

Emissions-Air-Biota-People

Why is Mercury Monitoring Important?

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Summary:

Why is it important to Monitor For Mercury?

- Human Health
- Health of Animals and Insects
- General Environmental Health, Hg Cycling in the Environment
- Policy Ramifications
 - Local regulations
 - Minamata Convention on Mercury
- Scientific/Research, cycling of metals

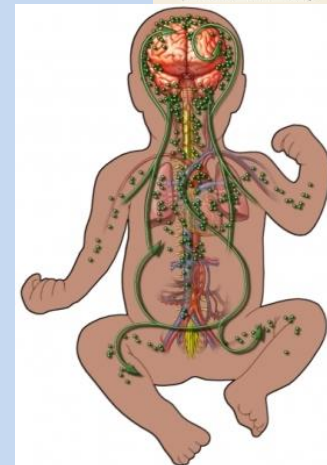
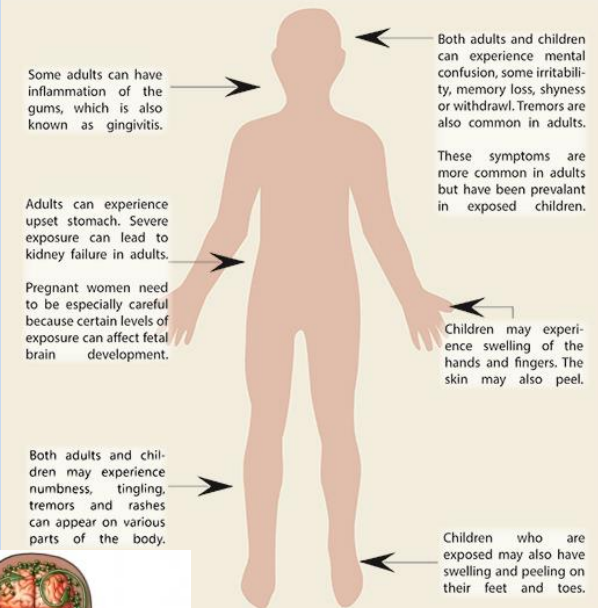
Measuring Mercury For The Human Health Impact

A Human Health Concern

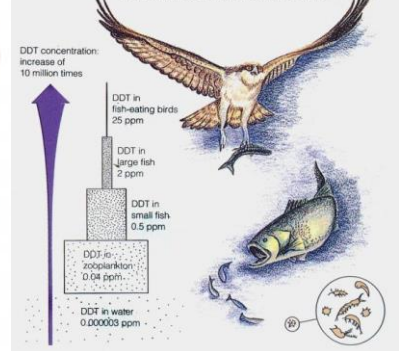
- Neurological Disorders
 - Persistent bioaccumulative neurotoxin
 - Large problem in children up to about 7-12 years
 - » Birth defects
 - » learning disabilities
 - Problem in adults under certain conditions

Environmental mercury: What does it do?

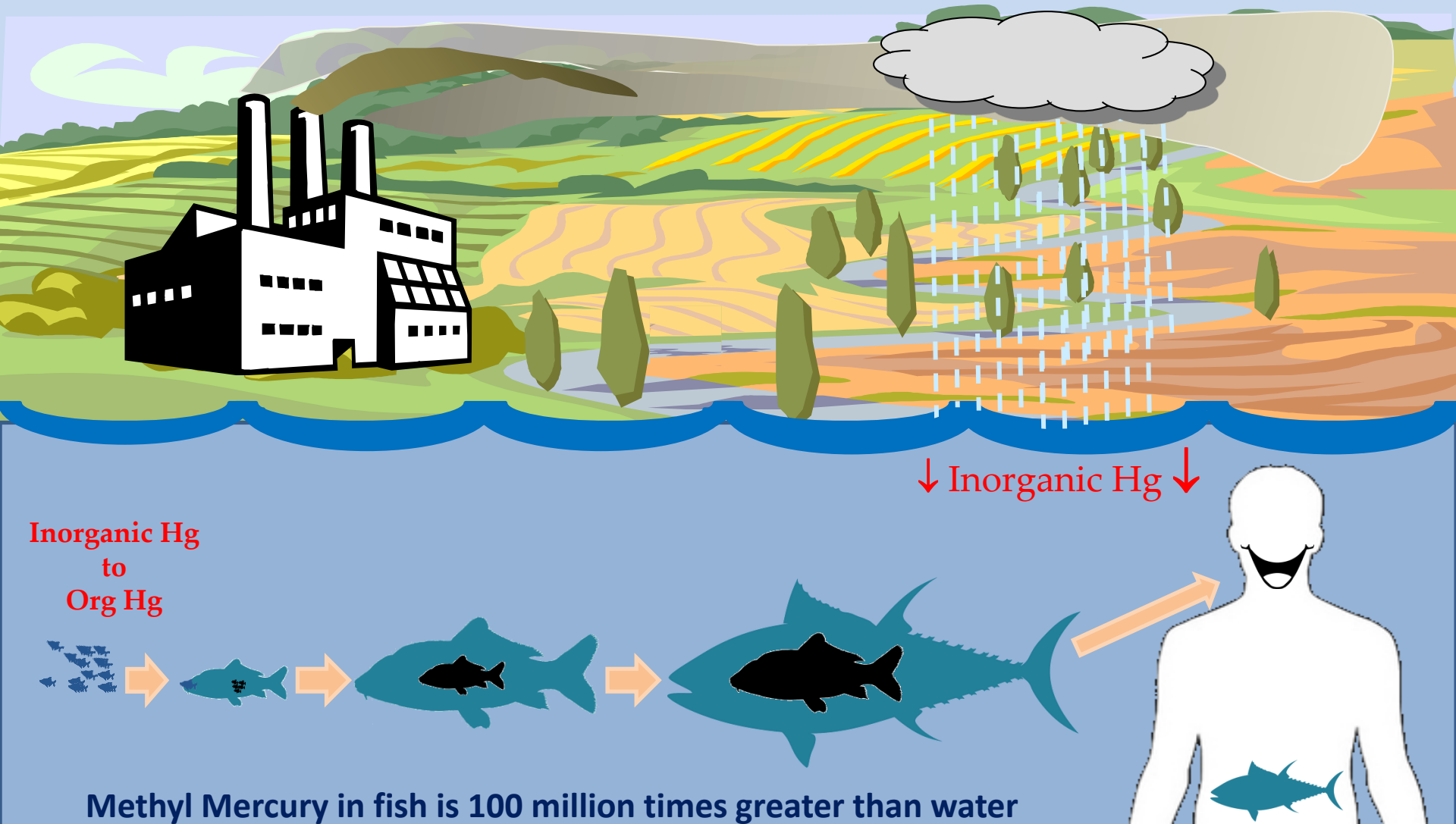
Mercury is more common than you would think. It can be found in thermometers, fluorescent light bulbs, batteries and other household items. Below are some of the side effects mercury can have on the human body.



BIOMAGNIFICATION OF DDT



Human Health: Accumulation of Methyl Mercury in Fish and Shellfish



Measuring Mercury For Human Health

Asians in particular, along with
Indigenous peoples

**Mercury exposure to humans is
primarily through the
consumption of fish**

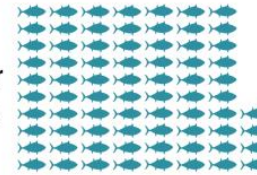
Fish Consumption High In Asia

A global estimate of seafood consumption by coastal Indigenous peoples

Andrés M. Cisneros-Montemayor, Daniel Pauly,
Lauren V. Weatherdon, and Yoshitaka Ota, 2016.

Coastal Indigenous peoples:

74 kg per capita



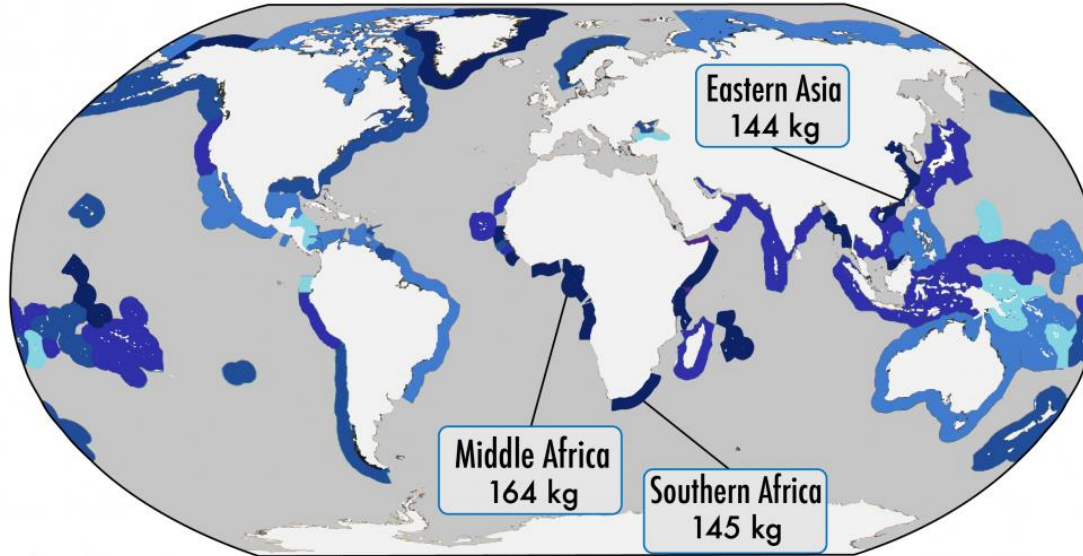
Global average:

19 kg per capita

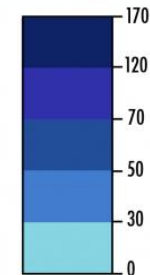


Coastal Indigenous
Peoples database:

More than **1900**
communities identified &
600 ethnic groups.



