

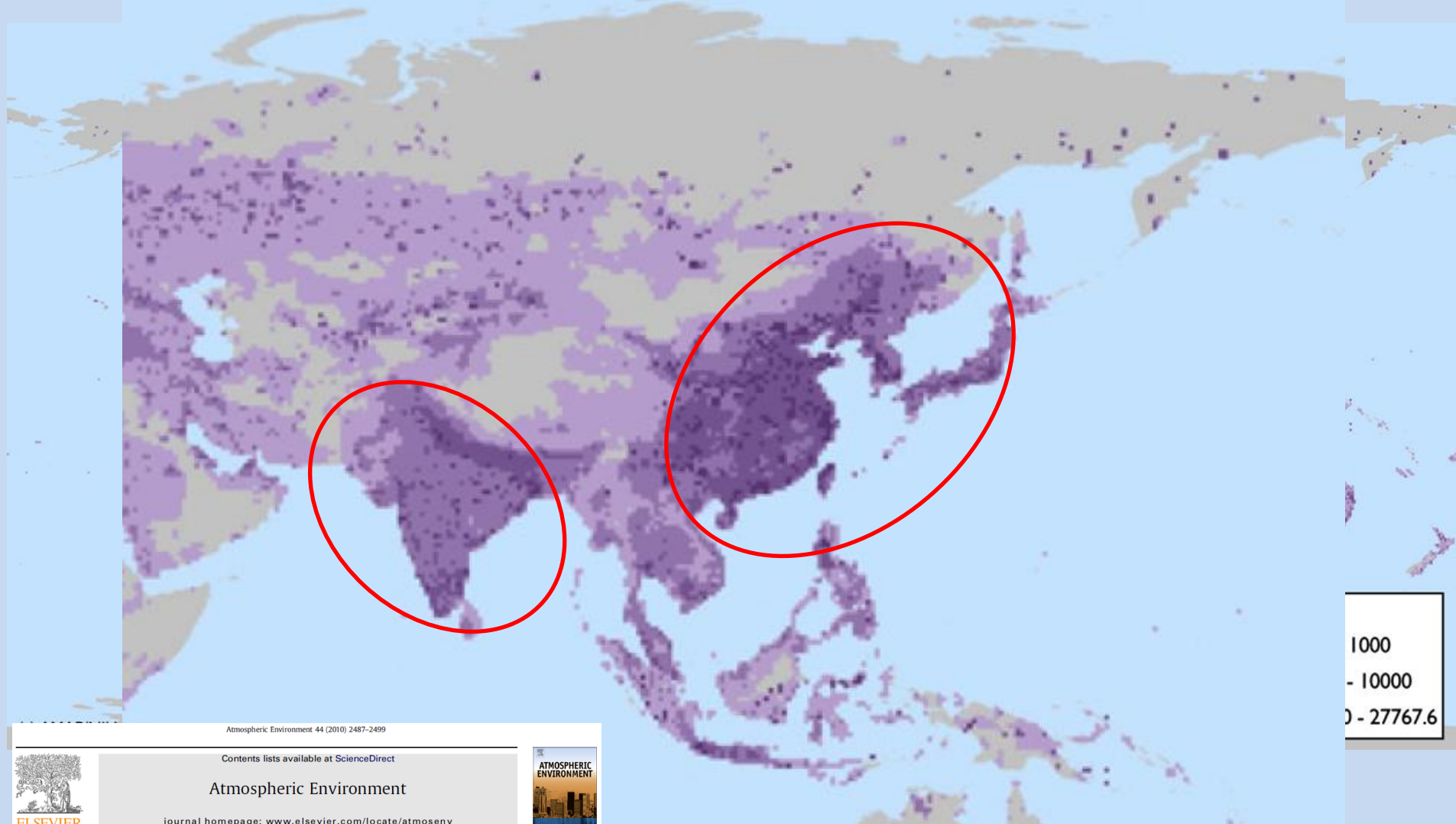
Vision for the Asia Pacific Mercury Monitoring Network

Guey-Rong Sheu & David Gay

History over the Past Year

- Introduction to history
 - Workshop in Taiwan, 2012
 - Bilateral talks between countries
 - Washington DC Proposal of APMMN

Why This Network Is Important?



Global emission of mercury to the atmosphere from anthropogenic sources in 2005 and projections to 2020

E.G. Pacyna^a, J.M. Pacyna^{a,b,*}, K. Sundseth^a, J. Munthe^c, K. Kindbom^c, S. Wilson^d,
F. Steenhuisen^e, P. Maxson^f

Mercury is a global pollutant, so...

- Need global organization
- Harmonize methods and sampling times
- Global reporting of measurements

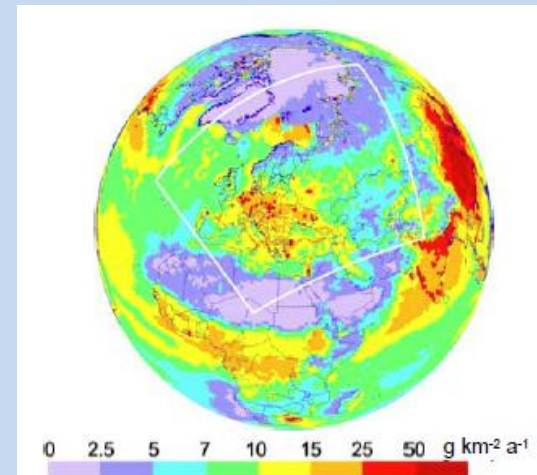
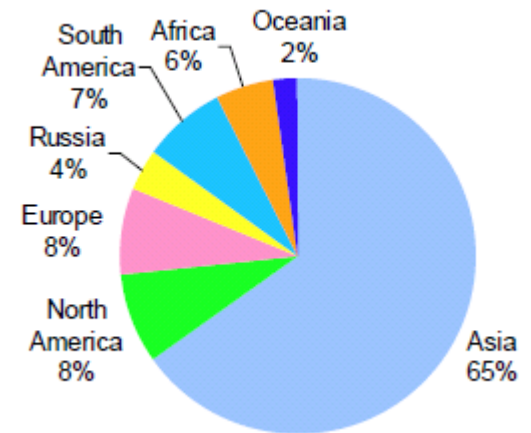
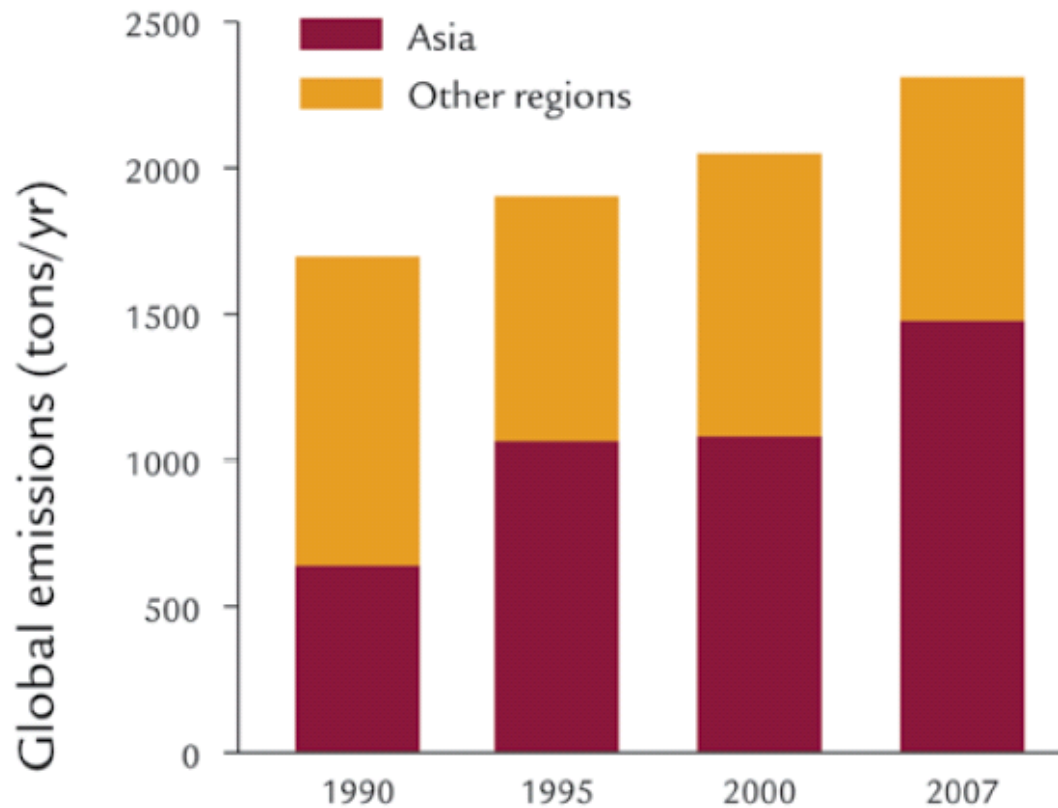


Fig. 3.13. Spatial distribution of mercury deposition flux on a global scale in 2010. White rectangle shows location of the EMEP domain.

