# Why is it Important to Measure Collaboratively as a Network?

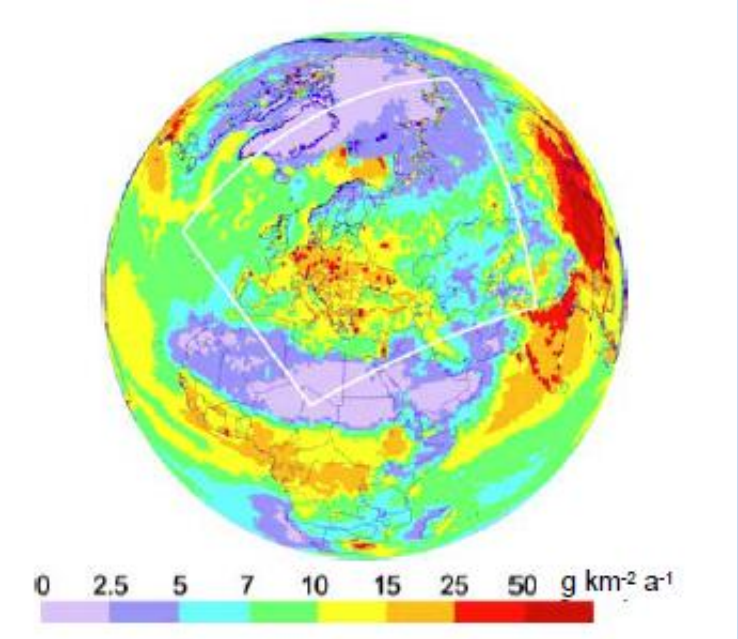
# Data that is Used For:

- Understanding the mercury science
- Used to make good policy decisions

# Consistency in Measurement is the KEY!

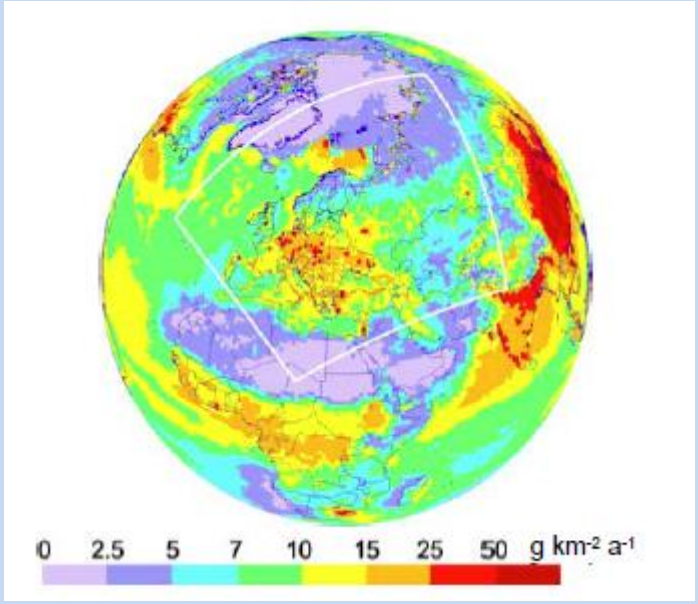
- Long term monitoring is required to see small changes.

- Using the same methods!!!
  - "apples to apples"
  - on a global basis



# The Value of Monitoring

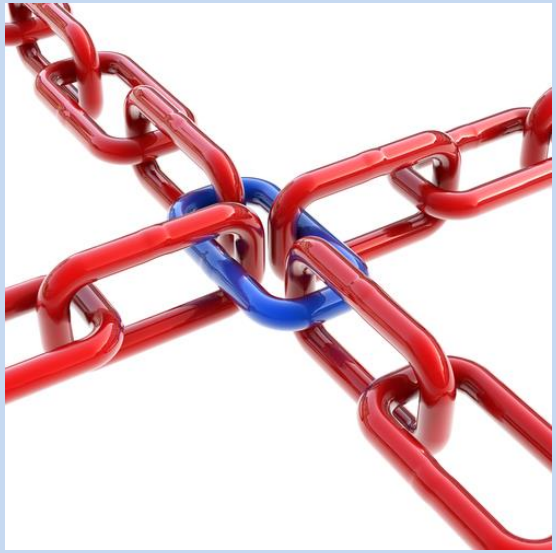
- Understand the problem….
  - Science
  - Deposition and cycling in the aquatic environment
- Track changes over time and space
  - Trends present?
  - Increasing or decreasing?
- Is Policy Working?
  - With legislation in place,
  - But is it working?
  - Is the problem improving?
- Determining the extent of the mercury problem
  - where are conditions better and worse



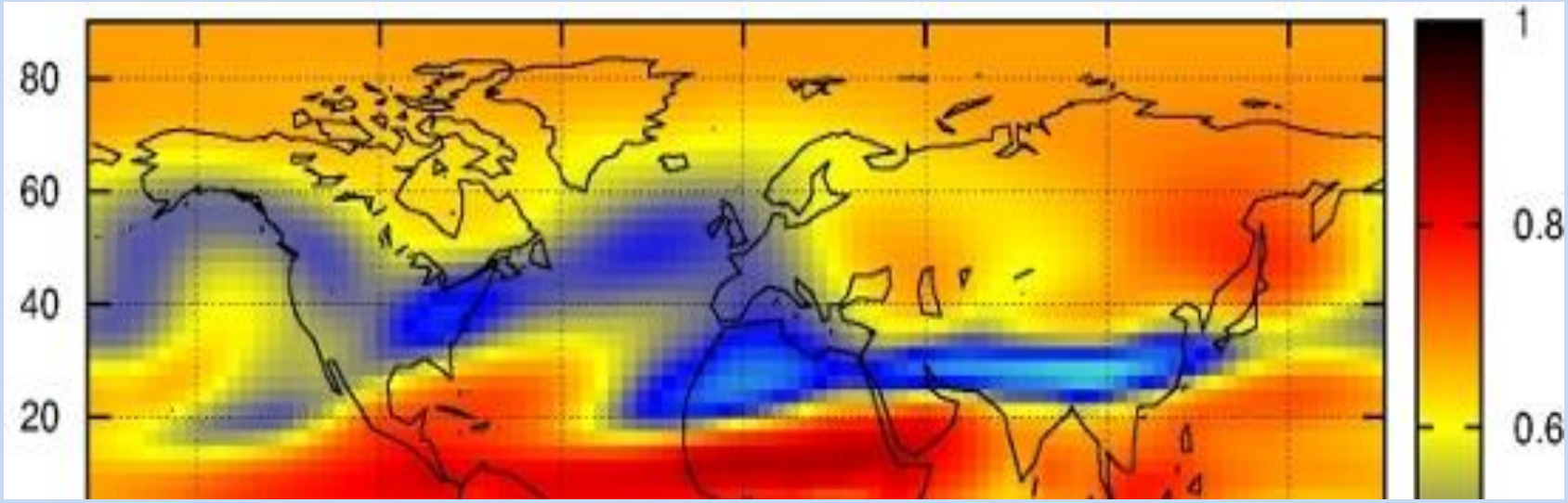

- Tracking changes with implementation of UNEP Mercury Protocols
  - where are conditions better and worse

