Concerns over Mercury Pollution in Asia

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Minamata Disease and Hg Pollution

- Minamata disease, a neurological disease caused by severe Hg poisoning due to consumption of contaminated fish, was first discovered in Minamata, Japan in **1956**.
- Hg-containing industrial wastewater discharge was the major Hg source to the fish in Minamata Bay.

(Time, 2010)

Recent UNEP Action on Global Hg Pollution

- The text of the Minamata Convention on Mercury was adopted by delegates from over 140 countries on January 19, 2013, following an intense round of negotiations in Geneva, Switzerland.
- The Minamata Convention on Mercury was opened for signature by governments at a Diplomatic Conference on October 9-11, 2013 in Japan.

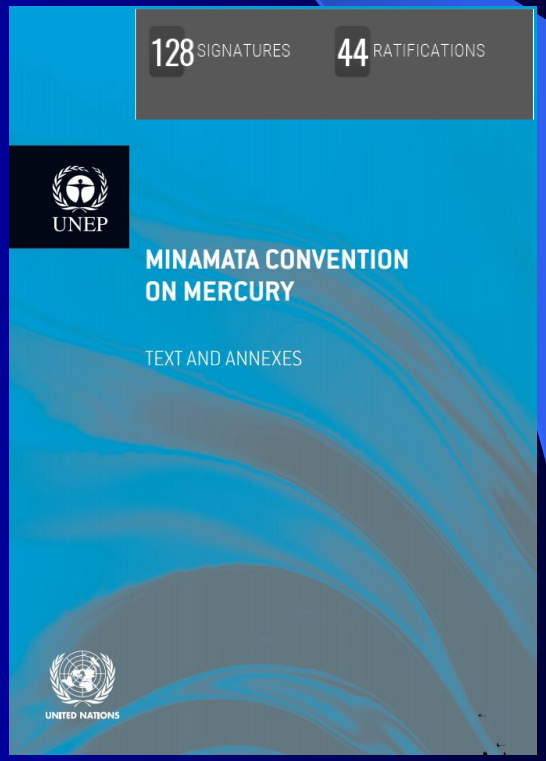
Minamata Convention Agreed by Nations

Sat, Jan 19, 2013

Global Mercury Agreement to Lift Health Threats from Lives of Millions World-Wide

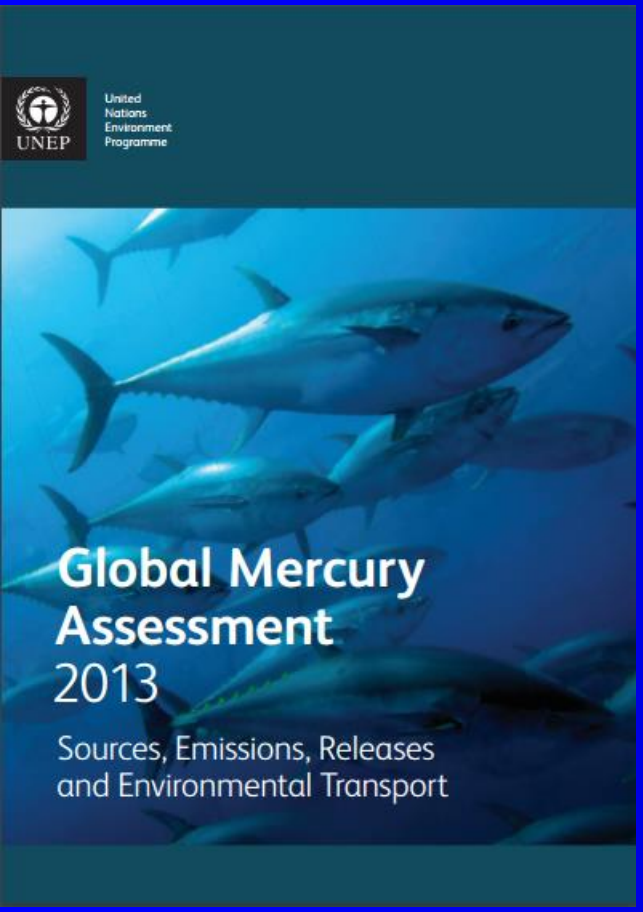
Geneva/Nairobi, 19 January 2013 - International effort to address mercury-a notorious heavy metal with significant health and environmental effects-was today delivered a significant boost with governments agreeing to a global, legally-binding treaty to prevent emissions and releases.

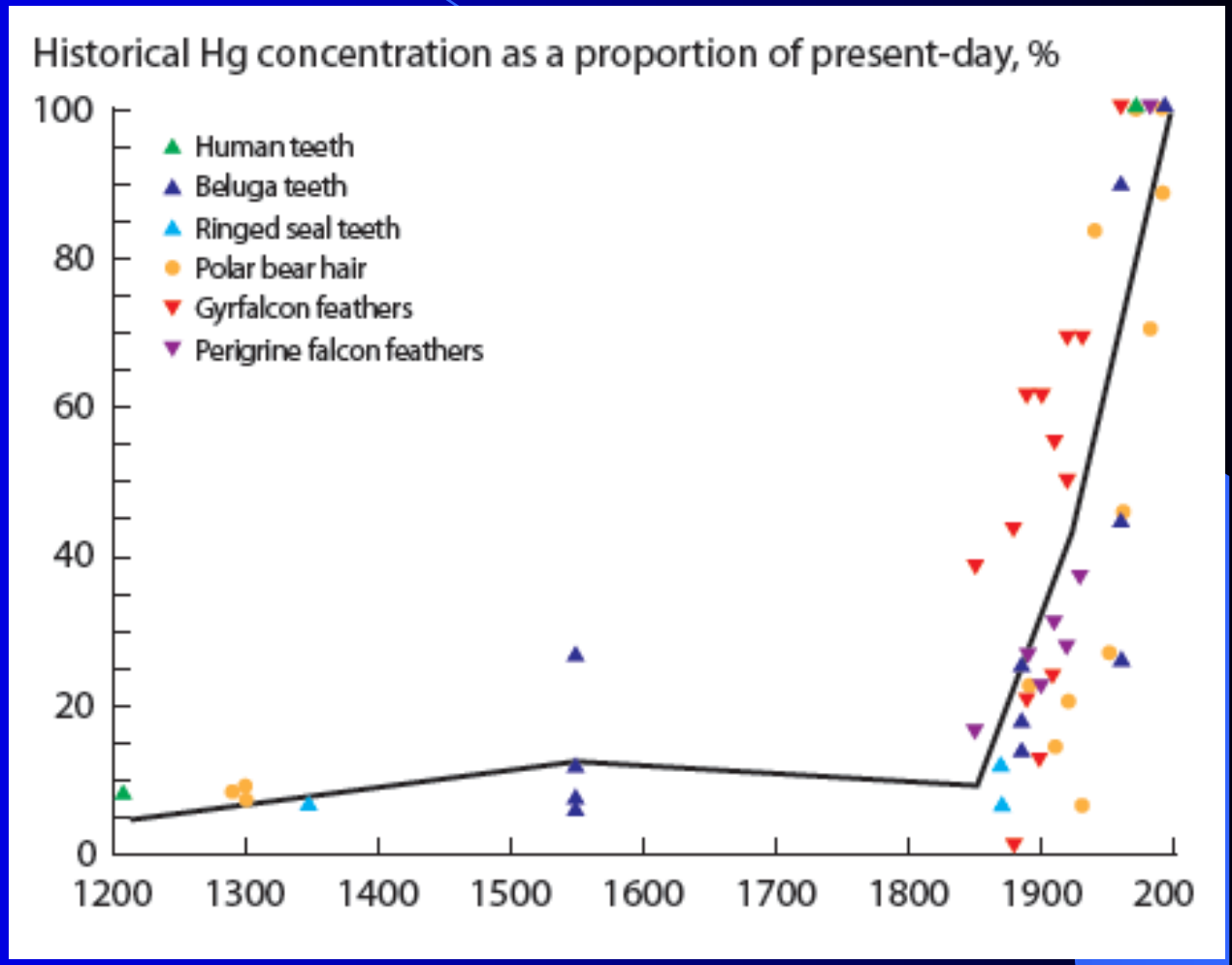
The Minamata Convention on Mercury-named after a city in Japan where serious health damage occurred as a result of mercury pollution in the mid-20th Century-provides controls and reductions across a range of products, processes and industries where mercury is used, released or emitted.



Global Hg Pollution

- Mercury is still a pollutant of global concern.





(UNEP, 2013)

Global Hg Pollution

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New study reveals elevated levels of mercury in women of child bearing age in Pacific Island countries

A new study, supported by the Minamata Convention's Interim Secretariat hosted by UN Environment (download full report with raw data annex or summary report), reveals that women of childbearing age living in four Pacific Island countries have elevated levels of mercury in their bodies. *Mercury monitoring in women of childbearing age in the Asia and the Pacific Region,* jointly conducted by the interim secretariat of the Minamata Convention, Biodiversity Research Institute (BRI), and the global NGO network IPEN, examined hair samples from women aged 18 - 44 from Cook Islands, Marshall Islands, Tuvalu, and Kiribati, and two landlocked Asian countries, Tajikistan and Nepal. The study found 96 percent of the women sampled from the Pacific Islands contained significantly elevated hair mercury levels.[1] Researchers hypothesized that the Pacific Island participants may have a higher mercury body burden than other locations due to their relatively high consumption of predatory fish species shown to have elevated mercury concentrations in previous studies

"Mercury has been recognized as a substance of global concern, with impacts on vulnerable populations," said Jacob Duer, Principal Coordinator of the Minamata Convention's Interim Secretariat. "Our results show why global action to prevent mercury releases through the Minamata Convention is so important."

In contrast to the Pacific Islands, samples from Tajikistan, where fish consumption is very low, had the least amount of mercury overall, with an average level of .06 ppm. In Nepal, elevated mercury levels were found in women with a low fish diet, but worked making gold-plated religious idols using mercury.

"This study underscores the importance of biomonitoring mercury pollution," said David Evers, PhD, executive director and chief scientist at BRI and co-author of the study. "Although the subjects in this study represent small selected populations, the information gained contributes to overall global information on mercury concerns. Mercury contamination is ubiquitous in marine and freshwater systems around the world. Biological mercury hotspots are globally common and are related to a variety of human activities. For these reasons, it is critical that we continue biomonitoring efforts to track potential impacts on local communities and on the environment in order to evaluate the effectiveness of the Minamata Convention."

Mercury exposure is particularly concerning for women of childbearing age as it can damage the nervous system, kidneys, and cardiovascular system. Developing organ systems, such as the foetal nervous system, are the most sensitive to the toxic effects of mercury, although nearly all organs are vulnerable.

"A global pollutant like mercury can contaminate people even if they are far from gold mining, coal power plants or incinerators," said Lee Bell, IPEN. "And that's why all sources of mercury need to be tackled.

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Minamata Convention's Interim Secretariat hosted by UN Environment is supporting work towards implementation of the Minamata Convention, including efforts on public information, awareness and education. The Minamata Convention has the objective to protect the human health and the environmetns from anthropogenic emissions and releases of mercury and mercury compounds, and will enter into force after the deposition of the 50th instrument of ratification. www.mercuryconvention.org

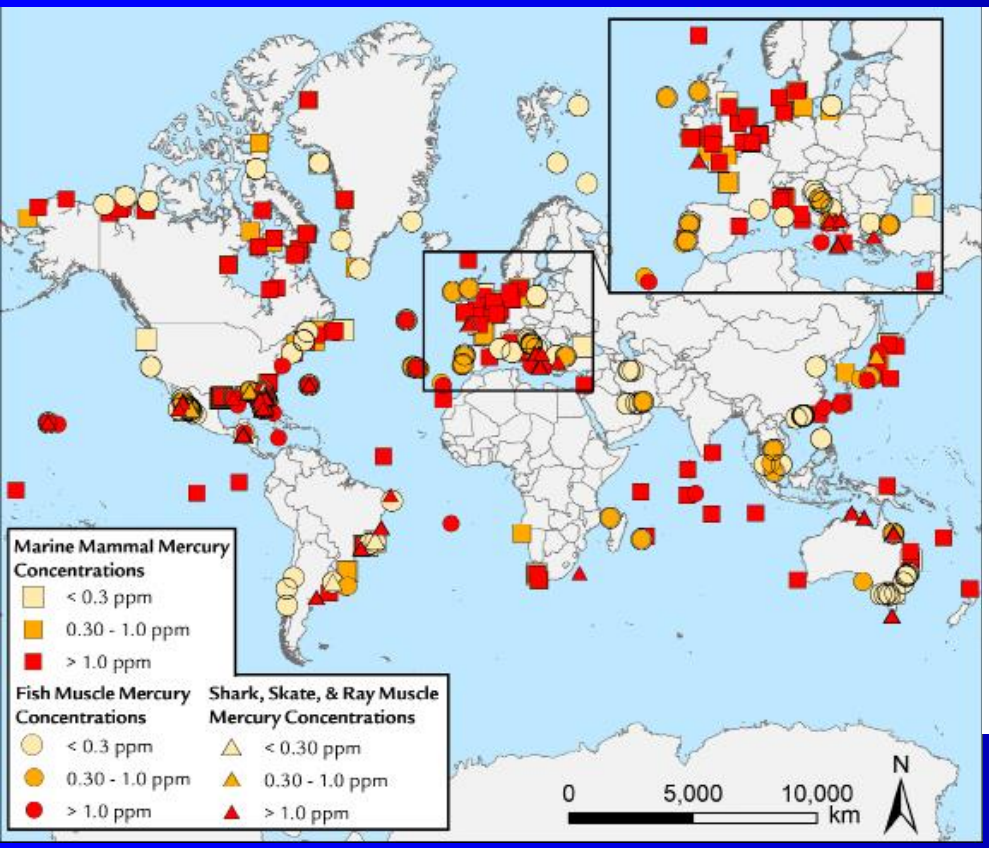
Biodiversity Research Institute is a nonprofit ecological research group whose mission is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers. BRI a the leading international institute supporting the global mercury monitoring efforts for the Minamata Convention on Mercury. www.briloon.org

IPEN is a network of non-governmental organizations working in more than 100 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals. www.ipen.org

[1] Women in the sampled Pacific Island countries contained average mercury concentrations between 2 ppm - 3.7 ppm. These concentrations exceed 1 ppm which is equivalent to US EPA's maximum tolerable daily mercury intake below which the appreciable risk of harmful effects during a lifetime is minimal.

