Mercury in the Global Atmosphere: Chemistry, deposition, and land-atmosphere interactions

or

Mercury rising…and falling: What climate scientists can learn from Hg pollution

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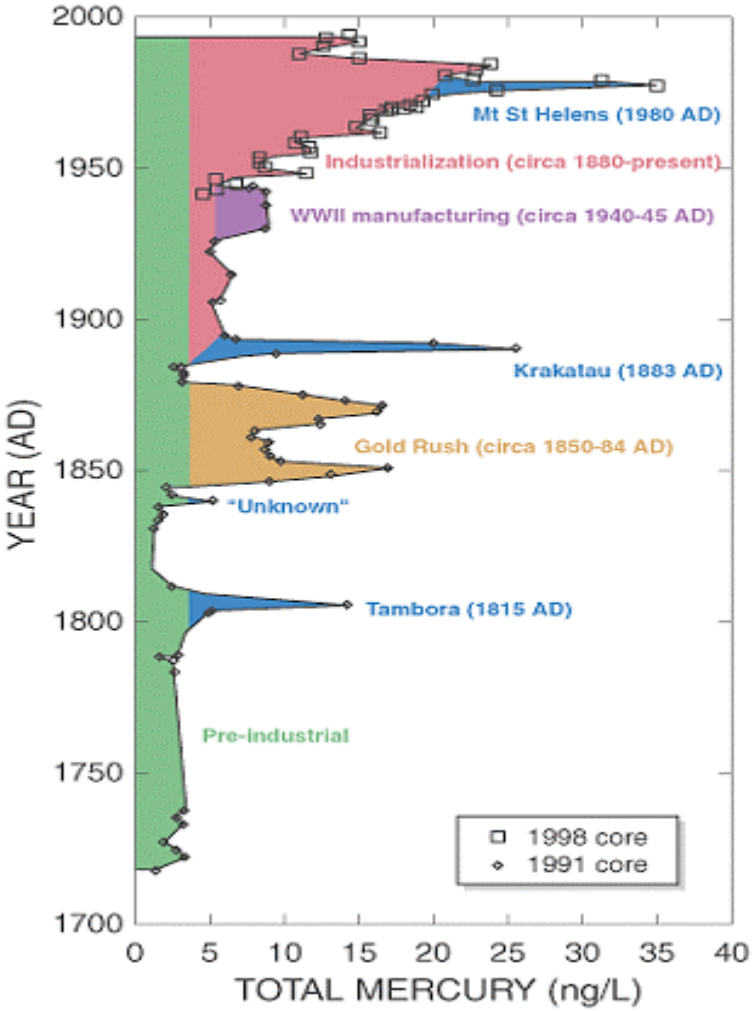
A science and policy challenge



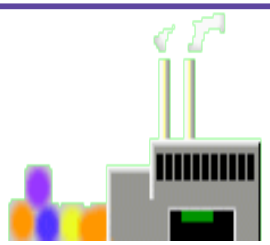
Ice core records (Wyoming) show increasing Hg deposition since industrialization [Schuster et al., ES&T 2002]

Most U.S. states have instituted dietary advice on fish consumption pregnant women, children to minimize methylmercury exposure [U.S. EPA/FDA, 2008]

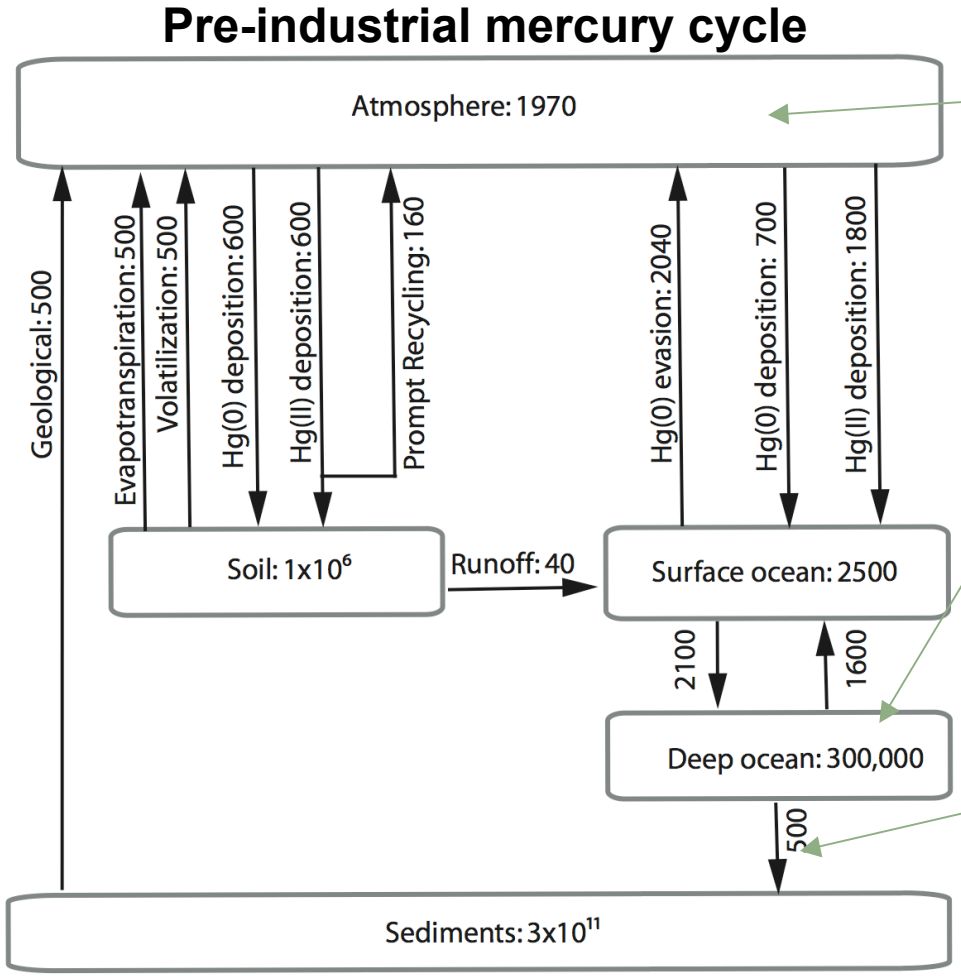
Arctic concern due to bioaccumulation, human exposure