# Vision of Results

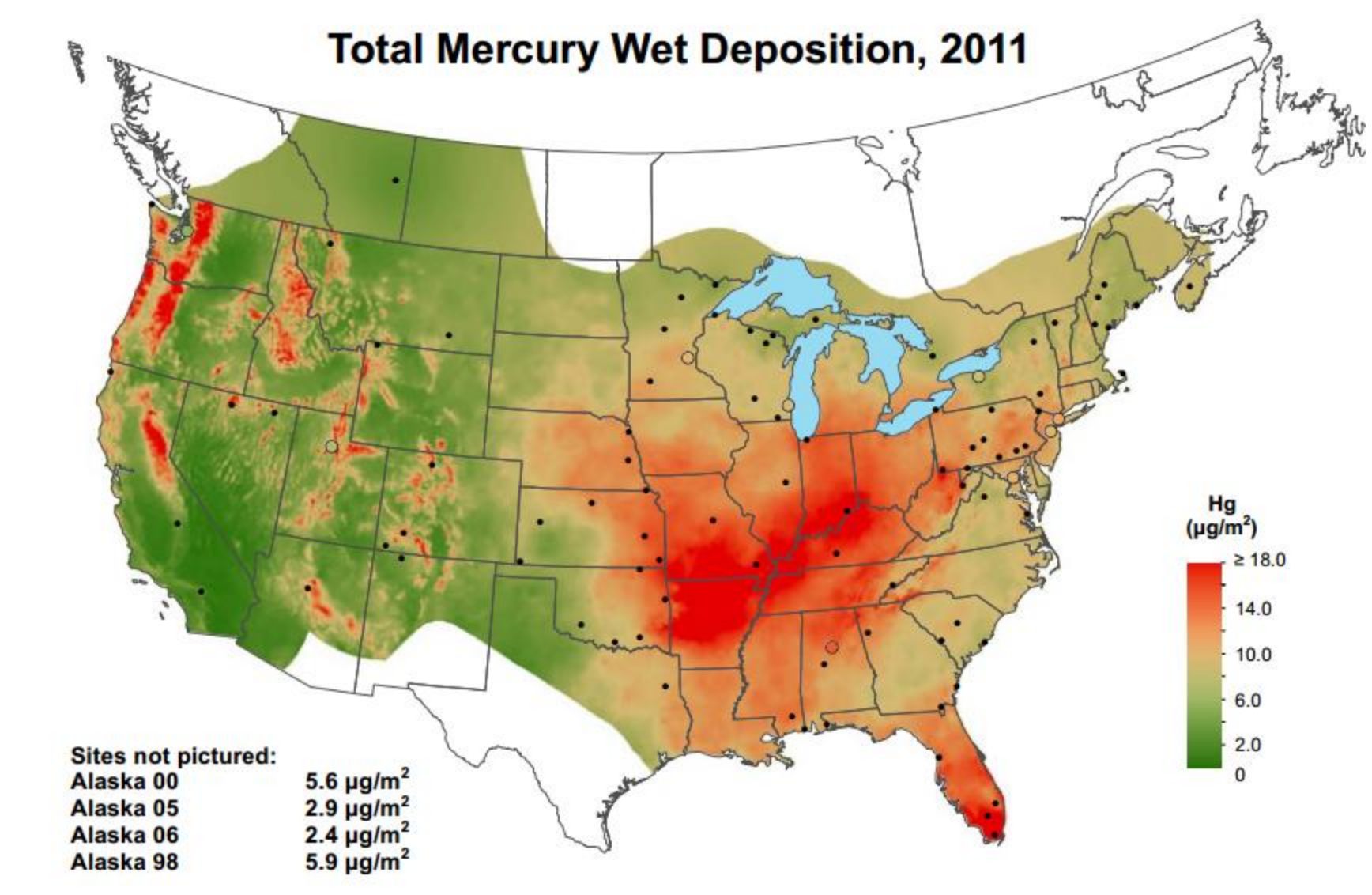
Cooperative Data Access will benefit *Everyone*



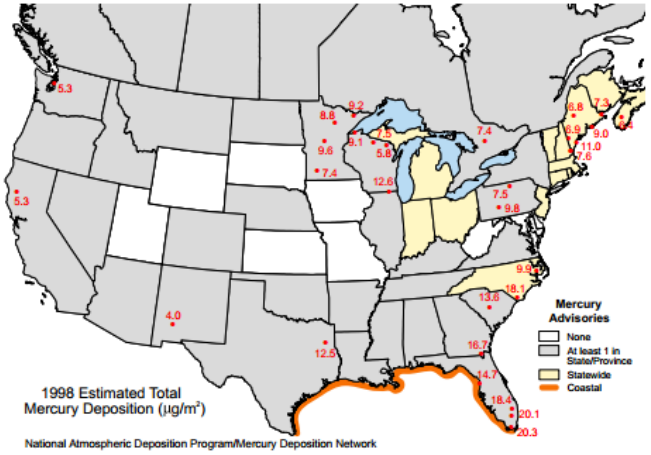
# Single Site vs. Network Perspective: Difference is Huge

