

MERCURY POLLUTION

tracking emissions to impacts

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[Flickr/JonPinder cc](#)



MERCURY: A GLOBAL POLLUTANT



[Flickr/vgm8383 cc](#)

United Nations
The second session of the Intergovernmental Negotiating Committee for a global legally binding instrument on mercury





Where does
mercury come
from?

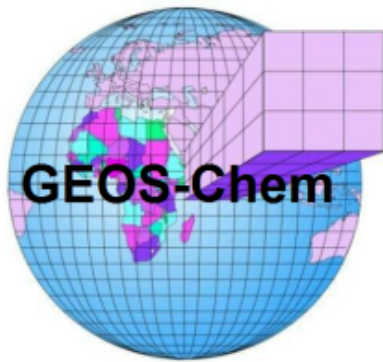


How does it
travel
worldwide?



Will policies
make a
difference?

A GLOBAL PERSPECTIVE REQUIRES GLOBAL MODELS



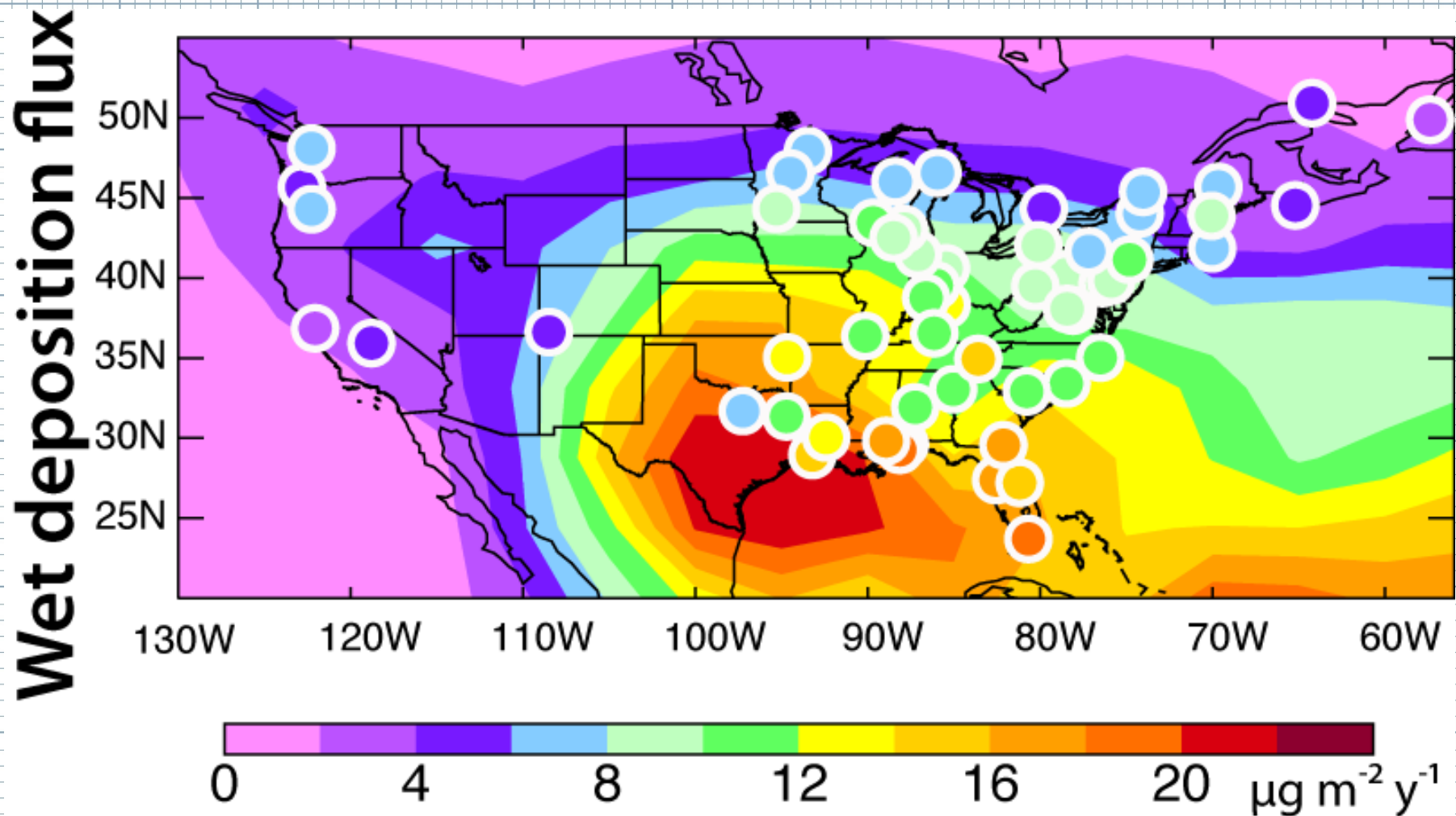
Global, 3D tropospheric chemistry model, 4x5 or 2x2.5 latitude-longitude resolution (nested grid over U.S.), assimilated meteorology

[*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?

