

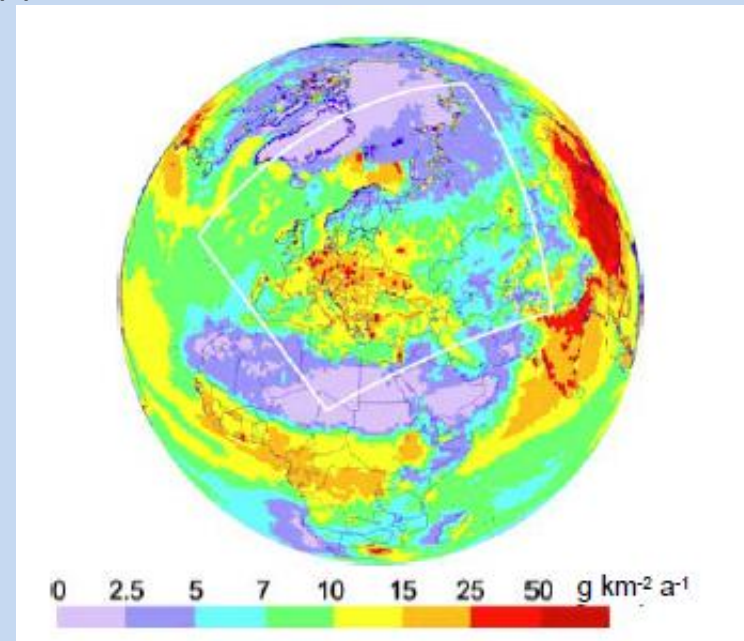
Why is it Important to
Measure Collaboratively as a
Network?

Data that is Used For:

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

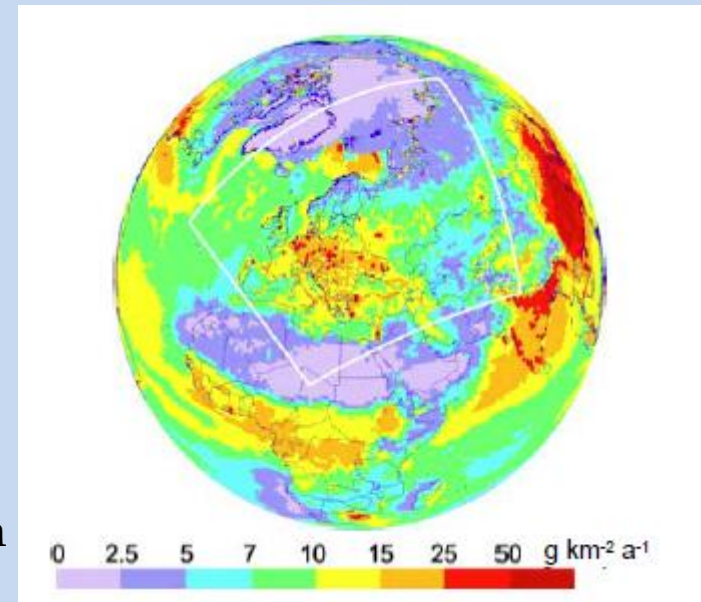
Consistency in Measurement is the KEY!

- Long term monitoring is required to see small changes.
- Using the same methods!!!
 - “apples to apples”
 - on a global basis



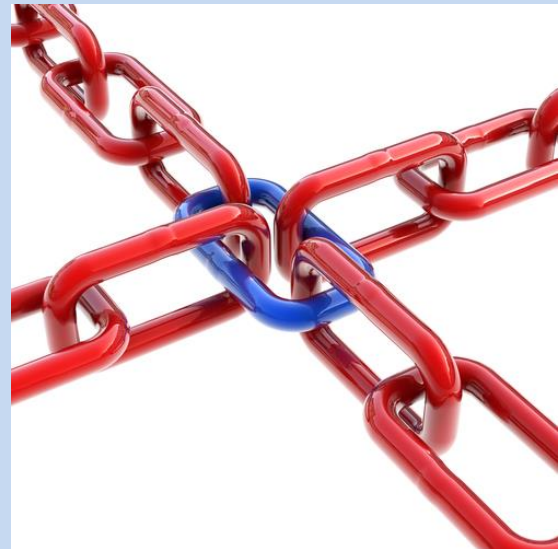
The Value of Monitoring

- 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

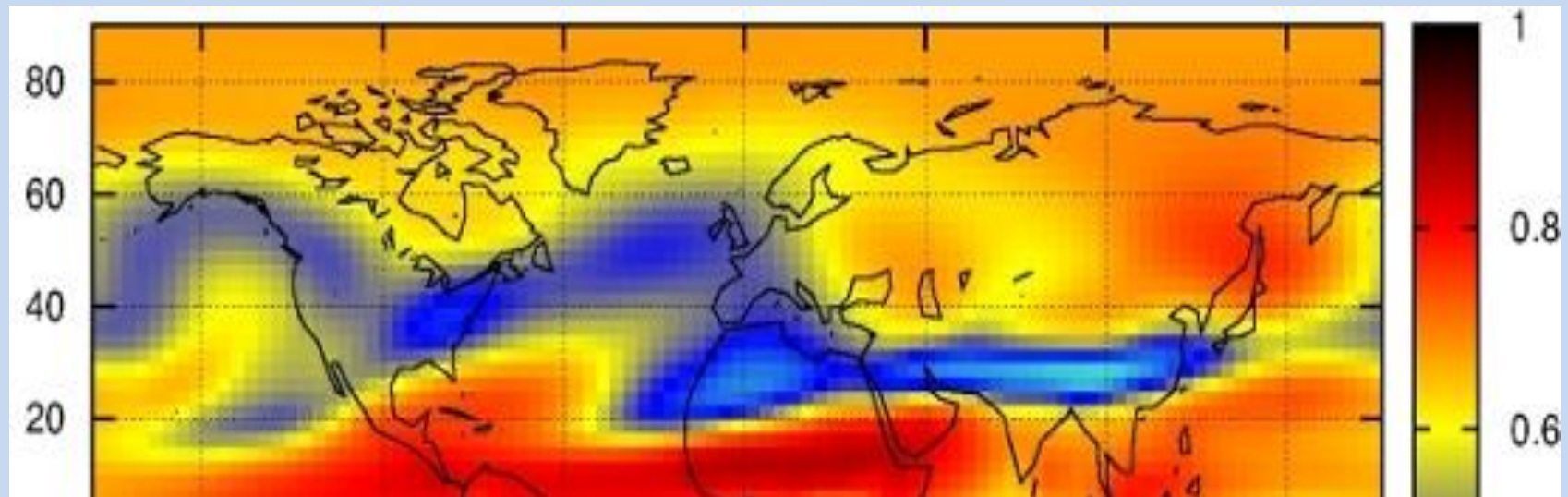


Vision of Results

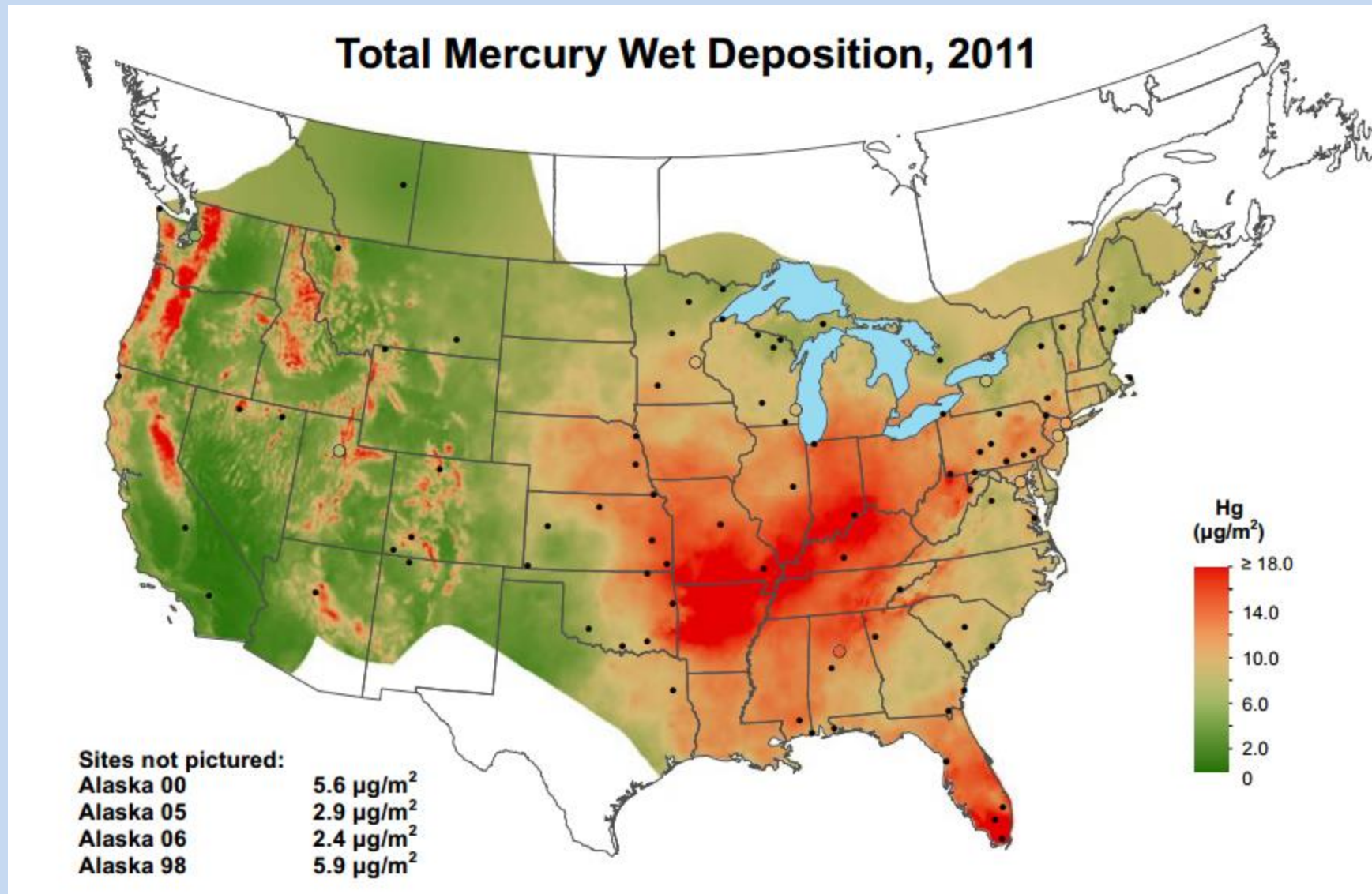
Cooperative Data Access will benefit Everyone



