

Modeling Terrestrial Mercury Dynamics with SiBCASA: Implications for the Earth System

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Mercury is one of the United Nations top 10 chemicals that endanger human health and the environment

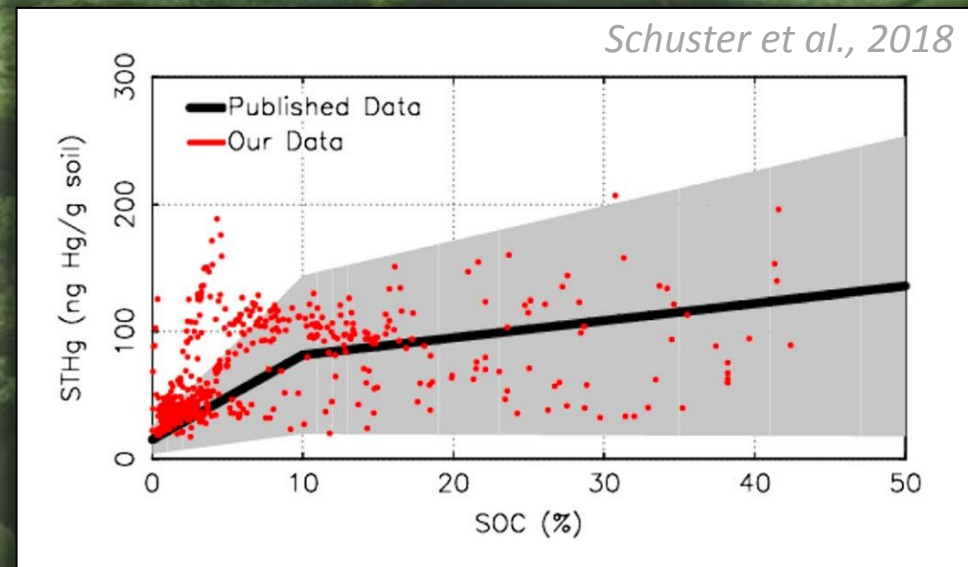
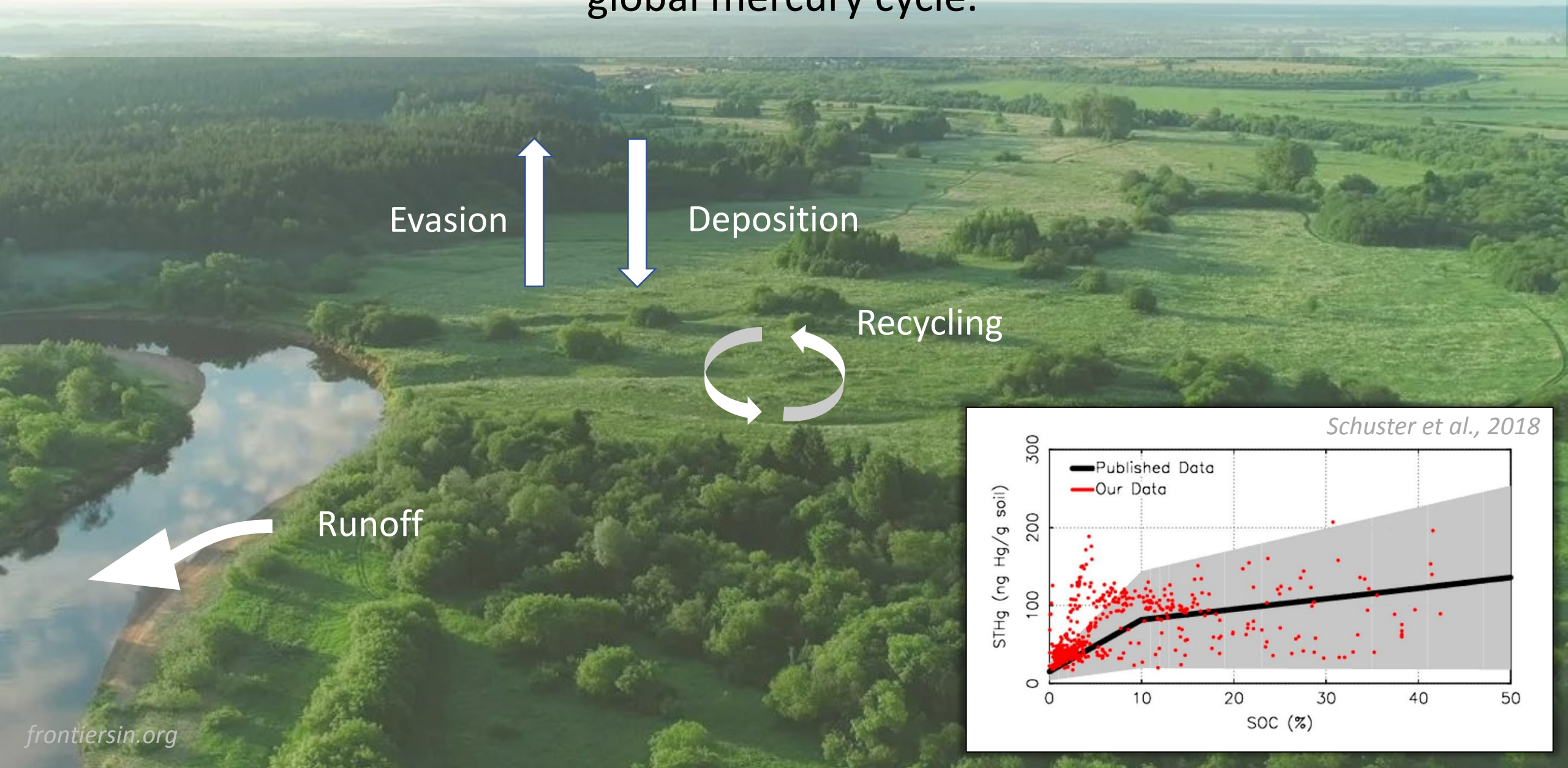
Millions of tons of trapped mercury could be released as world warms

