Tracking Mercury Pollution from Emissions to Impacts

Noelle E. Selin
Massachusetts Institute of Technology

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selin@mit.edu
http://mit.edu/selin
http://mit.edu/selingroup

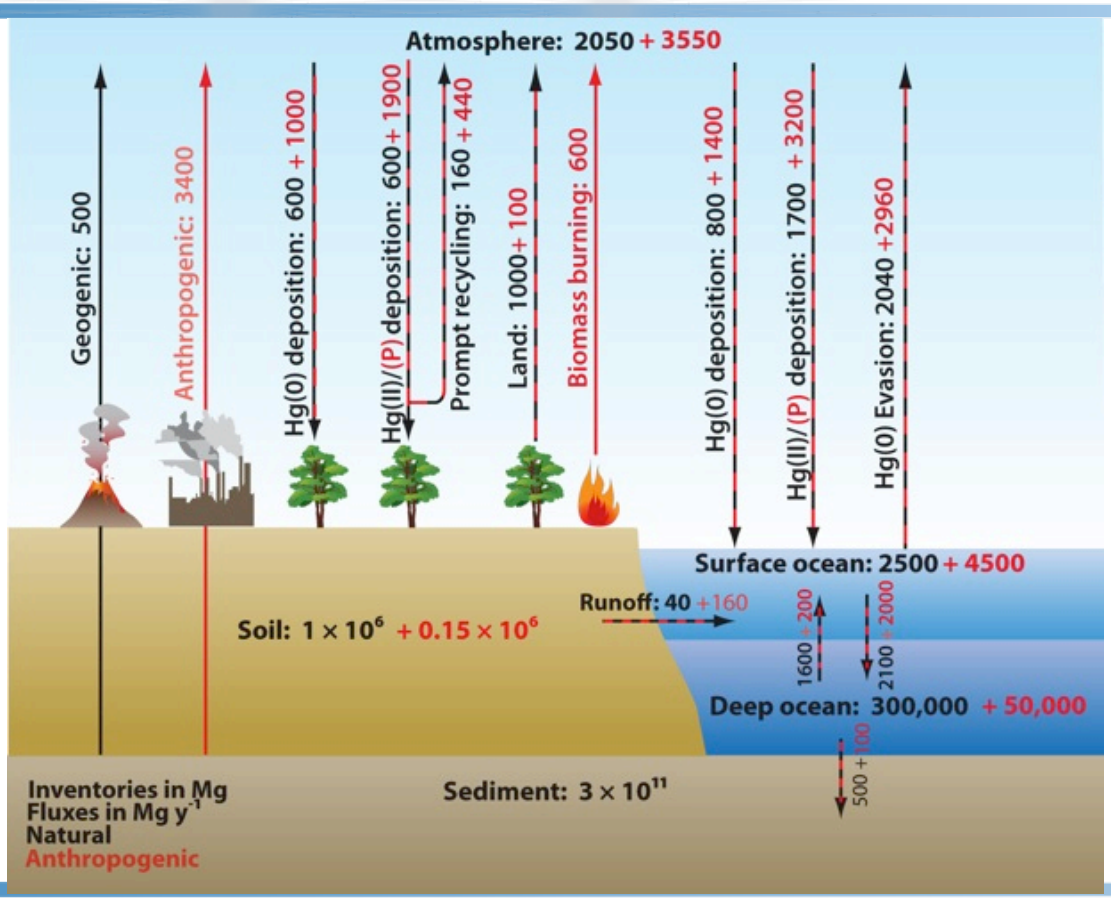
MIT ESD
Massachusetts Institute of Technology
Engineering Systems Division

EAPS

Questions

- What effect will the Minamata Convention have on the global biogeochemical cycle of mercury?
- Do we understand the pathway from emissions to impacts well enough to quantitatively evaluate global policy effectiveness?