Fish consumption in kg
per person per year:



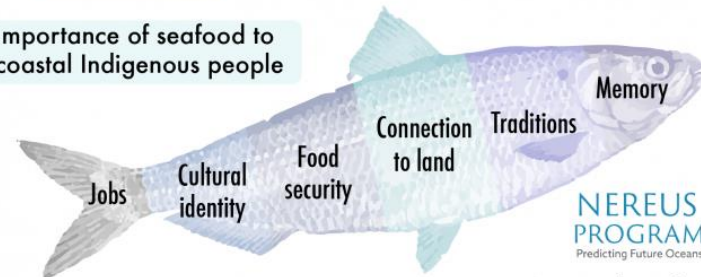
2.1

million metric
tonnes

Coastal Indigenous
people's consumption
of seafood per year



Importance of seafood to
coastal Indigenous people

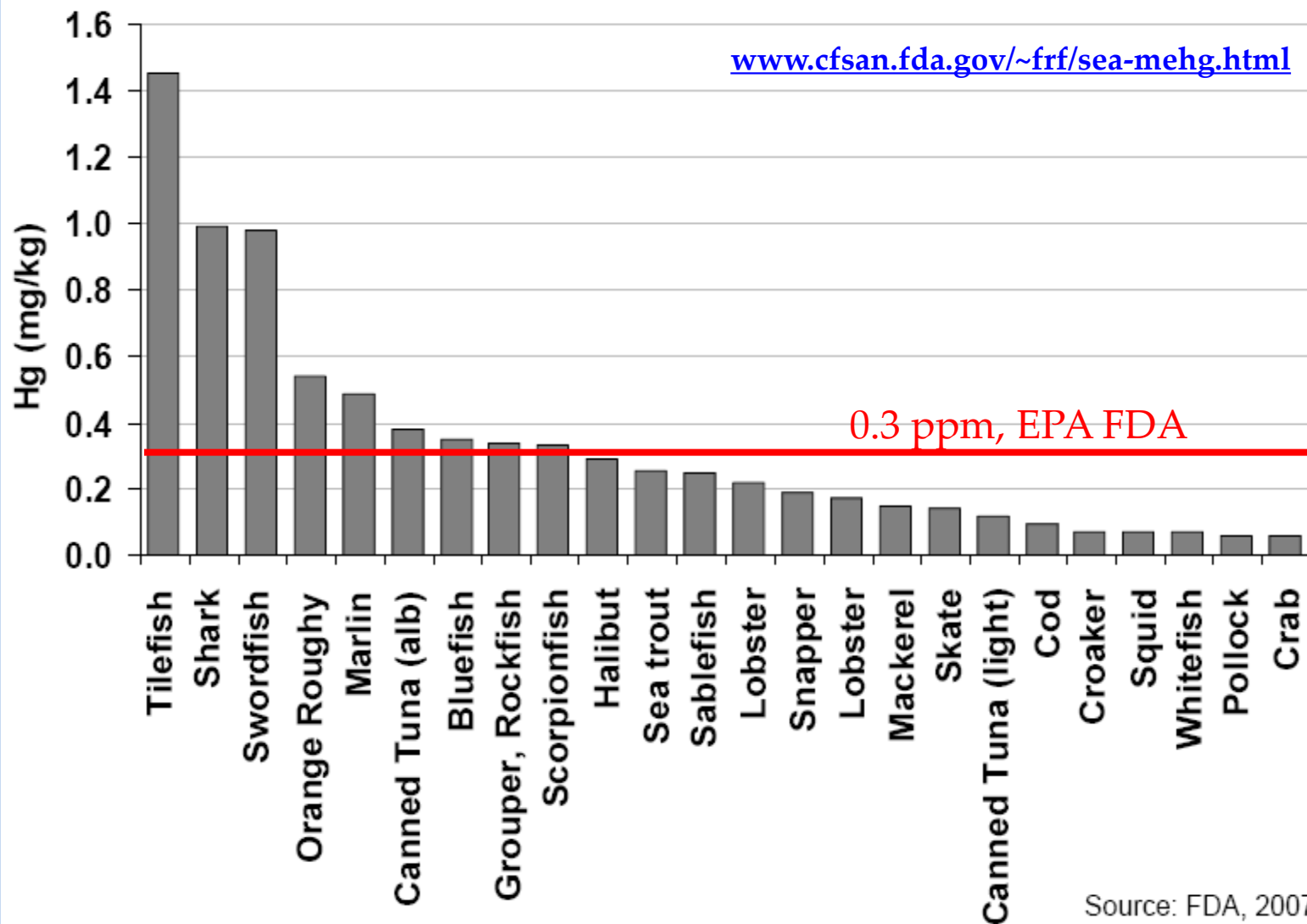


NEREUS
PROGRAM
Predicting Future Oceans

日本財団
THE NIPPON
FOUNDATION

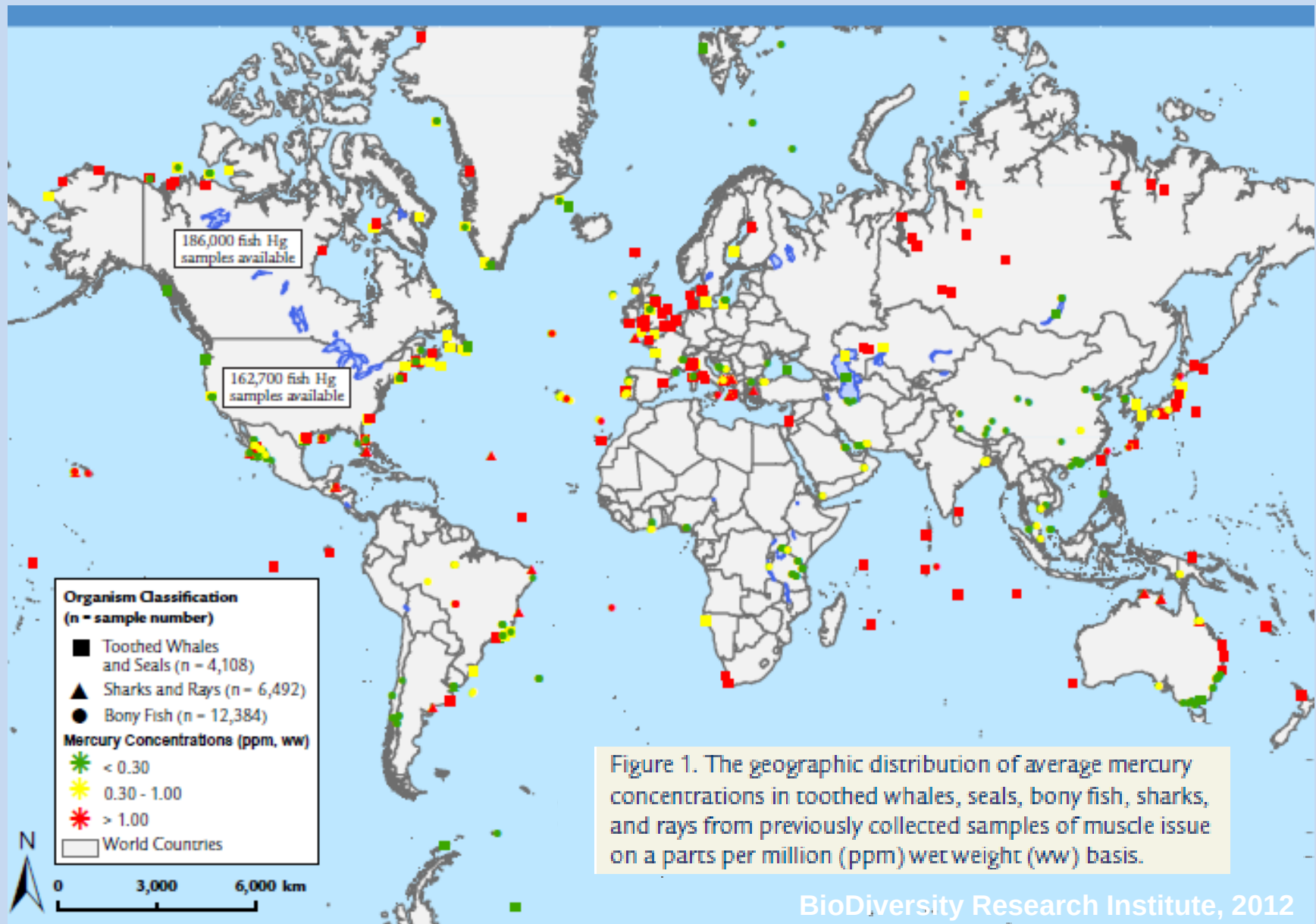
Design by Lindsay Lafreniere

FDA Reported National Hg Values



Source: FDA, 2007

Mercury in fish and marine mammals



Mercury is damaging to wildlife
exposed to mercury

(eating within the same food chain)

But it isn't just humans....



