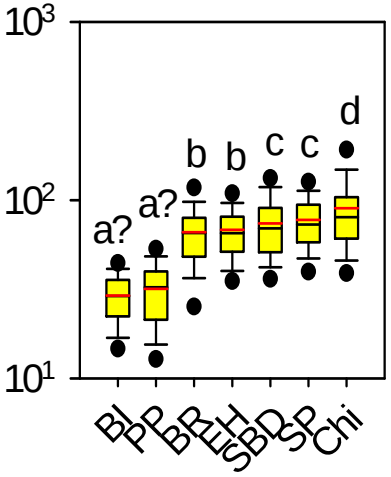


Ma et al. 2004a. How Do Climate Fluctuations Affect Persistent Organic Pollutant Distribution in North America? Evidence from a Decade of Air Monitoring. *Enviro. Sci. Technol.* 38 (9): 2538 –2543.

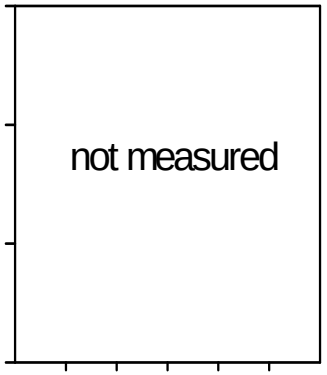

Brule River
Eagle Harbor
Chicago
Sleeping Bear
Sturgeon Point
Burnt Island
Point Petre
α-chlorodane
γ-chlorodane
t-nona
dieldrin
HCB
ln P288
-32
-34
-36
-38
-40
-33
-35
1992
1994
1996
1998
2000
2002
2004

Hexachlorobenzene

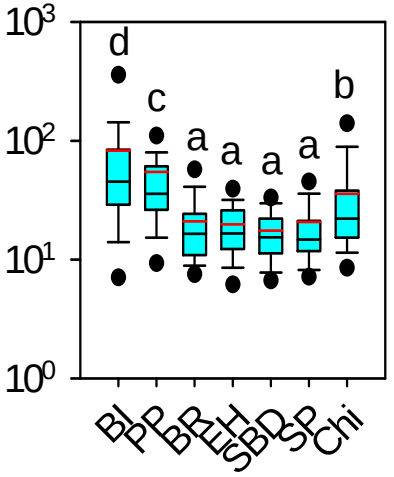
Vapor-phase conc. (pg/m^3)



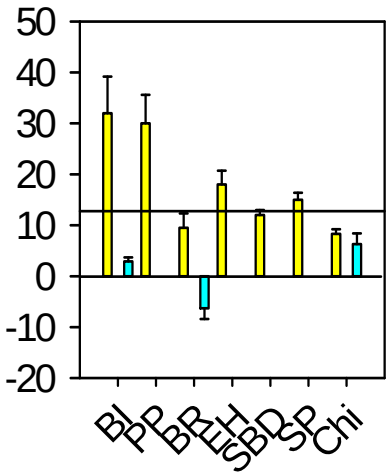
Particle-phase conc. (pg/m^3)



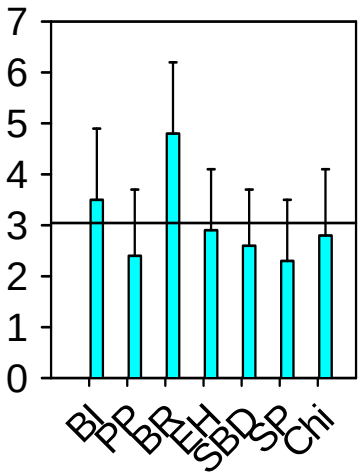
Precip. conc. (pg/L)



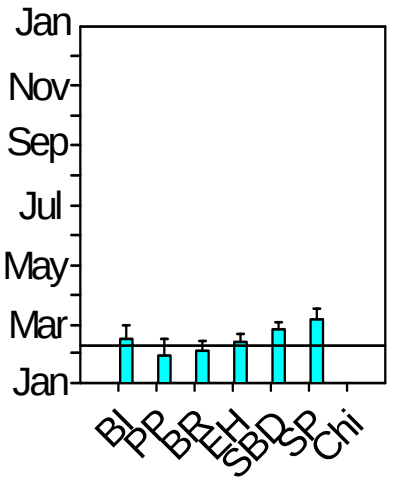
Half-lives (years)



Max to min ratios



Maximum dates



Half-Lives for gas-phase HCB are decreasing……

Data through….	2001	2002	2003
Eagle Harbor (Superior)	29	23.7	18
S.B. Dunes (Michigan)	15	15.7	12
Sturgeon Pt. (Erie)	18	17.1	15
IIT (Chicago)		19.4	8.3