Global Biogeochemical Cycle of Mercury



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

Minamata Convention Provisions

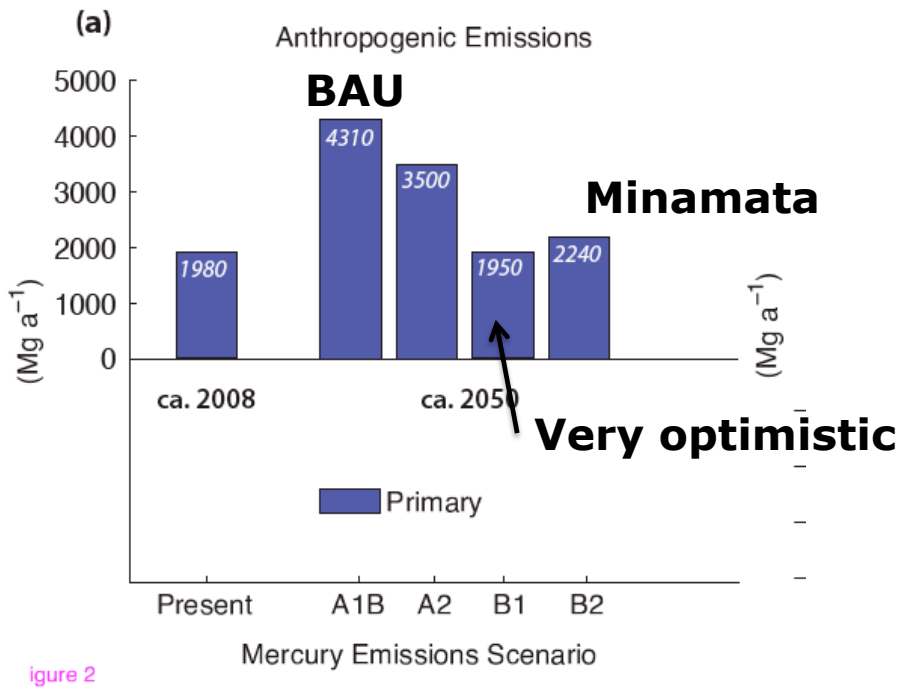
- Covers 96% of sources in present inventory of atmospheric emissions
- Separated into “intentional” and “unintentional” uses
  - Point sources: about half; largest source

Emissions in the Minamata Convention

- Emissions to air, releases to water/land
- Emissions controls on point sources:
  - New Sources: Best Available Technology, 5 years
  - Existing Sources: menu of choices, 10 years
- Releases: must take measures to control releases

