

An Overview of Mercury Pollution in China

Xinbin Feng

**State Key Laboratory of Environmental Geochemistry, Institute of
Geochemistry, Chinese Academy of Sciences, Guiyang, China**

**2015 International Workshop on Mercury Pollution Prevention and
Implementation of Minamata Convention, Beijing Dec.8-9, 2015**

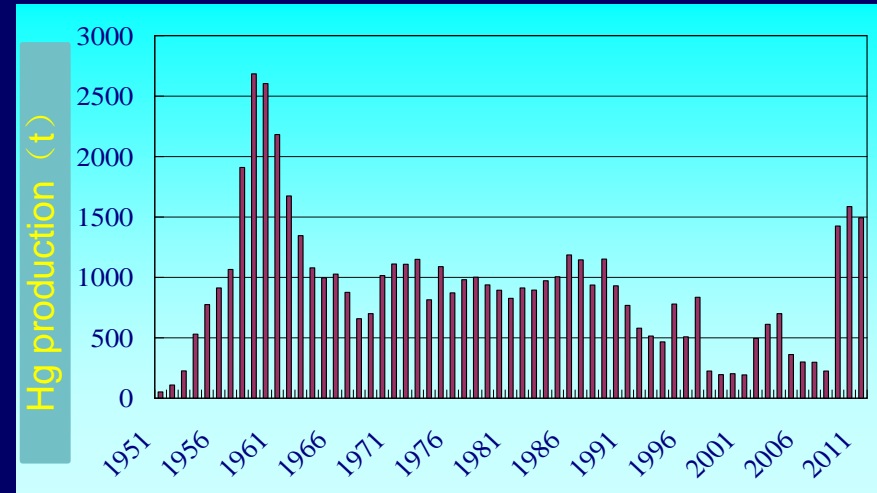
Hg pollution in China is of great global concern

■ China is regarded as the largest global Hg producer, user and emitter

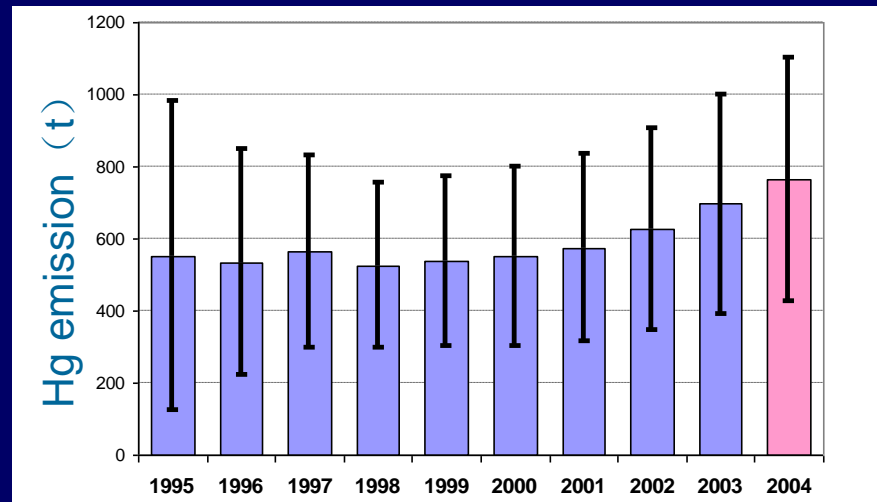
● Hg production reached 1493 Mg in 2011, accounting for 70% of global total

● Annual Hg consumption reached about 1500 Mg, about 50% of global total

● Annual Hg emission to the air reached 500-800 Mg, about 30% of global total



Annual Hg production in China



Annual Hg emission from China

(Wu et al., 2006)

Outline

- ◆ Hg distribution in ambient air in China
- ◆ Mercury contaminated sites
- ◆ Human Hg exposure

Outline

- ◆ Hg distribution in ambient air in China
- ◆ Mercury contaminated sites
- ◆ Human Hg exposure

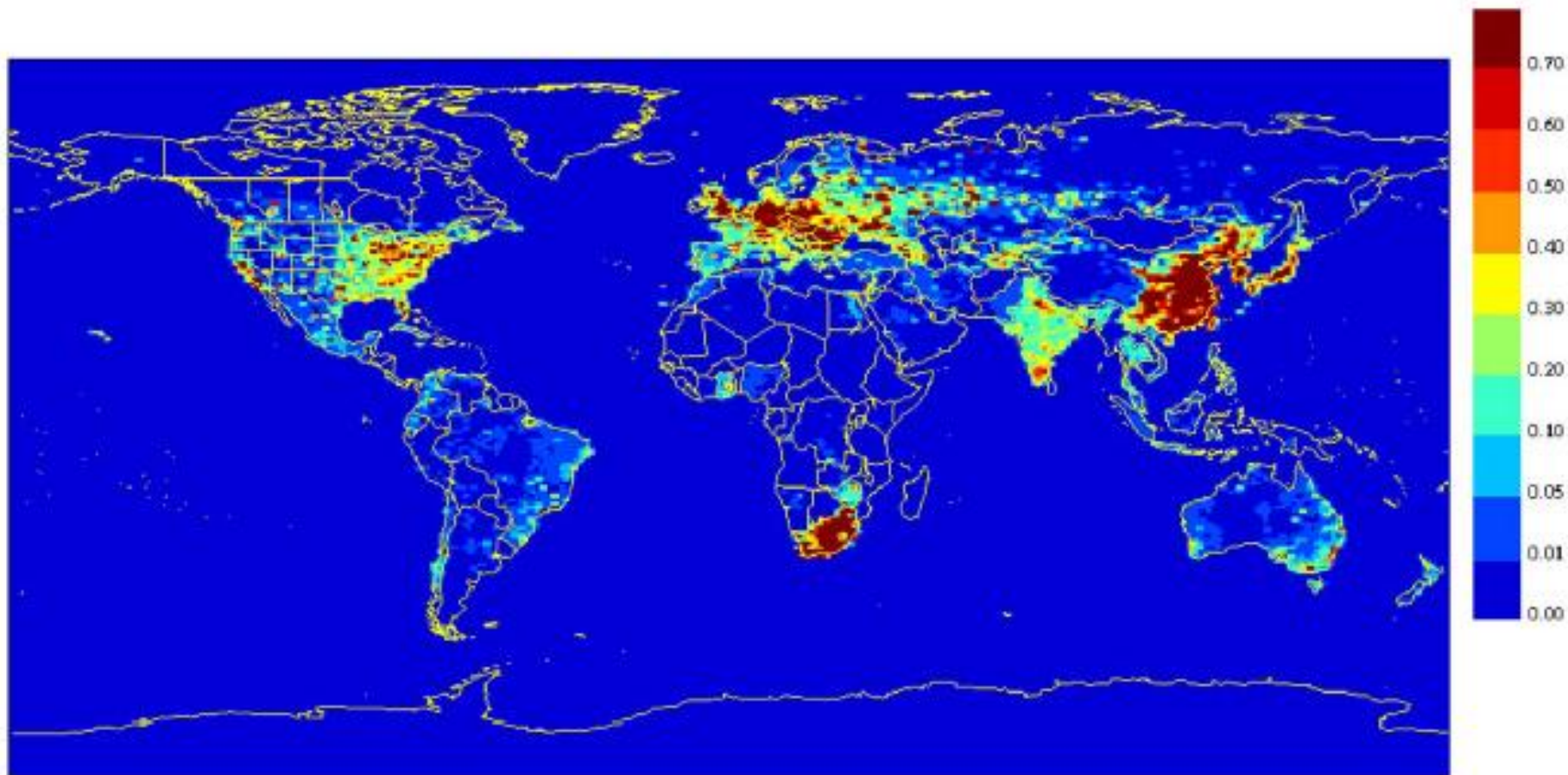
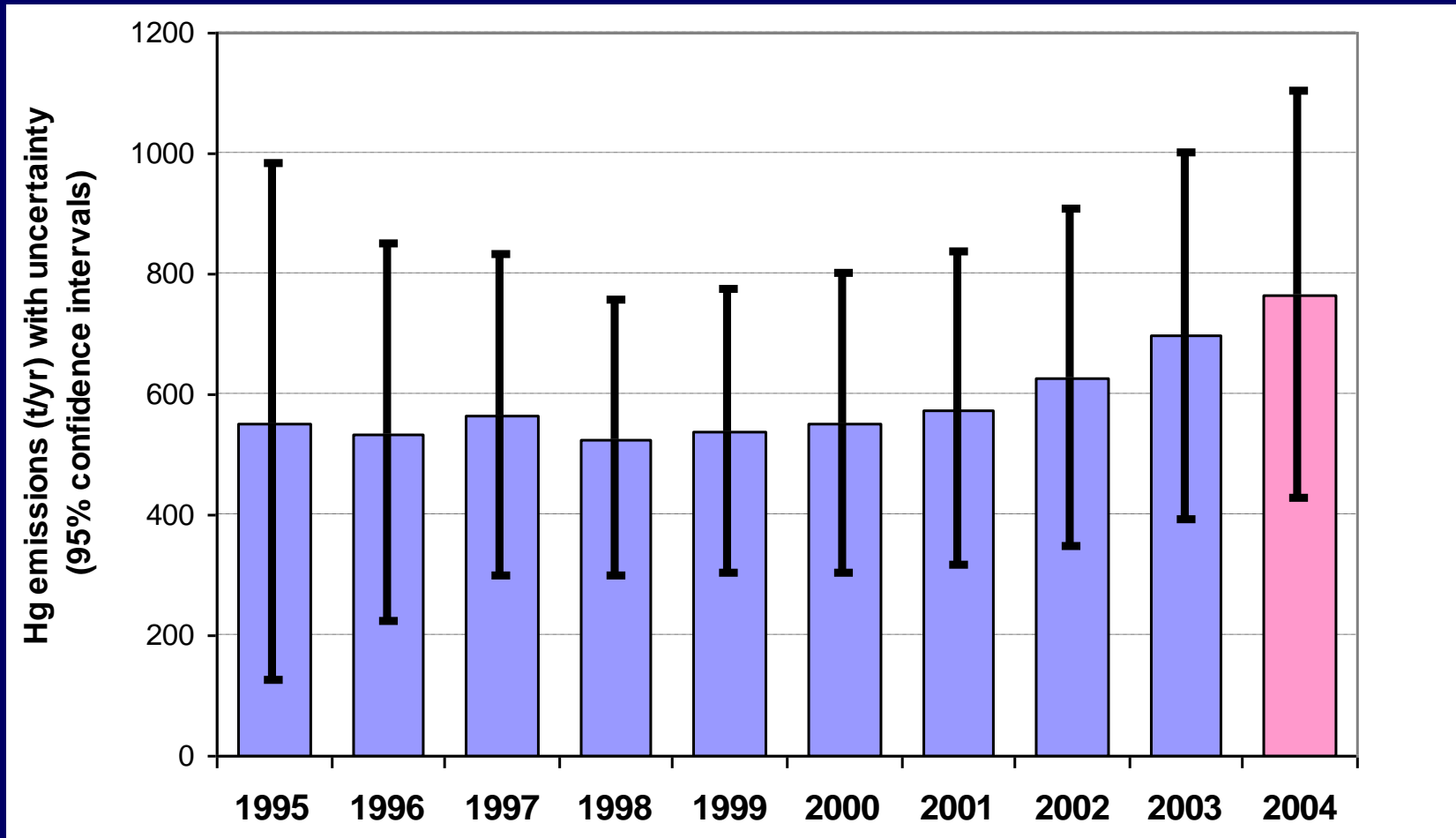


Fig. 1. Global anthropogenic emissions (tons/year).

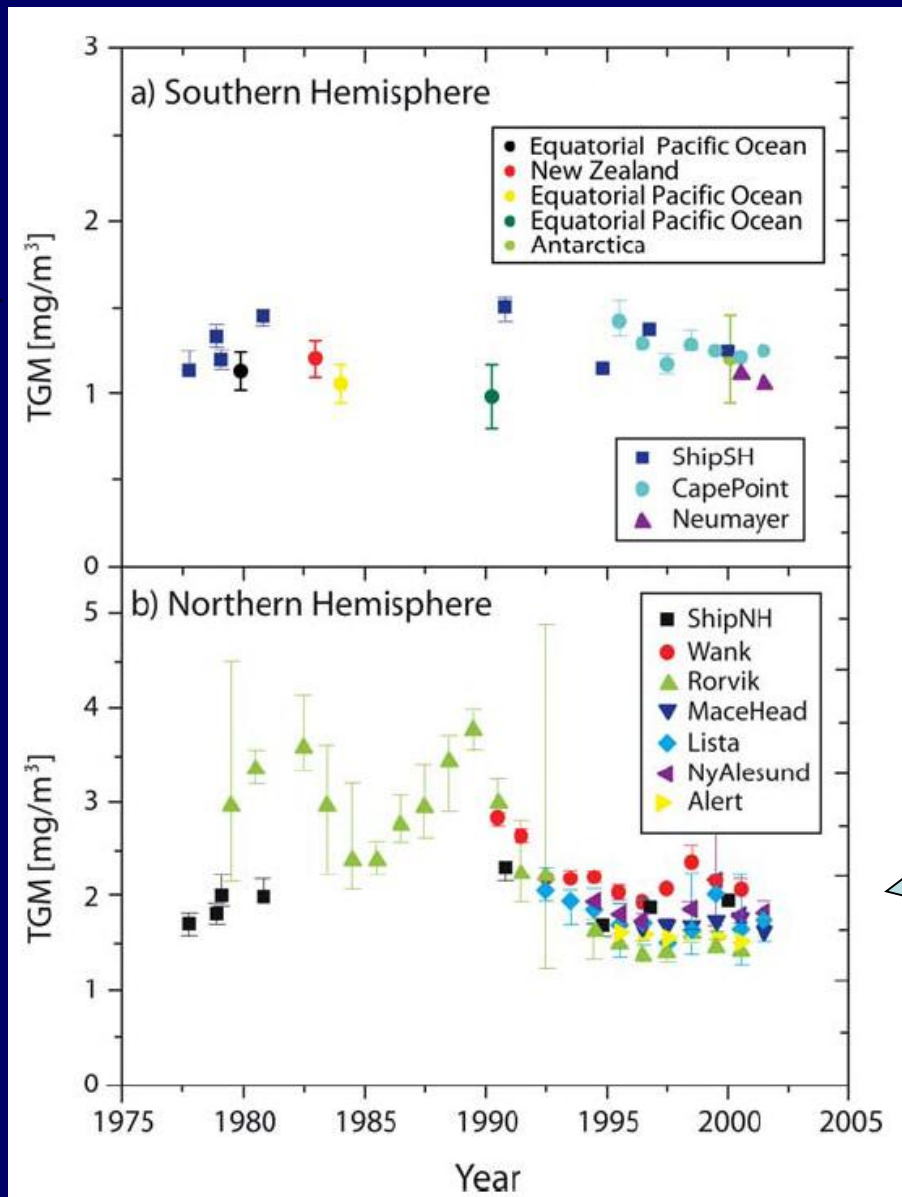
Global anthropogenic mercury emission (Pacyna et al., 2001)

Primary man-made Hg emissions are growing fast in recent years due to rapid economic growth (Wu et al., *Environ. Sci. Technol.*, 2007)



Uncertainty is still quite high, but diminishing over time ($\pm 78\%$ in 1995; $\pm 44\%$ in 2003)