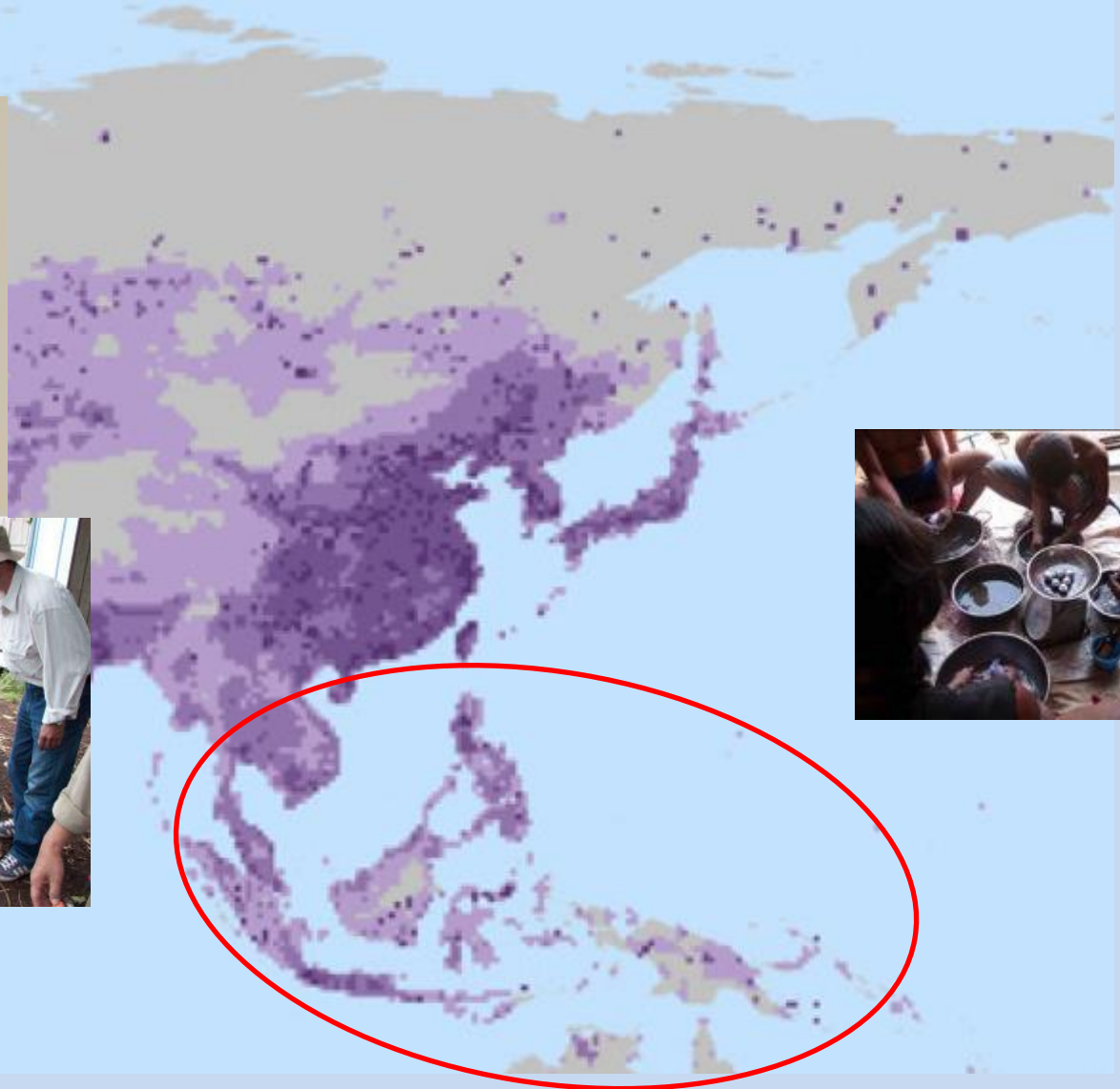
Emissions Are Increasing

Asian Growth



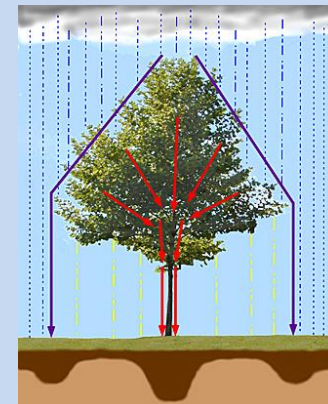
EMEP, 2012

Small Scale Artisanal Gold Mining?



Processes Contributing to Total Atmospheric Hg Deposition...

- Wet Deposition
- Dry Deposition
- Litterfall
- Throughfall



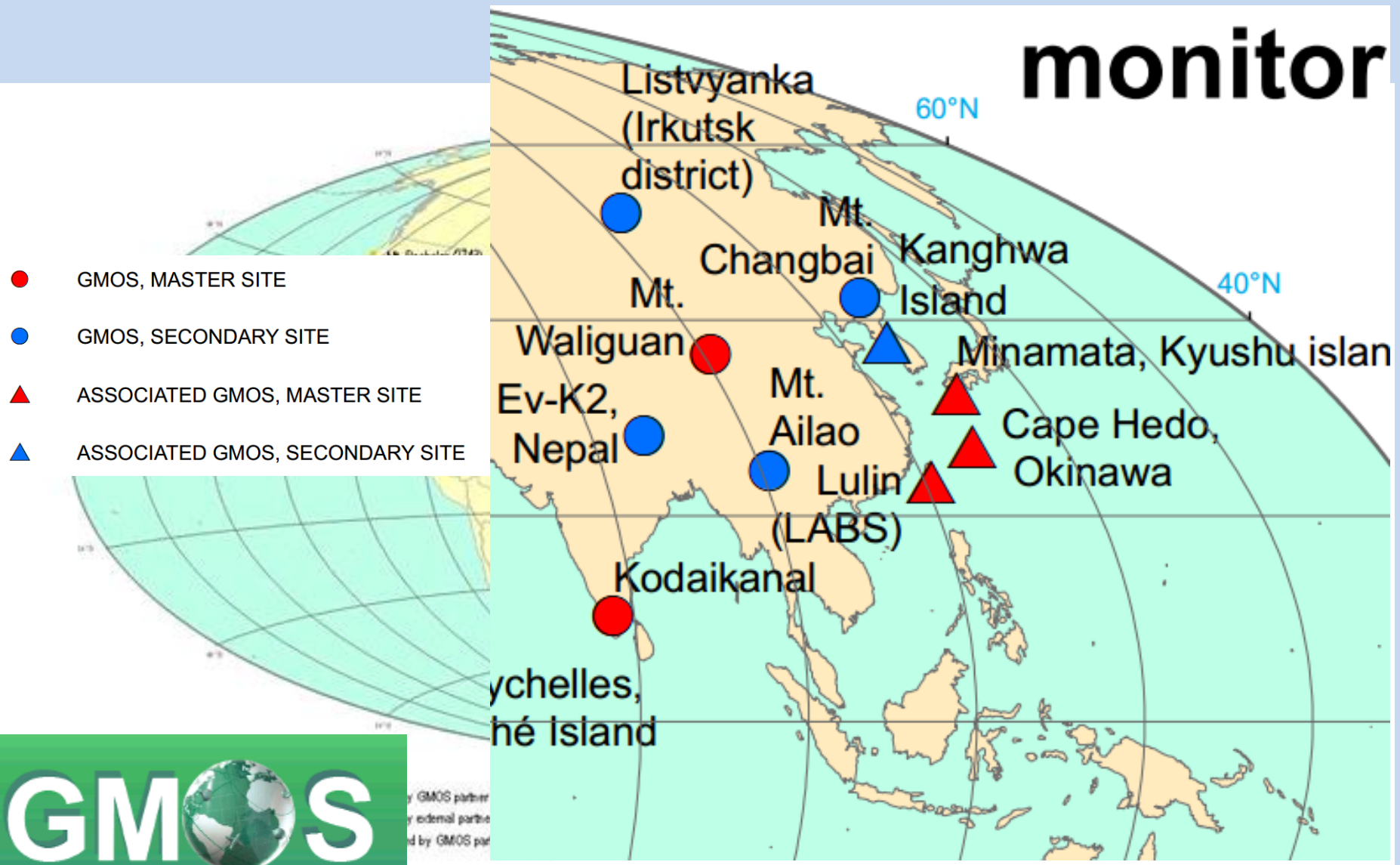
Vision

- Asia Pacific Mercury Monitoring Network
 - A group of countries, agencies, other groups
 - Making measurements of
 - mercury wet deposition and
 - Gaseous mercury concentrations
 - Using the same instruments and operating procedures
 - Sharing data to solve the mercury problem

East Asia



What About GMOS?



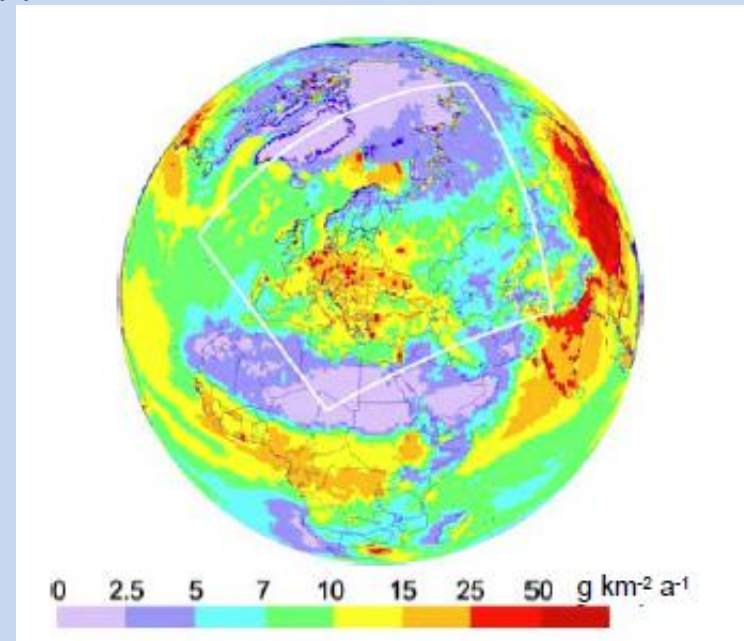
monitor

An Asian Monitoring Body

- Made up of scientists and policy analysts
- Who decide the operating rules
- Who decide how the data is quality assured
- Who decide how the data will be distributed

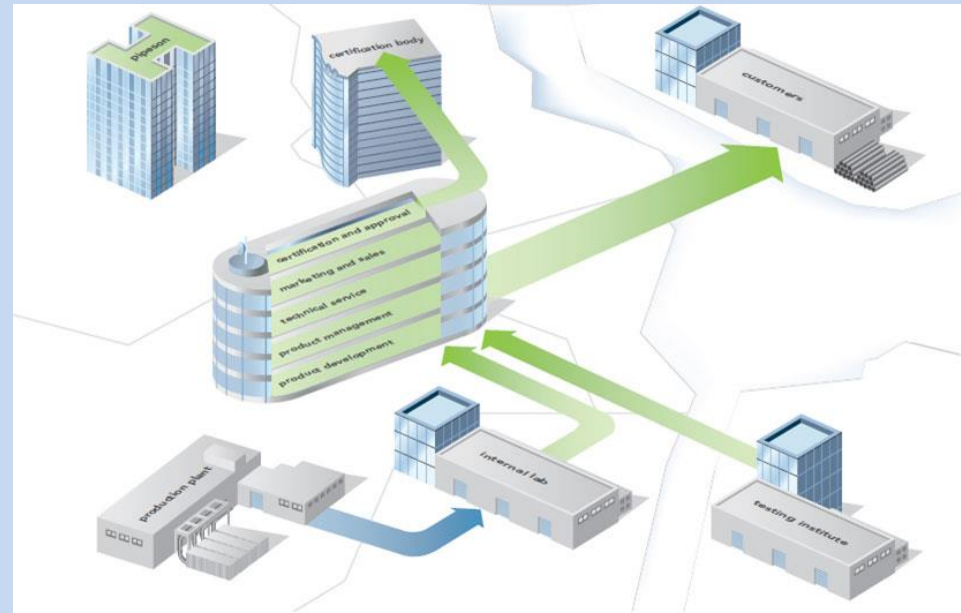
Consistency in Measurement is the KEY!