Global Hg Pollution

- Fish consumption is the major exposure route of Hg to many people worldwide.
- Hg concentrations in fish are elevated globally.



(Evers et al., 2012)

Nation	Standards
International Food Standards (Codex Alimentarius)	Fish: less than 0.5 mg/kg of methyl mercury Carnivorous fish (shark, swordfish, and tuna): less than 1 mg/kg of methyl mercury
US	Fish: less than 1 mg/kg of methyl mercury
EU	Fish: less than 0.5 mg/kg of total mercury Carnivorous fish including shark: less than 1 mg/kg of total mercury
Japan	Seafood (excluding abyssal fish and tuna): less than 0.4 mg/kg of total mercury, less than 0.3 mg/kg of methyl mercury
Australia and New Zealand	Fish: less than 0.5 mg/kg of total mercury Carnivorous fish including shark: less than 1 mg/kg of total mercury
Korea	Seafood (excluding abyssal fish and tuna): less than 0.5 mg/kg of total mercury

Global Hg Pollution

- Atmospheric deposition is the major source of Hg to many aquatic ecosystems.

Current Global Hg Budget

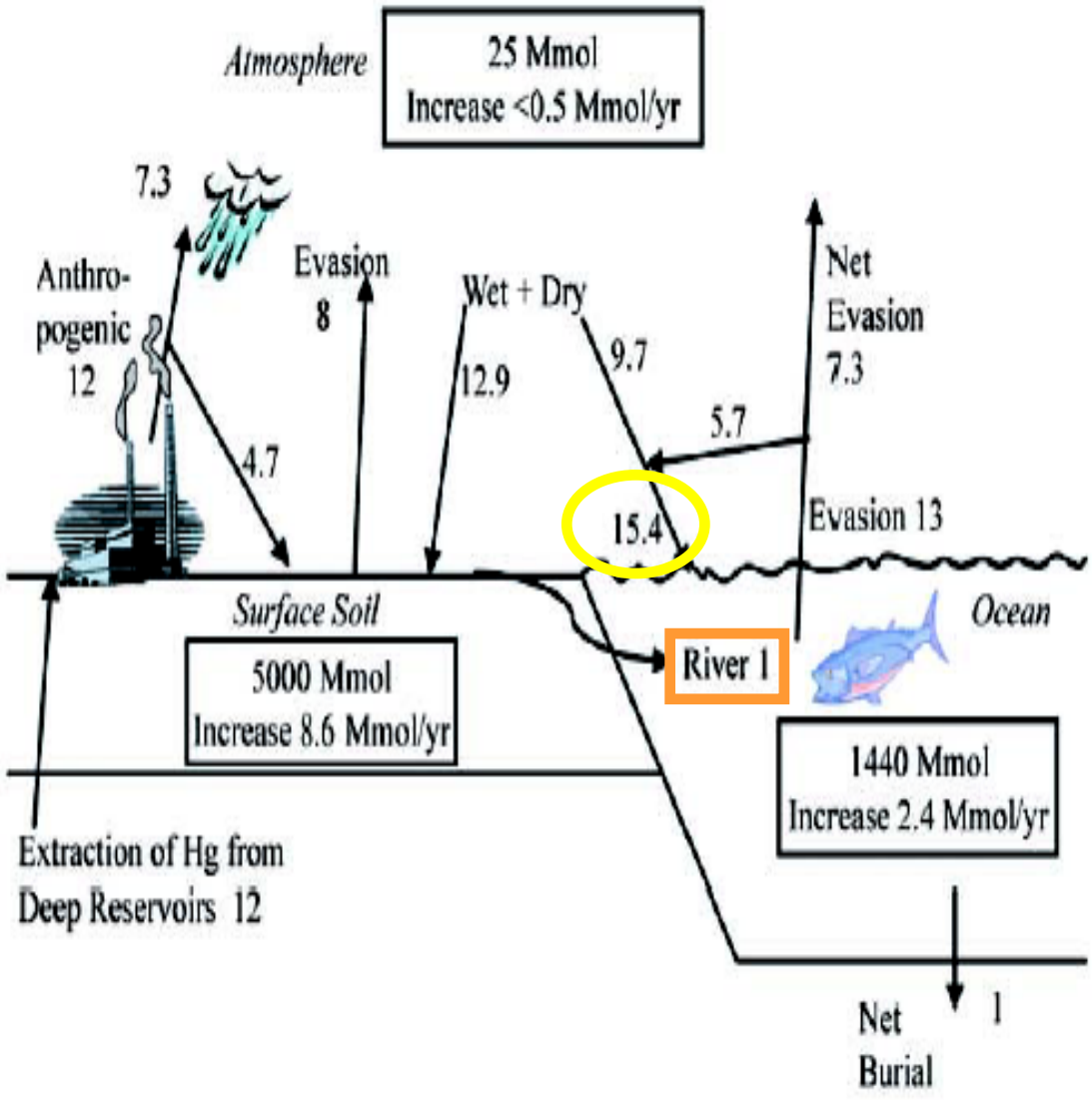


Figure 3. The current global mercury cycle. All fluxes are in Mmol yr^{-1}.

Annual fluxes to oceans:

Atmospheric deposition = 15.4 Mmol yr^{-1}

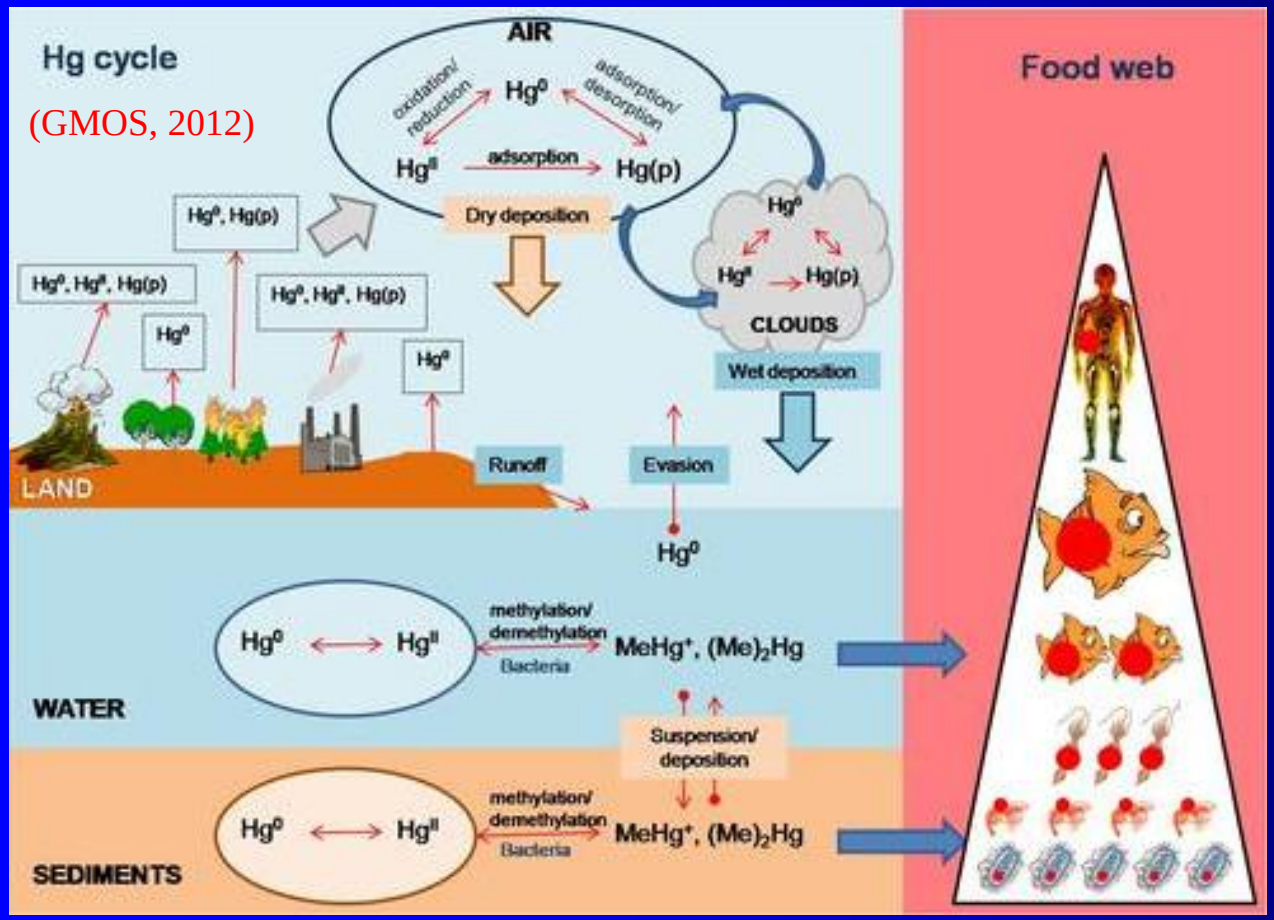
Riverine input = 1 Mmol yr^{-1}

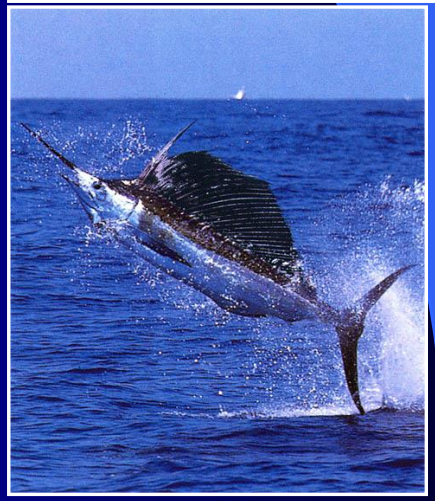
Atmospheric deposition >> Riverine input

(Mason and Sheu, 2002)

