MERCURY POLLUTION
tracking emissions to impacts

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Norma Slepecky Memorial Lecture, Syracuse University, 24 April 2015


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MERCURY: A WOMEN'S ISSUE


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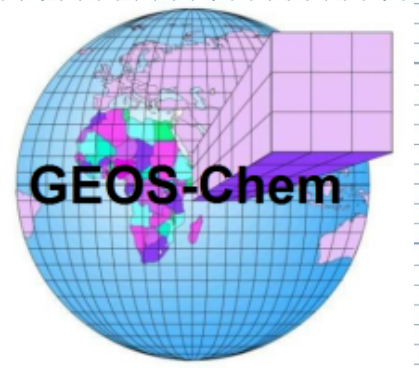
Where does mercury come from?

How does it travel worldwide?

Will policies make a difference?

A GLOBAL PERSPECTIVE REQUIRES GLOBAL MODELS

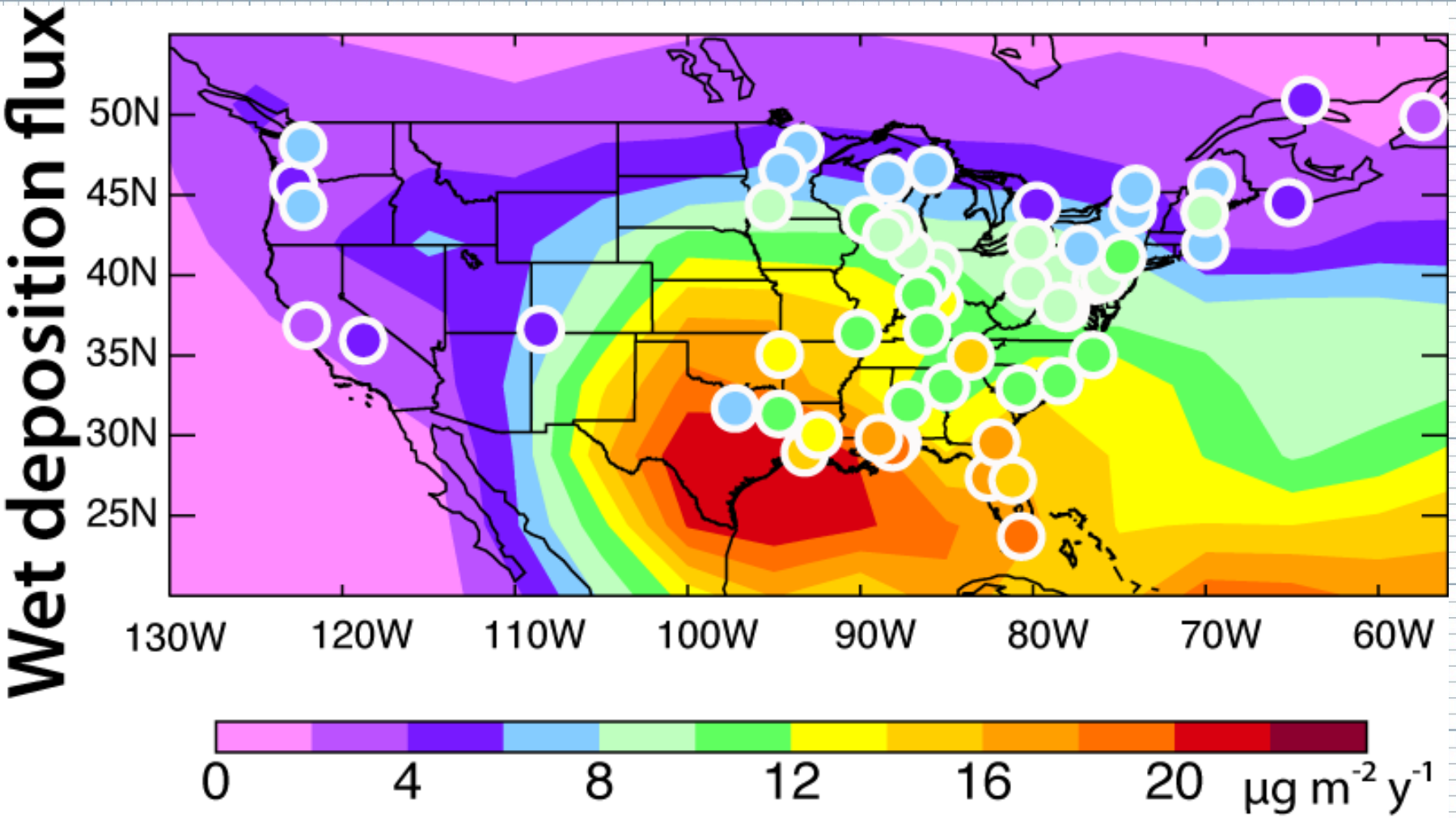


Global, 3D tropospheric chemistry model, 4x5 or 2x2.5 latitude-longitude resolution (nested grid over U.S.), assimilated meteorology

[*Bey et al.*, 2001]

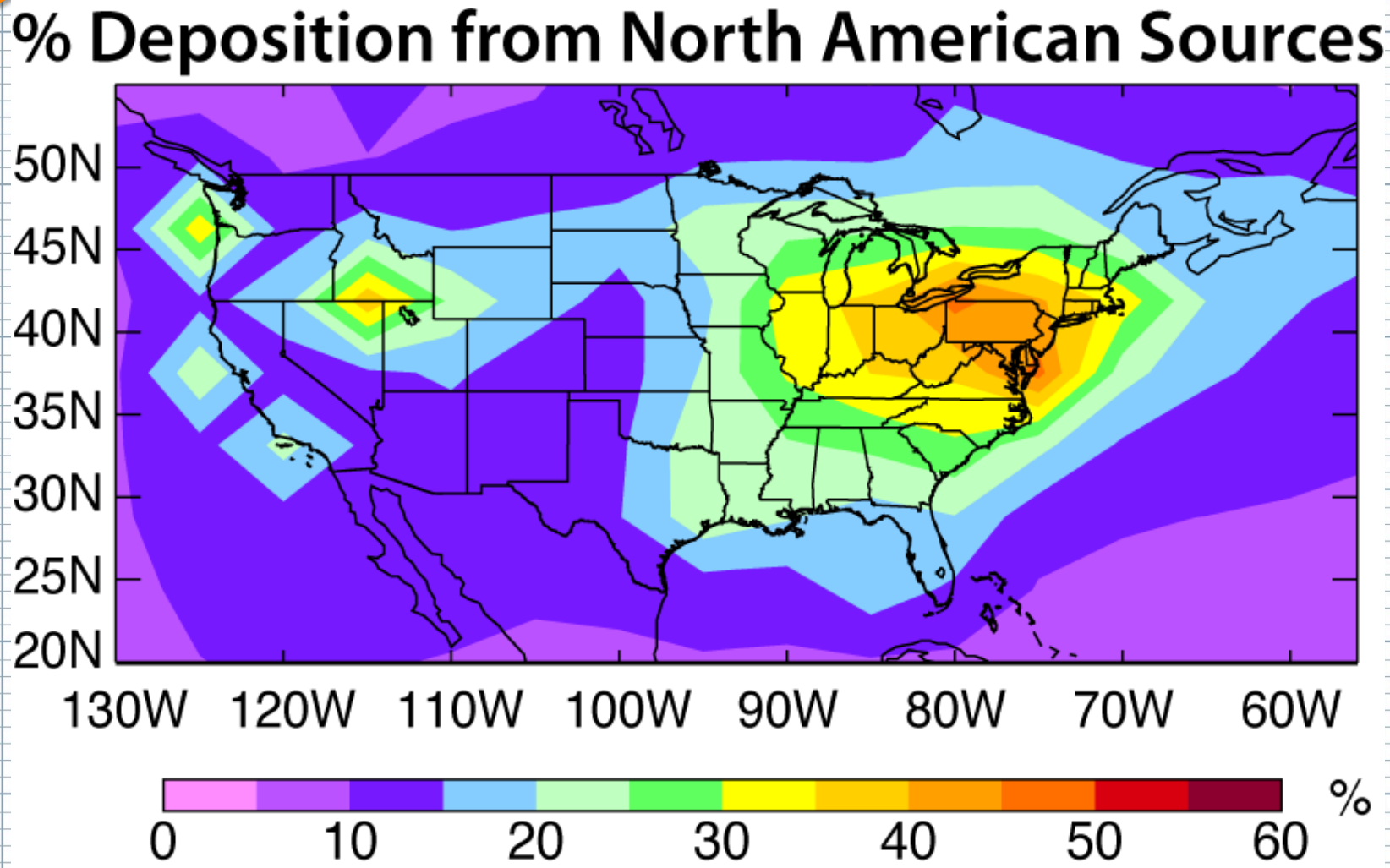
Mercury simulation includes land-atmosphere-ocean coupling *(Selin et al., 2007, 2008; Strode et al., 2007; Holmes et al., 2010; Soerensen et al., 2010)*

Where does mercury come from?