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



Open Access to the Data

- Quality assured using a single method
- Stored in one location
- Located on one server for utility by all

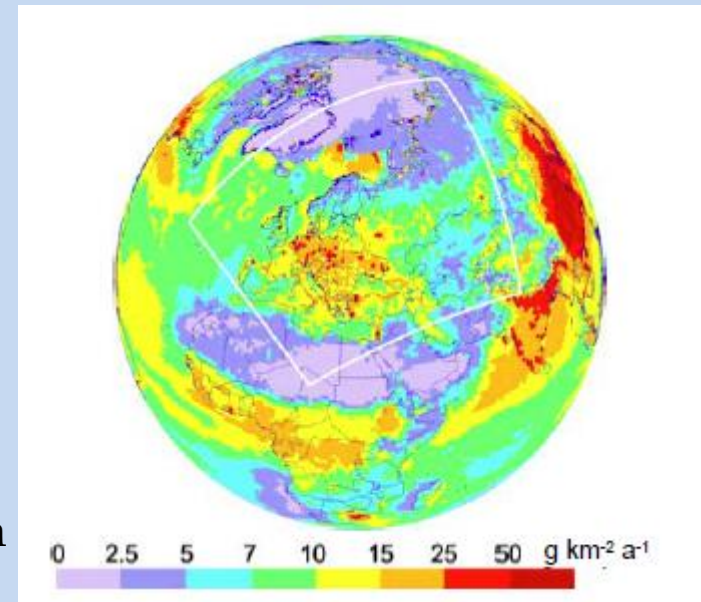


Data that is Used For:

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

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



Data that is Used For:

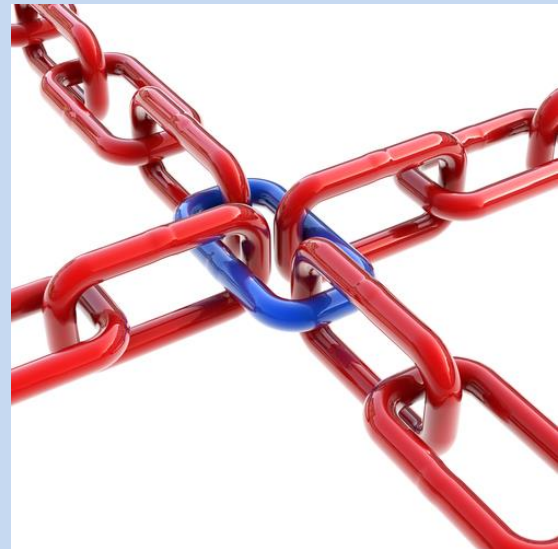
- Data that is useful to all, from all countries and organizations
- Data that is free to be used by all
- Data of high quality and renowned for consistency
- Continental Scale Observation
 - Expanding your networks beyond your country borders

What Do you Gain by Joining A Network?

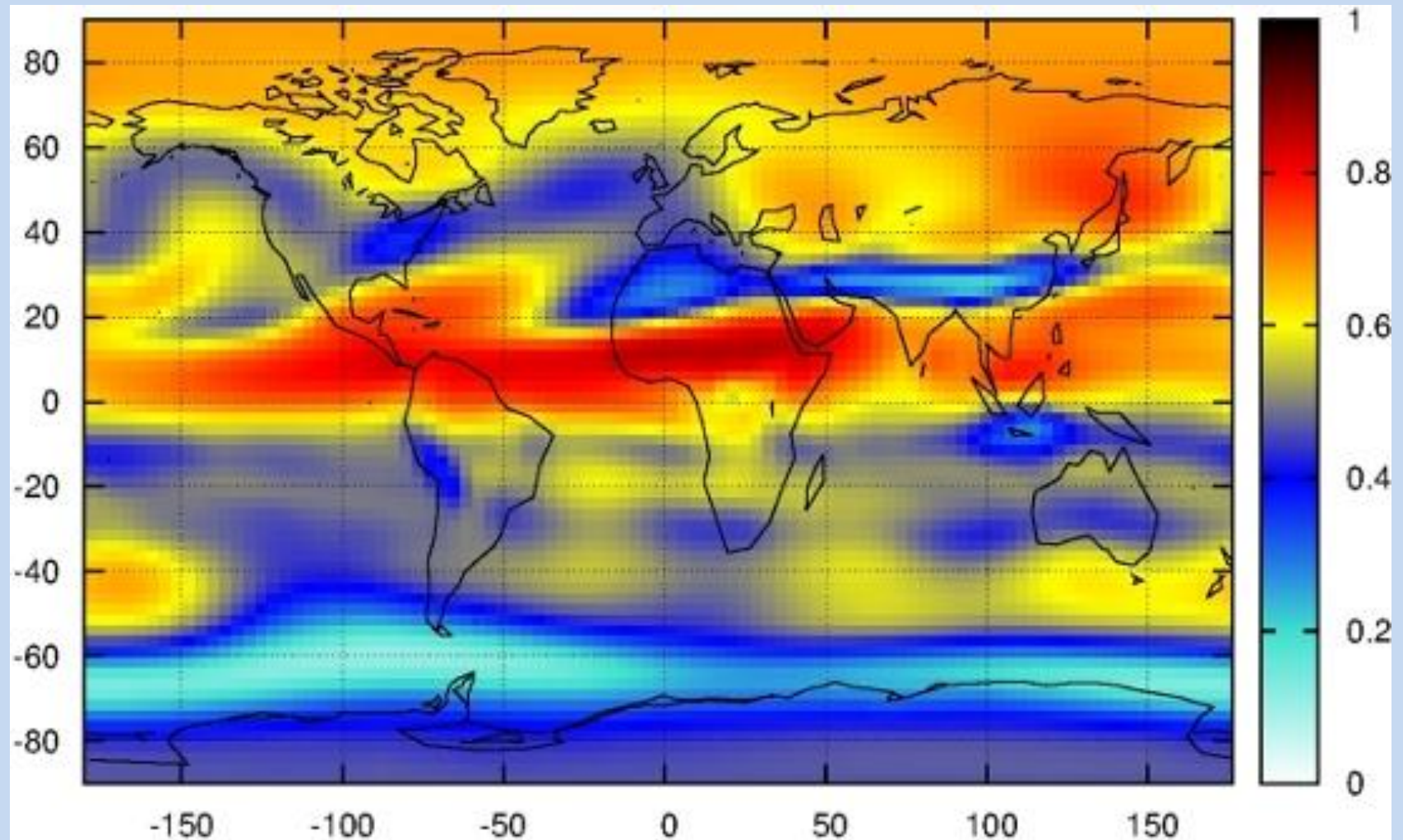
Questions That Can Be Asked

Vision of Results

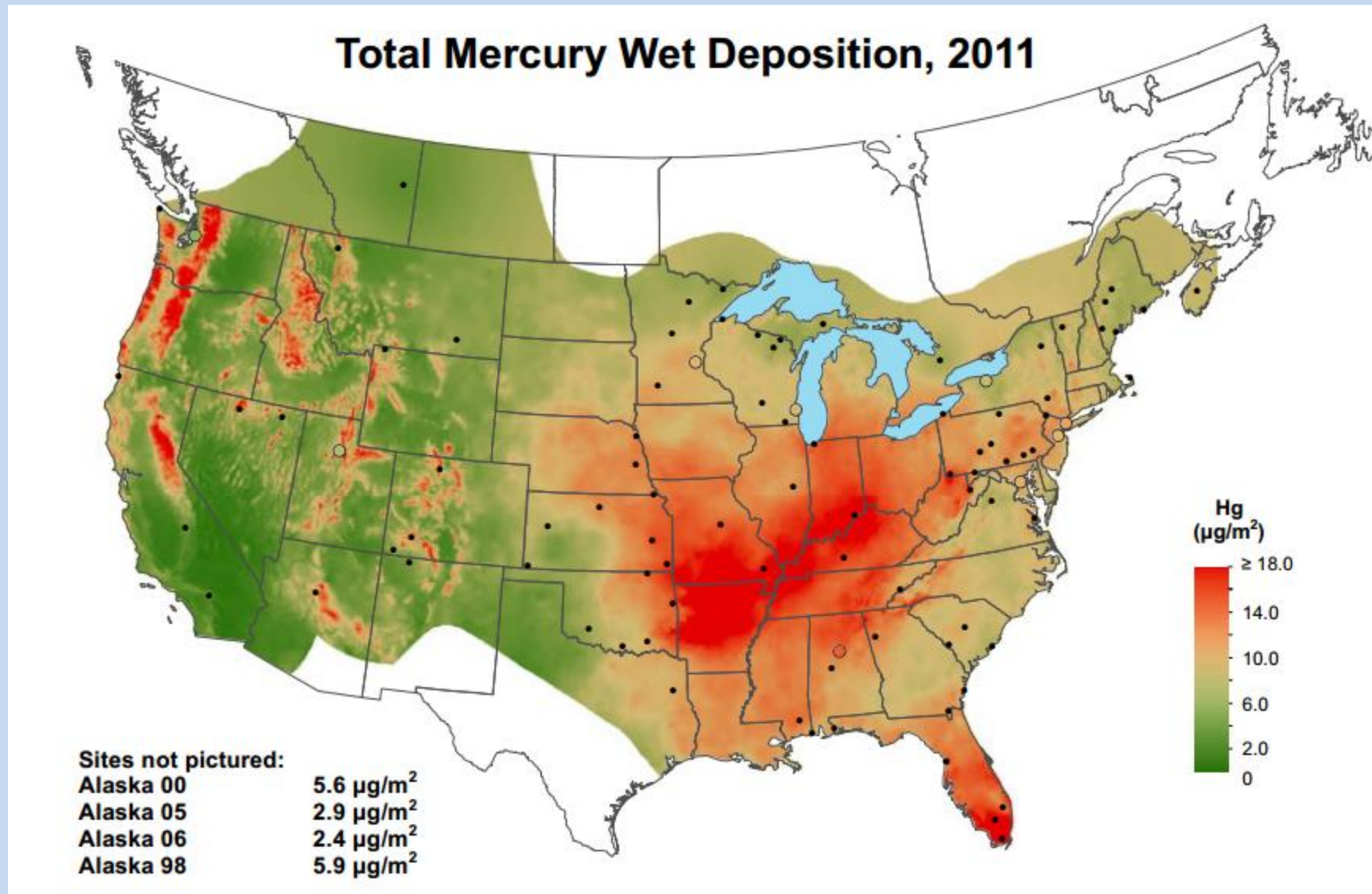
Cooperative Data Access will benefit Everyone

