Global Transport Modeling: Tracking Emissions to Impacts

Noelle E. Selin, Massachusetts Institute of Technology
Shiliang Wu, Michigan Tech

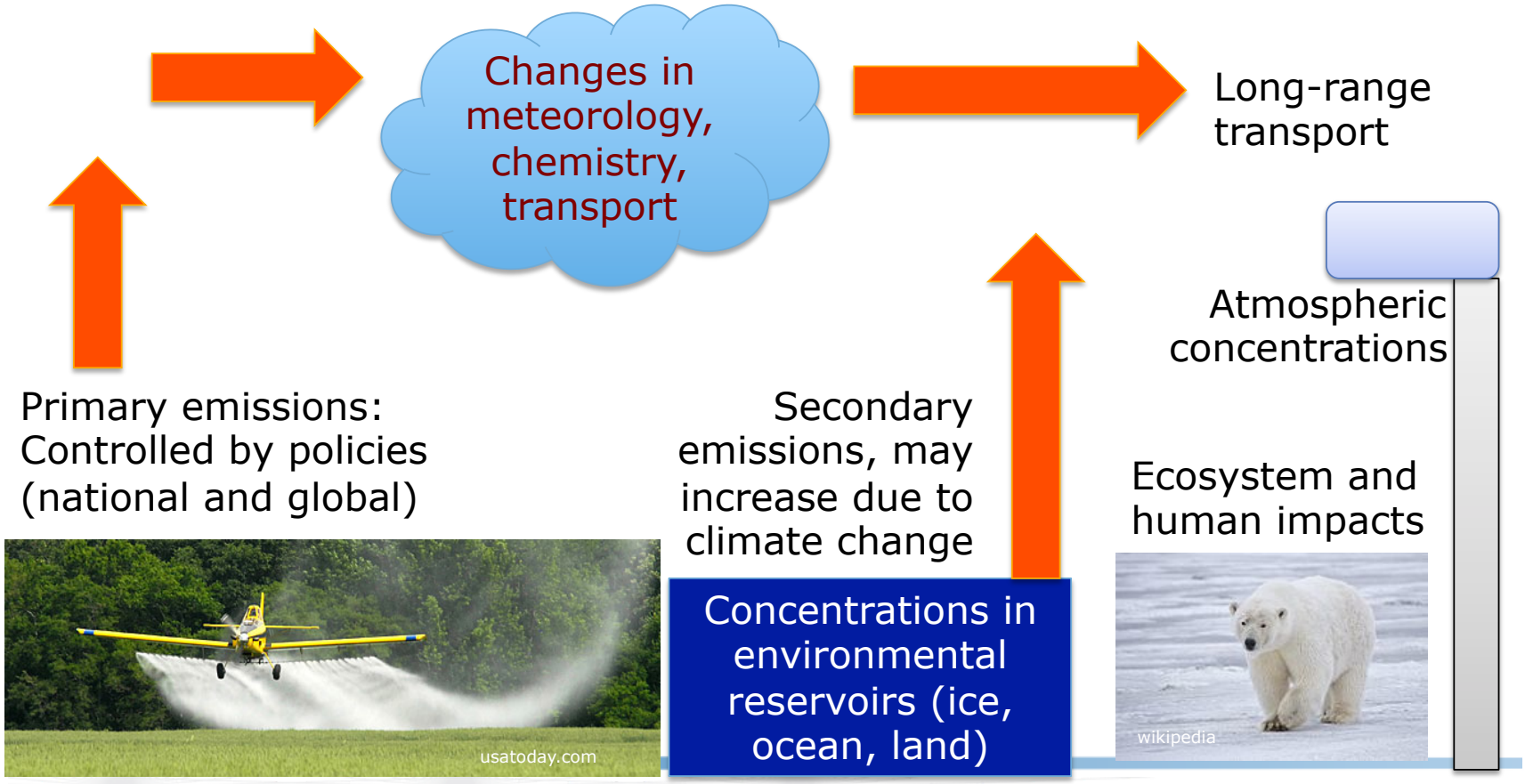
ASEP Community and Partner Workshop, 15 November 2013, Michigan Tech