Impacts on wildlife include

- reduced reproduction,
- changes to egg incubation times,
- behavioral changes, and
- neurological problems

From Wright et al, 2018; Aerosol and Air Quality Research, 18: 1953–1992

- Immunotoxicity
- nephrotoxicity
- diminishes neurological capacity and neurobehavioral function
- alters functioning of three major endocrine axes and impairs reproduction and
- alters offspring quality

From Eagles-Smith et al., 2018 [Ambio](#) 47, [Issue 2](#), pp 170–197

Why

It Is Important To Monitor For
Atmospheric Mercury

Atmospheric Deposition is the key input of Mercury in water bodies

Environ. Sci. Technol. 2006, 40, 6261–6268

Mercury in Soils, Lakes, and Fish in Voyageurs National Park (Minnesota): Importance of Atmospheric Deposition and Ecosystem Factors

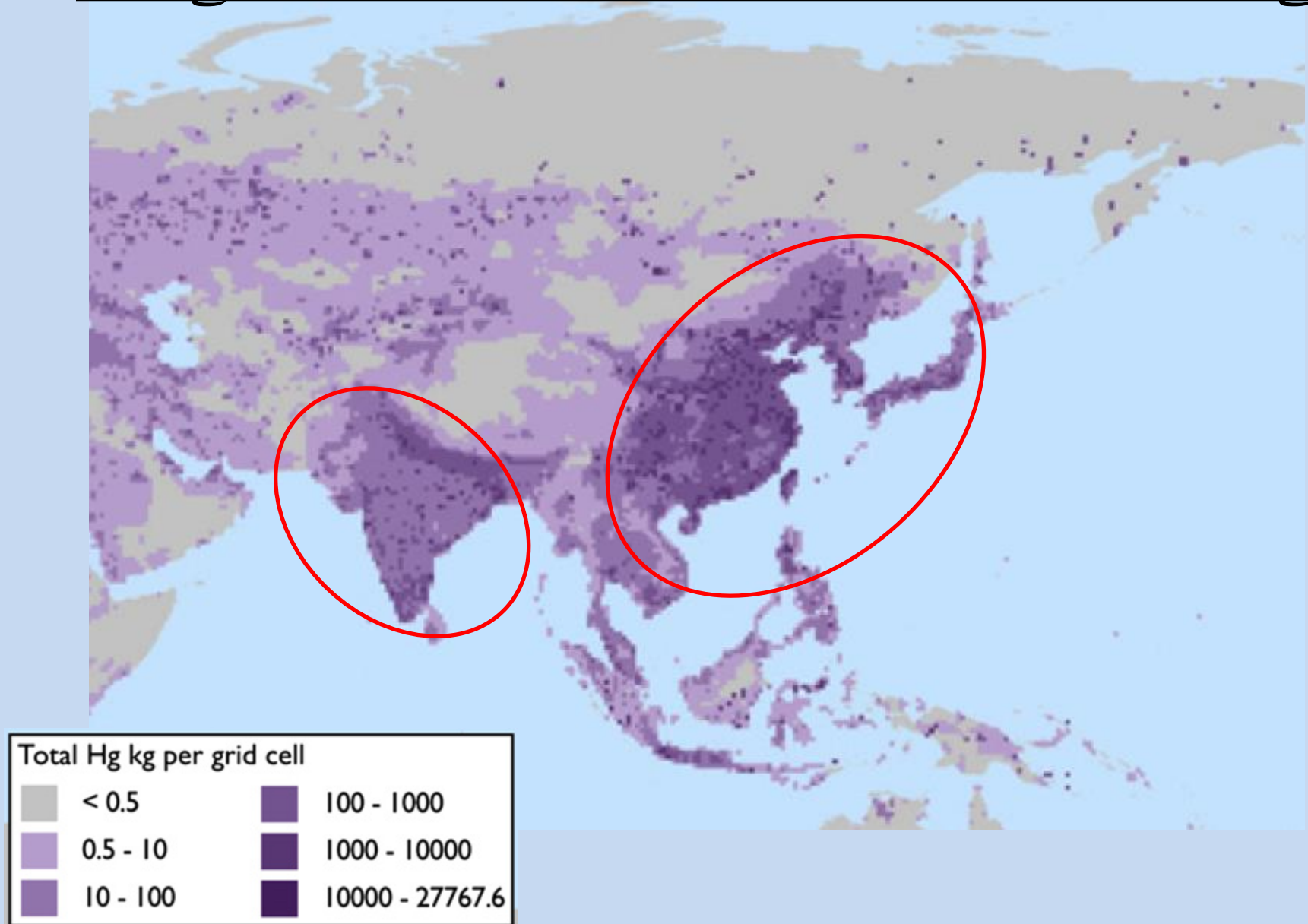
J. G. WIENER,^{*,†} B. C. KNIGHTS,[‡]
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W. F. CANNON,[#] AND S. J. BALOGH[△]

- Hg source to water bodies is *overwhelmingly atmospheric deposition and anthropogenic*

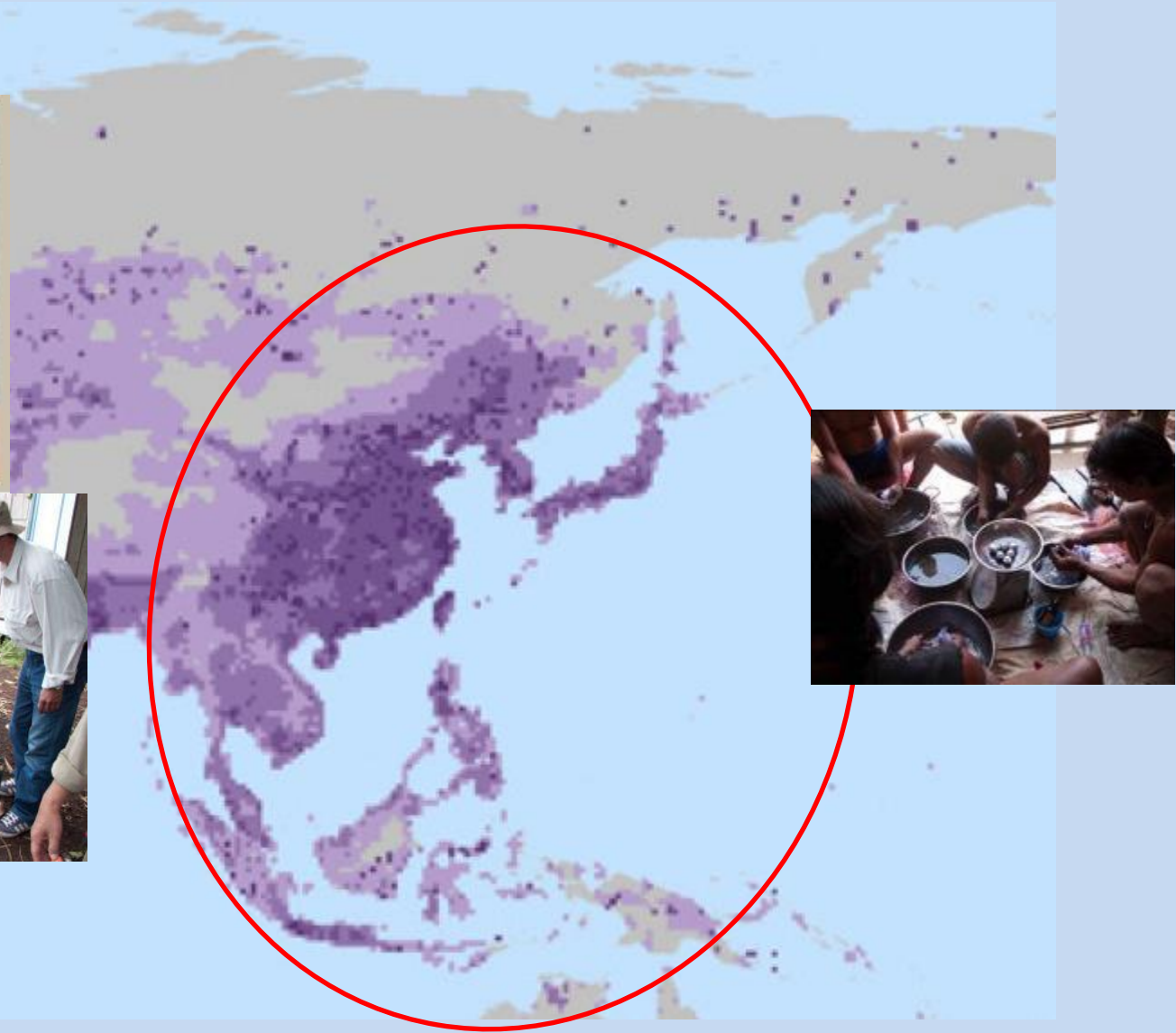
*“We conclude that **nearly all of the mercury in fish in this seemingly pristine landscape was derived from atmospheric deposition**, that most of this bioaccumulated mercury was from anthropogenic sources, and that both watershed and lacustrine factors exert important controls on the bioaccumulation of methylmercury.”*