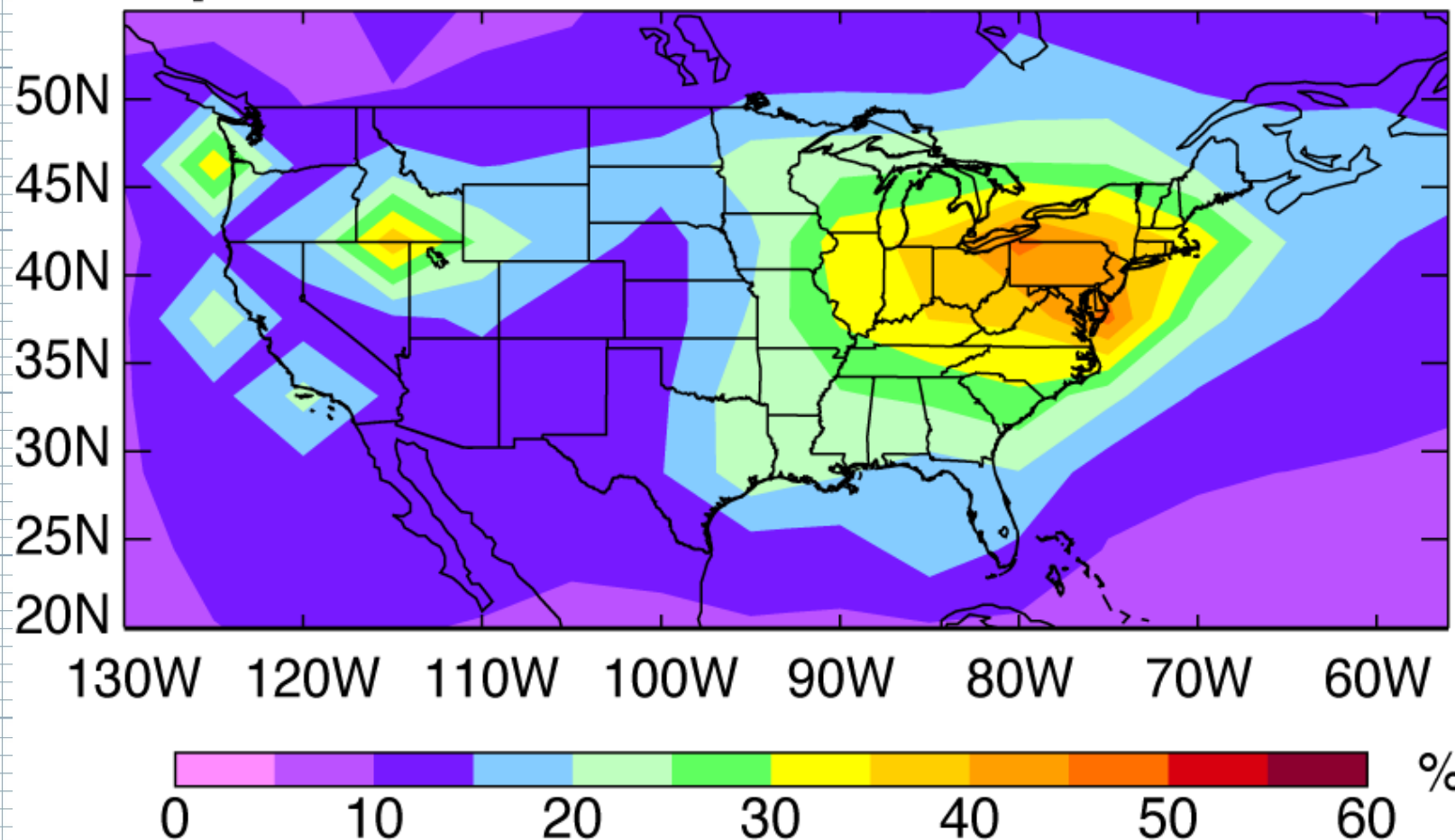


[Selin & Jacob, Atmos. Env. 2008]

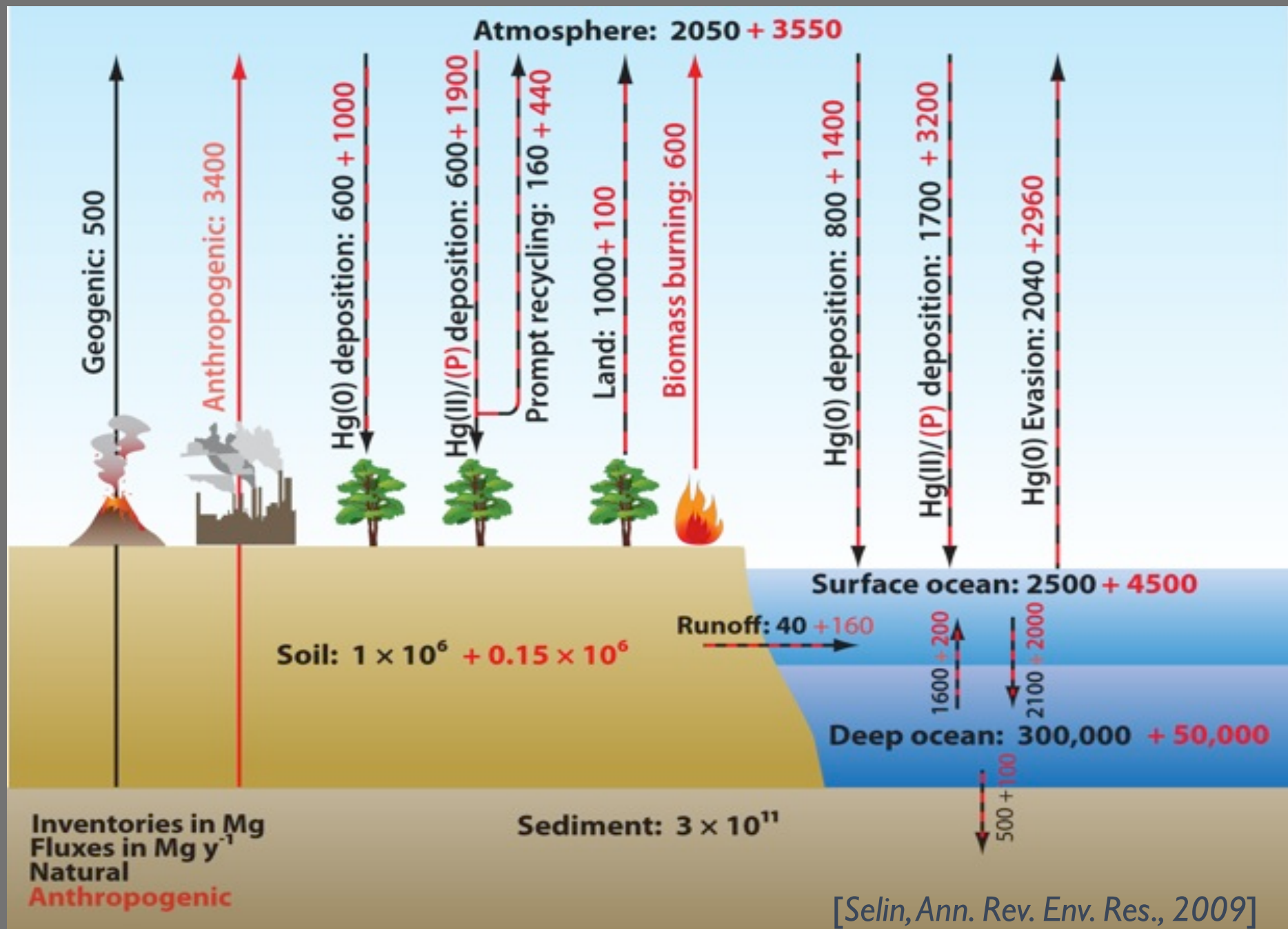


Domestic and international sources

% Deposition from North American Sources



[Selin & Jacob, Atmos. Env. 2008]

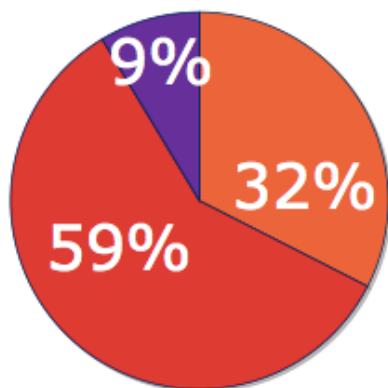




Where does Hg come from?

Northeast U.S.

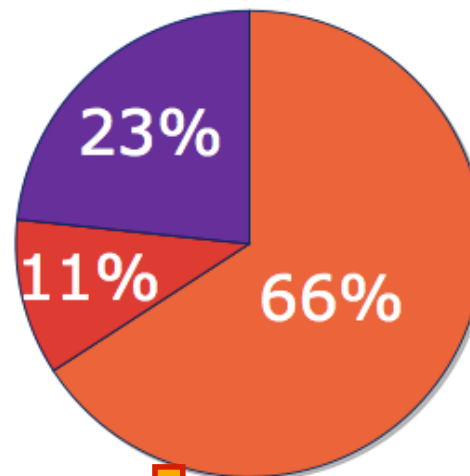
$24 \mu\text{g m}^{-2} \text{y}^{-1}$



International
Anthropogenic
Pre-industrial +
Historical
N. American
Anthropogenic

Southeast U.S.