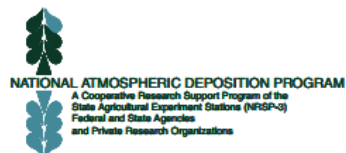
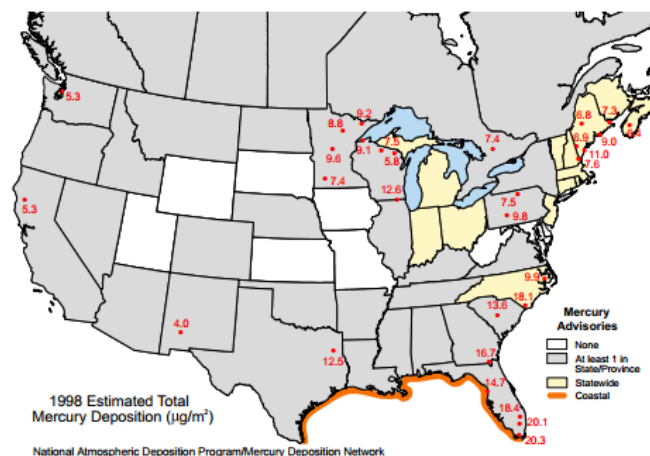
Single Site vs. Network Perspective: Difference is Huge



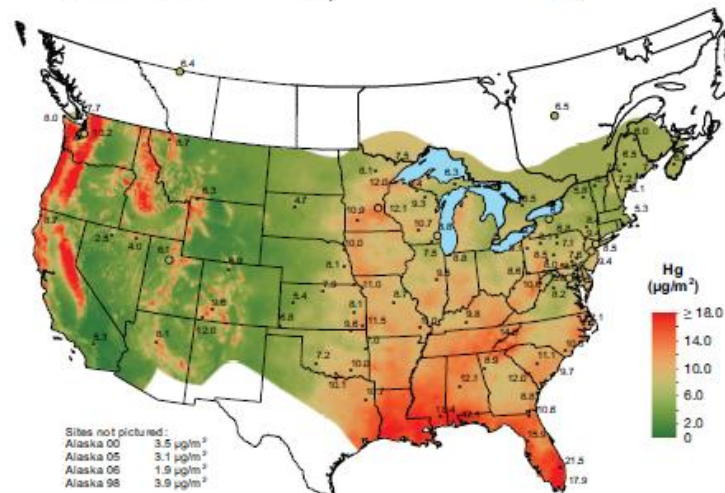
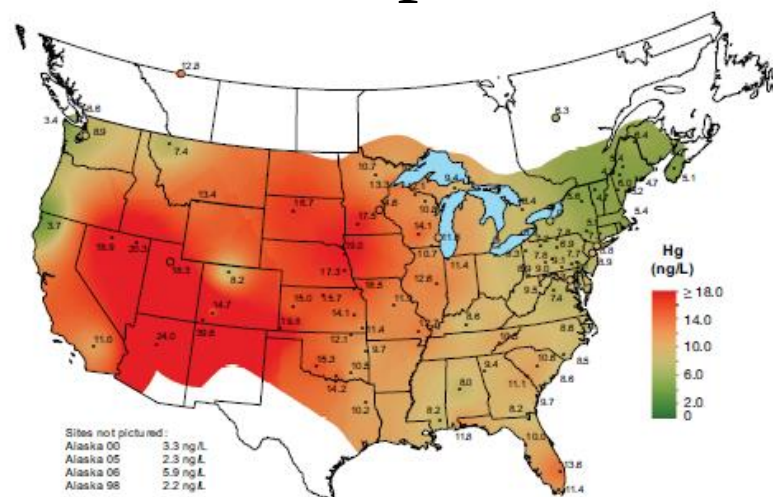
What Are The Asian Deposition Rates?