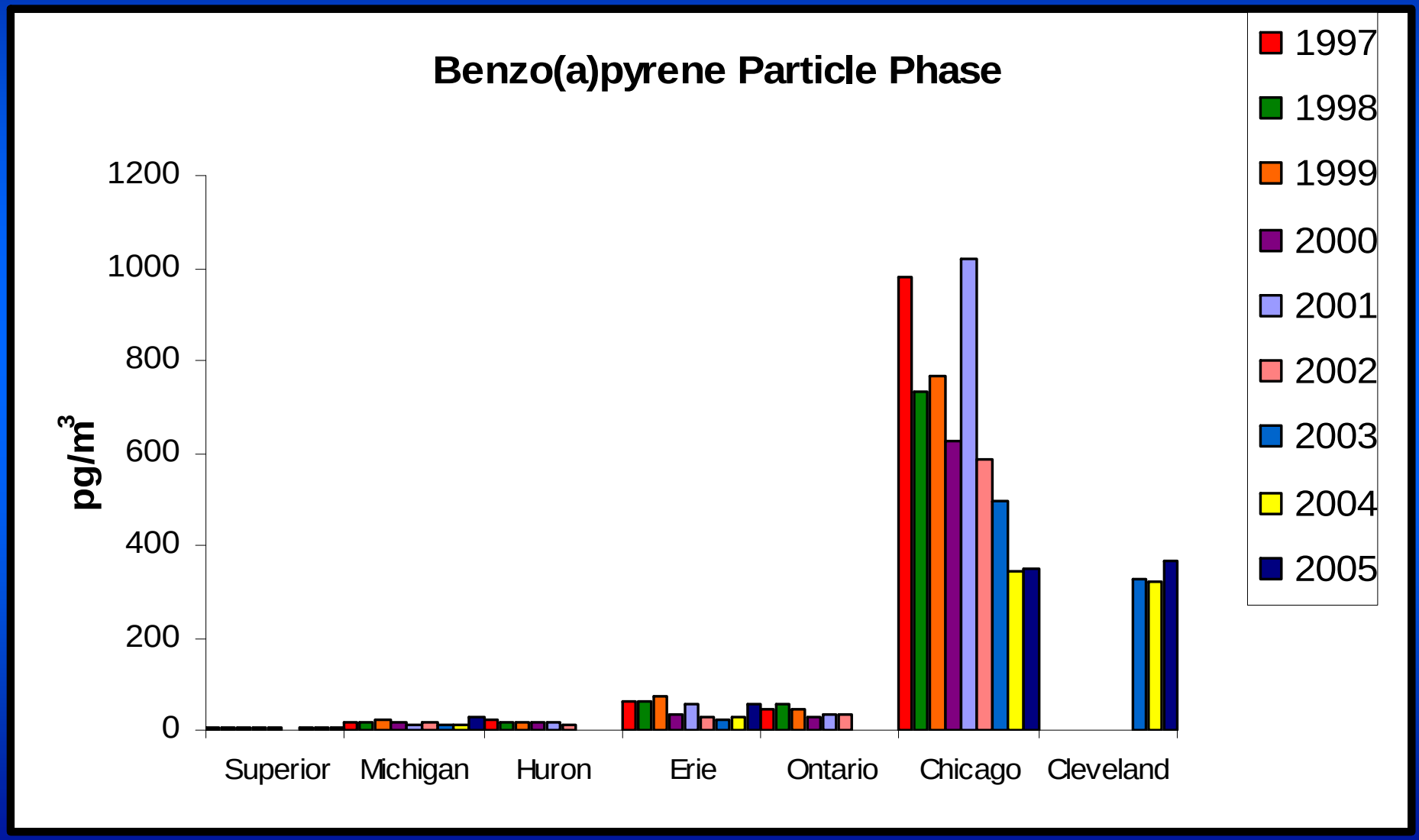
Buehler et al. 2004

Sun et al. 2006

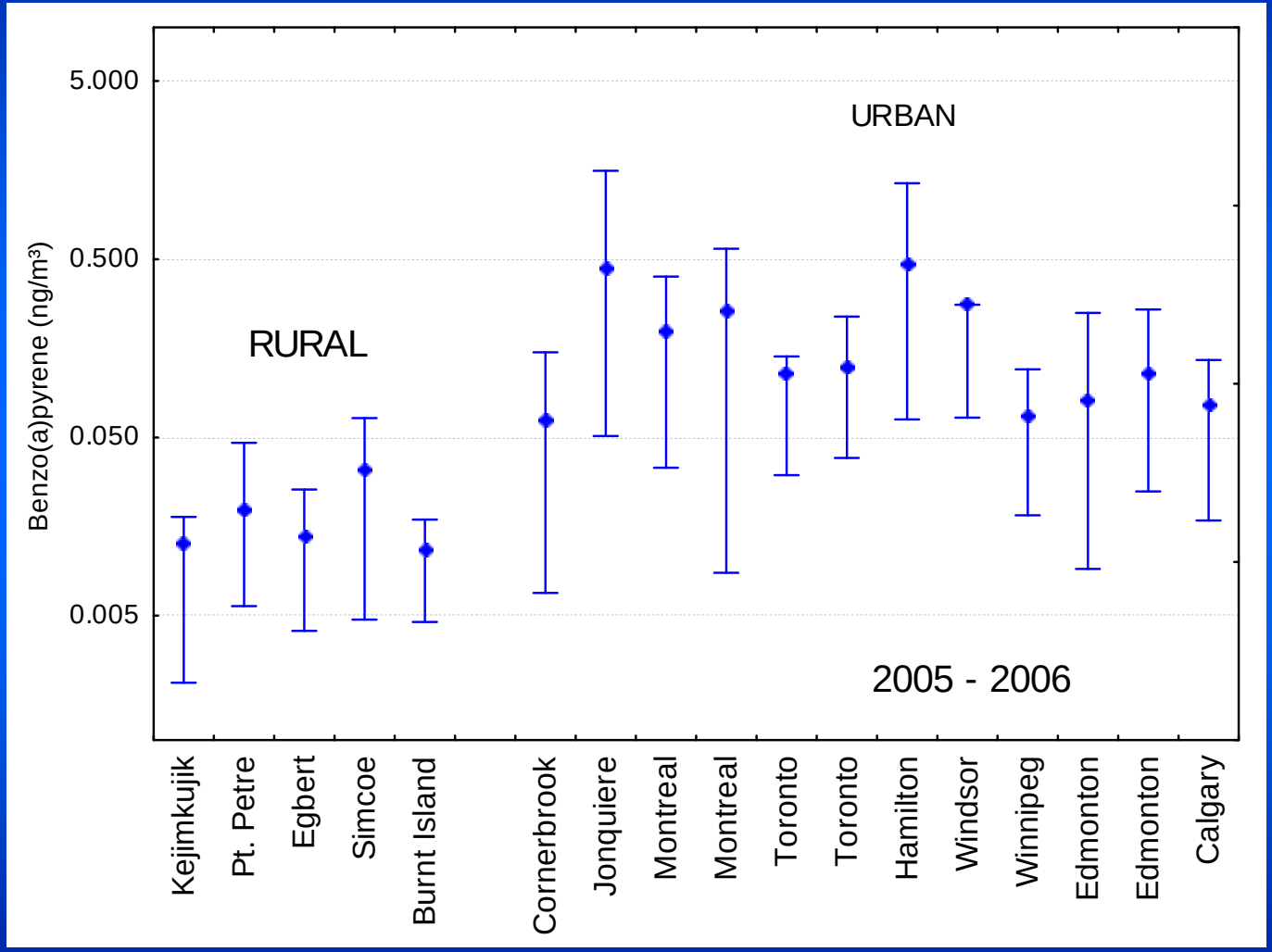
Most likely, increases in HCB in the late 1990s/early 2000s lengthened half-lives calculated previously.