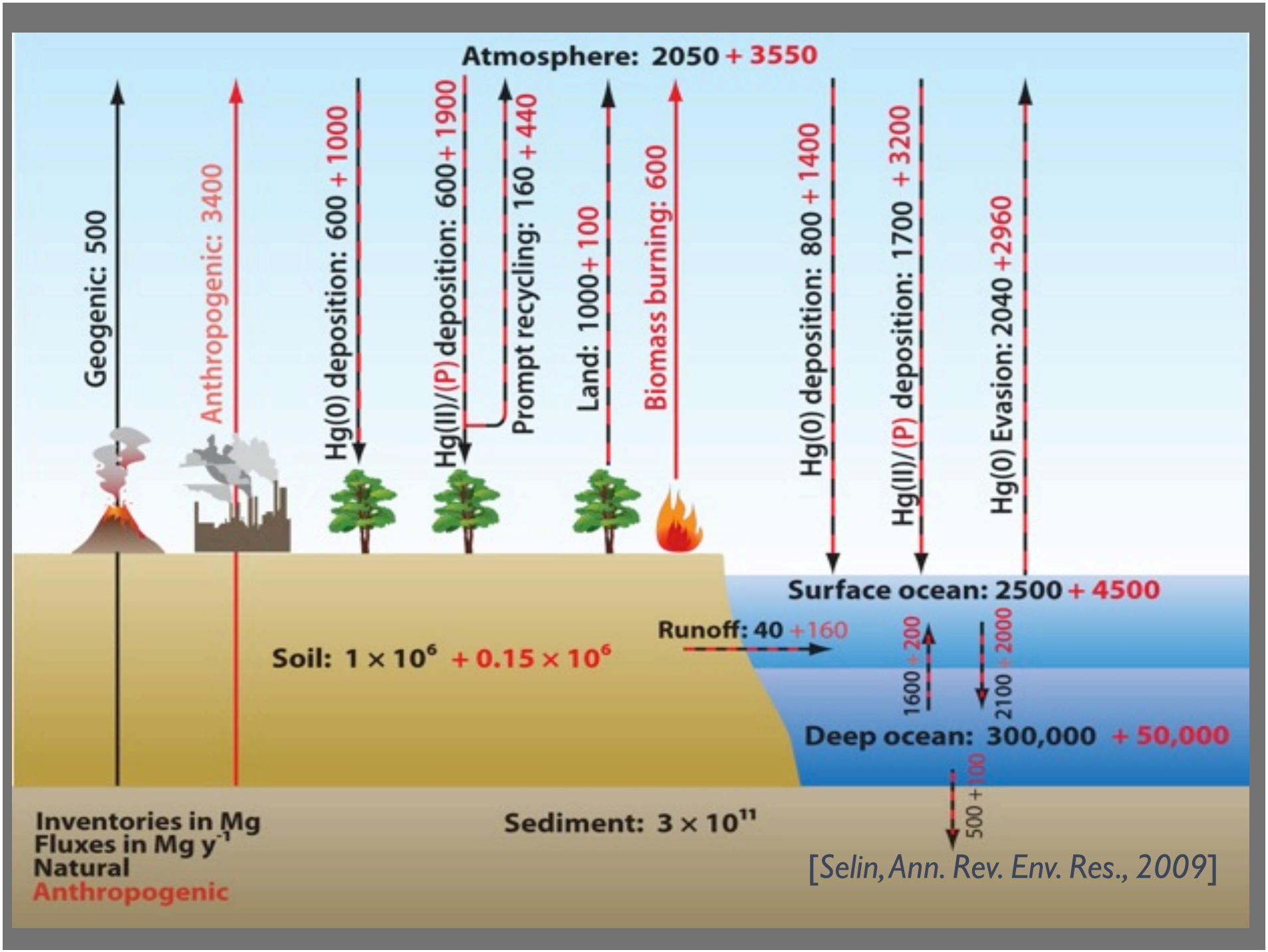


[*Selin & Jacob, Atmos. Env. 2008*]

Domestic and international sources



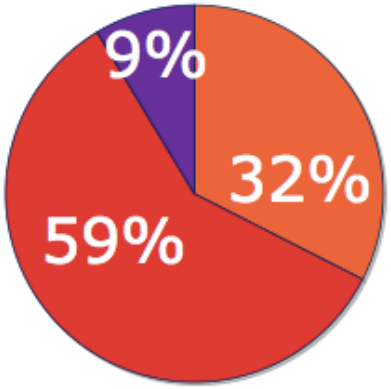
[Selin & Jacob, Atmos. Env. 2008]



[*Selin, Ann. Rev. Env. Res., 2009*]

Where does Hg come from?