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

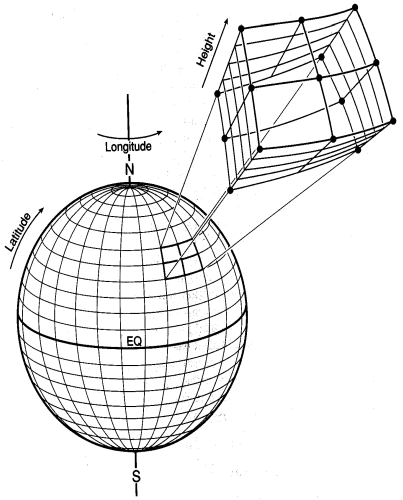
MIT ESD
Massachusetts Institute of Technology
Engineering Systems Division

EAPS

Transport and Fate of ASEPs



Brief introduction of GEOS-Chem

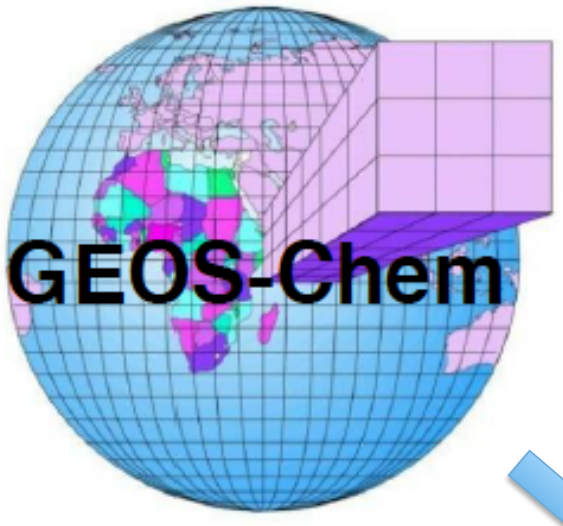


- Global 3-D Eulerian chemical transport model
- Adjustable resolution (1/2°x2/3° to 4°x5° horizontal; up to 72 vertical levels)
- Type of simulations:

  (1) Coupled ozone/NOx/VOC/aerosols simulation;

  (2) Rn-Pb-Be; (3) H_2; (4) Mercury/POPs; (5) Tagged Ox; (6) Tagged CO
- Heterogeneous chemistry with on-line aerosol fields
- Detailed inventories for fossil fuel, biofuel, biomass burning, and natural emissions (NOx, VOC, DMS, etc)
- Has been extensively applied in simulating tropospheric chemistry and composition, as well as air quality.

Modeling Emissions, Transport, Cycling and Deposition



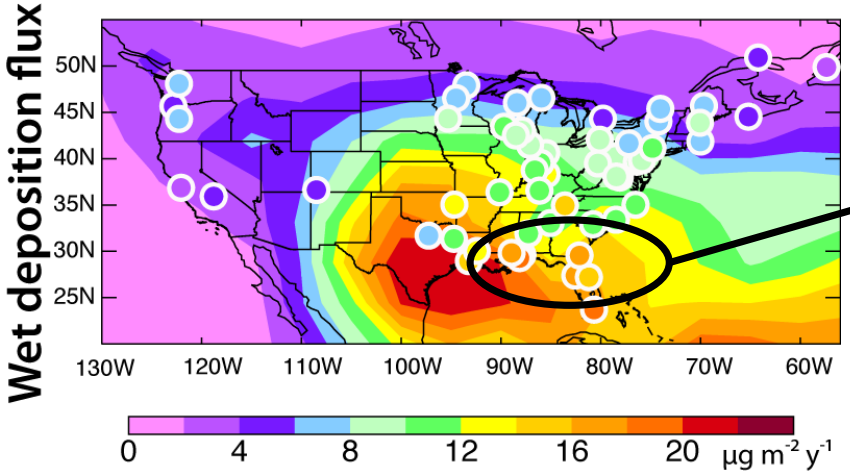
Mercury: Selin et al. 2007, 2008, Holmes et al. 2010, Soerensen et al. 2012, Zhang et al. 2012, others

