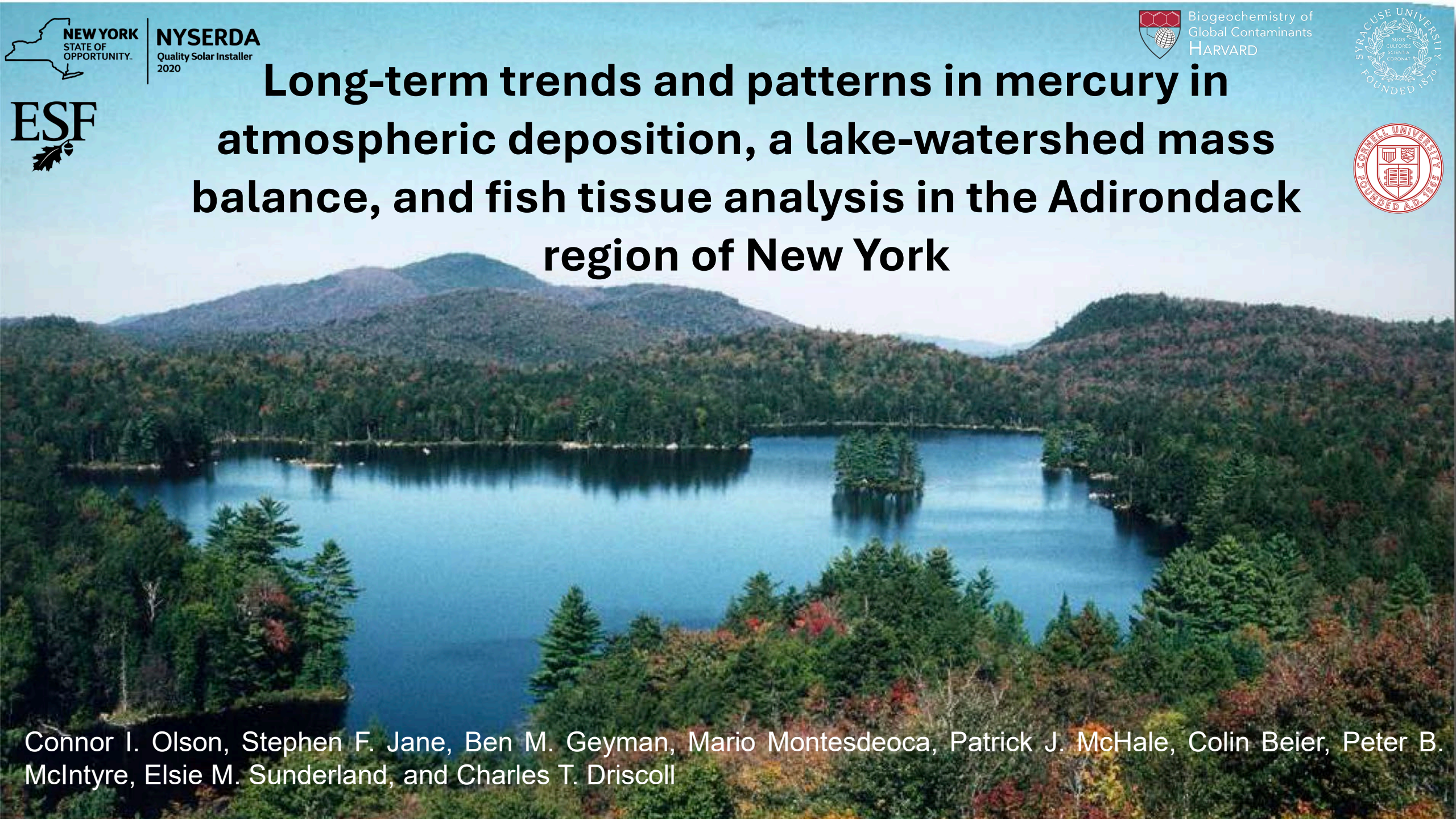
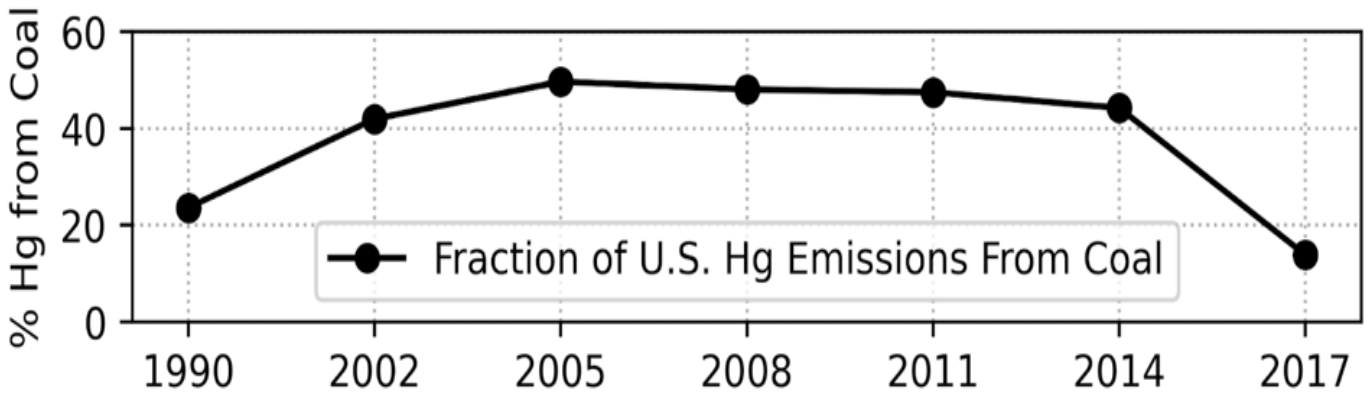
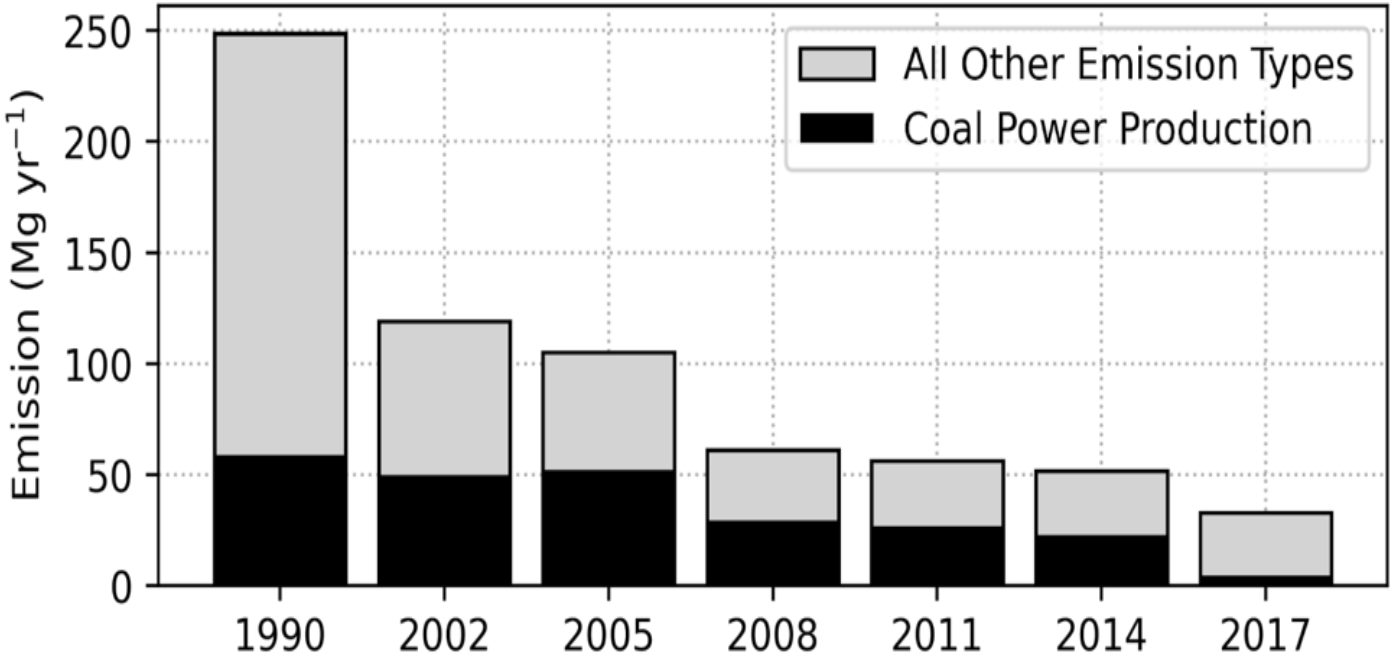
Long-term trends and patterns in mercury in atmospheric deposition, a lake-watershed mass balance, and fish tissue analysis in the Adirondack region of New York