SH



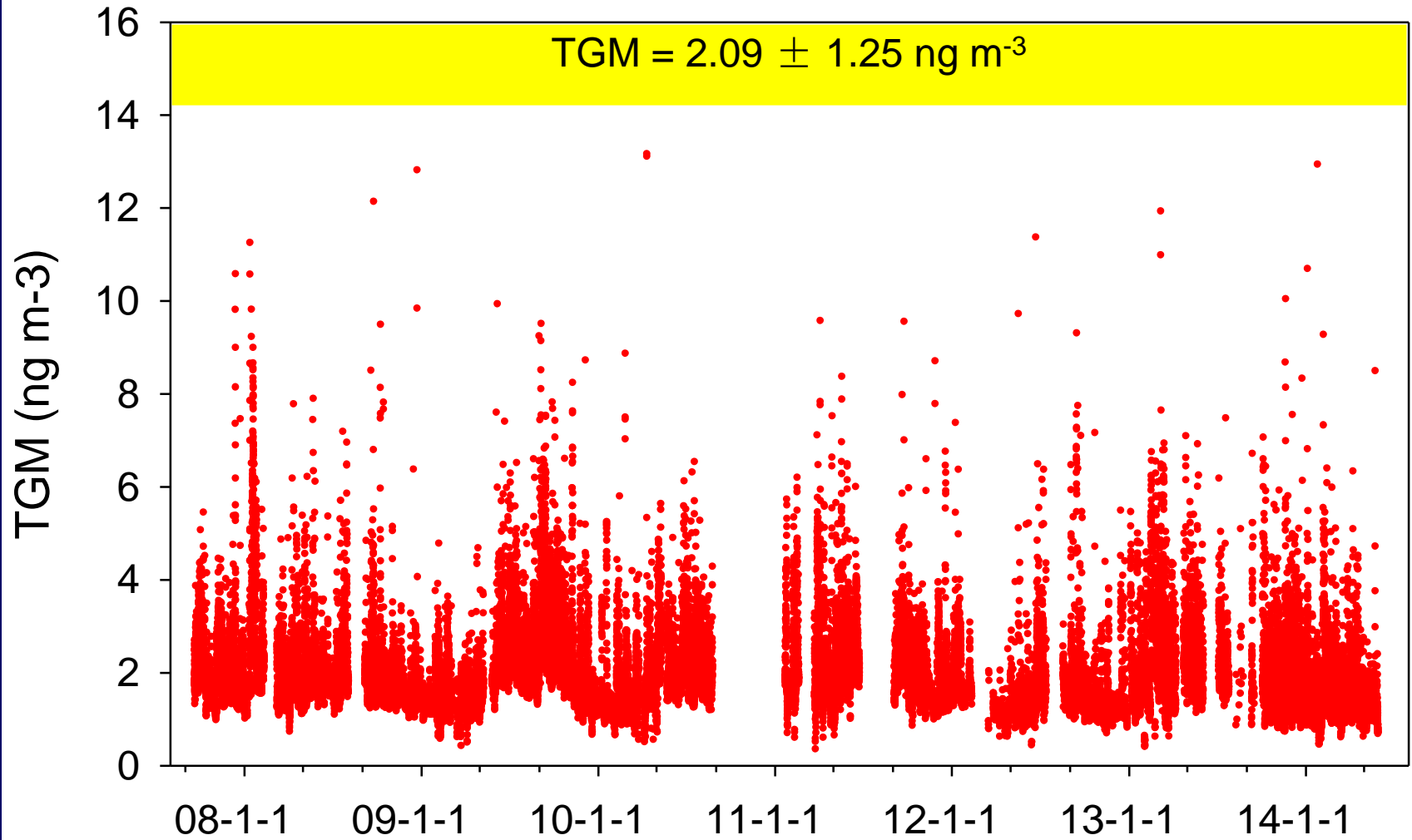
NH

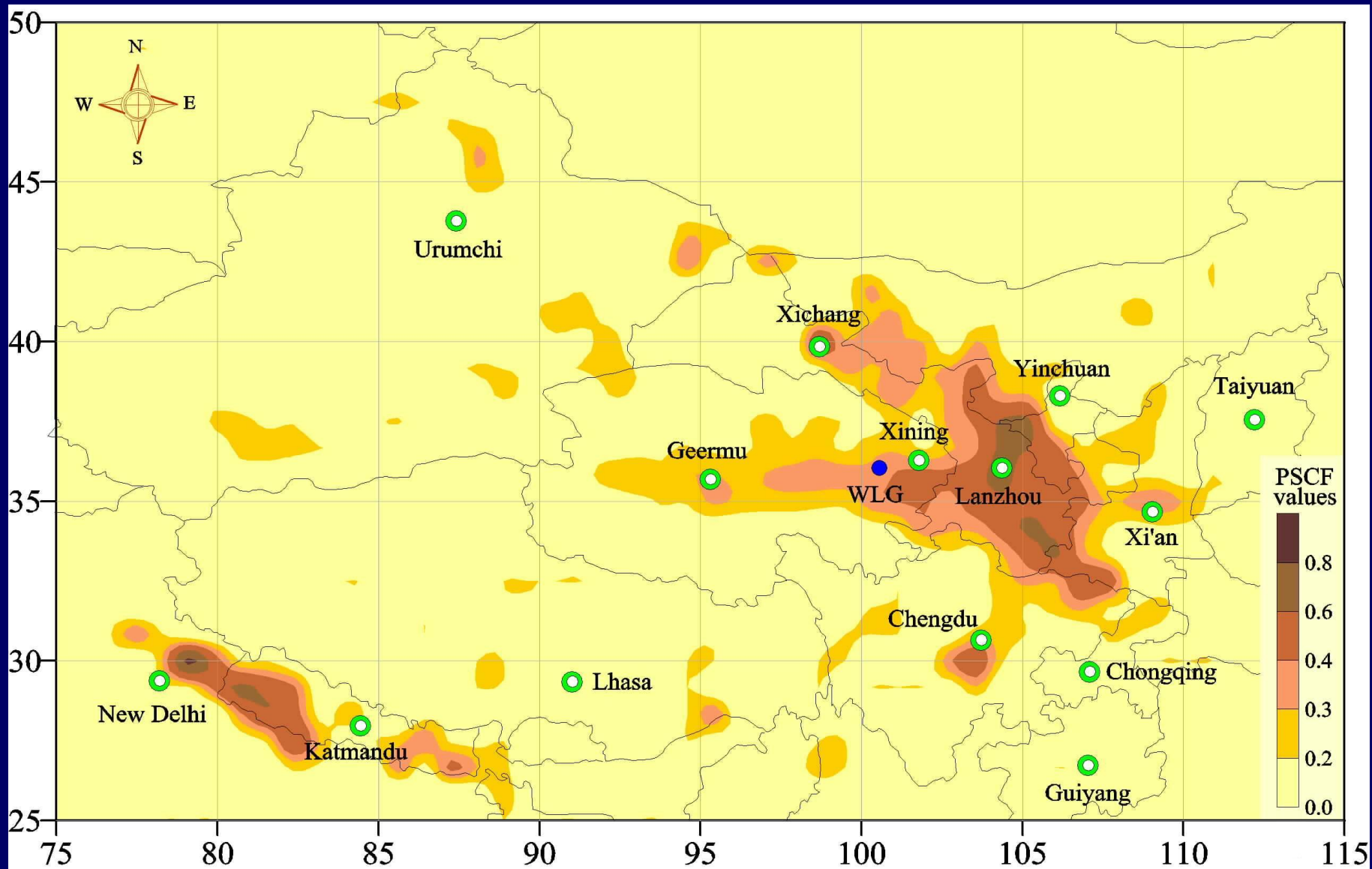
The temporal trend of mercury concentrations in ambient air at global background sites (Lindberg et al., 2007)

Atmospheric Hg observation network in China



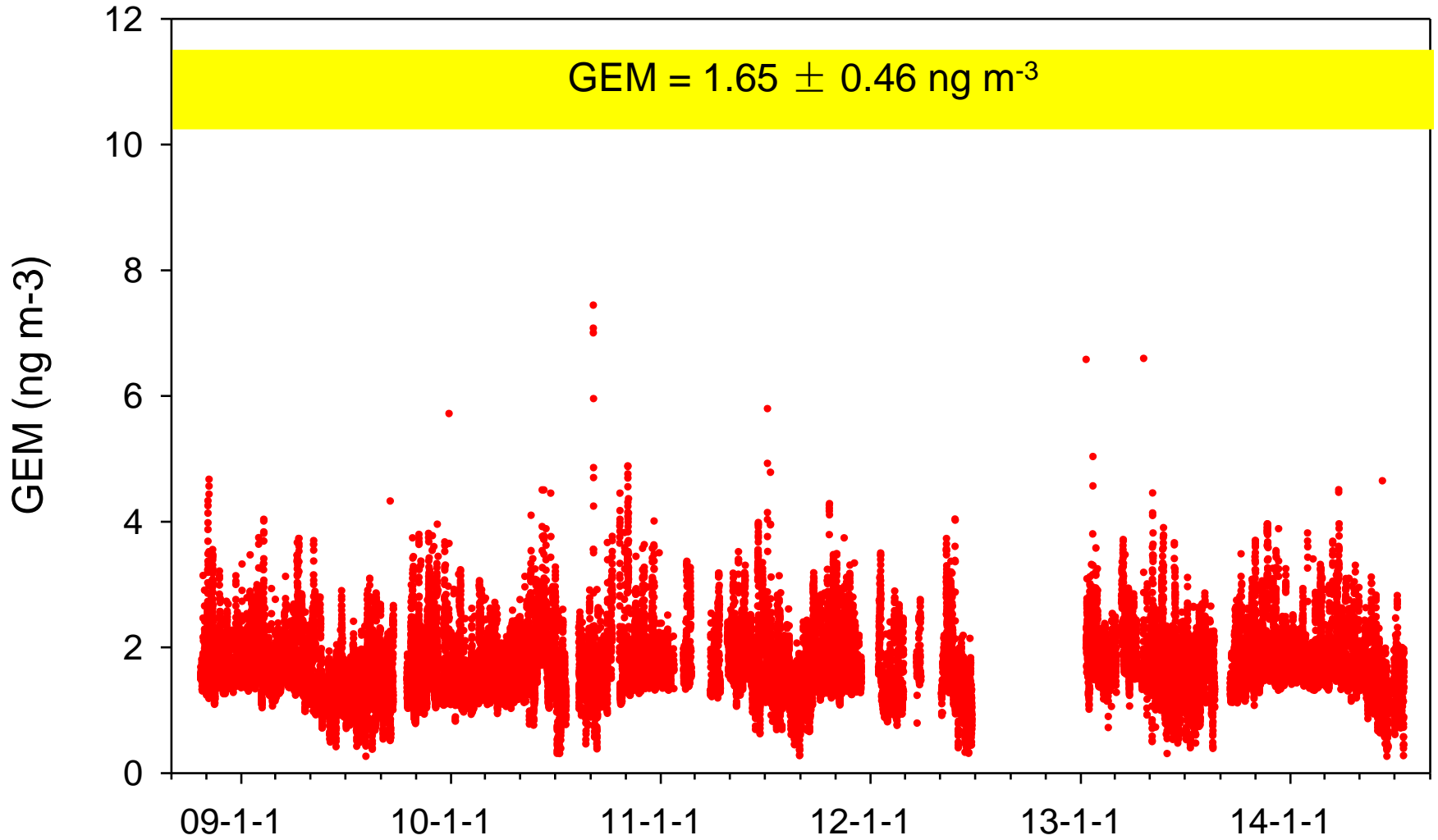
Time series of TGM at WLG during the last 7 years

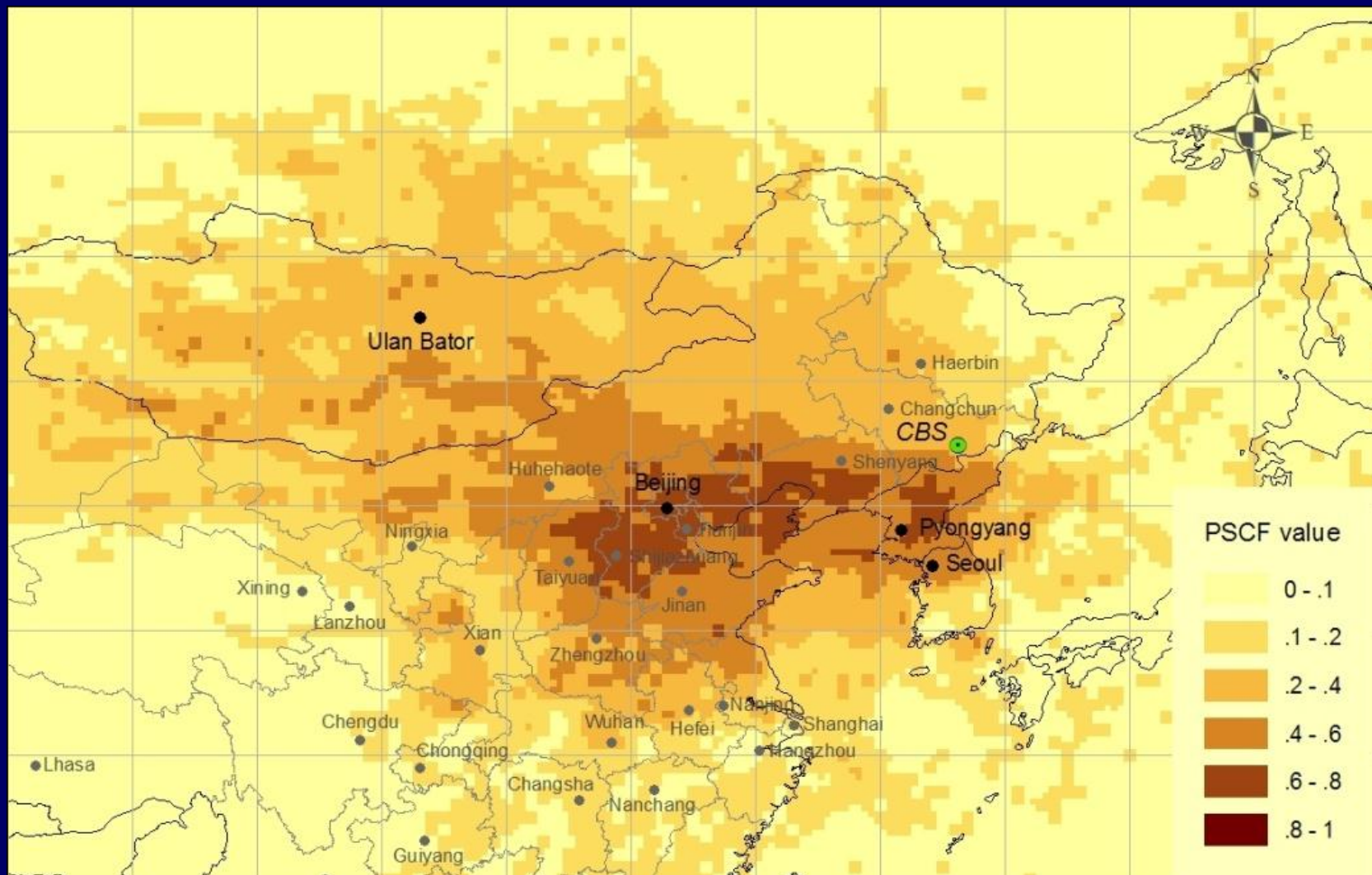




Potential sources of TGM at WLJ (Fu et al., 2012a)

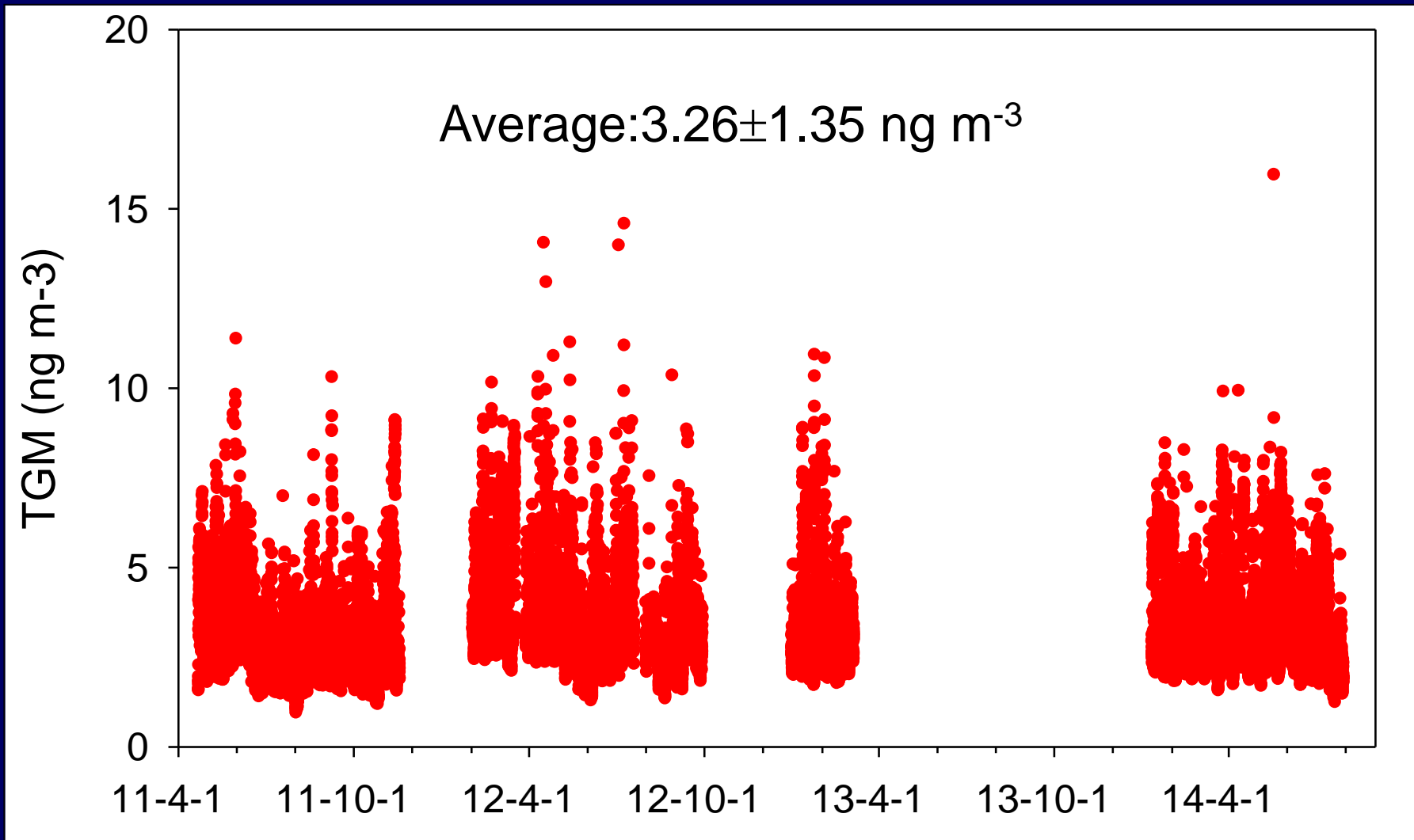
Time series of GEM at Mt. CB during the last 6 years