PAHs: Friedman and Selin, 2012; Friedman et al., submitted; Friedman et al., in prep (in standard model v. 9-02)

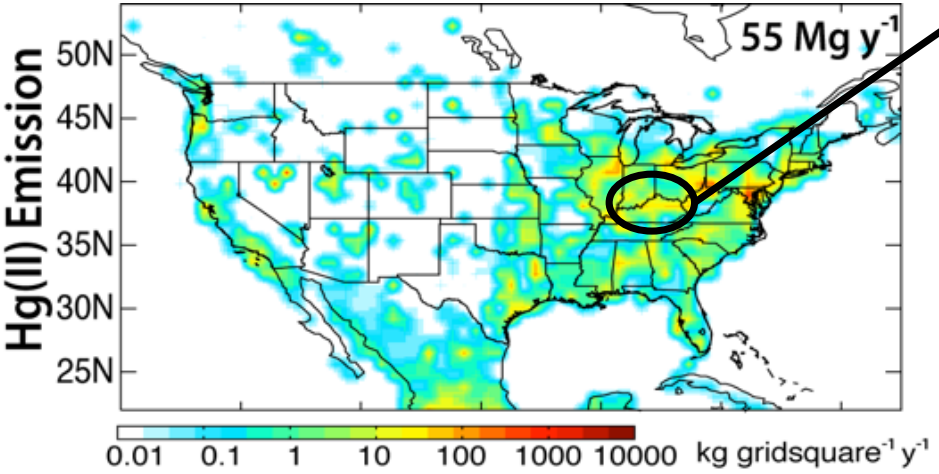
PCBs: under construction (C. Friedman, atmosphere, @MIT; H. Amos/E. Sunderland, ocean, @Harvard)

Climate change and land use: Wu et al. 2008, 2012

Mercury Deposition in the United States



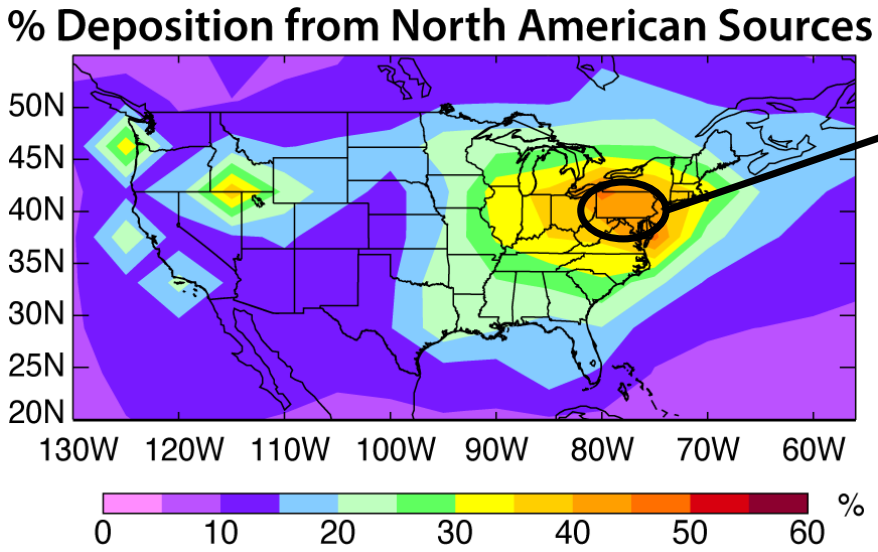
Southeast has highest wet deposition in the U.S. (model: background, circles: measurements from U.S. mercury deposition network)