Benzo(a)pyrene

Urban PAH levels are 10-100x higher in Chicago than in rural areas

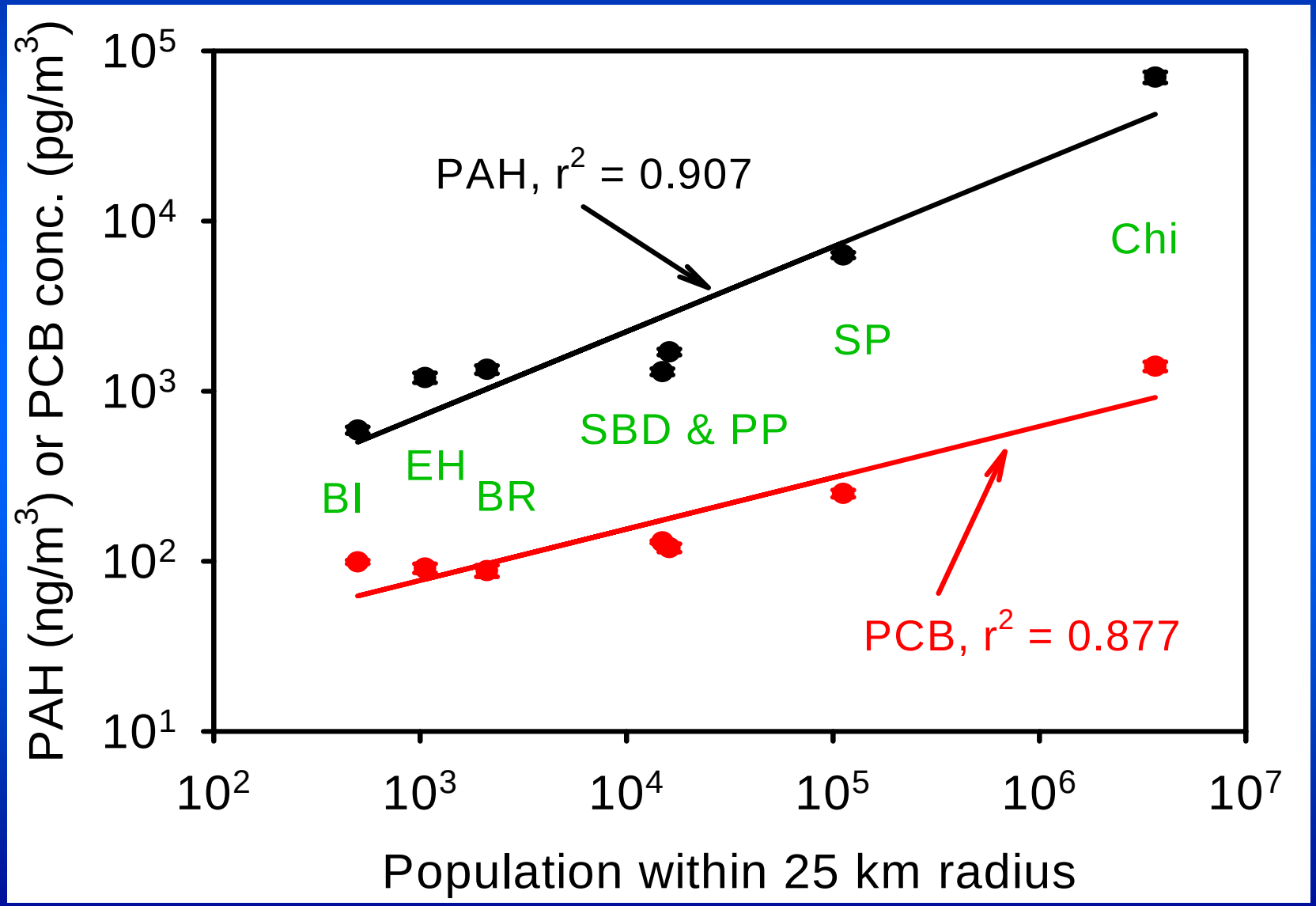


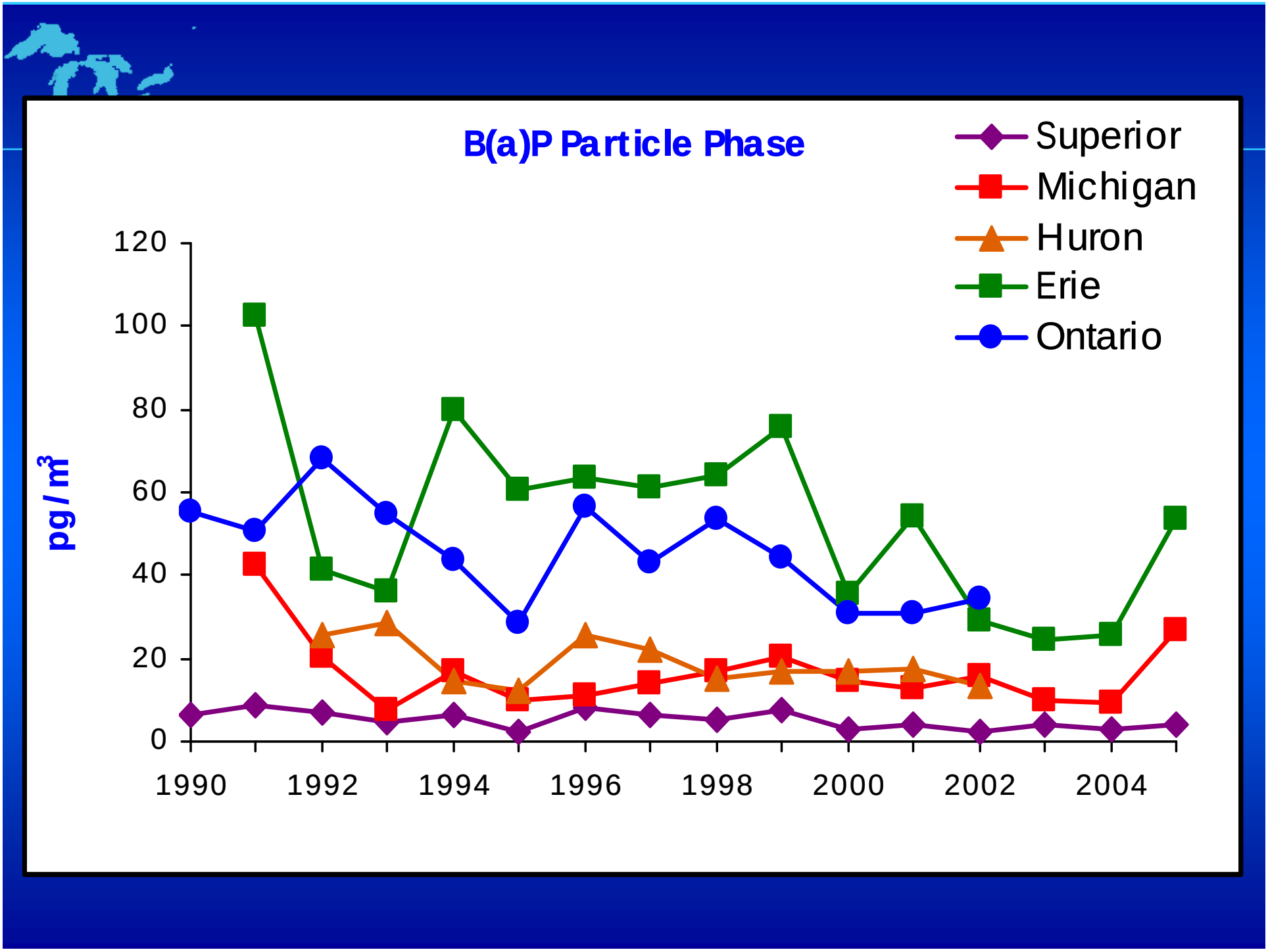
Rural BaP concentrations are about 10x lower than urban