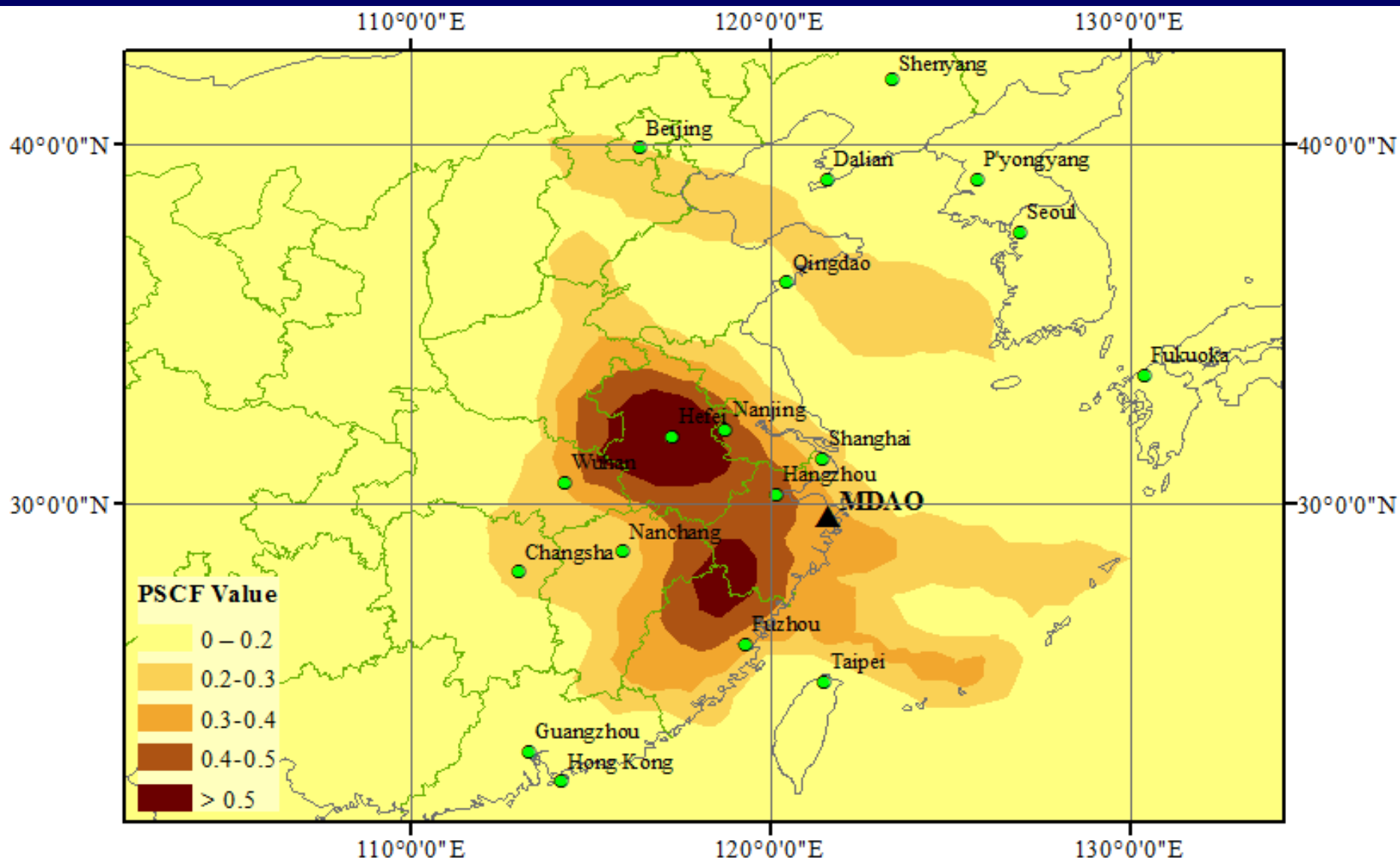




Potential sources of TGM at CBS (Fu et al., 2012b)

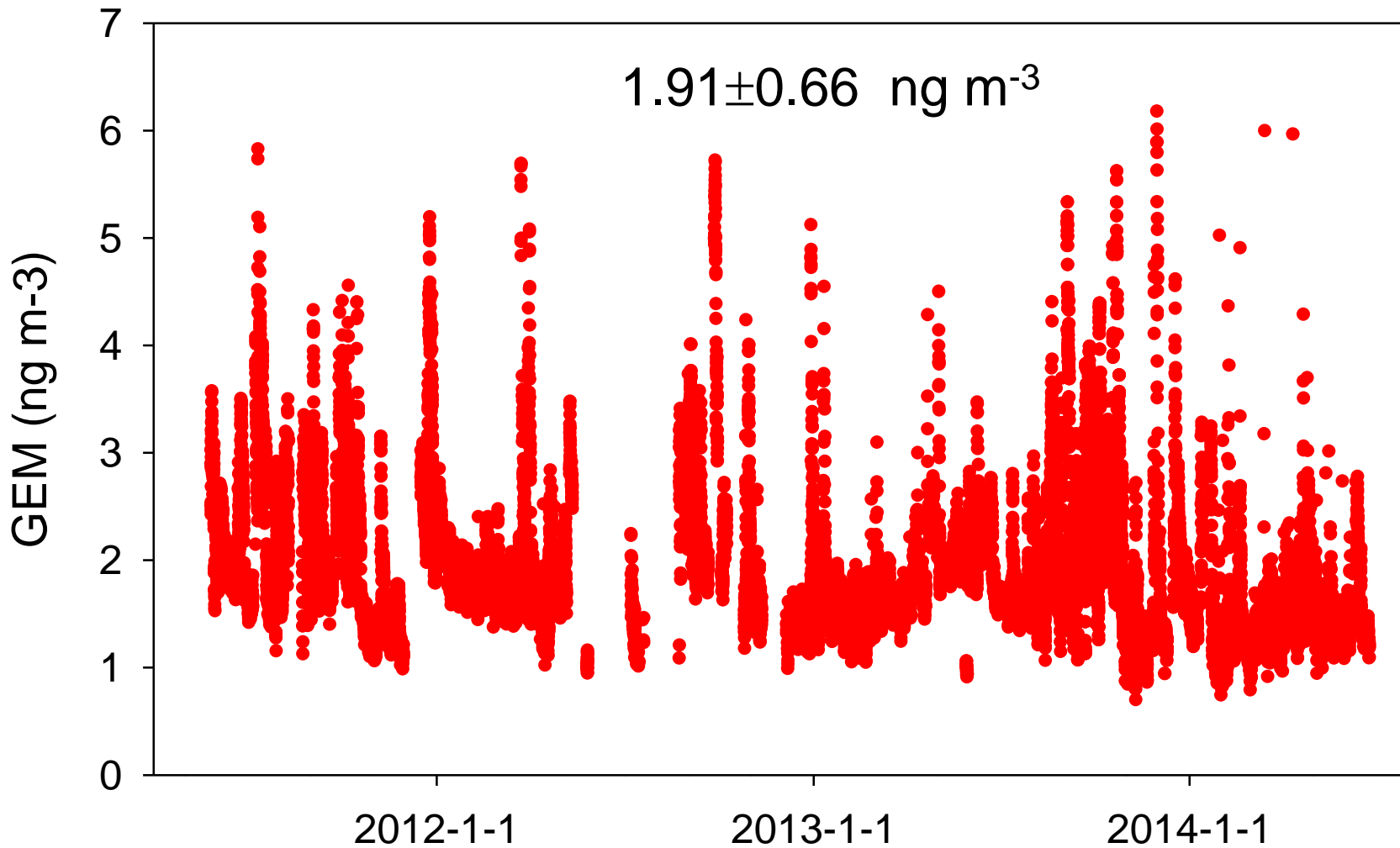
Time series of GEM at Damei site since April 2011



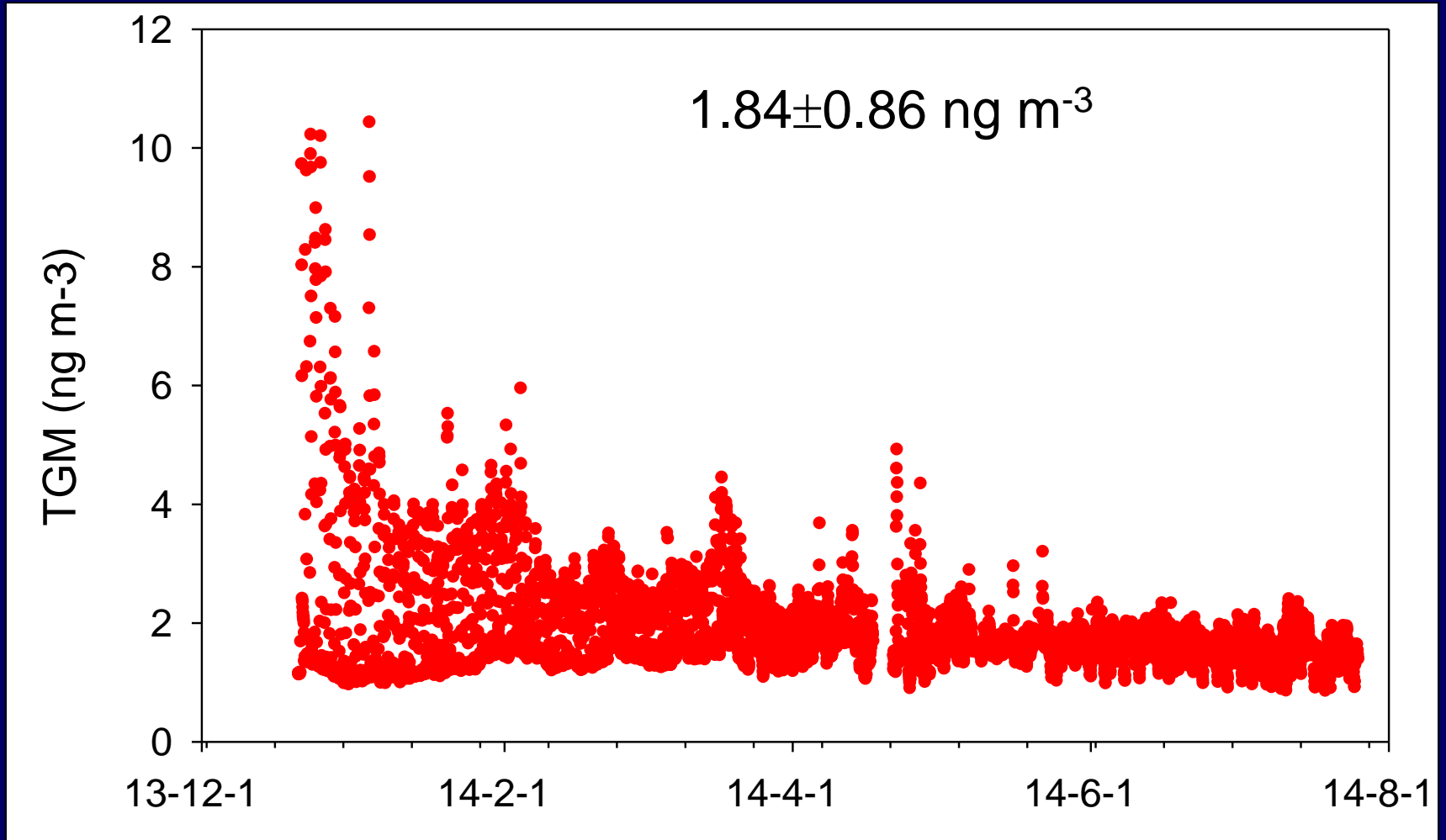


Potential sources of TGM at DMS

Time series of GEM at Ailaoshan site since April 2011



Time series of GEM at Bayinbuluke in Northwest China

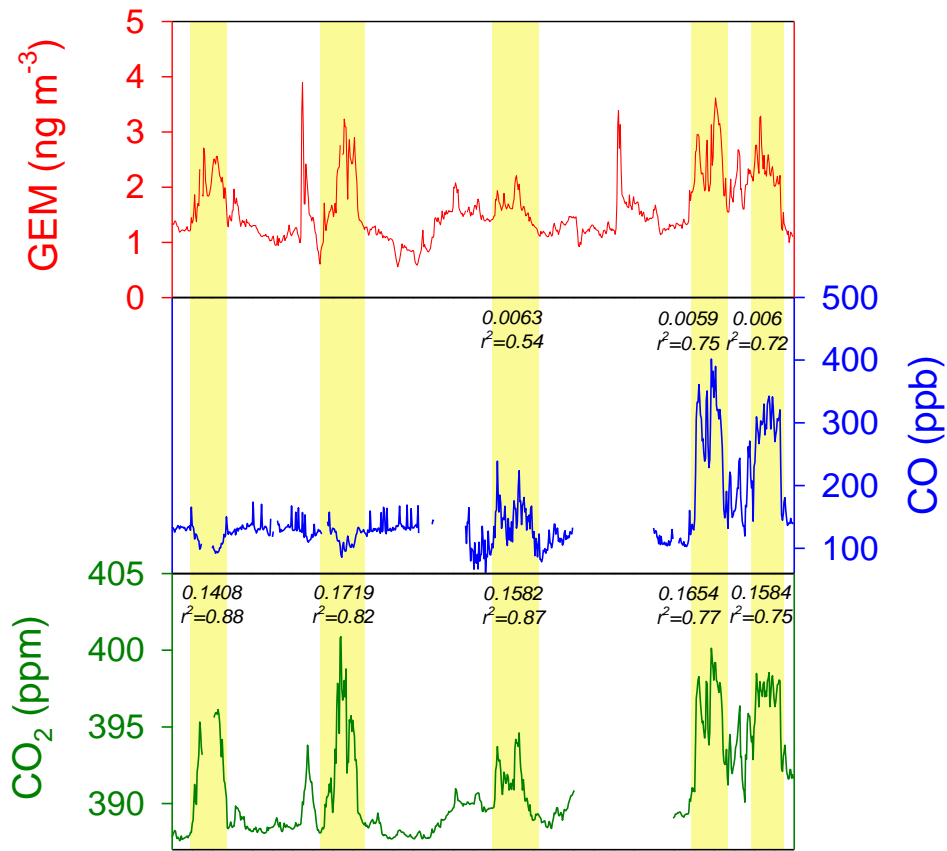


Estimate Hg emission from different regions in Asia



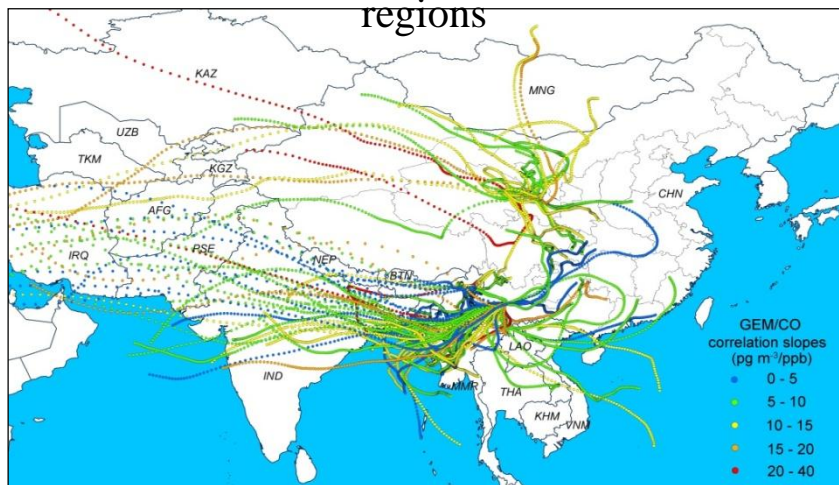
- GEM, CO and CO₂ have long resident times in the air
- GEM/CO and GEM/CO₂ ratios will be kept from the source to the receptor

GEM, CO and CO₂ conc. in air at Waliguan Station



Estimate Hg emission from different regions in Asia

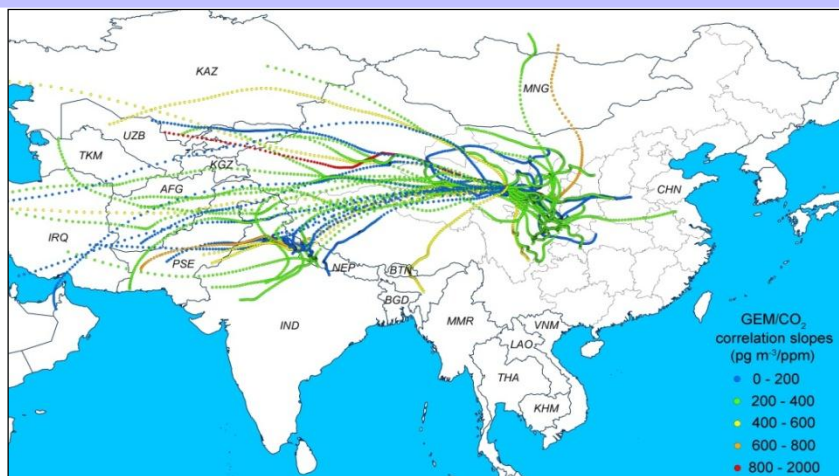
GEM/CO with air mass from different regions



