

US EPA ARCHIVE DOCUMENT

# Modelling the Long Range Transport of Toxic Substances to the Great Lakes: 10-Years of Progress and Next Steps

S. Venkatesh  
Environment Canada

T. Nettesheim  
US-EPA, Region 5

# LRT Challenge

- Assess atmospheric inputs of strategy substances to the Great Lakes. The aim of this effort is to evaluate and report jointly on the contribution and significance of long-range transport of strategy substances from world-wide sources. If ongoing long-range sources are confirmed, work within international frameworks to reduce releases of such substances.

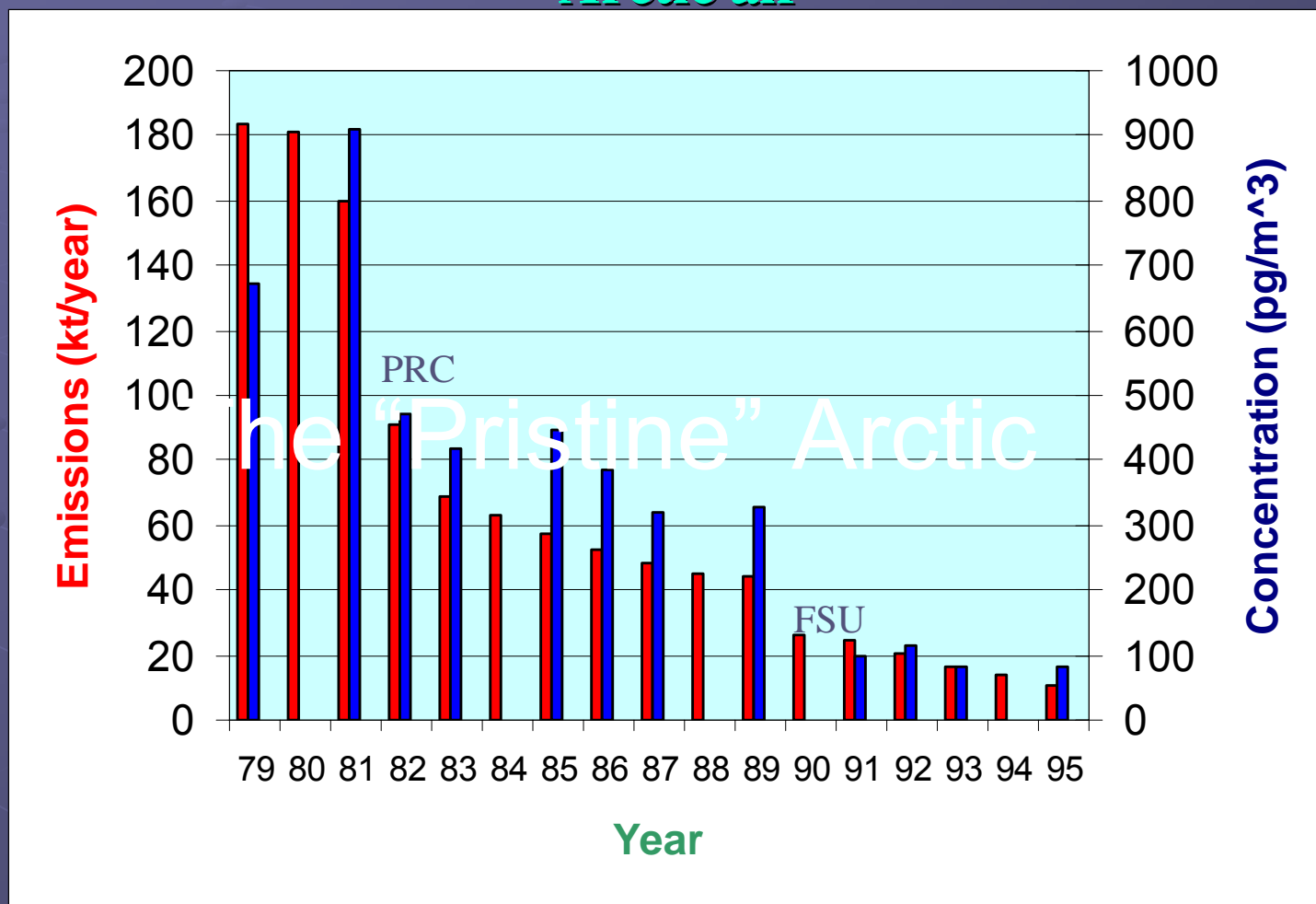
# Questions to Answer

- How do we know that LRT affects the GL region?
- What substances have we modelled and what can we say about them?
- How good are our capabilities in Regional and/or Global modelling of LRT?
- How has modelling helped - in our understanding and in policy-making?
- Where do we go from here?

Does LRT affect the GL region?

# $\alpha$ -HCH Story: Pathways

Global emissions of  $\alpha$ -HCH and its concentrations in Arctic air



Source: Li et al., 1998, 2000

# What substances have we modelled and what can we say about them?

- $\alpha$ -HCH, Lindane (pesticides),
- Toxaphene (pesticide),
- Endosulfan (CUP), DDT
- HCB (Industrial, pesticides, ...),
- PCB (Commercial chemical)
- Hg (Electricity generation),

The late 1990s

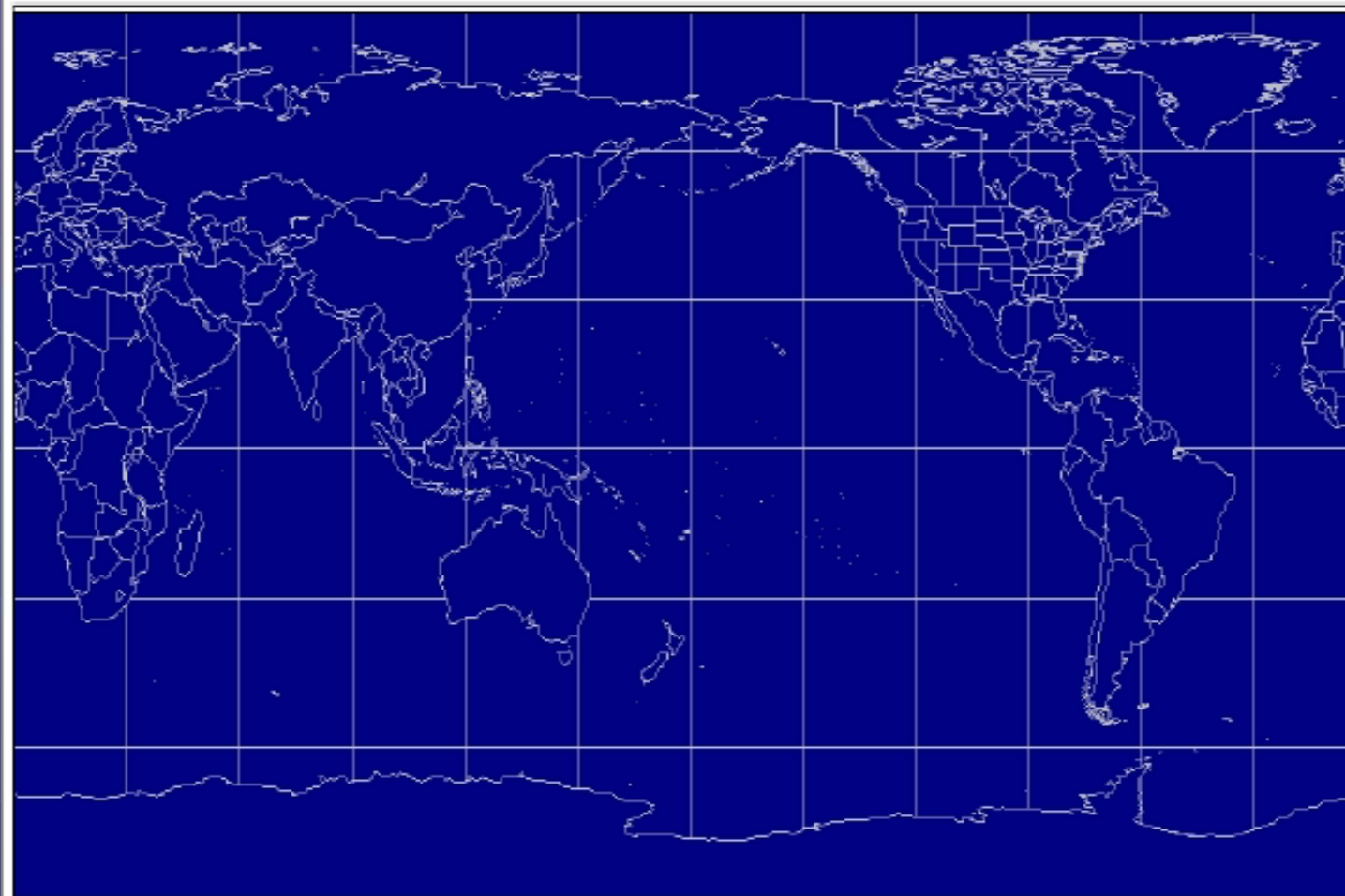


# Multi-compartment Environmental Diagnostics and Assessment (MEDIA)

## A Global model for $\alpha$ -HCH

(Jan 1993 to June 1994)