Continued thawing of Arctic permafrost will release the toxic load into waterways

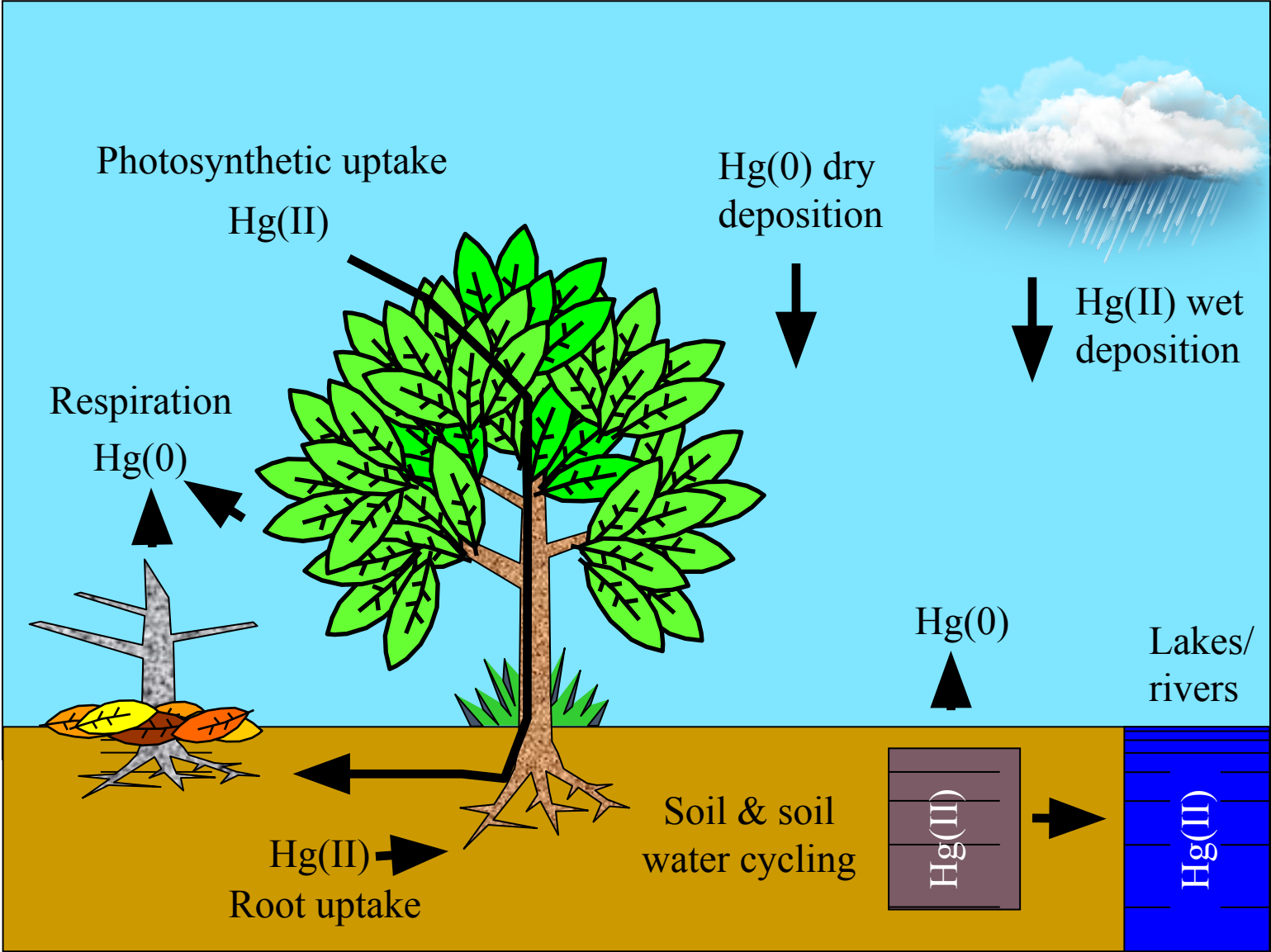
6 FEB 2018 • BY KATIE LANGIN




Since mercury binds to organic matter, the terrestrial carbon cycle modulates the global mercury cycle.



We've fully coupled the mercury cycle with carbon, water, and energy cycles in the Simple Biosphere Carnegie Ames Approach (SiBCASA) model.