For more: Policy session on Friday AM at ICMGP

Emissions and Deposition to 2050

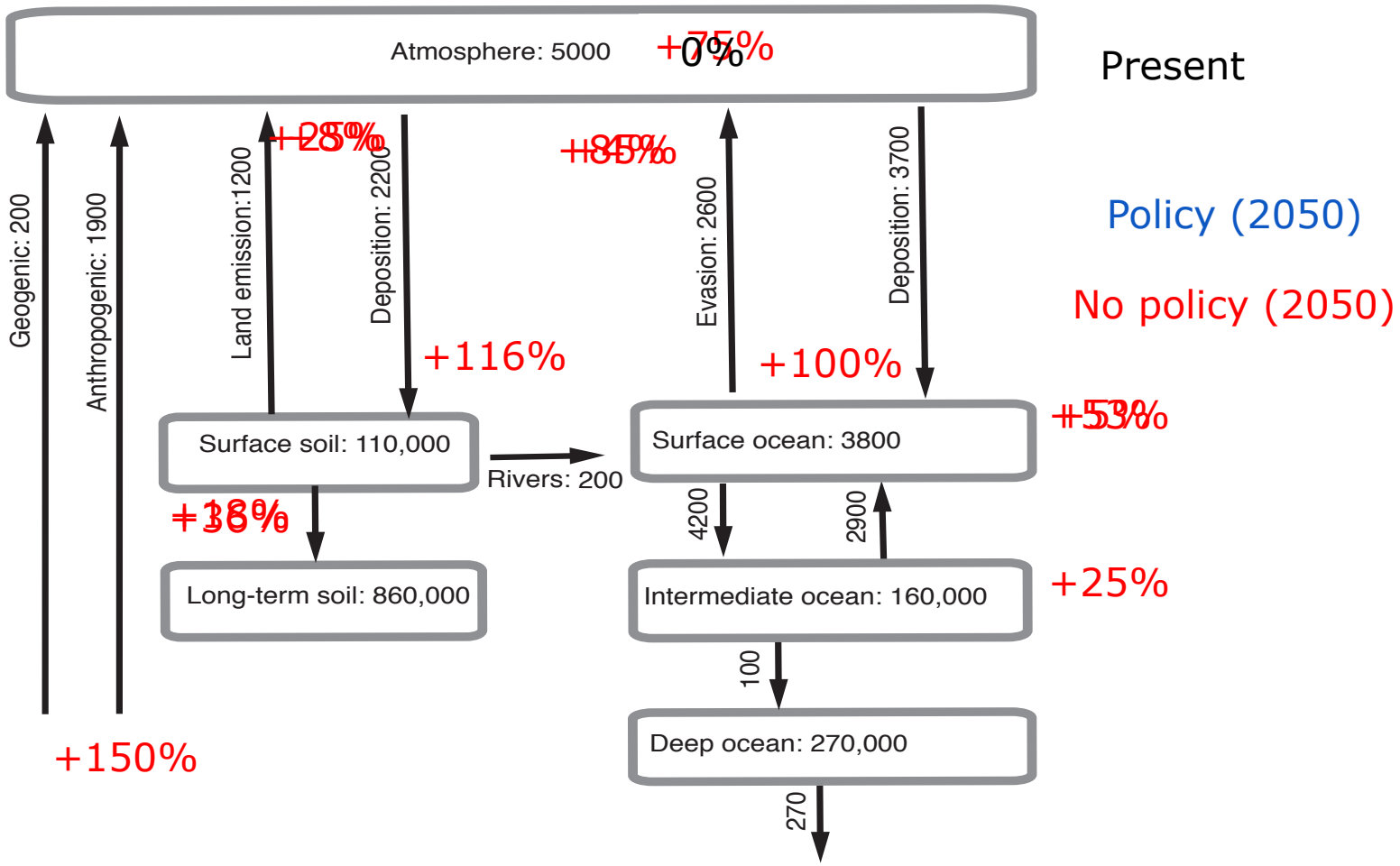


igure 2

- Minamata "BAT" provisions likely