Northeast U.S.
24 μg m^{-2} y^{-1}

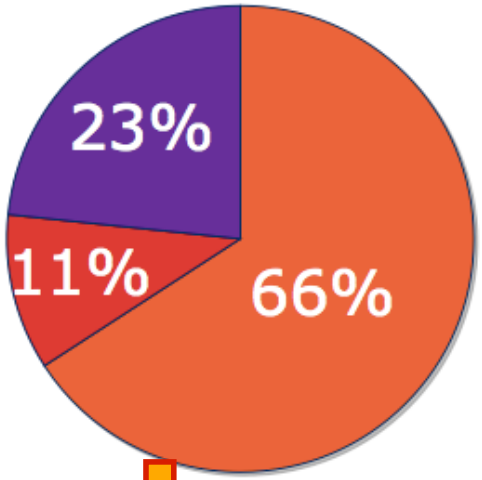


International Anthropogenic

Pre-industrial + Historical

N. American Anthropogenic

Southeast U.S.
34 μg m^{-2} y^{-1}

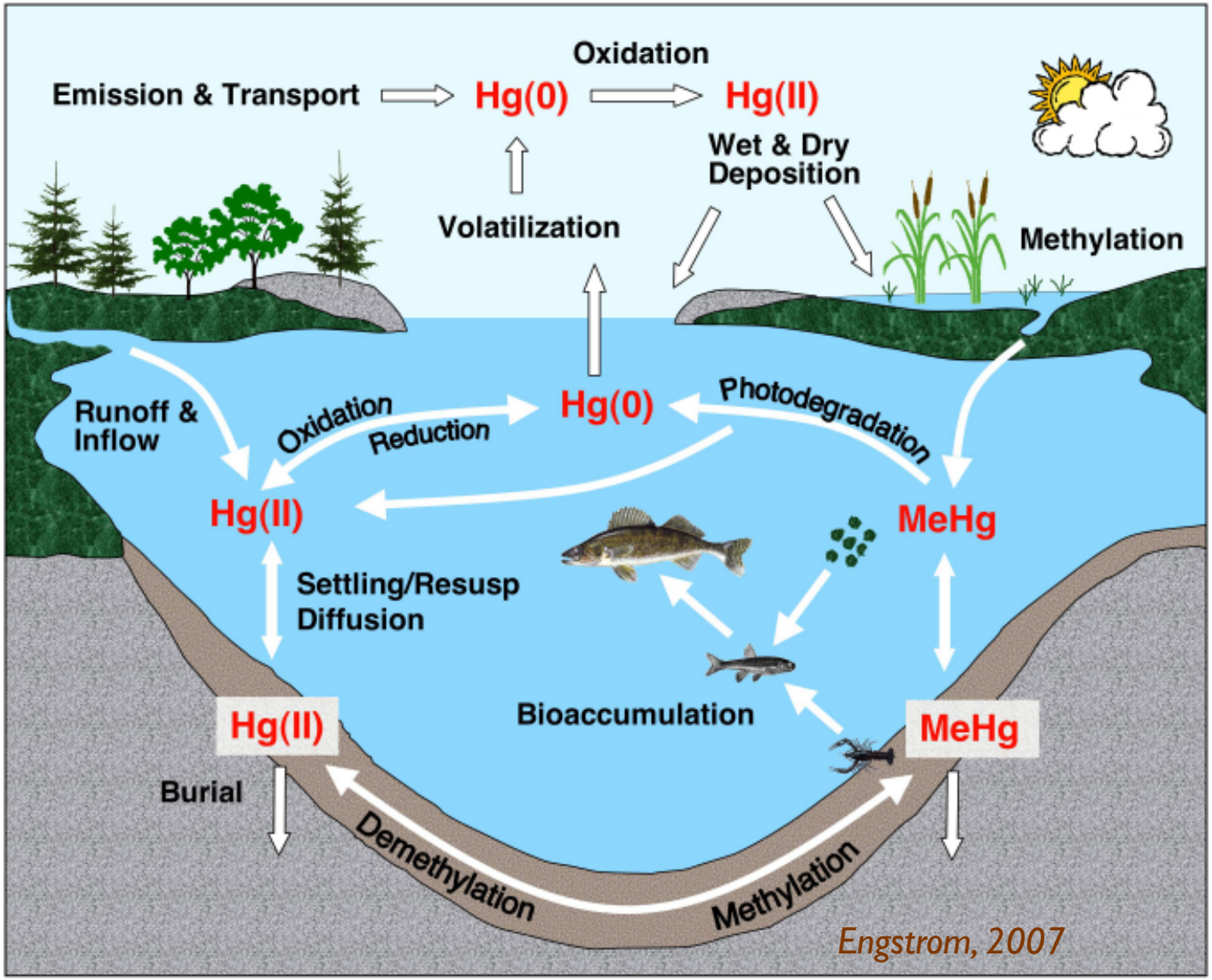


Lake, River, Watershed, and Aquatic food web models
[Knightes et al., 2009]

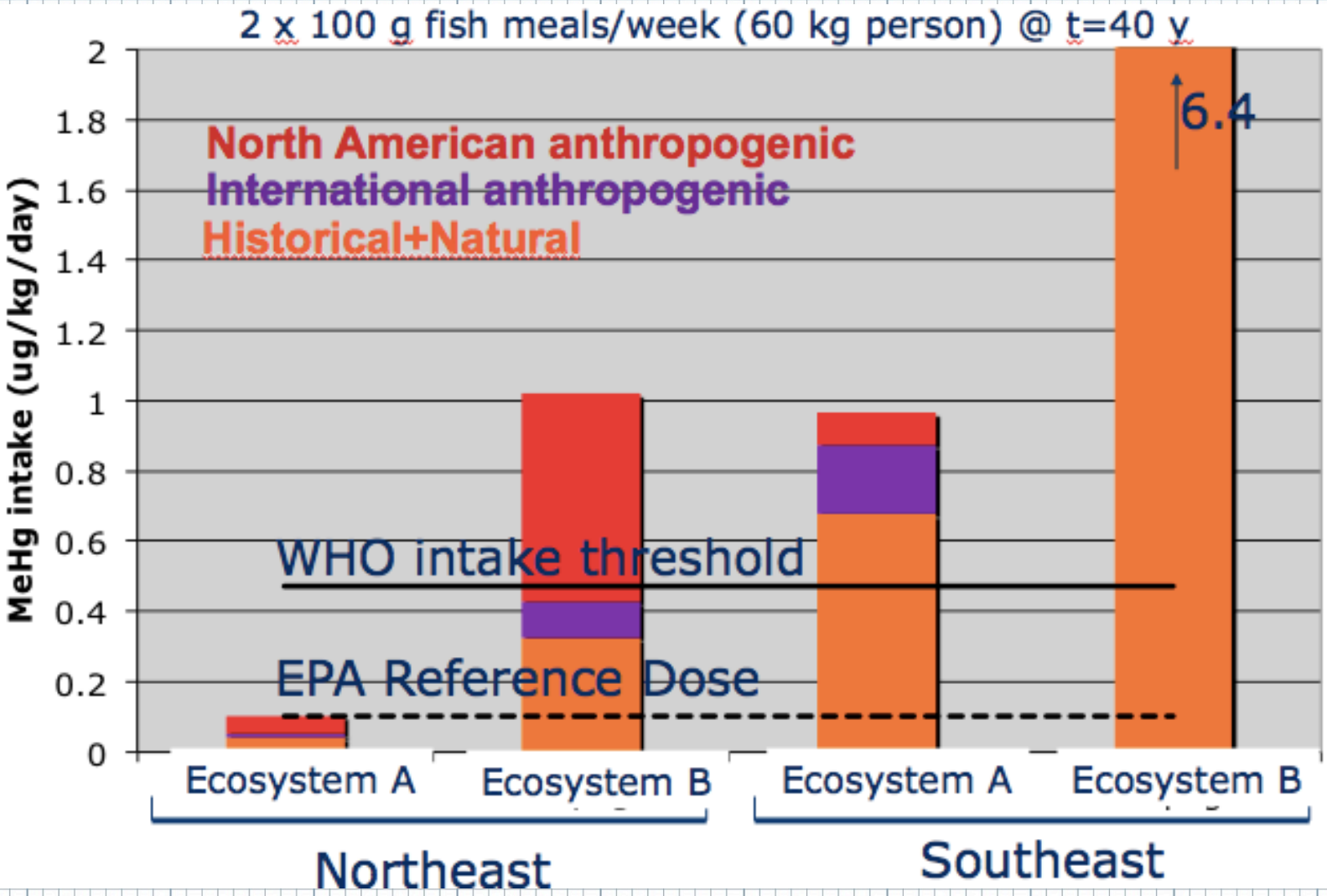
Policy and Timescale Analysis

Selin et al., Environmental Health Perspectives 2010

Where does Hg come from?