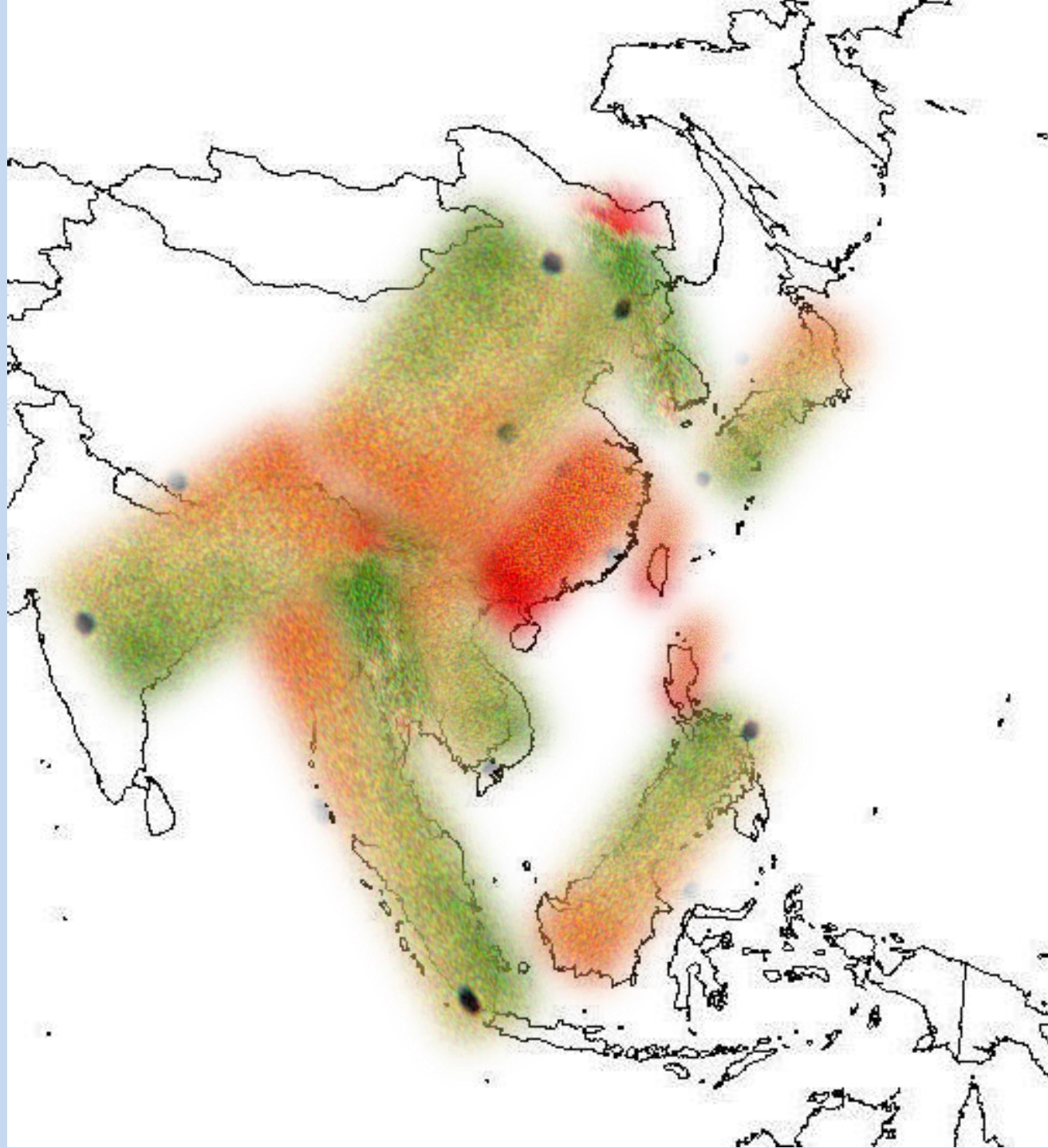


Difference is Huge

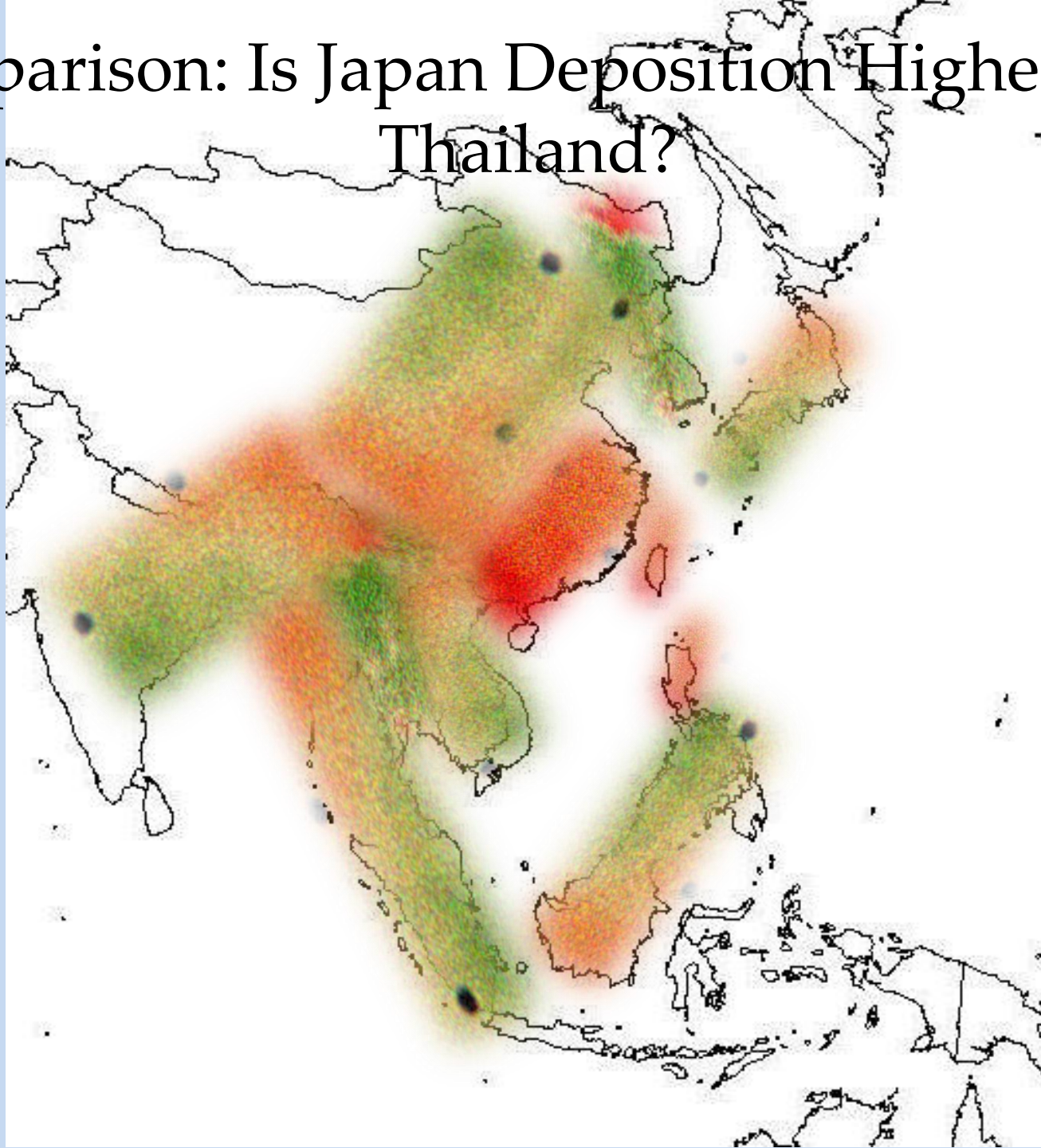


What Are The Asian Deposition Rates?



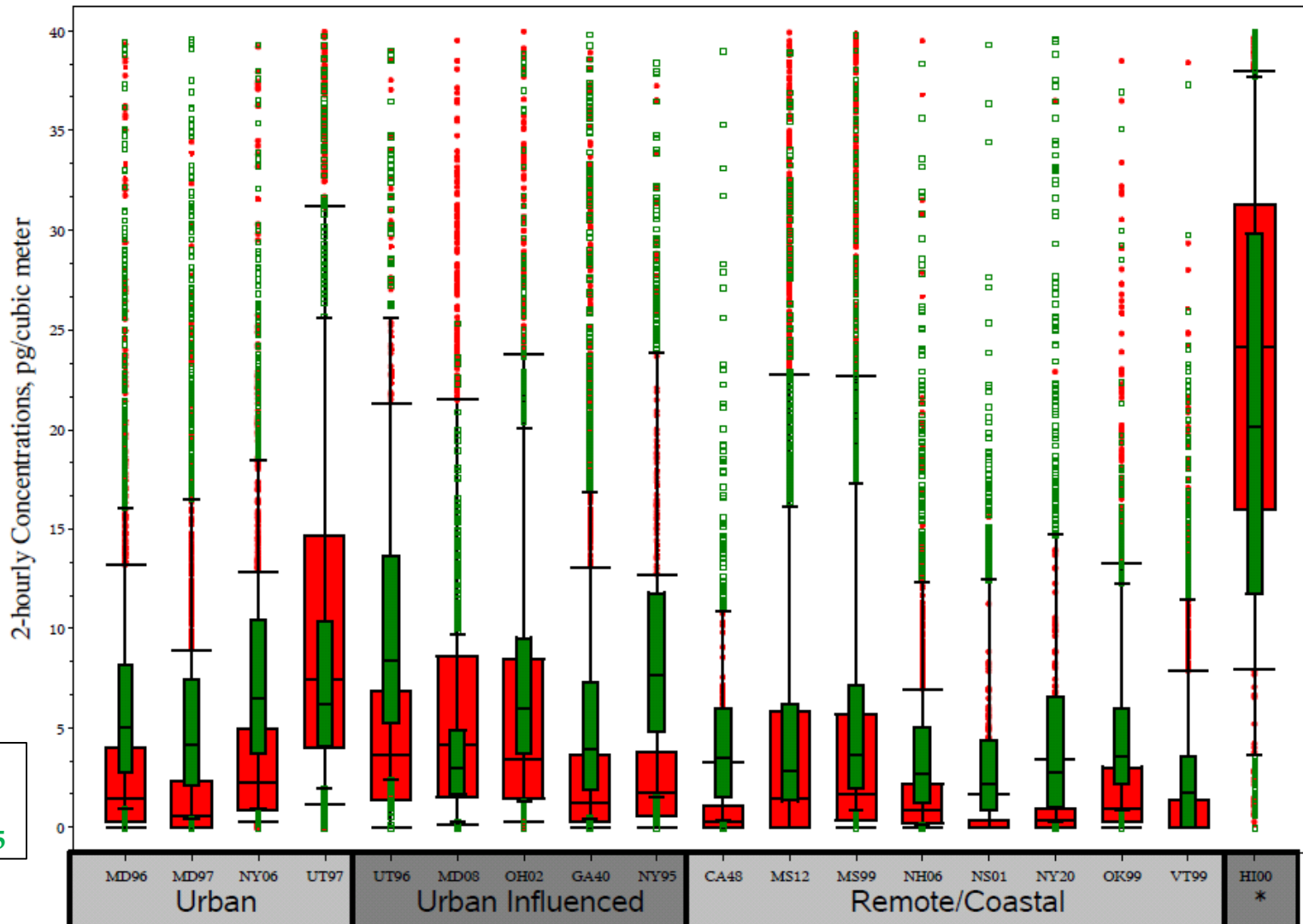


Comparison: Is Japan Deposition Higher than Thailand?