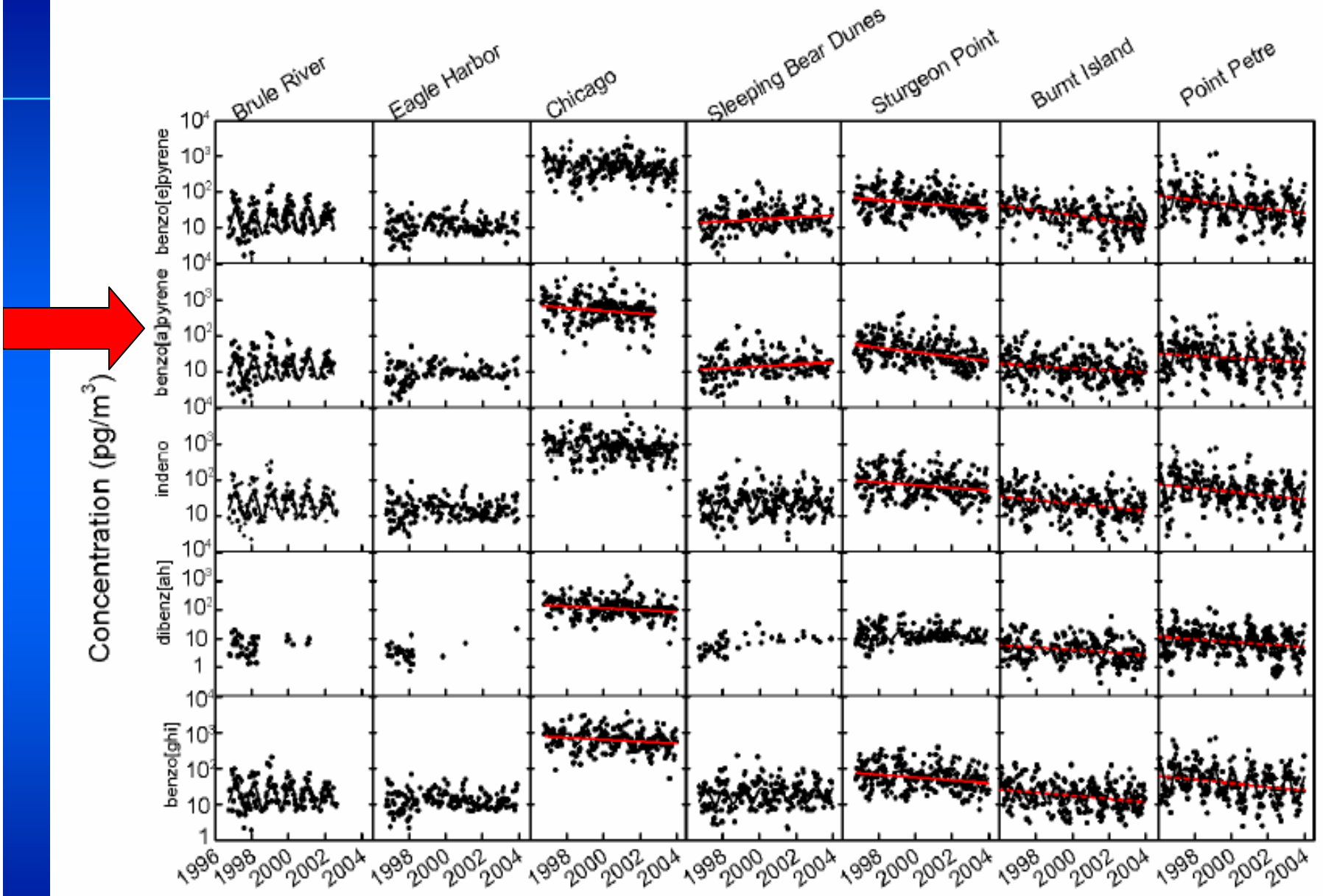


Benzo(a)pyrene Concentrations (ng/m³) 2005-2006
(Mean, 10th and 90th percentiles)

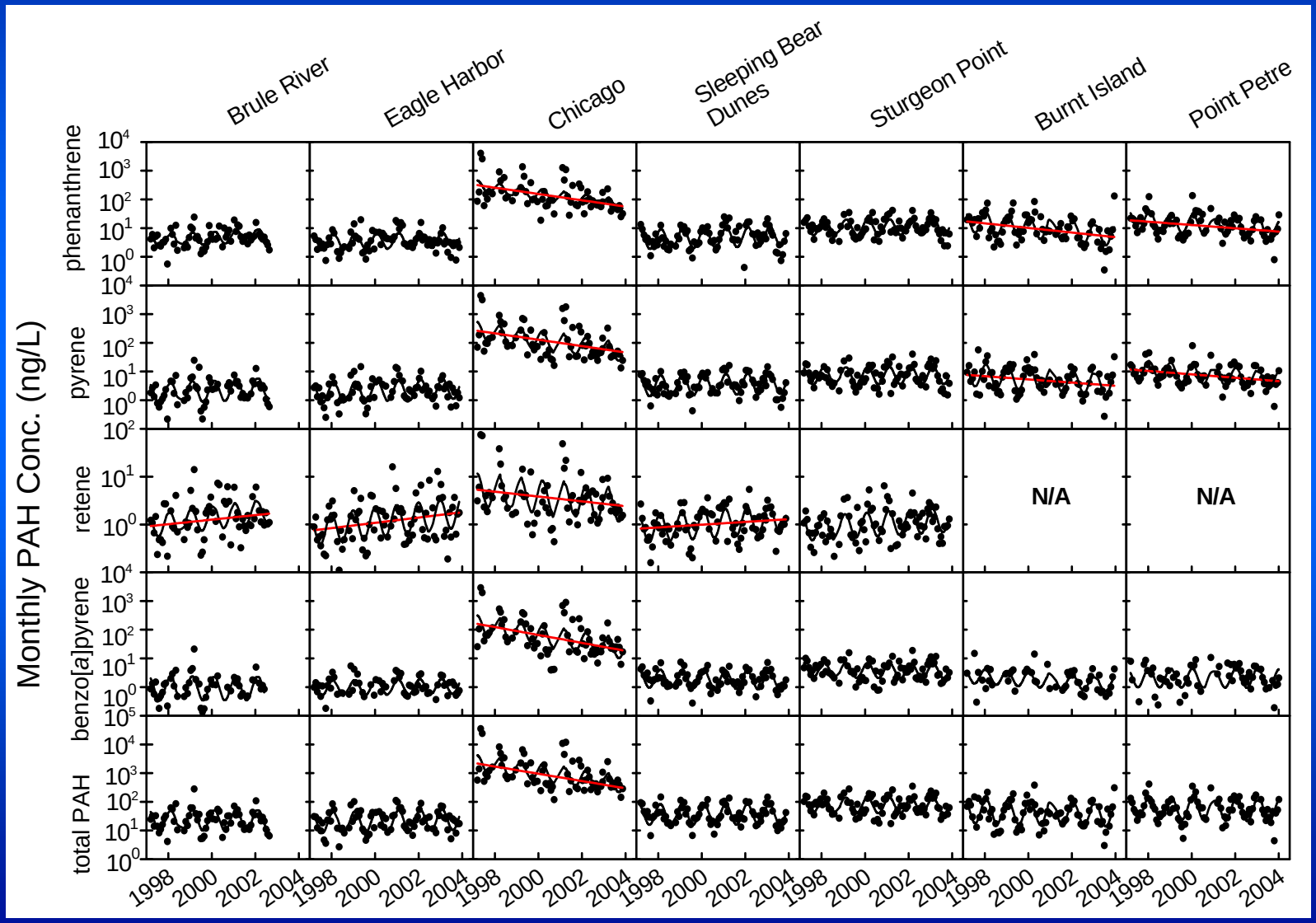
PAHs and PCBs are now largely an urban problem




B(a)P Particle Phase
Superior
Michigan
Huron
Erie
Ontario
pg / m3
120
100
80
60
40
20
0
1990
1992
1994
1996
1998
2000
2002
2004


Brule River
Eagle Harbor
Chicago
Sleeping Bear Dunes
Sturgeon Point
Burnt Island
Point Petre
benzo[e]pyrene
benzo[a]pyrene
indeno
dibenz[ah]
benzo[ghi]
Concentration (pg/m3)
1996
1998
2000
2002
2004