**Asia is the world's largest
atmospheric mercury source
region**

Largest Emissions Area and Growing

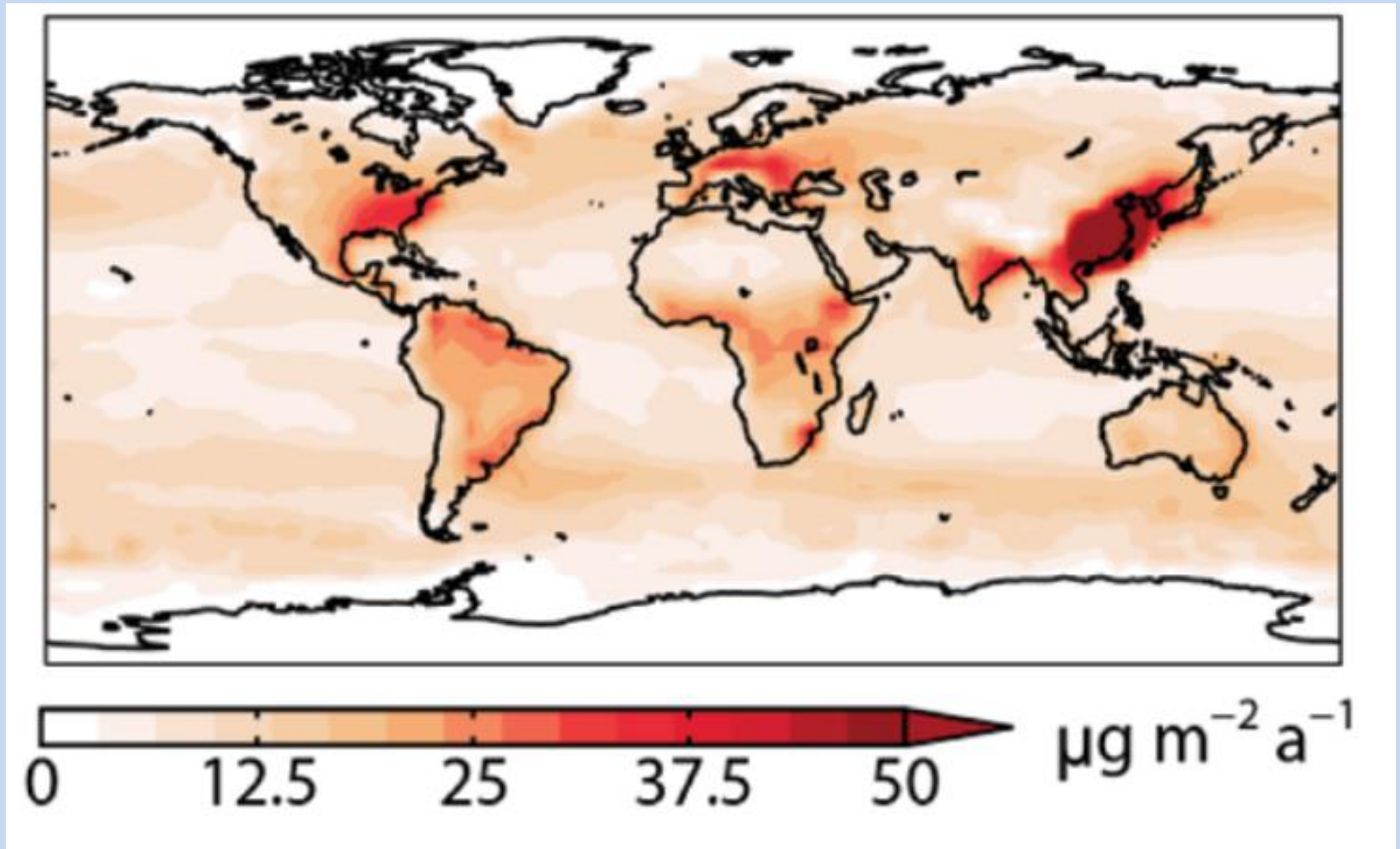


Small Scale Artisanal Gold Mining?



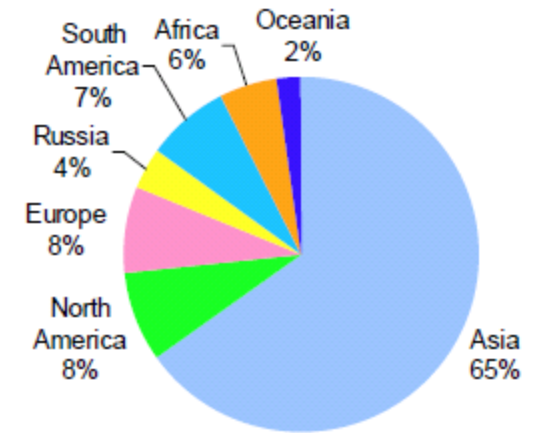
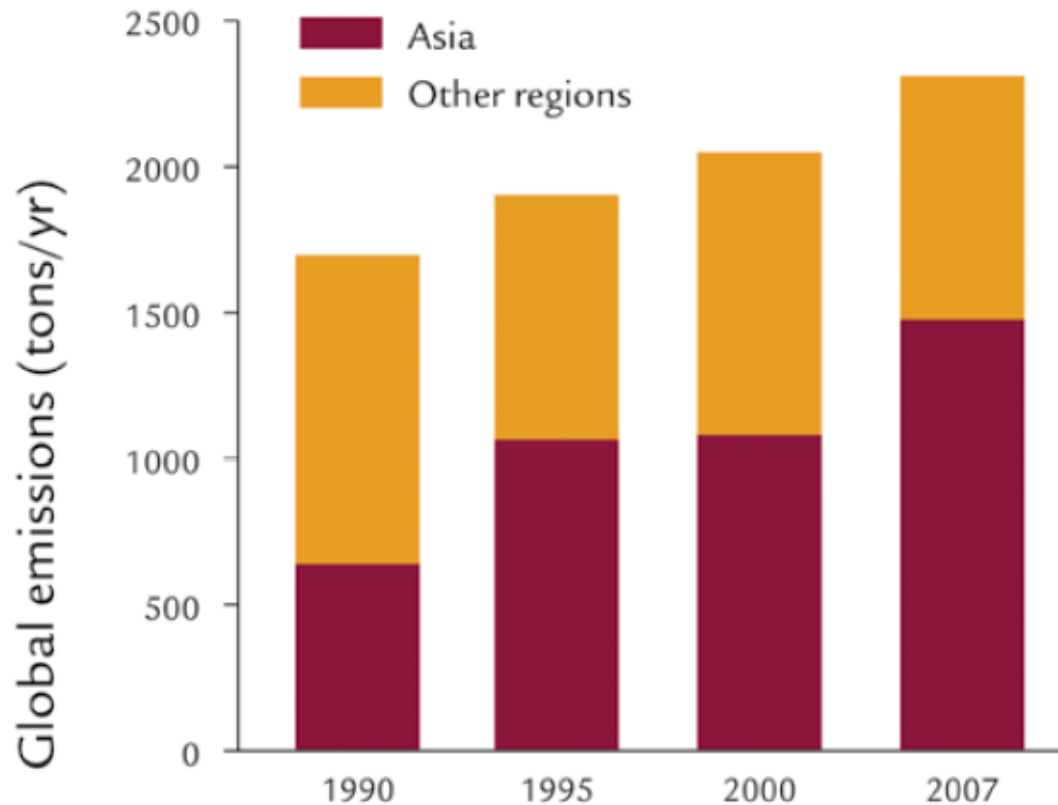
Estimated Global Wet Deposition of Mercury