Comparison: Where are Mercury Levels Higher? Lower?

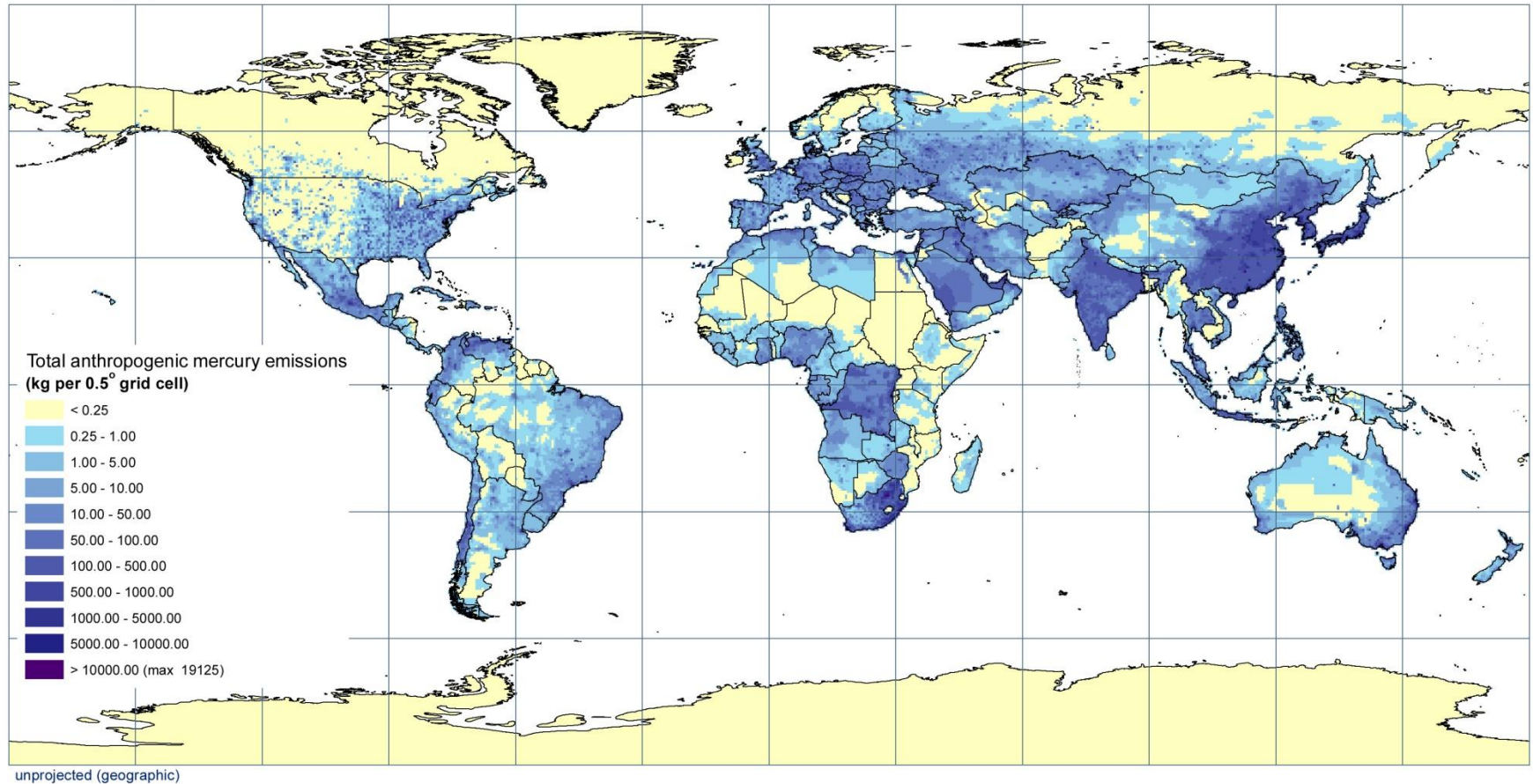
Particulate Bound and Oxidized Hg



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

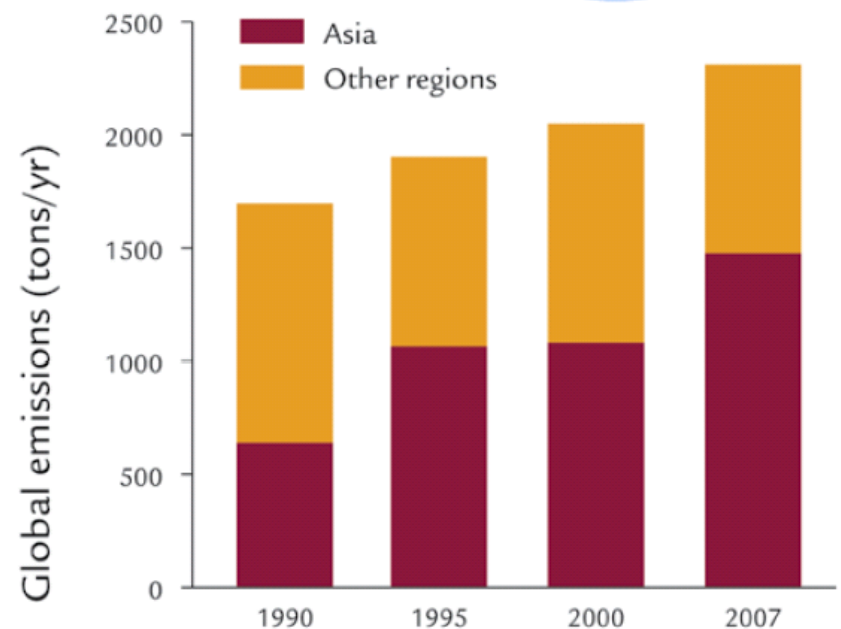
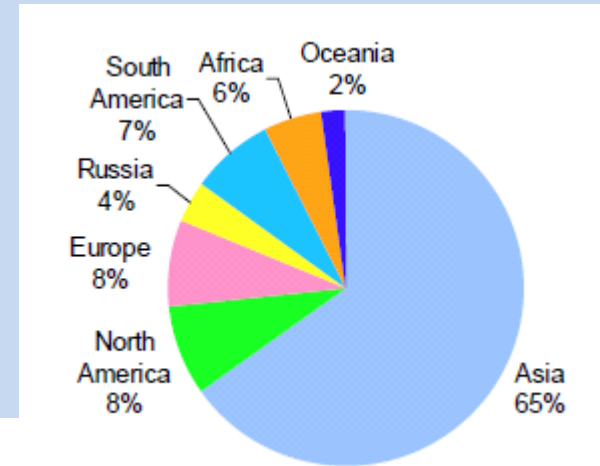


citation:

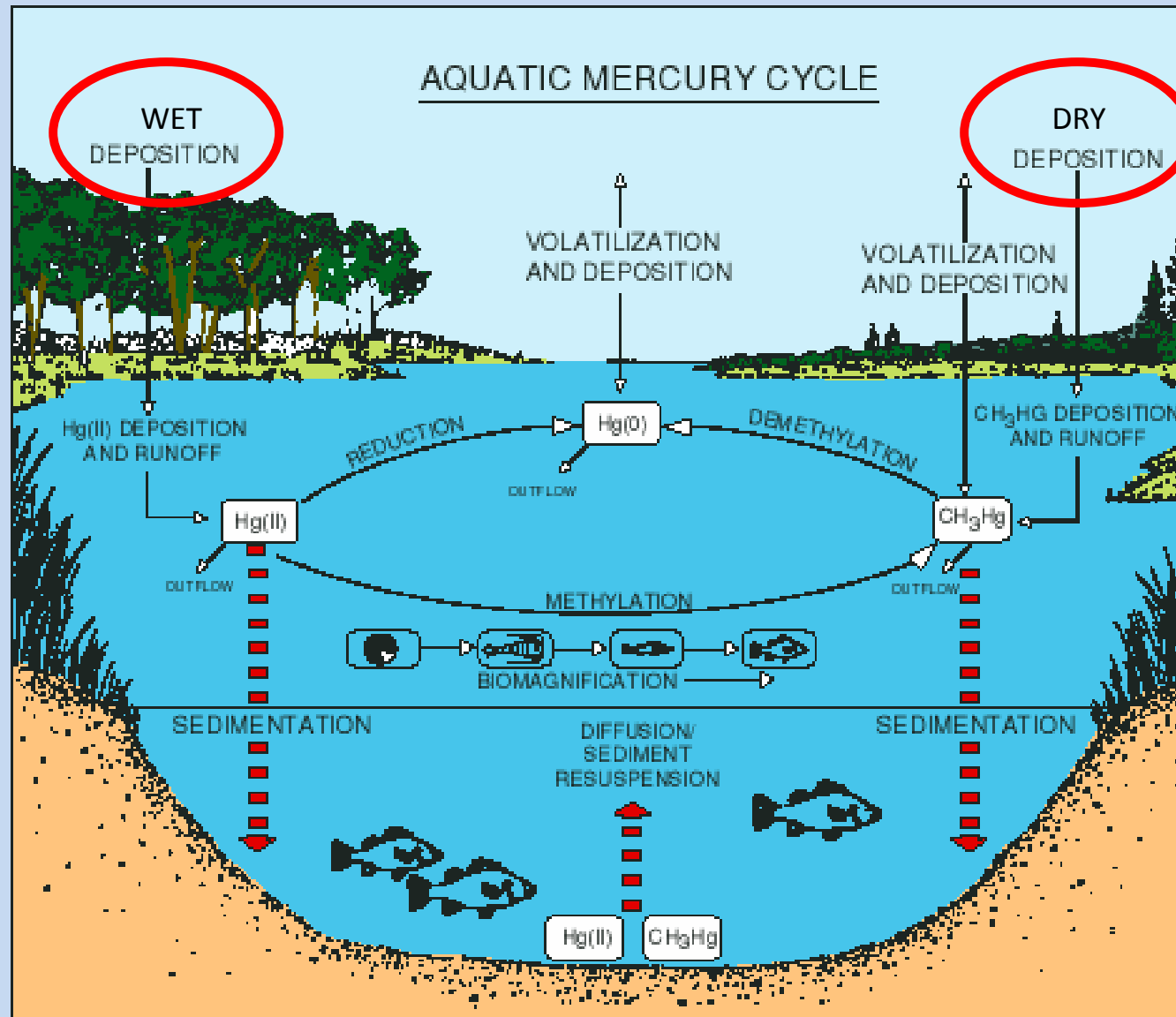
Pacyna, J., S. Wilson and F. Steenhuisen. 2005.
Spatially Distributed Inventories of Global Anthropogenic
Emissions of Mercury to the Atmosphere.
(www.amap.no/Resources/HgEmissions/HgInventoryMain.html)

Evaluation of Emission Inventories

- Are they correct?
 - In space?
 - In time?
 - Country by country?