to roughly correspond to "B2" scenario

Sunderland and Selin, 2013; Selin, 2013

Modeling of Future GBC under Policy

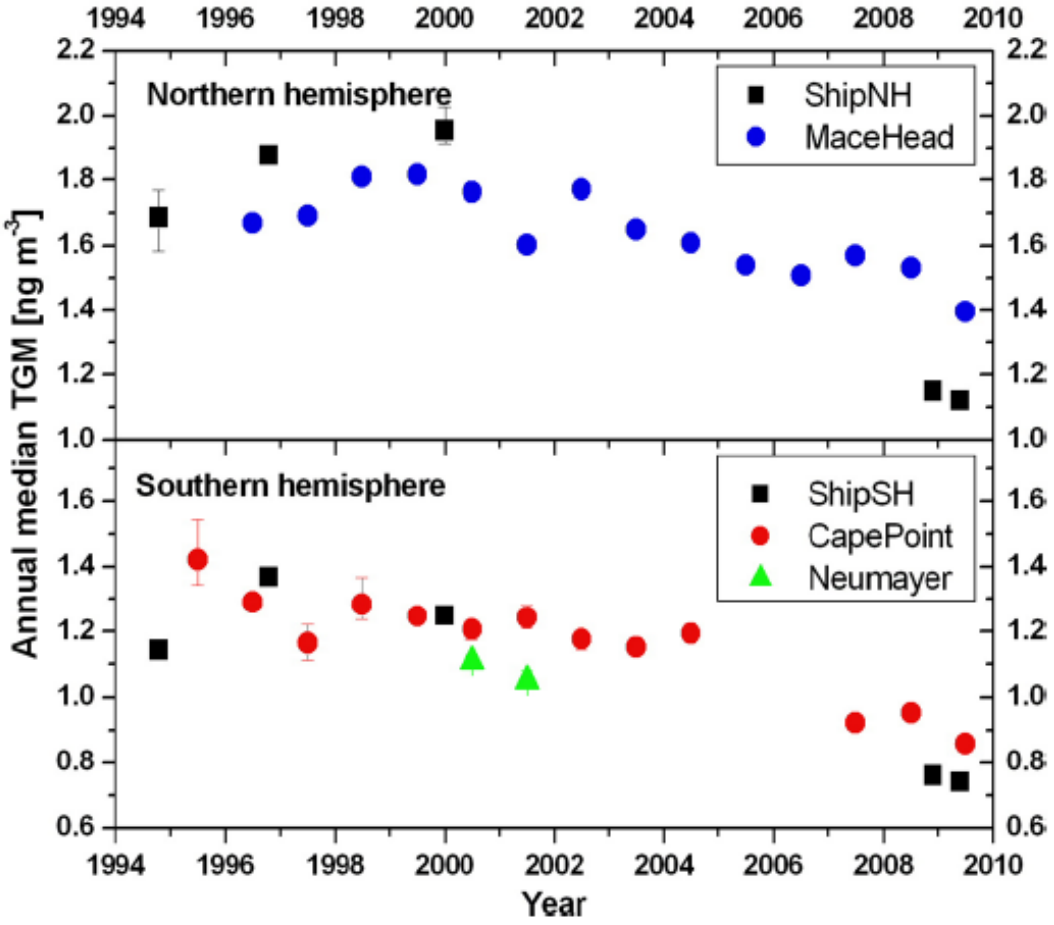