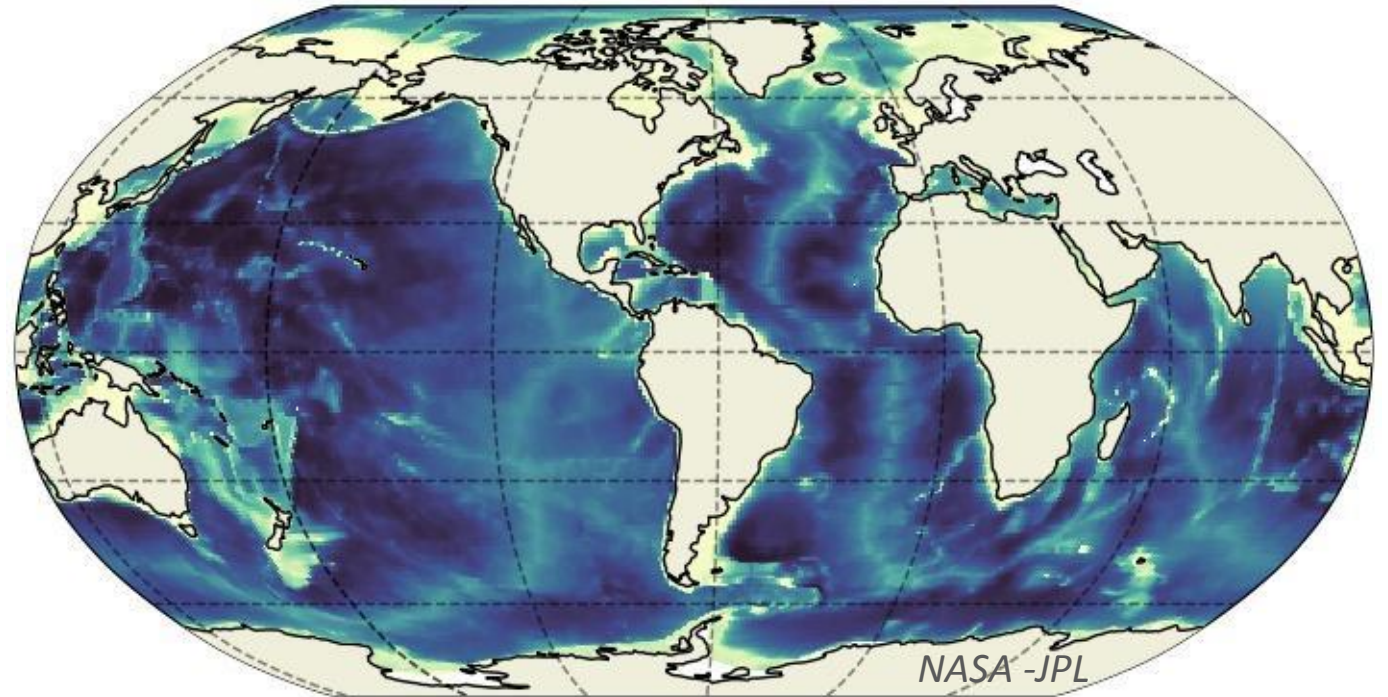


Research Question: How will mercury fluxes respond to key environmental factors such as temperature, soil moisture, and other meteorological drivers?

We conducted global simulations from 1901 to 2021 at $0.5^\circ \times 0.5^\circ$ resolution, forced with CRUNCEP data.

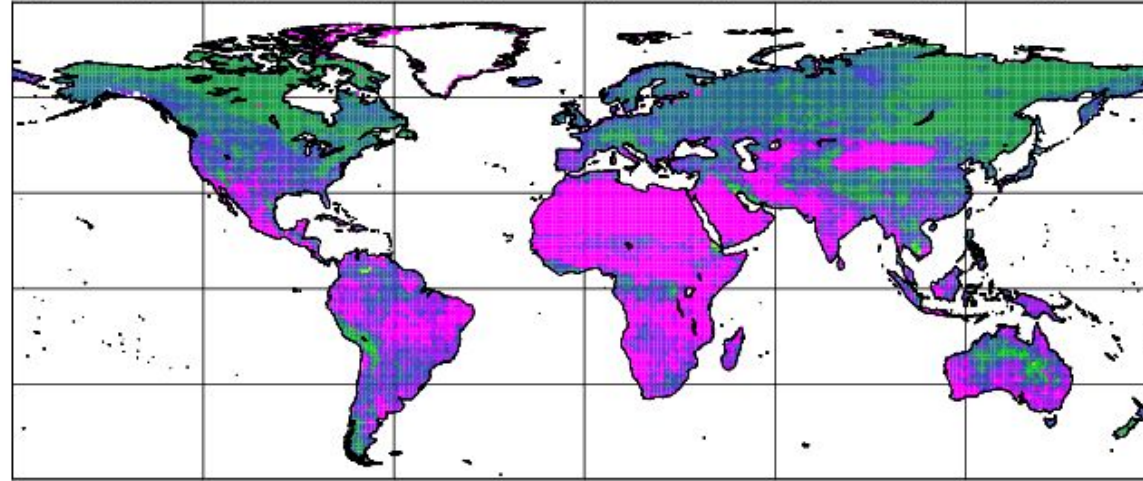
6-hourly time step:

- Near-surface air temperature (K)
- Precipitation rate (mm/day)
- Surface pressure (Pa)
- Specific humidity (kg/kg)
- Wind speed components (U and V wind, m/s)
- Surface downward shortwave radiation (W/m^2)
- Surface downward longwave radiation (W/m^2)