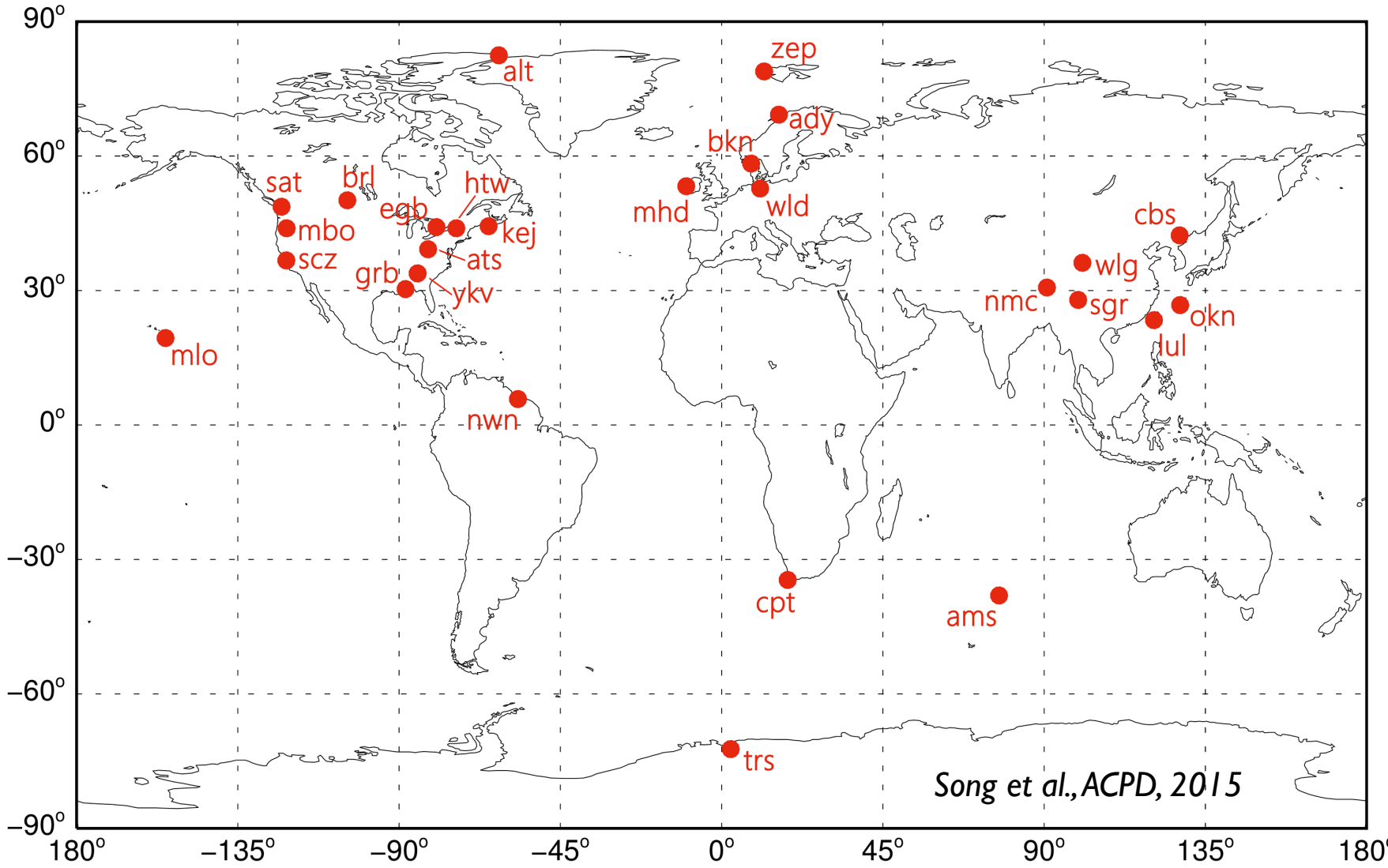


Where does Hg come from?

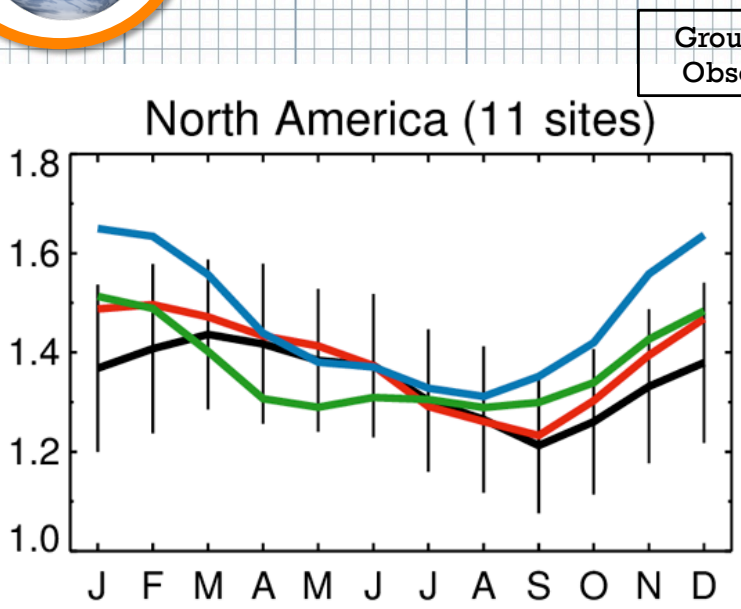


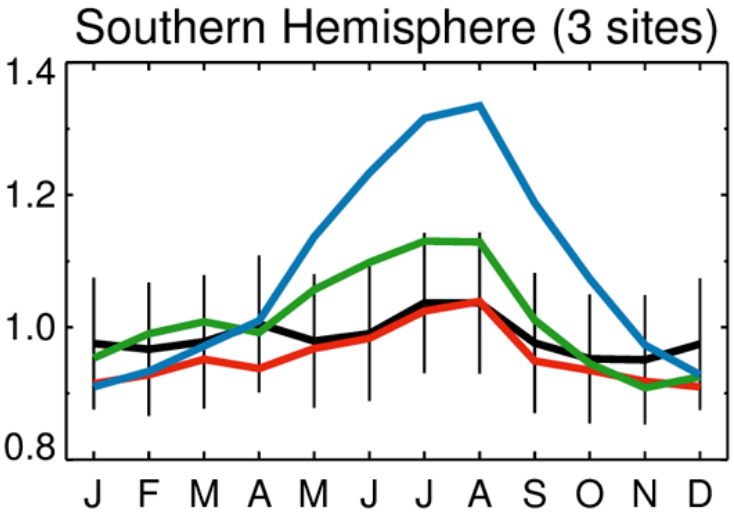
Selin et al., Environmental Health Perspectives 2010

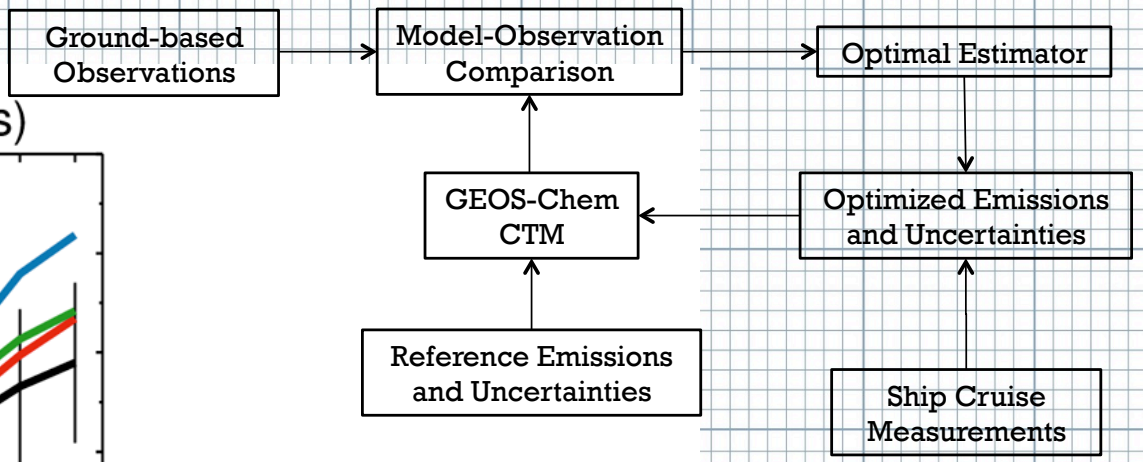
How does Hg travel worldwide?