$34 \mu\text{g m}^{-2} \text{y}^{-1}$

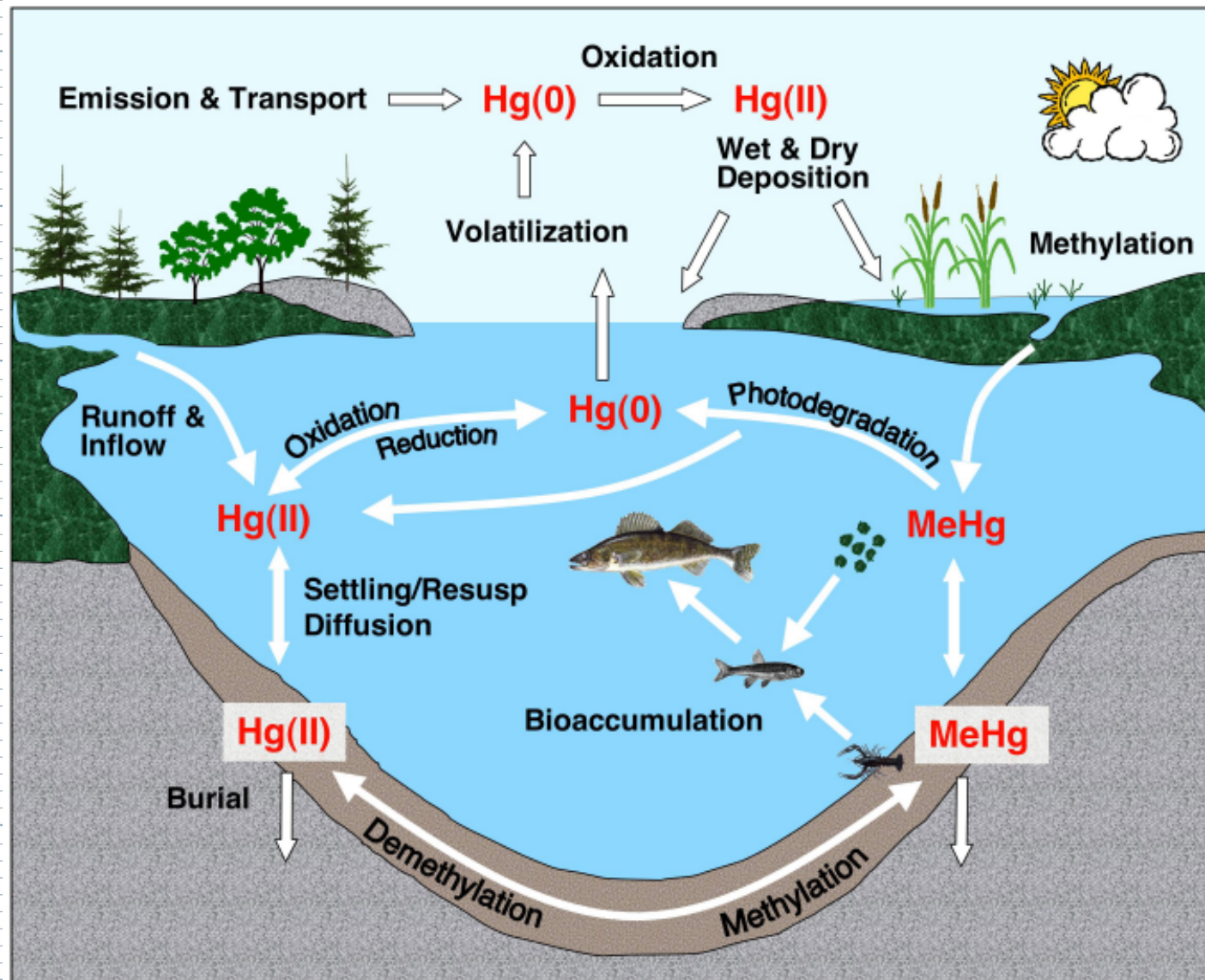


Lake, River, Watershed, and Aquatic food web models
[Knights et al., 2009]

Policy and Timescale Analysis

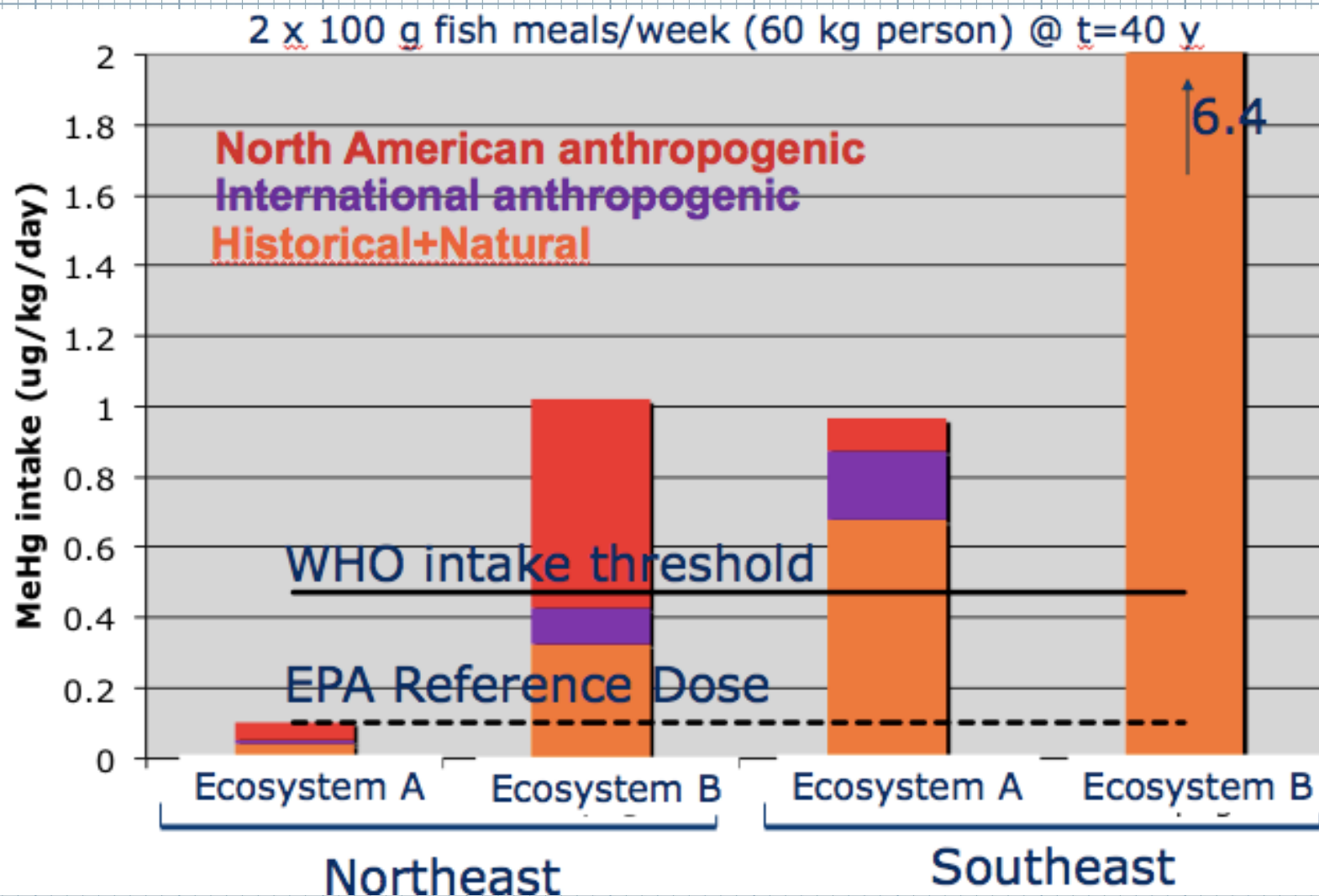


Where does Hg come from?