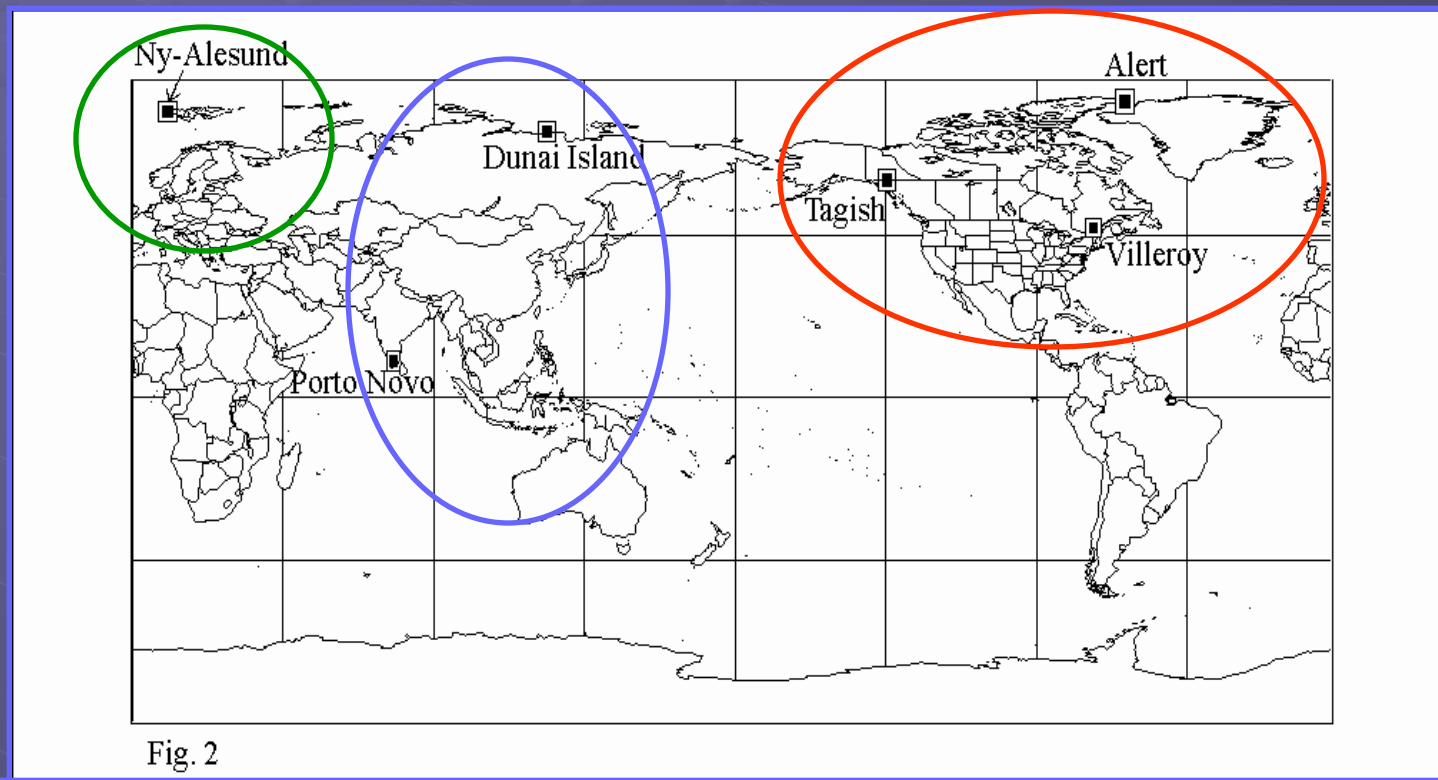
Pg/m<sup>3</sup>



← Arctic  
←

# Global model for $\alpha$ -HCH

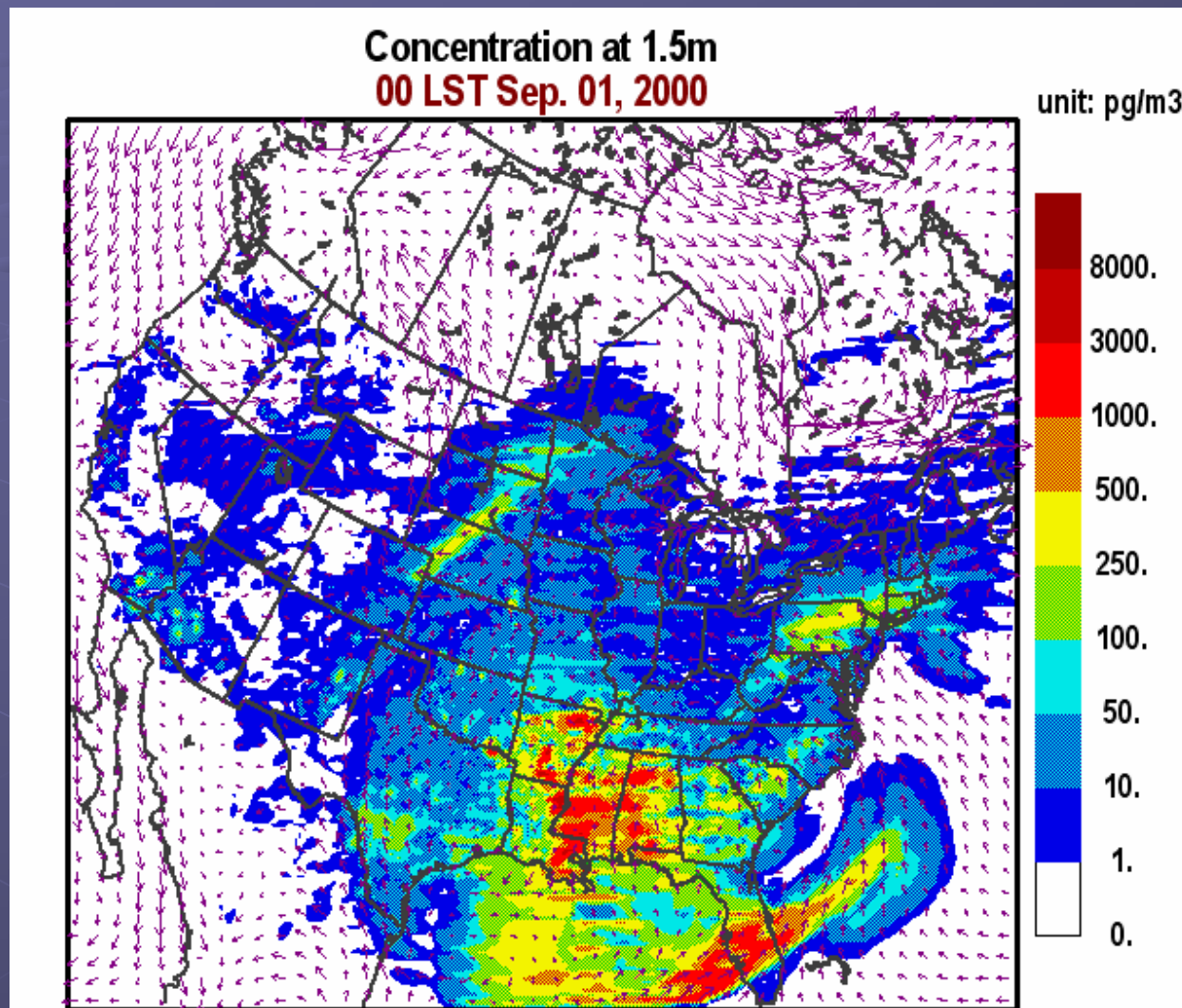
## Multi-compartment Environmental Diagnostics and Assessment (MEDIA)



- **Model Evaluation:** Model is able to capture both trends and short term components in the observed time series