Highest emission is from coal power plants in the Midwest

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

Contribution from US sources



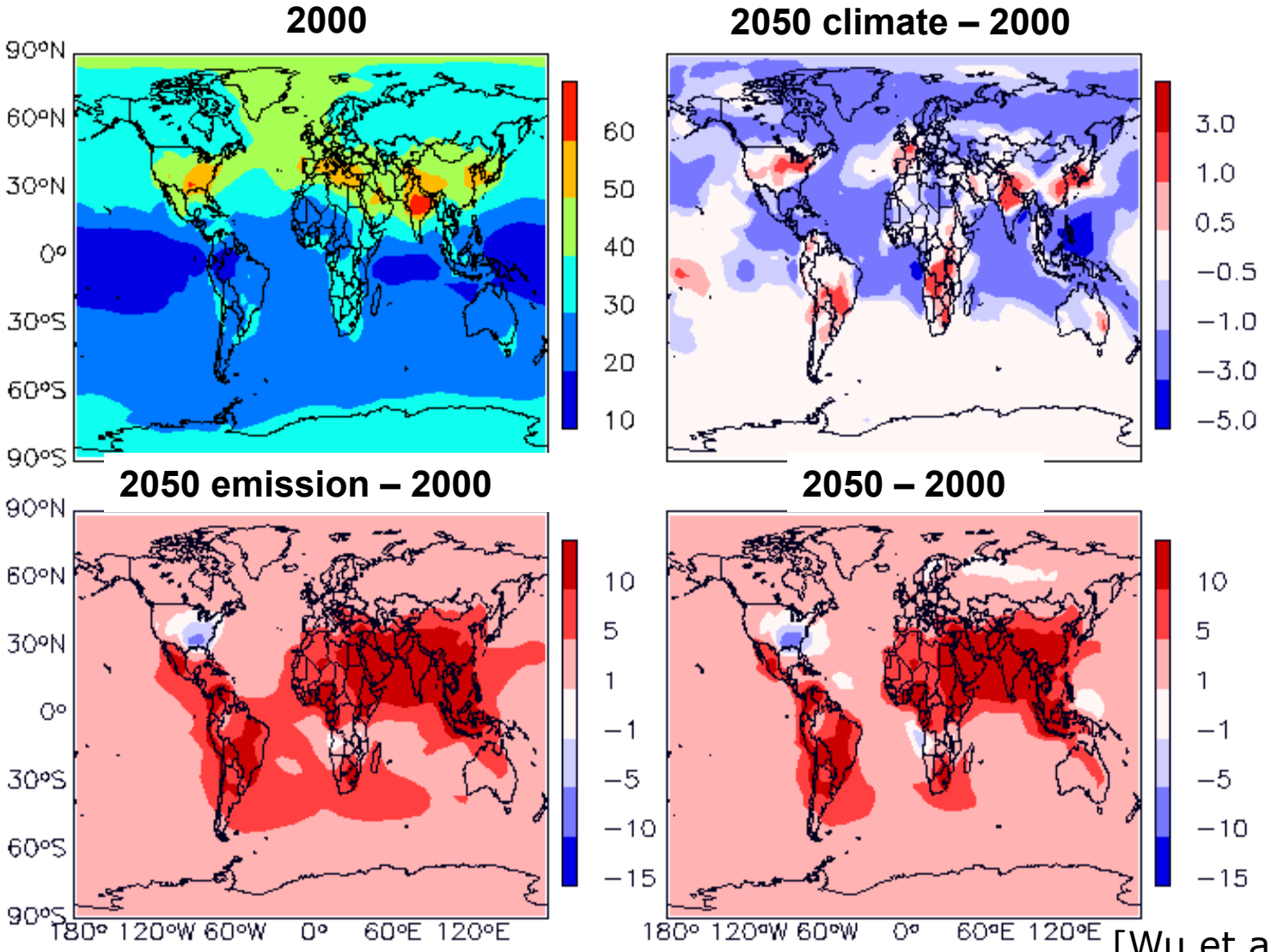
Up to 60% of deposition in Midwest/Northeast U.S. is from domestic sources