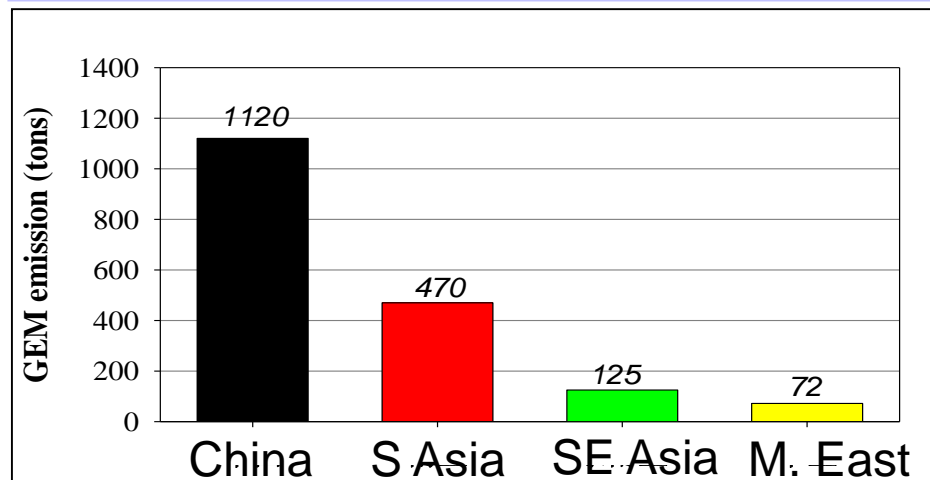
Air mass GEM/CO and GEM/CO₂ ratios

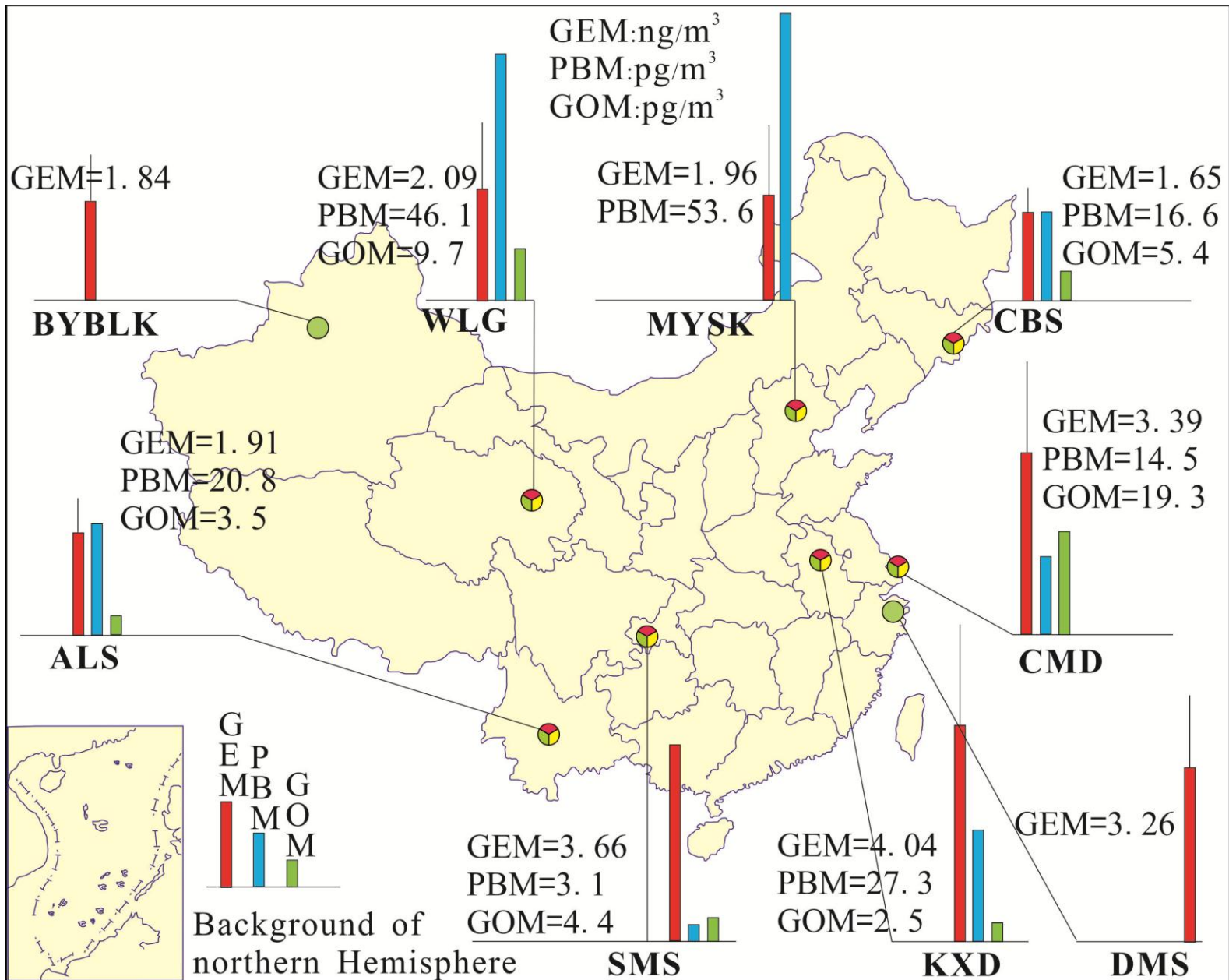
	Source region	Ratio		
		mean	1SD	N
GEM/CO (pg m ⁻³ /ppb)	China	7.3	4.3	37
	South Asia	7.8	6.4	40
	Southeast Asia	7.8	5.0	34
	Middle East	13.4	9.5	6
GEM/CO ₂ (pg m ⁻³ /ppm)	China	248	119	25
	South Asia	270	164	21
	Middle East	315	289	13

GEM/CO₂ with air mass from different regions



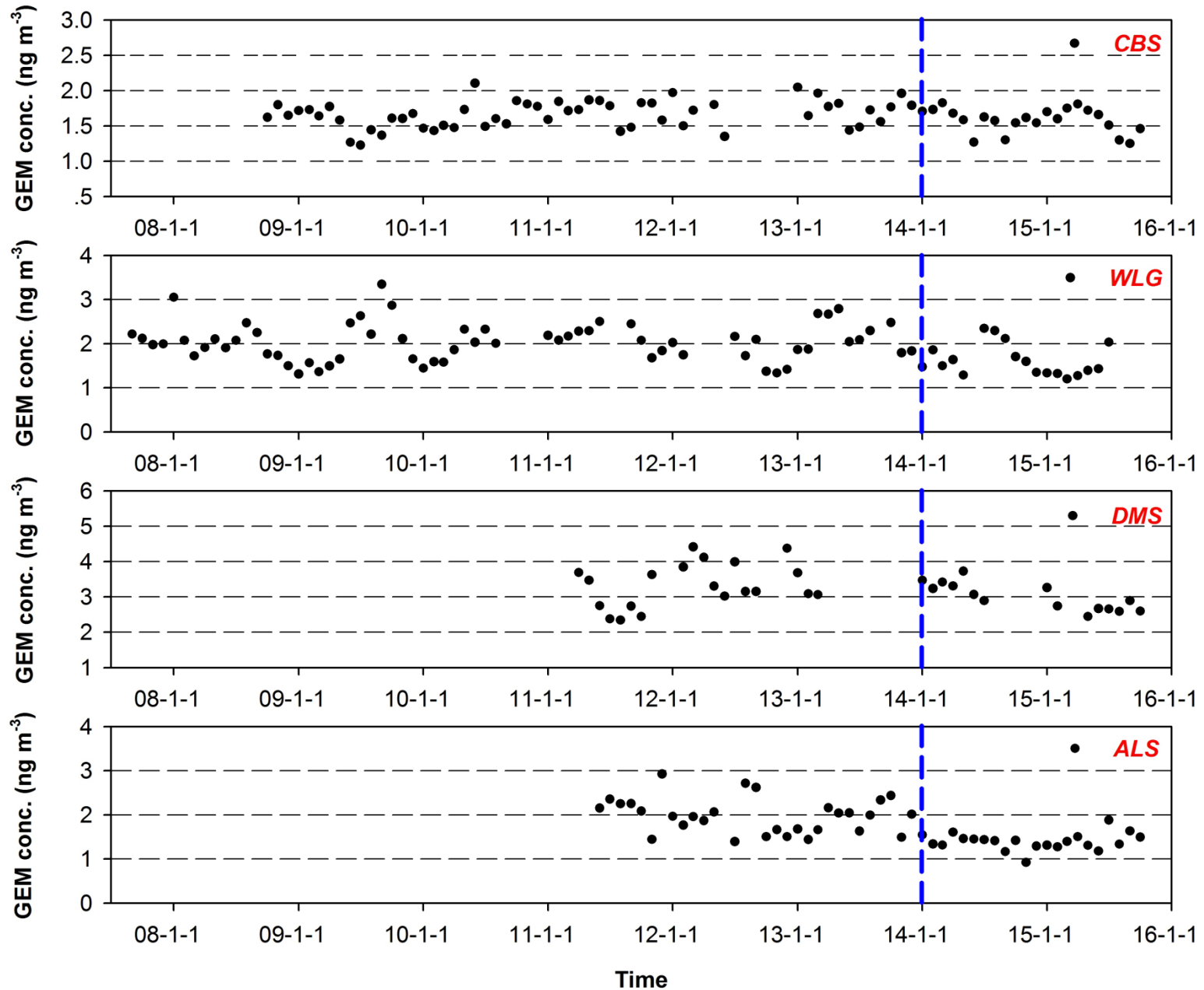
Estimated Hg emission from different regions





Mean concentrations at the 9 stations

Temporal variation of GEM concentrations

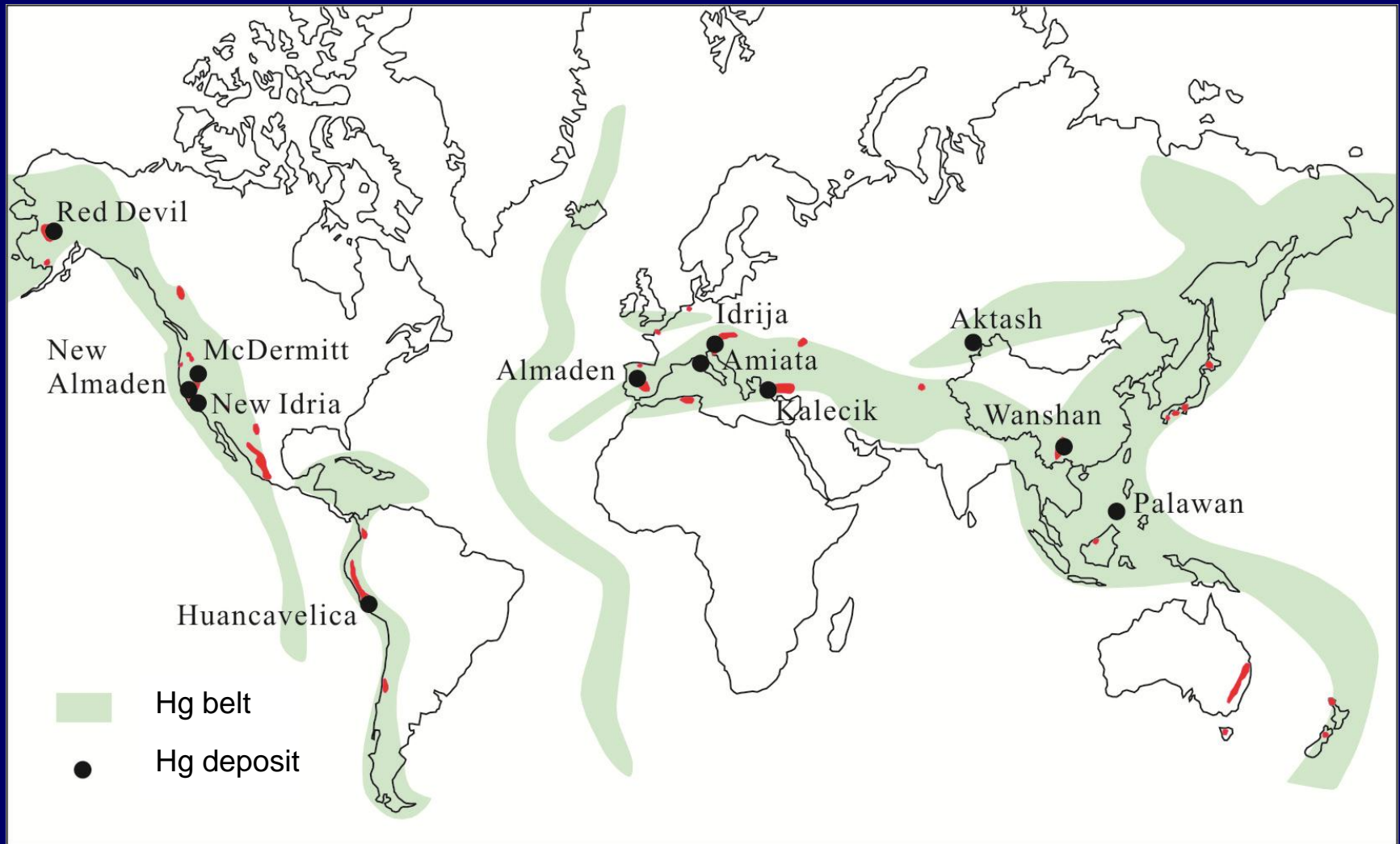


Outline

- ◆ Hg emissions and Hg in ambient air in China
- ◆ **Mercury contaminated sites**
- ◆ Human Hg exposure

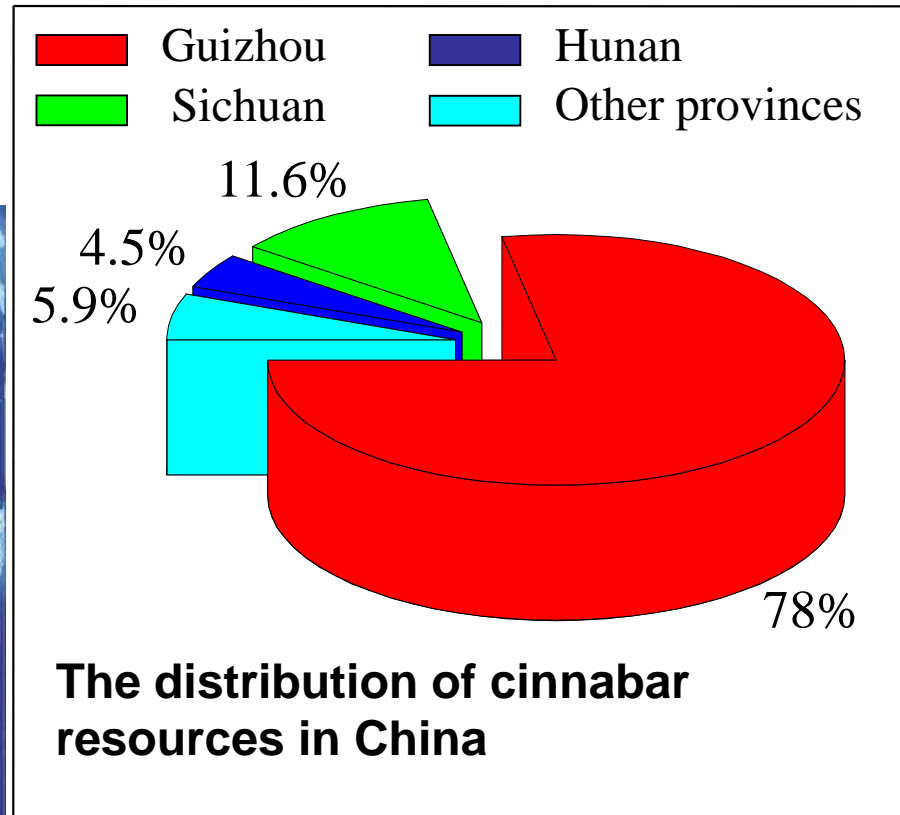
Mercury contaminated sites

- ✓ **Organic chemical plants/ chlorine alkali plants**
- ✓ **Mercury mining areas**
- ✓ **Gold mining areas**
- ✓ **Fluorescence lamp manufacturers**
- ✓ **Battery manufacturers**
- ✓ **Non-ferrous metal smelters (Zn and Pb)**



The distribution of Global mercuriferous Belt (after Gustin et al., 1999)

Hg deposits in China

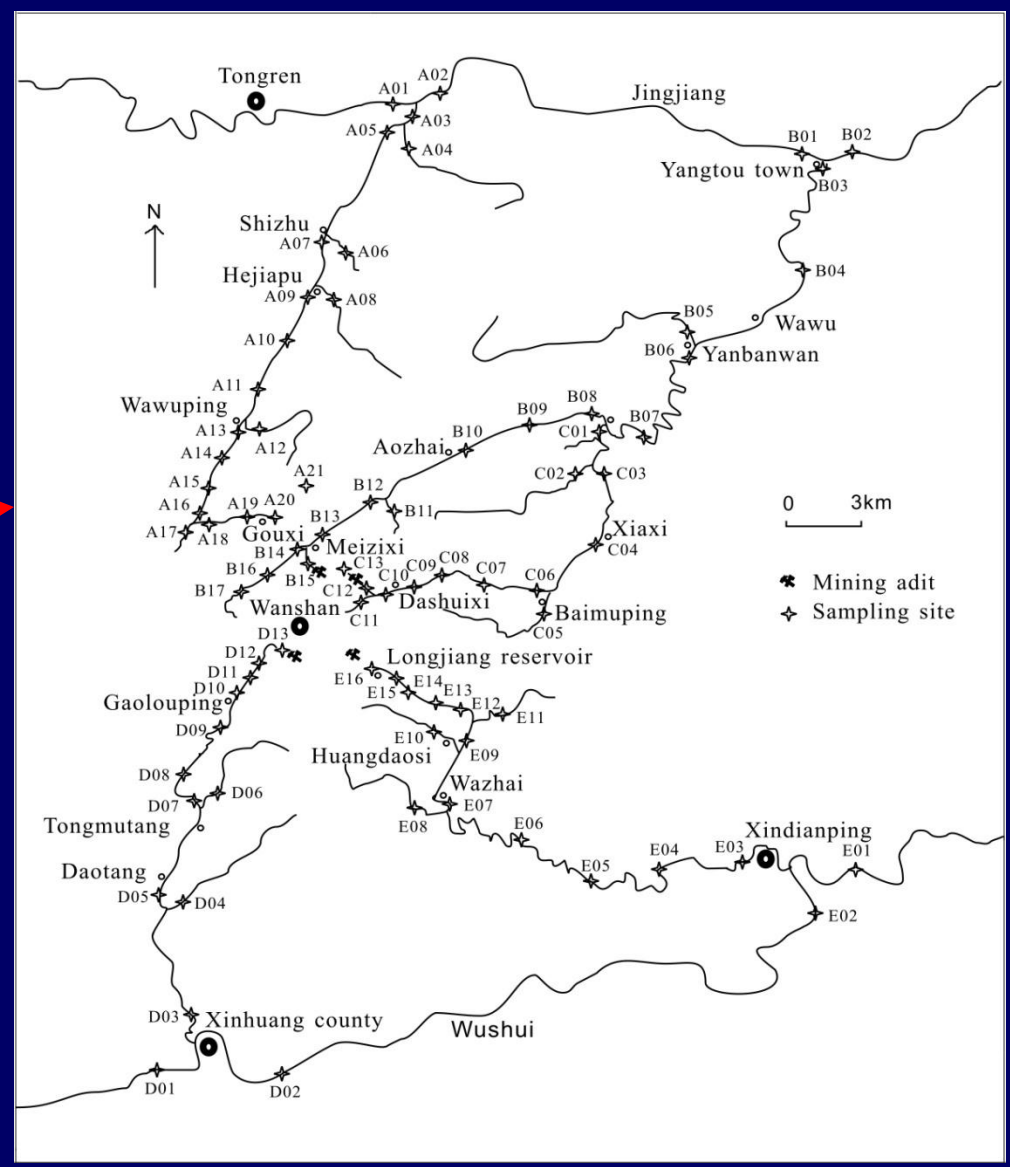
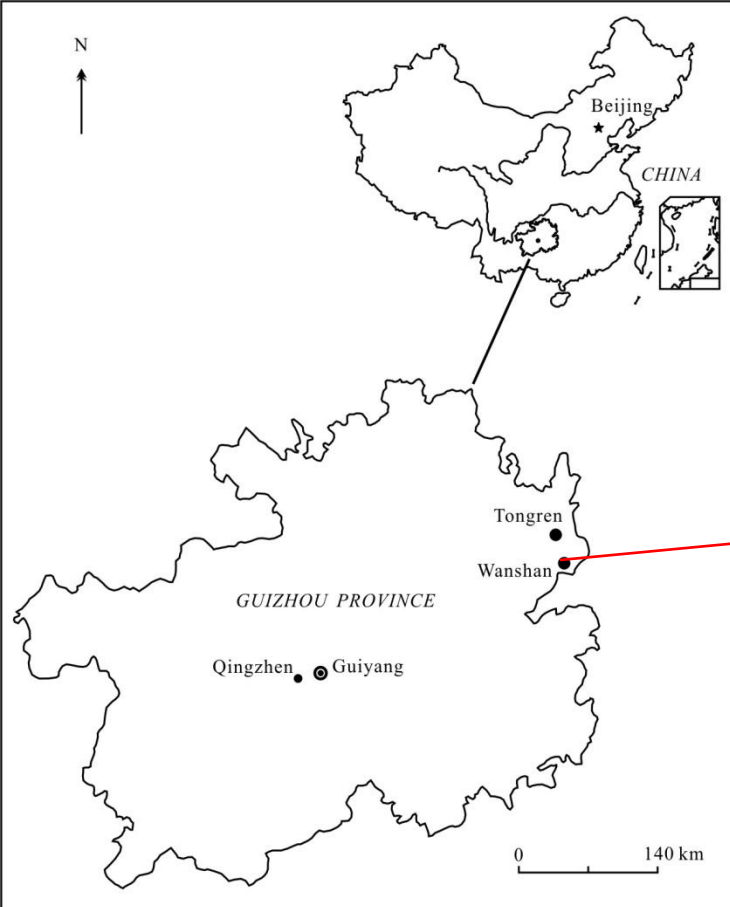