The early 2000s

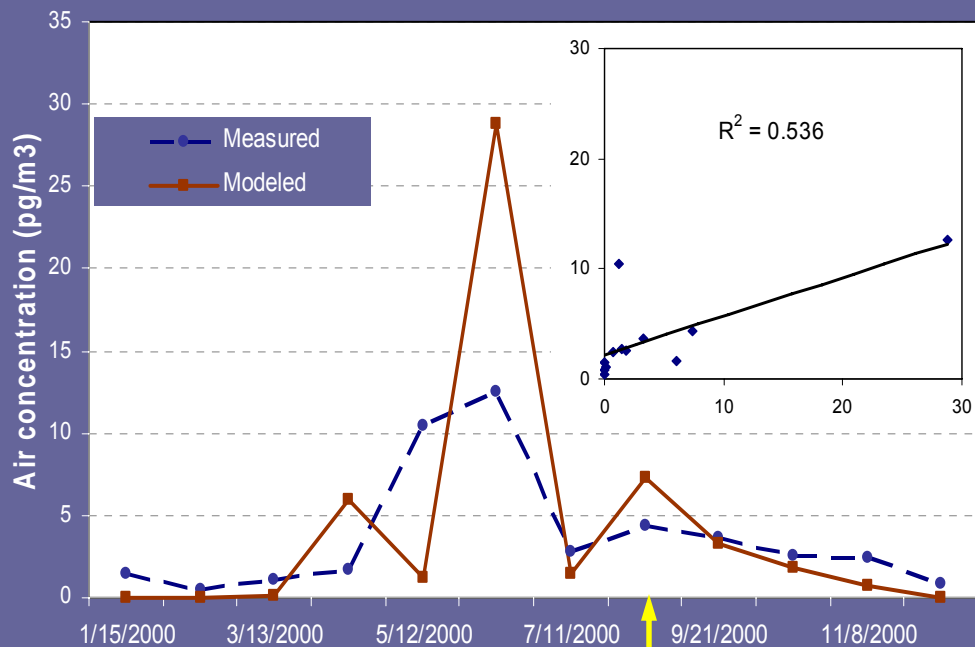
# LRT of Lindane and Toxaphene Canadian Model for the Environmental Transport of Organochlorine Pesticides (CanMETOP)



Air Quality Research Branch  
Environment Canada

PI: J. Ma  
Graphics by: P. Cheung

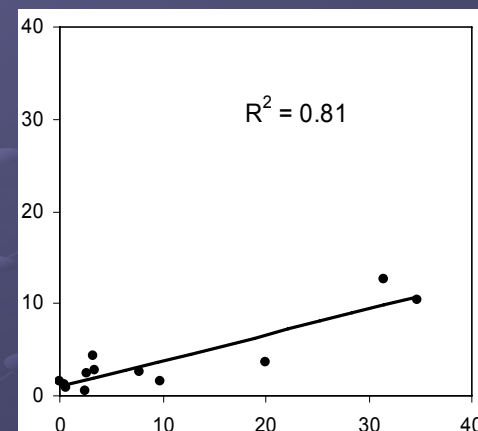
# Model Evaluation with IADN data



Daily

Unit:  $\text{pg m}^{-3}$

3 days



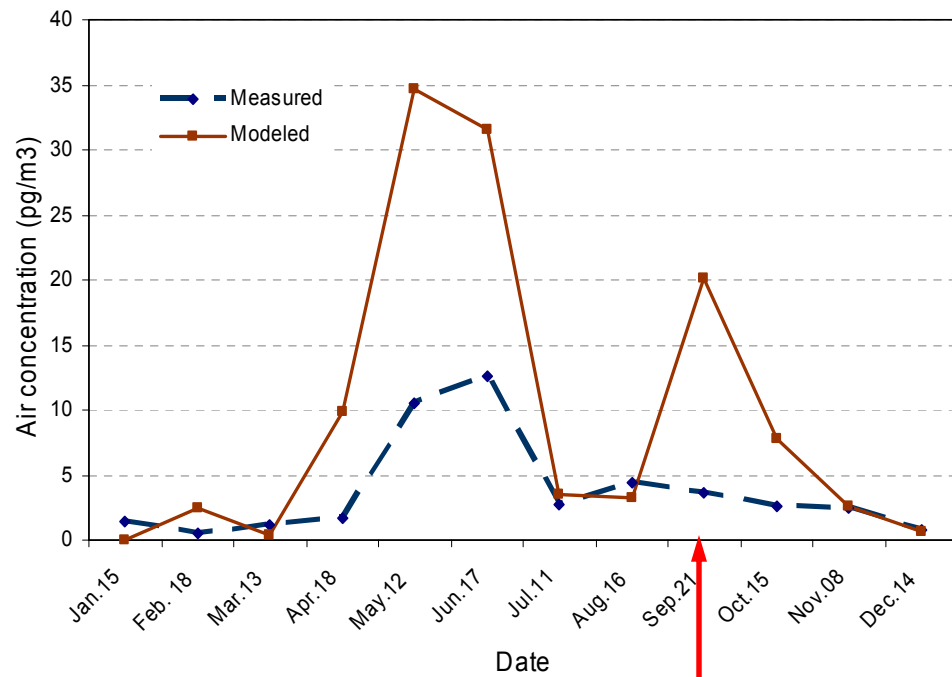
Comparison between modeled and measured air concentration at Point Petre (Lake Ontario)

Mean concentration ( $\text{pg m}^{-3}$ ) in June 2000:

Lake Ontario (ship):  $25 \pm 20$

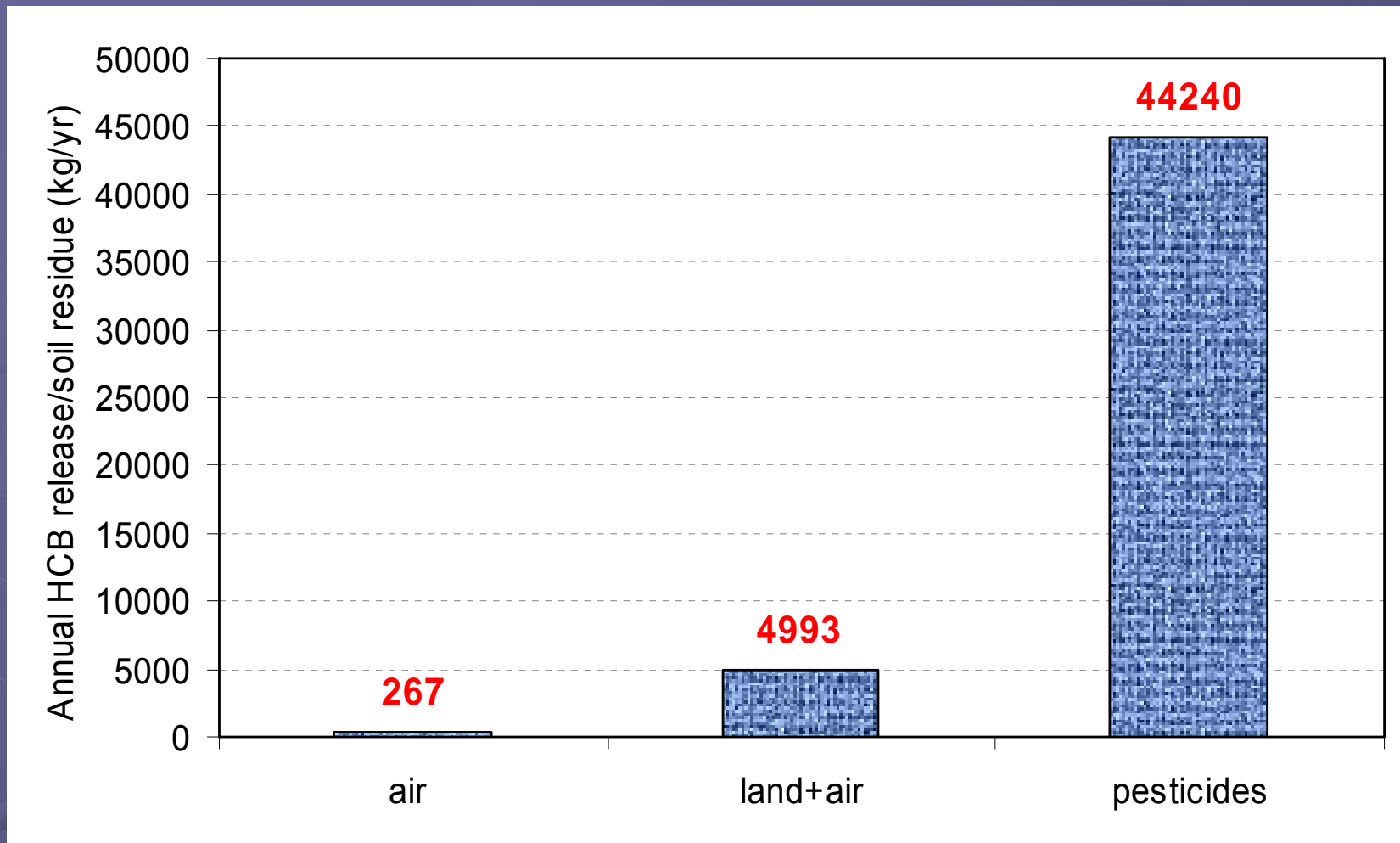
Model: 15 (averaged over Lake Ontario)