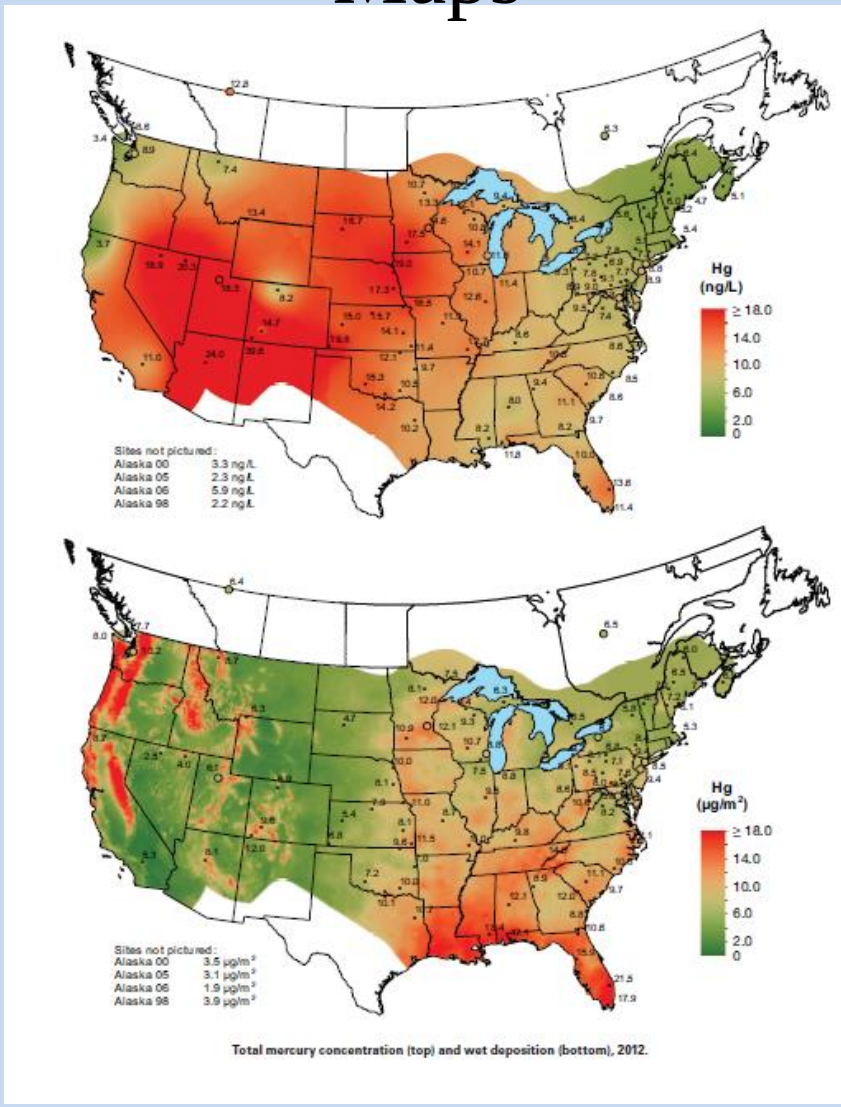


# What Are The Asian Deposition Rates?



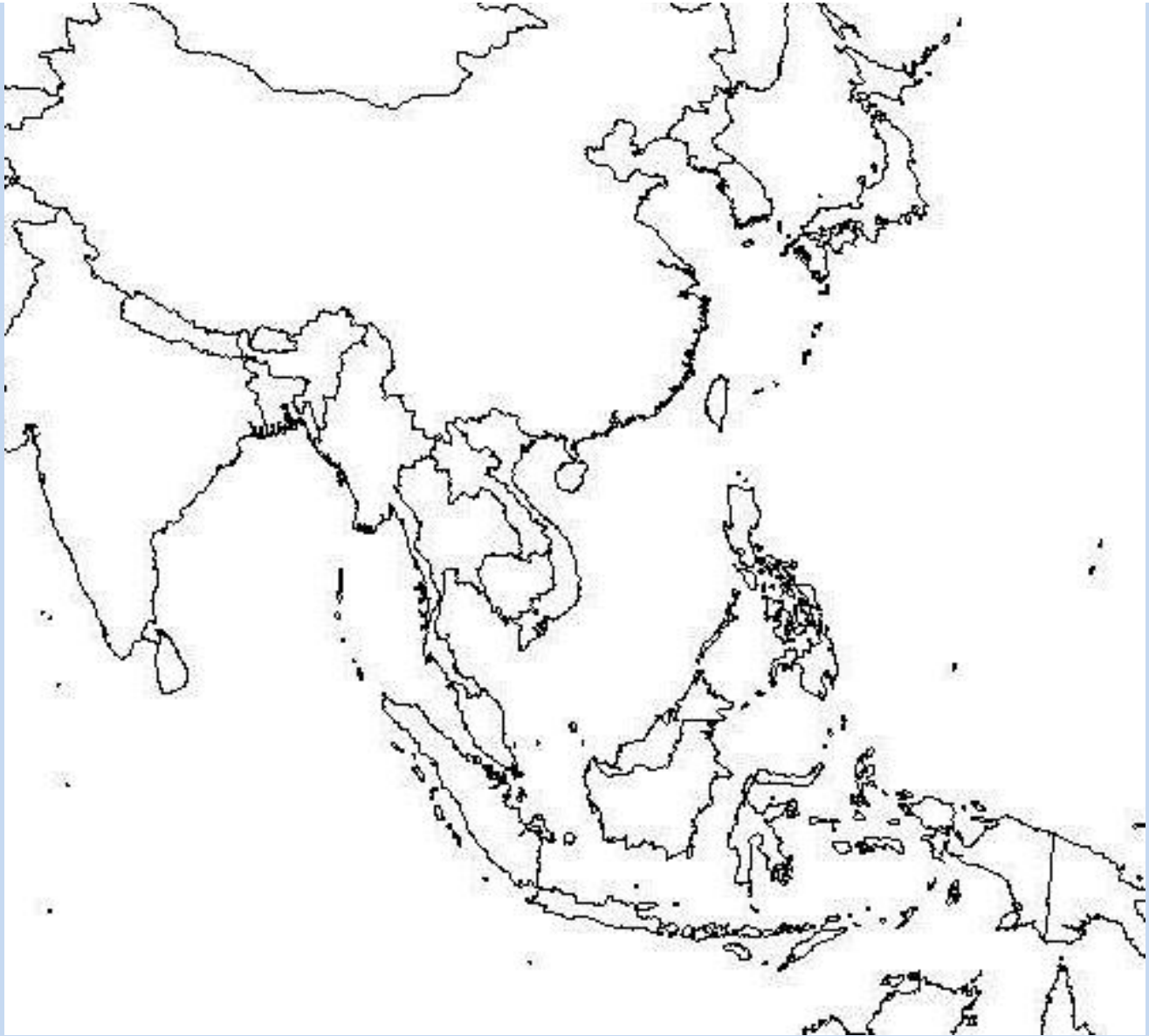
# 2012 MDN Maps



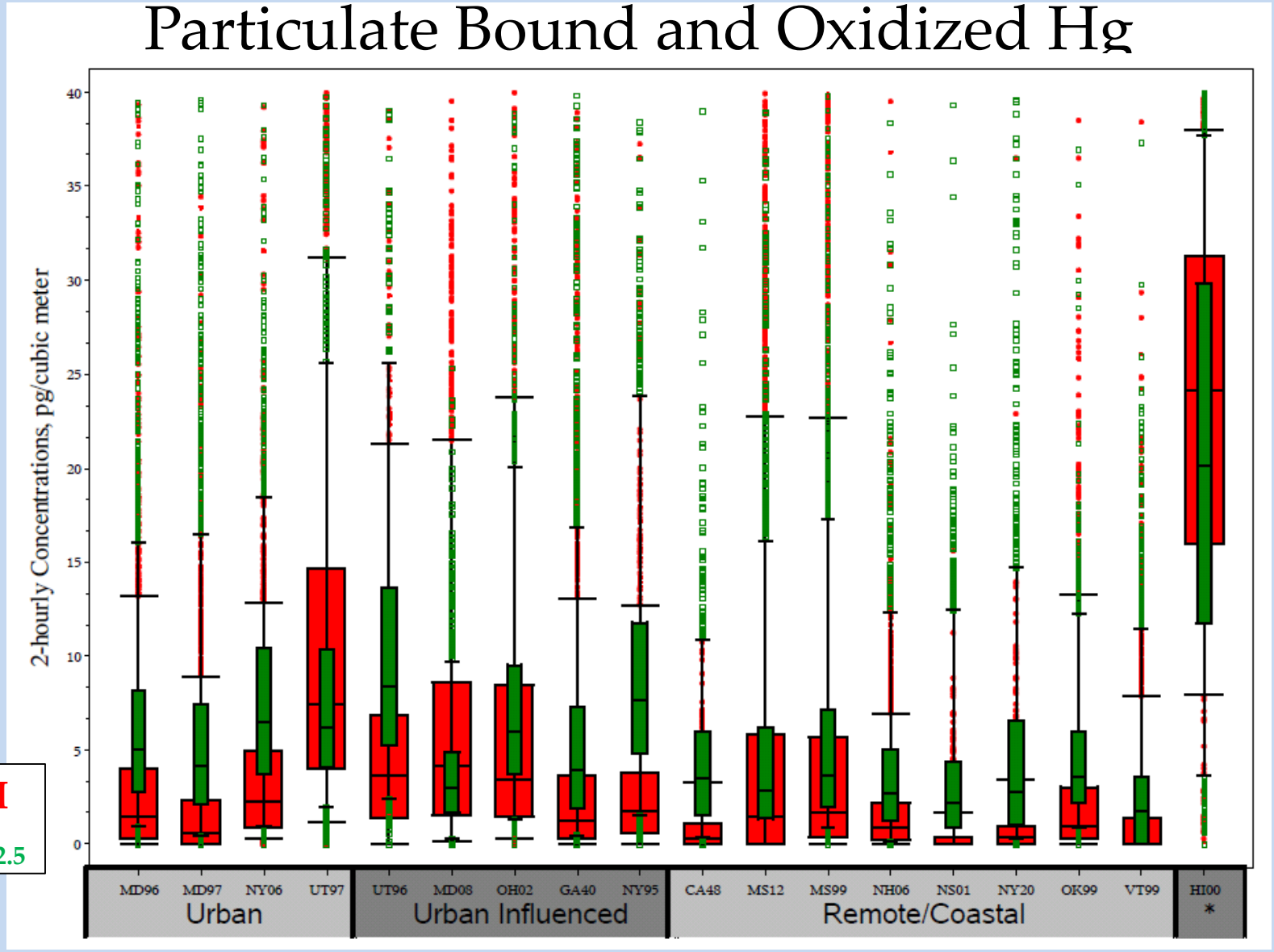




Total mercury concentration (top) and wet deposition (bottom), 2012.

# Comparison: Is Deposition in One Country high or low?



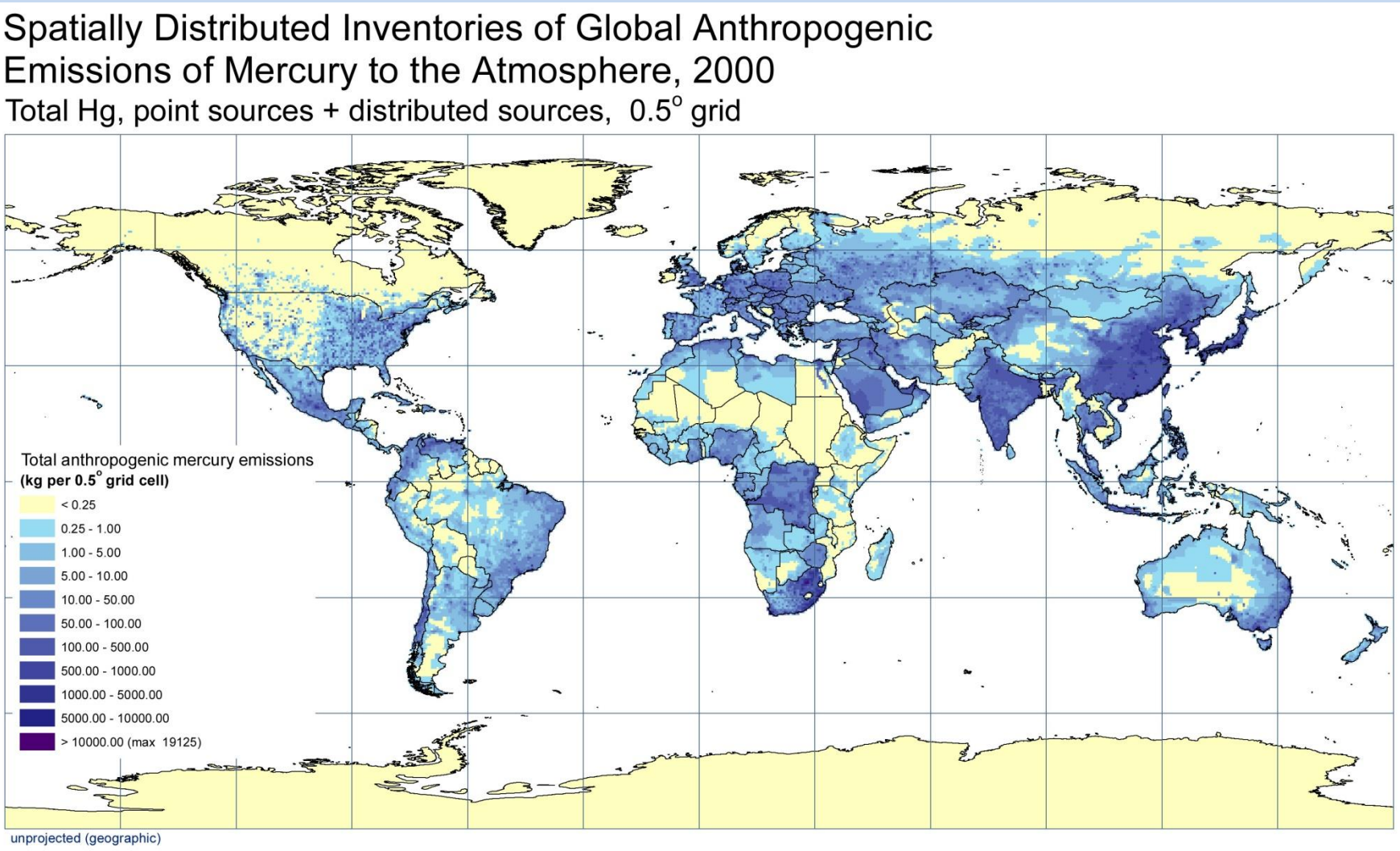
# Comparison: Where are Mercury Levels Higher? Lower?