National Atmospheric Deposition Program 1998 Wet Deposition

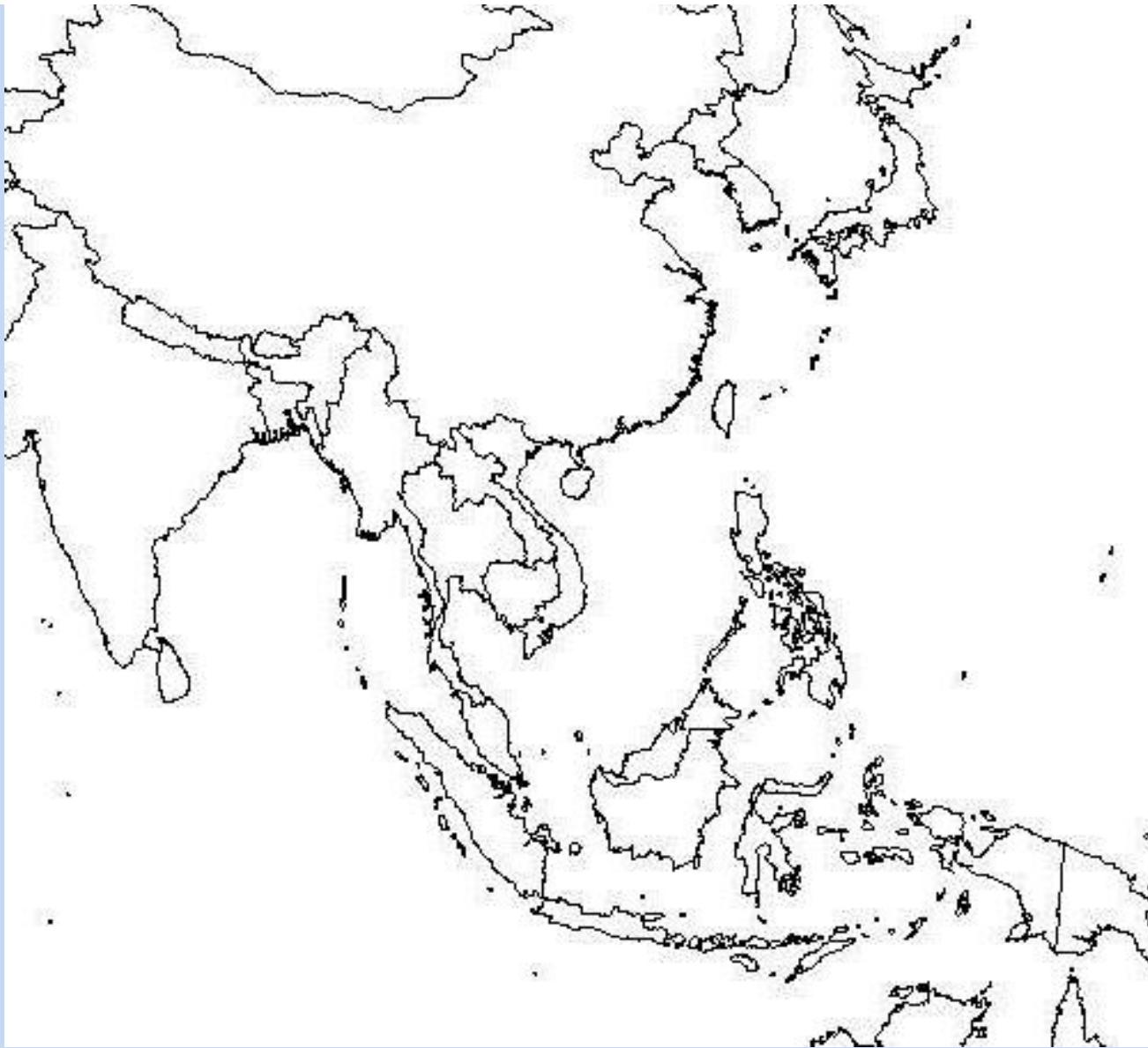


2012 MDN Maps



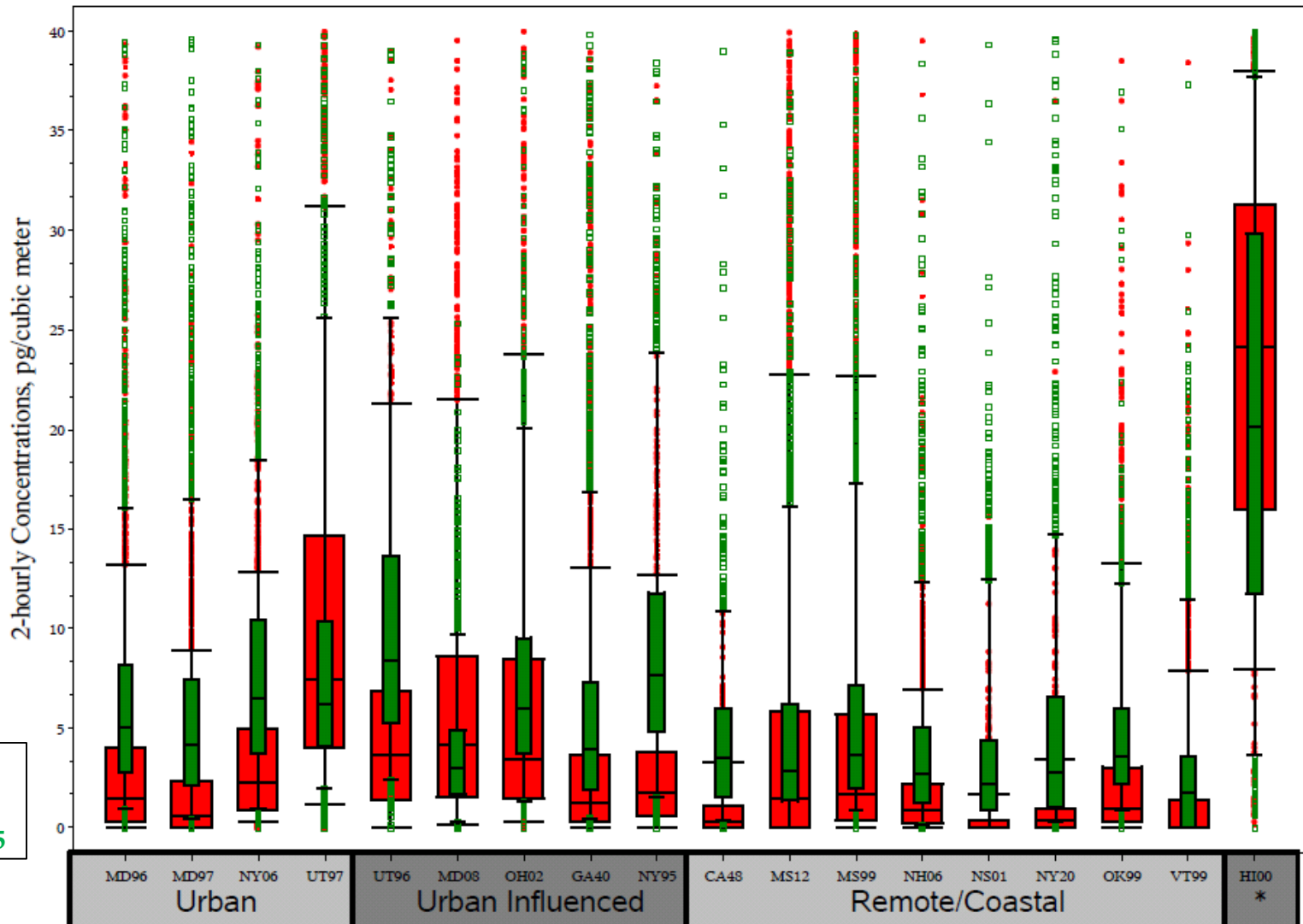
Total mercury concentration (top) and wet deposition (bottom), 2012.

Comparison: Is Deposition in One Country high or low?



Comparison: Where are Mercury Levels Higher? Lower?

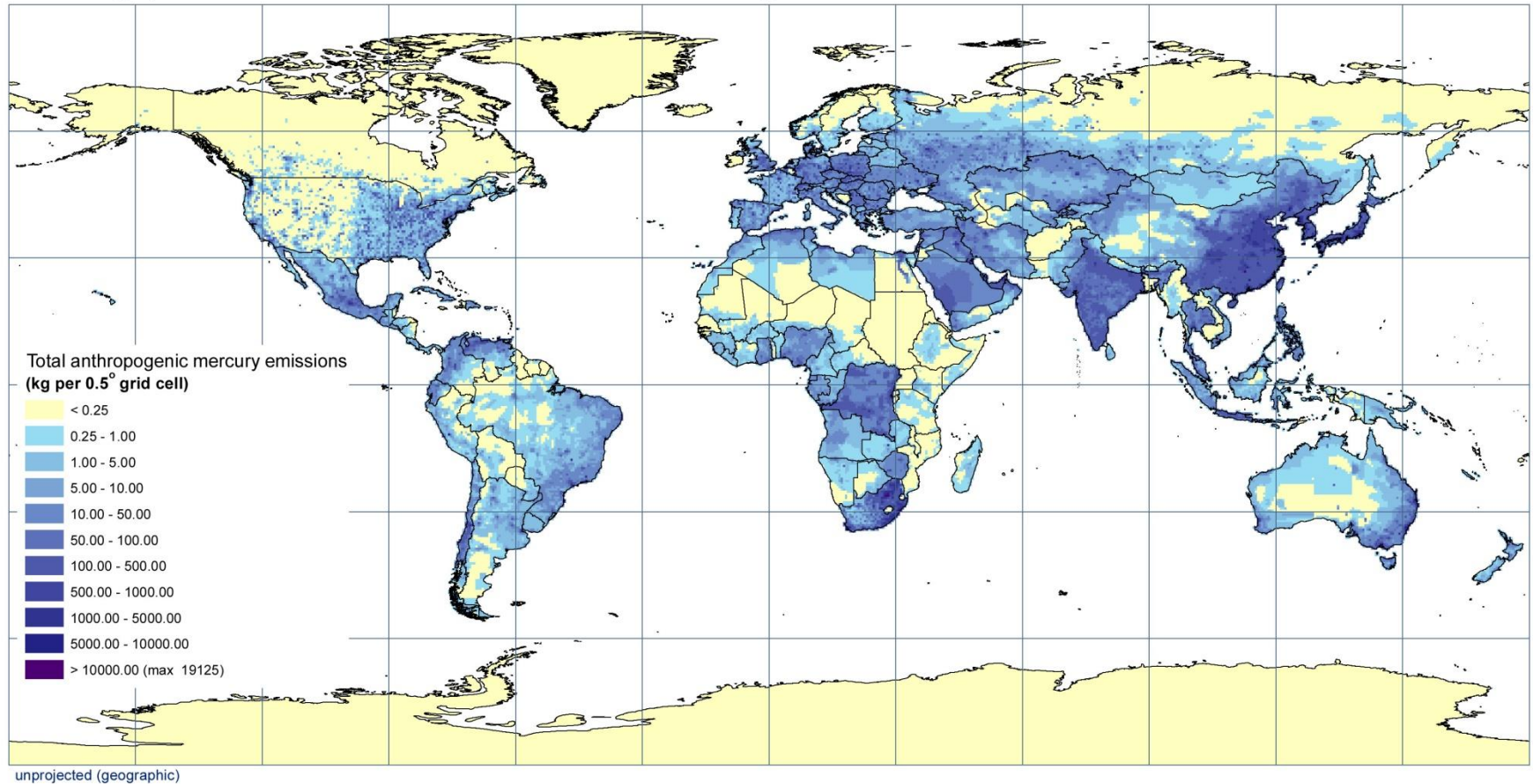
Particulate Bound and Oxidized Hg



Major Sources of Mercury Emission

Spatially Distributed Inventories of Global Anthropogenic Emissions of Mercury to the Atmosphere, 2000