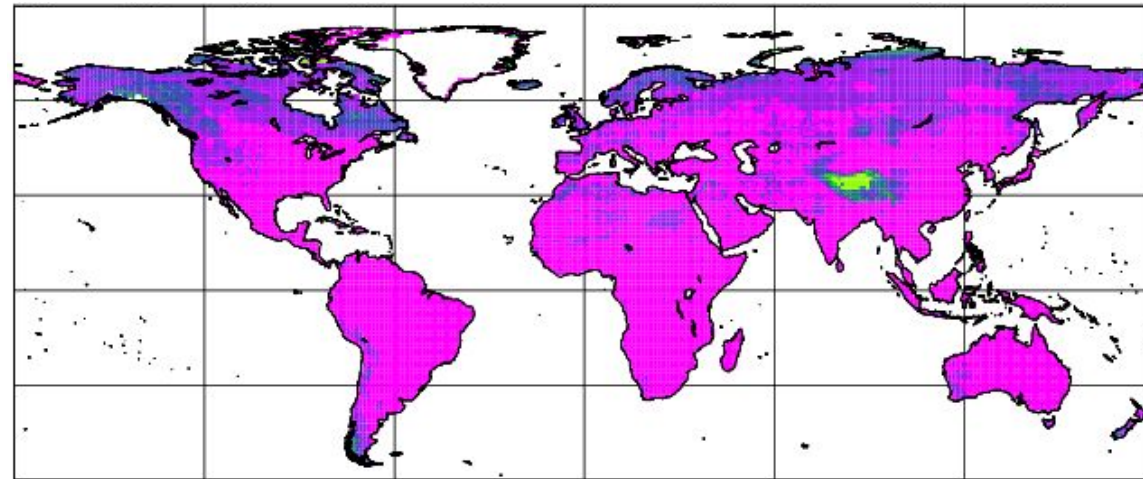


Temperature strongly influences the spatial variability of mercury evasion and uptake, especially in the cold northern hemisphere.

Evasion

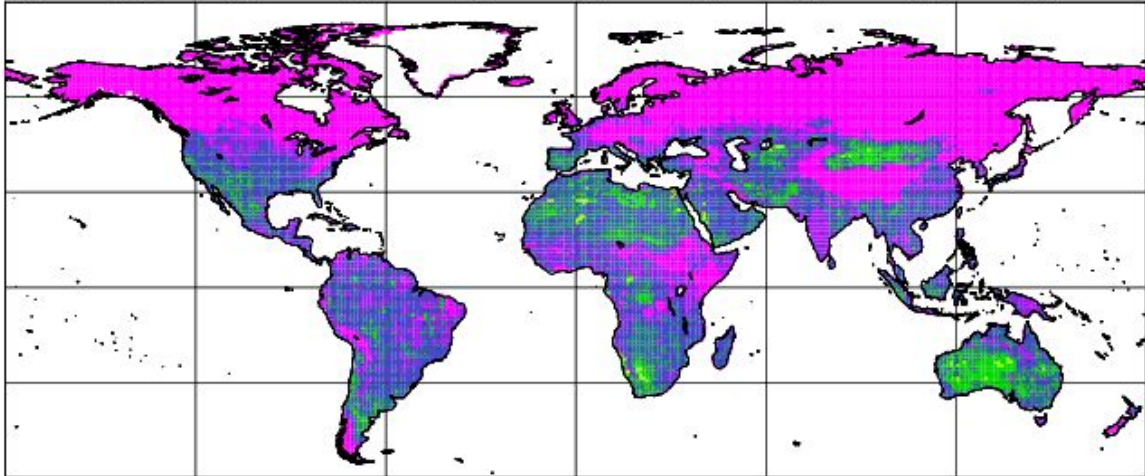


Uptake

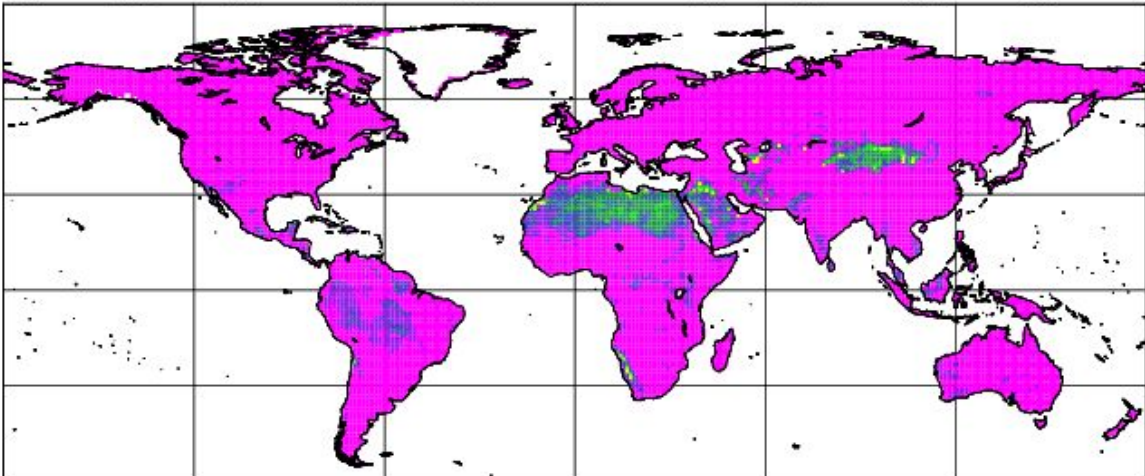


Soil moisture plays an important role on mercury fluxes in dry regions, particularly for evasion.