Global Hg Pollution

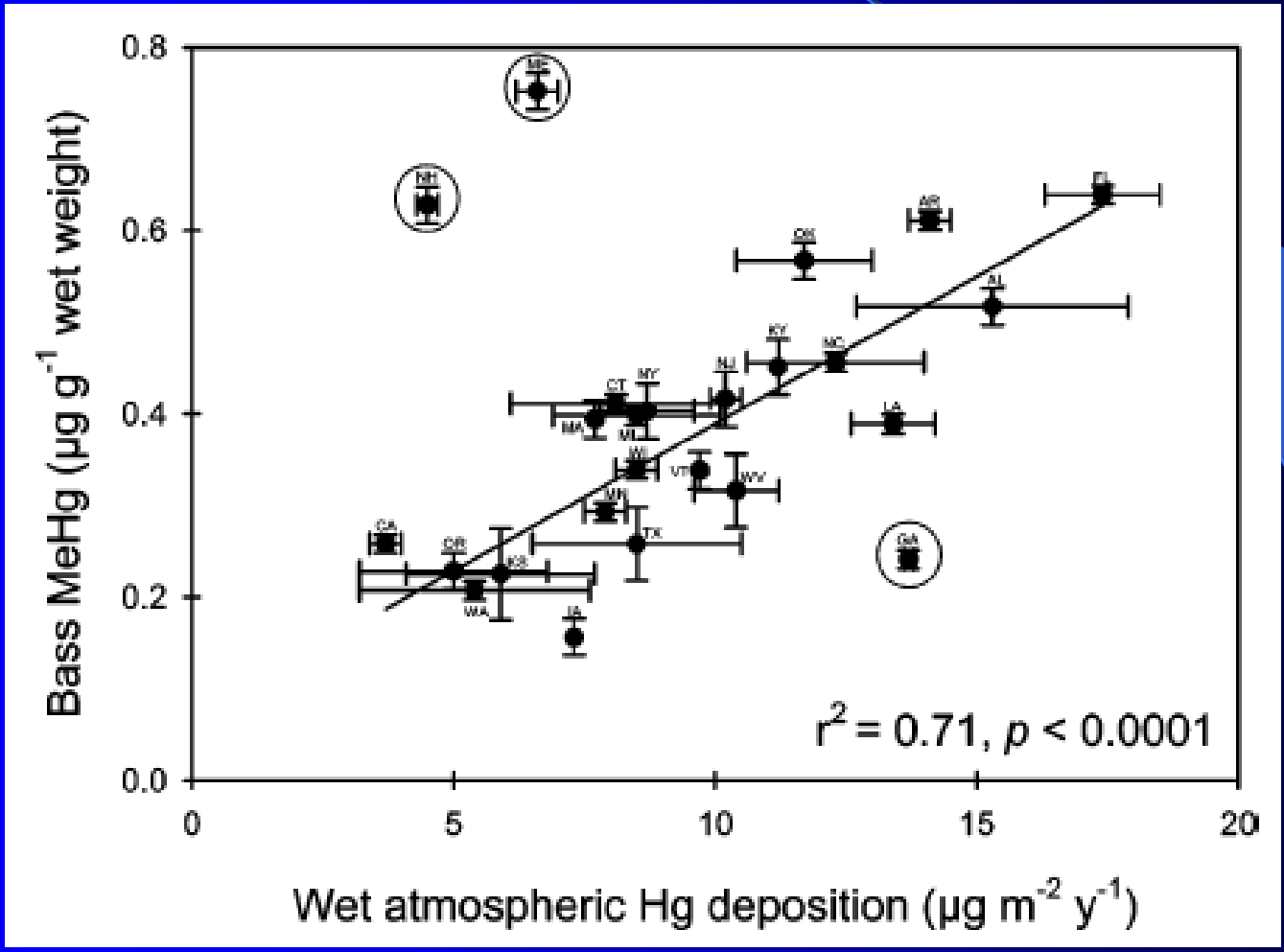
- Once deposits from atmosphere, inorganic Hg can get methylated by bacteria to form MeHg then bioaccumulates through food chain, resulting in higher concentrations in large long-lived predatory fish.





Correlation between Wet Hg Flux and Hg in Fish

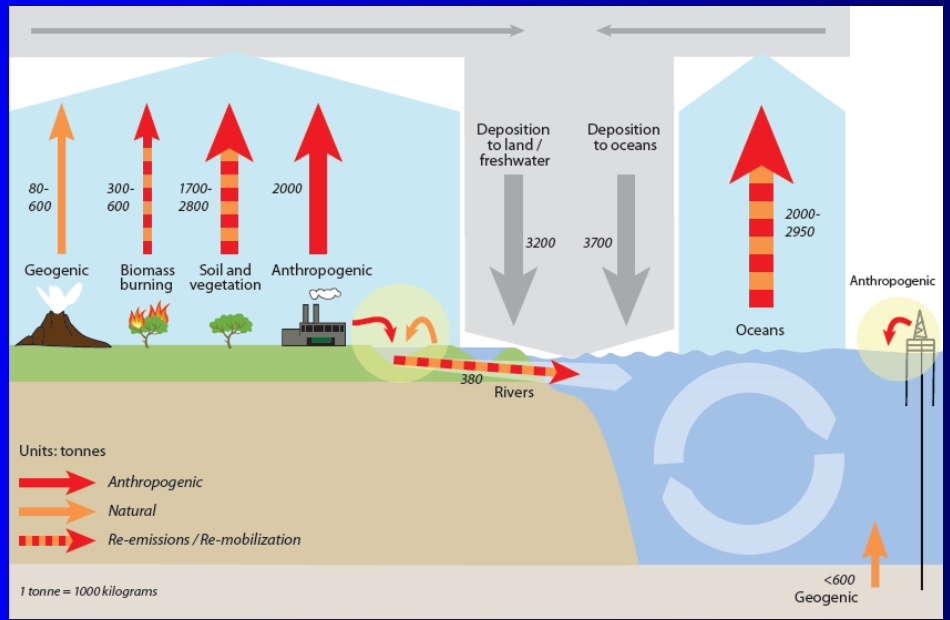
- Research results indicate a reasonable correlation between Hg in wet deposition and Hg in fish.



(Hammerschmidt and Fitzgerald, 2007)

Sources of Atmospheric Hg

- **Natural emissions**: mercury released from natural weathering of Hg-containing rocks or by geothermal activity.
  Estimate = **80-600 Mg yr^{-1} (about 10% of total)**
- **Anthropogenic emissions**: mercury released as a result of current human activities.
  Estimate of 2010 = **1960 (1010-4070) Mg yr^{-1} (about 30%)**
- **Re-emissions**: mercury released to the atmosphere that are derived from past natural and anthropogenic releases.
  Estimate = **4000-6300 Mg yr^{-1} (about 60%)**

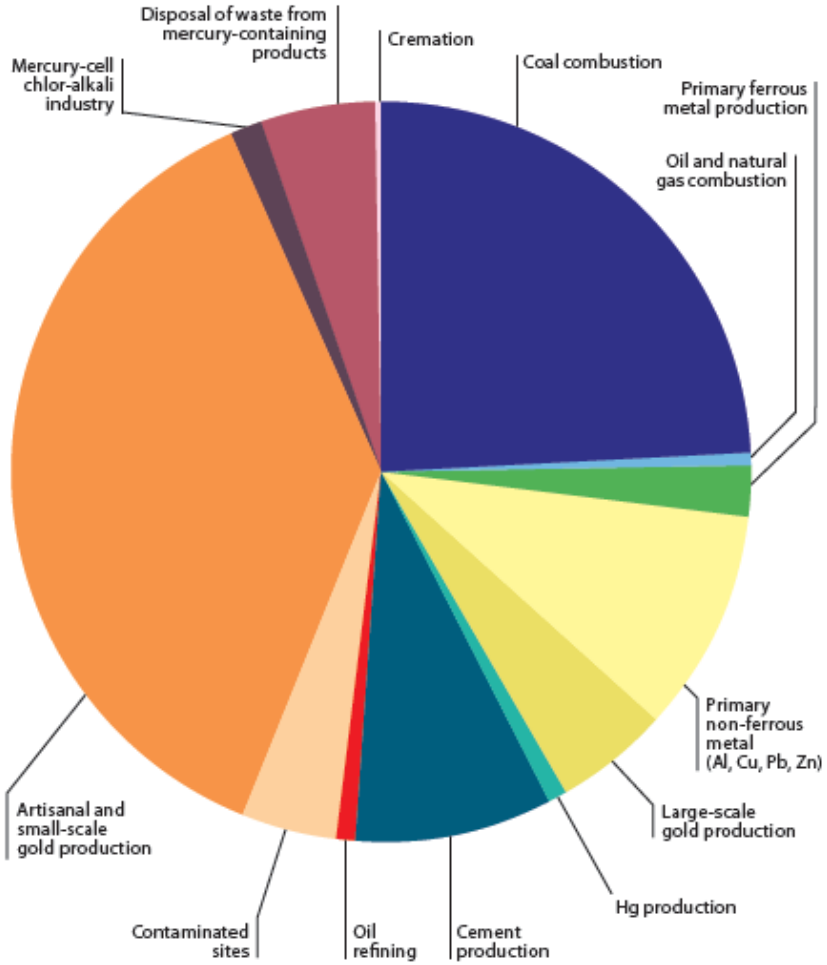


(UNEP, 2013)

Global Hg Pollution

- Anthropogenic Hg emission is an important contributor to the Hg in the atmosphere.

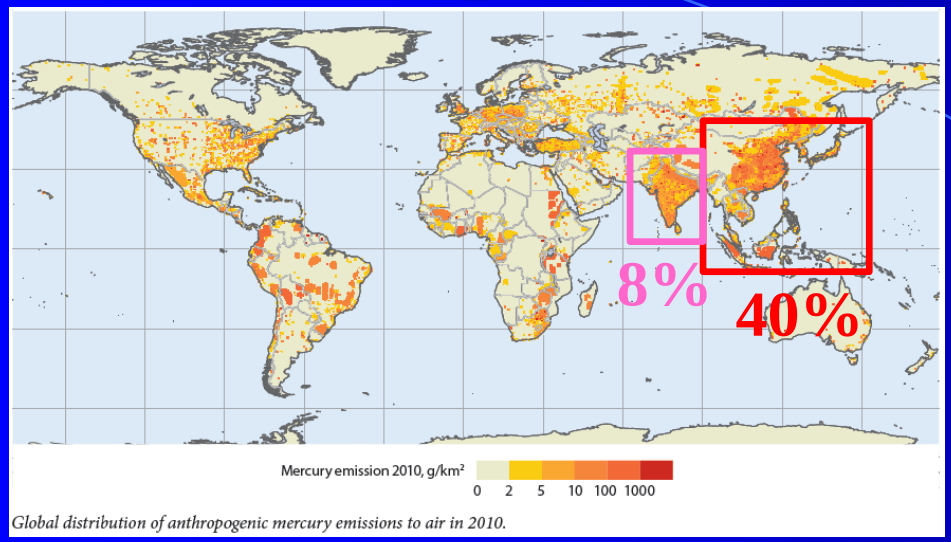
Sector	Emission (range), tonnes*	%**
By-product or unintentional emissions		
Fossil fuel burning		
Coal burning (all uses)	474 (304 - 678)	24
Oil and natural gas burning	9.9 (4.5 – 16.3)	1
Mining, smelting, & production of metals		
Primary production of ferrous metals	45.5 (20.5 – 241)	2
Primary production of non-ferrous metals (Al, Cu, Pb, Zn)	193 (82 – 660)	10
Large-scale gold production	97.3 (0.7 – 247)	5
Mine production of mercury	11.7 (6.9 – 17.8)	<1
Cement production	173 (65.5 - 646)	9
Oil refining	16 (7.3 - 26.4)	1
Contaminated sites	82.5 (70 - 95)	4
Intentional uses		
Artisanal and small-scale gold mining	727 (410 – 1040)	37
Chlor-alkali industry	28.4 (10.2 – 54.7)	1
Consumer product waste	95.6 (23.7 – 330)	5
Cremation (dental amalgam)	3.6 (0.9 - 11.9)	<1
Grand Total	1960 (1010 – 4070)	100



Relative contributions to estimated emissions to air from anthropogenic sources in 2010.

(UNEP, 2013)

Anthropogenic Hg Emissions in 2010



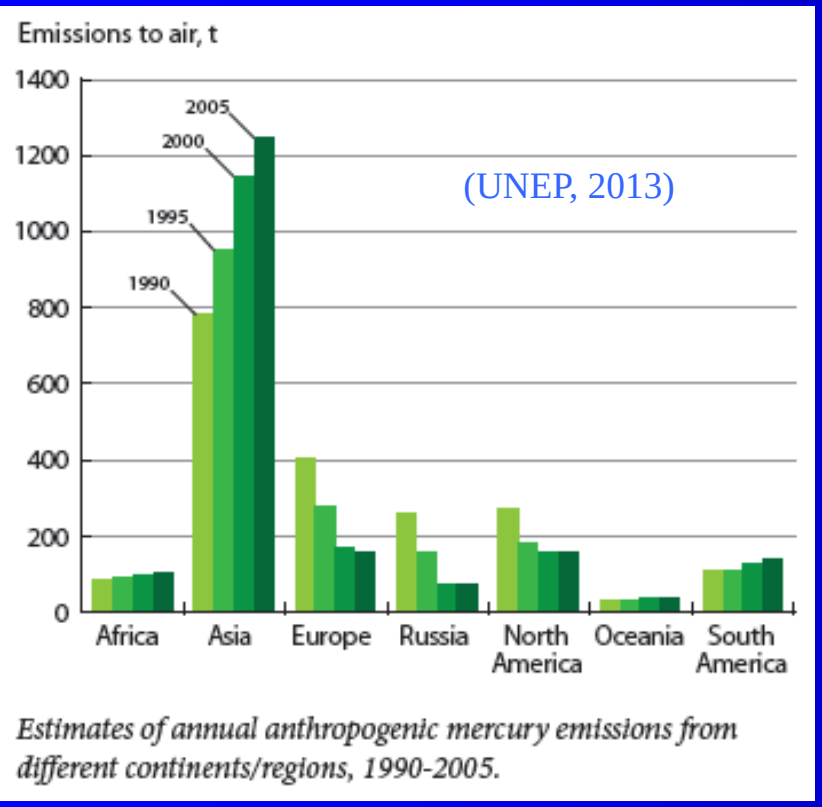
Global distribution of anthropogenic mercury emissions to air in 2010.