Cinnabar resources in Guizhou: 90000 tons, accounting for 78% of the total in China

125.8 million ton tailing

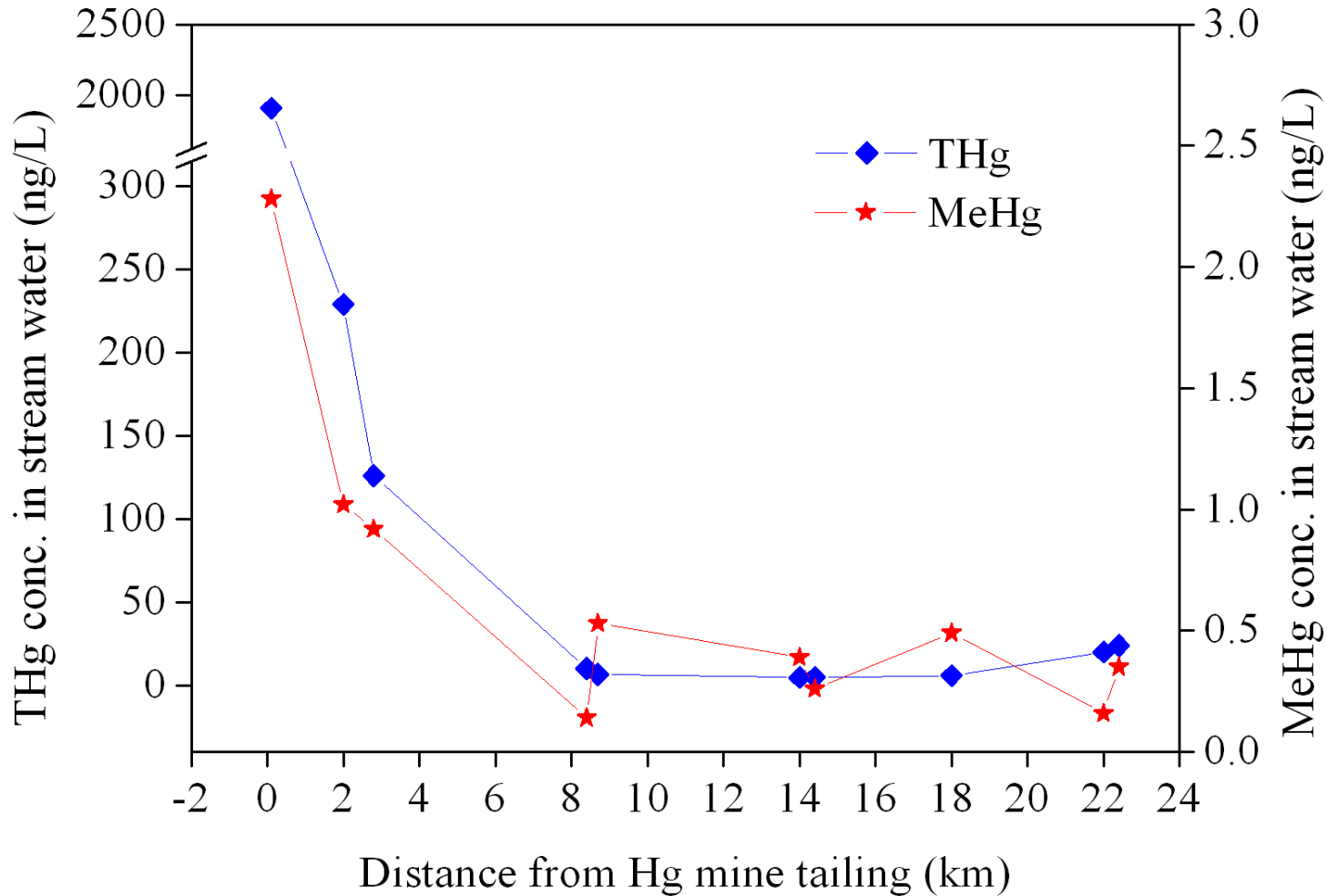


Calcine and tailing from Hg mines in Wanshan

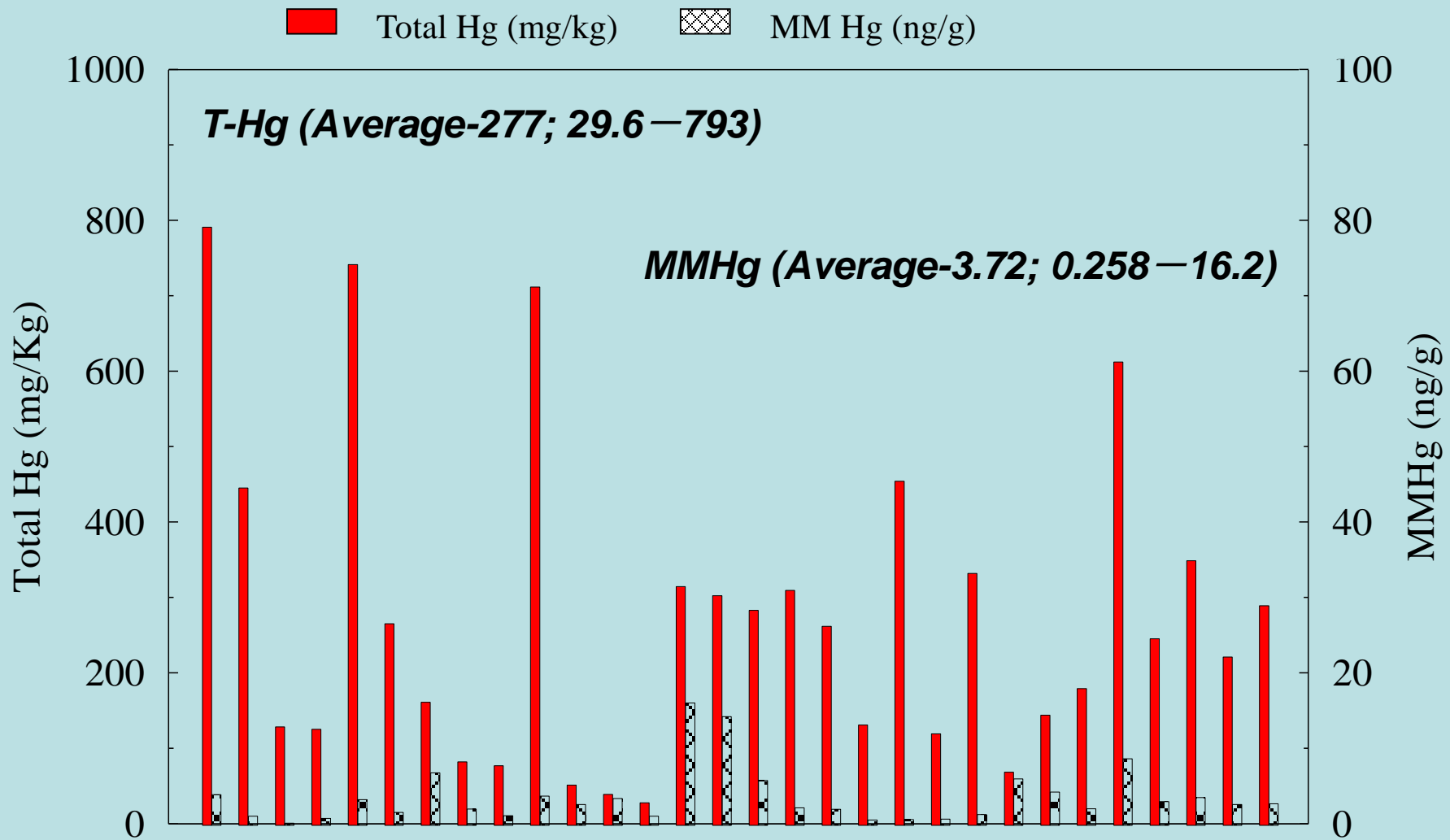


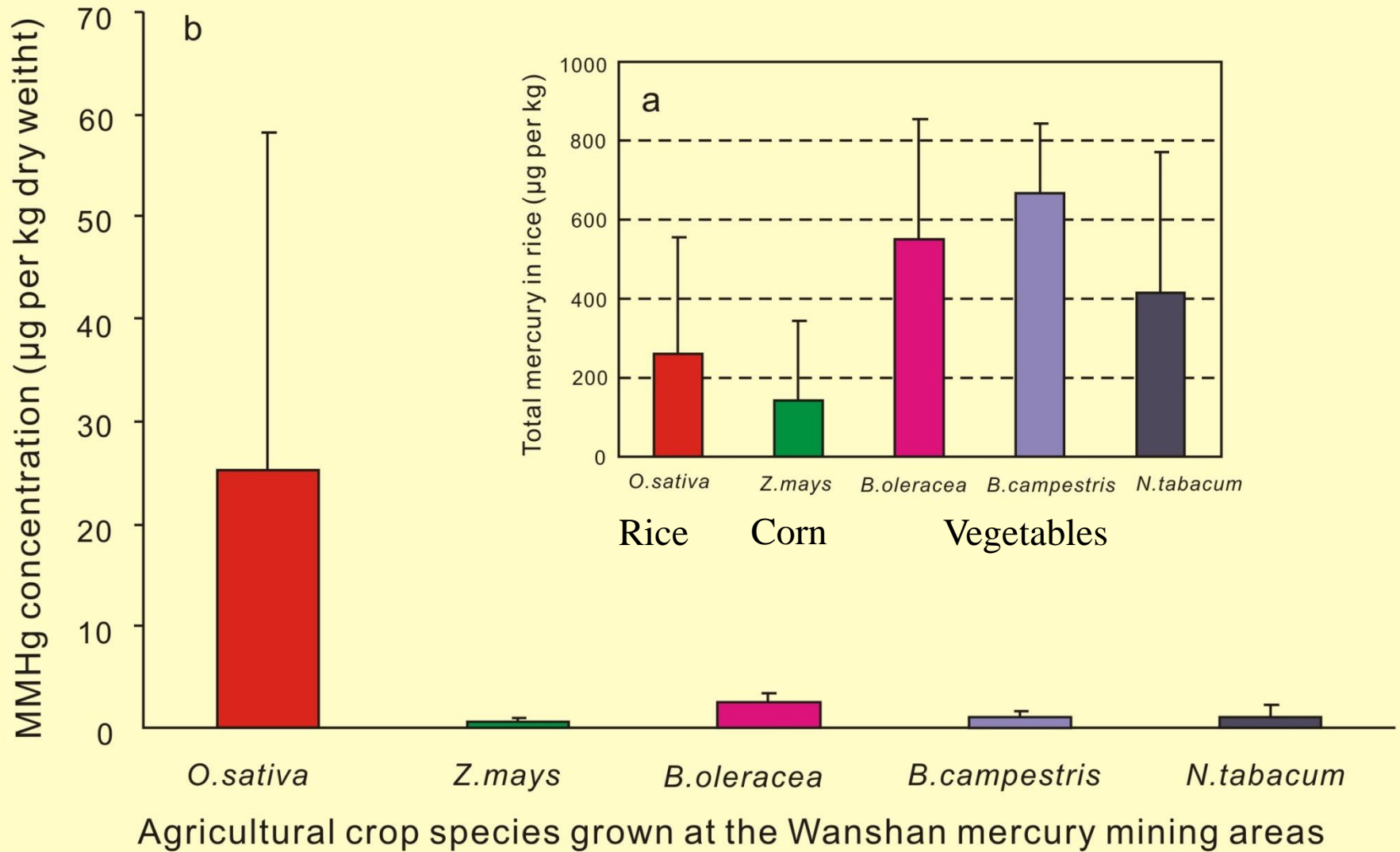
Sample locations in Wanshan

Example of water concentrations



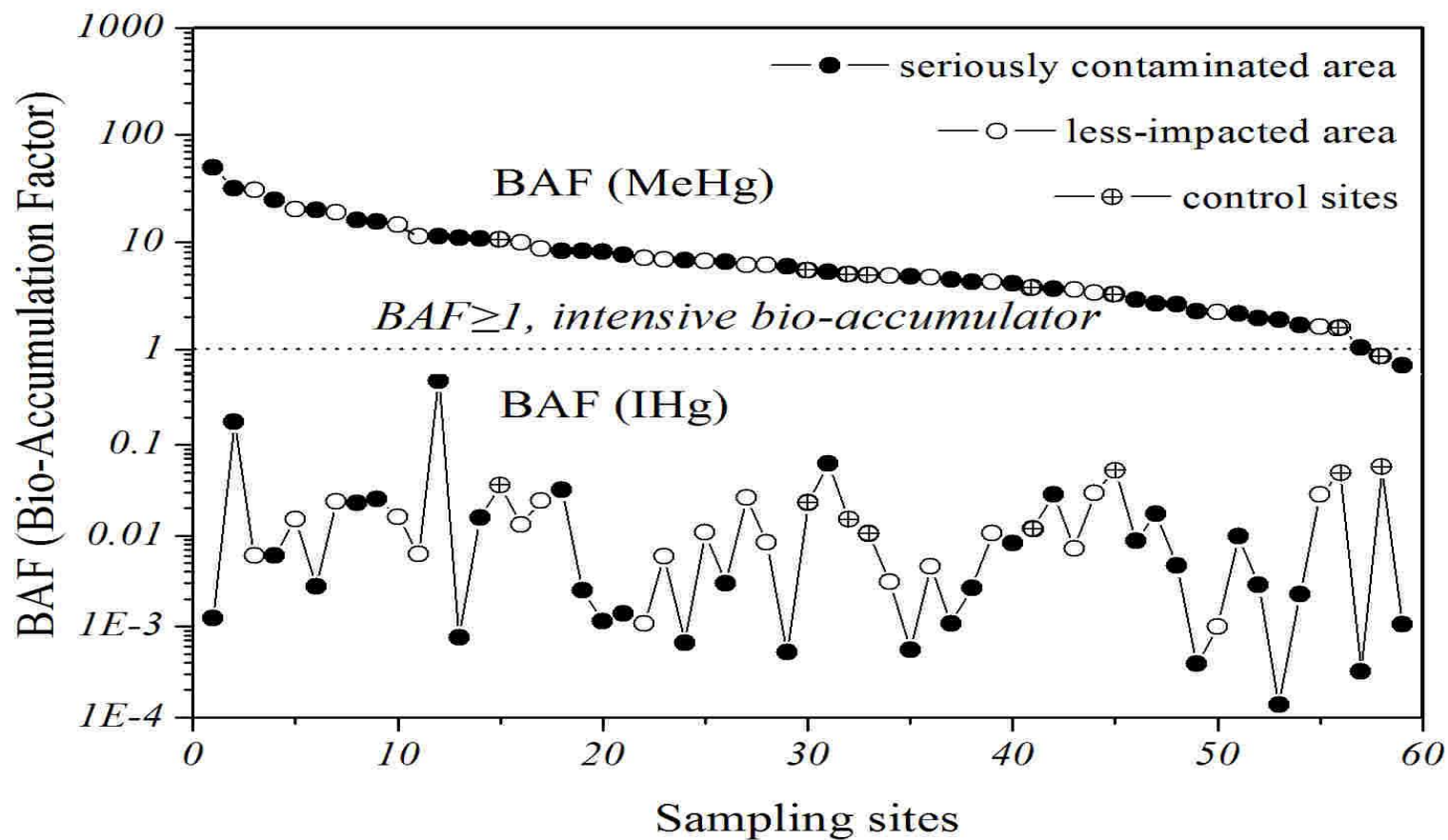
Mercury in soil from Hg mining areas

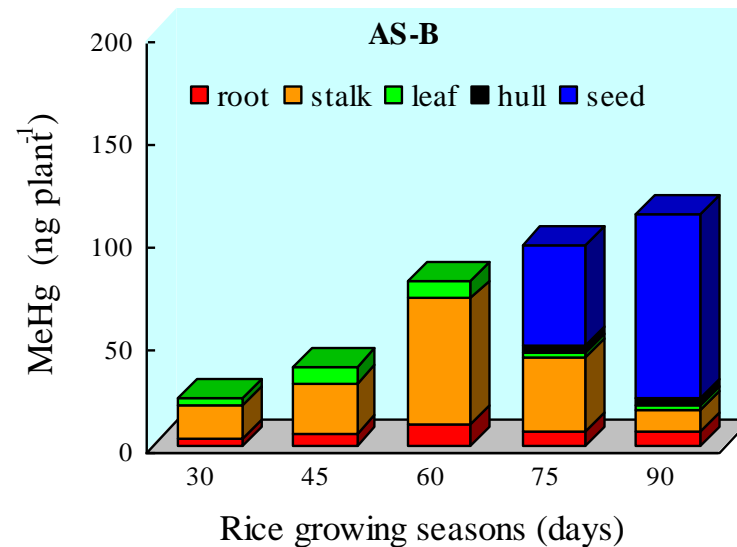
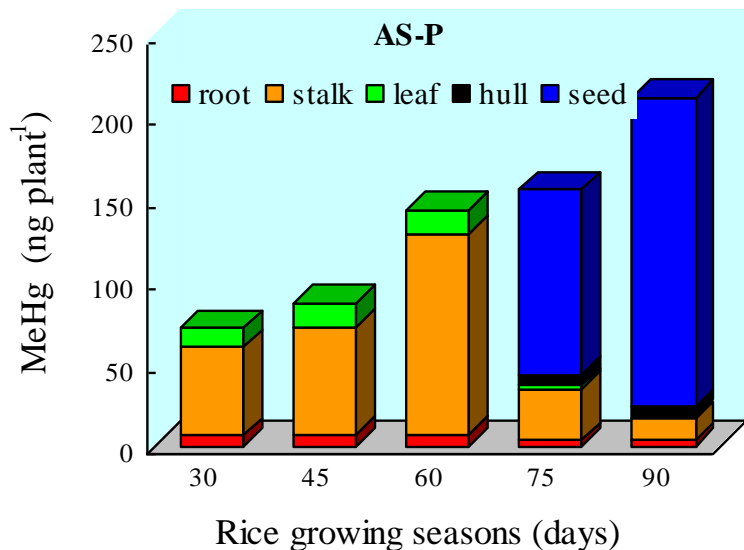
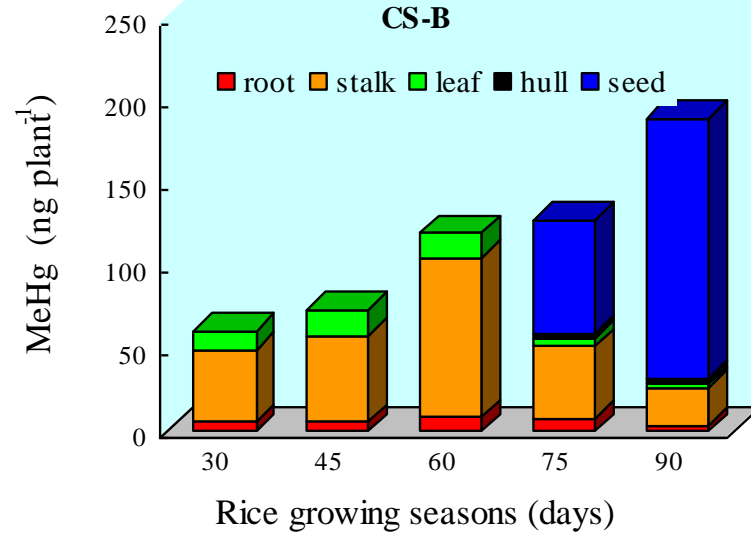
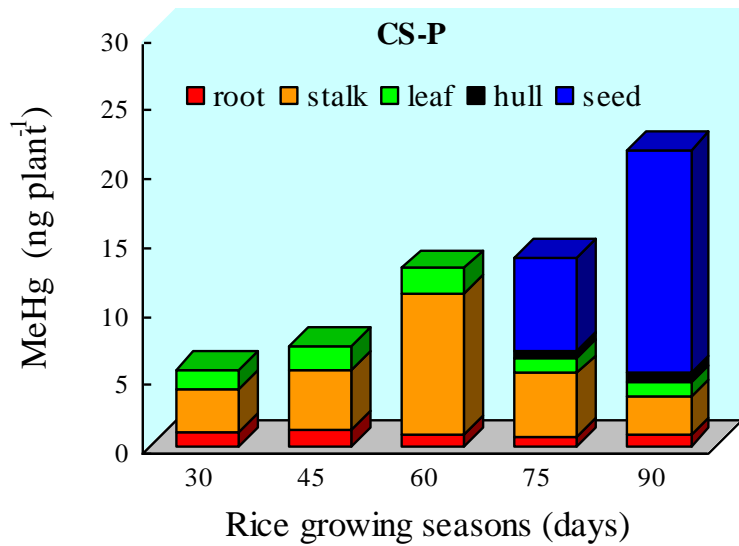




(Horvat et al., 2003; Qiu et al., 2008; Feng et al., 2008; Li et al., 2008)

Bioaccumulation factors of IHg and MeHg of rice

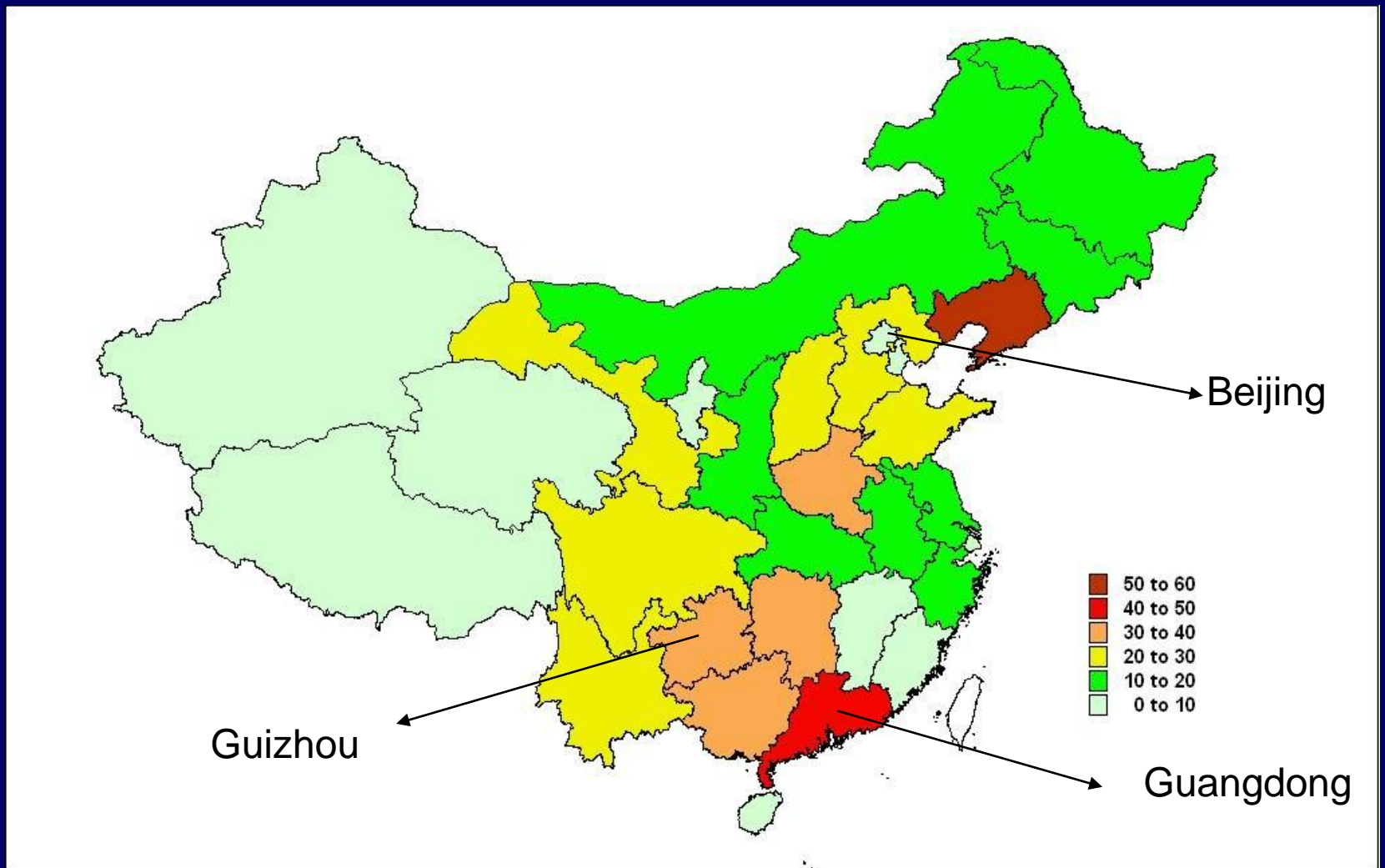




The process of MeHg accumulation in rice

Outline

- ◆ Hg emissions and Hg in ambient air in China
- ◆ Mercury contaminated sites
- ◆ Human Hg exposure



Mercury emission from different province in 1999 (Streets et al., 2005)