Point Petre:  $\sim 10$

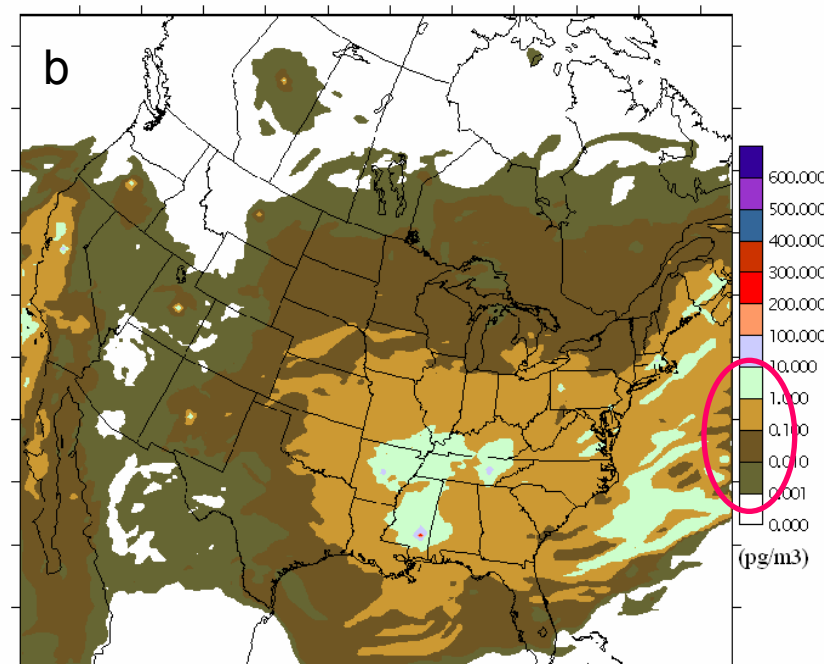
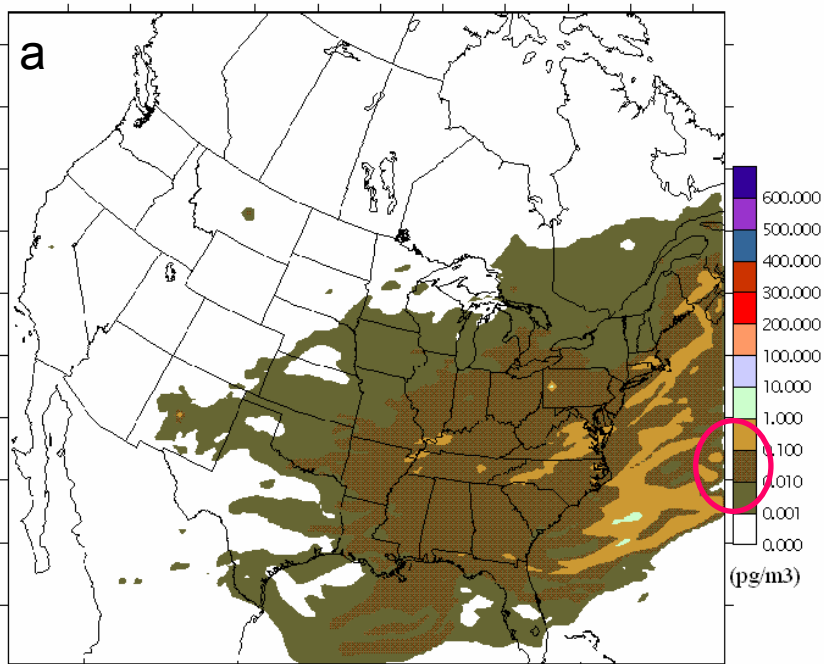


2006 – 2007

HCB

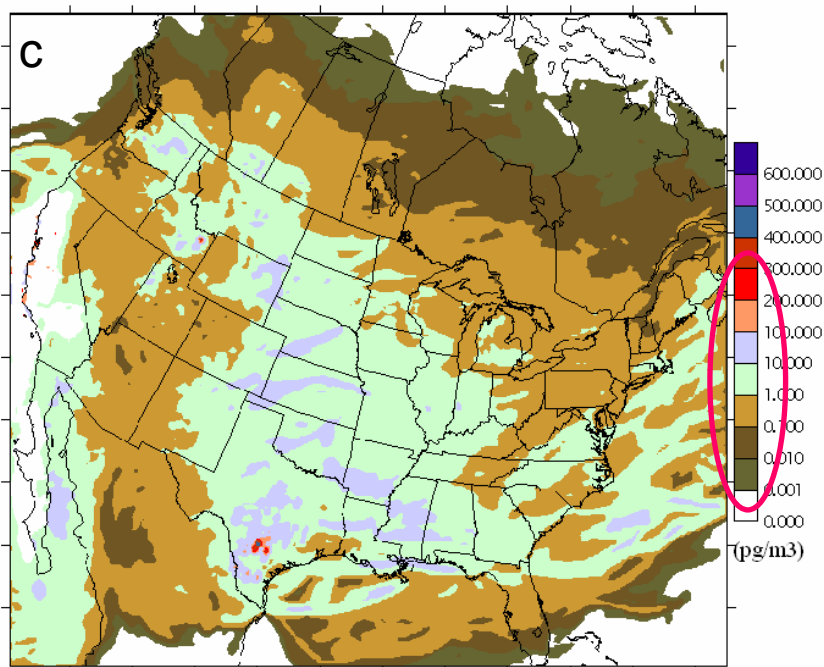


Annual air/land release of HCB in the US from USEPA Toxics Release Inventory (TRI) database and estimated HCB residue in soil in the US in 2001 from historical pesticides application (as a fungicide, atrazine, dacthal, lindane, Penta-chloro-nitro-benzene...)



Modeled HCB air concentration at 1.5 m averaged over summer 2001.

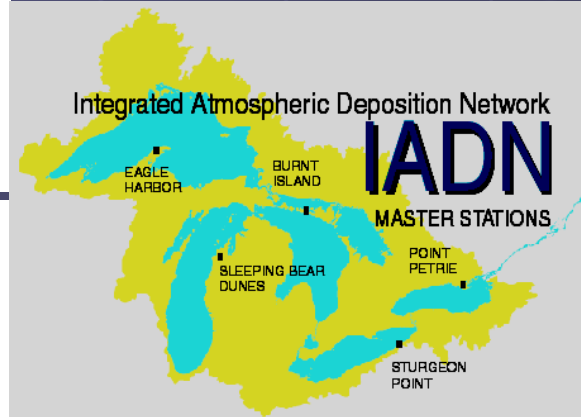
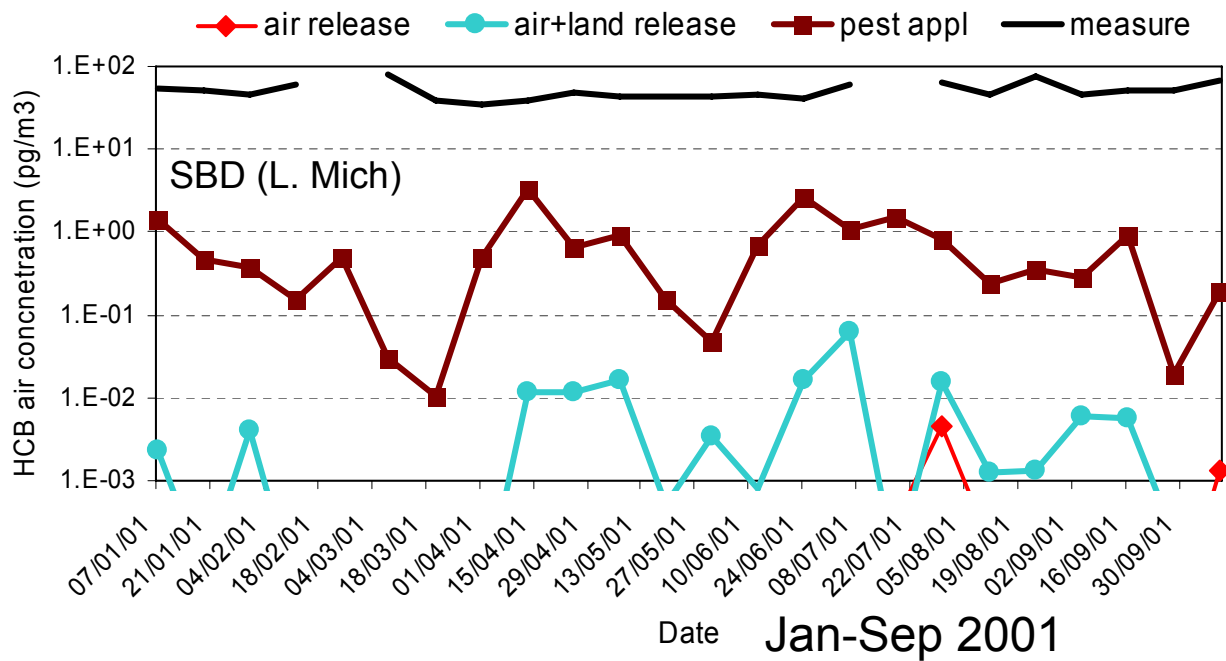
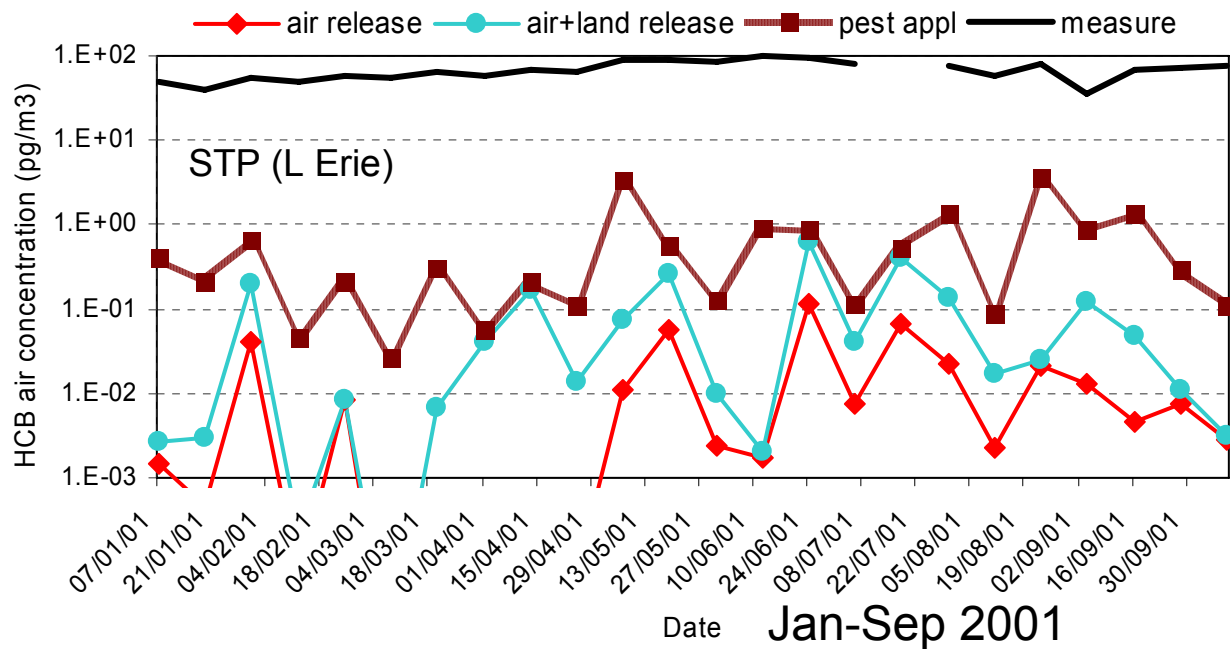
- a. TRI air release
- b. TRI air and land release
- c. Soil residues from historical pesticides application