Region*	Emission (range), tonnes**	%
Australia, New Zealand & Oceania	22.3 (5.4 - 52.7)	1.1
Central America and the Caribbean	47.2 (19.7 - 97.4)	2.4
CIS & other European countries	115 (42.6 - 289)	5.9
East and Southeast Asia	777 (395 - 1690)	39.7
European Union (EU27)	87.5 (44.5 - 226)	4.5
Middle Eastern States	37.0 (16.1 - 106)	1.9
North Africa	13.6 (4.8 - 41.2)	0.7
North America	60.7 (34.3 - 139)	3.1
South America	245 (128 - 465)	12.5
South Asia	154 (78.2 - 358)	7.9
Sub-Saharan Africa	316 (168 - 514)	16.1
Undefined (global total for emissions from contaminated sites)	82.5 (70.0 - 95.0)	4.2
Grand Total	**1960 (1010 – 4070)**	**100**

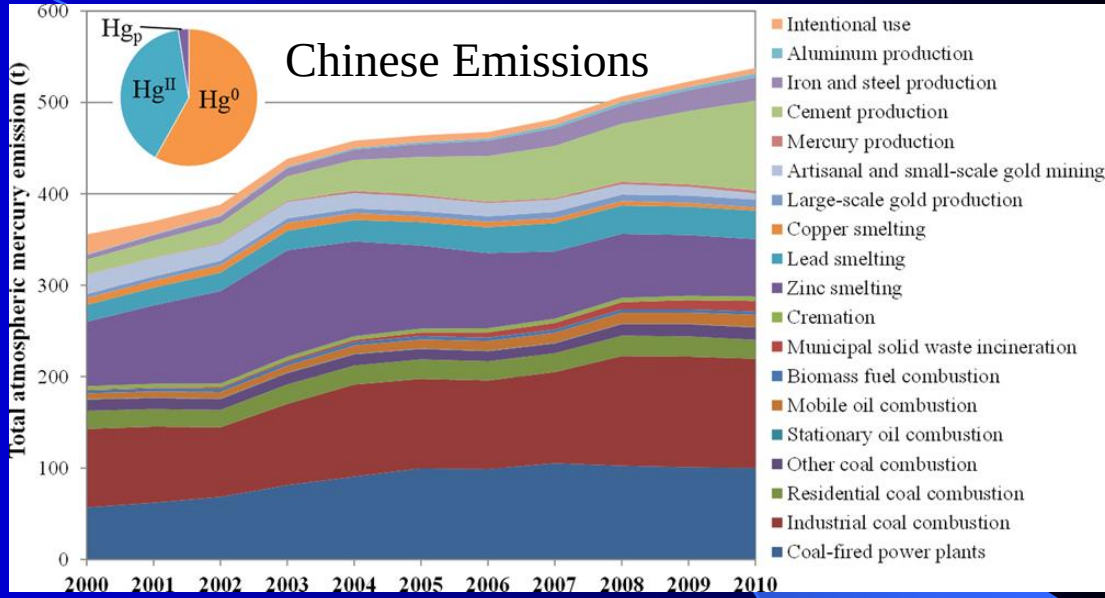
Country	Emission (tonnes)
Bangladesh	1.4
Cambodia	3.9
China	575.2
India	144.7
Indonesia	78.2
Japan	17.2
Korea	7.1
Laos	1.3
Malaysia	6.1
Mongolia	6.9
Philippines	33.1
Singapore	0.9
Sri Lanka	0.6
Taiwan	5.5
Thailand	14.9
Vietnam	11.6

(UNEP, 2013)

Trends in Anthropogenic Hg Emissions



Estimates of annual anthropogenic mercury emissions from different continents/regions, 1990-2005.



Anthropogenic Hg emissions from Europe and North America are declining, whereas emissions from Asia are increasing.

An average annual increase rate of 4.2% between 2000 and 2010 in China (Zhang et al., 2015)

Projections of Global Hg Emissions in 2050

Projections of Global Mercury Emissions in 2050 (Streets et al., 2009)

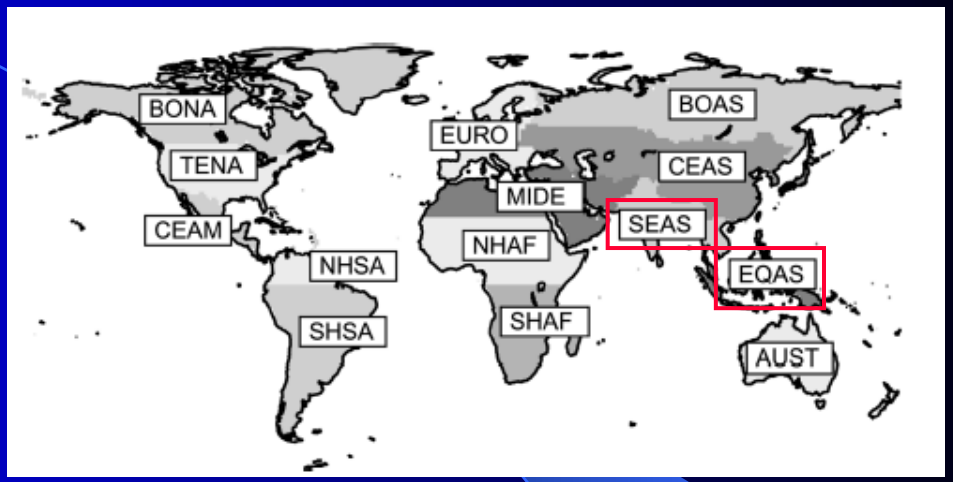
DAVID G. STREETS,*,† QIANG ZHANG,† AND YE WU‡

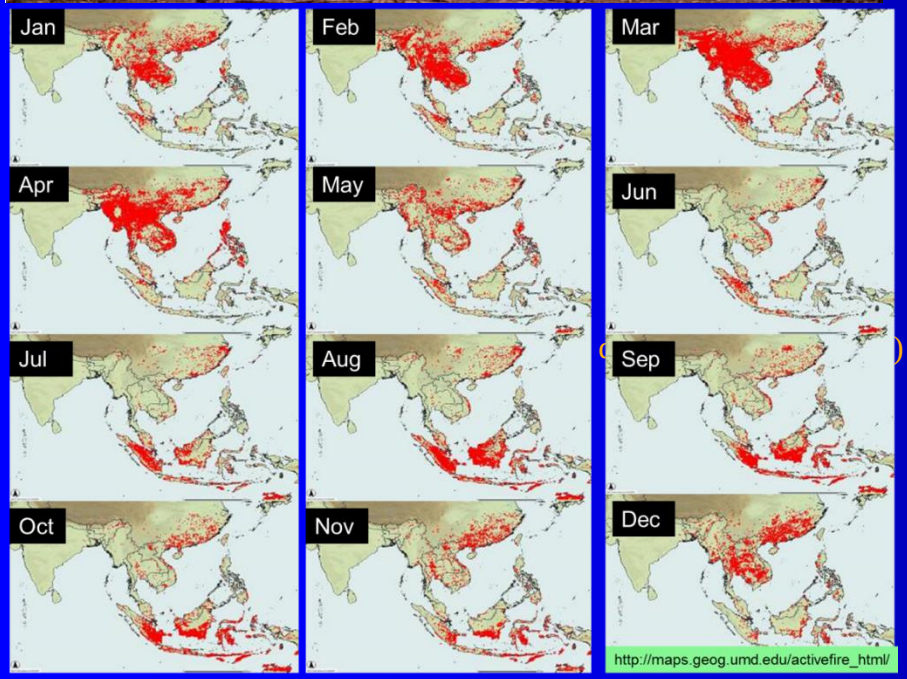
TABLE 4. Mercury Emissions in 2050 by Scenario and World Region (Mg/yr)

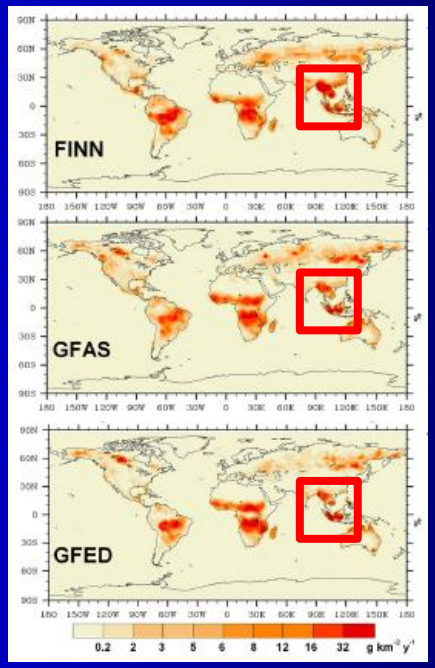
scenario	North America	Central and South America	Africa	Europe, Russia, Middle East	Asia and Oceania	world
2050 A1B	225.9	473.6	509.6	676.5	2970.0	4855.6
2050 A2	239.1	415.6	375.5	667.3	2208.5	3905.9
2050 B1	121.9	340.4	357.0	358.1	1208.9	2386.2
2050 B2	131.3	331.2	308.1	398.0	1461.4	2629.9

Projections under various IPCC scenarios of development. It is likely that Hg emission will increase in the future. The main driving force is the expansion of coal-burning electricity generation, especially in Asia.

Biomass Burning Hg Emissions







regions	Hg emissions Mg Hg/year mean	SD[a]
BONA	22	16
TENA	6	3
CEAM	22	25
NHSA	13	10
SHSA	95	39
EURO	2	1
MIDE	0	0
NHAF	83	13
SHAF	58	7
BOAS	99	83
CEAS	7	2
SEAS	57	35
EQAS	192	216
AUST	19	9
global	675	240
boreal[b]	121	85
temperate[c]	9	3
ROW[d]	545	224

SEAS + EQAS = 249 Mg Hg/year = 37% of global biomass burning emission

Distribution of Atmospheric Hg Concentrations and Deposition Fluxes: Modeling Results