How to explain recent trends in Hg?

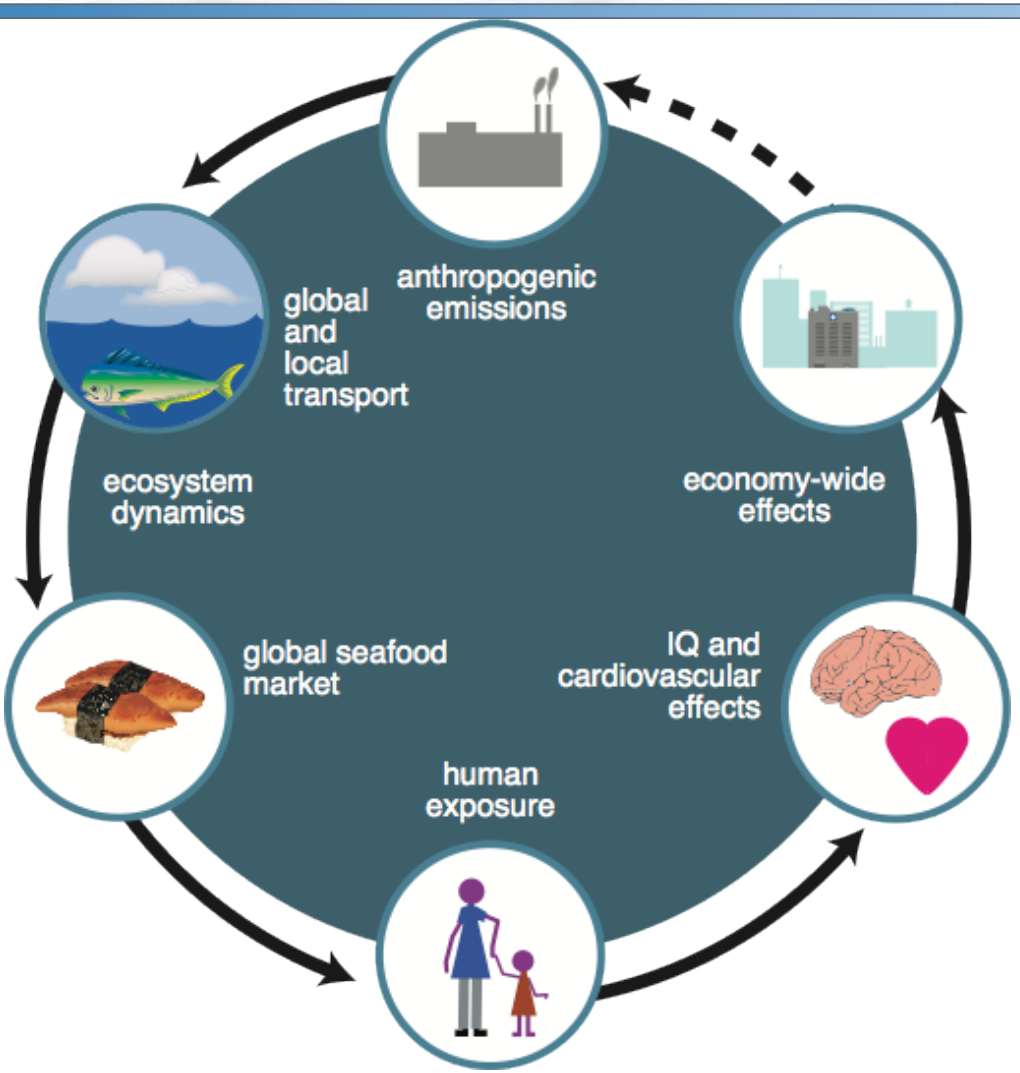
Slemr et al. (2011): 20% declines in atmospheric Mercury at Cape Point, Mace Head since 1995.