Do we understand Mercury Cycling?



How Important is Dry Deposition?

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

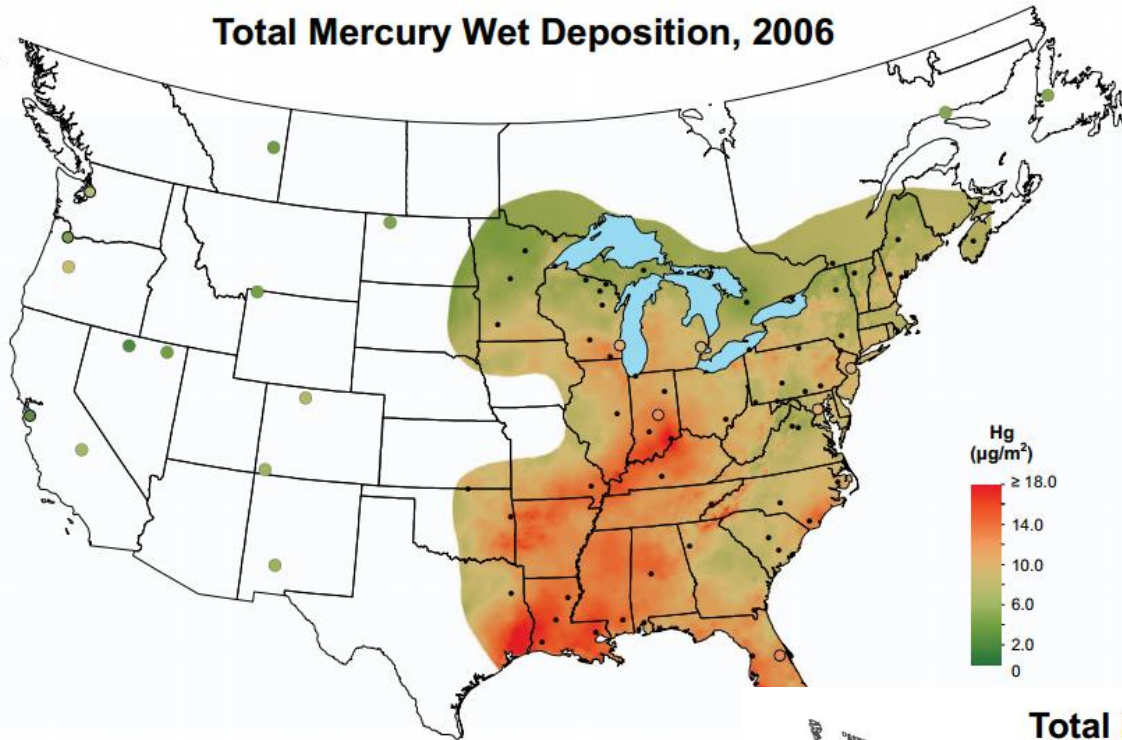
$$F = V_{\text{deposition}} * \text{Concentration}_{\text{air}}$$

where:

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

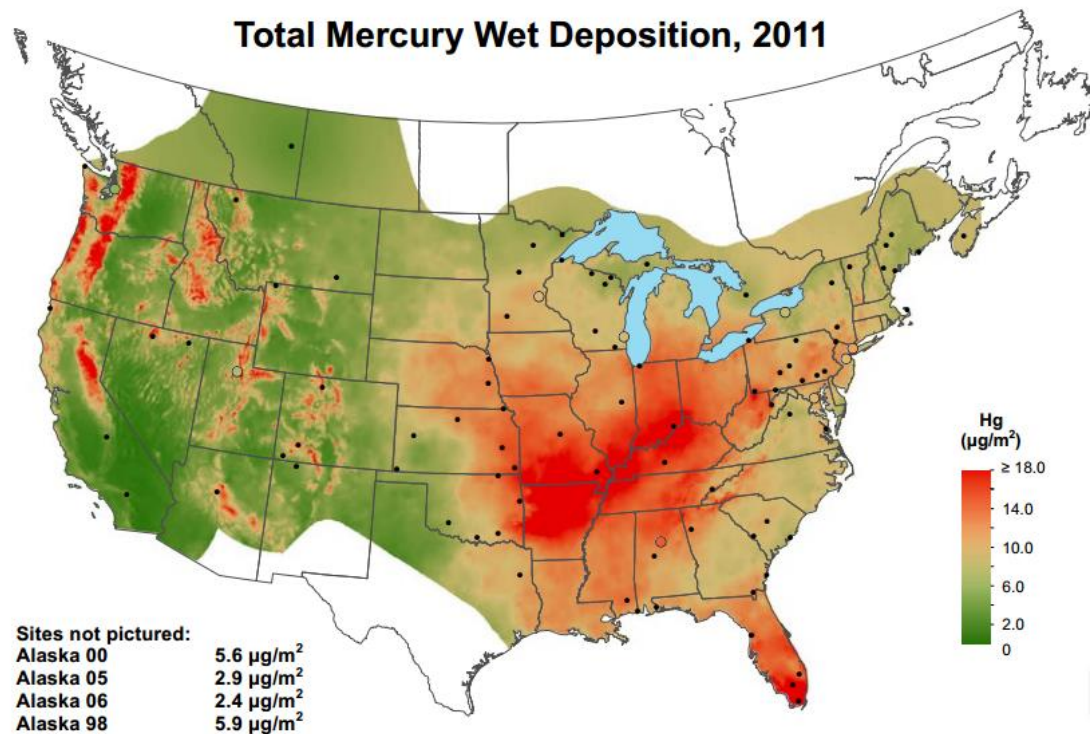
- R_a as aerodynamic resistance, R_b as quasi-laminar resistance, and R_c as canopy resistance

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?



Are Our Models/Predictions Correct?

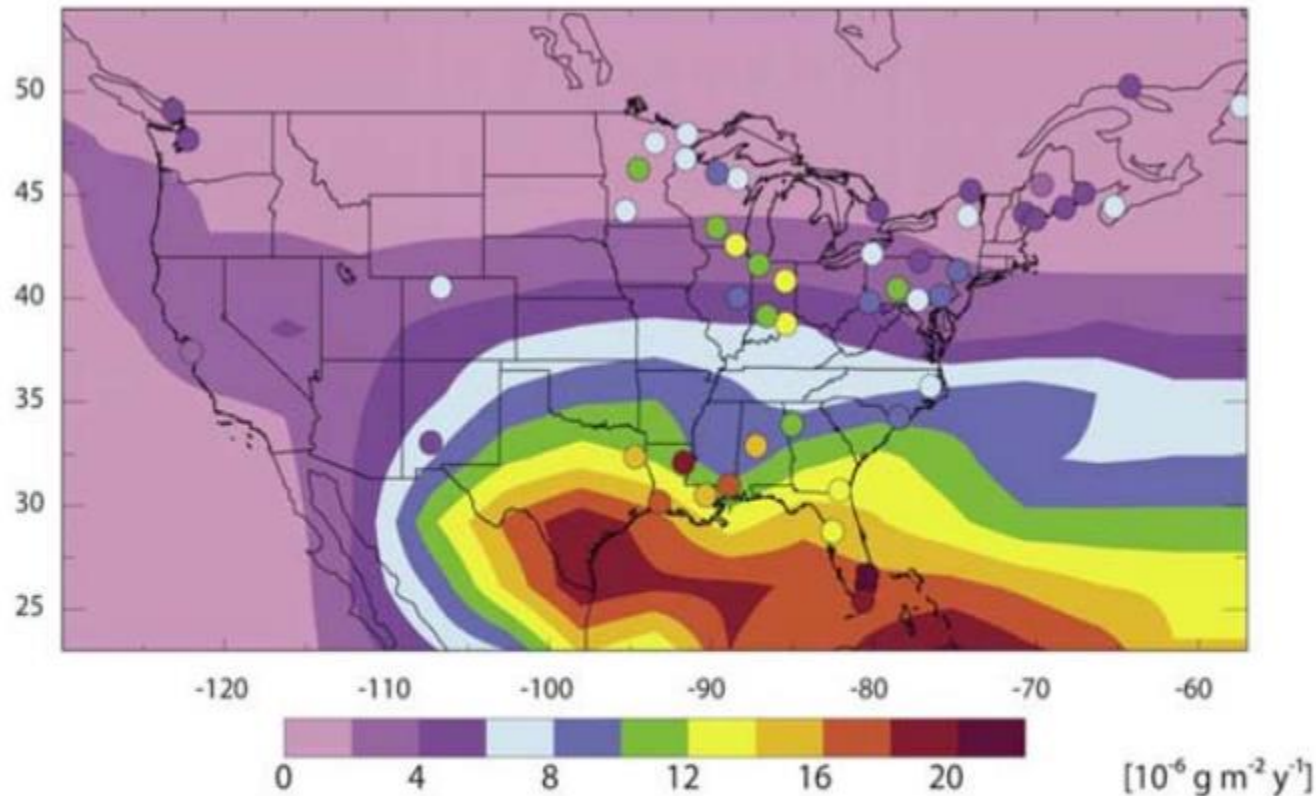
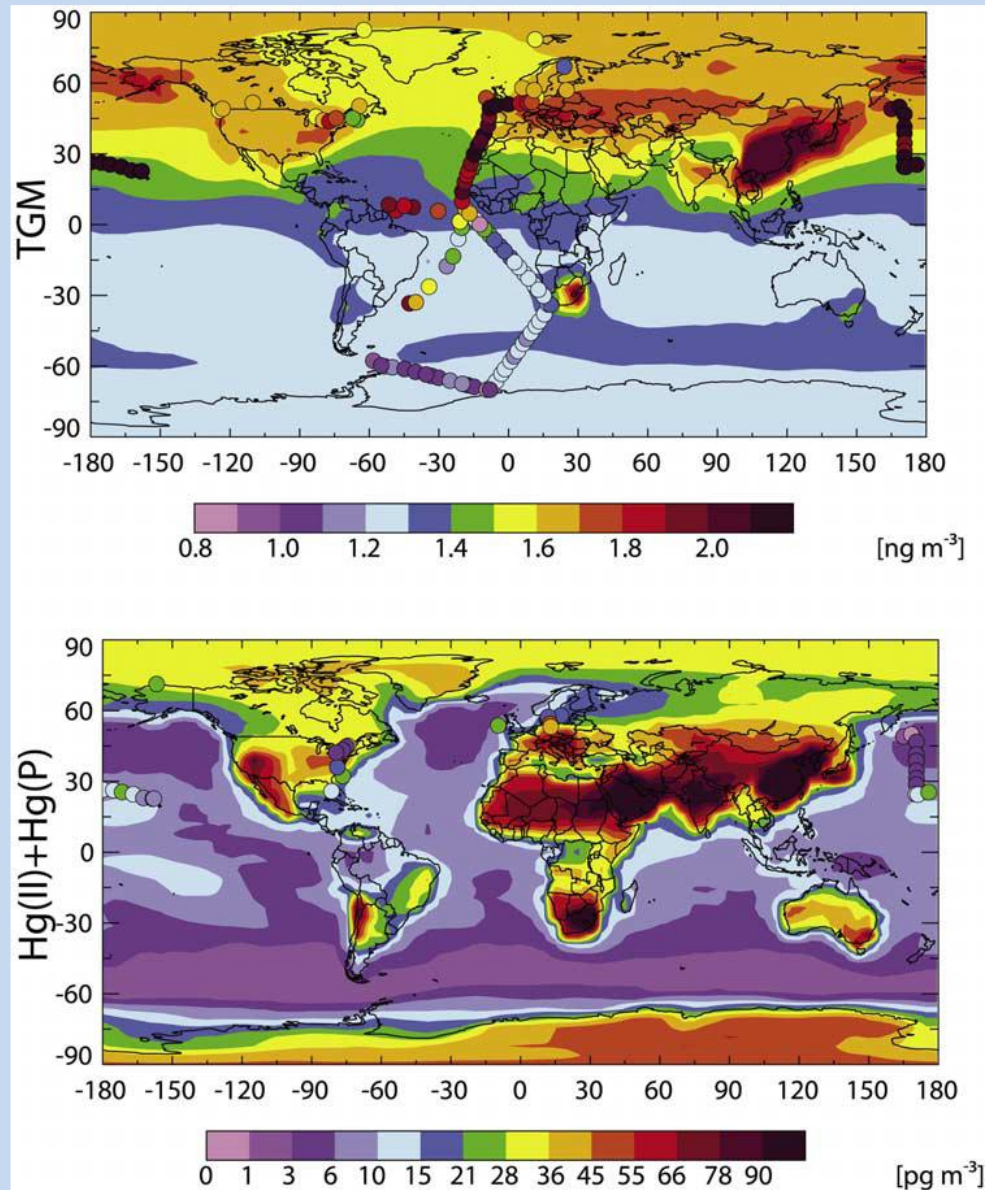