Fish sampling in Beijing

- ✓ Fish samples in markets were collected
- ✓ Each fish sample is a mixture of five fish with the same species
- ✓ Species collected included: grass carp, common carp, Bighead carp, Bluntnout bream
- ✓ Fifty samples were collected

Fish sampling in Guangdong province



Fish species collected in Guangdong province

Fish species	Sample numbers
Tilapia	27
Grass carp	30

- ✓ 7 farmed freshwater species
- ✓ 3 farmed marine fish species
- ✓ 3 wild marine fish species

Snubnose pompano	26
Crimson snapper	30
Hairtail	26
Gold thread	21
Common mullet	19

6 shrimp species

Greasy-back shrimp, Red swamp crayfish, Giant freshwater prawn, Kuruma prawn, Grass prawn, Mantis shrimp

2 crab species

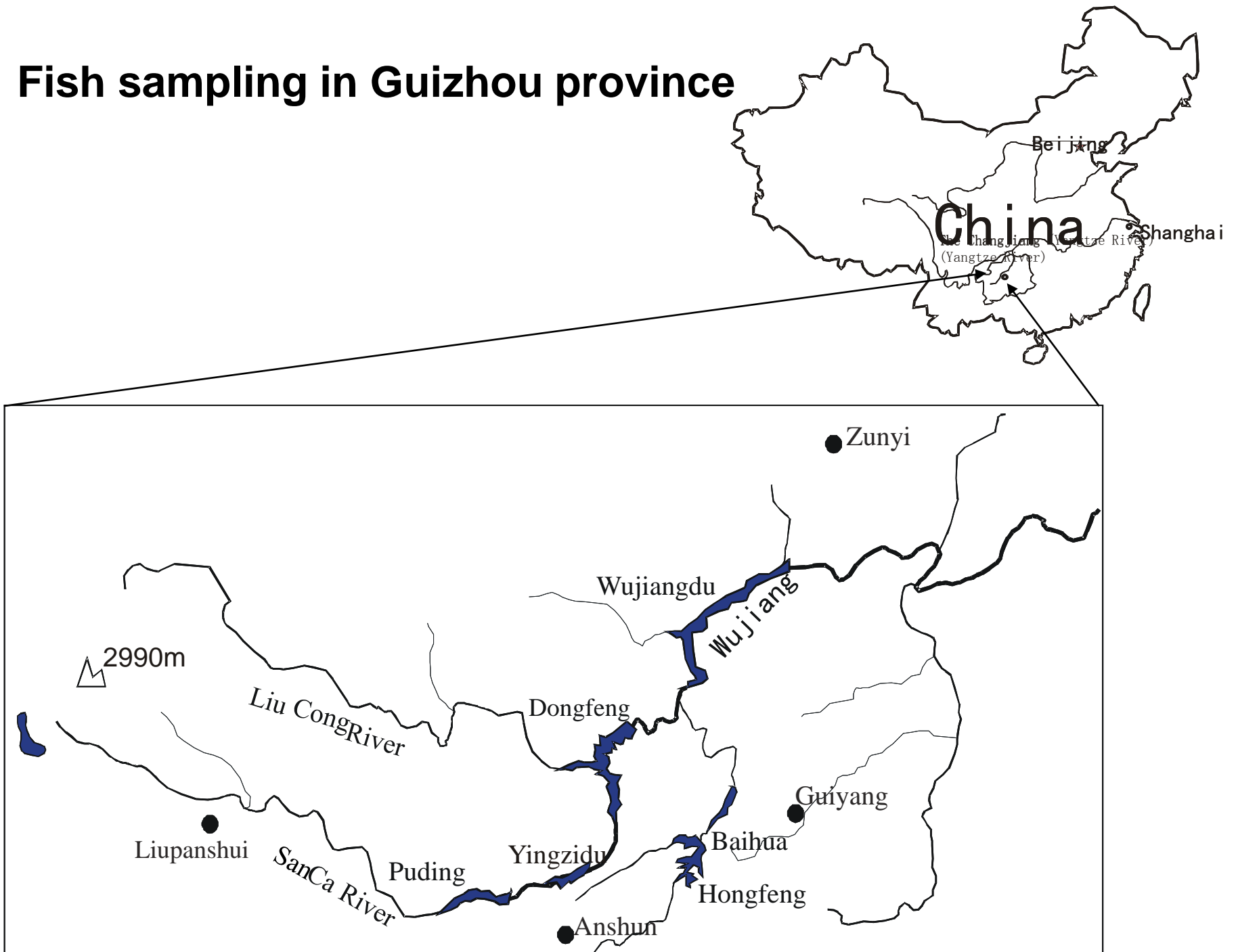
Samoaan crab, swimming crab

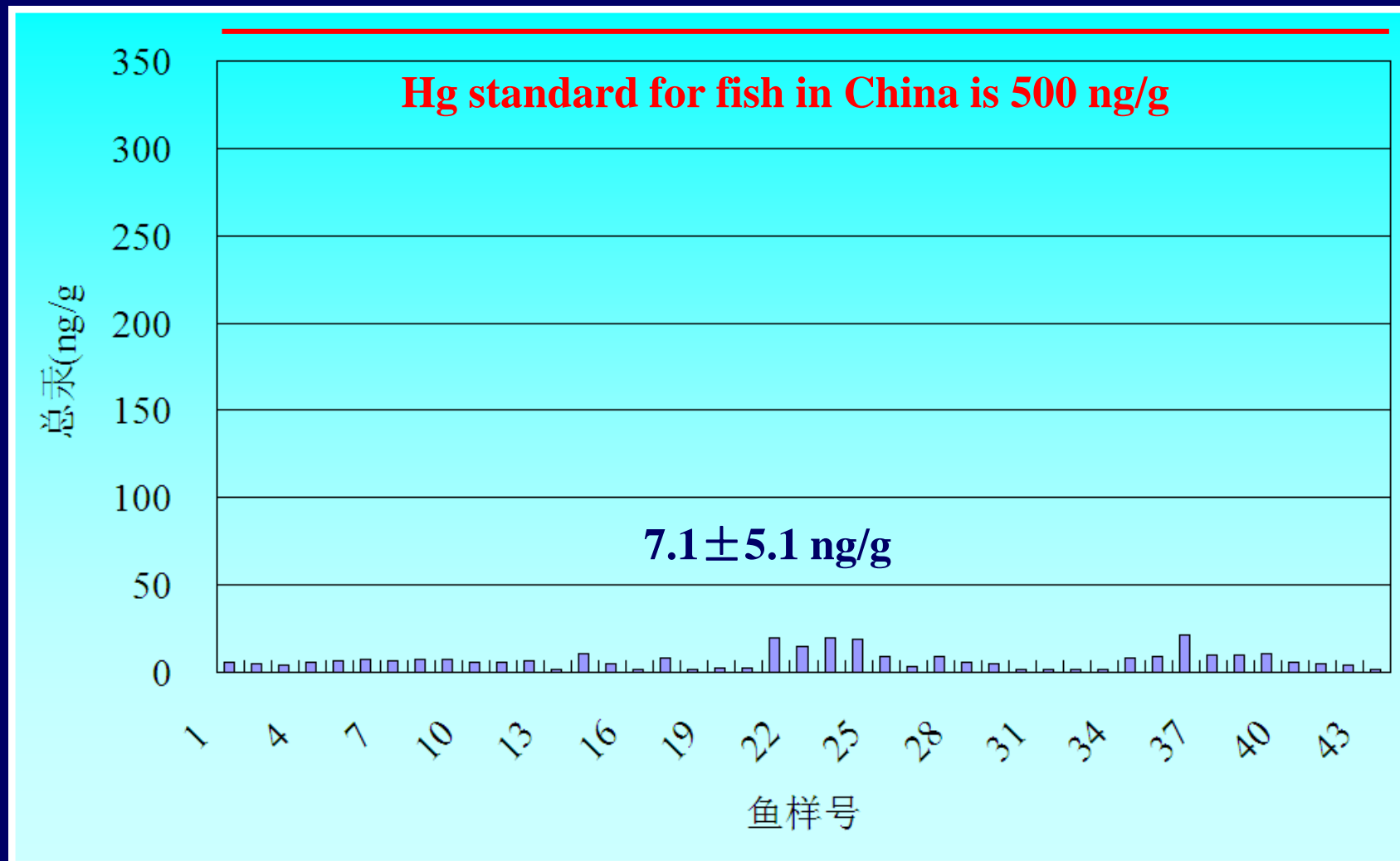
13 shellfish species

Abalone, Bay scallop, Giant Ezo scallop, Ark shell, Ark shell, Terebra maculata, Razor clam, Clam, Short-necked clam, Short-necked clam, mudsnail, Razor clam, Oyster