Soerensen et al (2012) hypothesize changing intermediate ocean concentrations

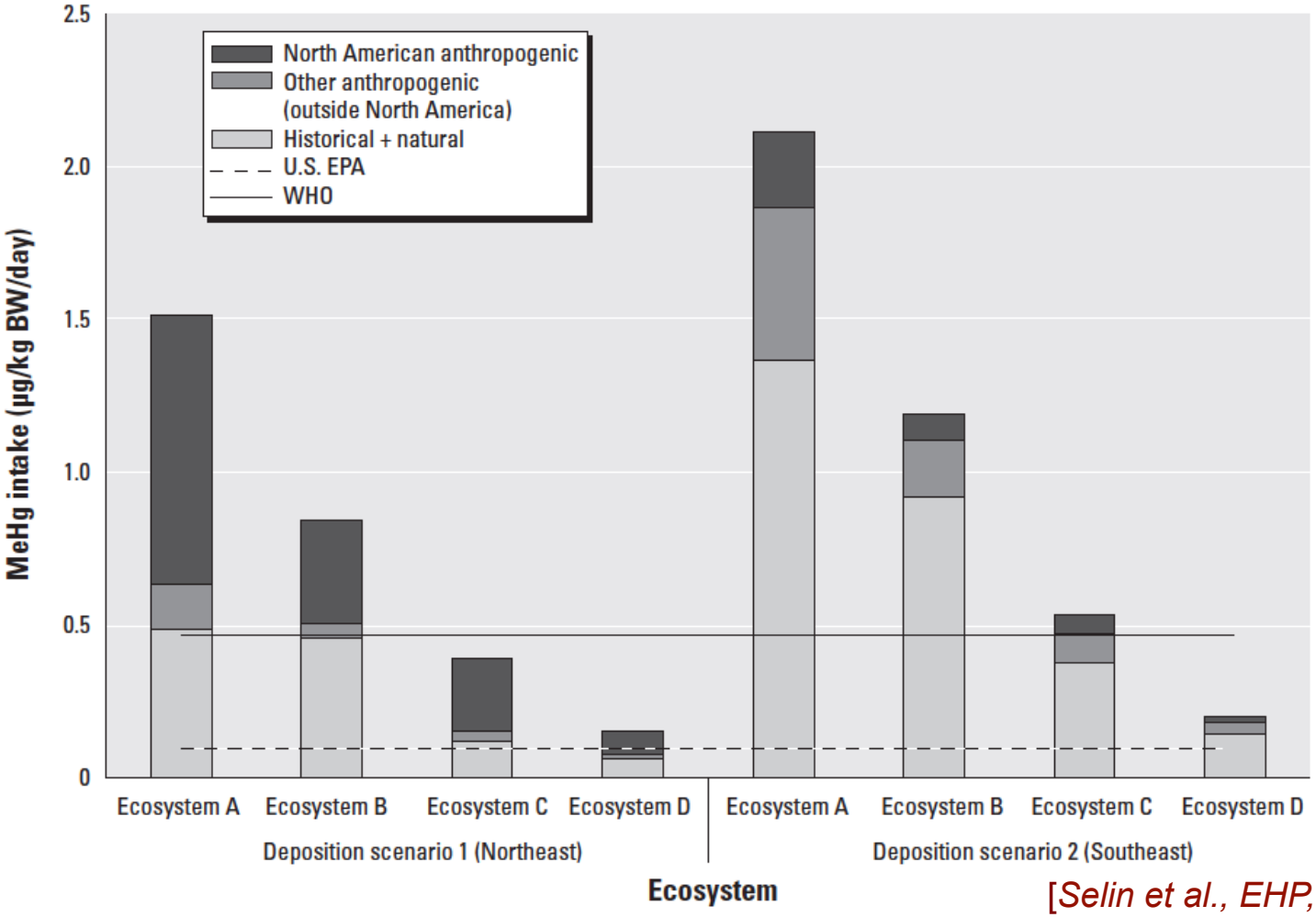
Inverse methods show that cruise data provide limited quantitative constraint; combination of factors most plausible (Song et al., in prep)