Modelled Net Mercury Deposition, Corbitt et al, EST 2011



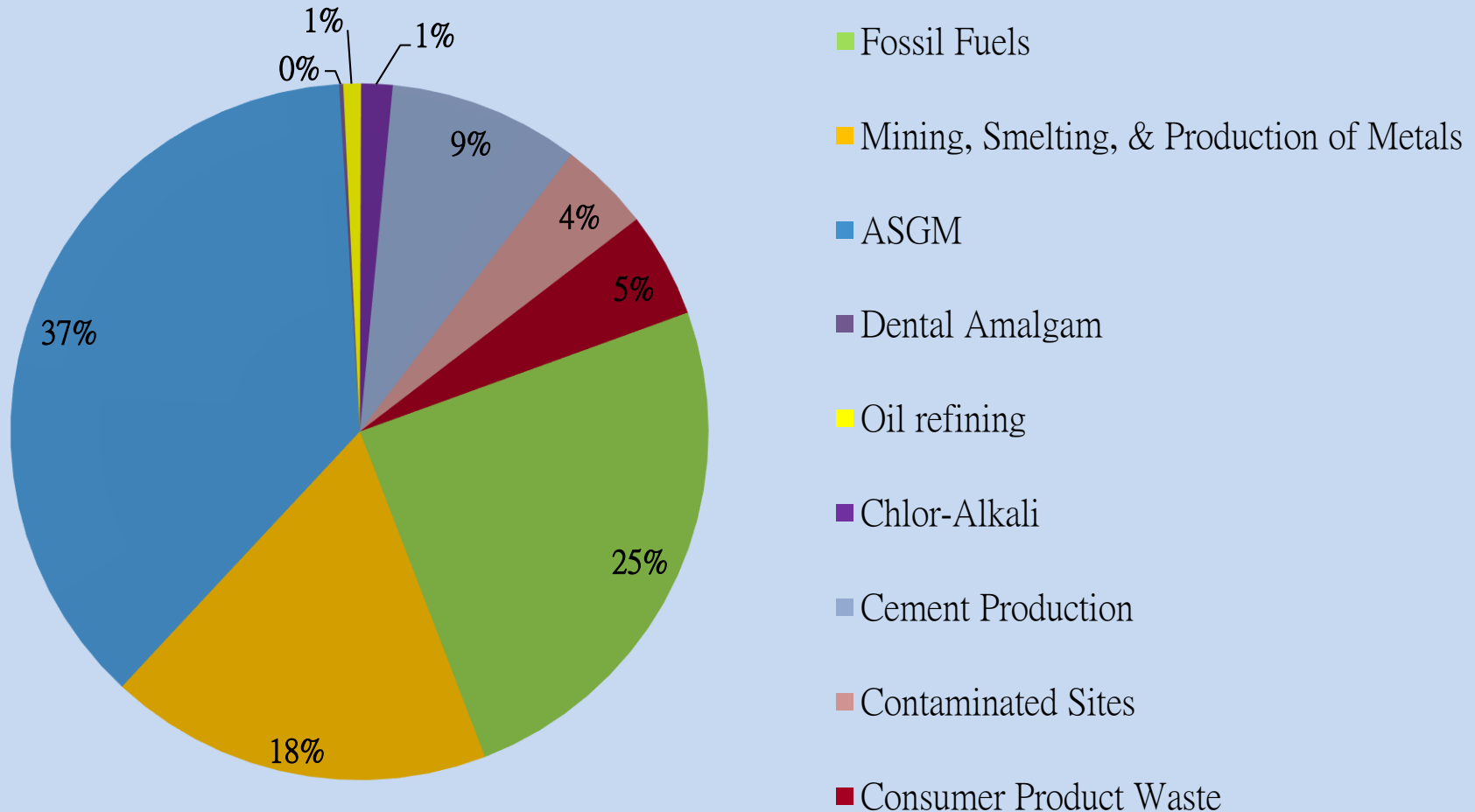
Emissions Are Increasing

Asian Growth



EMEP, 2012

What are the Mercury Sources?



Mercury stays in the atmosphere for at least 6 months (as elemental Hg)

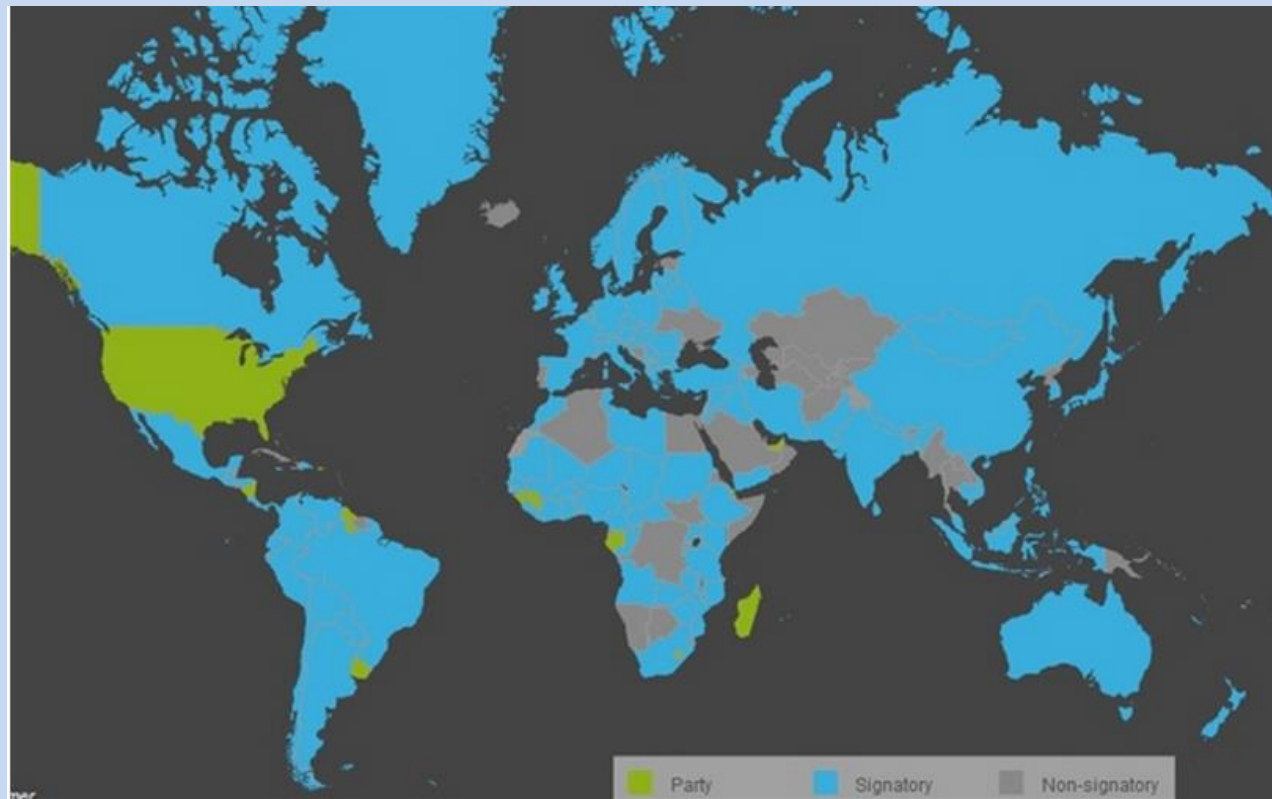
so regardless of whether your country emits mercury, you are receiving mercury as wet and dry deposition.

A true global pollutant.....