In total, we collected 518 fish and seafood samples

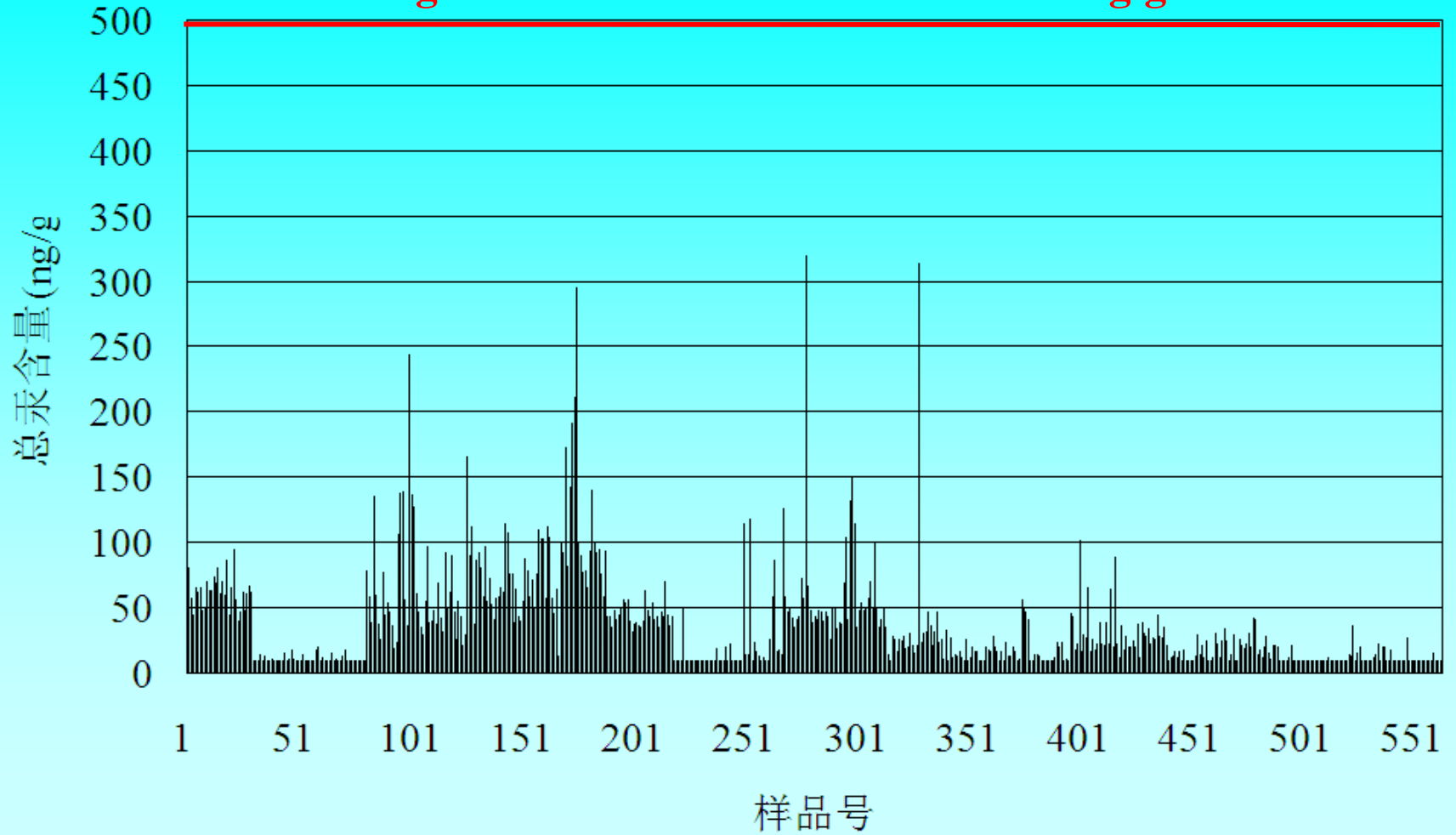
Fish sampling in Guizhou province





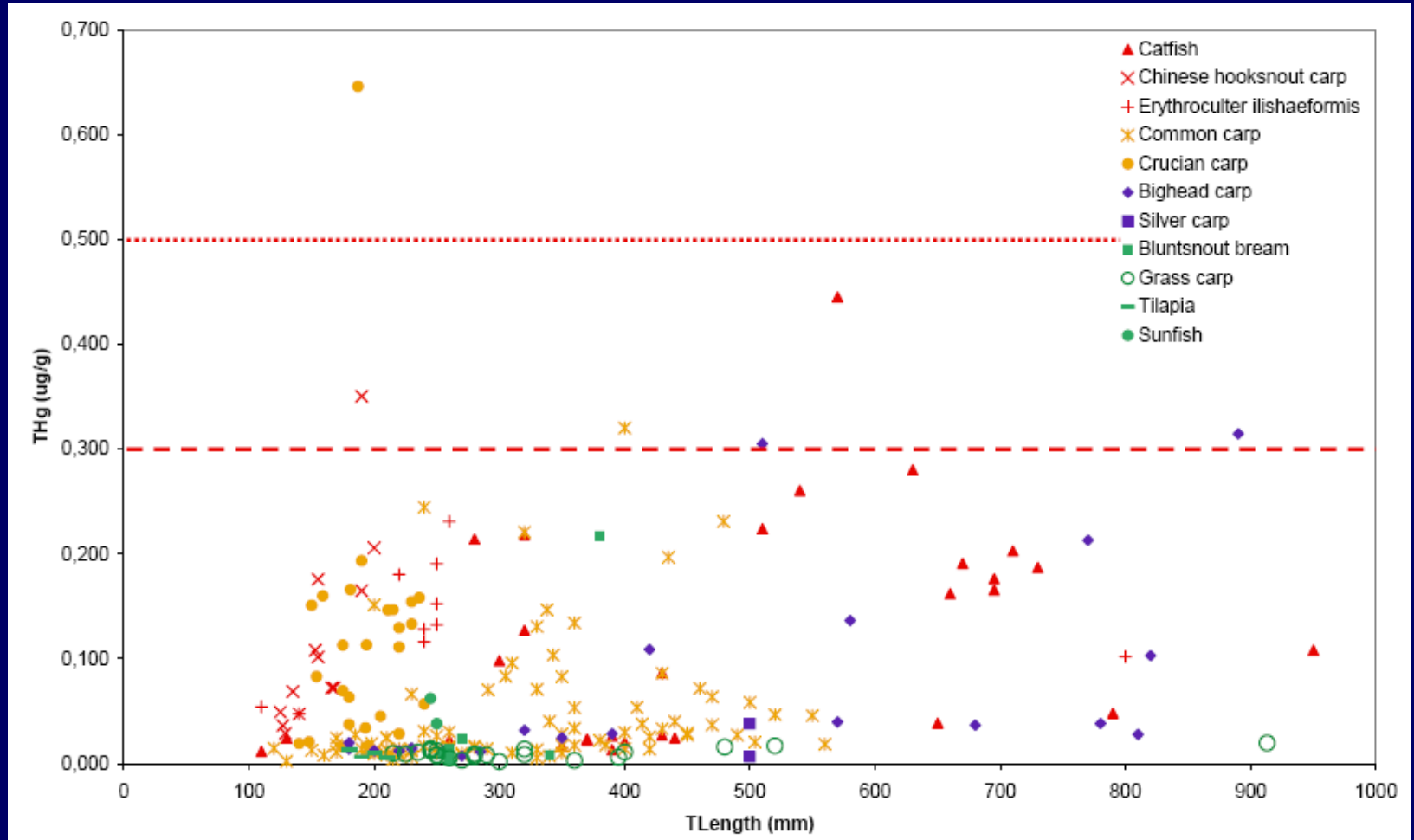
Hg concentrations in fish collected in markets in Beijing

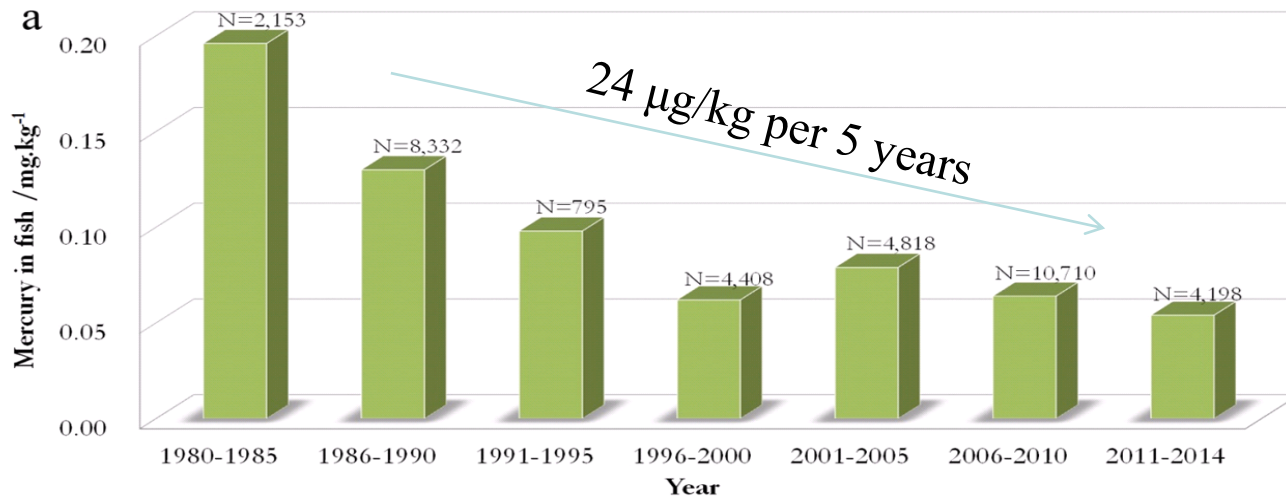
Hg standard for fish in China is 500 ng/g



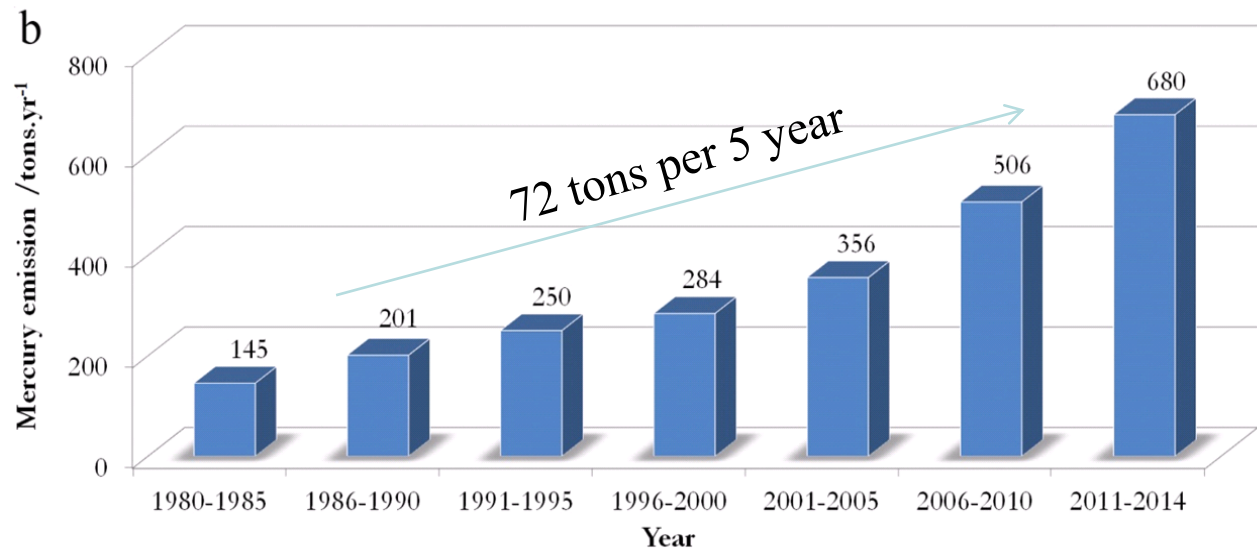
Mercury concentrations in fish collected in Guangdong province

Hg in fish from reservoirs in Guizhou

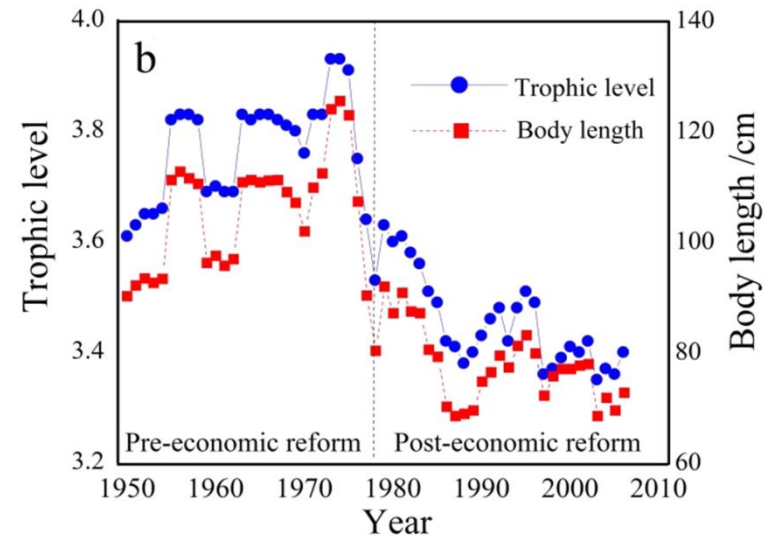
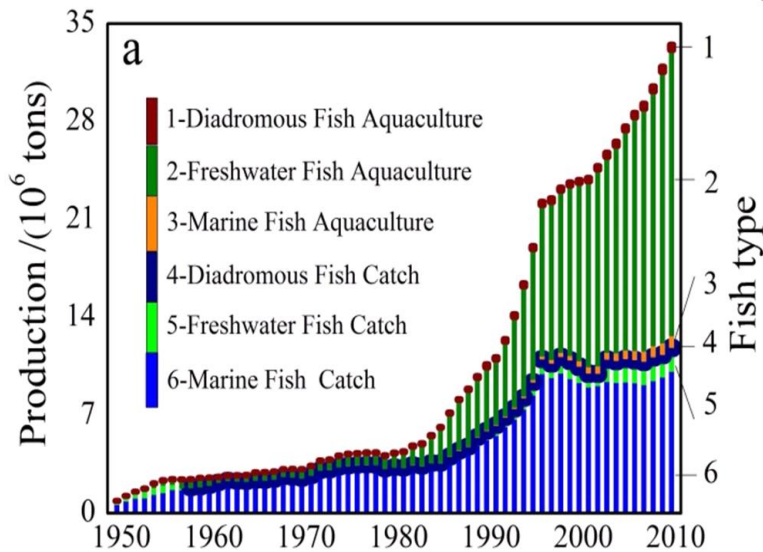




Trend of THg in fish in China (mg /kg)



Trend of Hg emission from anthropogenic sources in China(ton/a)



Trophic level changes of fish in China

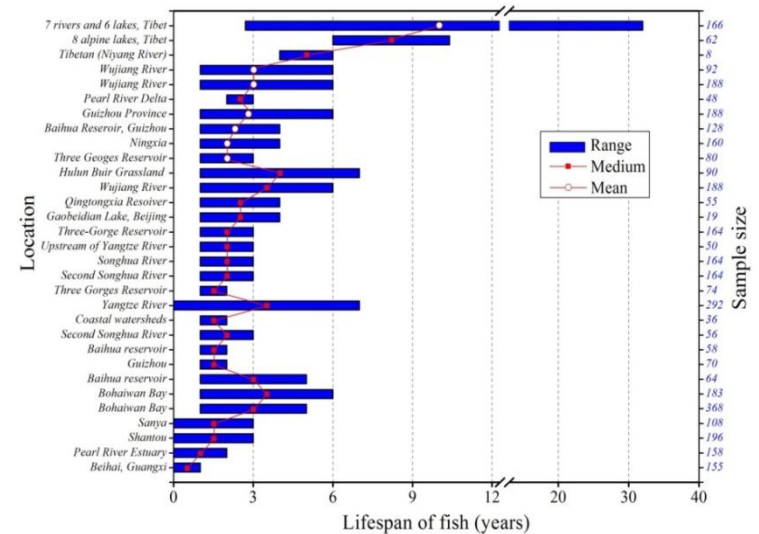
Fish production trend in China

Data from :