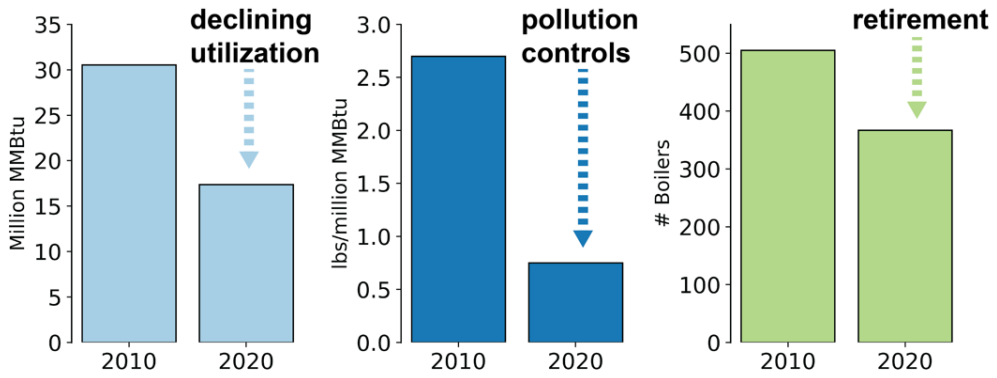


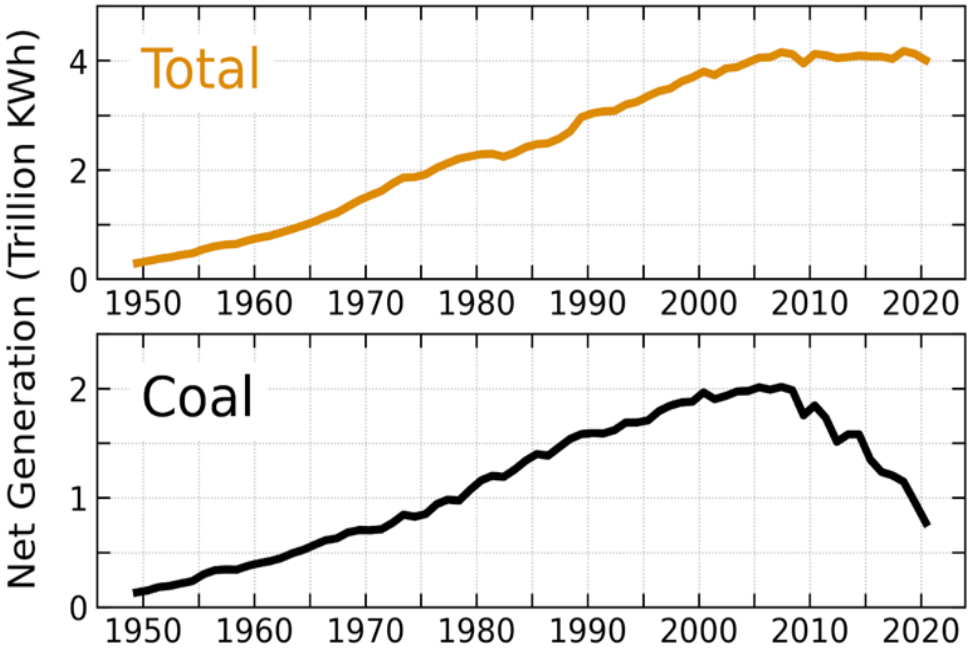
Connor I. Olson, Stephen F. Jane, Ben M. Geyman, Mario Montesdeoca, Patrick J. McHale, Colin Beier, Peter B. McIntyre, Elsie M. Sunderland, and Charles T. Driscoll

National Emissions* (1990 – 2017)









*Sunderland et al. (2021)