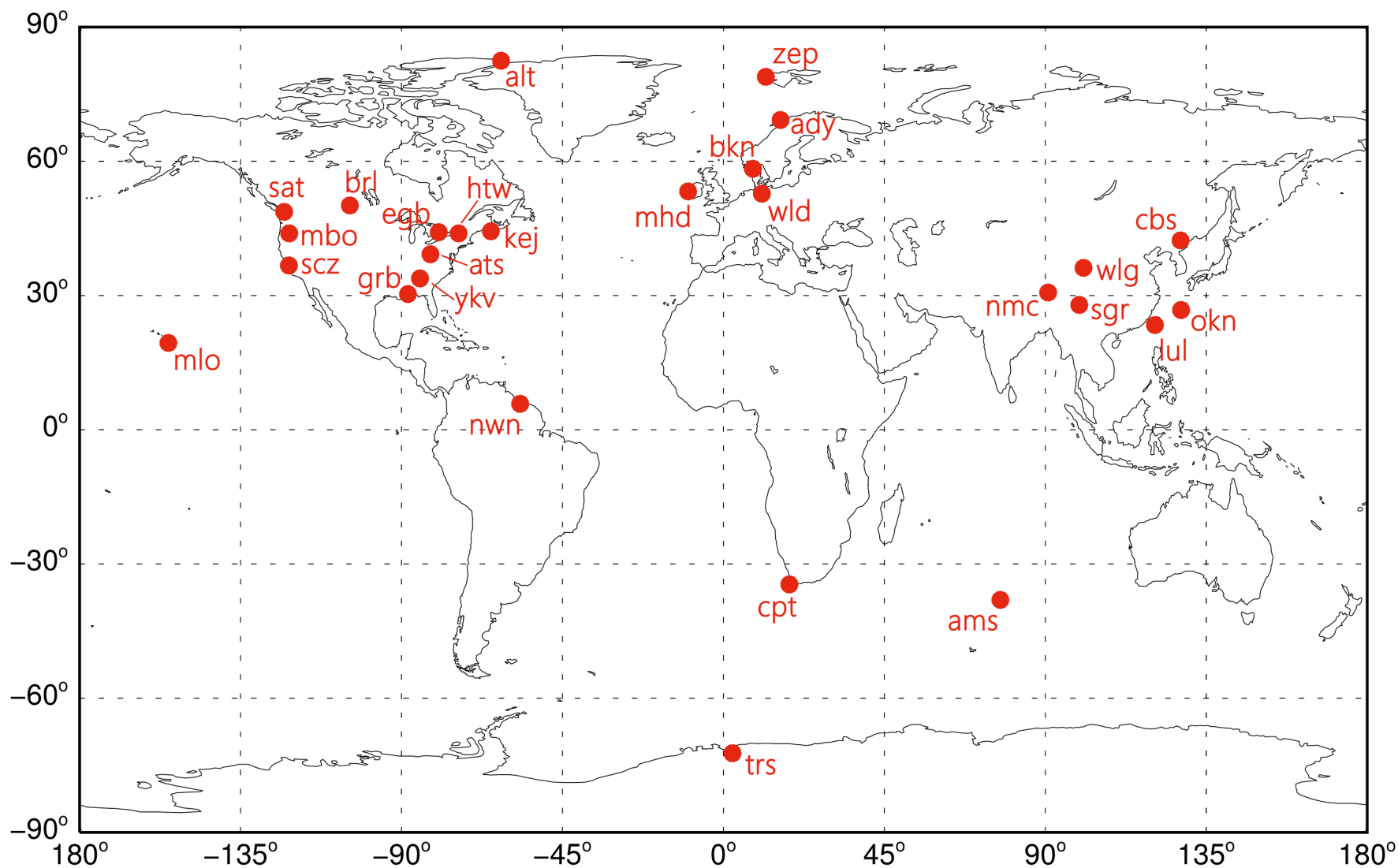


Where does Hg come from?





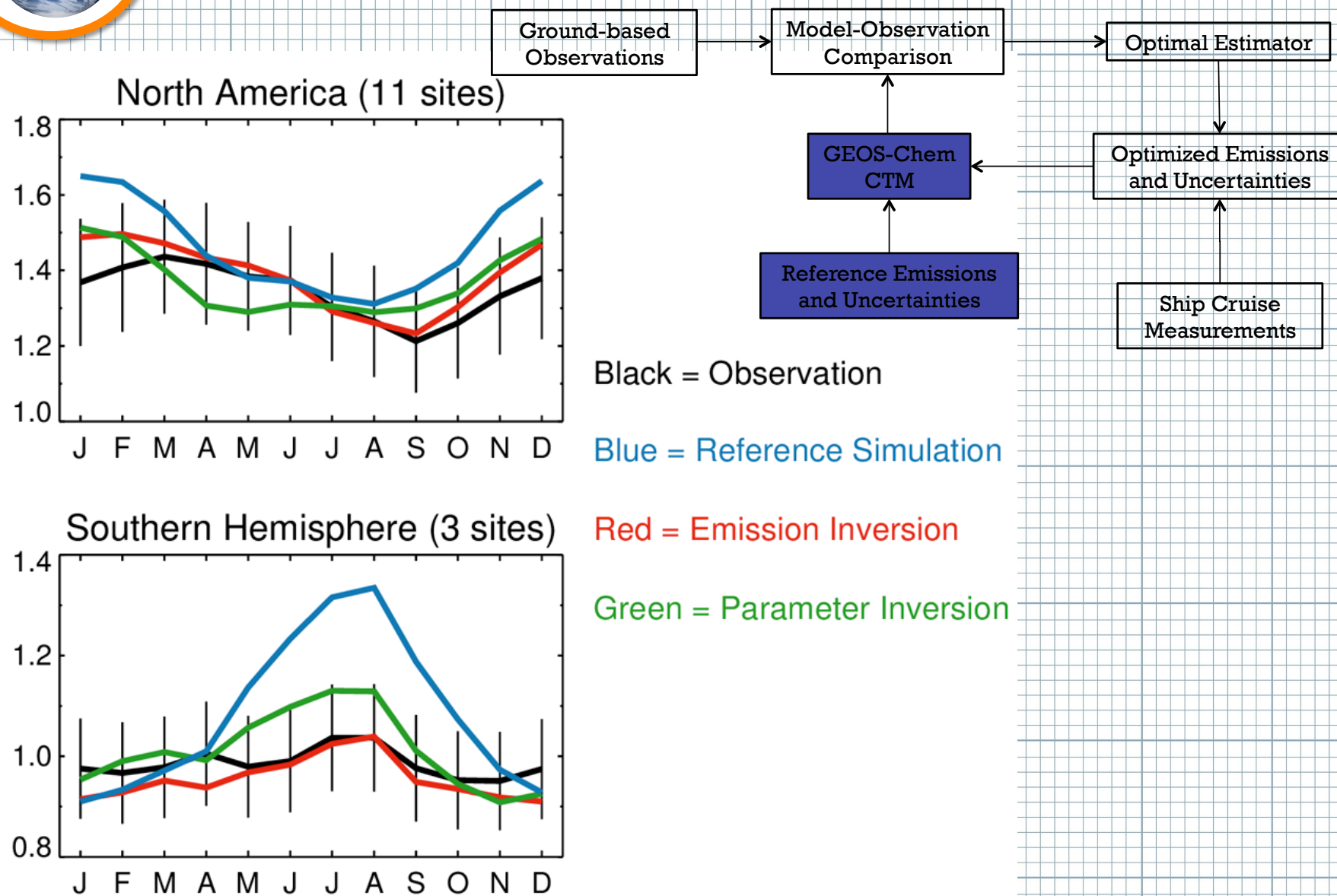
How does Hg travel worldwide?