Depending on the form in which it is emitted, mercury can deposit locally or travel globally → *important to account for atmospheric chemistry*

Policy implications:
Reducing deposition in both Northeast and Southeast will require actions on multiple political scales (national and global)

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

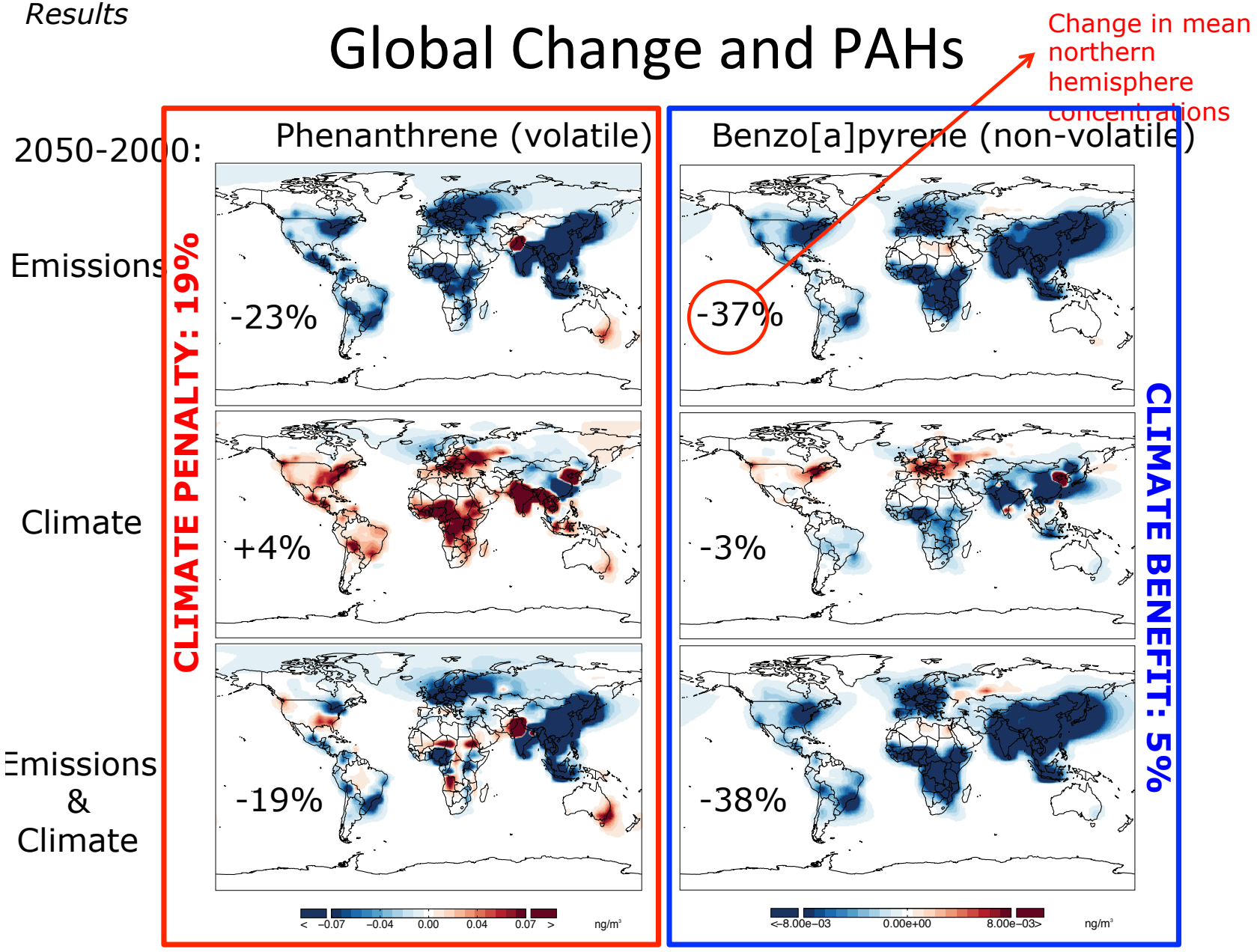
Effects of 2000-2050 global change on tropospheric ozone
(annual surface afternoon mean)