Evasion

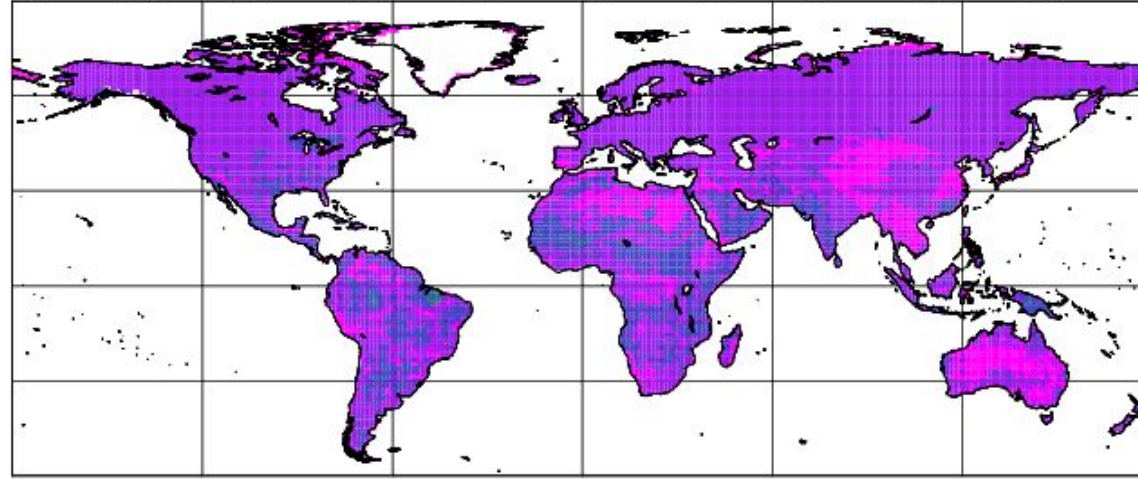


Uptake

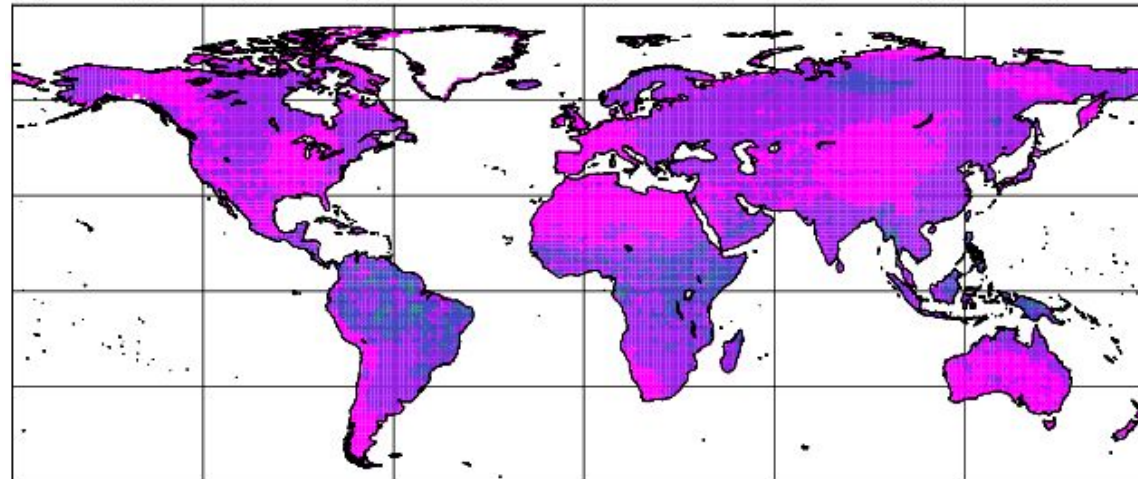


Humidity and **light** have a minimal impact on mercury uptake through plant photosynthesis.