Song et al., ACPD, 2015

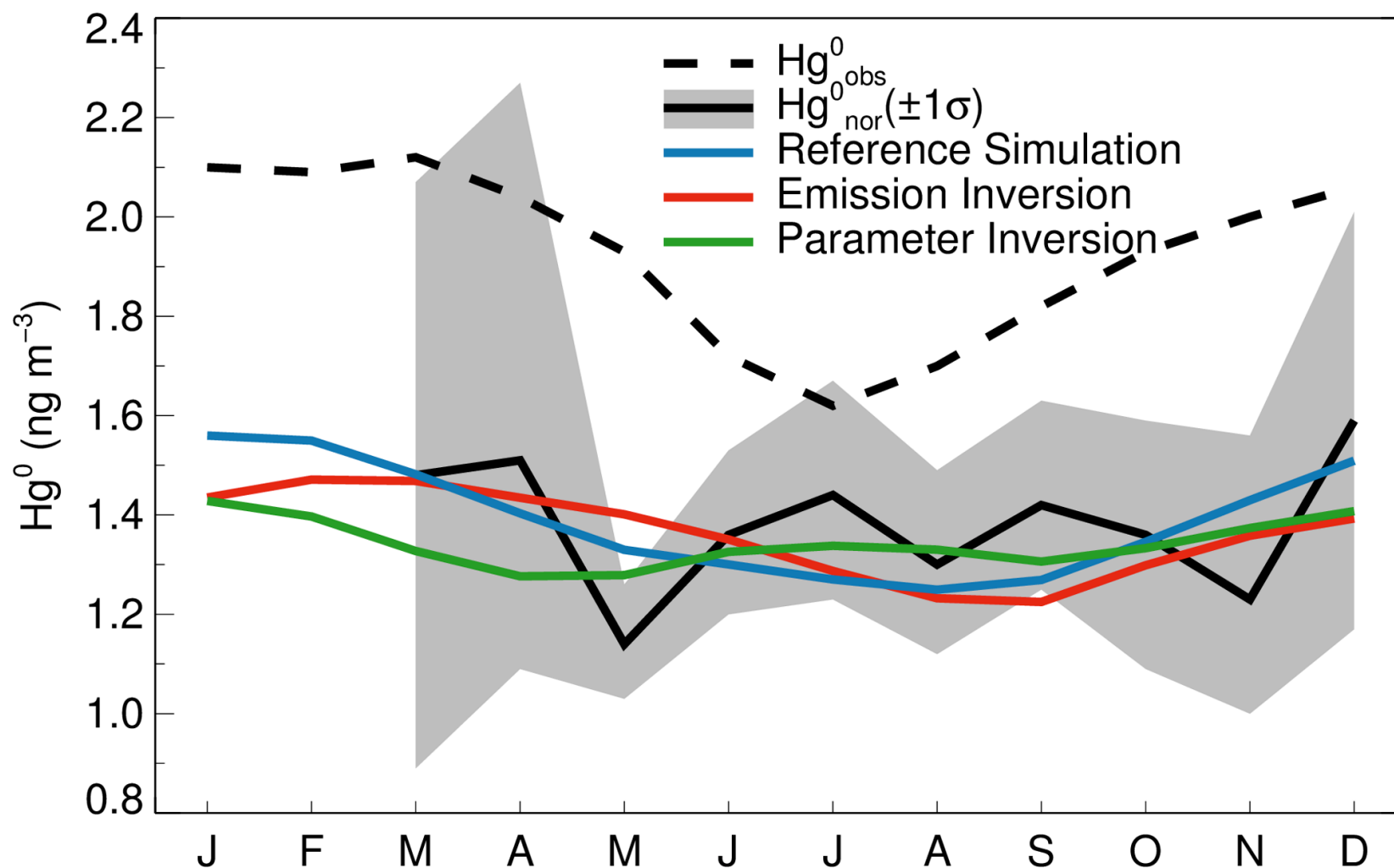


Inverse methods help match observations



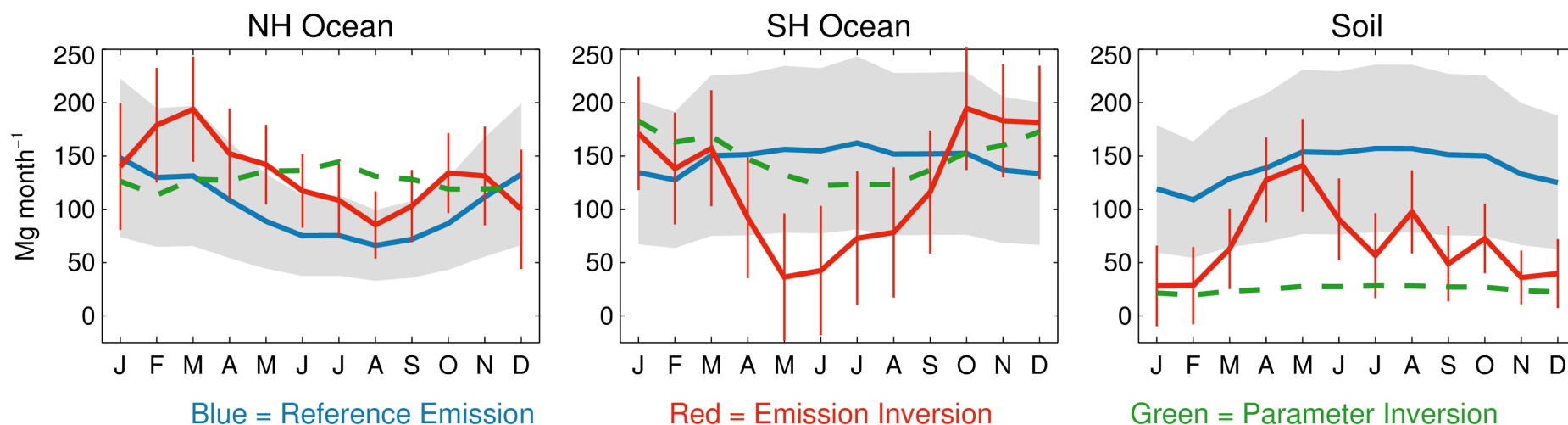


Cruise data provide independent test





Inversion changes our global budget



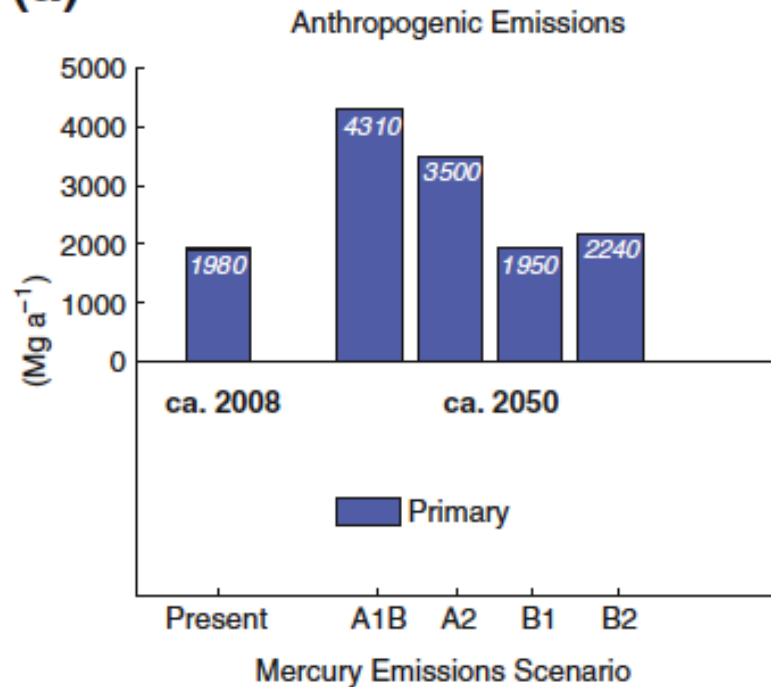
- Average uncertainties are reduced from 100% to ~ 64%.
- Significant changes in the seasonal variation of ocean and soil emissions.
 - More emissions from Asia than we thought
 - Constrains the timescale of legacy mercury
- **More mercury stored in the land, less in the ocean**

