MCHgMAP: **Tracking mercury in the environment to inform the Minamata Convention's effectiveness evaluation**

Multi-Compartment Hg Modeling and Analysis Project

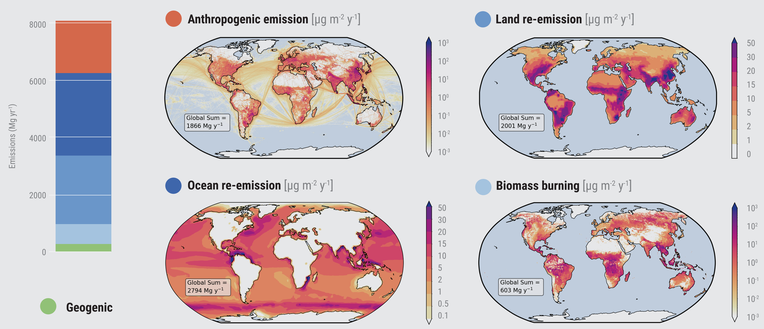
Aim — Multi-model assessment and attribution of geospatial variation and temporal trends in Hg pollution

Objective — Informs effectiveness evaluation of multilateral environmental agreements (Minamata and LRTAP Conventions)

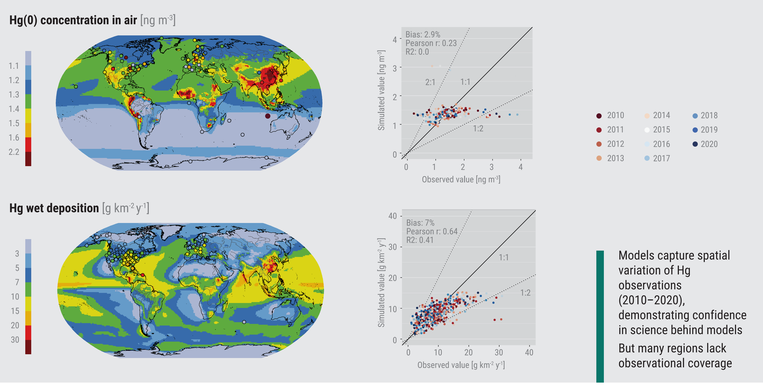
Approach — Coupling atmospheric, oceanic, terrestrial, and mass balance models for multi-compartment simulation of Hg dispersion

Collaboration — Integrates Hg emissions, monitoring, and modelling communities to enhance data collection and simulation processes

Global atmospheric Hg emissions



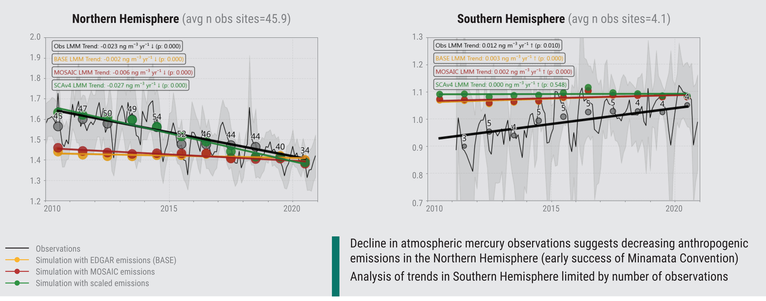
Geospatial patterns of Hg pollution



Models capture spatial variation of Hg observations (2010–2020), demonstrating confidence in science behind models