Tracking emissions to impacts is complex

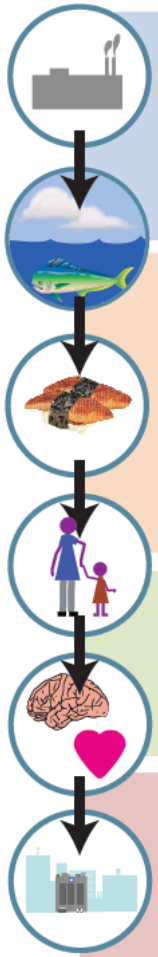


Sources of Fish MeHg & Exposure are Variable



[*Selin et al., EHP,* 2010]

Integrated Assessment for Mercury



Chemical Transport Modelling: GEOS-Chem

Zhang et al. 2012, Corbitt et al. 2011, Streets et al. 2009, Amos et al. 2012

Ecosystem and Exposure Intake Modelling

Chen et al. 2012, Knightes et al. 2009, Mason et al. 2012, Sunderland and Mason 2007, Sunderland 2007, Pirrone et al. 2010, Mahaffey et al. 2009

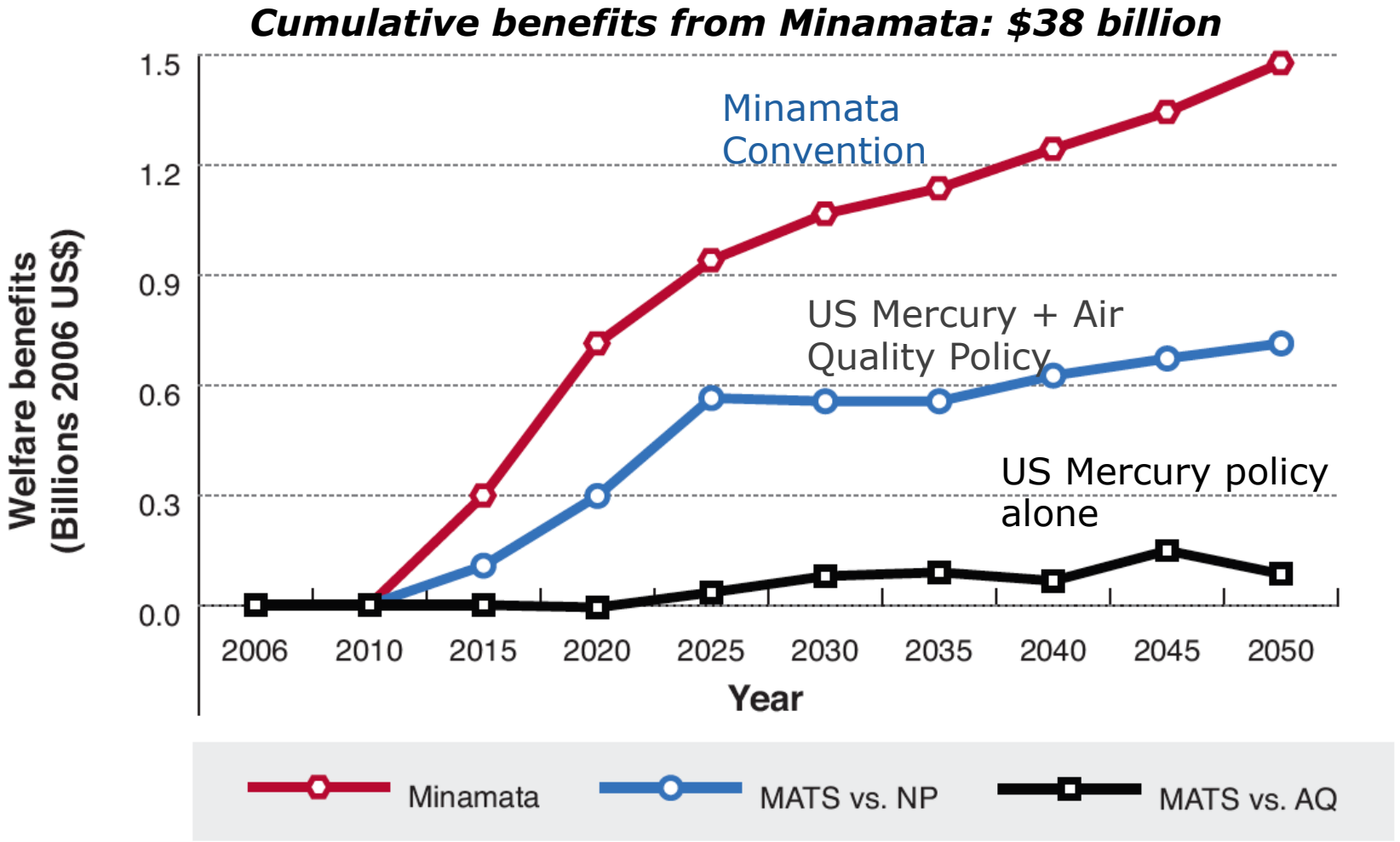
Health Impacts Modelling

Rice et al. 2010, Axelrad et al. 2007, Budtz-Jorgensen et al. 2007, Virtanen et al. 2005, Roman et al. 2011, Guallar et al. 2002

Economic Modelling: US Regional Energy and Environmental Policy Model (USREP)