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

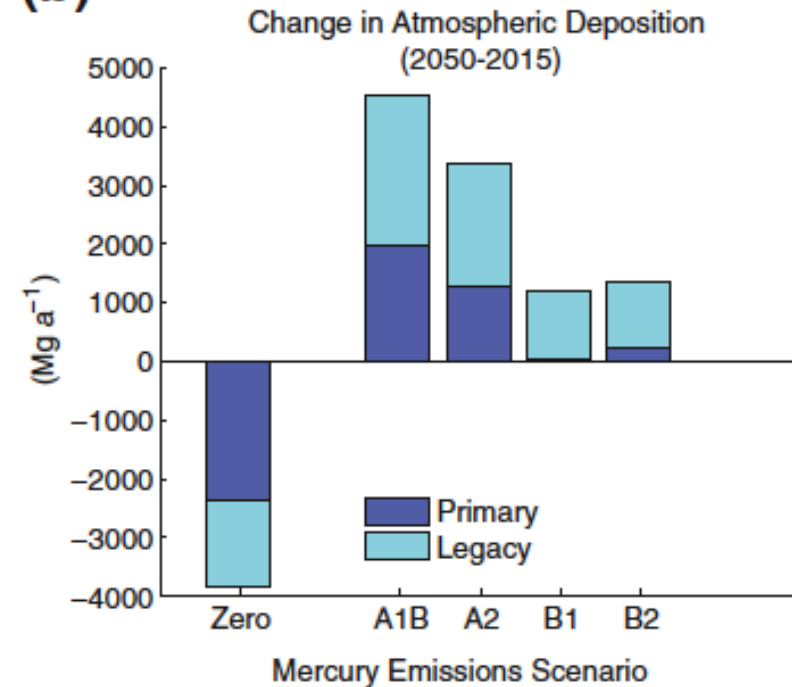


Will policy make a difference?

(a)



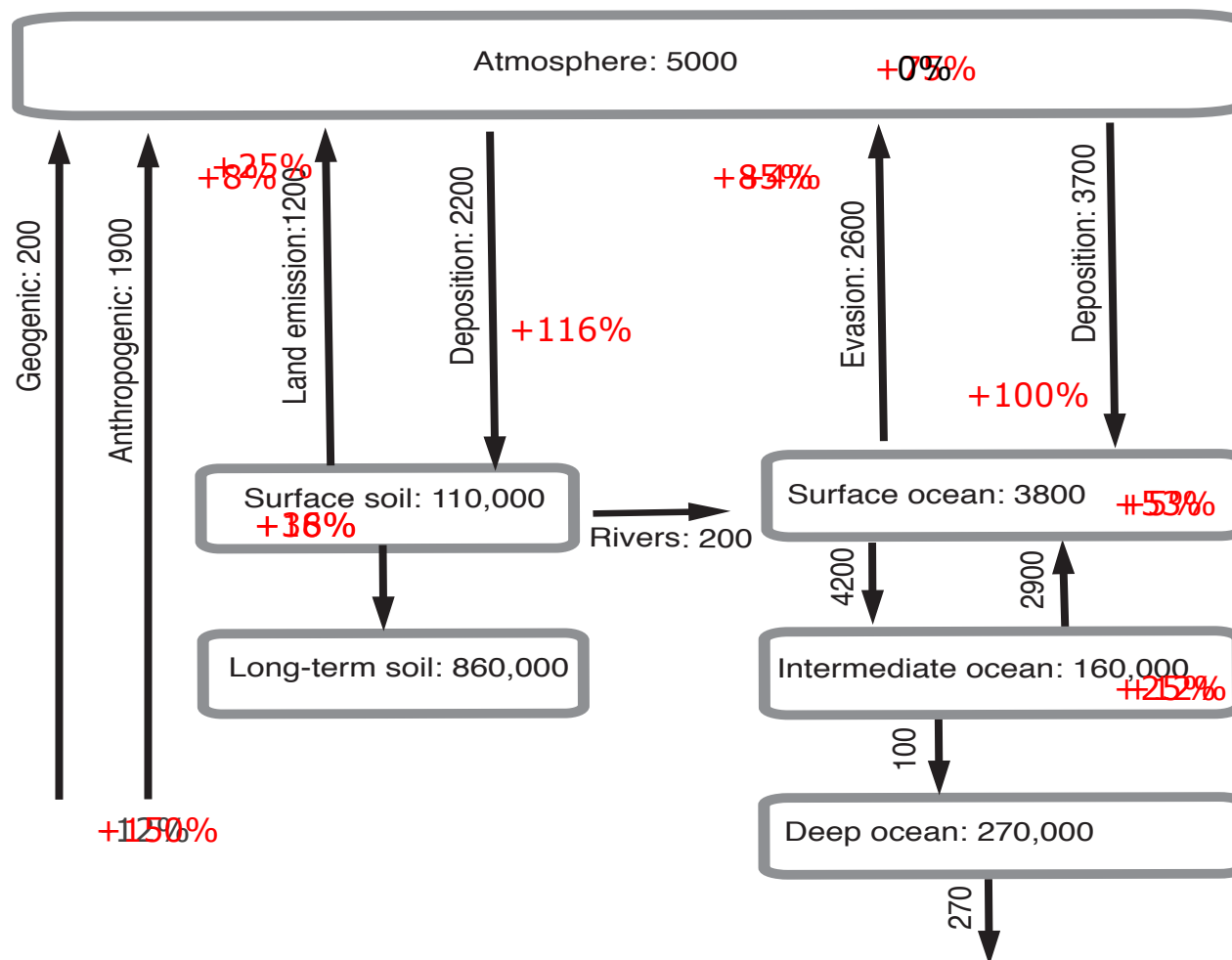
(b)



Sunderland and Selin, *Env Hlth*, 2013



Will policy make a difference?