PAHs in precipitation are generally decreasing at Chicago



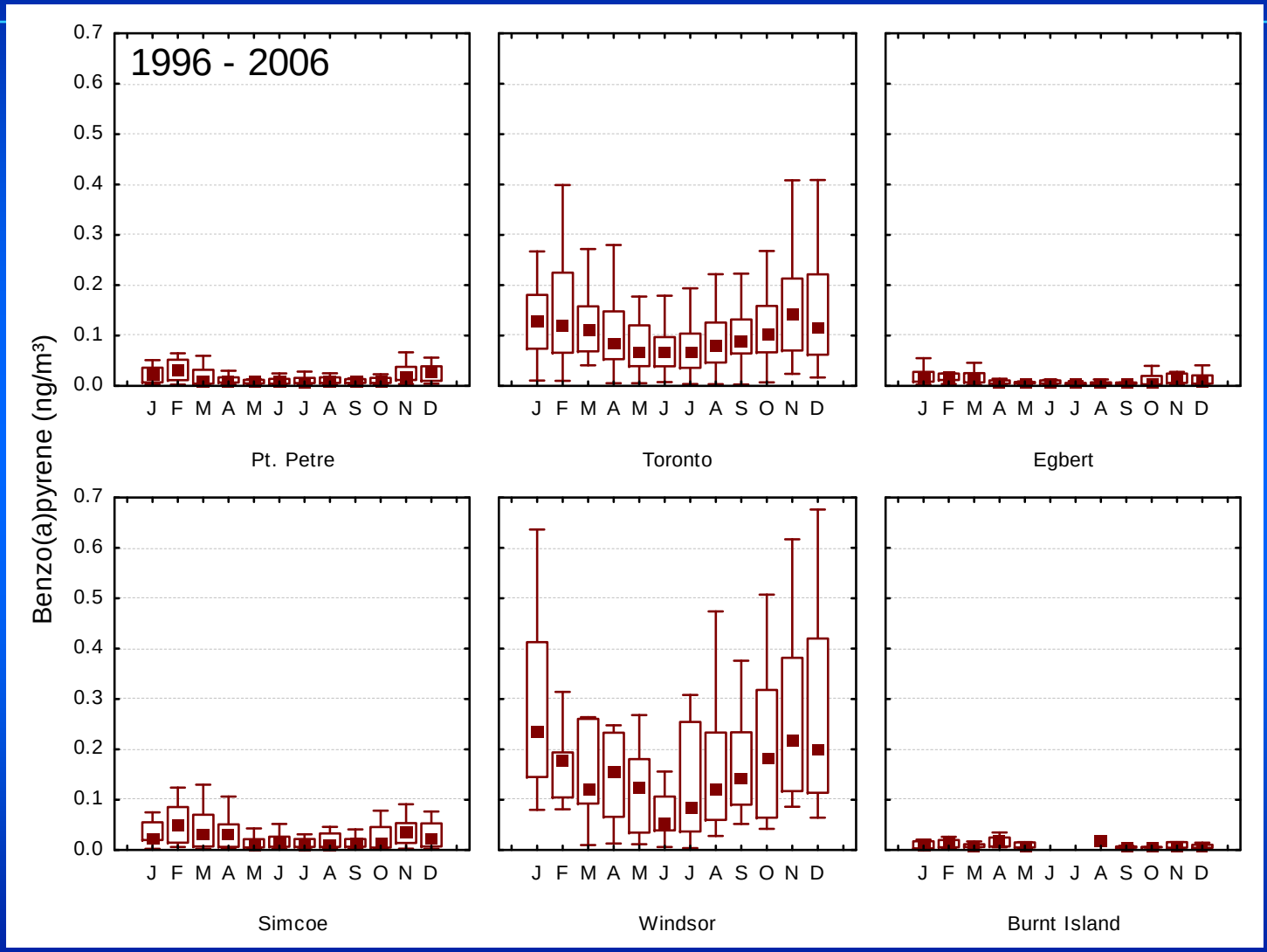
Some evidence of decreasing BaP concentrations on particles…..
but are levels increasing at Sleeping Bear Dunes?

Site	Precipitation	Particles
Eagle Harbor (Superior)	ns	ns
S.B. Dunes (Michigan)	ns	-11 (ms)
Burnt Island (Huron)	ns	11 (ms)
Sturgeon Pt. (Erie)	ns	4.8
Pt. Petre (Ontario)	ns	11 (ms)
IIT-Chicago	2.4	9.6 (ms)