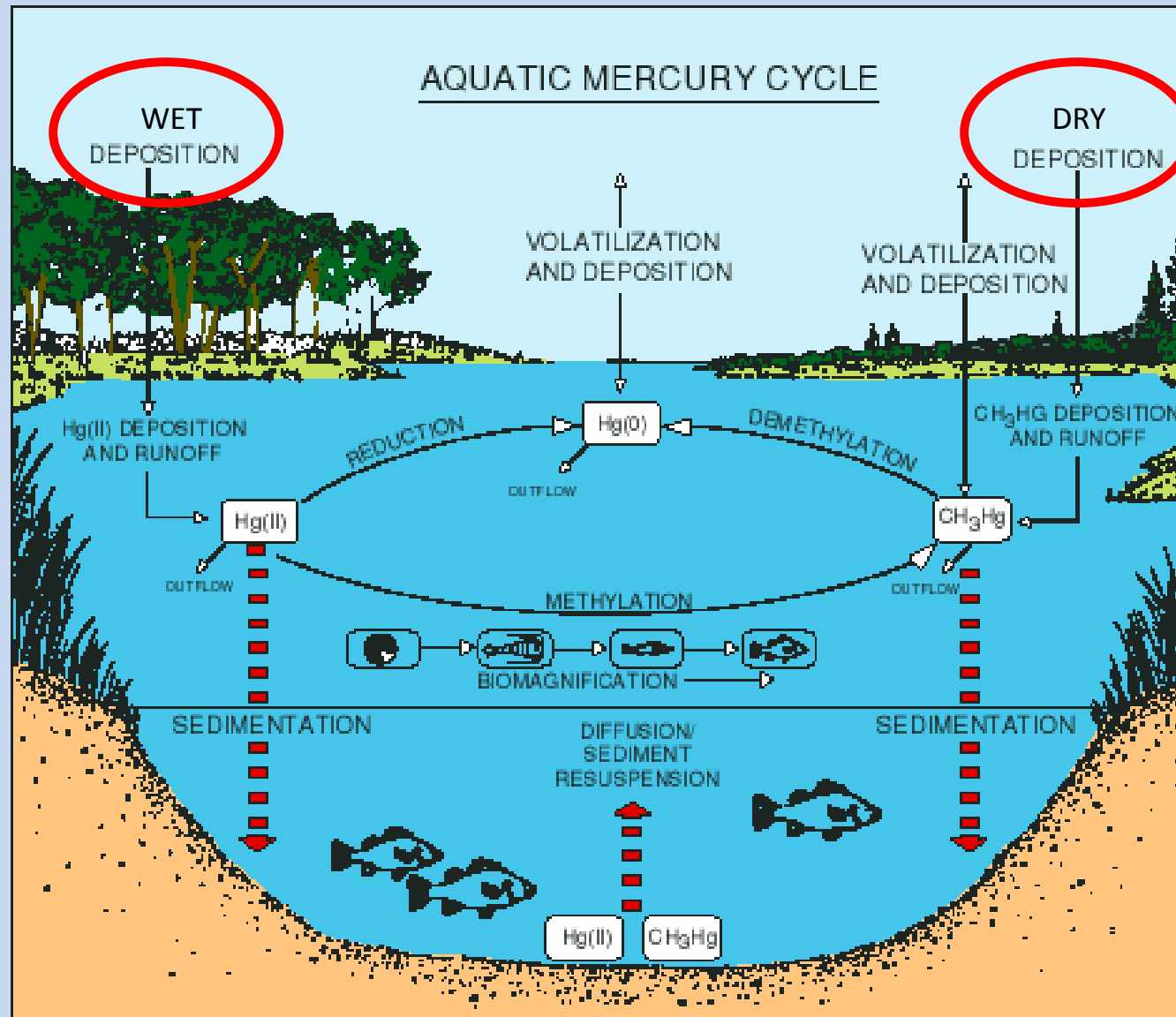
Total Hg, point sources + distributed sources, 0.5° grid



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)

Do we understand Mercury Cycling?



How Important is Dry Deposition?

- flux (F) = air concentration $\times$ dry deposition velocity (V_d)

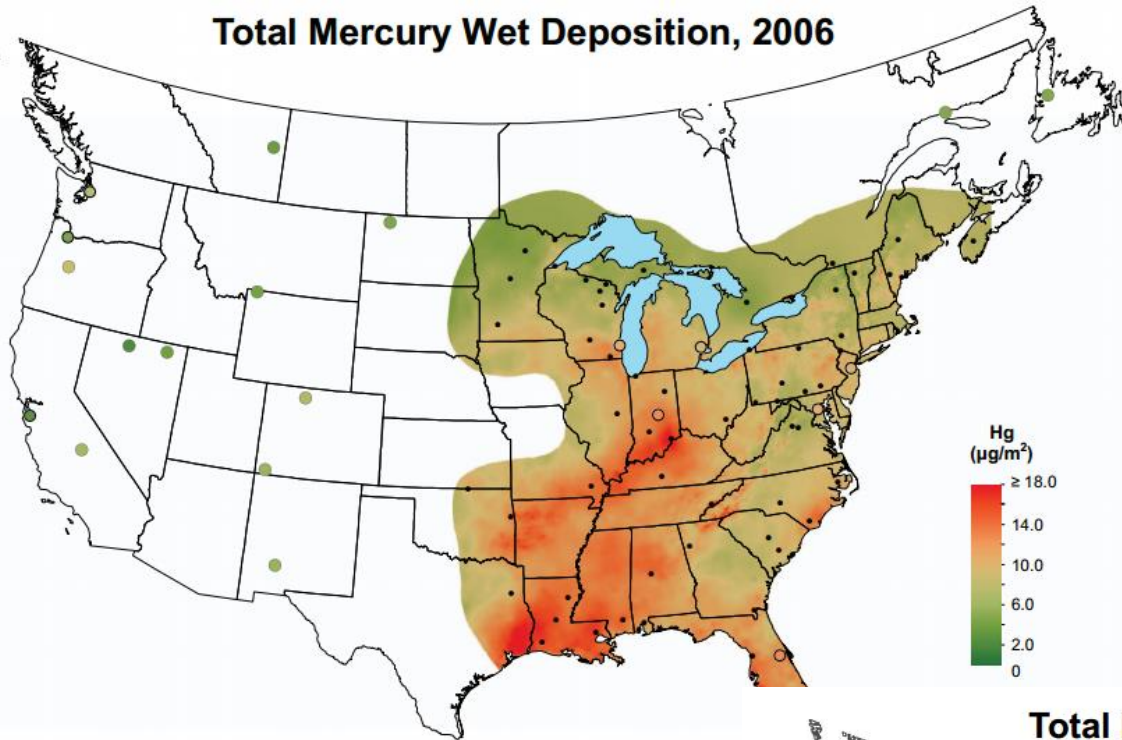
$$F = V_{\text{deposition}} * \text{Concentration}_{\text{air}}$$

where:

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

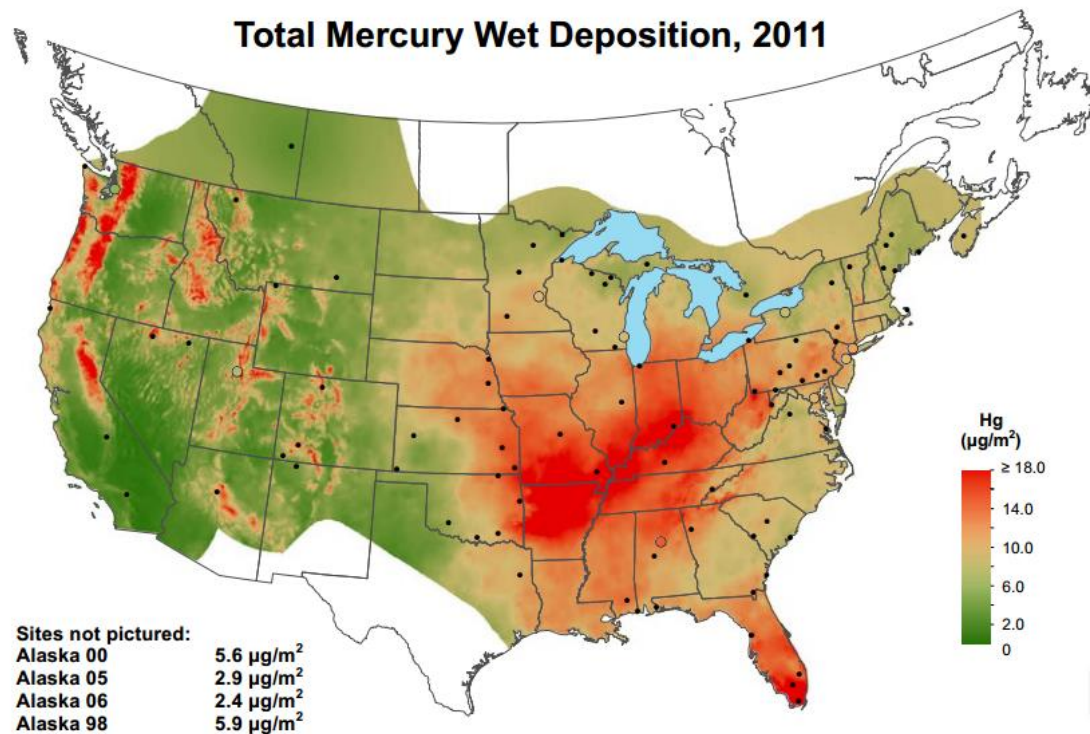
- R_a as aerodynamic resistance, R_b as quasi-laminar resistance, and R_c as canopy resistance

Total Mercury Wet Deposition, 2006



Is the spatial aspect of
Mercury Deposition
Changing over time?