GOM

$PBM_{2.5}$

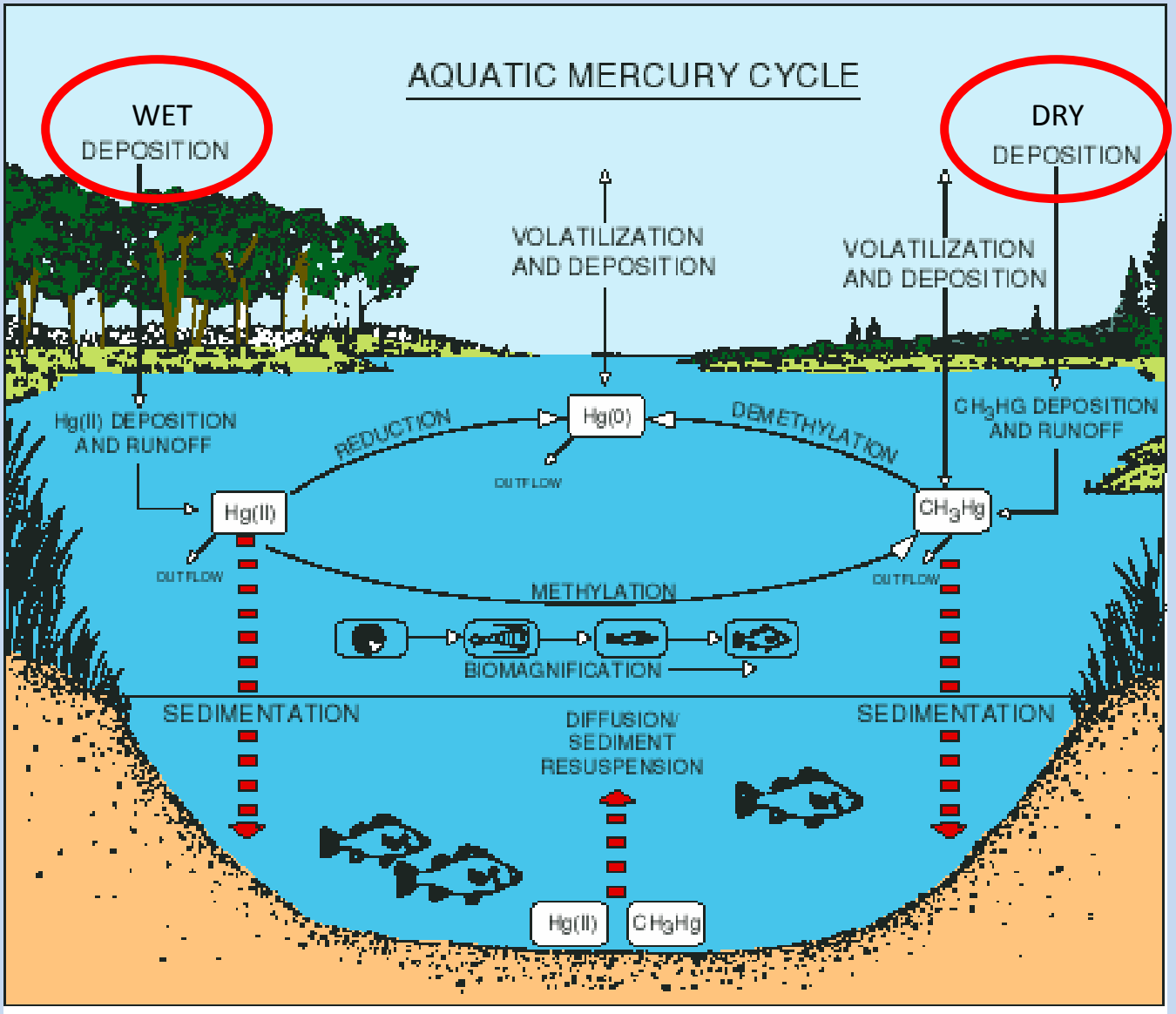
# Major Sources of Mercury Emission




citation:
Pacyna, J., S. Wilson and F. Steenhuisen. 2005.
Spatially Distributed Inventories of Global Anthropogenic Emissions of Mercury to the Atmosphere.
(www.amap.no/Resources/HgEmissions/HgInventoryMain.html)

S. Wilson (AMAP), F. Steenhuisen (Arctic Centre, RuG), J. Pacyna (NILU)

# Do we understand Mercury Cycling?



# How Important is Dry Deposition?

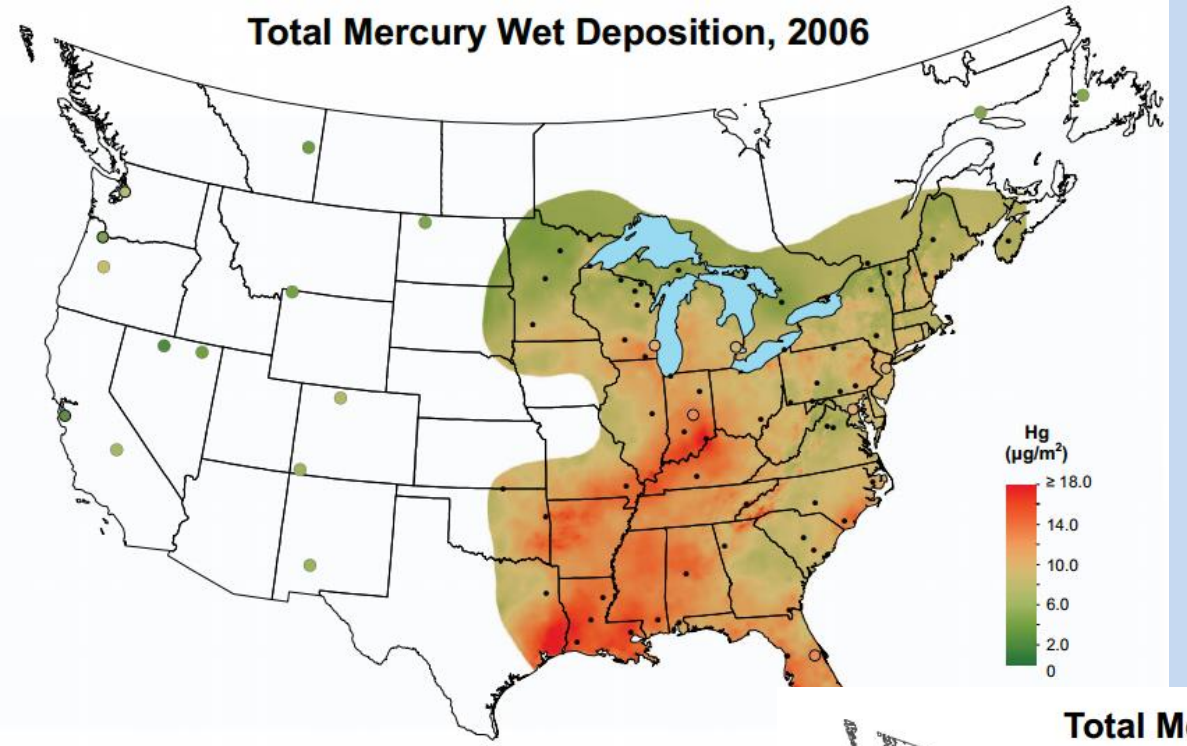
- flux (*F ) = air concentration x dry deposition velocity ($V_d$)*

$$F = V_{deposition} * Concentration_{air}$$

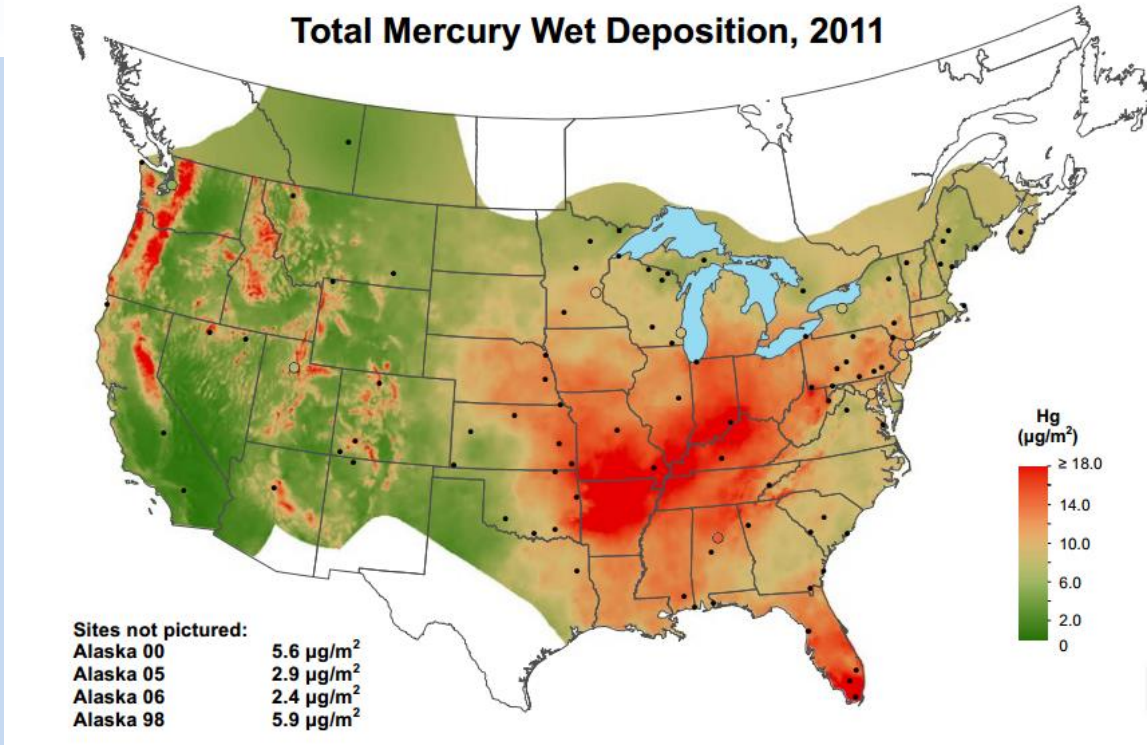
where:

$$V_d = \frac{1}{R_a + R_b + R_c}$$

- *$R_a$ as aerodynamic resistance, $R_b$ as quasi-laminar resistance, and $R_c$ as canopy resistance*




Is the spatial aspect of Mercury Deposition Changing over time?