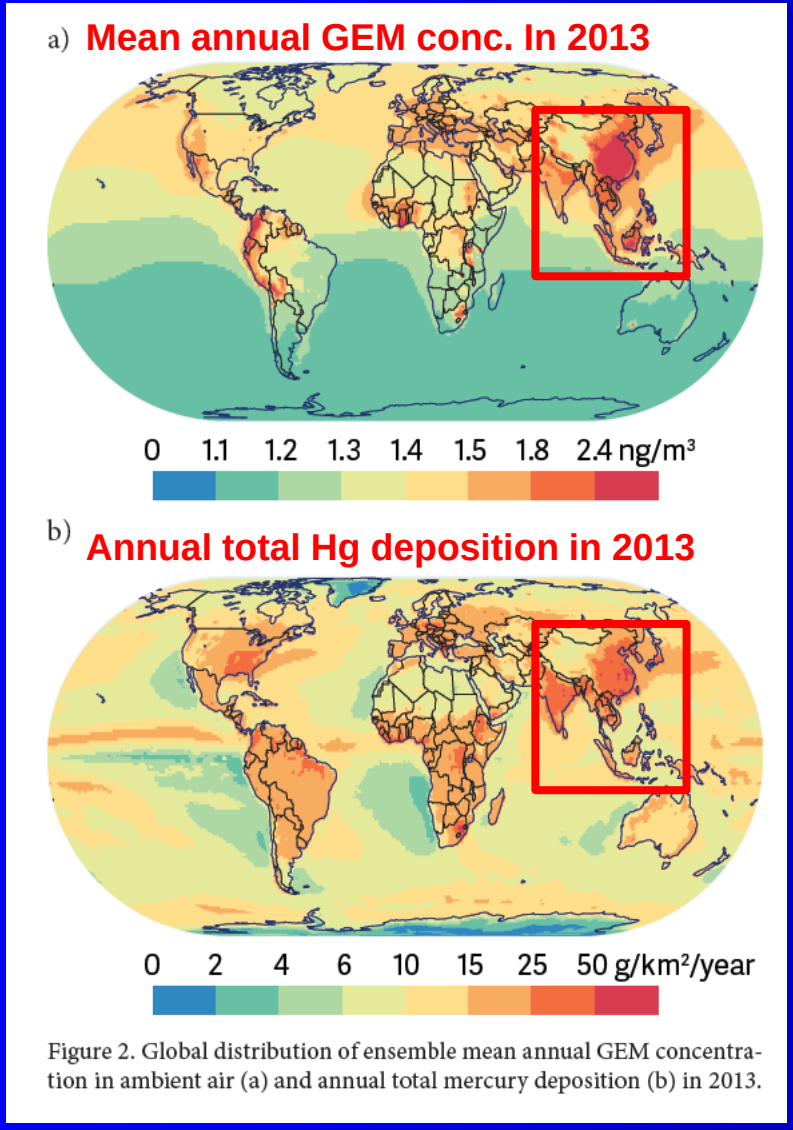
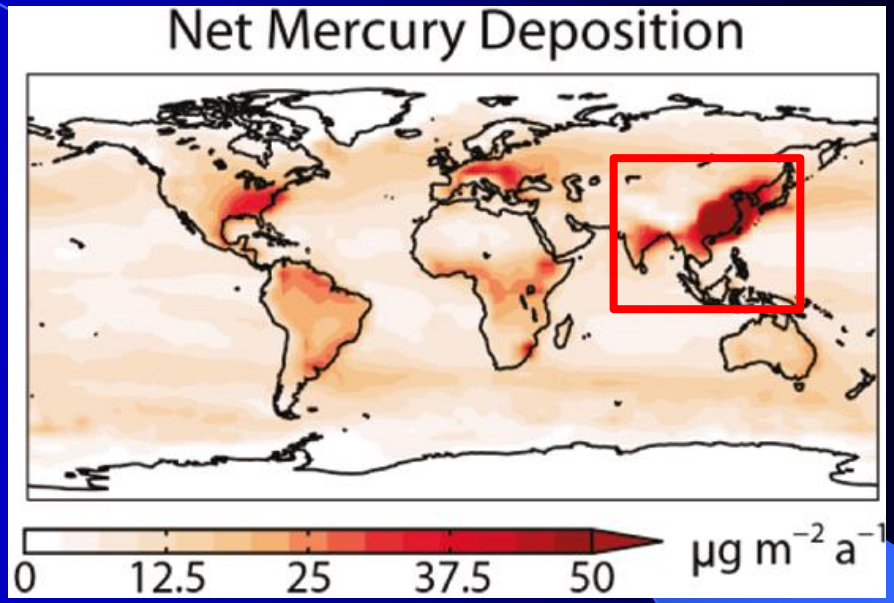
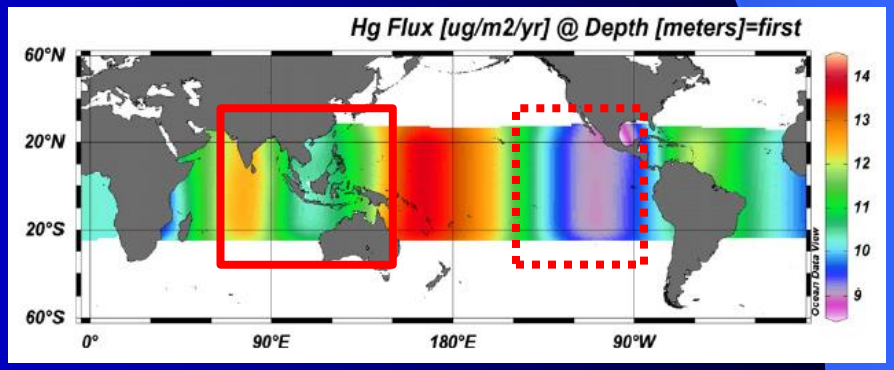


Figure 2. Global distribution of ensemble mean annual GEM concentration in ambient air (a) and annual total mercury deposition (b) in 2013.

AMAP/UNEP, 2015

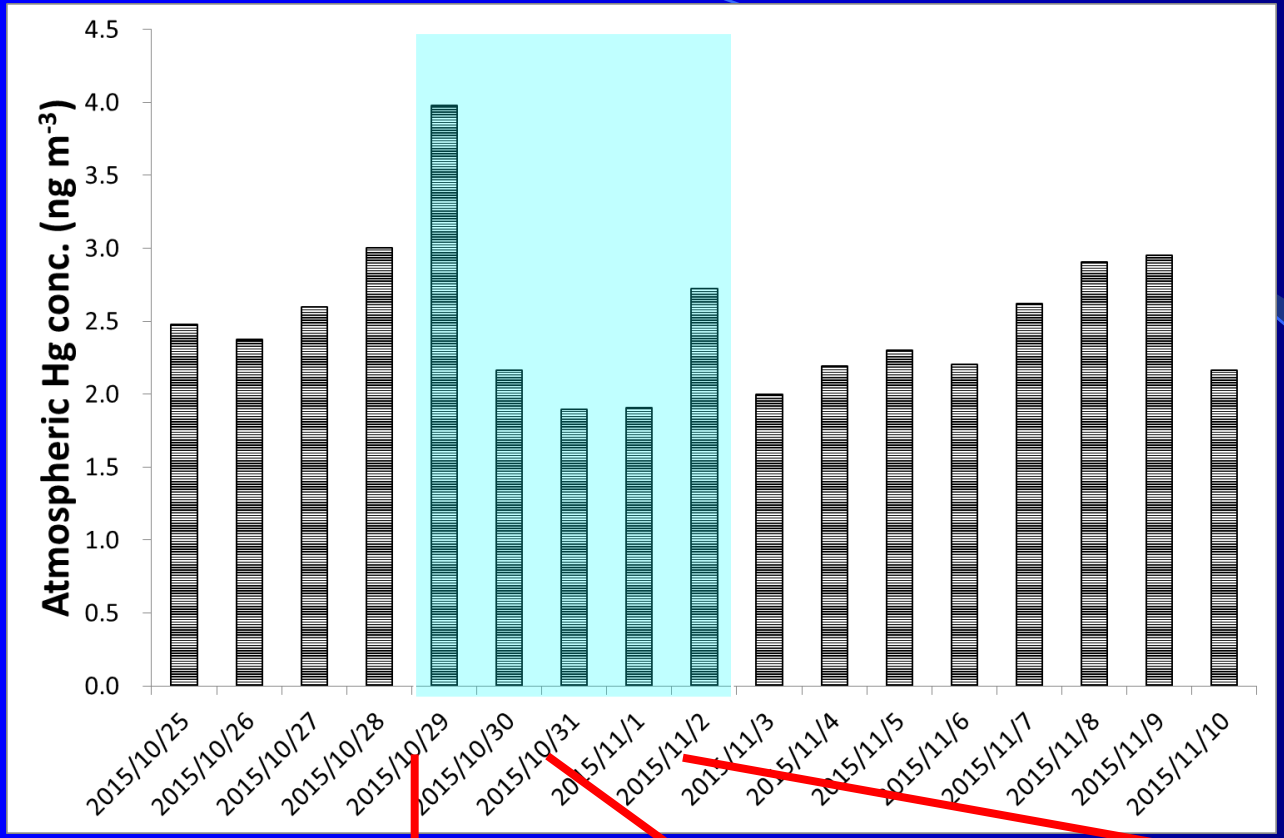


Corbitt et al., 2011

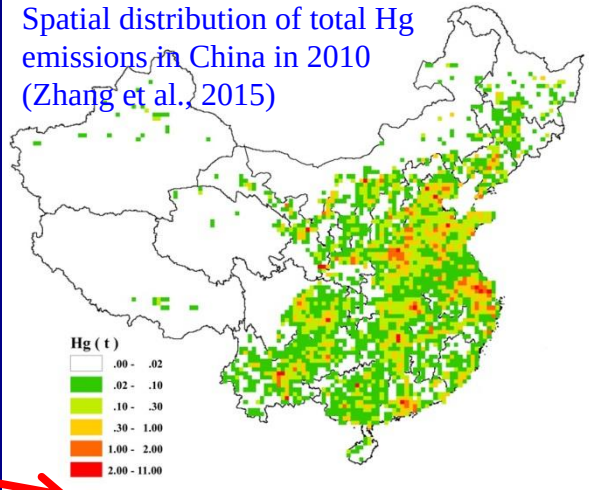


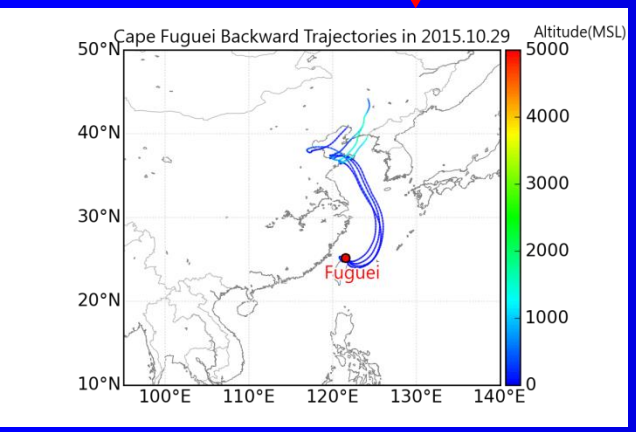
Costa et al., 2012

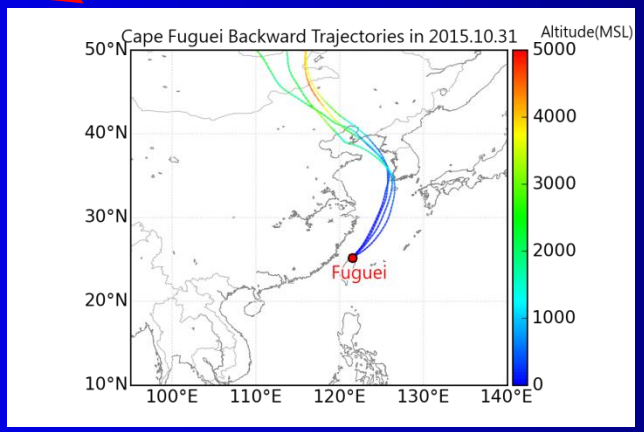
Ambient Hg at Cape Fuguei in 10/25-11/10/2015