Total Mercury Wet Deposition, 2011



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?

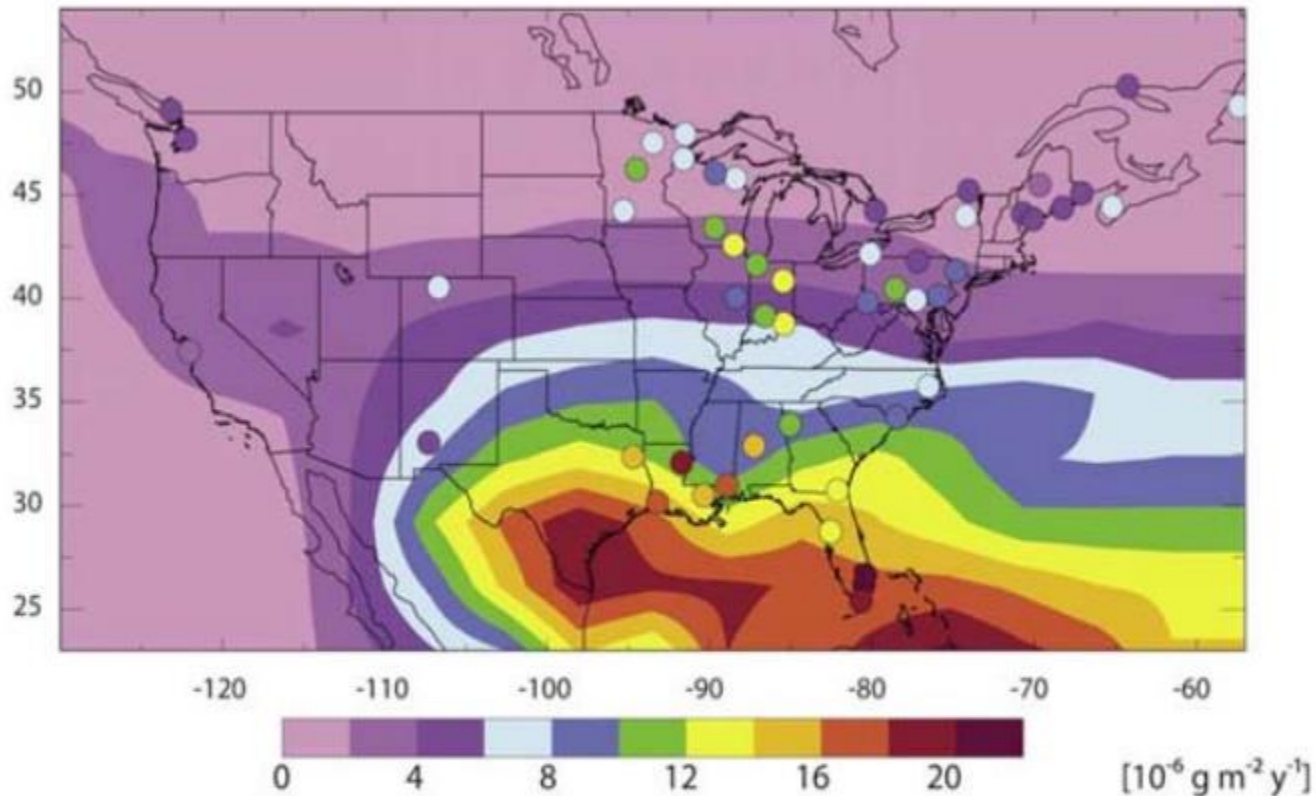
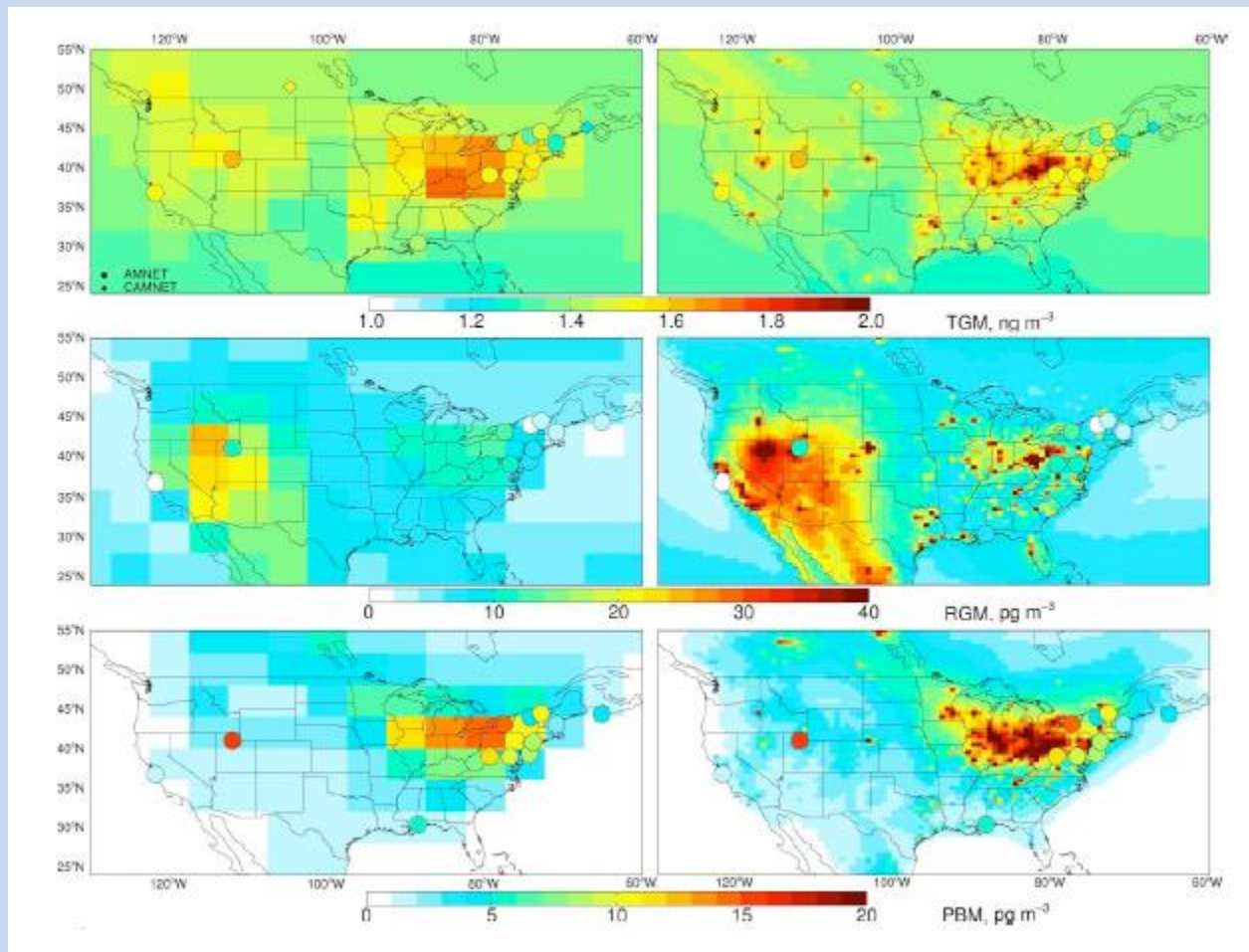


Figure 13.1 - Annual mercury wet deposition fluxes over the United States for 2003 – 2004. Observations from the Mercury Deposition Network (circles) are compared to model results (background). From Selin et al. (2007).

Do Models Predict Gaseous Concentrations Correctly?