# Is Deposition Increasing At My Site? At All Sites? Continent Wide?

- Is the problem getting better or worse?
- Quickly or slowly?
- Some places more than others?

# Do Models Predict Wet Deposition Correctly?

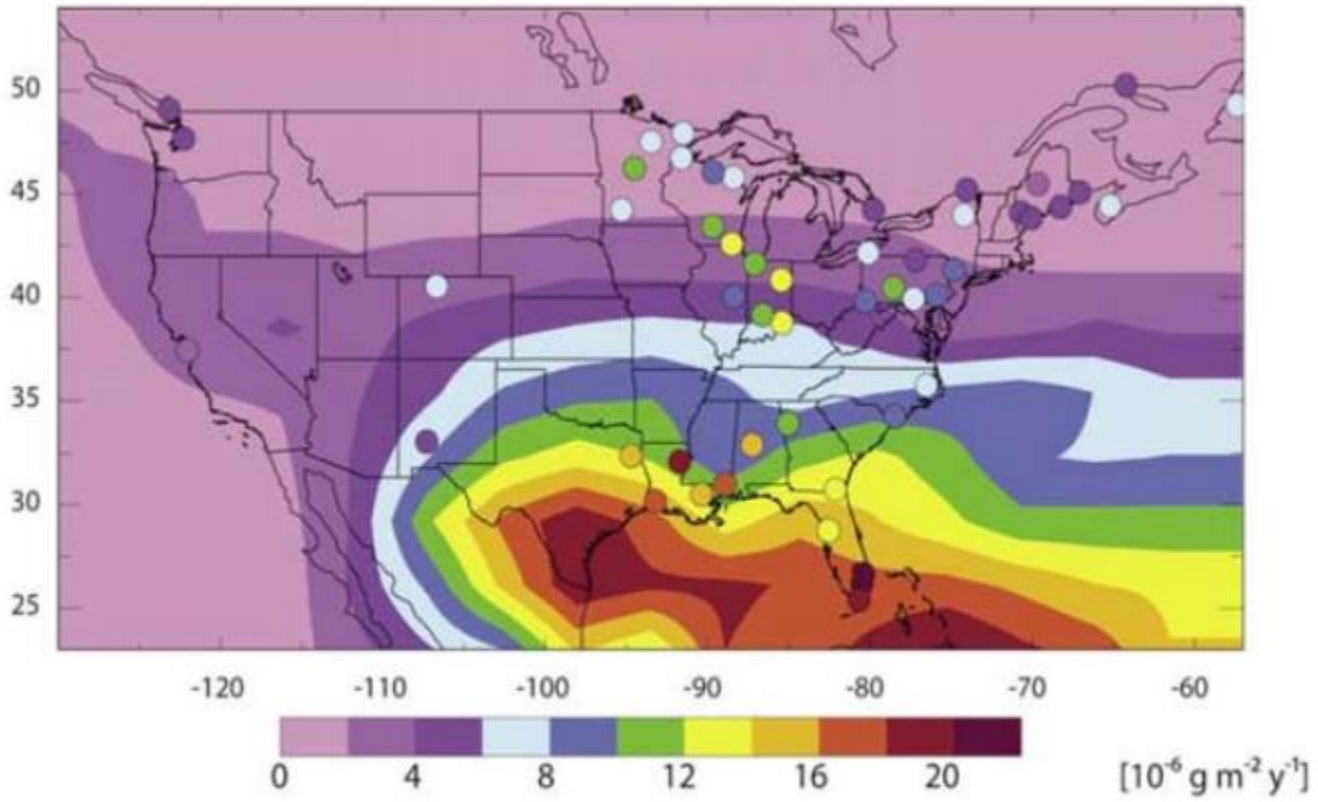
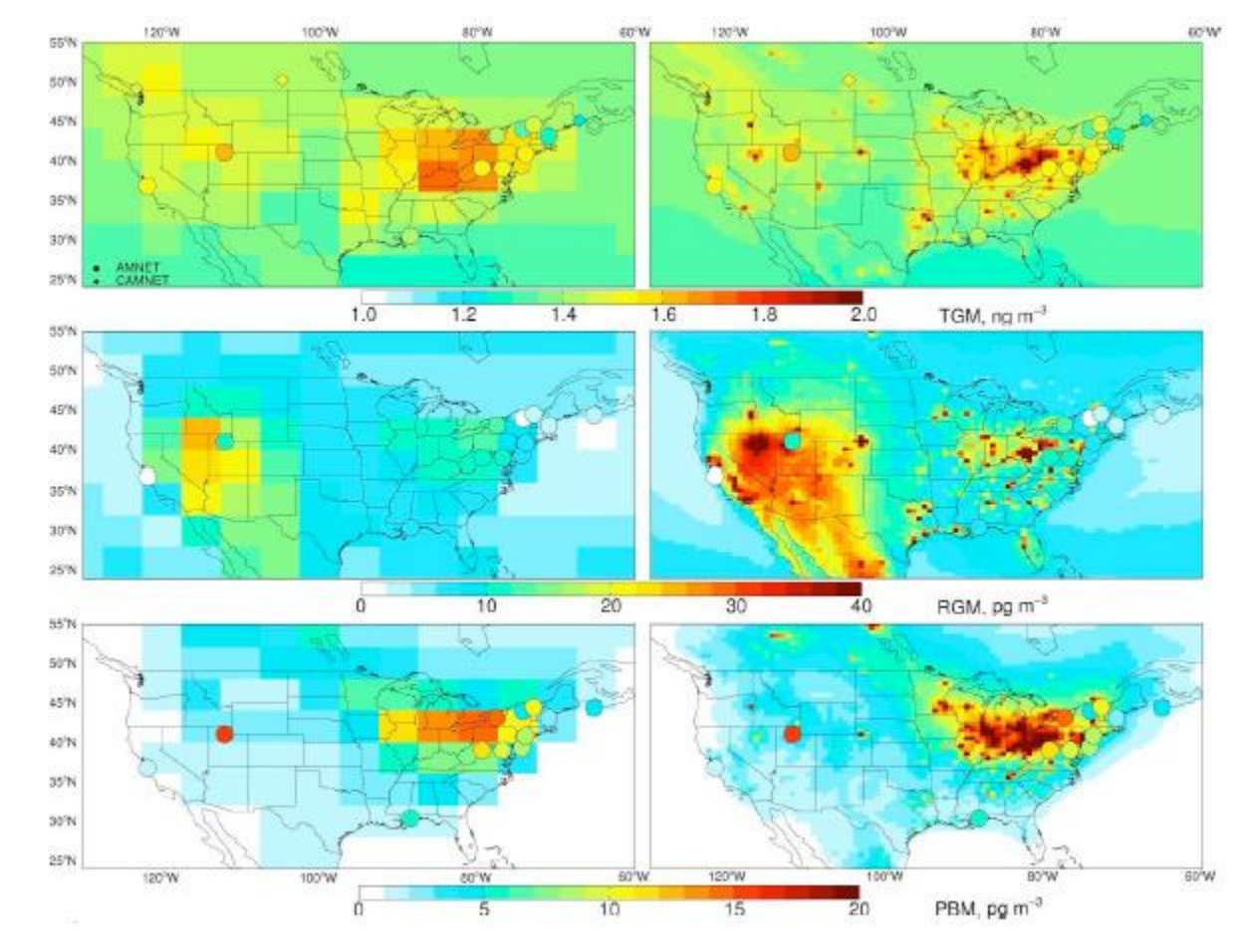



**Figure 13.1** - Annual mercury wet deposition fluxes over the United States for 2003 – 2004. Observations from the Mercury Deposition Network (circles) are compared to model results (background). From Selin et al. (2007).