Mercury in polar bear fur up 5-12X since 1890, [Dietz et al., ES&T 2006]

Major source: coal-fired power plants [Pacyna et al., 2006]



Long-term human influences on biogeochemical cycle



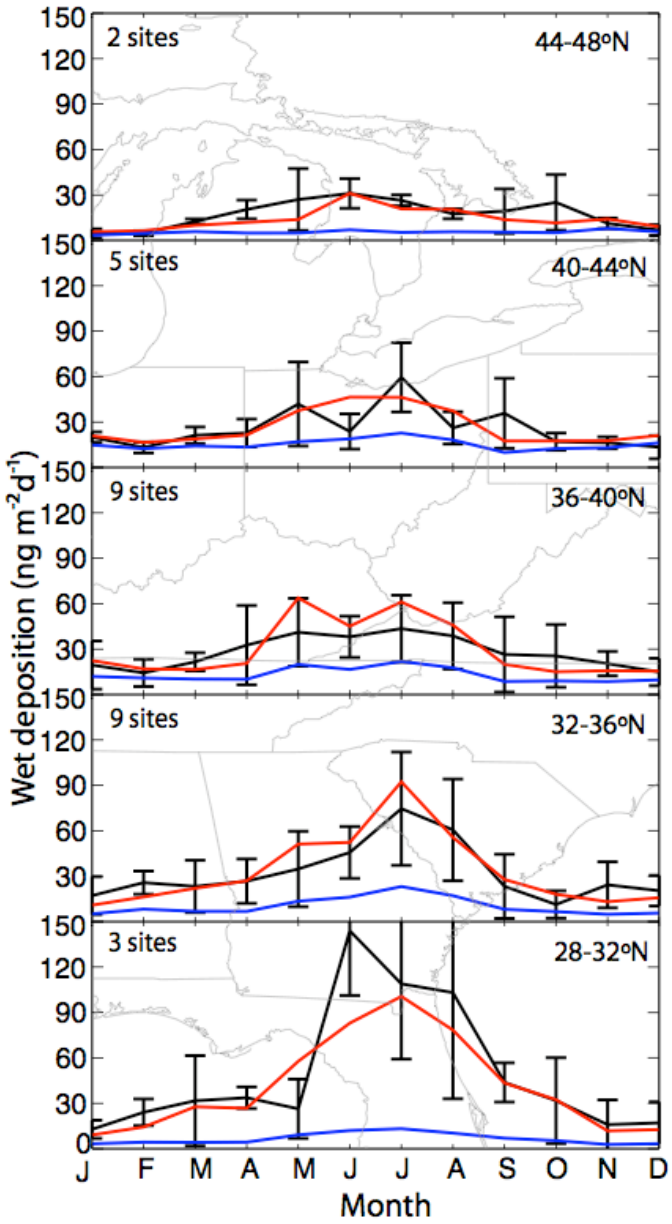
Amount in present-day atmosphere is 3x pre-industrial

Large reservoirs in soils, deep ocean, enriched by prior human activity

Very long time scales for burial

Pre-industrial Hg budget from GEOS-Chem global, 3D mercury model [Selin et al., 2008]

Policy challenges across spatial scales



In the Midwest/Northeast U.S., most deposition comes from domestic sources

Southeast U.S. has the highest measured wet deposition, but a low domestic fraction