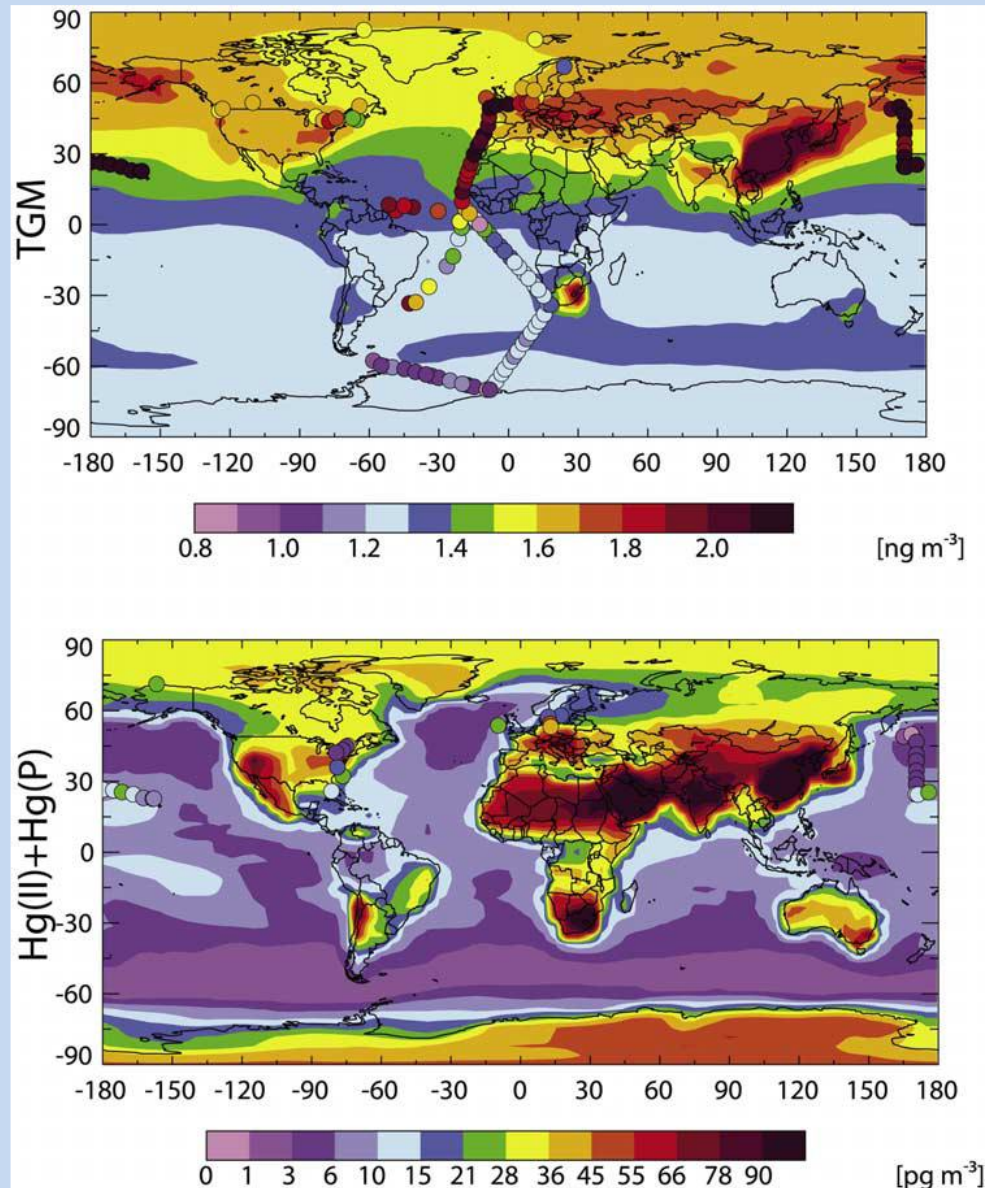
Global and Nested Model Comparisons with AMNet Data Nested-grid simulation of mercury over North America



Y.Zhang, 2012

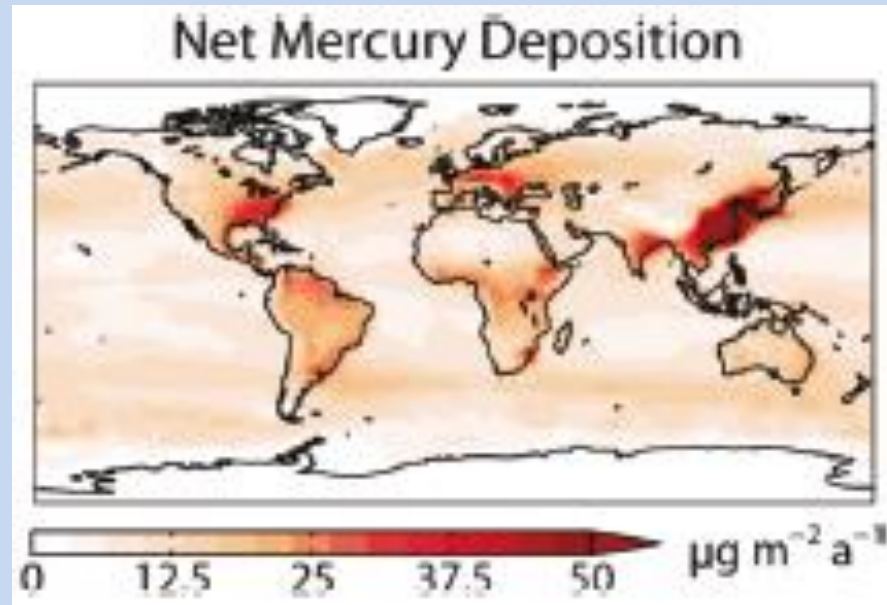
Fig. 7. Annual mean surface concentrations of TGM (top), RGM (middle) and PBM (bottom) during 2008–2009. Results from the global (left column) and nested (right column) IPR simulations are compared to observations from 14 AMNet sites (circles) and 5 CAMNET sites (diamonds). Two pairs of AMNet sites are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