Present

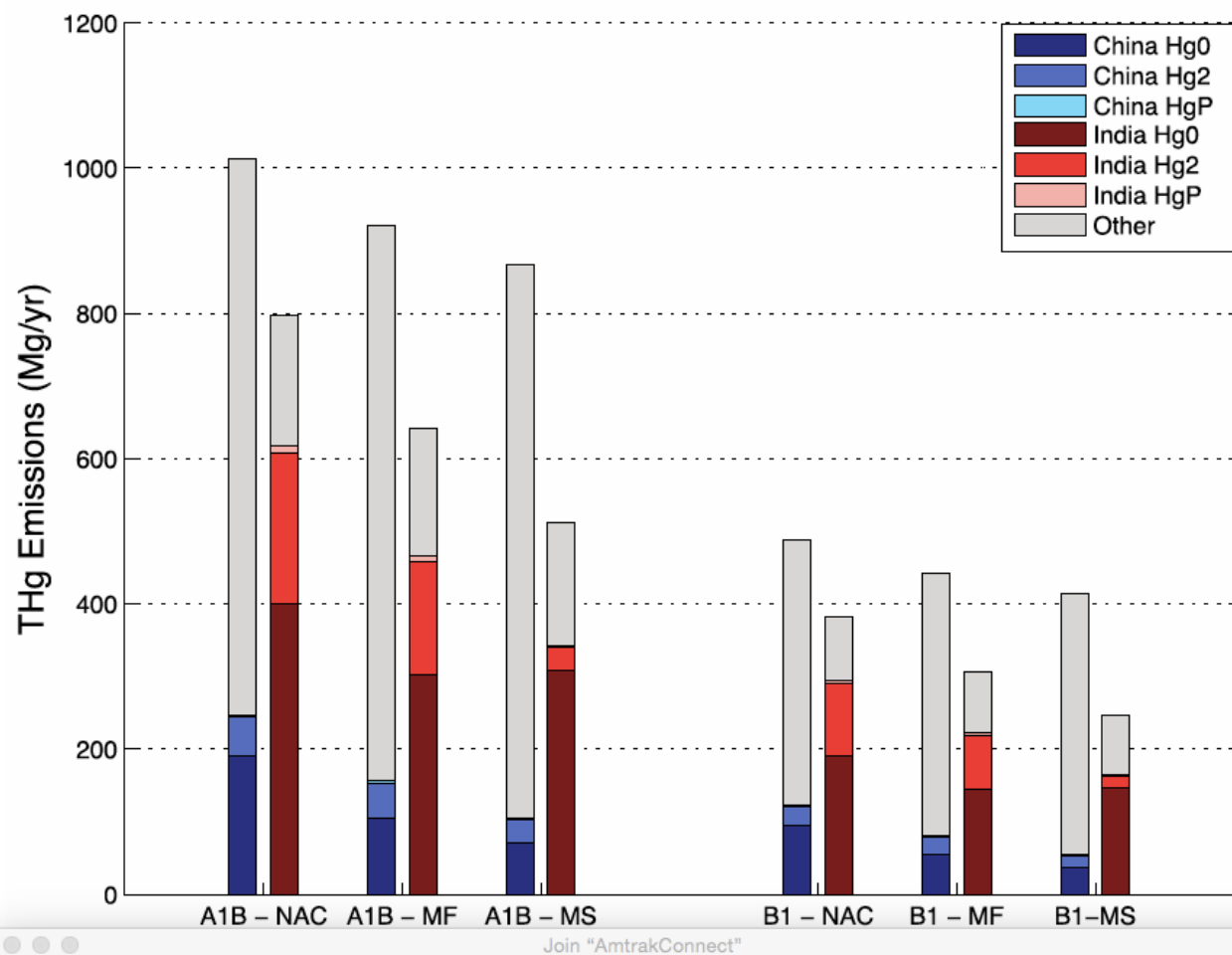
Policy (2050)

No policy (2050)



Will policy make a difference?

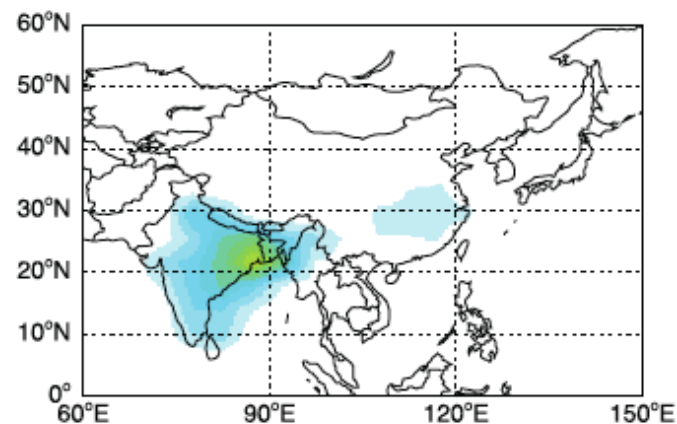
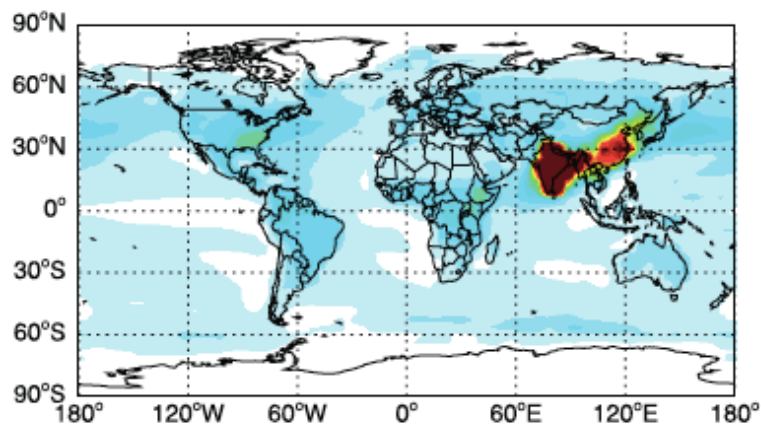
For new/existing sources, each Party shall require the use of best available techniques and best environmental practices to control and, where feasible, reduce emissions, as soon as practicable but no later than five/ten years after the date of entry into force of the Convention for that Party.



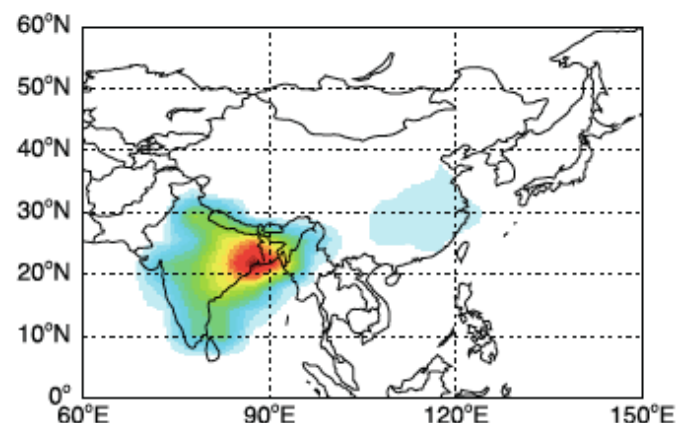
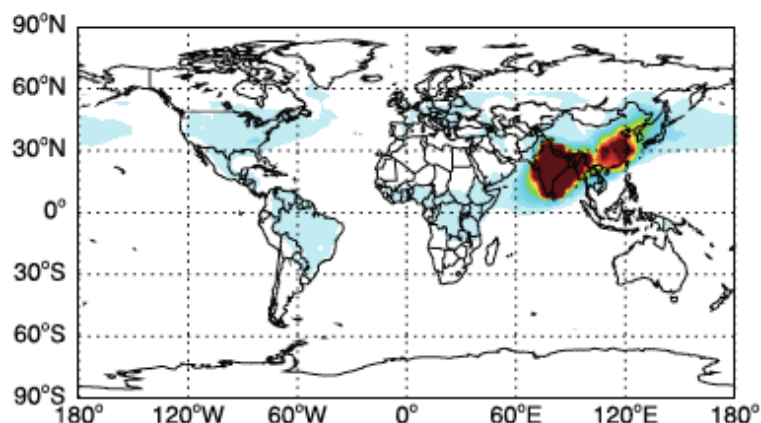


Will policy make a difference?