Responding to the
Minamata Protocol

Minamata Convention On Mercury

- 128 signatories, 112 ratifications
- Controls emissions and releases
- Calls for *data and cooperative monitoring*



Many Asian Countries have signed onto this agreement

Country	Signature Date	Ratification et al.
Afghanistan		02/05/2017 (a)
Australia	10/10/2013	
Bangladesh	10/10/2013	
Cambodia	10/10/2013	
China	10/10/2013	31/08/2016
India	30/09/2014	18/06/2018
Indonesia	10/10/2013	22/09/2017
Japan	10/10/2013	02/02/2016 (A)
Korea (Republic of)	24/09/2014	
Lao People's Democratic Republic		21/09/2017 (a)
Malaysia	24/09/2014	
Marshall Islands		29/01/2019 (a)
Mongolia	10/10/2013	28/09/2015
Nepal	10/10/2013	
New Zealand	10/10/2013	
Palau	9/10/2014	21/06/2017
Philippines	10/10/2013	
Samoa	10/10/2013	24/09/2015
Seychelles	27/05/2014	13/01/2015
Singapore	10/10/2013	22/09/2017
South Africa	10/10/2013	29/04/2019
Sri Lanka	8/10/2014	19/06/2017
Thailand		22/06/2017 (a)
Viet Nam	11/10/2013	23/06/2017 (AA)

A Critical Time for Mercury Science to Inform Global Policy

Celia Y. Chen,^{*,†} Charles T. Driscoll,[‡] Collin A. Eagles-Smith,[§] Chris S. Eckley,^{||} David A. Gay,[⊥] Heileen Hsu-Kim,[#] Susan E. Keane,[¶] Jane L. Kirk,[□] Robert P. Mason,[■] Daniel Obrist,[○] Henrik Selin,[●] Noelle E. Selin,[△] and Marcella R. Thompson[▽]

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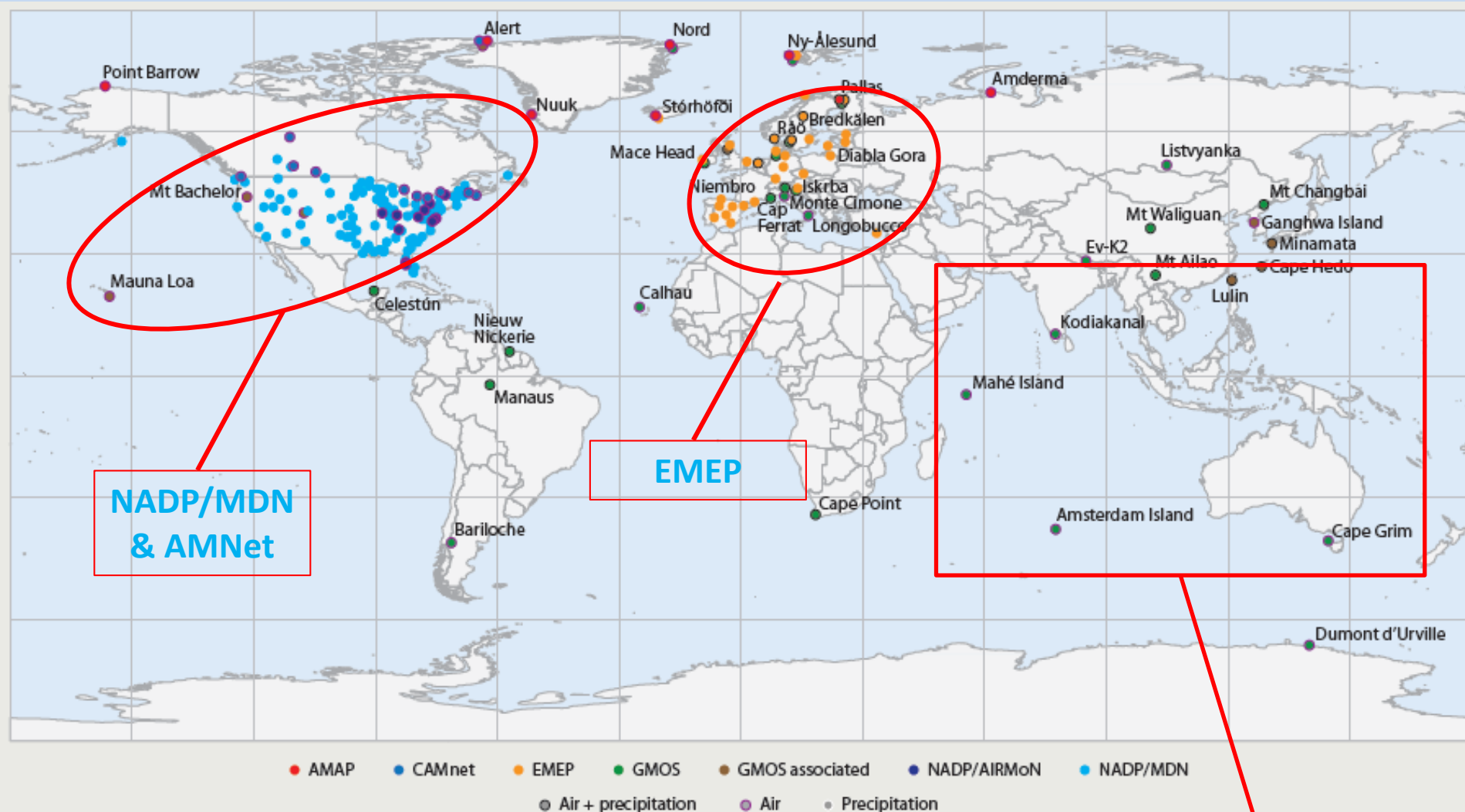
[○]University of Massachusetts, Lowell, Department of Environmental, Earth and Atmospheric Sciences, Lowell,

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Much of Asia Deposition

**is not currently being measured or
measured consistently**

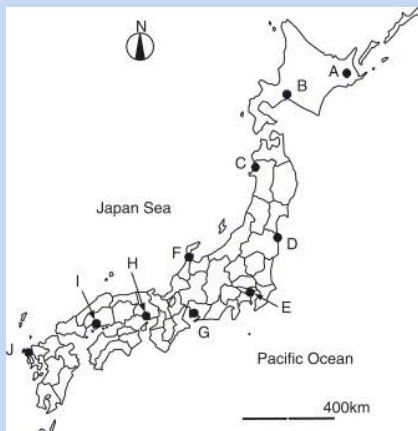
Few Long-Term Mercury Measurements Made in Asia



Currently, there is no long-term or background atmospheric Hg monitoring activity in SE Asia; few measurements in East Asia; limited accessible data; no regional network

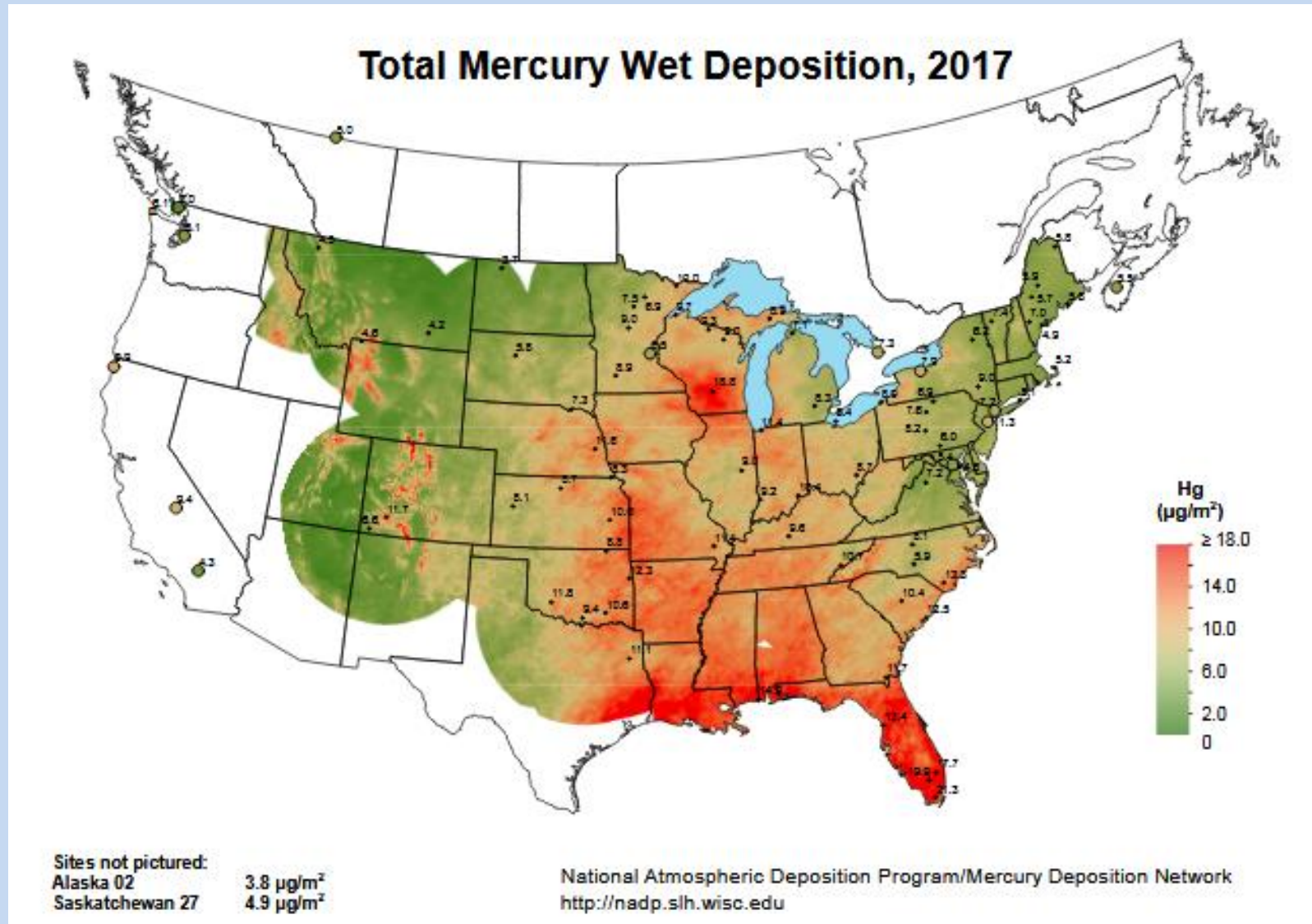
Several East Asia Countries Have Monitoring Programs