Inverse methods help match observations







Black = Observation

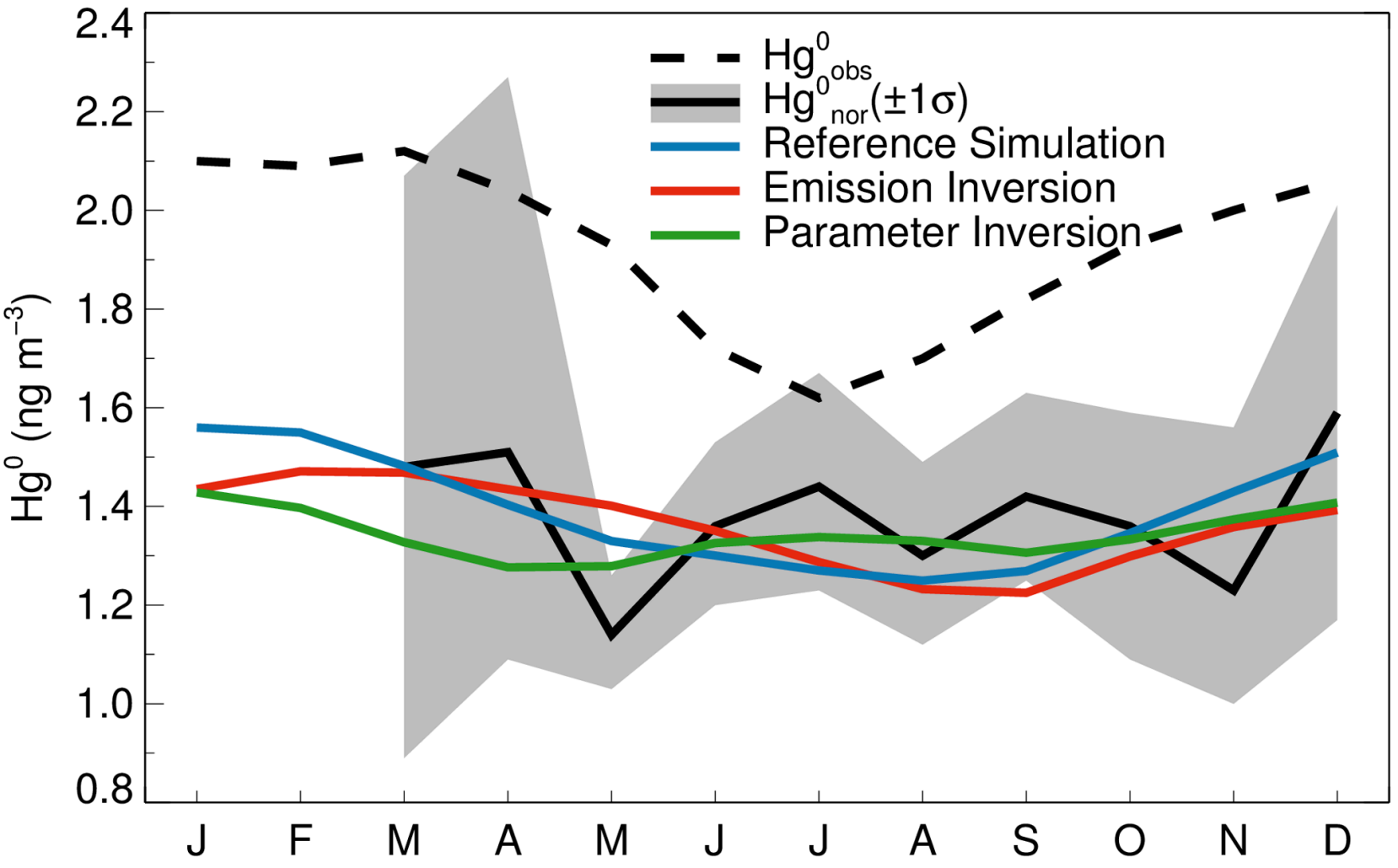
Blue = Reference Simulation

Red = Emission Inversion

Green = Parameter Inversion

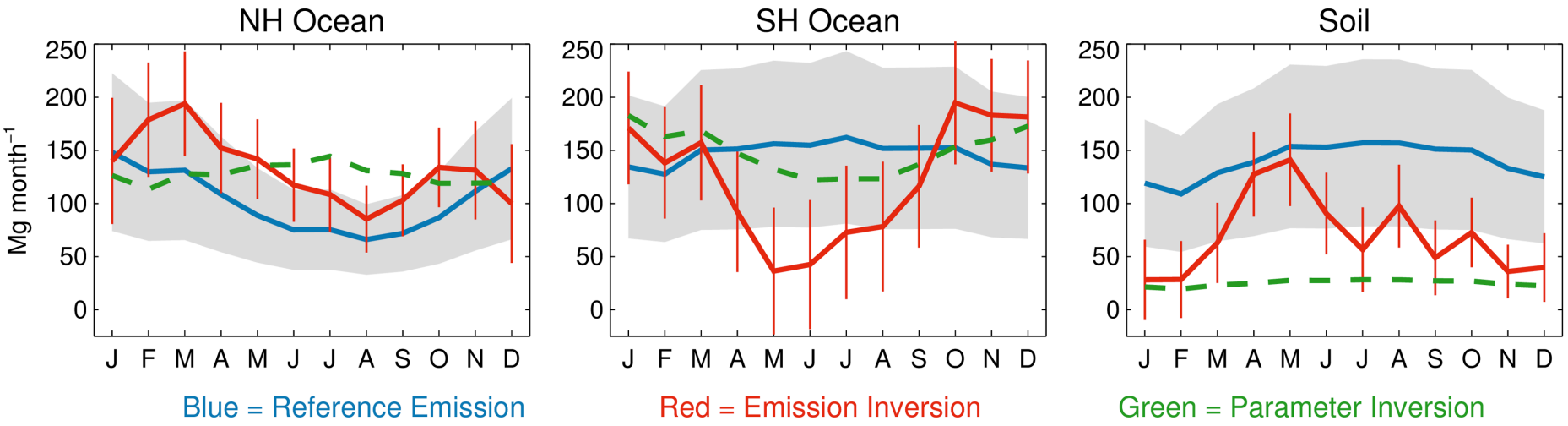
Song et al., ACPD, 2015

Cruise data provide independent test



Song et al., ACPD, 2015

Inversion changes our global budget

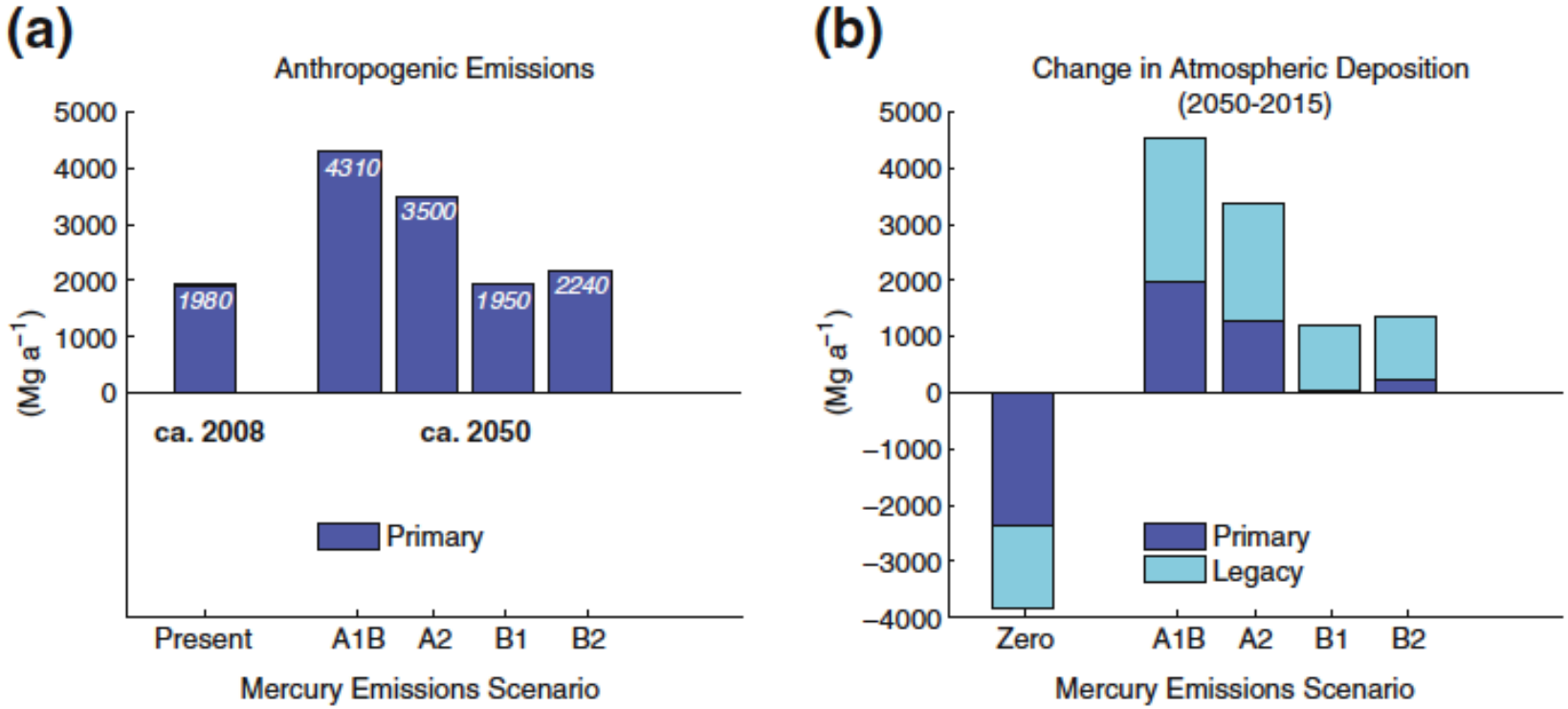


- Average uncertainties are reduced from 100% to ~ 64%.
- Significant changes in the seasonal variation of ocean and soil emissions.
- More emissions from Asia than we thought
- Constrains the timescale of legacy mercury
- **More mercury stored in the land, less in the ocean**