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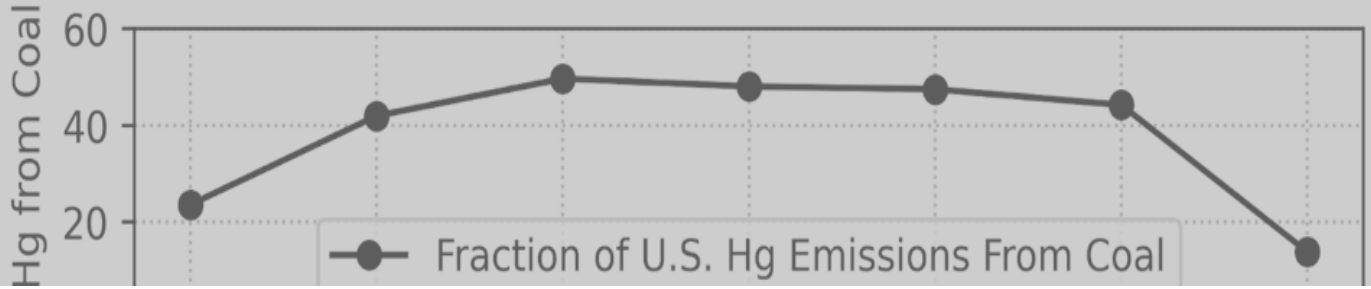
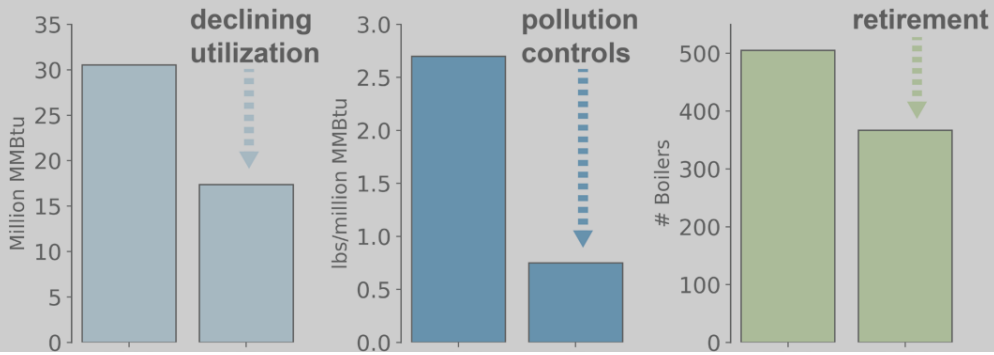
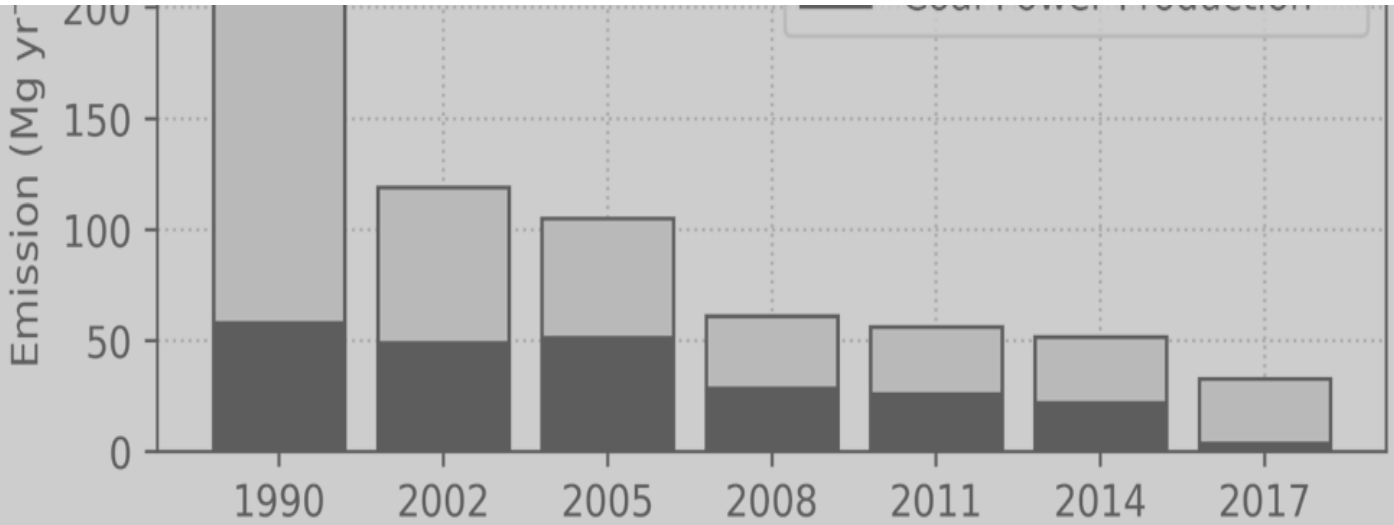
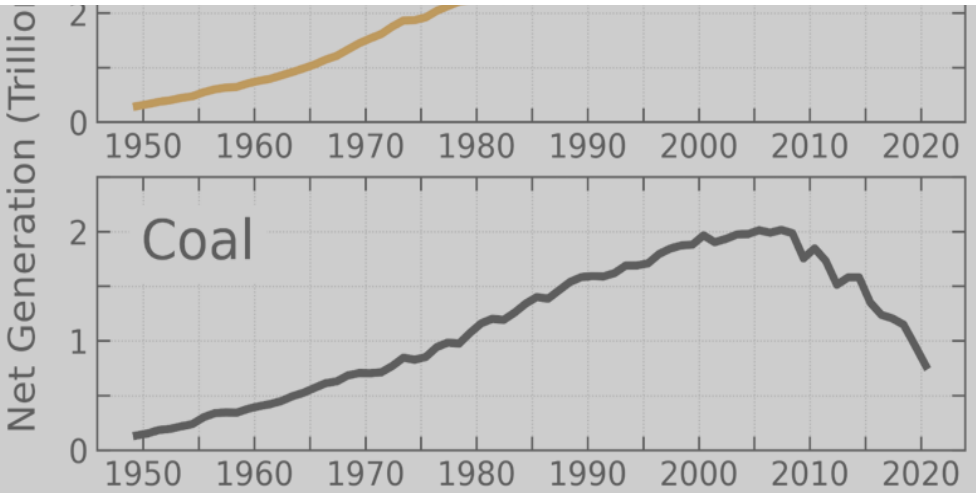