- **Korea** – National Institute of Environmental Research (NIER)
- **Japan** – Dr. Maramoto, Dr. M. Sakata, et al., wet deposition
- **Taiwan** – Mt. Lulin and other stations – see work by Guey-Rong Sheu
- **China** - see work by Xinbin Feng, others



Scientific Needs for
Understanding the Mercury
Problem

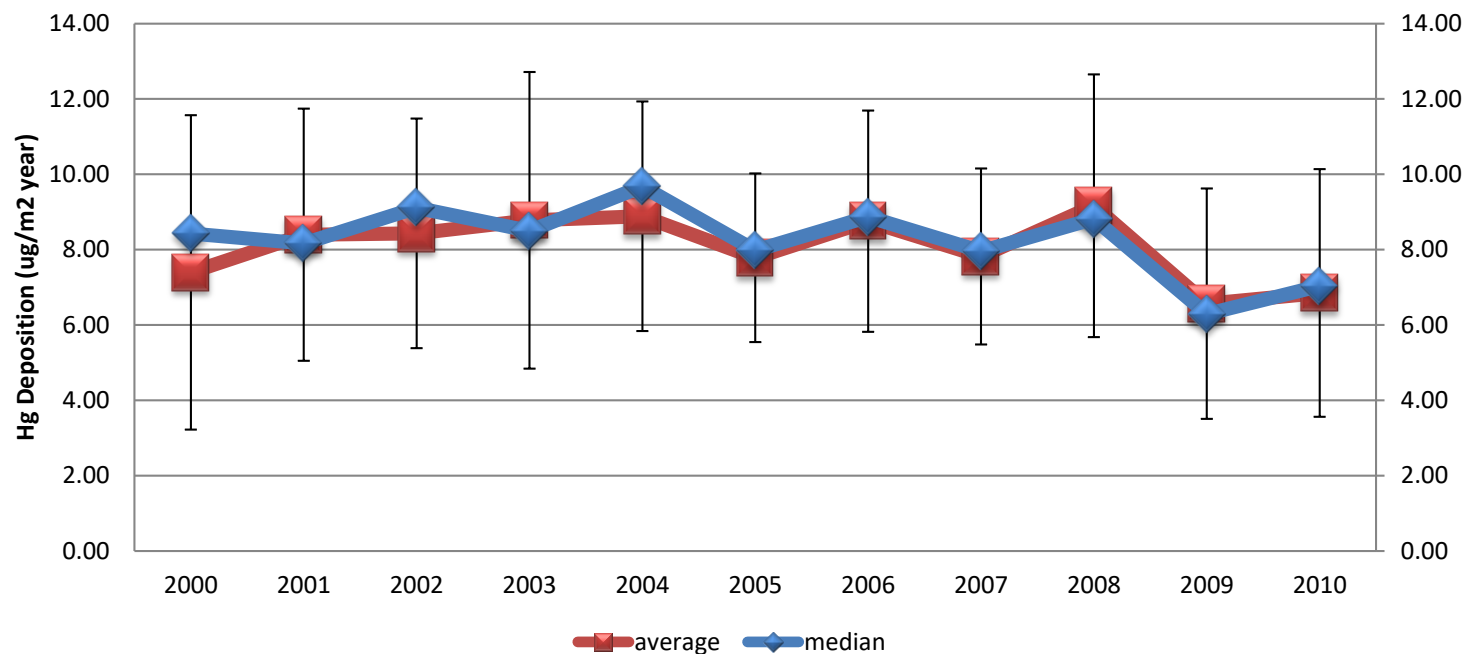
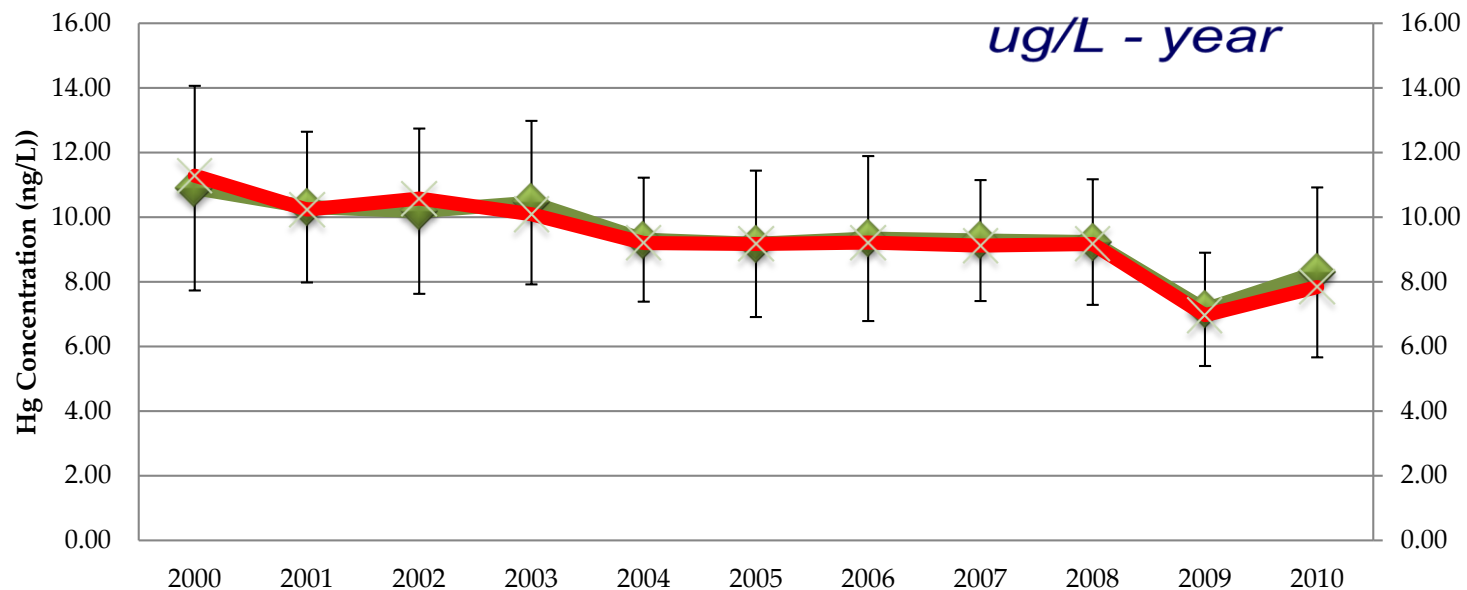
Determining Rates of Deposition over Space