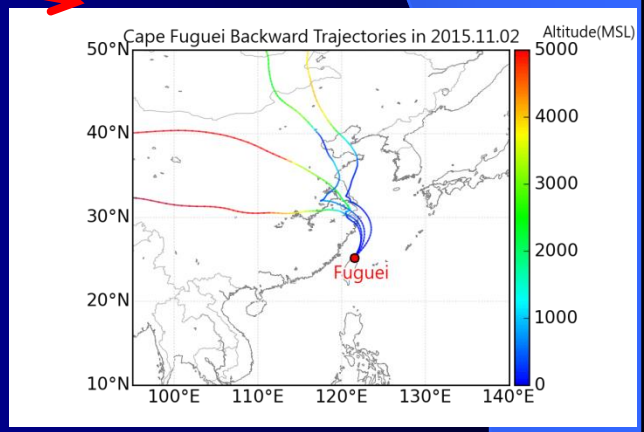


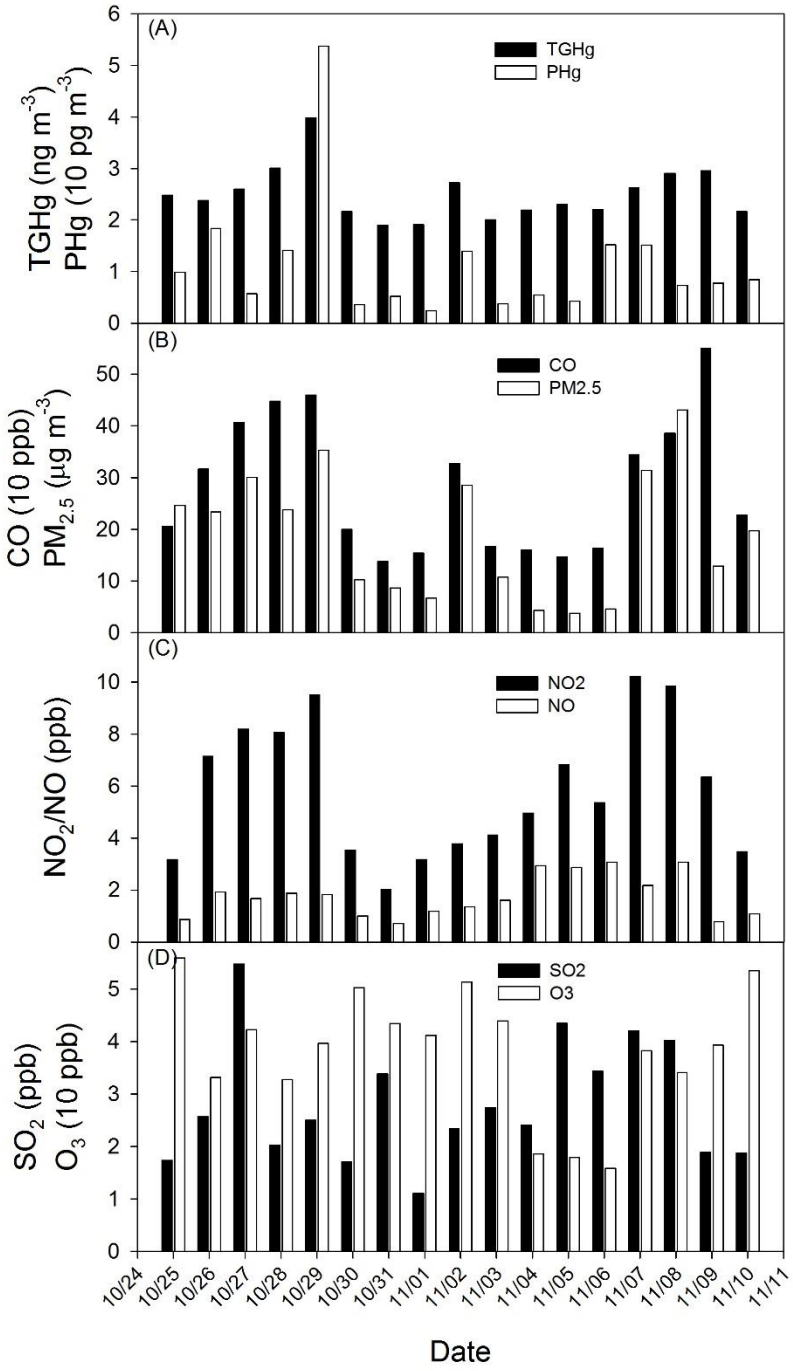
Spatial distribution of total Hg emissions in China in 2010 (Zhang et al., 2015)










(A)
TGHg
PHg
TGHg (ng m-3)
PHg (10 pg m-3)
(B)
CO
PM2.5
CO (10 ppb)
PM2.5 (μg m-3)
(C)
NO2
NO
NO2/NO (ppb)
(D)
SO2
O3
SO2 (ppb)
O3 (10 ppb)
10/24
10/25
10/26
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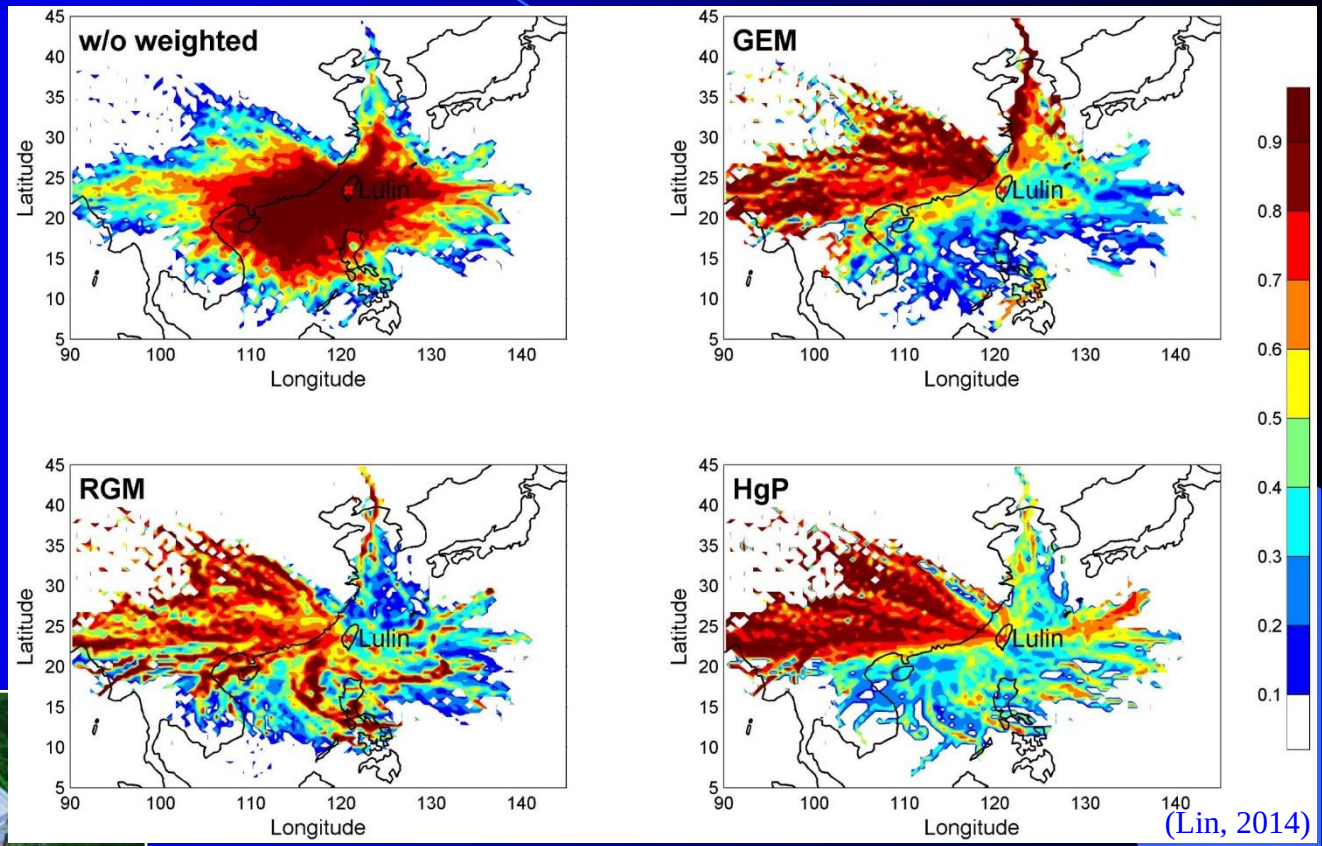
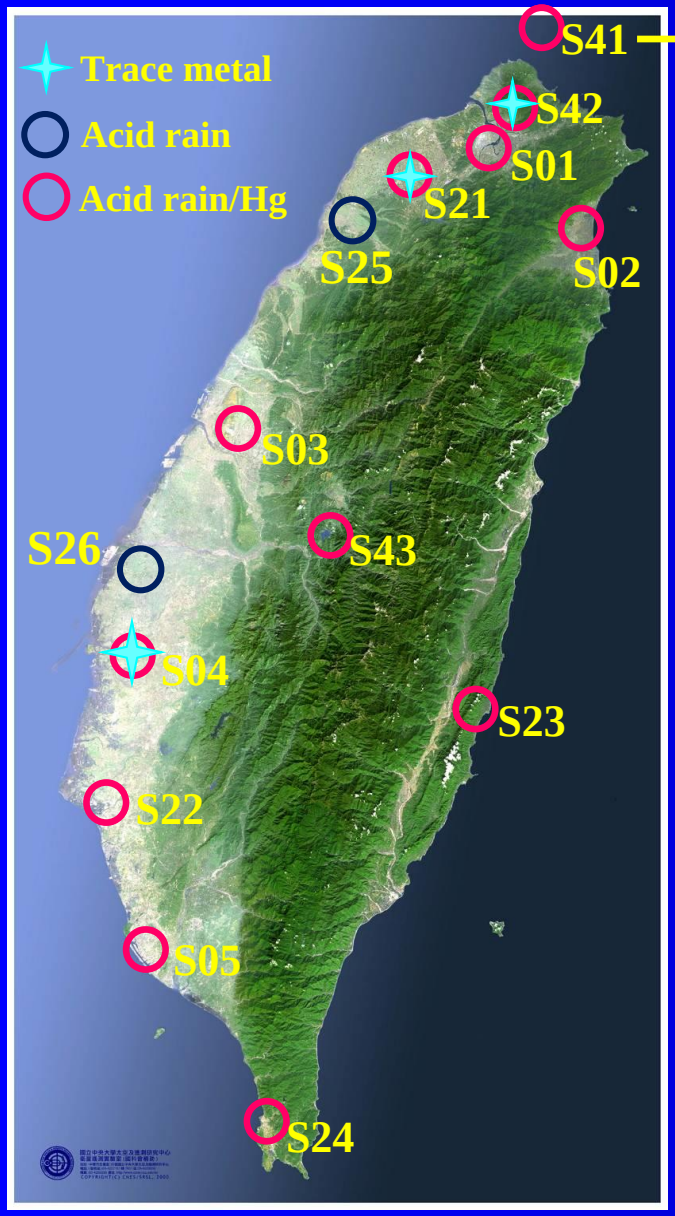
Source-Receptor Relationship (LABS): Concentration-Weighted Trajectory



(Lin, 2014)

Wet Deposition Monitoring Network of Hg and Acid Rain



- 14 sites for acid rain (2003)
- 12 sites for Hg (2008)
- 3 sites for trace metals (2008)

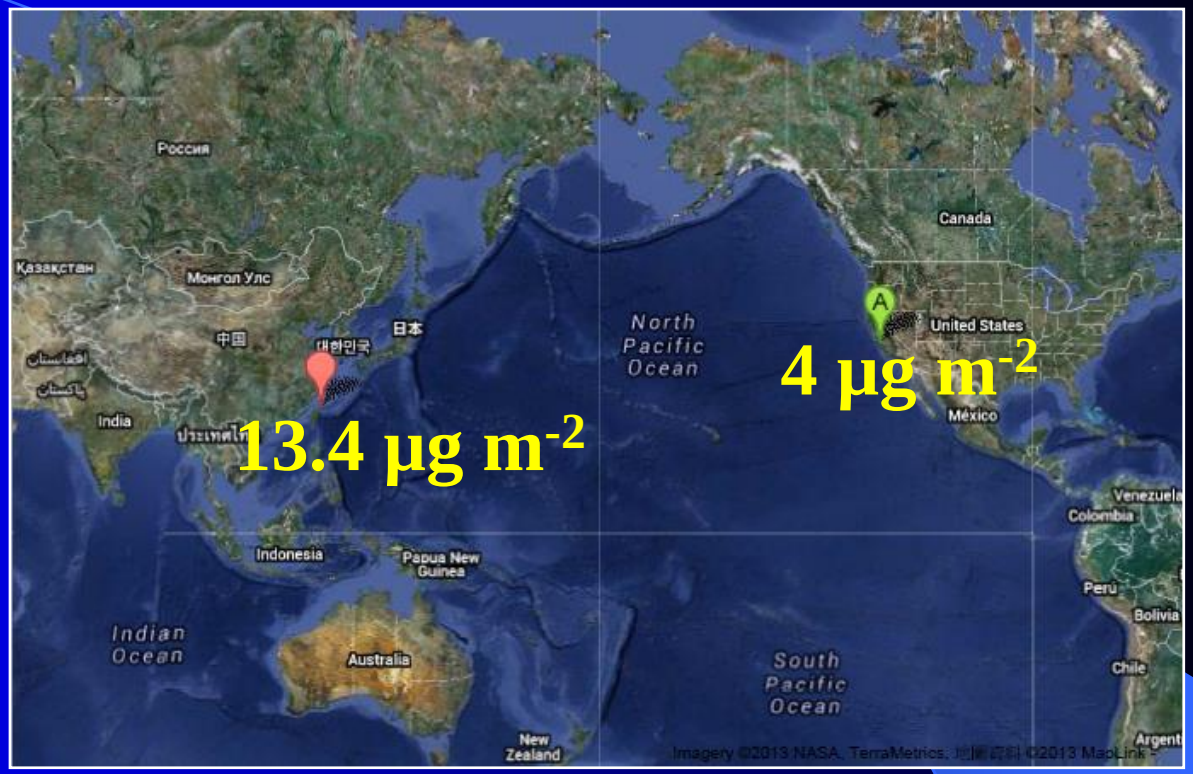
Site No.	Site Name	Charateristics	Altitude (m a.s.l.)
S01	Taipei	Urban	28
S02	Yilan	Urban	10
S03	Taichung	Urban	214
S04	Chiayi	Urban/Agriculture	27
S05	Kaohsiung	Urban/Coastal	17
S21	Jhongli	Suburb/Industrial	131
S22	Tainan	Suburb	17
S23	Chenggong	Suburb/Coastal	34
S24	Hengchun	Suburb/Coastal	22
S41	Pengjiayu	Remote/Island	102
S42	Anbu	Rural/Mountain	826
S43	Sun Moon Lake	Rural/Mountain	1018