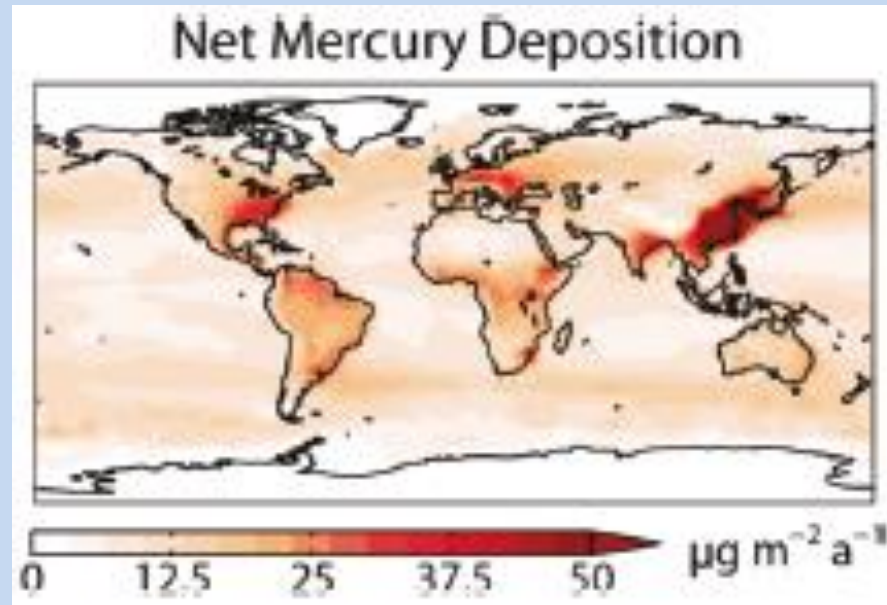
Figure 13.1 - Annual mercury wet deposition fluxes over the United States for 2003 – 2004. Observations from the Mercury Deposition Network (circles) are compared to model results (background). From Selin et al. (2007).

Distribution of Atmospheric Hg Concentrations: Modeling Results



Selin et al., 2007

Distribution of Atmospheric Hg Deposition Fluxes: Modeling Results



Corbitt et al., 2011

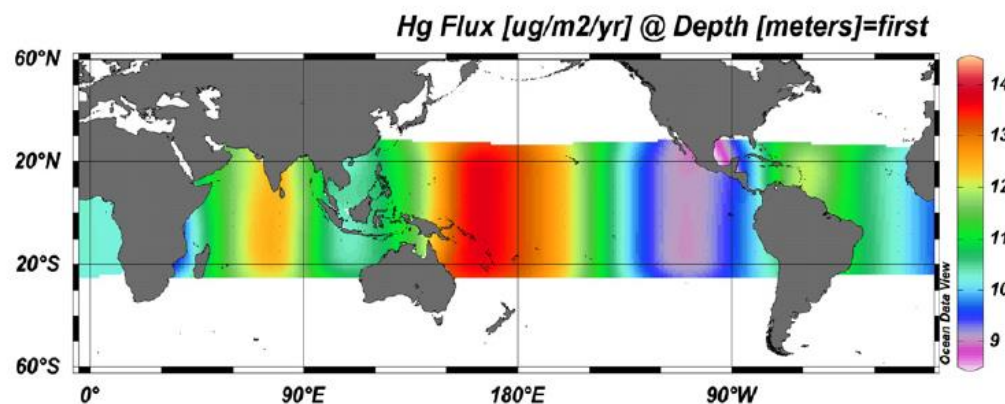


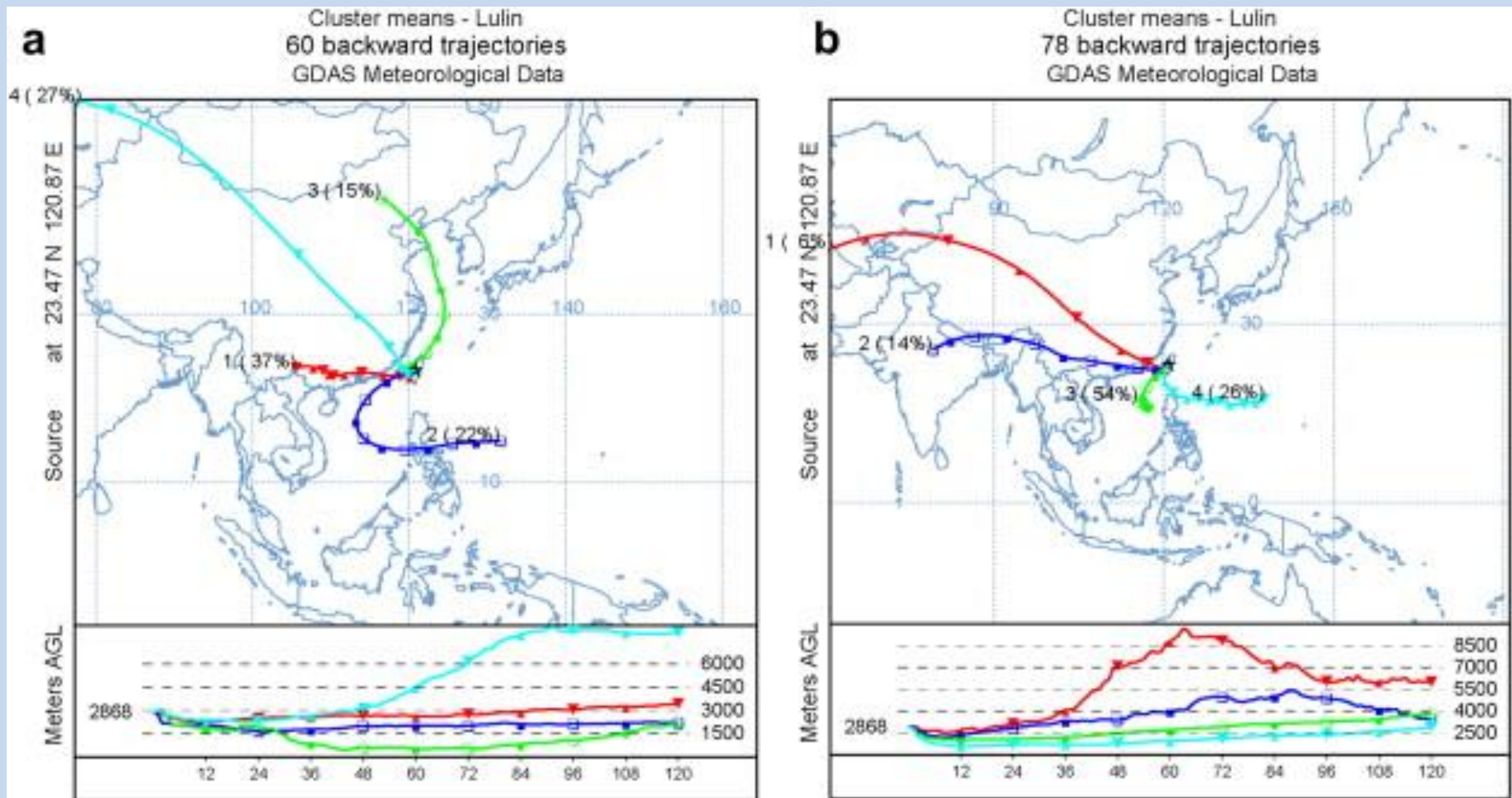
Fig. 2. Annual mercury deposition (wet plus dry, including $\text{Hg}(0)$; $\mu\text{g m}^{-2} \text{yr}^{-1}$) over the tropical oceans simulated using GEOS-Chem. Deposition shown here is averaged over tropical latitudes (24°N to 24°S).