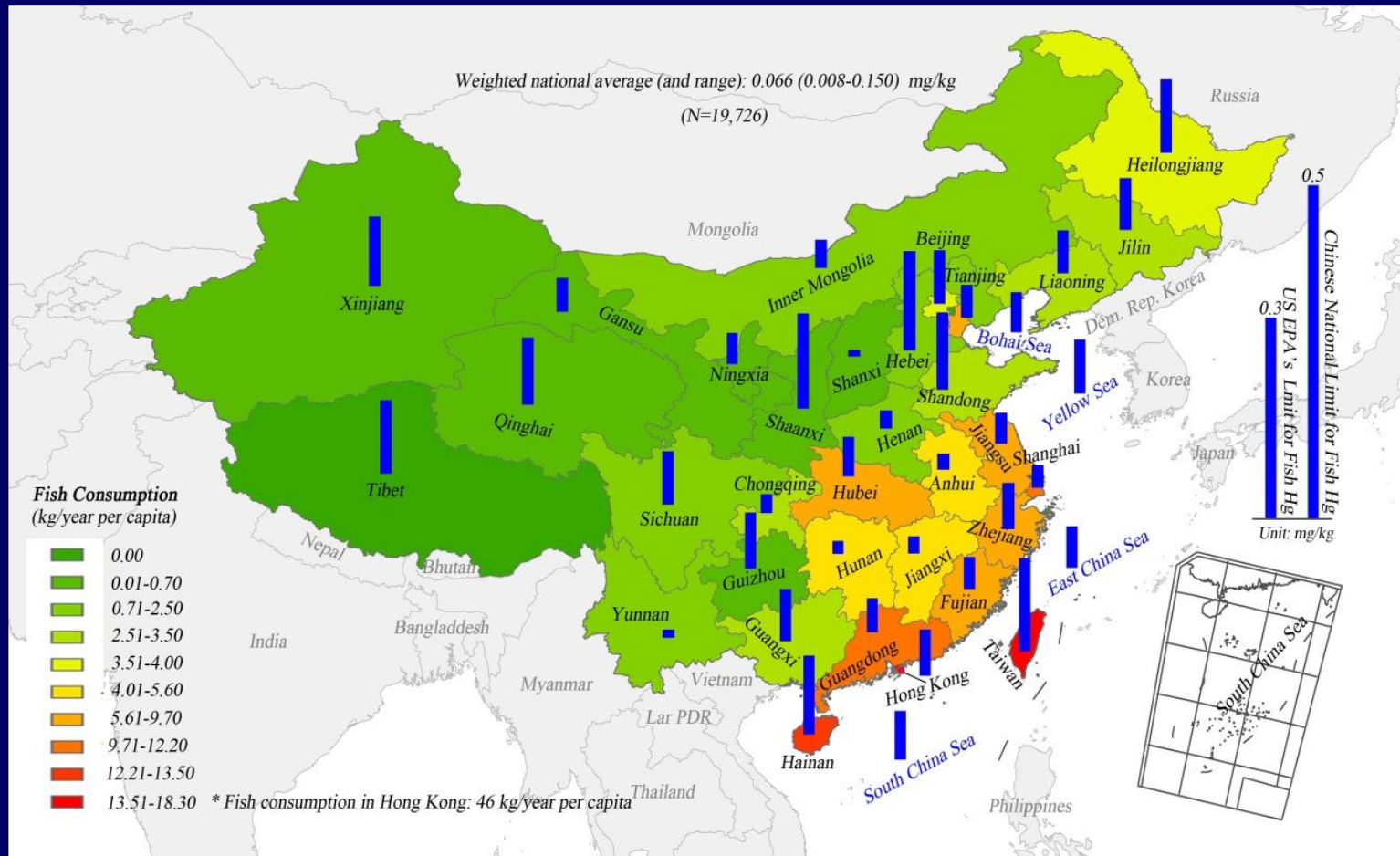
<http://www.fao.org/fishery>

<http://www.searoundus.org>

Zhang et al., *Environ Sci Technol.* 2015, submitted



Age distribution of fish



Hg concentrations in fish in China (Data published from 2011-2014)

Zhang et al., Environmental Science and Technology, 2015, submitted

Hg mines in Guizhou

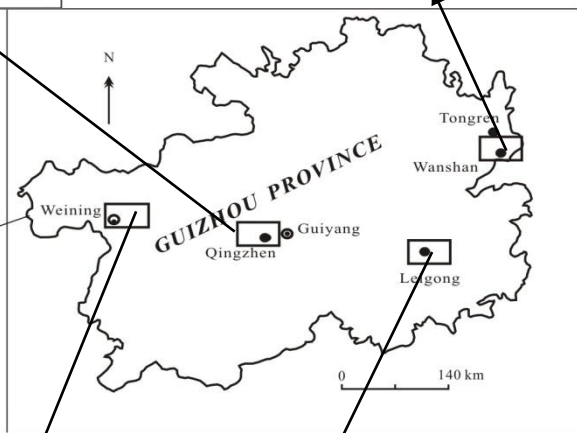
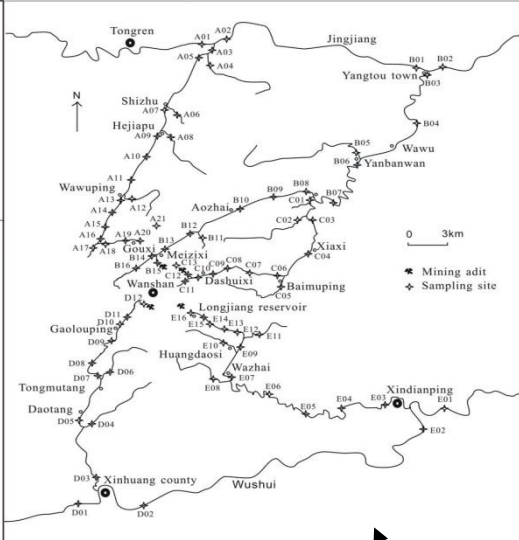
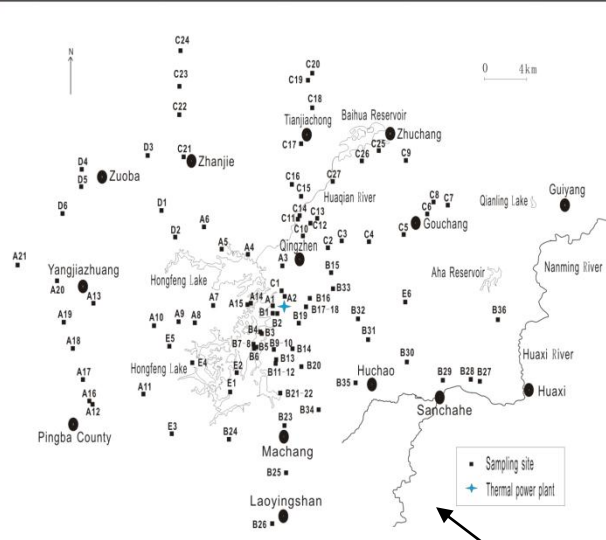


Early Hg mining history: Qin Dynasty (221B.C.)

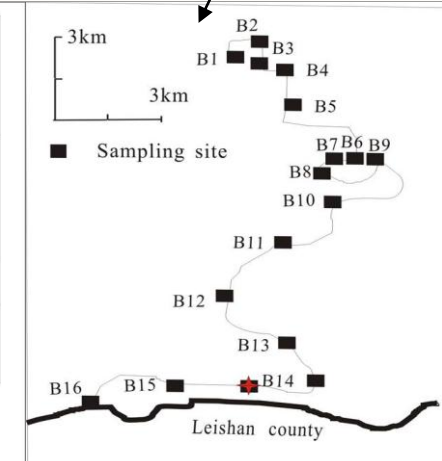
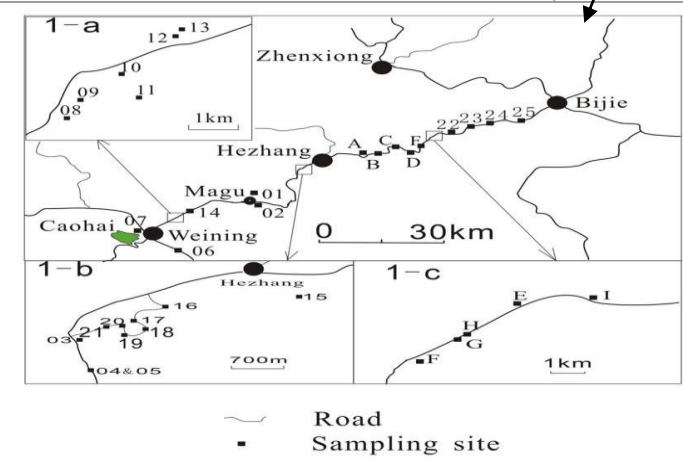
All large scale Hg mining activities ceased in 2004

Large scale Hg mining activities experienced 630 years





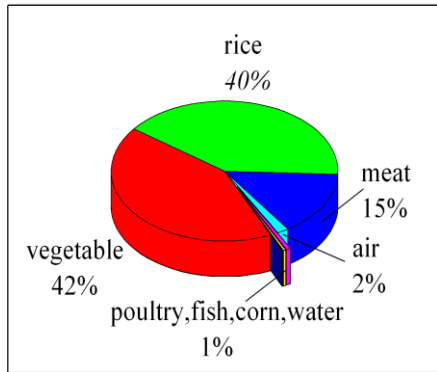
**Sampling locations
in 4 studied areas,
Guizhou, China**



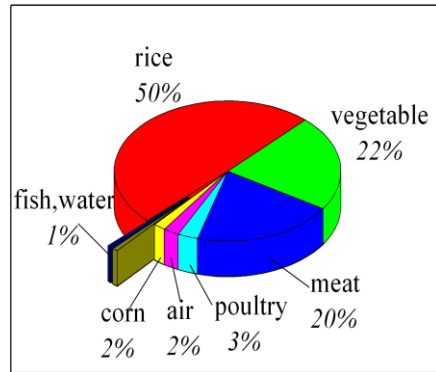
— Road
■ Sampling site

Percentage of THg intake (upper figures) and MeHg intake (lower figures) from different mediums in four areas in Guizhou

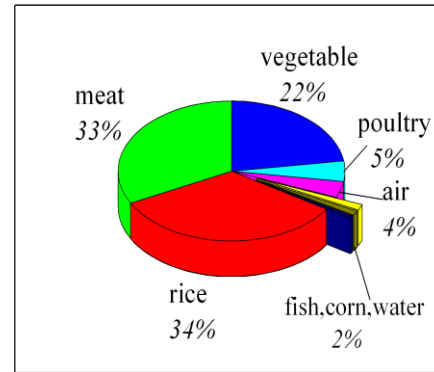
Wanshan



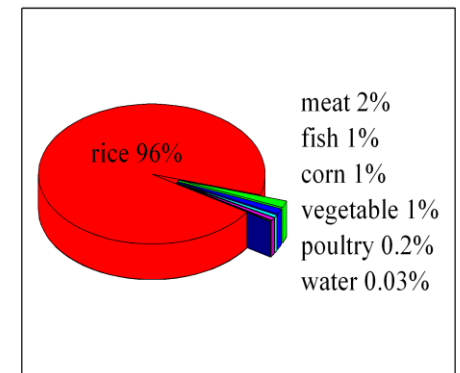
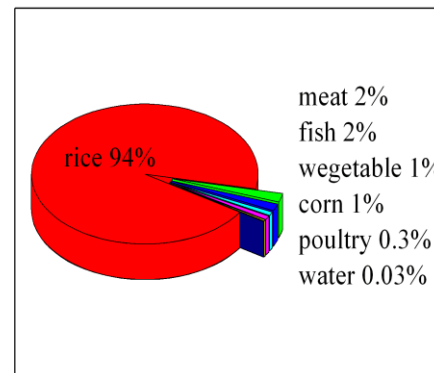
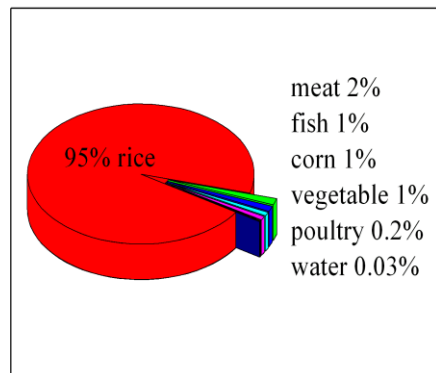
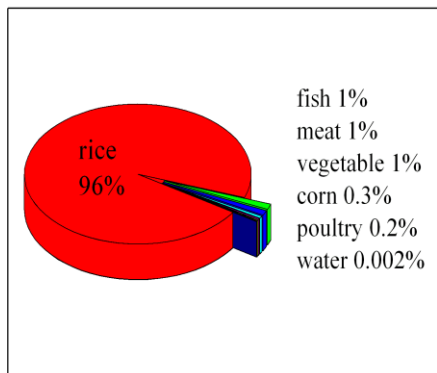
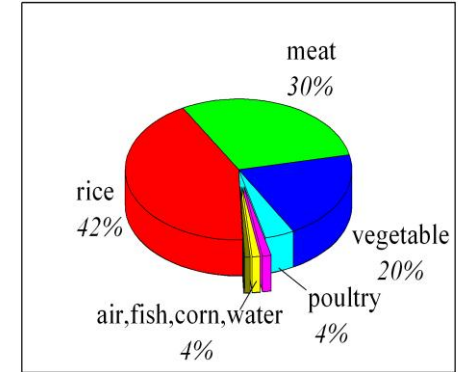
Qingzhen

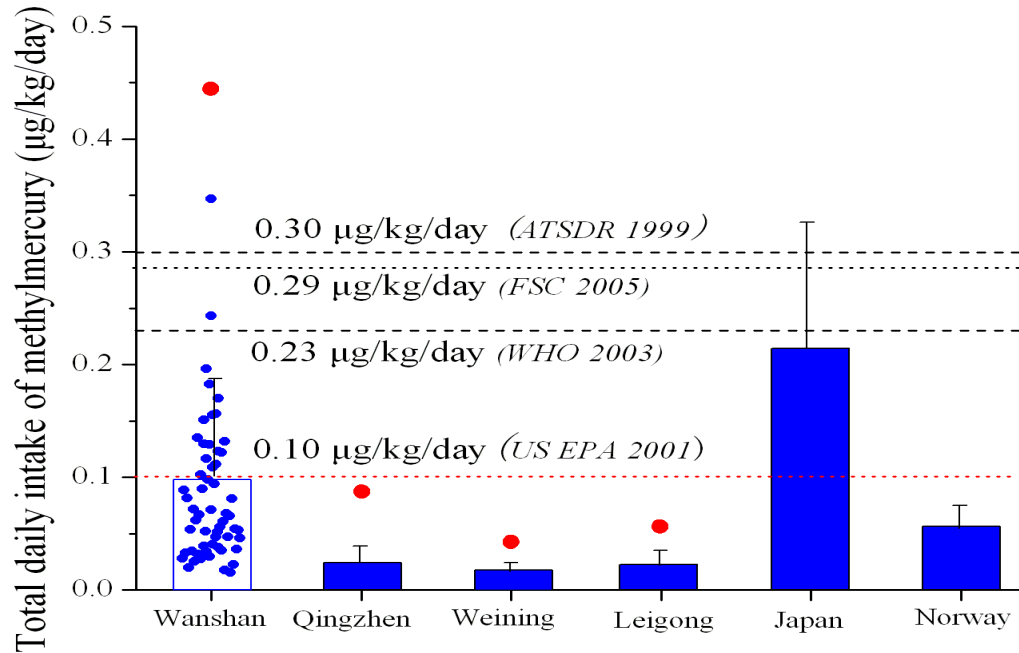
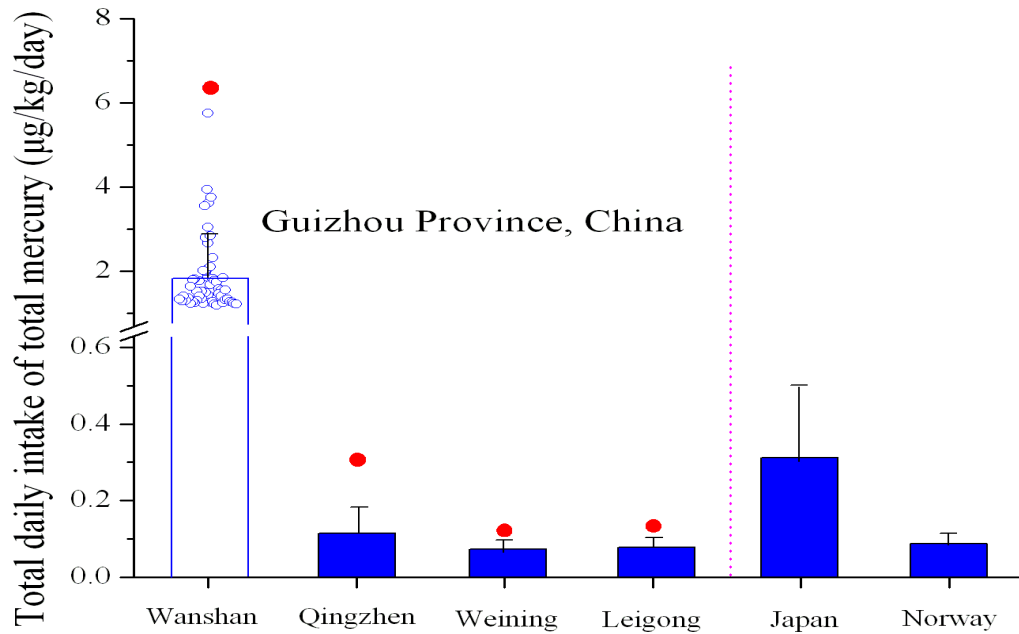


Weining



Leishan





Total Mercury Exposure

Methyl-mercury Exposure

Zhang, Feng et al., *Environmental Health Perspectives*, 2010, 118: 1183-1188

Main conclusions

1. Rapid economy growth in China resulted in the emission and discharge of a large amount of mercury to the environment, and consequently the local environments are seriously contaminated with Hg.
2. Fish in China generally contain low levels of mercury due to the fact that the practices of aquaculture activities don't favor accumulation of MeHg in fish, and the Chinese people therefore don't have any potential health concerns related to MeHg exposure through fish eating.
3. MeHg in rice may constitute a concern of health in some highly contaminated areas in China.

Acknowledgment

- Dr. Thorjorn Larssen, NIVA
- Prof. Shuxiao Wang, Tsinghua University
- Prof. Dingyong Wang, Southwest University
- Prof. Zhouqing Xie, China University of Science and Technology
- My students: Guangle Qiu, Lihai Shang, Xuewu Fu, Hua Zhang, Ping Li, Bo Meng, Haiyu Yan, Hui Zhang
- Chinese Academy of Sciences
- Natural Science Foundation of China
- Ministry of Science and Technology
- ...