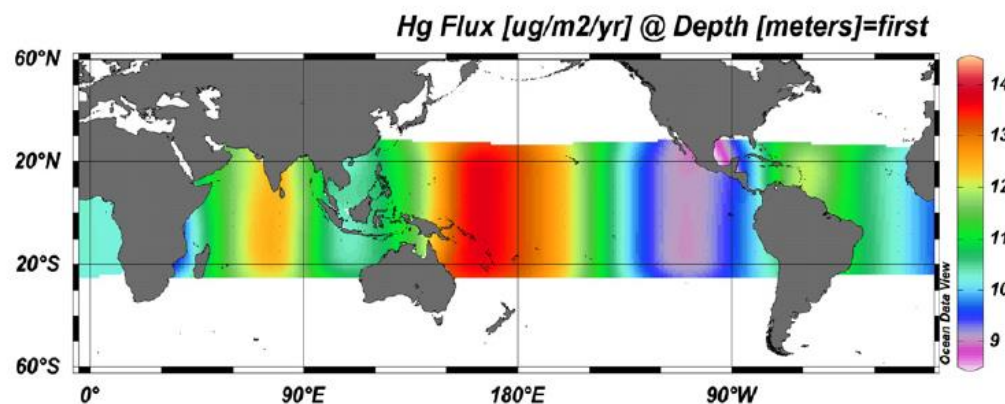


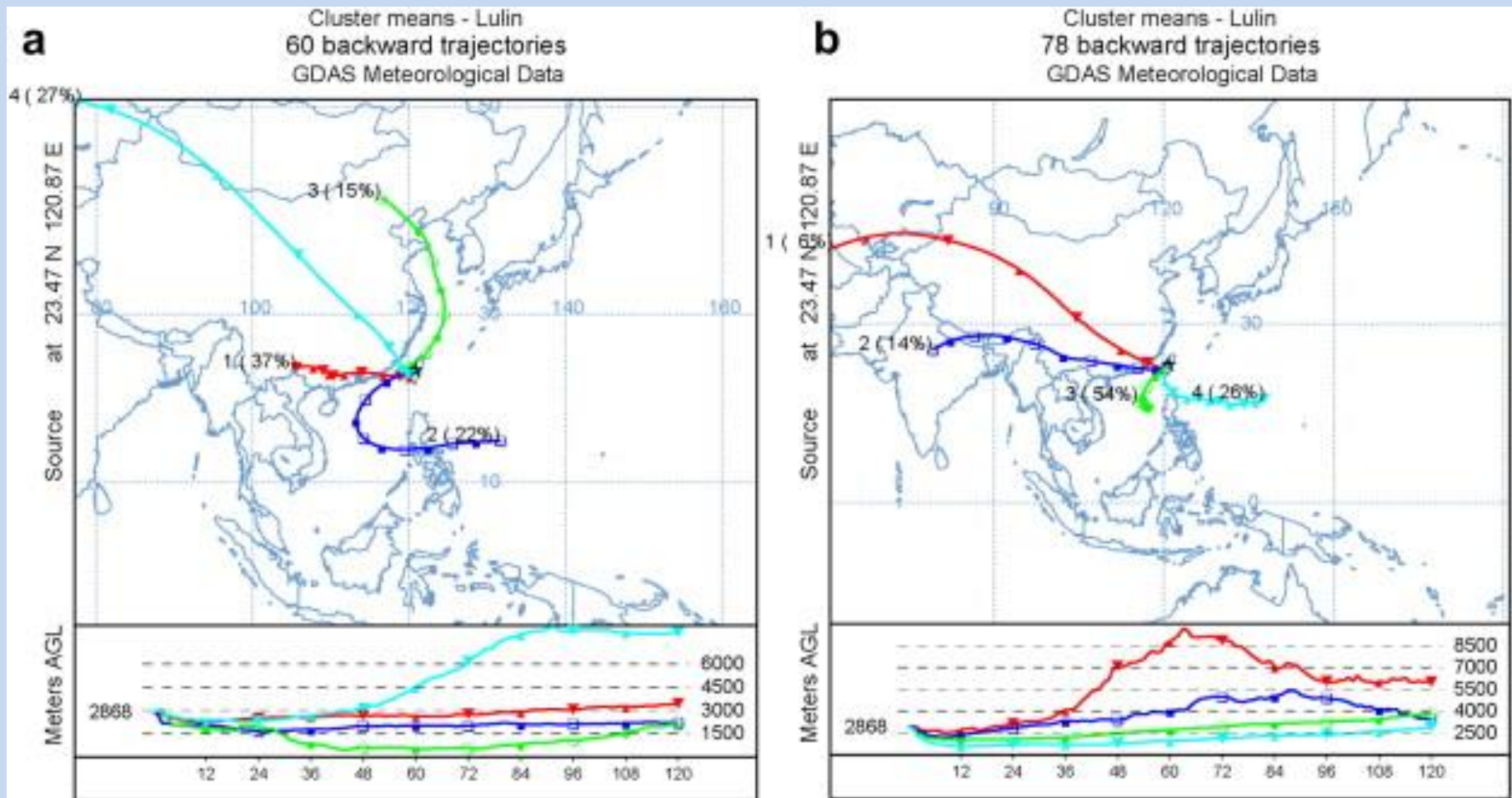
Fig. 2. Annual mercury deposition (wet plus dry, including $\text{Hg}(0)$; $\mu\text{g m}^{-2} \text{yr}^{-1}$) over the tropical oceans simulated using GEOS-Chem. Deposition shown here is averaged over tropical latitudes (24°N to 24°S).

Costa et al., 2012

Model Development

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

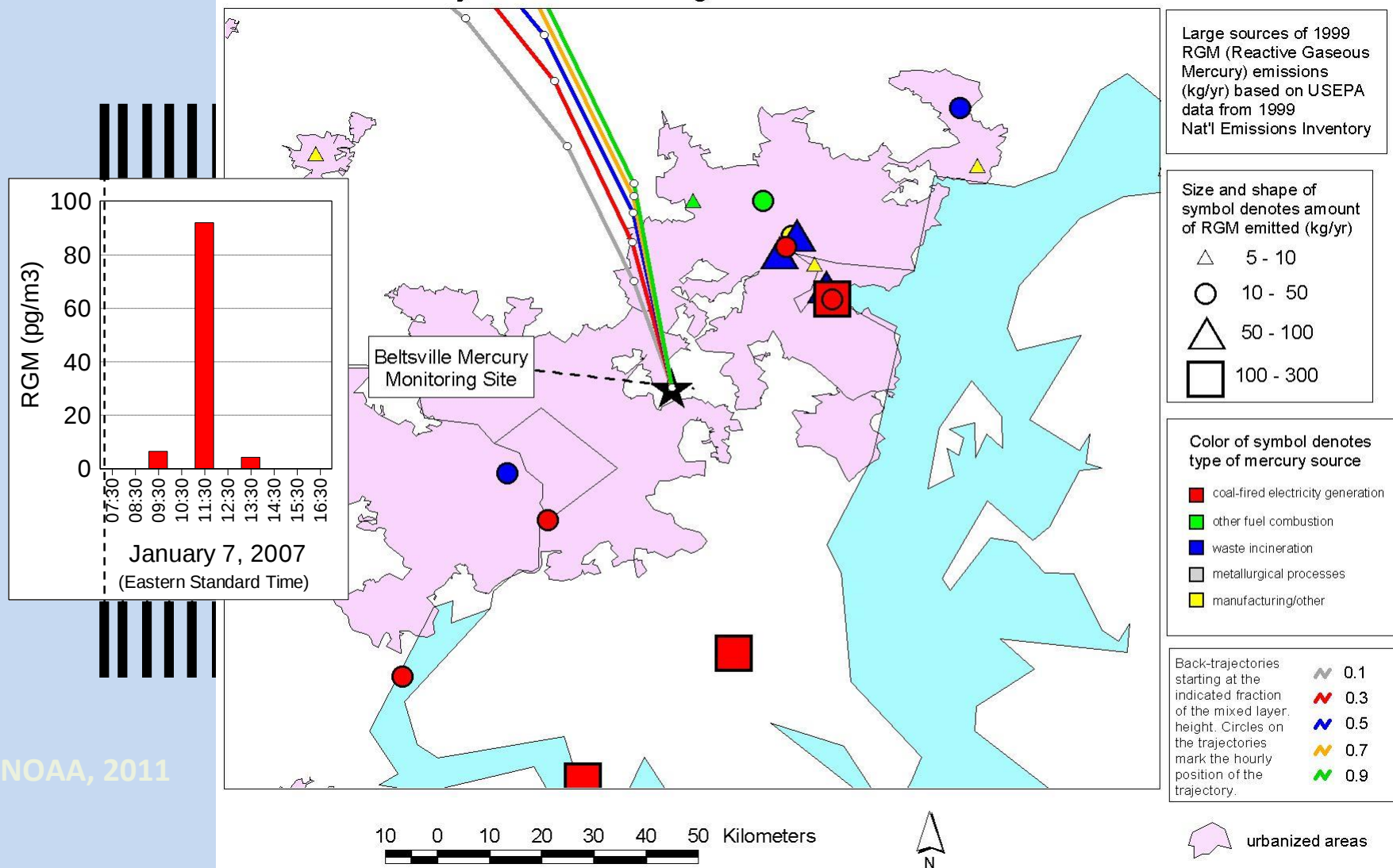
With Back Trajectories, Where Is this Mercury Coming From?



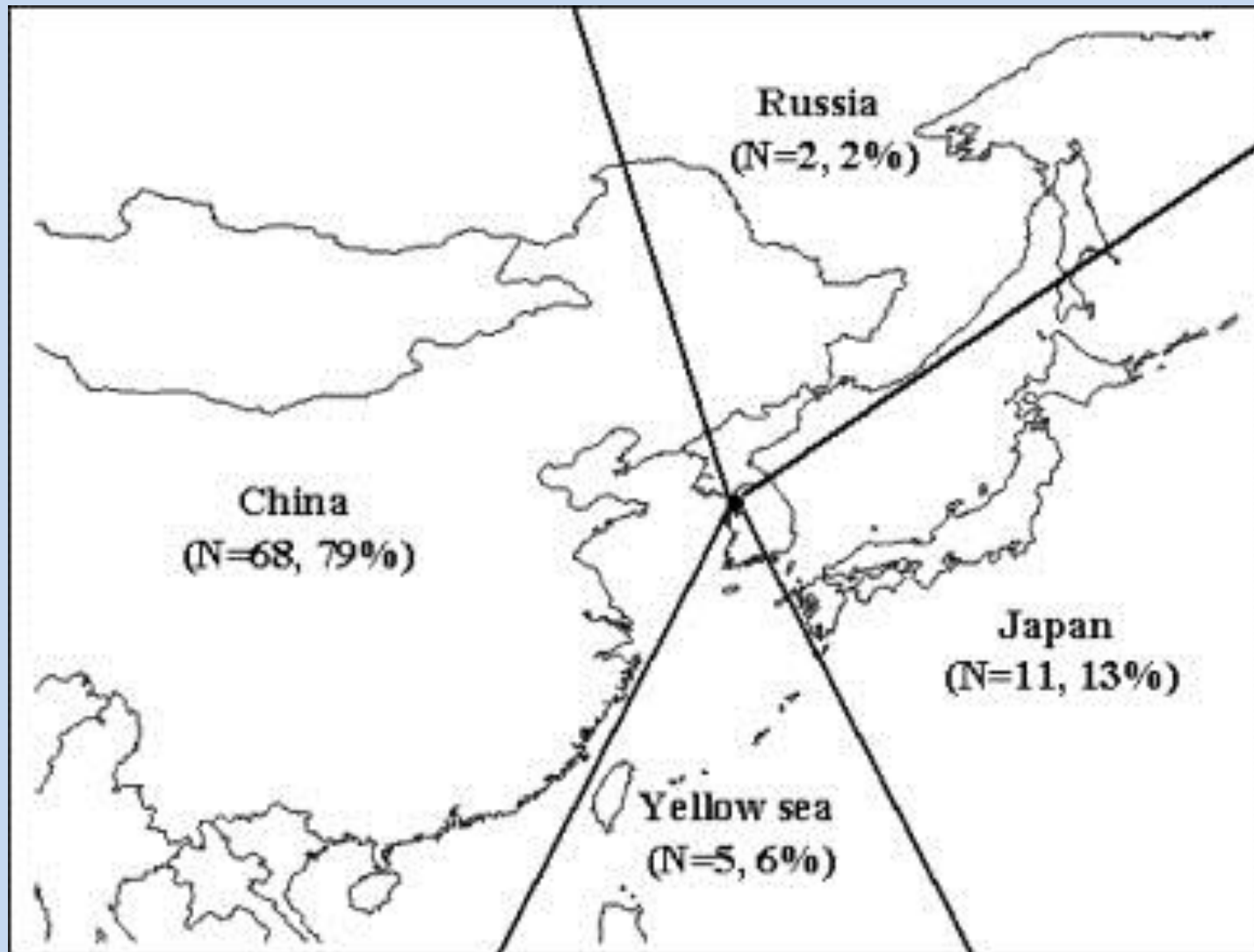
Chang, S. S., Lee, W. J., Wang, L. C., Lin, N. H., & Chang-Chien, G. P. (2012). Influence of the Southeast Asian biomass burnings on the atmospheric persistent organic pollutants observed at near sources and receptor site. *Atmospheric Environment*.