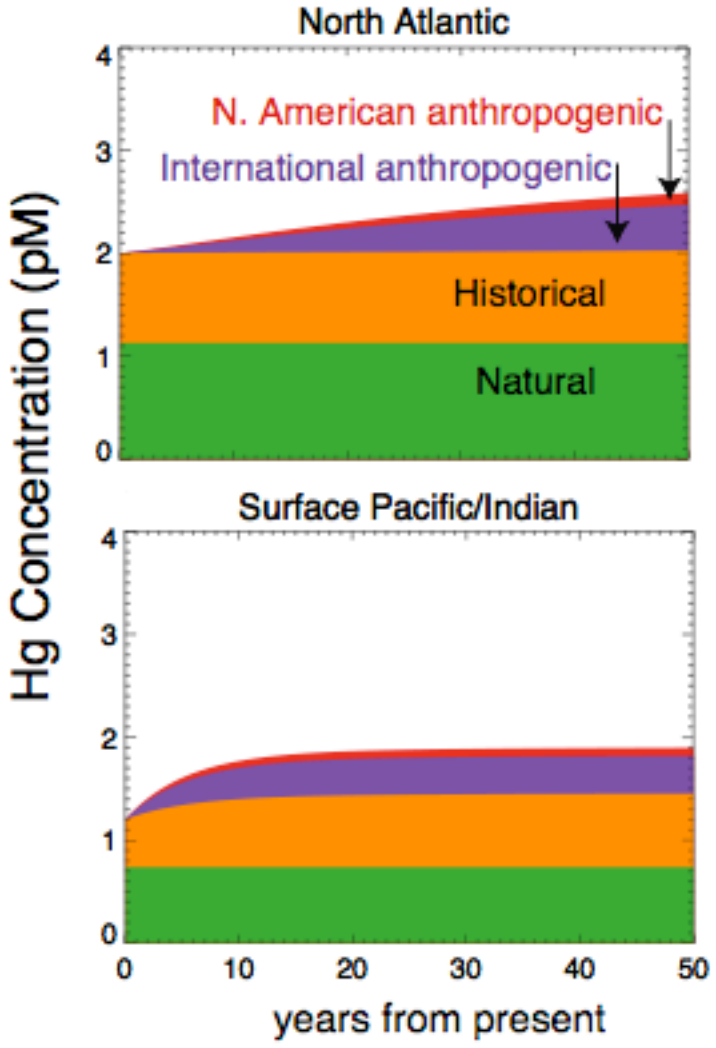
Average over U.S.: 20% of deposition from domestic sources

Linking domestic to international policies: cross-scale issues

Measurements (MDN, 2007)
GEOS-Chem
Domestic contribution

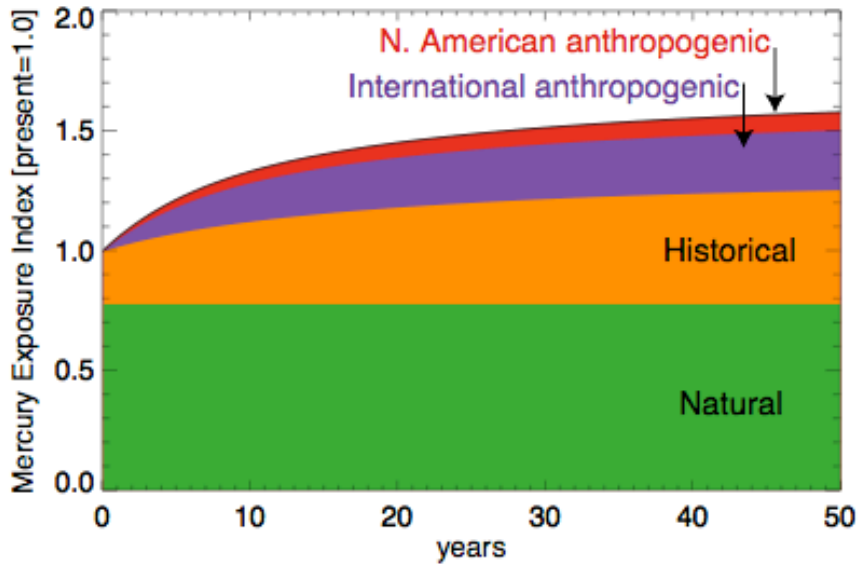
[Selin and Selin, 2006; Selin and Jacob, 2008]

Policy challenges across temporal scales



"current emissions" scenario

Use source-attributed deposition to drive ocean model and illustrate prospects for policy interventions



U.S. commercial market Hg exposure will increase regardless of emissions controls!

[Selin et al. in prep.]

Lessons for climate, and from climate

- Mercury is a lot like the climate problem:
  - Policy challenges across space and time
  - Time lags in responding to anthropogenic actions
  - Large-scale disruptions of global biogeochemical cycles that will take centuries to millennia to return to pre-industrial levels
  - Potential for climate and land-use change to further disrupt mercury cycle
- Future challenge to mercury policy: how to balance adaptation and mitigation?