24 km x 24 km resolution, meteorological data from GEM

LRT HCB

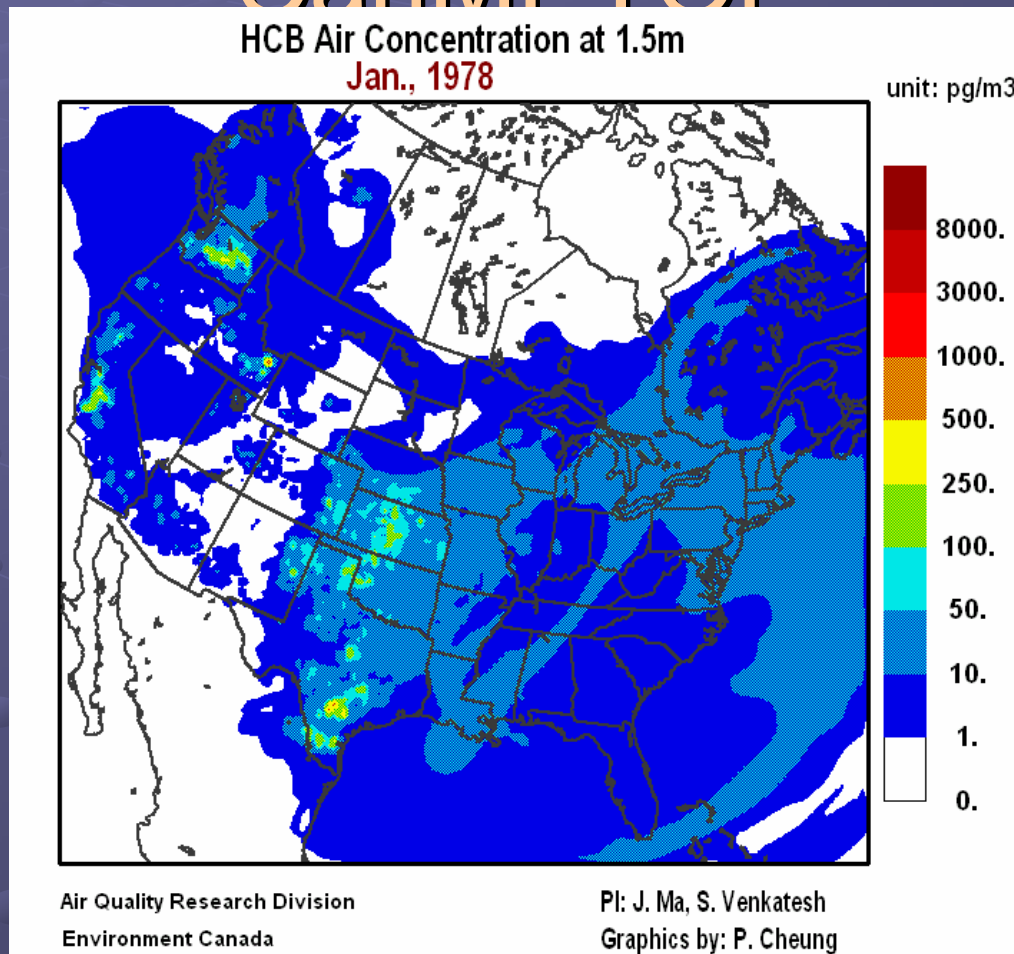




# LRT of HCB

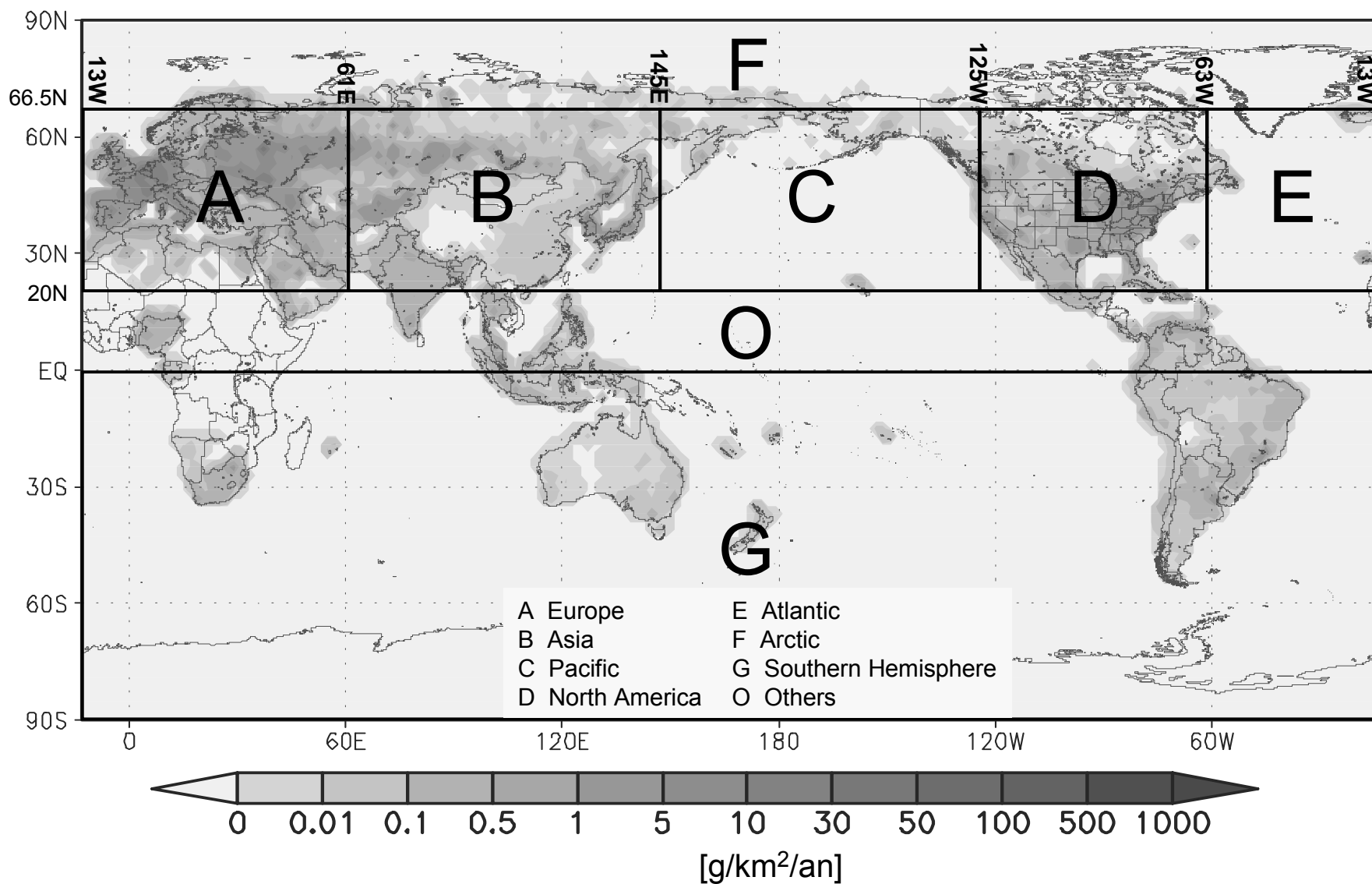