A. Δ Gross Deposition, NAC - MF

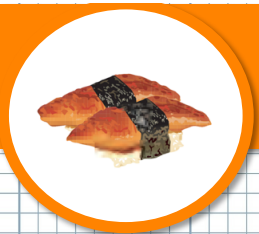


B. Δ Gross Deposition, MF - MS

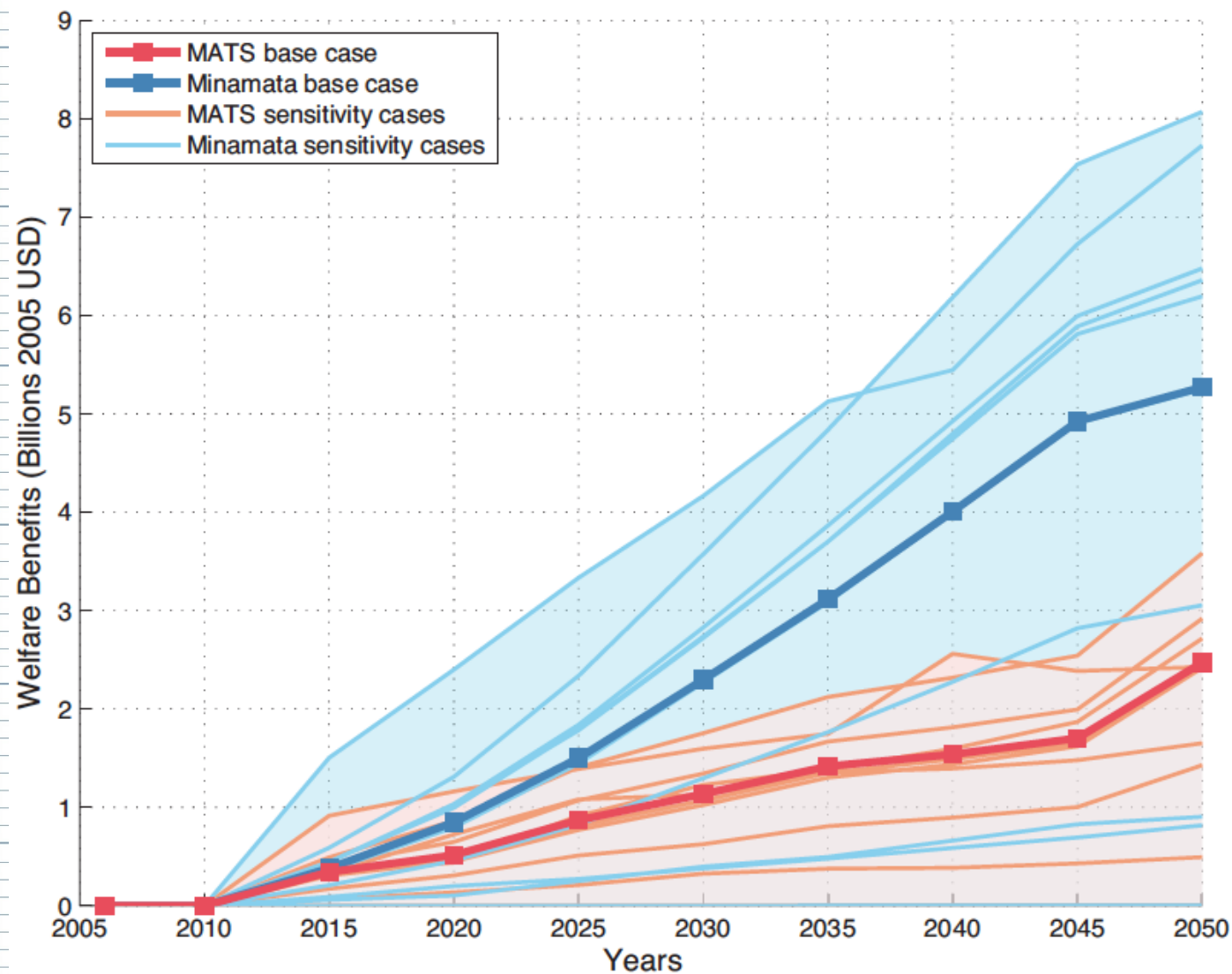


< 0.01 1.01 2.01 3.00 4.00 5.00 $>$ $\Delta \mu\text{g}/\text{m}^2/\text{y}$

< 1 13 26 39 52 65 $\Delta \mu\text{g}/\text{m}^2/\text{y}$



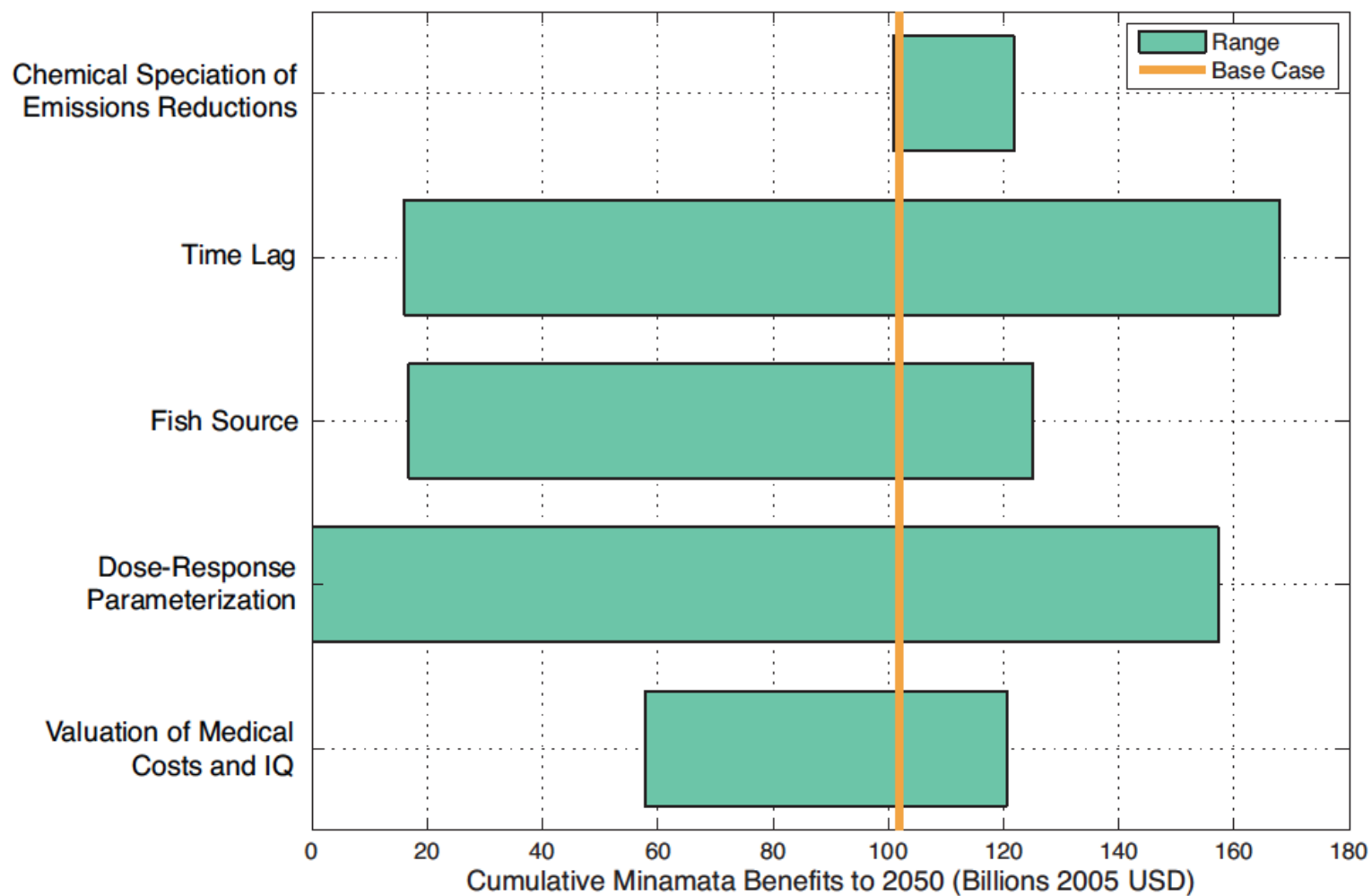
Will policy make a difference?



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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