Rausch 2010, Saari et al. 2013

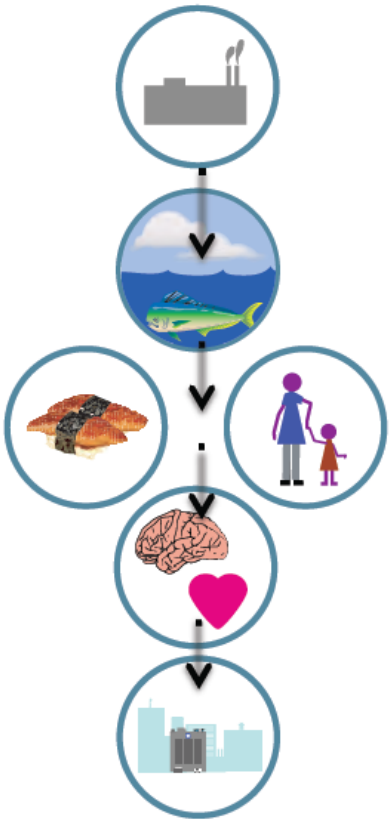
U.S. benefits from Minamata Convention

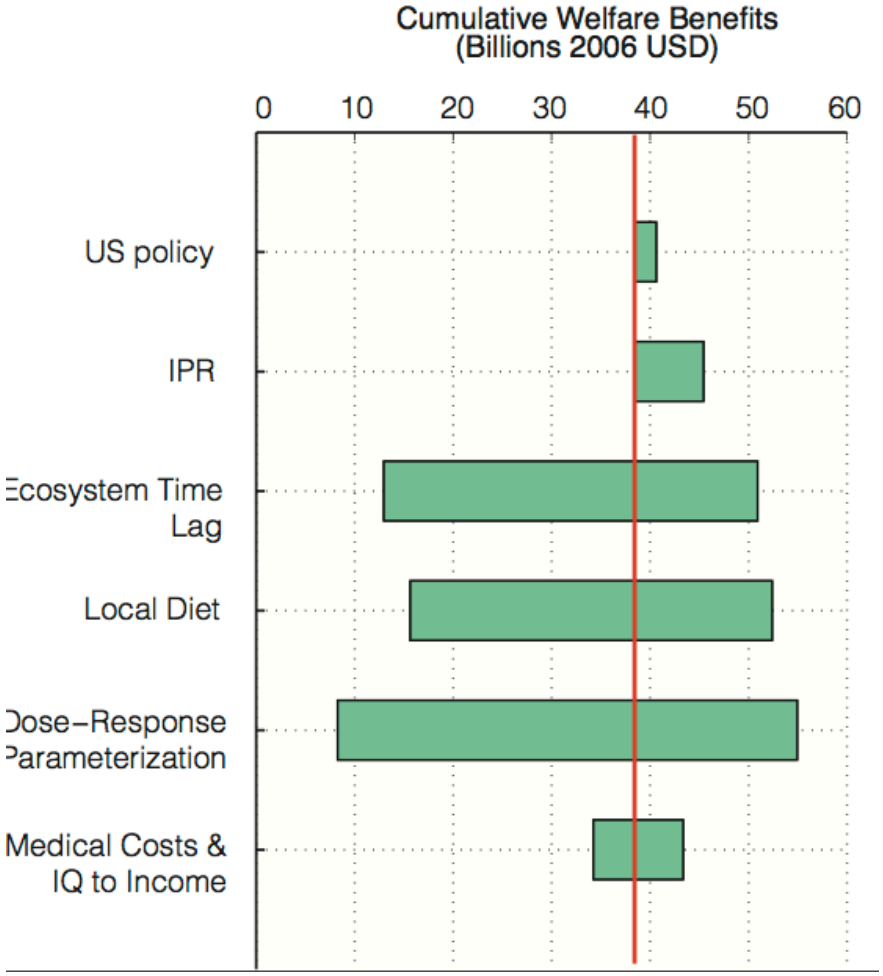


Discounted at 3%

In preparation

Policies-to-impacts sensitivity analysis





In preparation

Conclusions

- Globally, future changes on order of 1-2%/year from Minamata Convention; mostly avoided increases
- Scientific knowledge not sufficient at present to attribute causes
- Increased role for measurement, modeling, effectiveness evaluation
- Best available estimates suggest substantial benefit from global action over and above domestic control
- Additional benefits are likely that are not accounted for here

Acknowledgments

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MIT graduate students Shaojie Song, Amanda Giang

Student participants in trip to Mercury negotiations (INC5, Geneva, January 2013)

For more information:

- N.E. Selin, "Global Change and Mercury Cycling: Challenges for Implementing a Global Mercury Treaty," *Environmental Toxicology and Chemistry*, 2013
- E. M. Sunderland and N. E. Selin, "Future trends in environmental mercury concentrations: Implications for prevention strategies." Environmental Health, 12(2), 2013
- N.E. Selin et al. "Sources of mercury exposure for U.S. seafood consumers: Implications for policy." E*nvironmental Health Perspectives,* 118(1):137-143, 2010

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