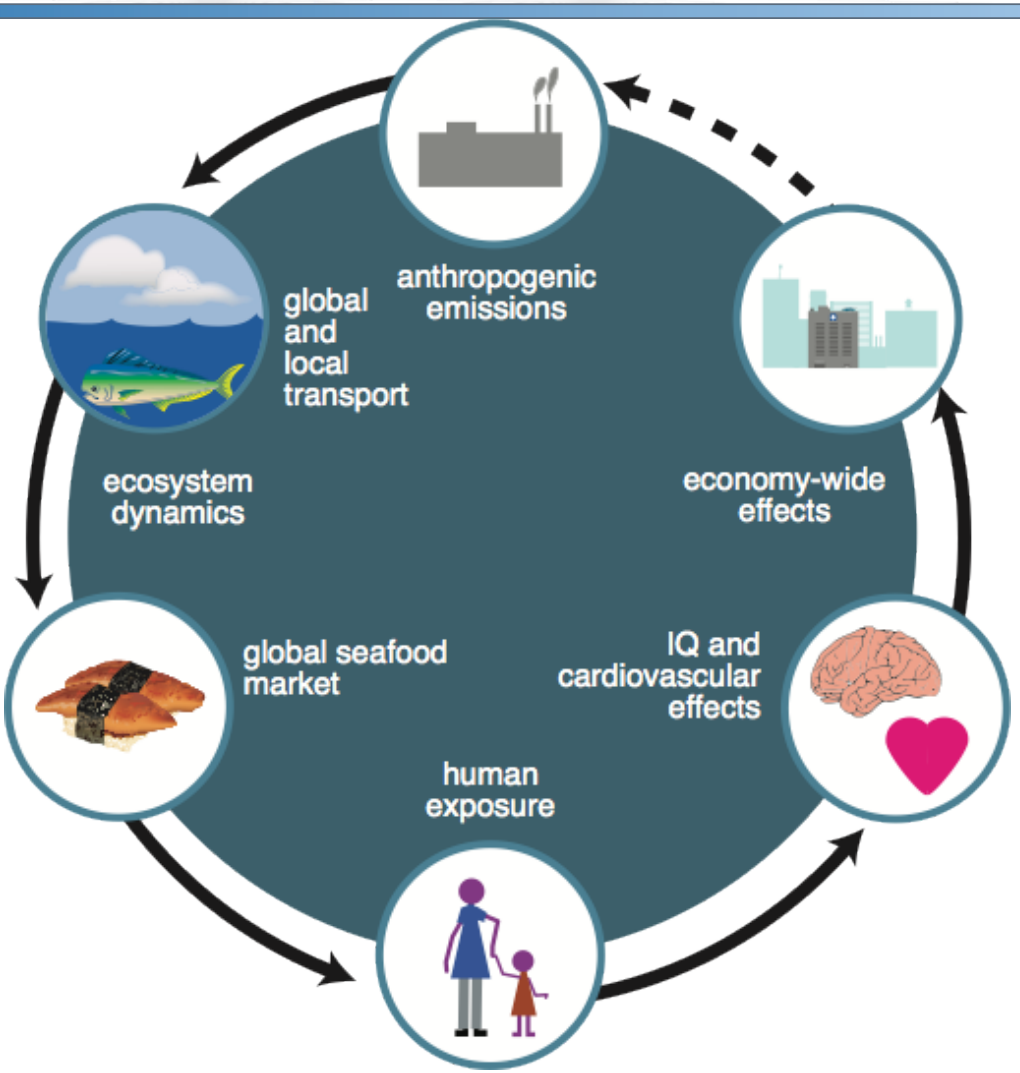
[Wu et al. 2008]