# Do Models Predict Gaseous Concentrations Correctly?

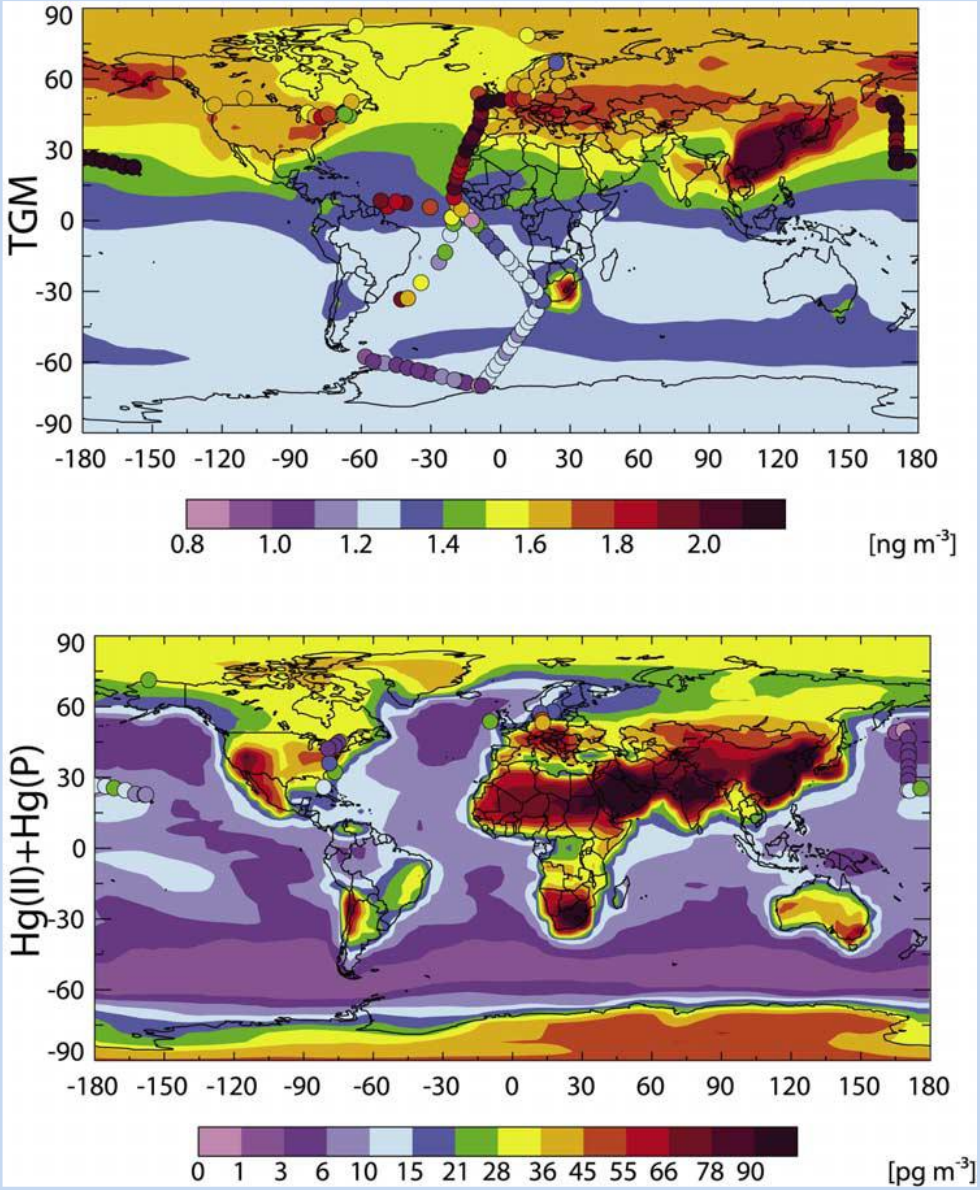
**Global and Nested Model Comparisons with AMNet Data**
**Nested-grid simulation of mercury over North America**




Y.Zhang, 2012

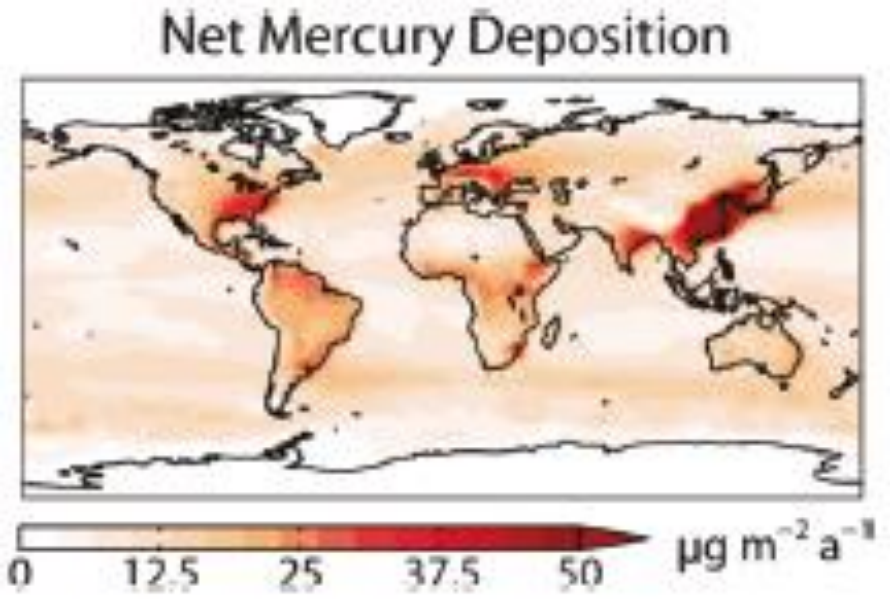
**Fig. 7.** Annual mean surface concentrations of TGM (top), RGM (middle) and PBM (bottom) during 2008–2009. Results from the global (left column) and nested (right column) IPR simulations are compared to observations from 14 AMNET sites (circles) and 5 CAMNET sites (diamonds). Two pairs of AMNet sites are collocated, so only 12 AMNet sites are identifiable.