What magnitude of environmental response should we expect?





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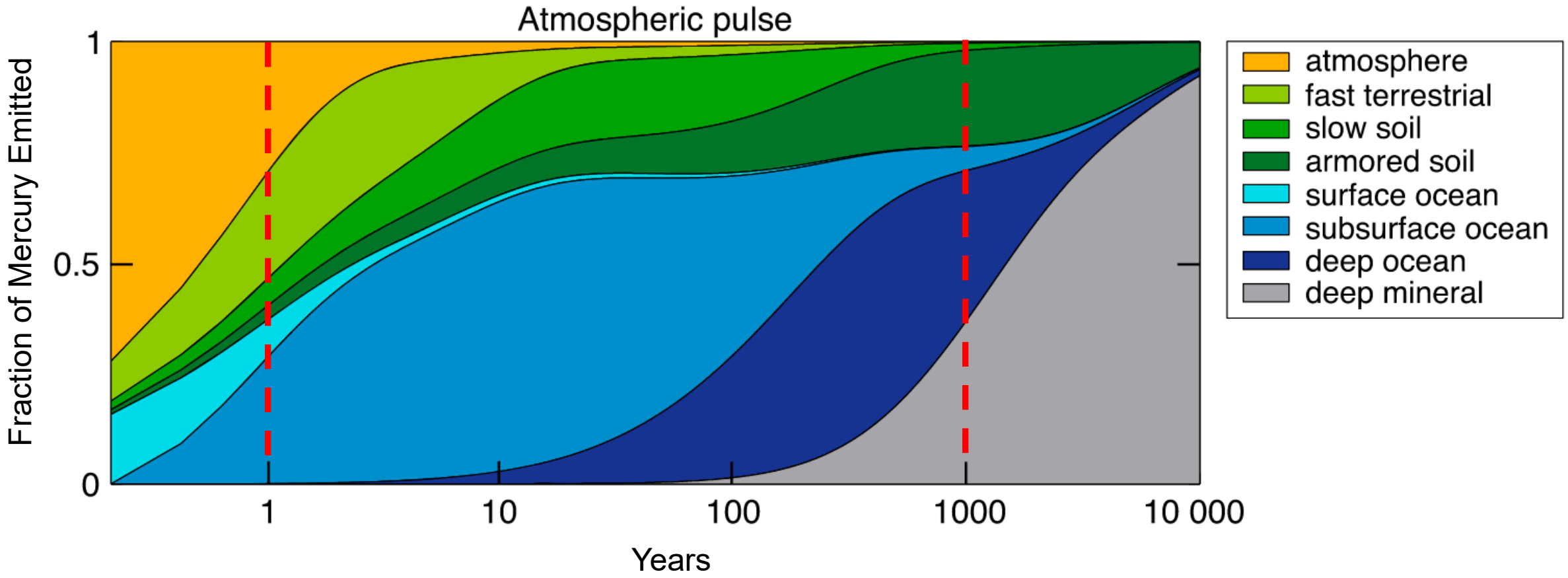
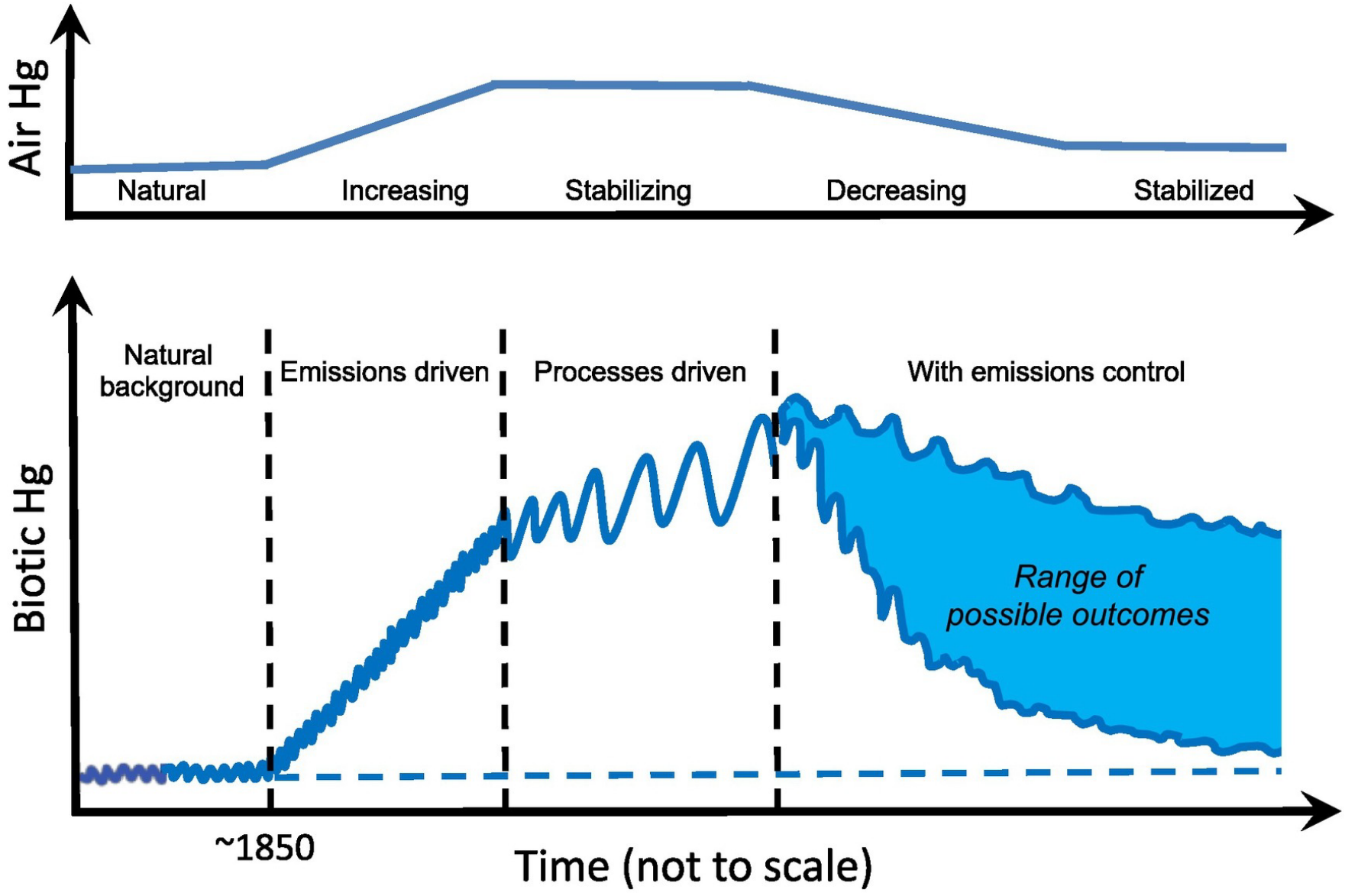


20% in soils after 1,000 years!