Costa et al., 2012

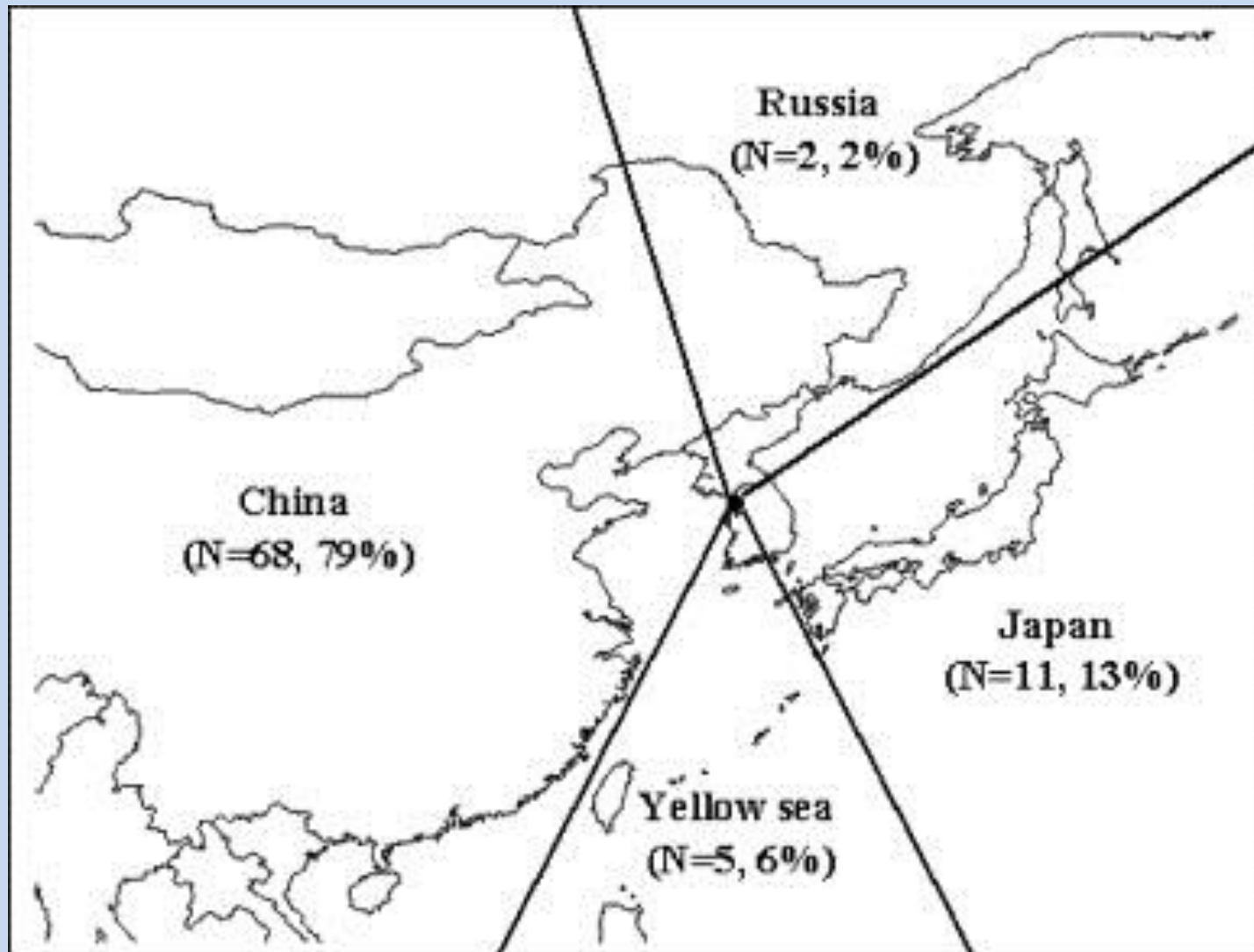
Model Development

- 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?

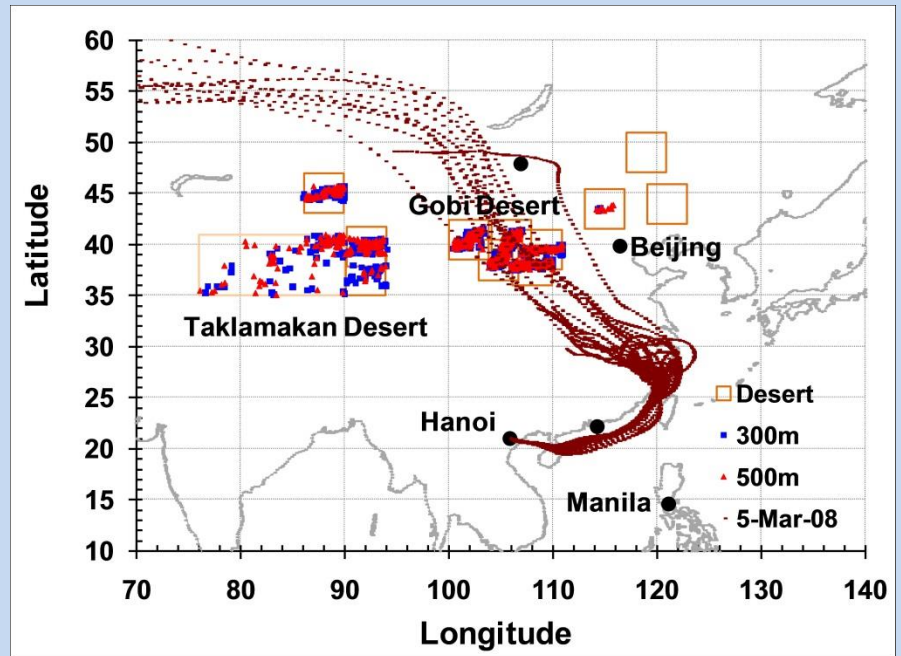
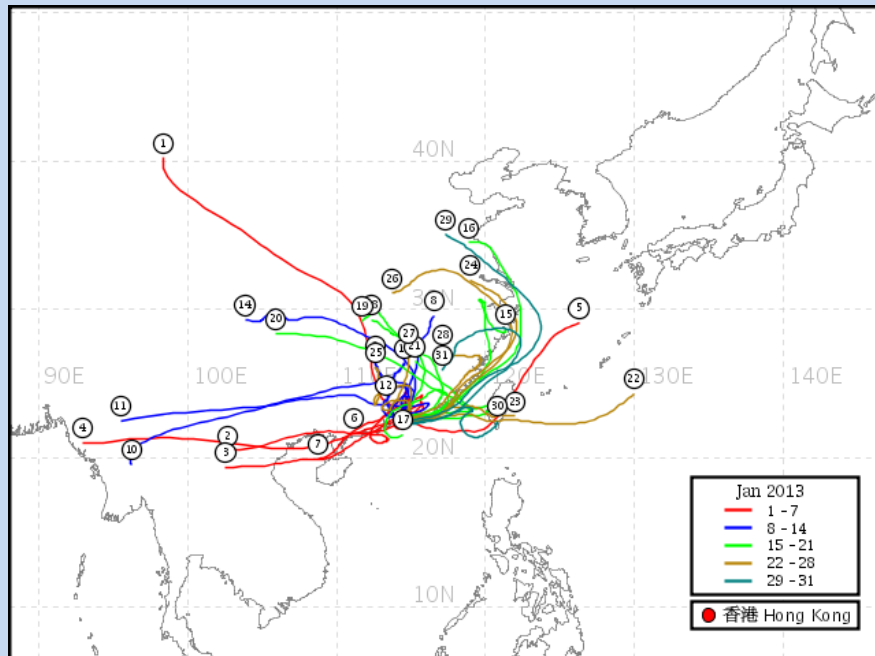


Chang, S. S., Lee, W. J., Wang, L. C., Lin, N. H., & Chang-Chien, G. P. (2012). Influence of the Southeast Asian biomass burnings on the atmospheric persistent organic pollutants observed at near sources and receptor site. *Atmospheric Environment*.



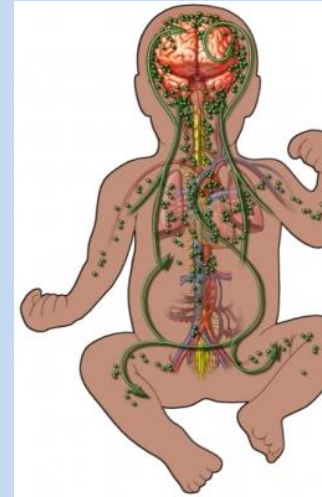
Choi, E. M., Kim, S. H., Holsen, T. M., & Yi, S. M. (2009). Total gaseous concentrations in mercury in Seoul, Korea: local sources compared to long-range transport from China and Japan. *Environmental Pollution*, 157(3), 816-822.

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.

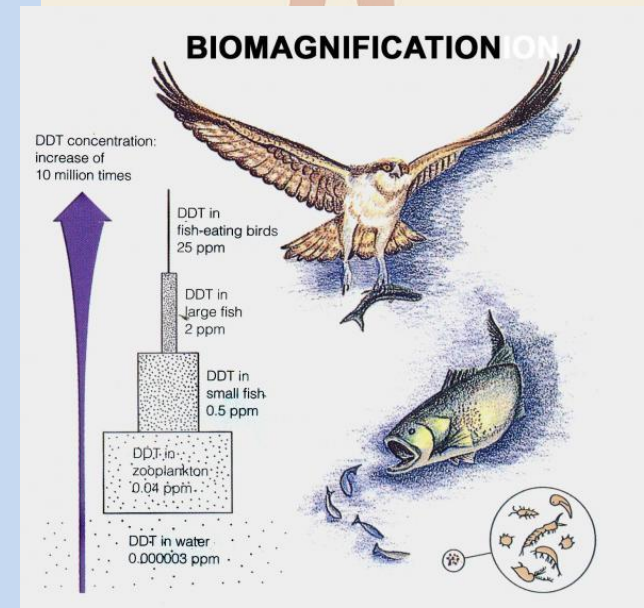
Adults can experience upset stomach. Severe exposure can lead to kidney failure in adults.

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!*