Impacts of mercury emitting sources

Back Trajectories Arriving at 1/07/2007 07:00 EST

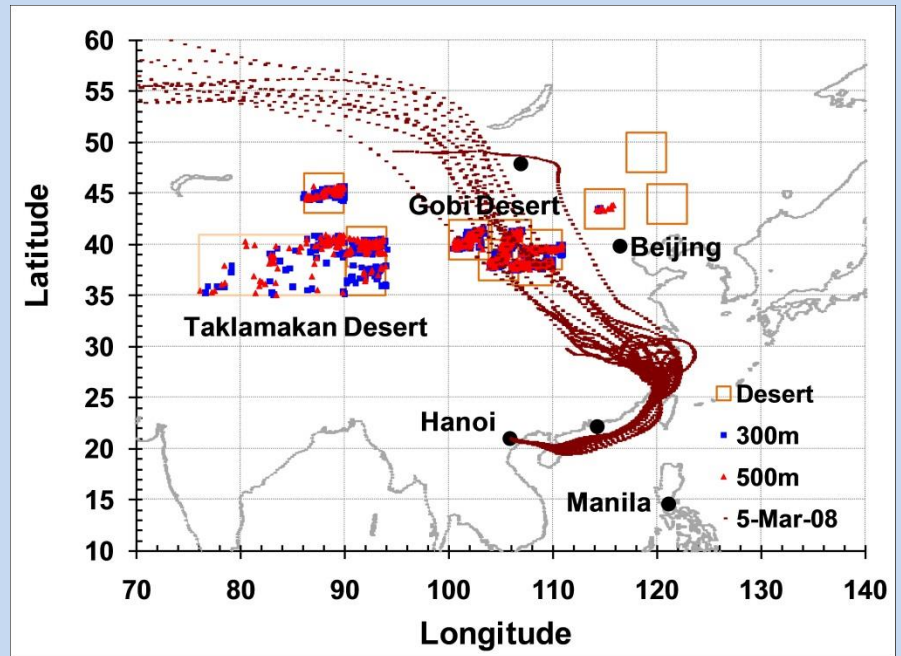
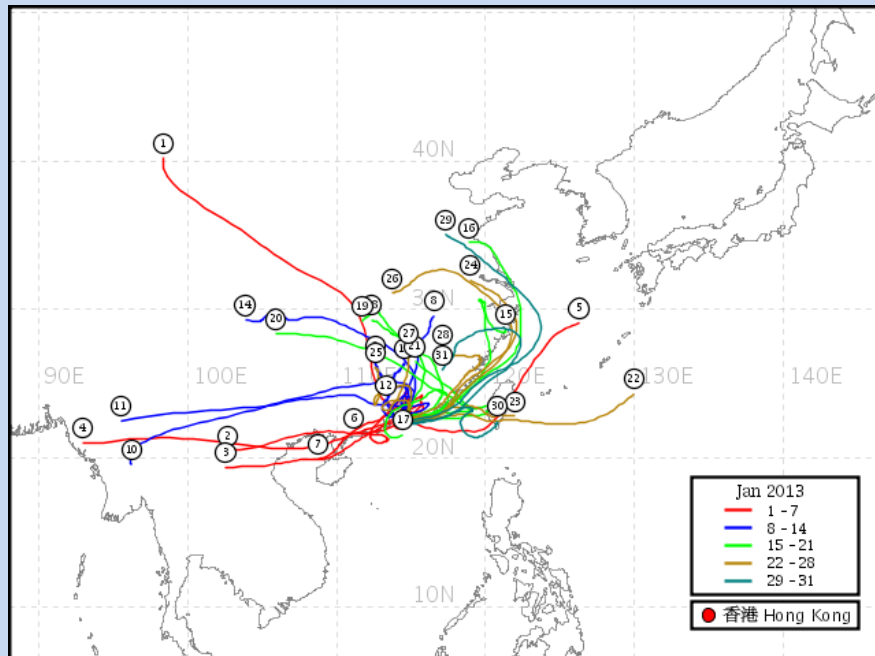


Sometimes, we see evidence of local and regional “plume” impacts



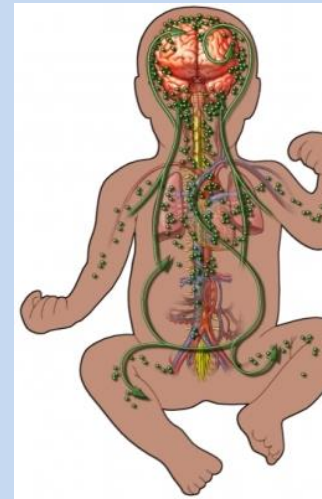
Choi, E. M., Kim, S. H., Holsen, T. M., & Yi, S. M. (2009). Total gaseous concentrations in mercury in Seoul, Korea: local sources compared to long-range transport from China and Japan. *Environmental Pollution*, 157(3), 816-822.

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?



Environmental mercury: What does it do?

Mercury is more common than you would think. It can be found in thermometers, fluorescent light bulbs, batteries and other household items. Below are some of the side effects mercury can have on the human body.

Some adults can have inflammation of the gums, which is also known as gingivitis.

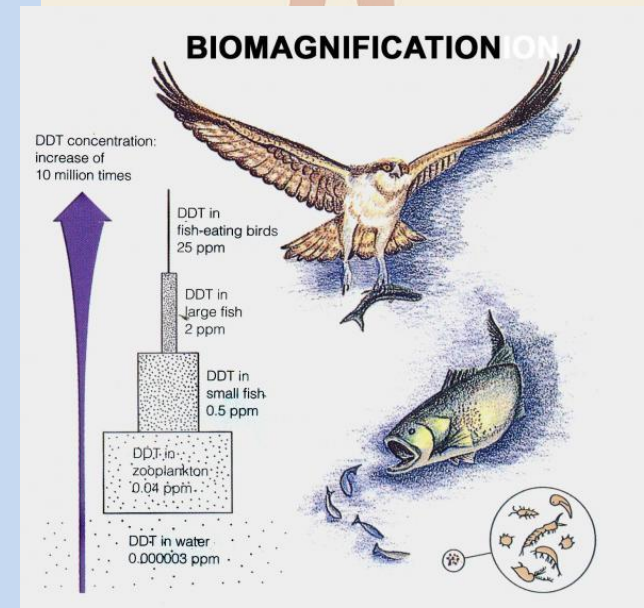
Adults can experience upset stomach. Severe exposure can lead to kidney failure in adults.

Pregnant women need to be especially careful because certain levels of exposure can affect fetal brain development.

Both adults and children can experience mental confusion, some irritability, memory loss, shyness or withdrawal. Tremors are also common in adults.

These symptoms are more common in adults but have been prevalent in exposed children.

Children may experience swelling of the hands and fingers. The skin may also peel.



Working together is the *best way forward!*