# What are the Distribution of Atmospheric Hg Concentrations: Modeling Results




Selin et al., 2007

# Distribution of Atmospheric Hg Deposition Fluxes: Modeling Results




Corbitt et al., 2011

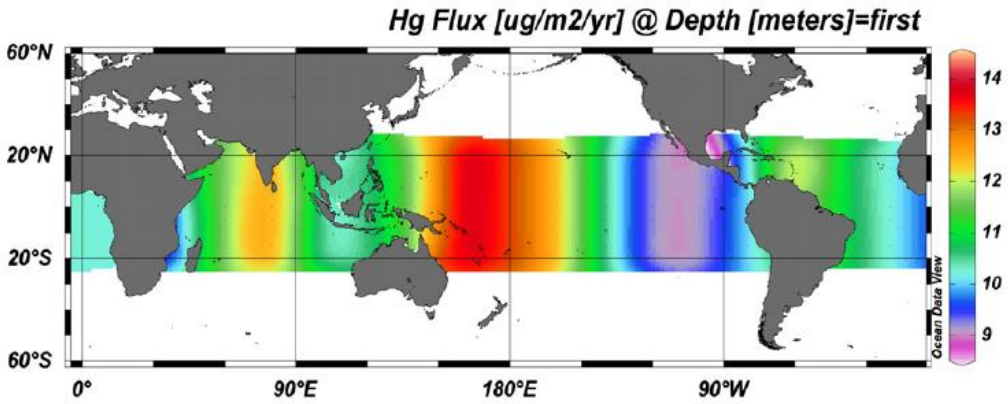


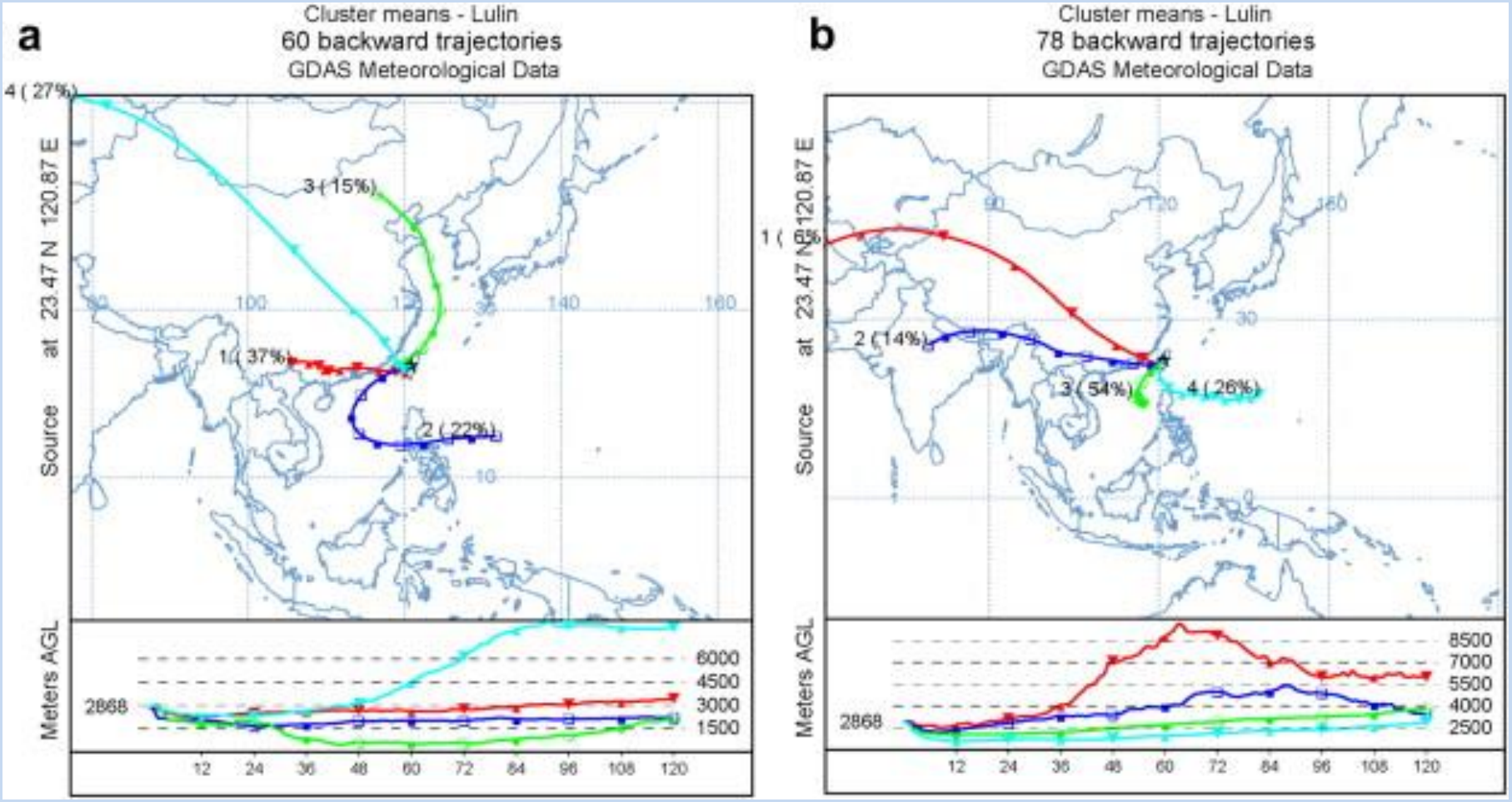

**Fig. 2.** Annual mercury deposition (wet plus dry, including Hg(0); $\mu g\ m^{-2}\ yr^{-1}$) over the tropical oceans simulated using GEOS-Chem. Deposition shown here is averaged over tropical latitudes (24°N to 24°S).

Costa et al., 2012

# Model Development

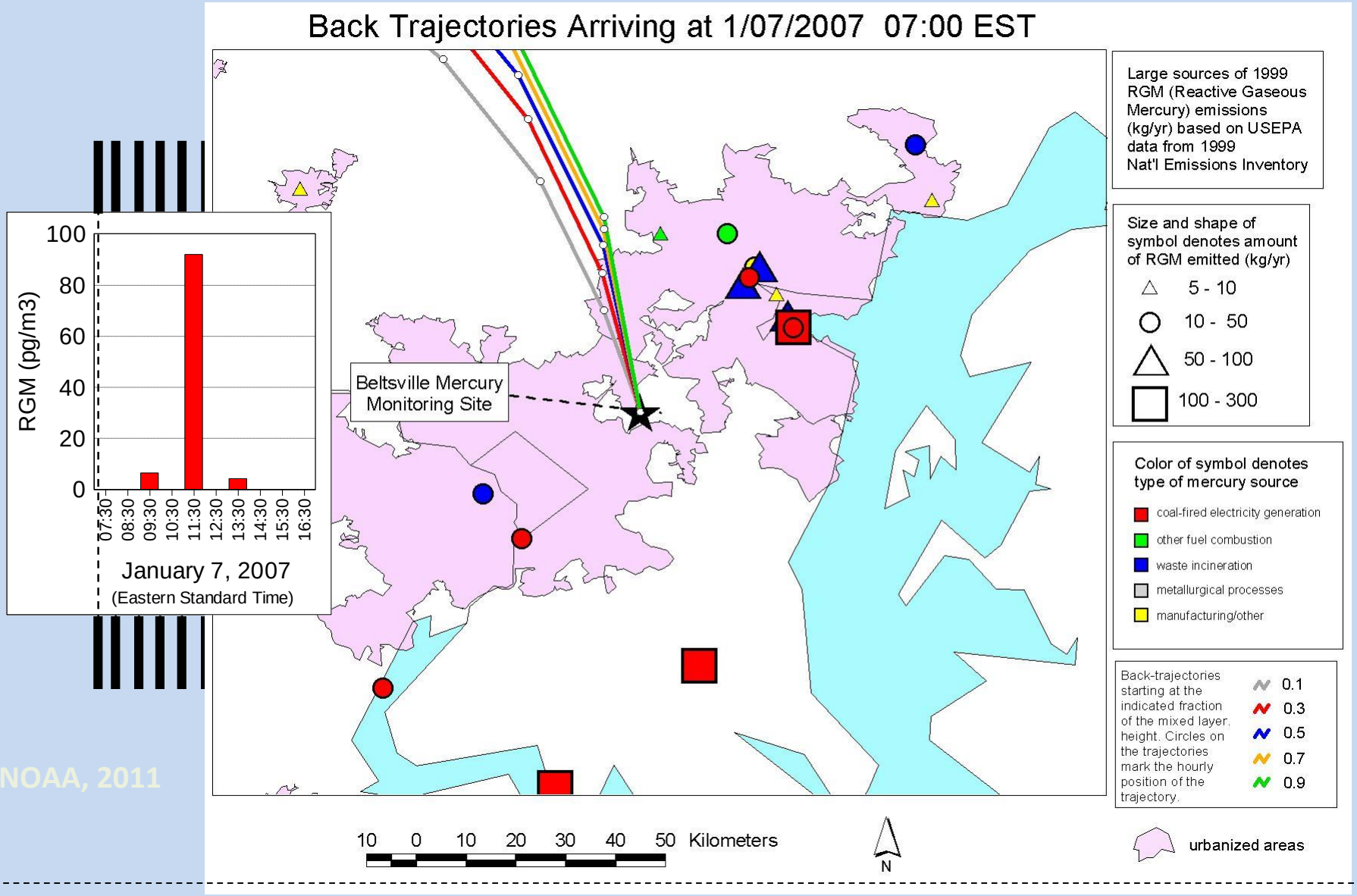
- Evalation of transport
- Evaluation of mercury chemisty within models
- What are the Sources and Receptor relationships?