## 20-year Simulations using

### CanMETOP

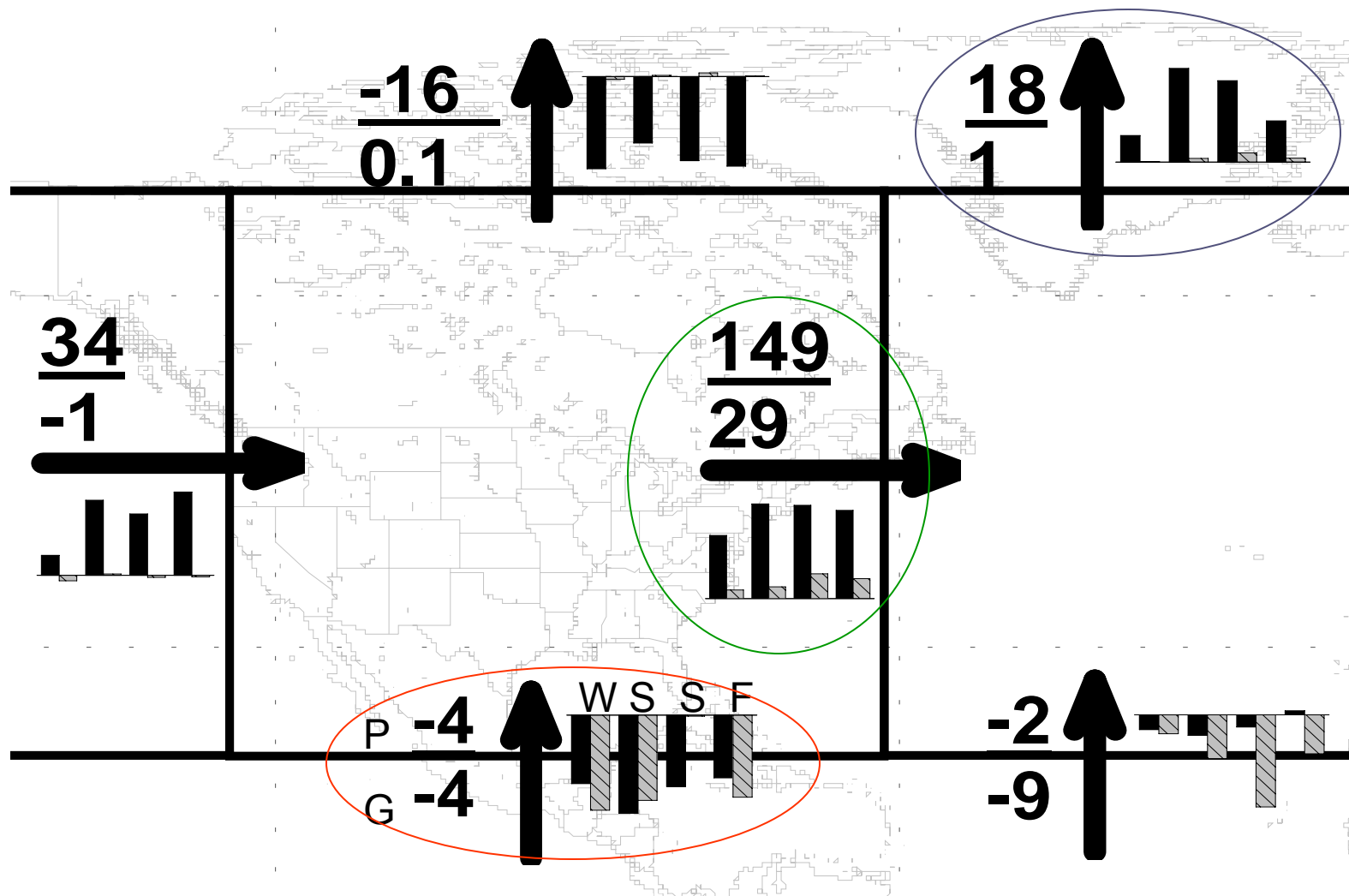


# PCB – Global Transport

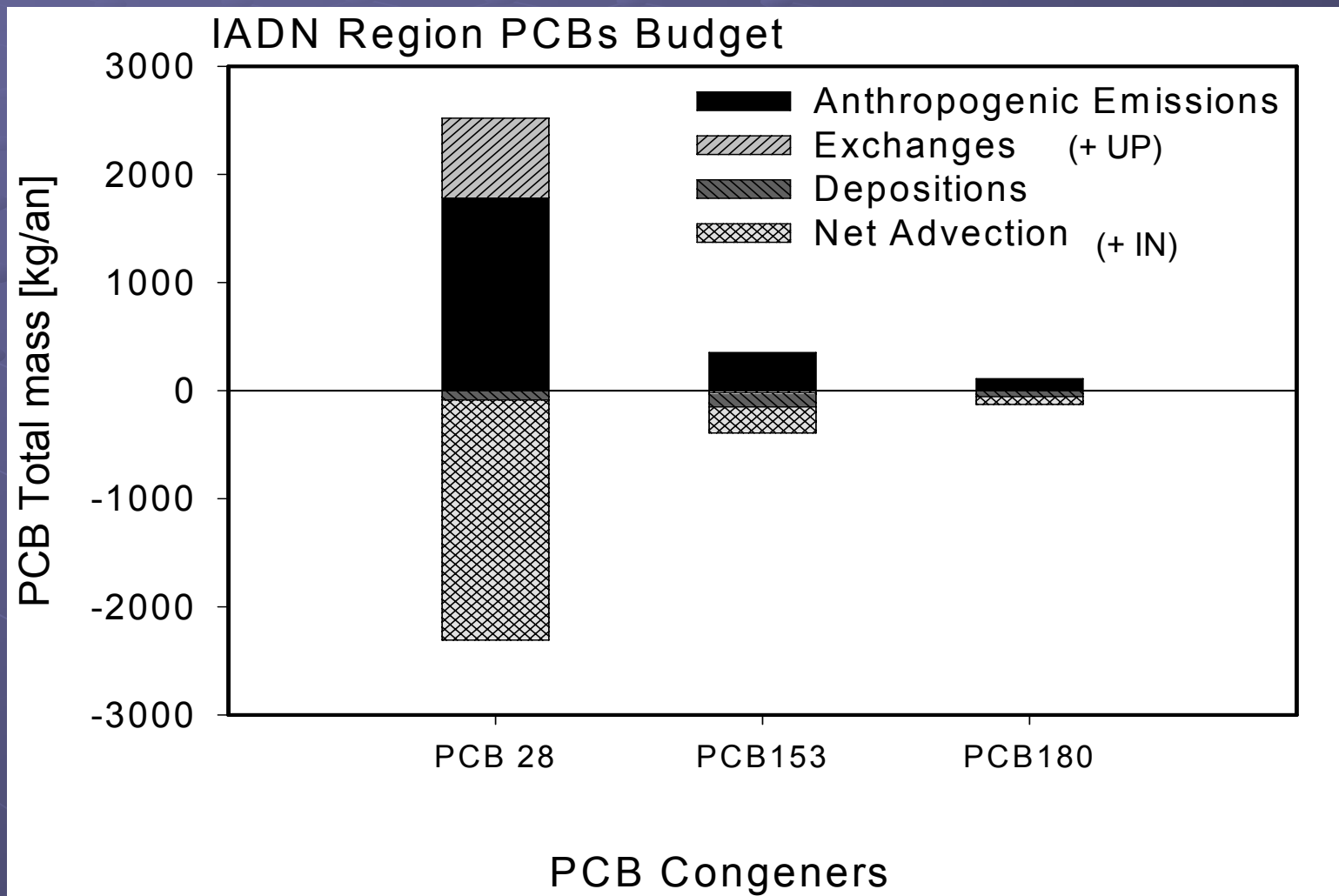
# GEM/POPs Global Transport of PCBs - Emissions