Humidity



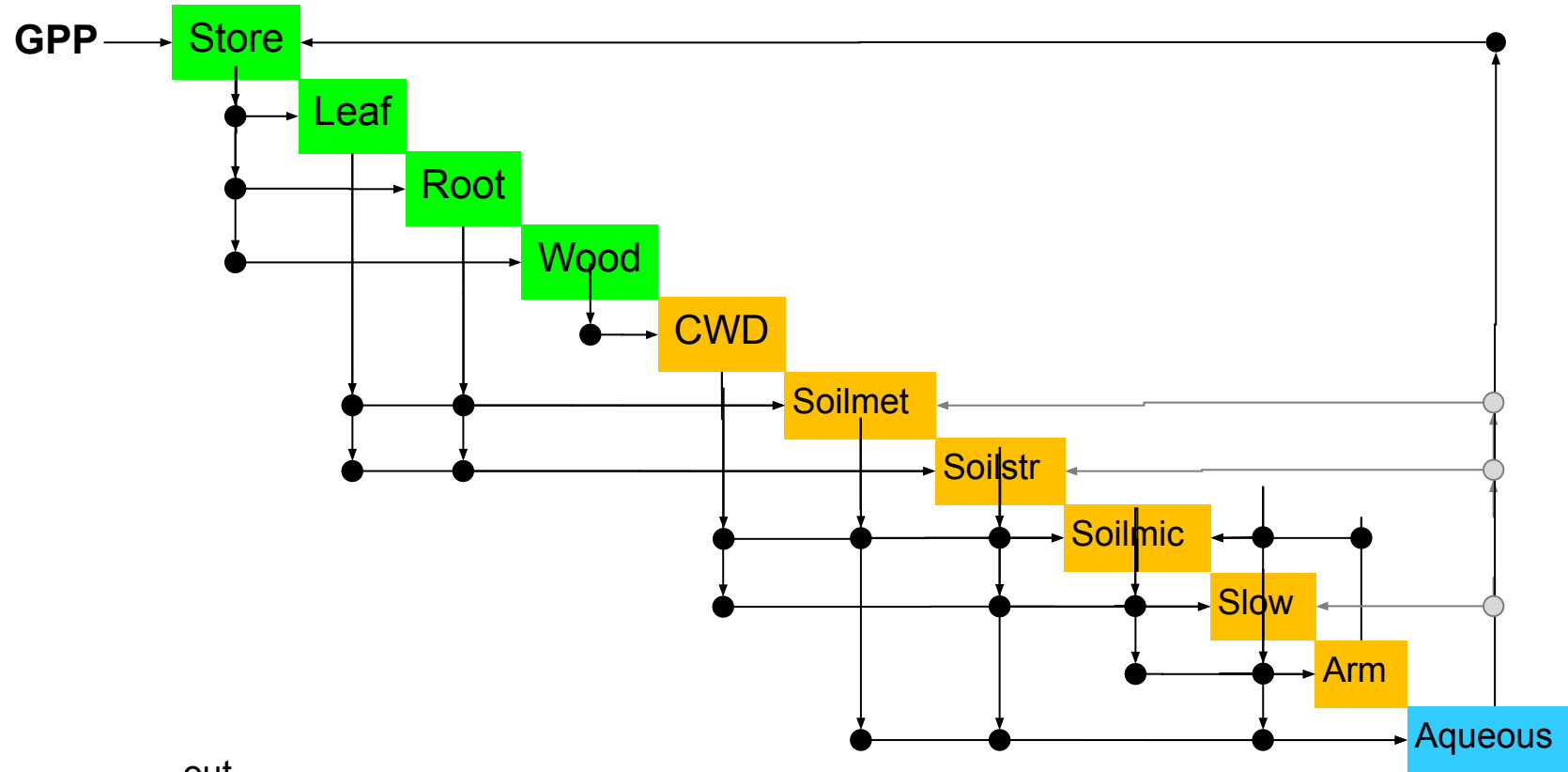
Light



In conclusion..

- The terrestrial biosphere modulates the global mercury cycle.
- Our model is only one of four known models that integrate mercury biogeochemistry into broader Earth system modeling.
- Our model is perhaps the most advanced terrestrial Hg land model.

Carbon and Hg Pools



- Live Biomass
- Soil Carbon
- Aqueous