# With Back Trajectories, Where Is this Mercury Coming From?



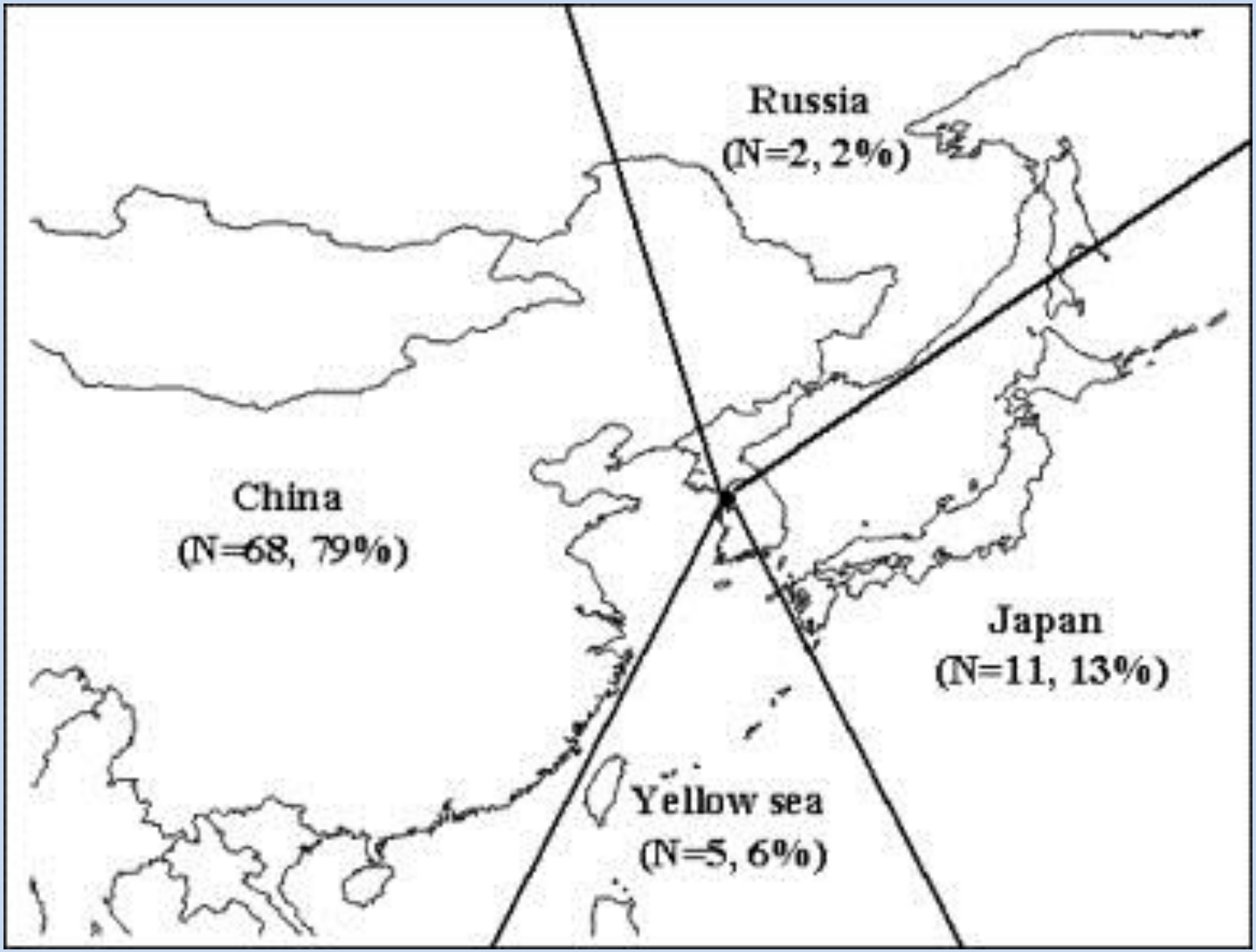

Chang, S. S., Lee, W. J., Wang, L. C., Lin, N. H., & Chang-Chien, G. P. (2012). Influence of the Southeast Asian biomass burnings on the atmospheric persistent organic pollutants observed at near sources and receptor site. *Atmospheric Environment*.

# Impacts of mercury emitting sources



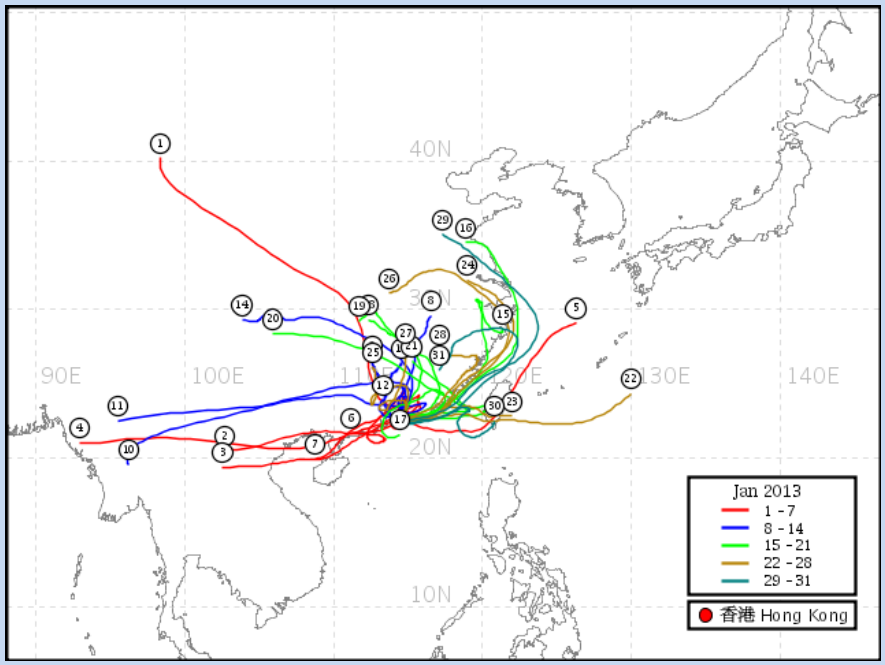

NOAA, 2011

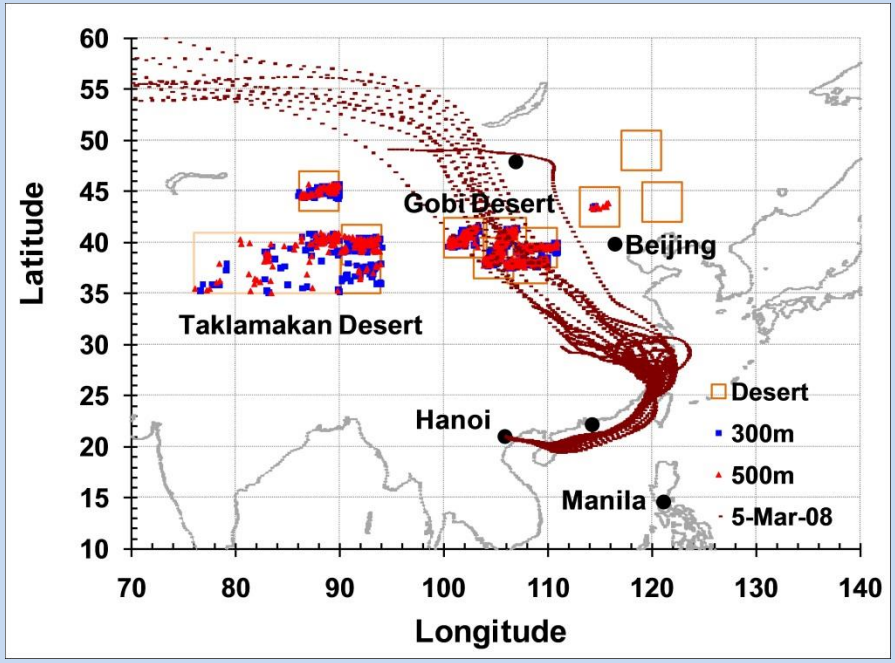
Sometimes, we see evidence of local and regional "plume" impacts




Choi, E. M., Kim, S. H., Holsen, T. M., & Yi, S. M. (2009). Total gaseous concentrations in mercury in Seoul, Korea: local sources compared to long-range transport from China and Japan. *Environmental Pollution*, *157*(3), 816-822.

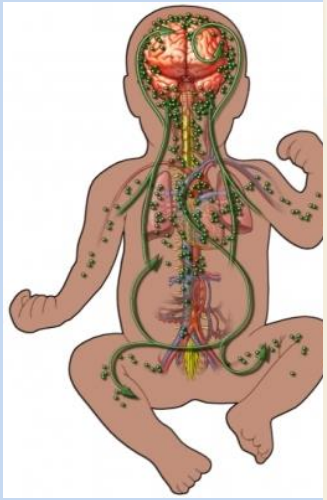
# Is all Mercury at my location from the *Same Source* as in All Countries?

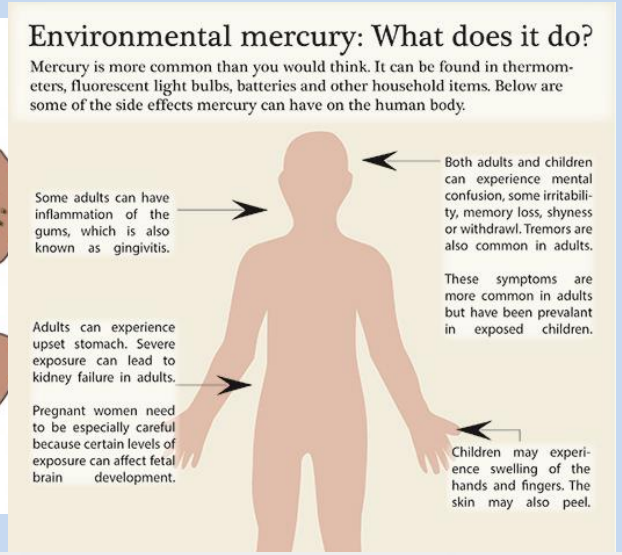


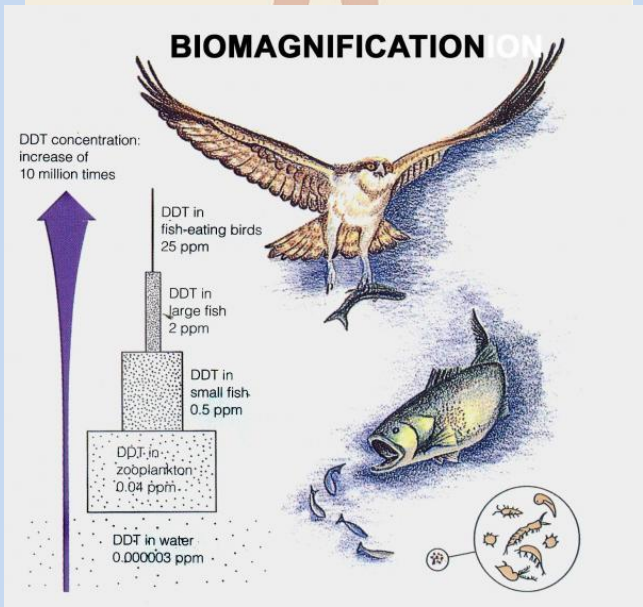



# Health Effects? Any Changes

- Are biological concentrations going down with decreasing deposition?
- Increasing with increasing deposition?
- Are our policy changes having any effect?





Working together is the *best way forward!*