Results

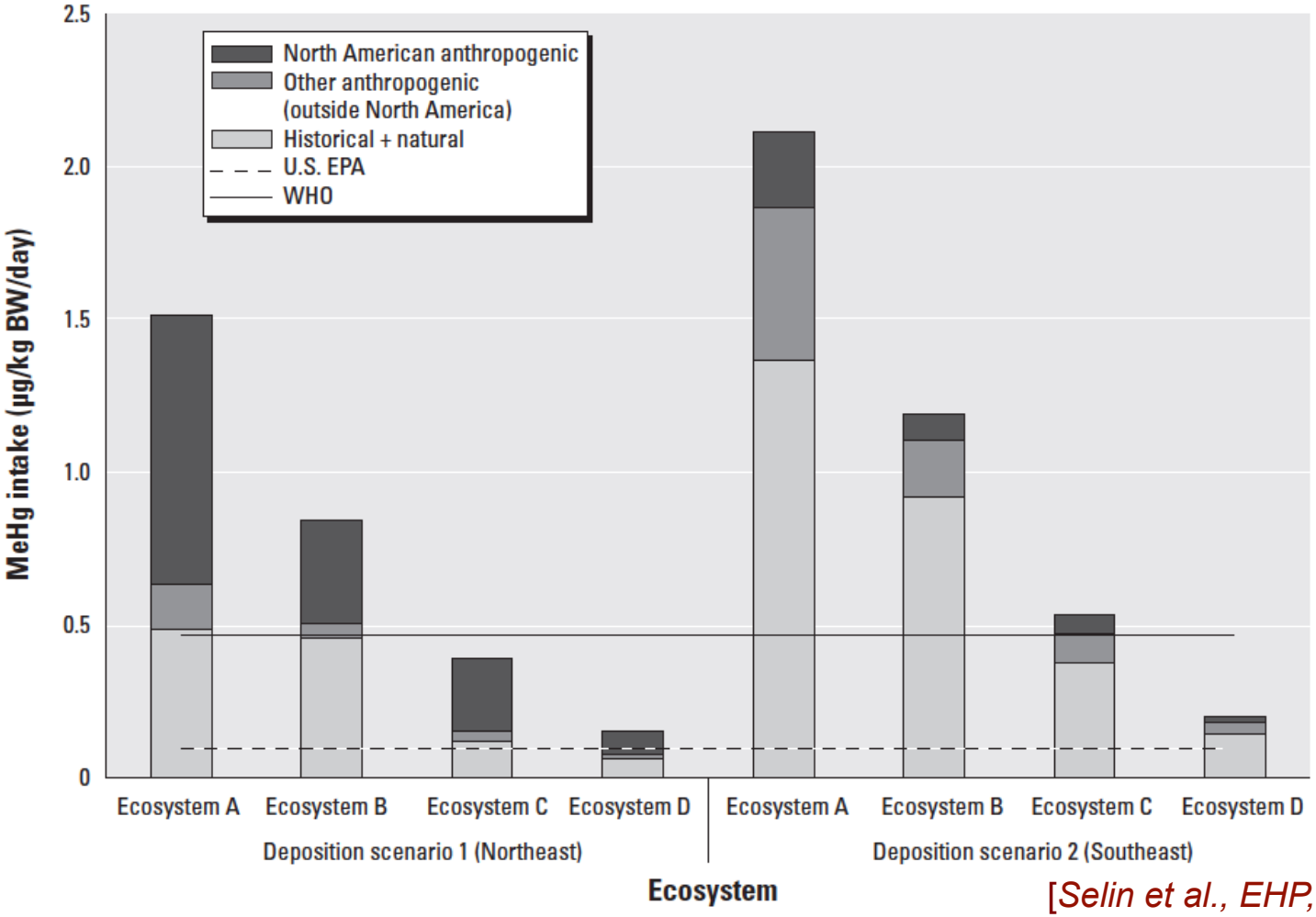
Global Change and PAHs



Tracking emissions to impacts is complex

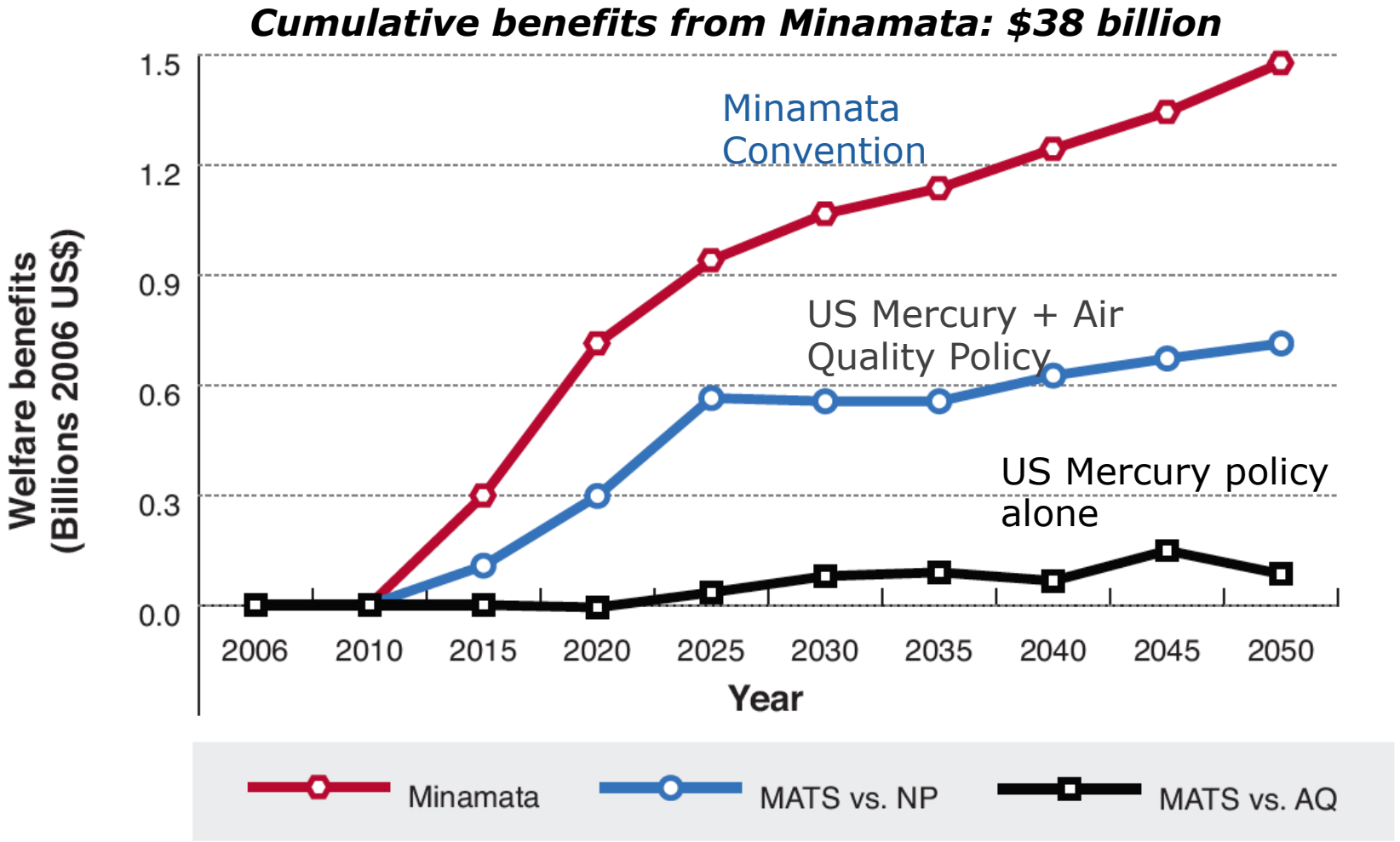


Sources of Fish MeHg & Exposure are Variable



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

U.S. benefits from Minamata Convention



Discounted at 3%

In preparation