Comparison with Literature Values

Location	Site characteristic	Rainfall (mm)	VWM conc. (ng L^{-1})	Wet deposition Flux (μg m^{-2} yr^{-1})	Reference
12 sites in Taiwan	Various	1022-5206	5.6-21.7	11.0-63.4	This study
Equatorial Pacific Ocean	Open ocean	---	2.9	---	Mason et al., 1992
North Pacific Ocean	Open ocean	---	14.3	---	Laurier et al., 2003
Bermuda	Island	---	4.7	---	Gichuki and Mason, 2014
Long Marine Lab, CA, USA	Coastal (Pacific)	---	6.0	4.0	Steding and Flegal, 2002
Monterey Bay, CA, USA	Coastal (Pacific)	---	5.8	4.16	Conaway et al., 2010
CBL, MD, USA	Coastal (Atlantic)	710-1170	11.4-15.0	8.2-17.2	Mason et al., 2000
Nam Co, China	High elevation	364.9	4.8	1.75	Huang et al., 2012
Mt. Leigong, China	Mountain	1533	4.0	6.1	Fu et al., 2010
Chuncheon, Korea	Rural	1061.9	8.8	9.4	Ahn et al., 2011
Pensacola, FL, USA	Urban/suburb	---	17.3	---	Landing et al., 2010
4 sites in Xiamen, China	Urban/suburb	1001-1271	11.4-14.0	11.4-17.6	Xu et al., 2014
Seoul, Korea	Urban	1235-1645	10.1-16.3	16.8-20.2	Seo et al., 2012
Nanjing, China (9 months)	Urban	1068	52.9	56.5	Zhu et al., 2014
Chongqing, China	Urban	921	30.67	---	Wang et al., 2012
Moffett Field, CA, USA	Urban	---	11.6	4.4	Steding and Flegal, 2002
110 sites in USA (MDN/NADP)	Various	---	2.2-39.6	1.9-21.5	NADP 2013 Annual Summary
10 sites in Japan	Various	882-2317	---	5.8-17.7	Sakata and Marumoto, 2005
2 sites in South Africa	Various	---	10.6-15.8	---	Gichuki and Mason, 2013

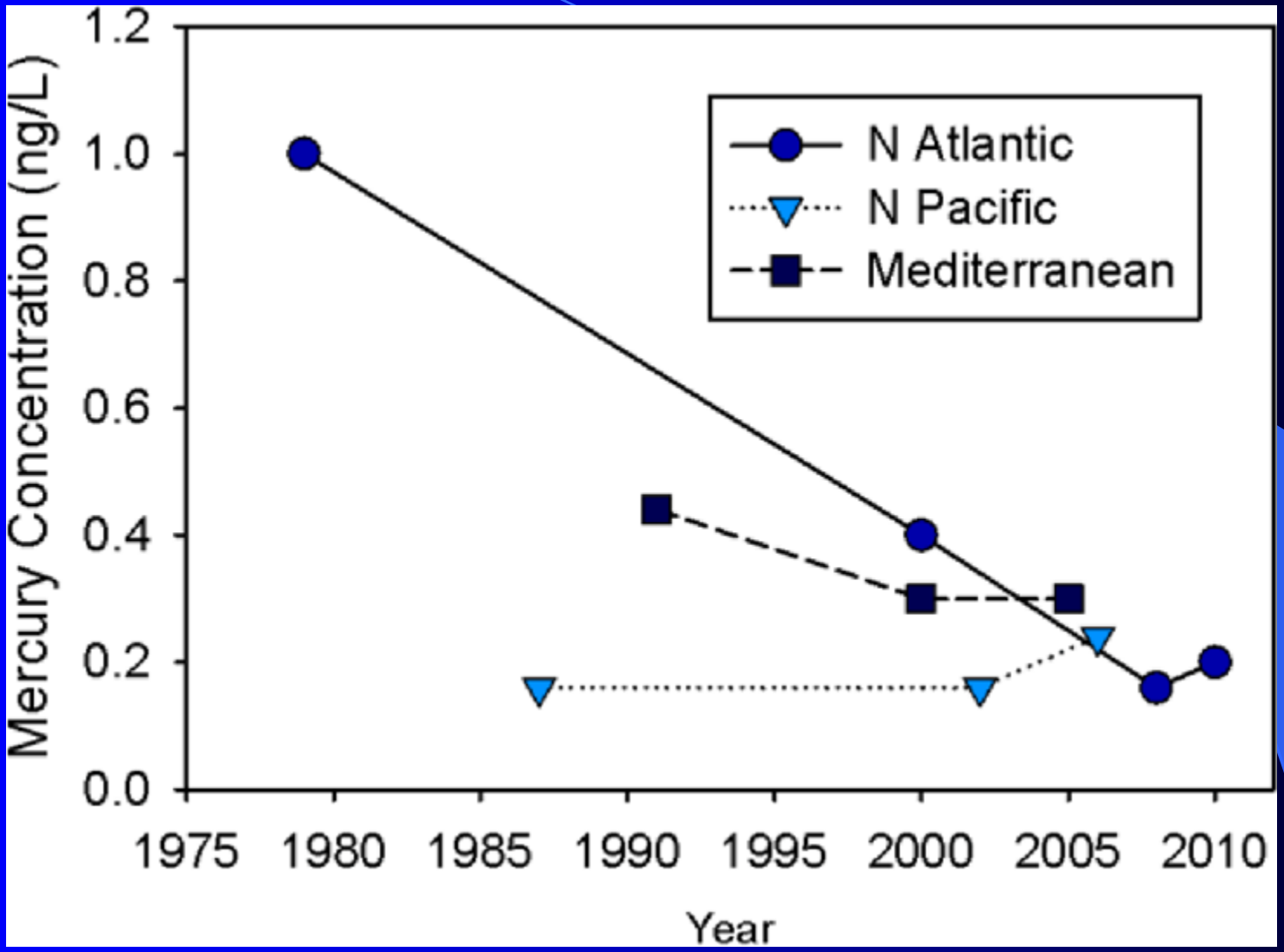
Rainwater Hg concentrations in Taiwan are comparable to other countries. However, wet Hg deposition fluxes are much higher in Taiwan primarily due to higher rainfalls.

Wet Hg Deposition: W. vs. E. Pacific Ocean



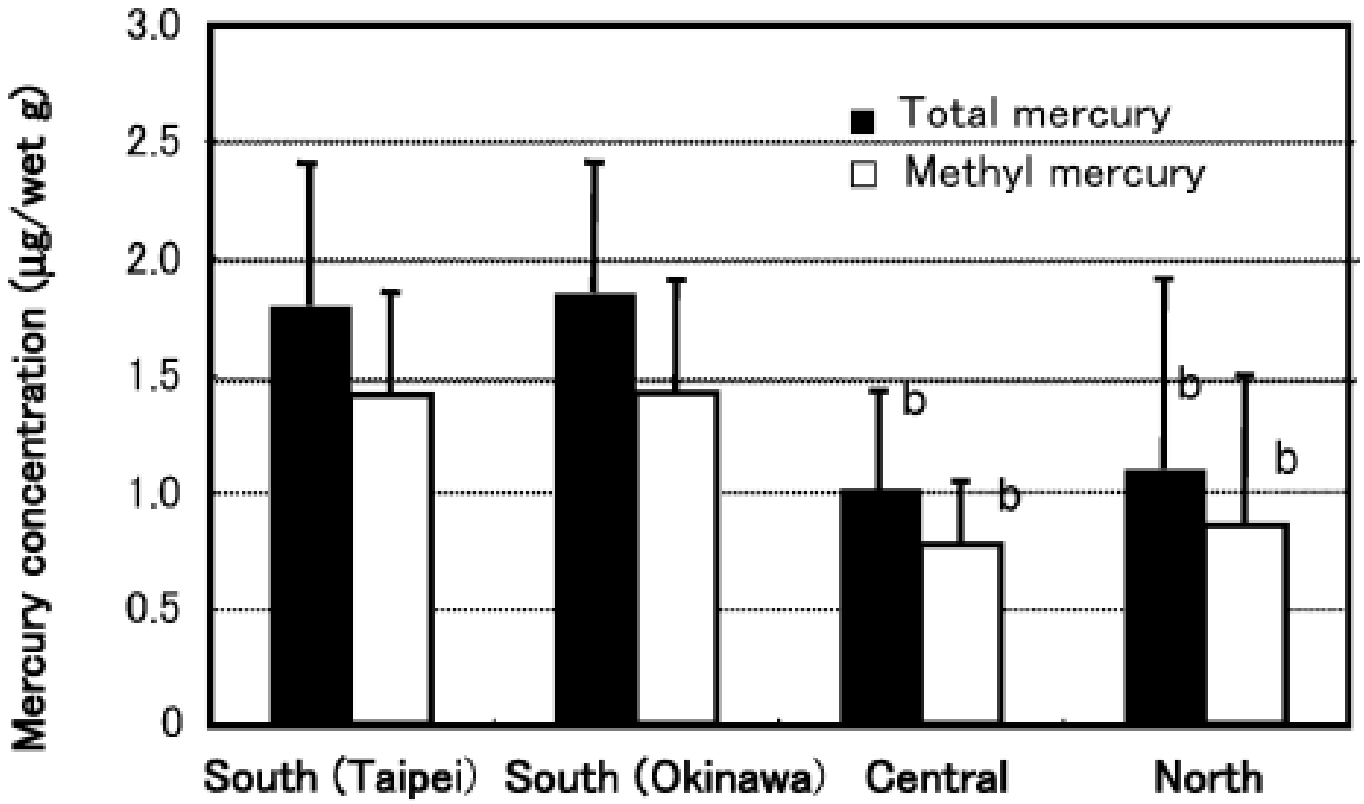
- The annual wet depositional flux was 13.4 µg m^{-2}, about 3.4 times the fluxes measured at sites on the Pacific coast of the USA.
- This supports the hypothesis that Hg deposition is higher in the western than in the eastern Pacific.

Trend in SW Hg Conc. in Surface Oceans



(Driscoll et al., 2013)

Levels of Hg in Pacific Tuna



Environ. Sci. Technol. **2010**, *44*, 5971–5978

Warmer Oceans Could Raise Fish Hg Levels

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Warmer oceans could raise mercury levels in fish

3 October 2013

Dartmouth and other researchers studied killifish under varying temperatures in the lab and in salt marsh pools in Maine. Credit: NOAA

More information:
www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0058401

Provided by Dartmouth College

Rising ocean surface temperatures caused by climate change could make fish accumulate more mercury, increasing the health risk to people who eat seafood, Dartmouth researchers and their colleagues report in a study in the journal *PLOS ONE*.

Until now, little has been known about how global warming may affect mercury bioaccumulation in marine life, and no previous study has demonstrated the effects using fish in both laboratory and field experiments. Mercury released into the air through industrial pollution can accumulate in streams and oceans and is turned into methylmercury in the water.

The researchers studied killifish under varying temperatures in the lab and in salt marsh pools in Maine. Fish in the marshes ate insects, worms and other natural food sources, while the lab fish were fed mercury-enriched food. Results showed the fish in warmer waters ate more but grew less and had higher methylmercury levels in their tissues, suggesting increases in their metabolic rate caused the increased uptake of the toxic metal.

Rising Hg Levels in the Pacific Tuna

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Mercury levels in Hawaiian bigeye, yellowfin tuna rising

7 March 2017, by Jim Erickson

Bigeye tuna. Credit: Allen Shimada, NOAA NMFS OST

Mercury concentrations in Hawaiian-caught bigeye and yellowfin tuna are steadily rising and mirror increases in North Pacific waters that have been linked to atmospheric mercury emissions from Asia.

Researchers compiled and re-analyzed data from previously published reports on yellowfin and bigeye tuna caught near Hawaii over the past four decades, then used a mathematical model to look for trends.

They found that mercury concentrations in yellowfin tuna increased about 5.5 percent per year between 1998 and 2008. Levels in bigeye tuna increased about 3.9 percent per year from 2002 to 2008. Mercury concentrations tended to be greater in bigeye tuna than in yellowfin tuna.

The work was reported in a study scheduled for online publication March 6 in the journal *Environmental Toxicology and Chemistry*. The first author is Paul Drevnick, a former University of Michigan researcher who now works for the Alberta provincial government in Calgary. The other author is Barbara Brooks of the Hawaii Department of Health.

Most of the work was done while Drevnick was at U-M, and the research was funded in part by the university. The new study updates yellowfin findings that Drevnick reported two years ago and expands the effort to include bigeye tuna.