But many regions lack observational coverage

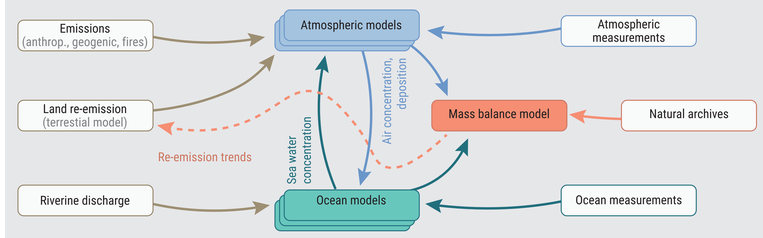
Long-term changes of atmospheric Hg



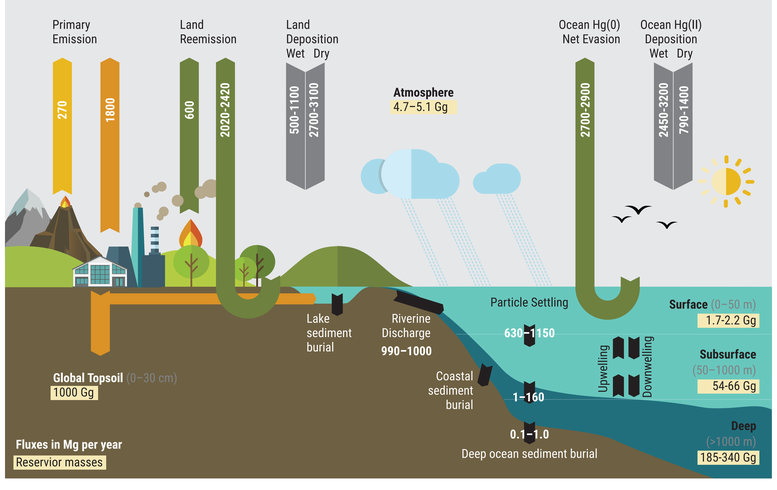
Decline in atmospheric mercury observations suggests decreasing anthropogenic emissions in the Northern Hemisphere (early success of Minamata Convention)

Analysis of trends in Southern Hemisphere limited by number of observations

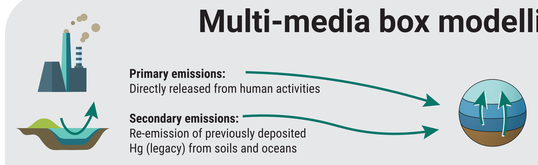
Multi-model simulating platform



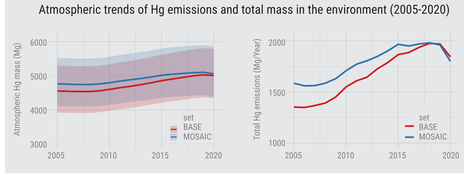
Global cycling of Hg in the environment



Multi-media box modelling



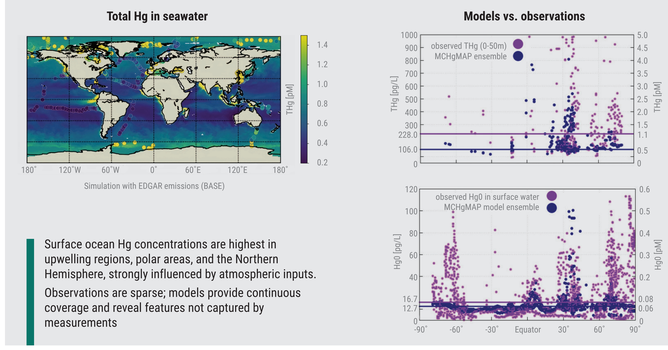
Atmospheric trends of Hg emissions and total mass in the environment (2005-2020)



Legacy soil and ocean re-emissions dominate global Hg cycling, while ongoing primary anthropogenic emissions contribute ~25%.

Recent trends show a worrying feedback. Between 2010 and 2020, re-emissions from soils and oceans have risen, driven by continued primary emissions.

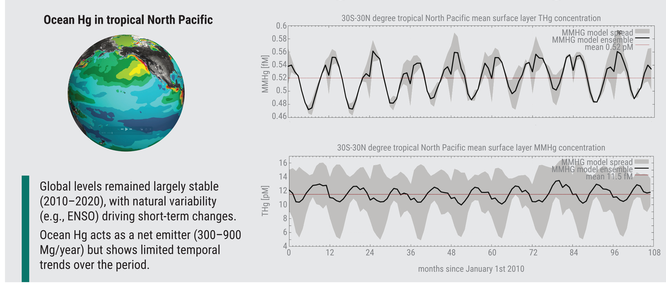
Spatial variation of Hg in the ocean



Surface ocean Hg concentrations are highest in upwelling regions, polar areas, and the Northern Hemisphere, strongly influenced by atmospheric inputs.

Observations are sparse; models provide continuous coverage and reveal features not captured by measurements

Temporal changes of ocean Hg



Global levels remained largely stable (2010–2020), with natural variability (e.g., ENSO) driving short-term changes.

Ocean Hg acts as a net emitter (300–900 Mg/year) but shows limited temporal trends over the period.

Multi-model ensemble

Model	Institution
Atmospheric models	
GEM-MACH-Hg	Environment and Climate Change Canada (Canada)
GEOS-Chem	Massachusetts Institute of Technology (USA)
WACCM	Institute of Physical Chemistry Blas Cabrera (Spain)
GLEMOS*	Jožef Stefan Institute (Slovenia)
Ocean models	
ICON-MERCY	HEREON (Germany)
MITgcm	Tulane University (USA)
Multi-media mass balance models	
Global Biogeochemical Box Model (GBBM)	University Grenoble Alpes, CNRS (France), Harvard University (USA)
Terrestrial model	
2D air-land Hg exchange model	University of West Florida (USA), Institute of Geochemistry, CAS (China)

*did not participate in the current round

White paper: **Dastoor et all., *GMD*, published 2025**

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