- **Challenges of measurement uncertainty, especially intercomparison errors**

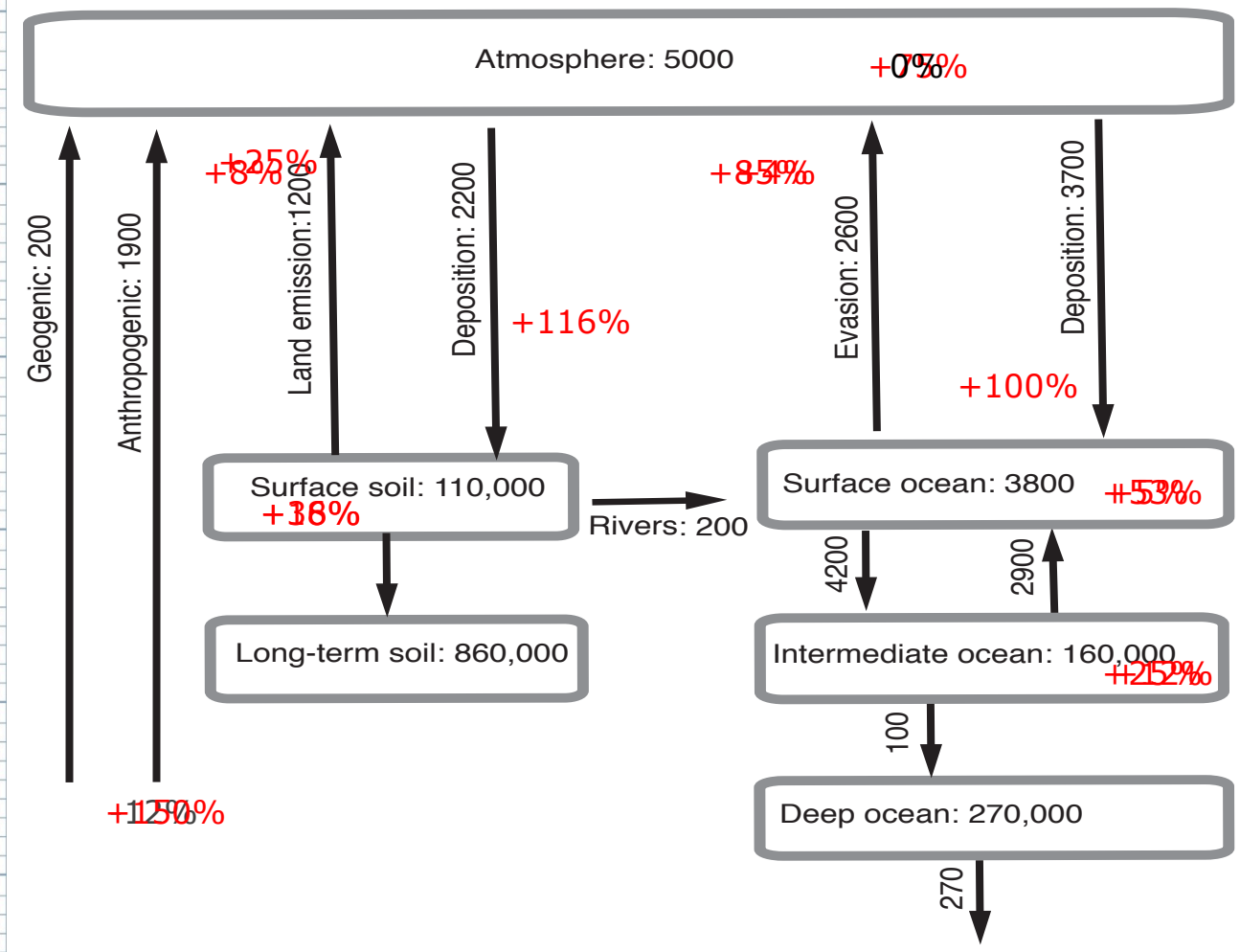
Song et al., ACPD, 2015

Will policy make a difference?



Sunderland and Selin, Env Hlth, 2013

Will policy make a difference?



Present

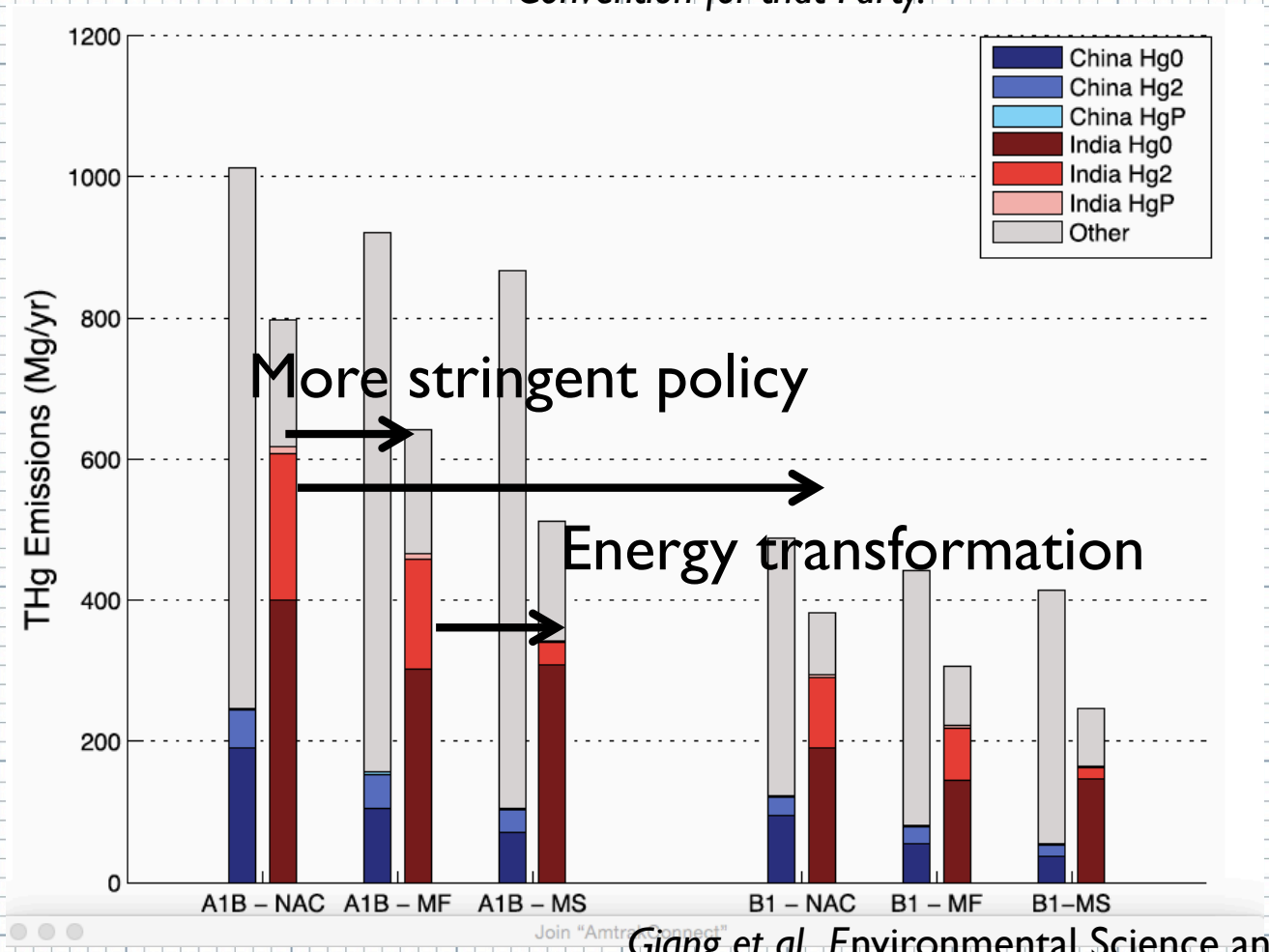
Policy (2050)

No policy (2050)

Selin, Environmental Toxicology and Chemistry, 2014

Will policy make a difference?