"This paper confirms our previous work showing that mercury concentrations in yellowfin tuna caught near Hawaii are increasing, and it demonstrates that the same phenomenon is happening in bigeye tuna," Drevnick said.

Both yellowfin and bigeye tuna are marketed as ahi and are widely used in raw fish dishes—especially sashimi—or for grilling. In January, the U.S. Food and Drug Administration and the U.S. Environmental Protection Agency added bigeye tuna to its list of fish to be avoided by pregnant women, women who might become pregnant, breastfeeding women and young children due to mercury concerns.

Mercury is a toxic trace metal that can accumulate to high concentrations in fish, posing a health risk to people who eat large, predatory marine fish such as swordfish and tuna. In the open ocean, the principal source of mercury is atmospheric deposition from human activities, especially emissions from coal-fired power plants and artisanal gold mines.

In North Atlantic waters, mercury concentrations peaked in the 1980s and '90s and are now declining in response to environmental regulations in North America and Europe.

But in the North Pacific, mercury concentrations in waters shallower than 1,000 meters increased about 3 percent per year between 1995 and 2006 and are expected to double by 2050 if current mercury deposition rates are maintained, according to Drevnick.

"The temporal trend in mercury concentrations in

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Mercury levels in Hawaiian yellowfin tuna increasing

2 February 2015

Mercury concentrations in Hawaiian yellowfin tuna are increasing at a rate of 3.8 percent or more per year, according to a new University of Michigan-led study that suggests rising atmospheric levels of the toxin are to blame.

Mercury is a potent toxin that can accumulate to high concentrations in fish, posing a health risk to people who eat large, predatory marine fish such as swordfish and tuna. In the open ocean, the principal source of mercury is atmospheric deposition from human activities, especially emissions from coal-fired power plants and artisanal gold mining.

For decades, scientists have expected to see mercury levels in open-ocean fish increase in response to rising atmospheric concentrations, but evidence for that hypothesis has been hard to find. In fact, some studies have suggested that there has been no change in mercury concentration in ocean fish.

By compiling and re-analyzing three previously published reports on yellowfin tuna caught near Hawaii, U-M's Paul Drevnick and two colleagues found that the concentration of mercury in that species increased at least 3.8 percent per year from 1998 to 2008.

A paper about the study is scheduled for online publication in the journal *Environmental Toxicology and Chemistry* on Feb. 2. The other authors are Carl Lamborg of the Woods Hole Oceanographic Institution, now at the University of California at Santa Cruz, and Martin Horgan.

"The take-home message is that mercury in tuna appears to be increasing in lockstep with data and model predictions for mercury concentrations in water in the North Pacific," said Drevnick, an assistant research scientist at the U-M School of Natural Resources and Environment and at the U-M Biological Station. "This study confirms that mercury levels in open ocean fish are responsive to mercury emissions."

Drevnick and his colleagues reanalyzed data from three studies that sampled the same yellowfin tuna population near Hawaii in 1971, 1998 and 2008. In each of the three studies, muscle tissues were tested for total mercury, nearly all of which was the toxic organic form, methylmercury.

In their re-analysis, Drevnick and his colleagues included yellowfins between 48 and 167 pounds and used a computer model that controls for the effect of fish body size. Data from 229 fish were analyzed: 111 from 1971, 104 from 1998 and 14 from 2008.

The researchers found that mercury concentrations in the yellowfins did not change between the 1971 and 1998 datasets. However, concentrations were higher in 2008 than in either 1971 or 1998. Between 1998 and 2008, the mercury concentration in yellowfins increased at a rate greater than or equal to 3.8 percent a year, according to the new study.

"Mercury levels are increasing globally in ocean water, and our study is the first to show a consequent increase in mercury in an open-water fish," Drevick said. "More stringent policies are needed to reduce releases of mercury into the atmosphere. If current deposition rates are maintained, North Pacific waters will double in mercury by 2050."

Yellowfin tuna, often marketed as ahi, is widely used in raw fish dishes—especially sashimi—or for grilling. The Natural Resources Defense Council's guide to mercury in sushi lists yellowfin tuna as a "high mercury" species.

More information: Drevnick, P. E., Lamborg, C. H. and Horgan, M. J. (2015), Increase in mercury in Pacific yellowfin tuna. *Environmental Toxicology*

Decreasing Hg Levels in the Atlantic Tuna

medical xpress

Mercury levels dropping in north Atlantic tuna

23 November 2016

(HealthDay)—Mercury levels in one tuna species have decreased along with industrial emissions of the dangerous chemical element, a new study finds.

The results suggest that reductions in mercury emissions could quickly result in lower mercury levels in some species of ocean fish, according to researcher Nicholas Fisher and colleagues. Fisher is a professor at the School of Marine and Atmospheric Sciences at Stony Brook University in Stony Brook, N.Y.

Mercury, a neurotoxin, can harm the nervous system of humans. It accumulates in tuna and other types of fish, which has led to warnings against eating too much tuna, the researchers said in background notes.

Although increased coal burning in Asia has raised mercury emissions globally, levels have fallen in North America 2.8 percent a year between 1990 and 2007, the researchers said.

Over a similar period, mercury in north Atlantic waters dropped 4.3 percent annually. And mercury in the air above the North Atlantic Ocean declined 20 percent from 2001 to 2009, the researchers said.

To assess the effects of those declines, the research team analyzed mercury levels in tissue samples from nearly 1,300 Atlantic bluefin tuna caught between 2004 and 2012.

During that time, mercury levels in the fish fell an average of 19 percent, the researchers said in a news release from the American Chemical Society.

Although encouraging, the study results don't actually prove a direct cause-and-effect relationship between changes in regional mercury emissions and lower levels of the toxin in fish.

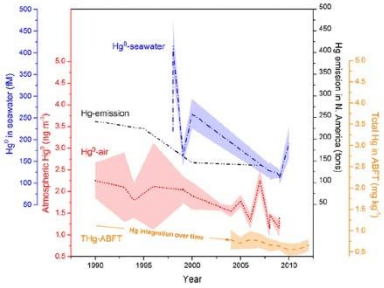
The findings were published recently in the journal *Environmental Science & Technology*.

More information: The U.S. Environmental Protection Agency has more on mercury.

PHYS.ORG

Mirroring a drop in emissions, mercury in tuna also declines

10 November 2016



Credit: American Chemical Society

For years, public health experts have warned against eating certain kinds of fish, including tuna, that tend to accumulate mercury. Still, tuna consumption provides more mercury to U.S. consumers than any other source. But recently, as industry cuts down on its mercury emissions, research has found mercury concentrations in some fish are dropping. The latest study, published in *Environmental Science & Technology*, reports that this is the case for prized Atlantic bluefin tuna.

Although global mercury emissions continue to rise due largely to increases in coal burning in Asia, emissions in North America between 1990 and 2007 went down 2.8 percent per year, according to published studies in 2010 and 2013. Over a similar period, mercury in north Atlantic waters dropped 4.3 percent annually. And between 2001 and 2009, mercury in the air above the north Atlantic declined by 20 percent, or about 2.5 percent per year.

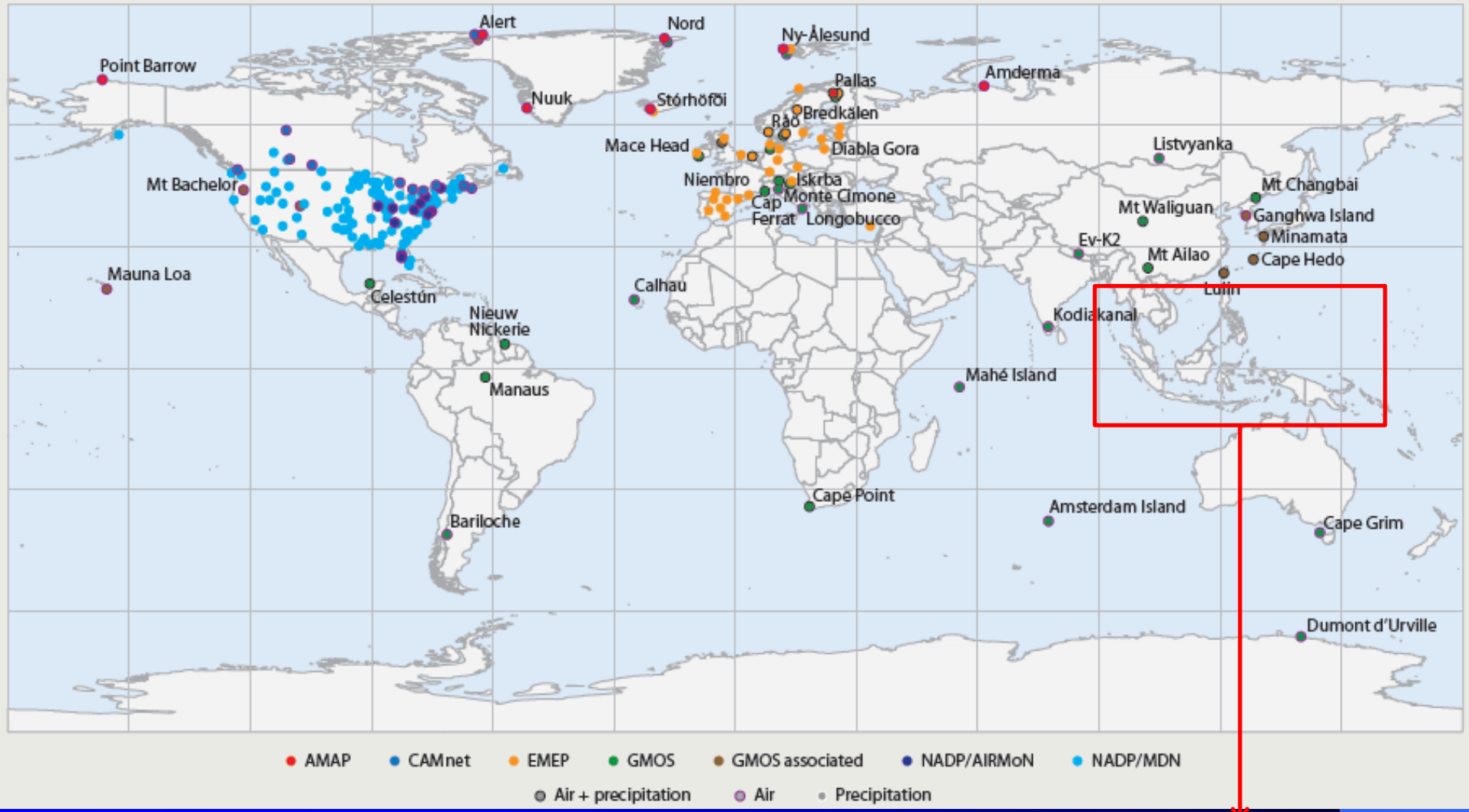
To see whether the regional emissions reductions were having an effect on fish at the top of the ocean food chain, researchers from Stony Brook University, the University of Massachusetts and Harvard University collected and analyzed tissue samples from nearly 1,300 Atlantic bluefin tuna captured between 2004 and 2012. Tests for mercury content showed that over this eight-year period, the concentration in the fish dropped an average of 19 percent. The finding suggests that reductions in mercury emissions could rapidly lead to reduced mercury concentrations in some marine fish, the researchers say.

More information: Cheng-Shiuan Lee et al. Declining Mercury Concentrations in Bluefin Tuna Reflect Reduced Emissions to the North Atlantic Ocean, *Environmental Science & Technology* (2016). DOI: 10.1021/acs.est.6b04328

Abstract

Tunas are apex predators in marine food webs that can accumulate mercury (Hg) to high concentrations and provide more Hg (?40%) to the U.S population than any other source. We measured Hg concentrations in 1292 Atlantic bluefin tuna (ABFT, Thunnus thynnus) captured in the Northwest Atlantic from 2004 to 2012. ABFT Hg concentrations and variability increased nonlinearly with length, weight, and age, ranging from 0.25 to 3.15 mg kg−1, and declined significantly at a rate of 0.018 ± 0.003 mg kg−1 per year or 19% over an 8-year period from the 1990s to the early 2000s. Notably, this decrease parallels comparably reduced anthropogenic Hg emission rates in North America and North Atlantic atmospheric Hg0 concentrations during this period, suggesting that recent efforts to decrease atmospheric Hg loading have rapidly propagated up marine food webs to a commercially important species. This is the first evidence to suggest that emission reduction efforts have resulted in lower Hg concentrations in large, long-lived fish.

Atmospheric Hg Monitoring Worldwide



Currently, long-term or background atmospheric Hg monitoring activities in SE and S Asia are lacking.

- Goal
  - Systematically monitor wet deposition and atmospheric concentrations of mercury in a network of stations throughout the Asia-Pacific region

THANK YOU!

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