# Inter-continental transports of PCB180 for North America



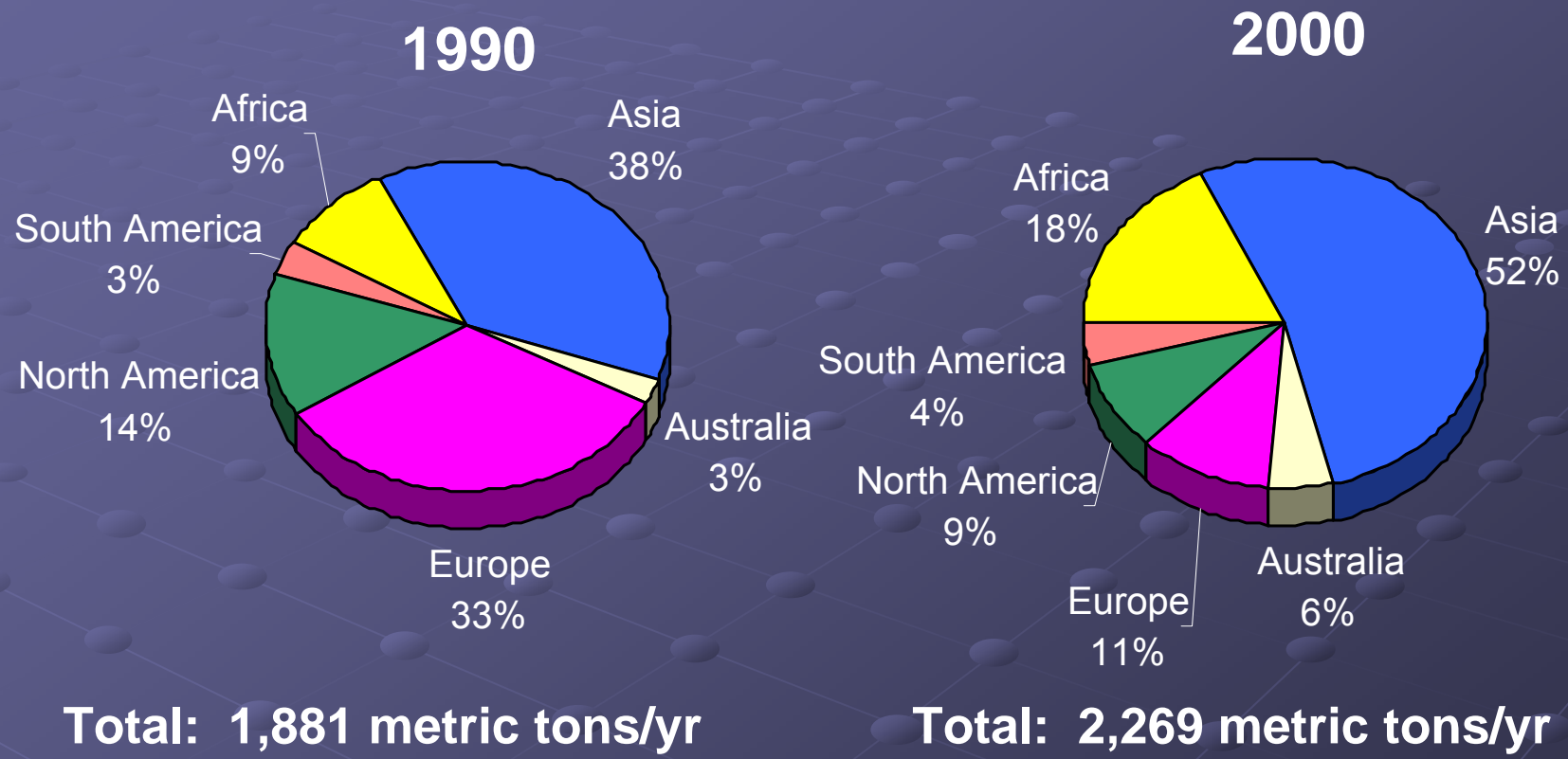
# PCB budget for Great Lakes region (76W-90W, 40N-48N)



# Mercury – Global Transport



# Anthropogenic Air Emissions of Mercury: Distribution by Region in 1990 and 2000

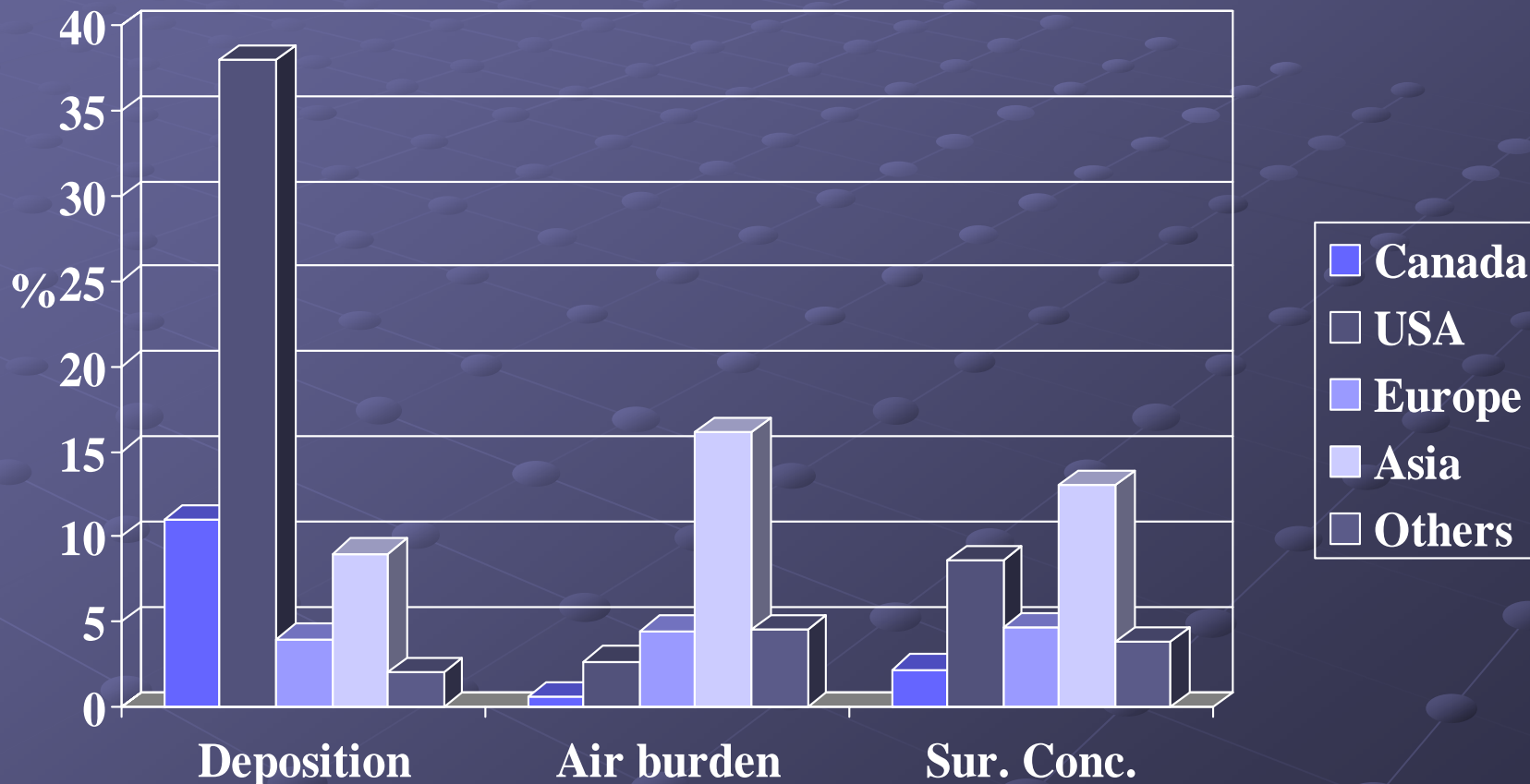


Asia and Africa account for about 70% of global emissions and show steady, significant increases due to industrialization.