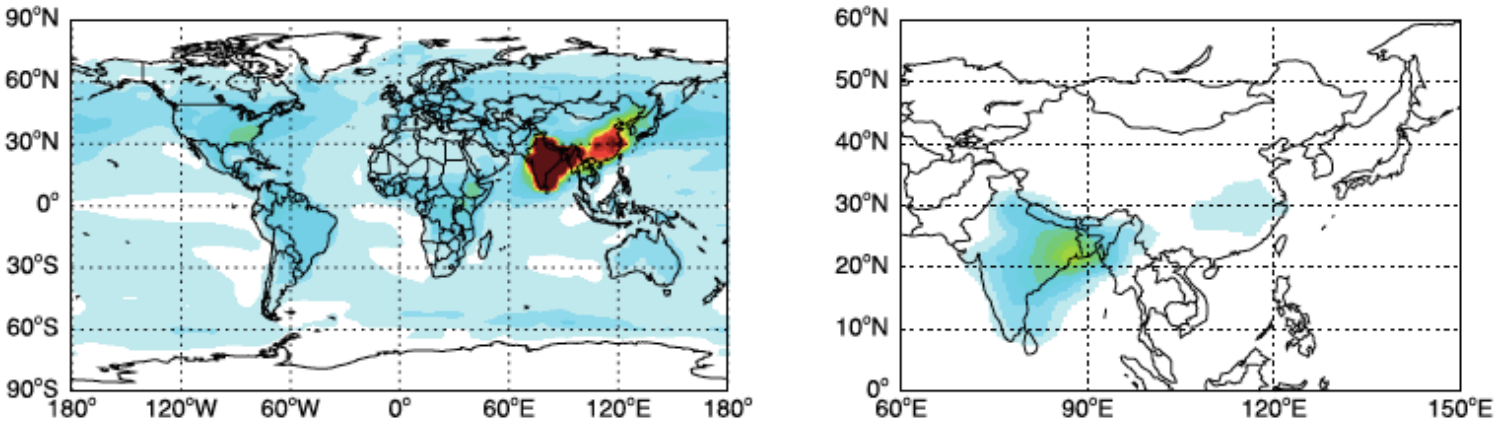
For new/existing sources, each Party shall require the use of best available techniques and best environmental practices to control and, where feasible, reduce emissions, as soon as practicable but no later than five/ten years after the date of entry into force of the Convention for that Party.



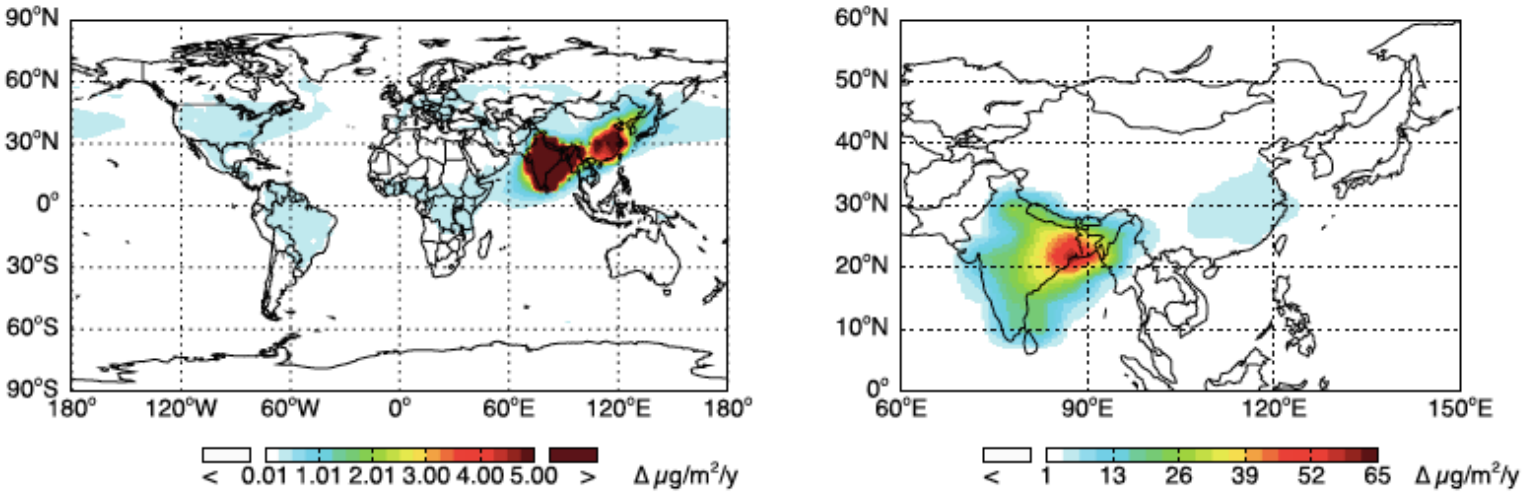
Giang et al., Environmental Science and Technology, 2015

Will policy make a difference?