Trends in Concentrations

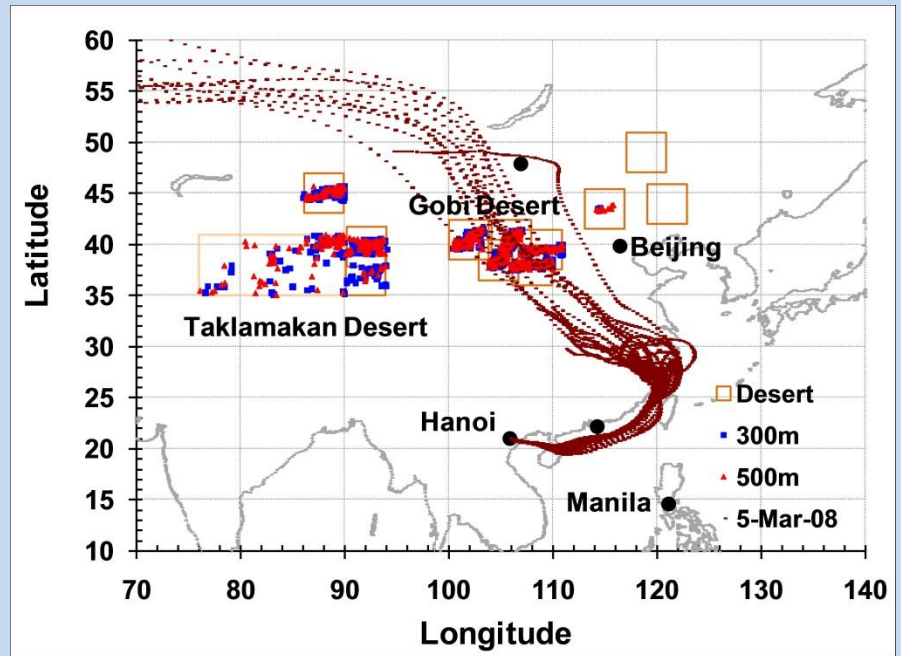
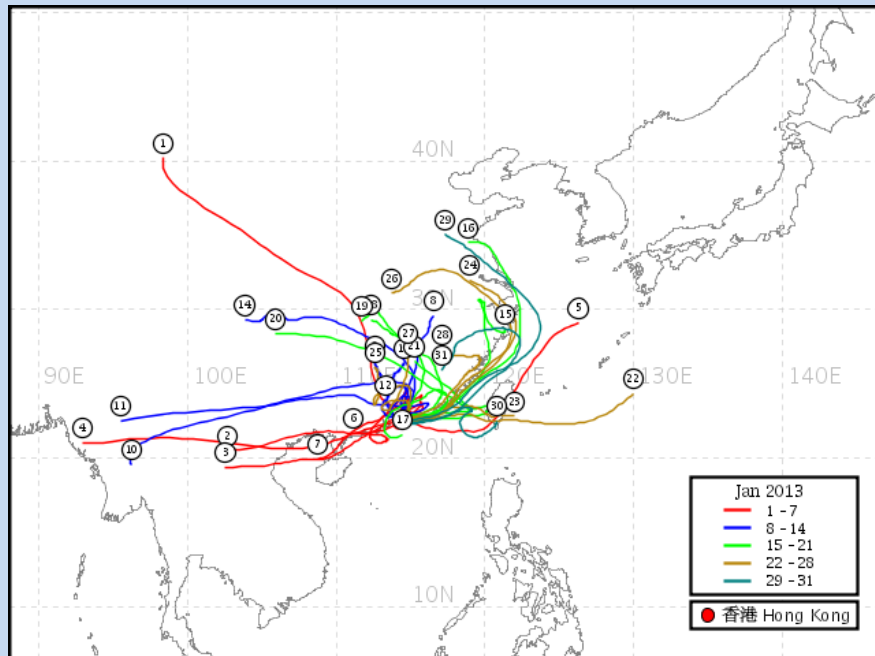
- Measurements are needed..
 - to determine if deposition is being reduced
 - How fast deposition is being reduced
 - If deposition is going down in all areas
 - If fish concentrations are also being reduced
 - If human exposure is decreasing
- Mercury reduction is proceeding in some countries, and the Minamata Convention should continue this trend.

Great Lakes Mercury Wet Concentration and Deposition



Given Measurements, you can determine where the Hg comes from...

Local regional or global



- All Scientists need sound measurements from everywhere, particularly in Asia
 - To understand the global problem...
 - To run global models...
 - To track results of the Minamata Convention

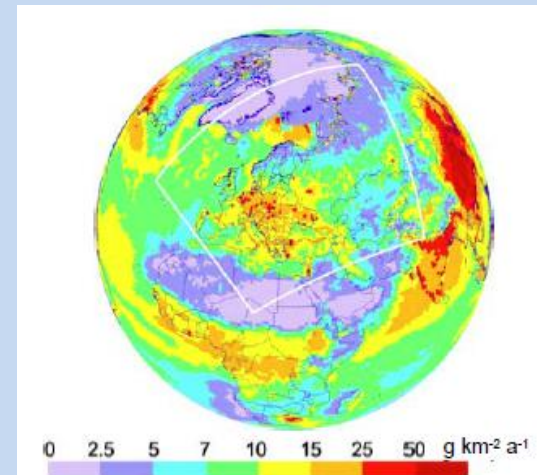
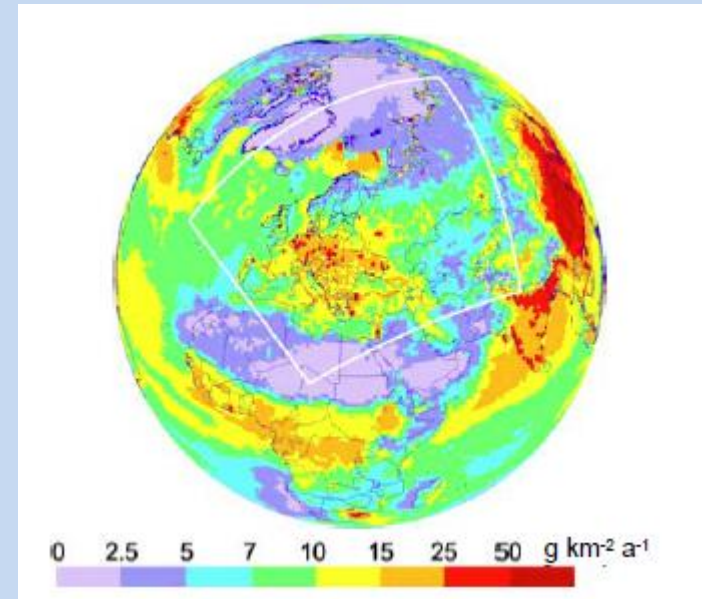


Fig. 3.13. Spatial distribution of mercury deposition flux on a global scale in 2010. White rectangle shows location of the EMEP domain.

Strength in Network Design

The Value of Monitoring

- Using same methods!!!
 - “apples to apples”
 - on a global basis
 - Harmonization of measurements
- Long term monitoring is required to see small changes.
- Sharing Data
 - We need global data to understand a global pollutant
 - Working together is the *best way forward*
- Understand the problem through science
- Is Policy Working?
 - Put legislation in place
 - But is it working
 - Is the problem improving

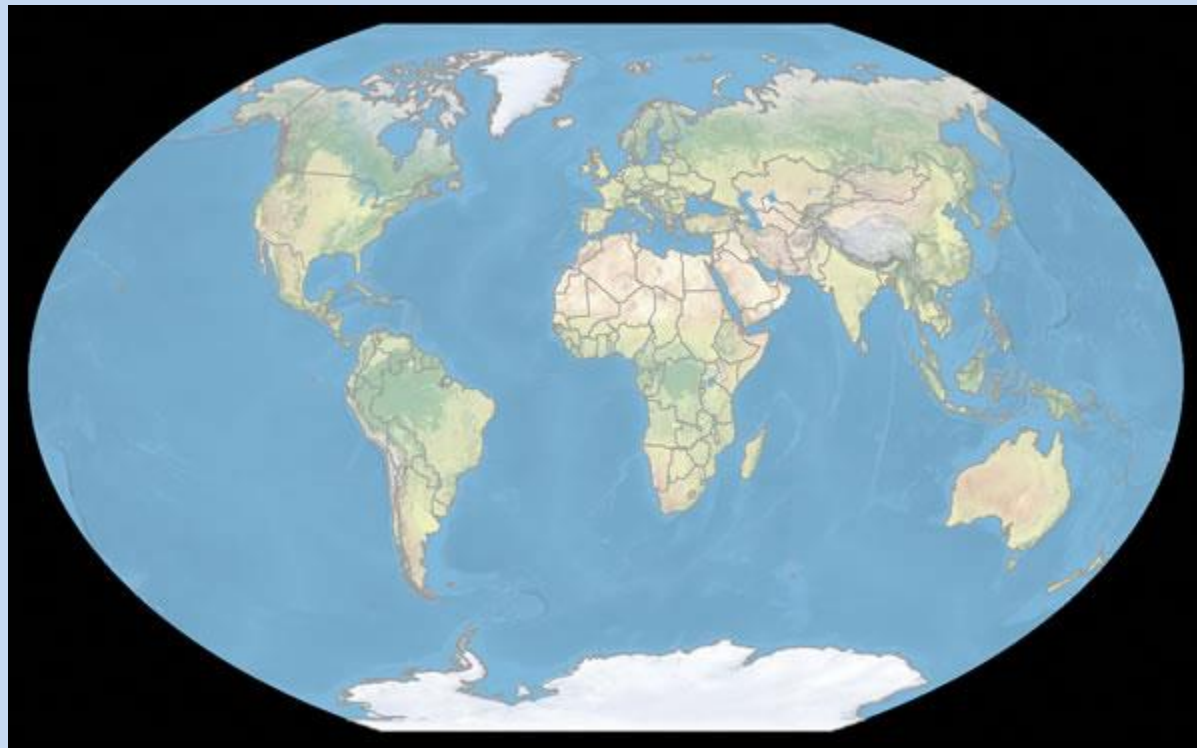


Summary:

Why is it important to Monitor For Mercury?

- Human Health
- Health of Animals and Insects
- General Environmental Health, Hg Cycling in the Environment
- Policy Ramifications
 - Local regulations
 - Minamata Convention on Mercury
- Scientific/Research, cycling of metals

The Asia-Pacific Mercury Monitoring
Network could provide these
measurements!



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