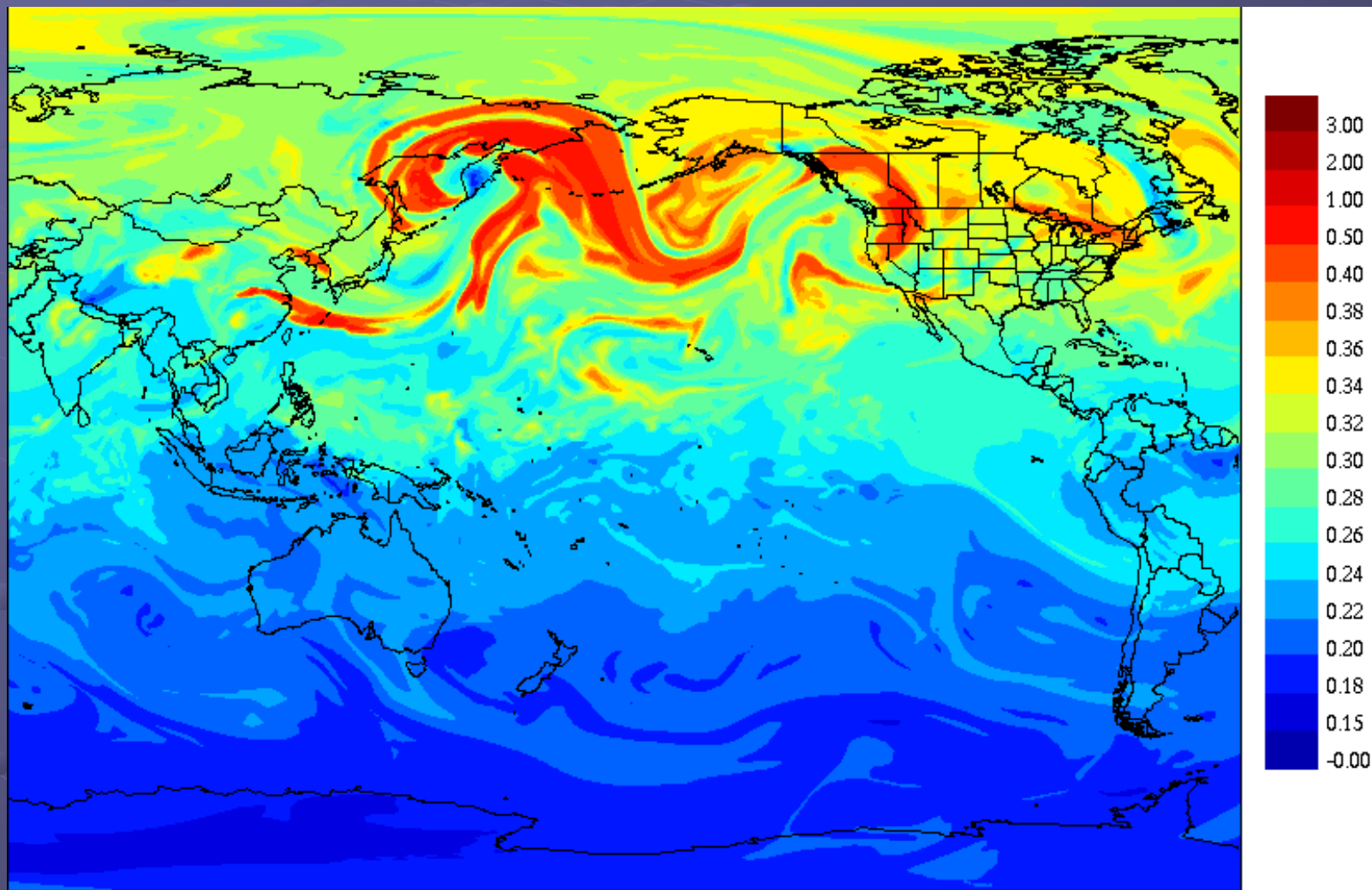
Based on Pacyna, J., Munthe J., Presentation at Workshop on Mercury: Brussels, March 29-30, 2004  
 Slide courtesy Grace Howland, Air Pollution Prevention Directorate, Environment Canada



# Annual average contributions to the Great Lakes from 1995 Anthropogenic emissions

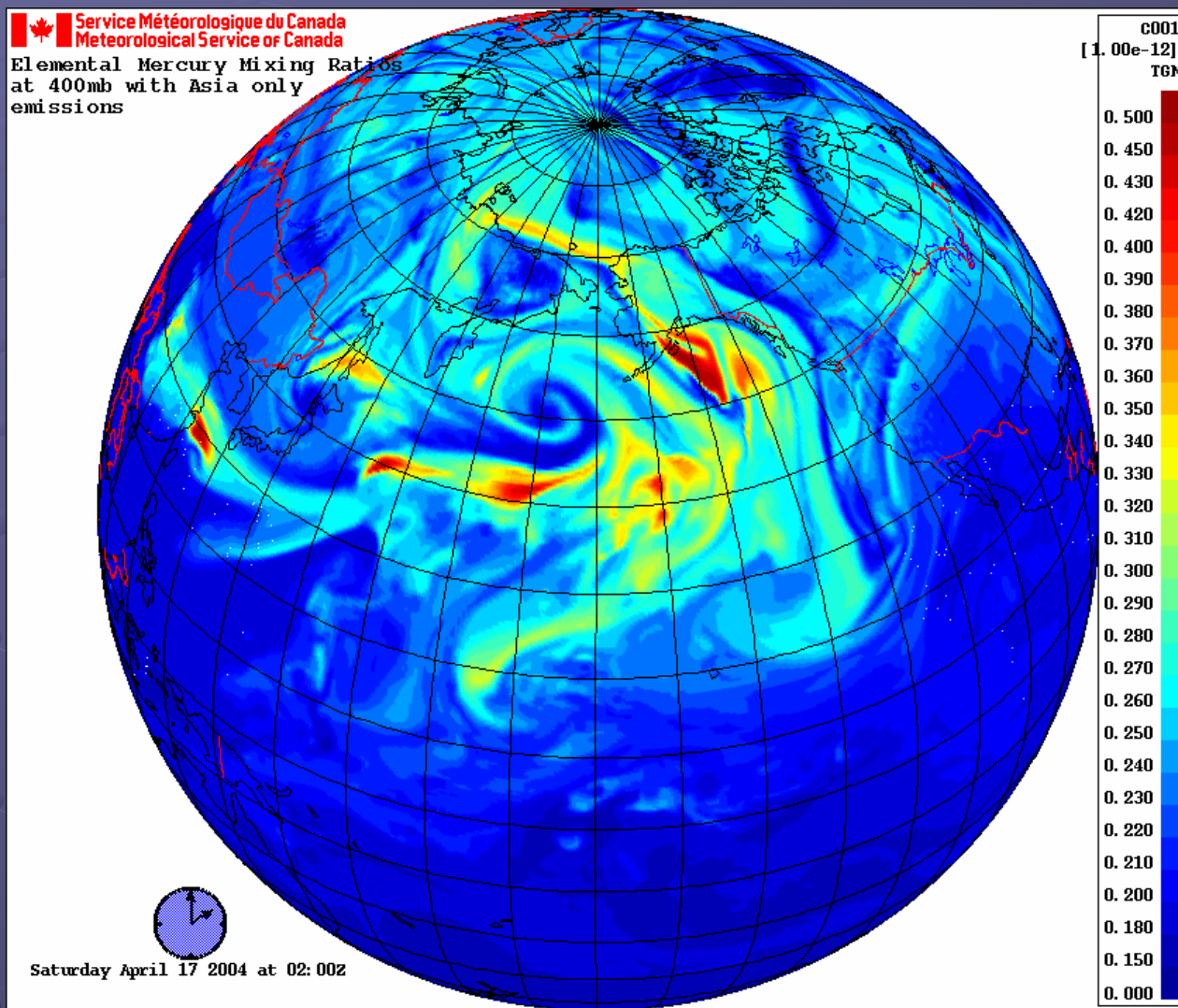


GRAHM air concentrations of mercury (ng/m<sup>3</sup>) at 00Z on April 25, 2004 at 500mb showing an episode of Asian outflow of mercury reaching N. America and which was observed at Mt. Bachelor in central Oregon



# Mercury Episode Animation

(00Z on April 25, 2004 at 500mb)



# Where do we go from here?

- Enhanced global inventories and modelling
  - Lindane, PCB
  - Greater focus on CUPs
  - International model inter-comparisons
    - Hg, POPs (global, NA)
- What Questions do the policy-makers want answered?
- Work within Int'l frameworks

# Canada-USA-China Joint Lindane Project

- Financially supported by
  - Environment Canada
  - US EPA
  - The North America Commission for Environmental Cooperation (CEC)
  - Harbin Institute of Technology, China
    - (Peking University, China)

# LRT Challenge – Status (2007)

- Assess atmospheric inputs of strategy substances to the Great Lakes. The aim of this effort is to evaluate and report jointly on the contribution and significance of long-range transport of strategy substances from world-wide sources. If ongoing long-range sources are confirmed, work within international frameworks to reduce releases of such substances.