A. Δ Gross Deposition, NAC - MF



B. Δ Gross Deposition, MF - MS



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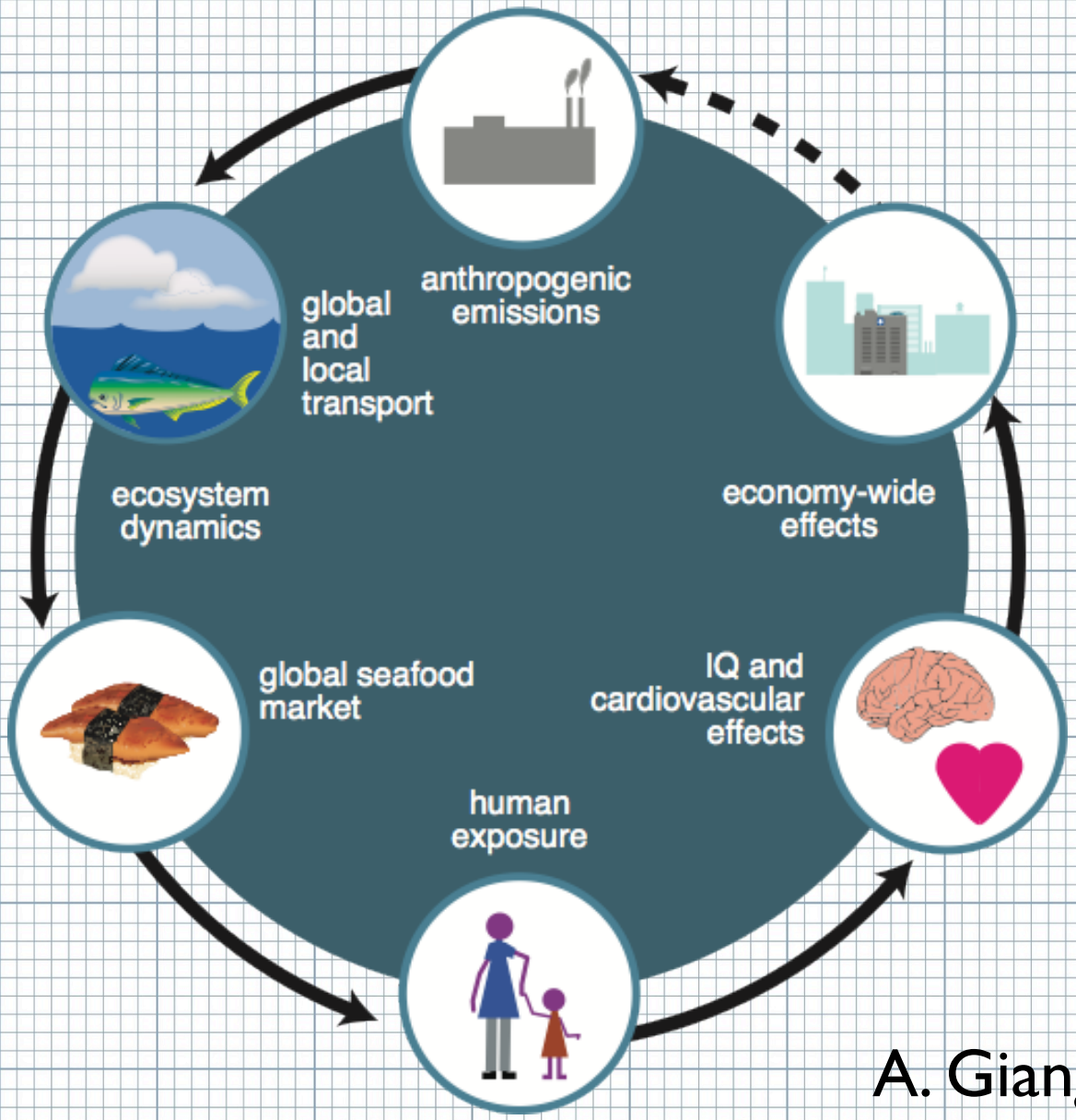
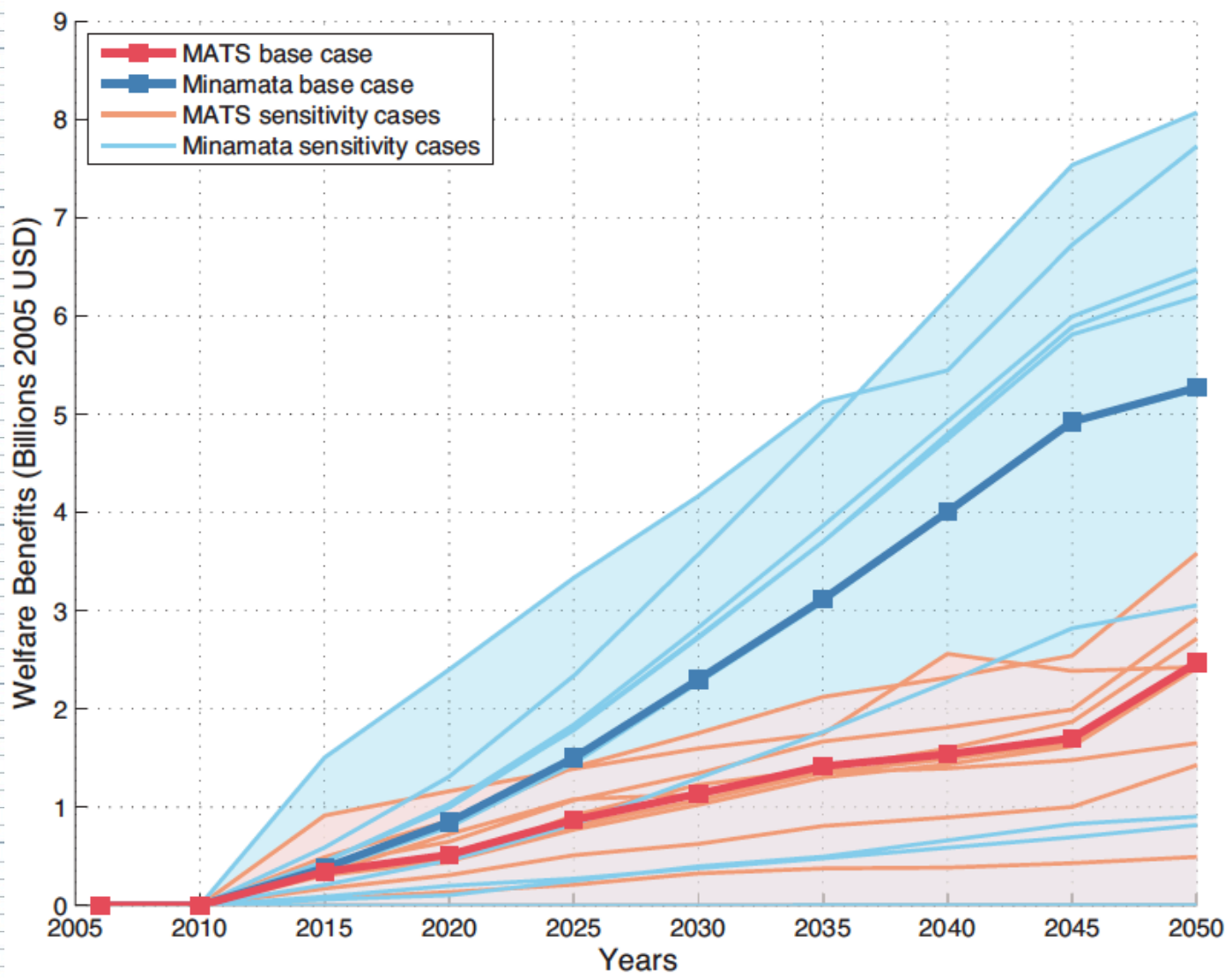


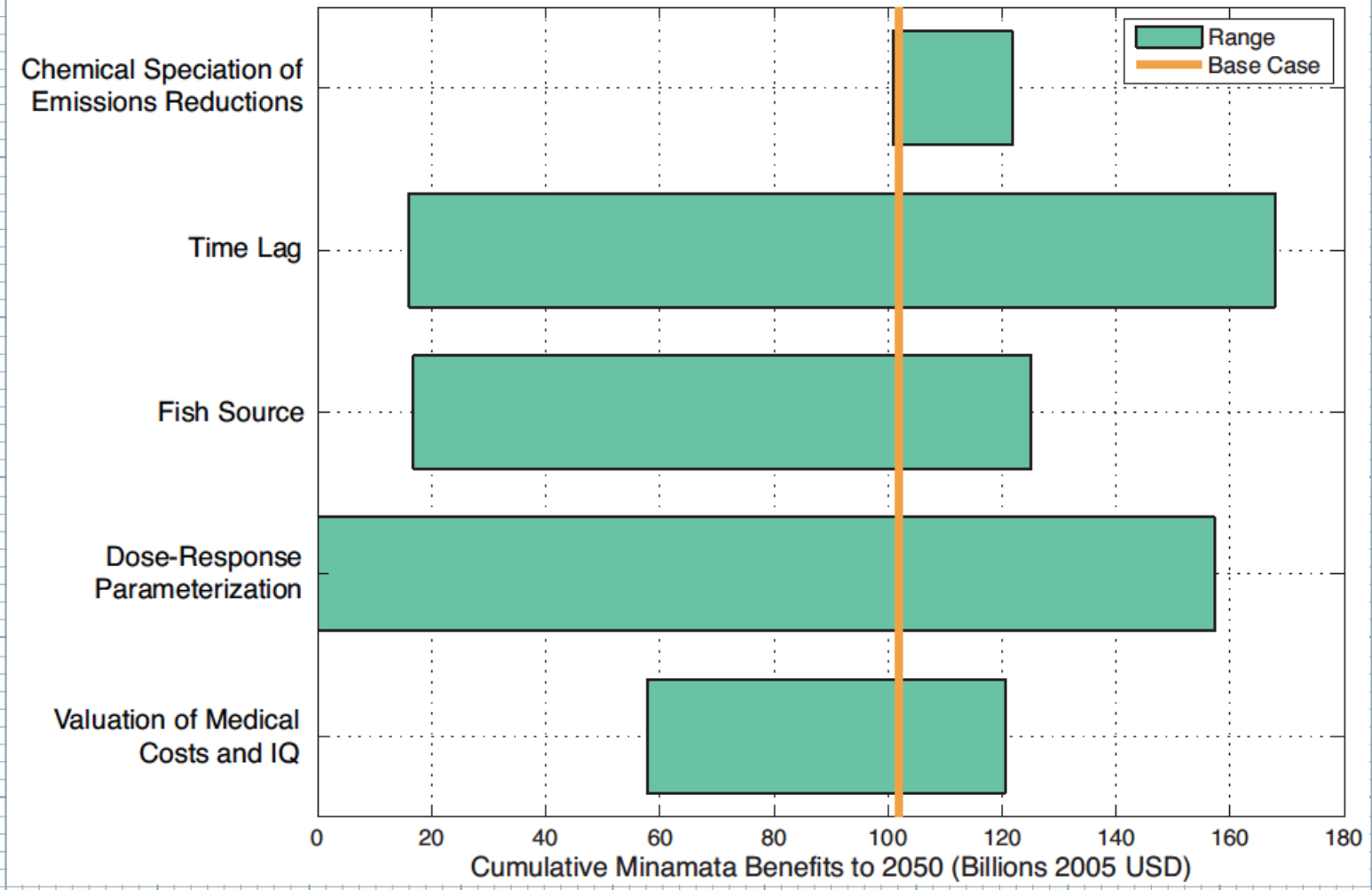
A. Giang, in prep.

Will policy make a difference?



Giang et al., in prep

Uncertainty analysis



Giang et al., in prep

To learn more, play the Hg game

http://mit.edu/mercurygame

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