But decreases in low MW PAHs at Cdn sites

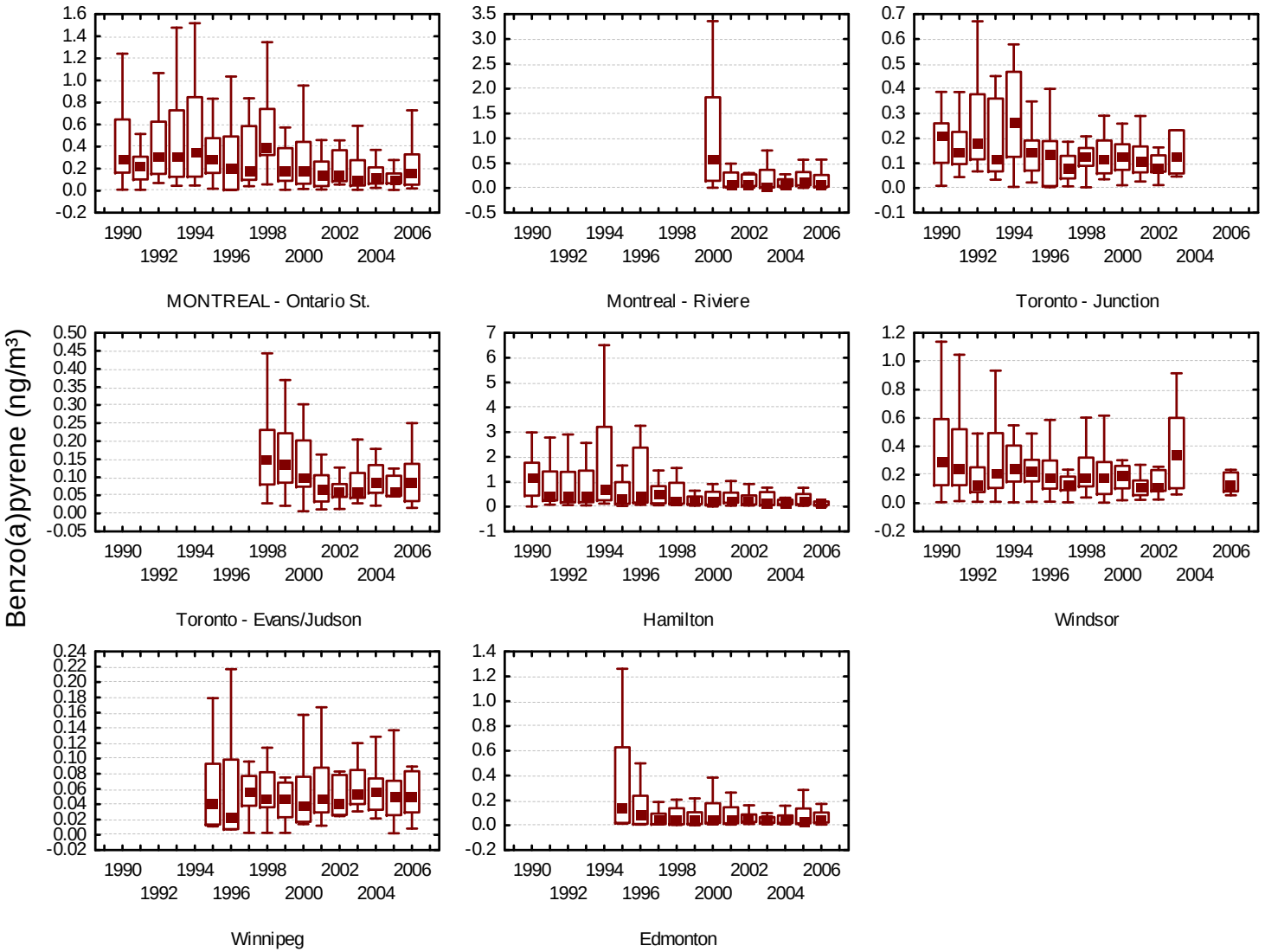
BaP half-lives for data through 2003

BaP higher in winter



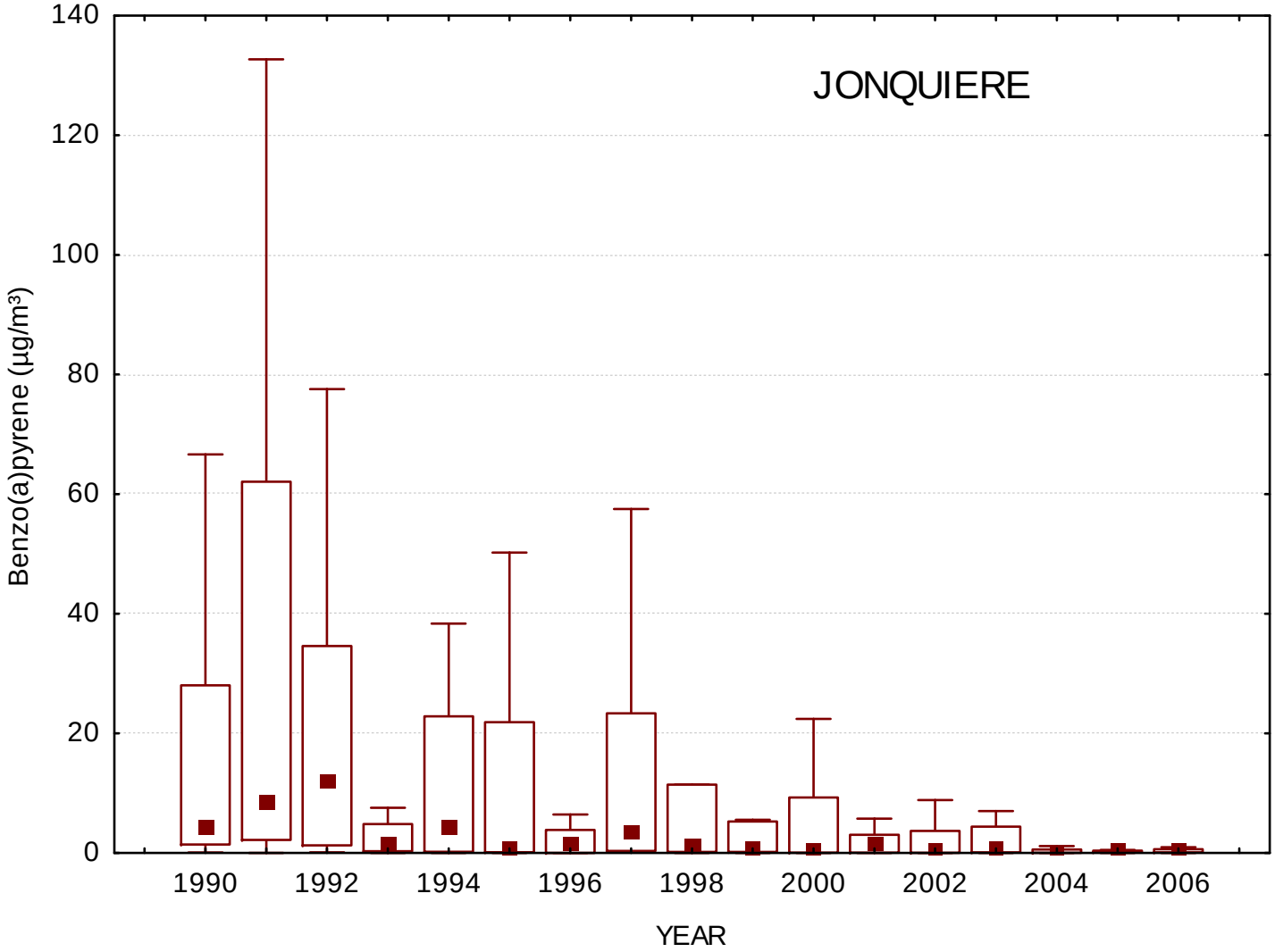
Seasonal Variation of B(a)P (ng/m³) at Ontario Sites (1996-2006)

