What capabilities do we have for quantifying the relationship between atmospheric Hg deposition and human/biological mercury exposure?
Quantifying perturbations to the global Hg cycle requires that we understand their temporal evolution in different reservoirs.

**Fate of a unit pulse of Hg to the atmosphere (eigenanalysis)**

The lifetime of anthropogenic Hg in soils and the ocean ranges from years to millennia.

*Amos et al., 2013; 2014*
Global Biogeochemical Modeling (Harvard/MIT)

GEOS-Chem (atmosphere)

MITgcm with ecology (ocean)

LITHOSPHERE

GTMM/CASA (terrestrial)

North America
- Harvard (Sunderland/Jacob)
- MIT (Selin)
- Illinois (Horowitz)
- UBC (Giang)

China
- Holmes (FSU)
- Nanjing U. (Y. Zhang)

Australia
- Wollongong (Fisher)
Mercury multi-media modelling (GLEMOS)

Initial development of multi-media modelling approach for Hg

Motivation:

- Mercury easily cycles between the atmosphere and water/soil/vegetation
- Legacy/natural sources make up 65% of Hg deposition within EMEP
- Delayed response of Hg media content to emissions reduction

On-going work:

- Development of Hg media modules for GLEMOS (ocean, soil, vegetation)
- Assessment of long-term Hg accumulation in media since pre-industrial times
- Evaluation against observations

Travnikov, MSC E (Russian Federation)
WorM3: World Multimedia Mercury Model

Based on BETR-Global (global POPs modeling)
Yearly-scale assessments
15° x 15° → 3.75° x 3.75°

Variation:
Regional Assessment

Asif Qureshi, K. Subhavana (2020)

We developed a novel multi-compartment model for mercury cycling in the marine environment:
- Includes transport, transformation, and bio-accumulation of Hg and MeHg
- Generalized NPZD ecosystem model with 3 phytoplankton and 2 zooplankton species
- A simple closure term for higher trophic levels

Future plans:
- Apply and evaluate the model for different ocean basins
- Include higher trophic levels (fish), fish migration, and more complex ecosystems
- Implement bacteria into the ecosystem to investigate biotic methylation processes
GEM-MACH-Hg

Environment and Climate Change Canada (Dastoor)

Semeniuk and Dastoor, 2017, Global Biogeochemical Cycles

Figure 4. Horizontal slices of MeHg⁺ concentration (fm) at various depths: (a) base of mixed layer, (b) 1033 m, and (c) 3257 m.
Summary

• Emerging capability for global biogeochemical modeling for Hg in many countries
• Many examples in the peer-reviewed literature already
• Focus now is on marine, terrestrial modeling at the global scale
• Some large-scale studies linking to marine fish and ecosystem scale biotic endpoints
• Links to human populations in a meaningful way requires information on their consumption preferences