NAPS sites - Small or no decrease



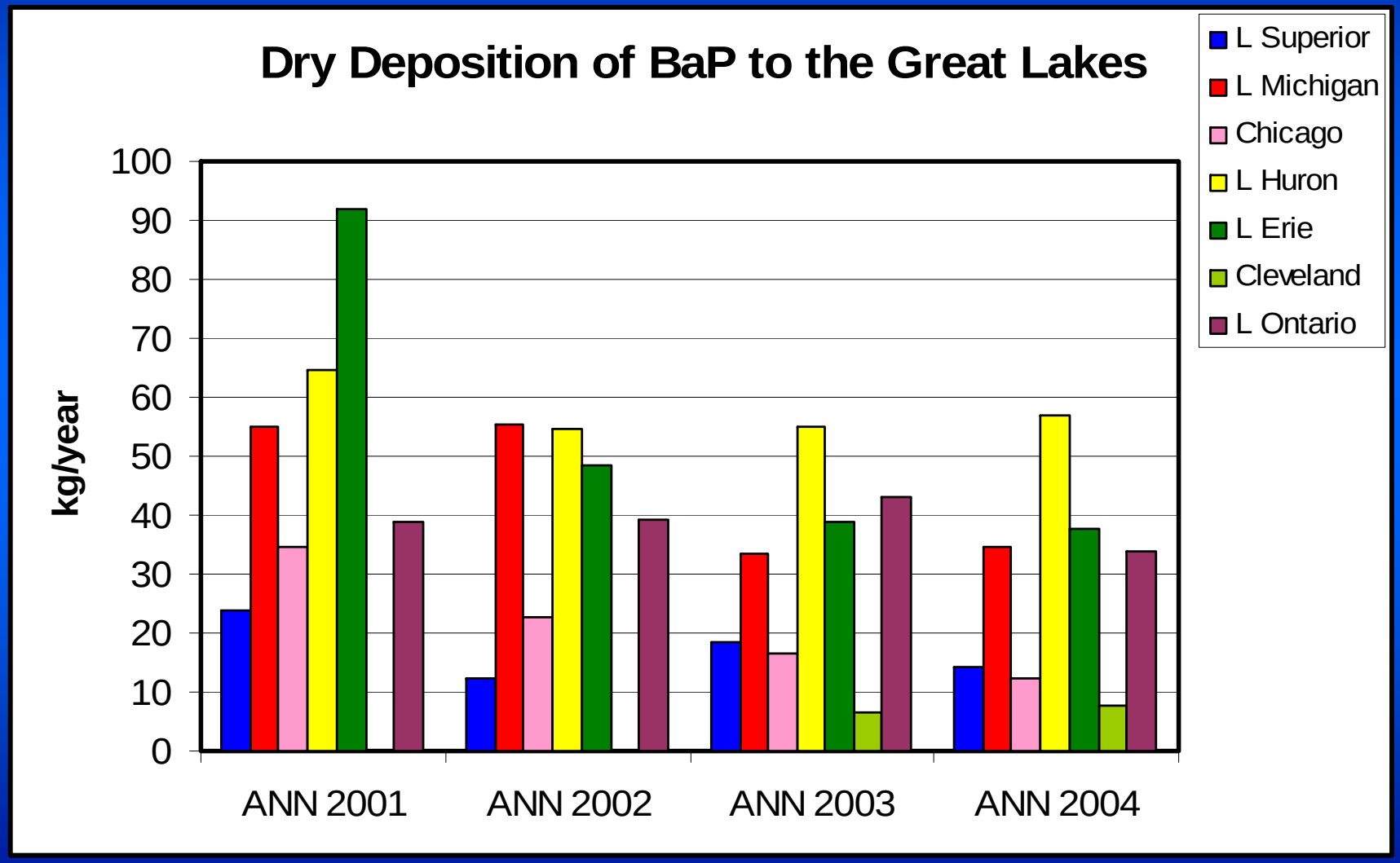
Trend in Benzo(a)pyrene Concentrations (ng/m3) (1990-2006)

Possible decrease in *mean* in major source areas?



Benzo(a)pyrene Concentrations (ng/m³) at Jonquière

Urban Impact for benzo(a)pyrene and other PAHs Significant: Chicago load increases Lake Michigan load by about 50%



Conclusions: HCB

- Levels are decreasing slowly again after increases in the late 90s
- Little spatial variation in concentrations

Conclusions: BaP/PAHs

- Rural sites:
  - In general, no trend over time for BaP and other PAHs in precipitation, except:
  - Decreases in low MW PAHs in precip seen only at Canadian IADN sites
  - Some evidence of decreases in the particle phase, except possible increase at Sleeping Bear Dunes (L Michigan)
- Chicago
  - PAHs in precipitation at Chicago are decreasing with a half-life of 2-5 years (2.4 years for BaP)
  - Half-life for BaP on particles is 9.6 years (marginally significant)
- Source reductions may be having an impact in urban/source areas
- Retene increasing at Brule River, Eagle Harbor and Sleeping Bear Dunes (due to wood burning?)

IADN Resources

- Main website: Station and other info, data request
  - http://www.msc.ec.gc.ca/iadn/
- U.S. IADN Information Page: Links to reports, Resource Page with SOPs, etc.
  - http://www.epa.gov/glnpo/monitoring/air_new_design/iadn_info.html
- U.S. IADN Government Reporting Indicator Page
  - http://www.epa.gov/glnpo/glindicators/air/airb.html
- Todd Nettesheim (EPA), Liisa Jantunen (EC)

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