Amos et al. (2013)

What magnitude of biotic response should we expect?

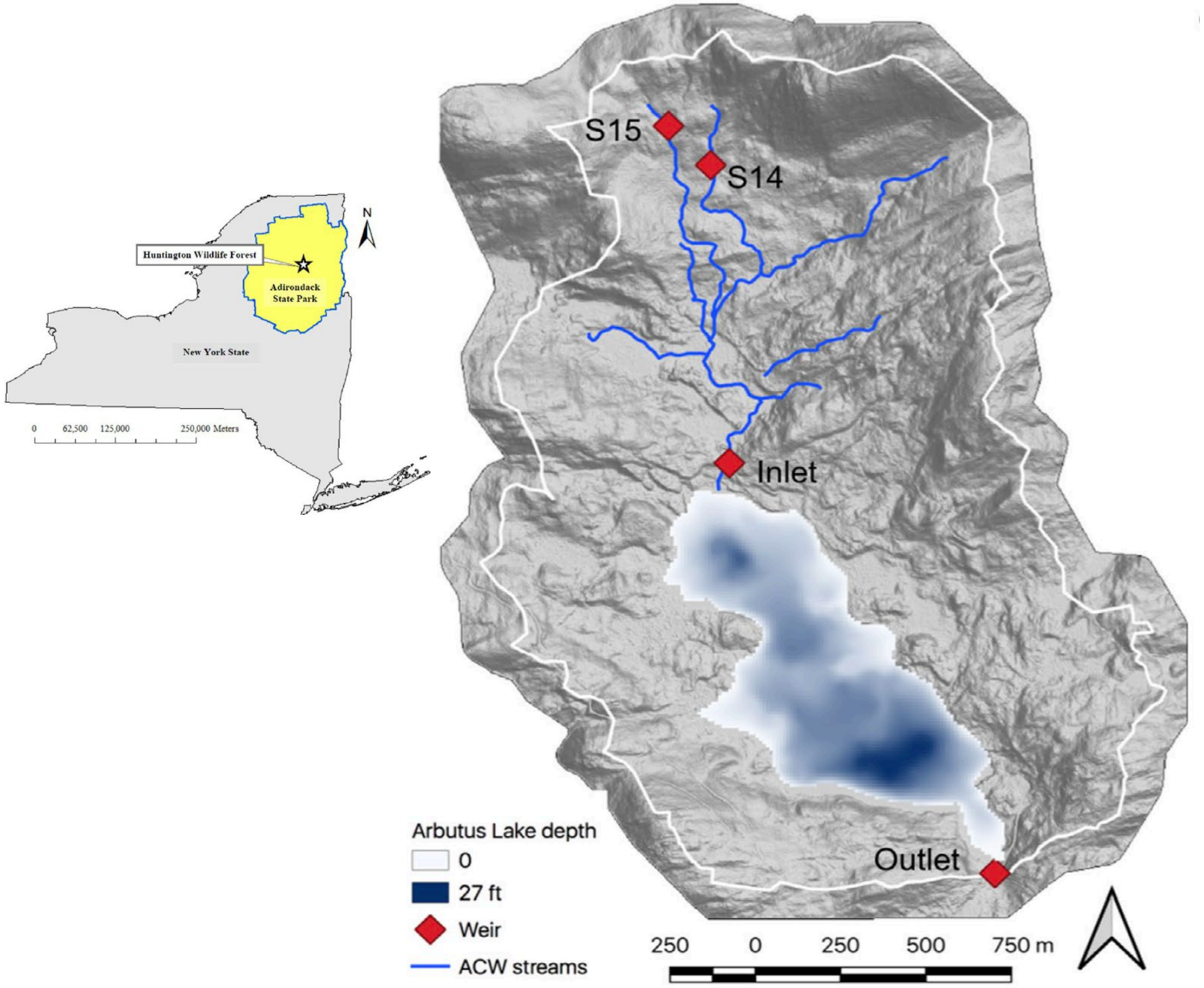


Wang et al. (2010)

Huntington Wildlife Forest and Arbutus Lake

Hg Monitoring Efforts

- Hg Air Fractions (AMNet; 2009 – 2018)
- Hg Wet Deposition (MDN; 1999 – 2020)
- Hg Litterfall (MLN; 2001 – 2021)
- Hg Watershed Flux (2004 – 2020)



Huntington Wildlife Forest and Arbutus Lake

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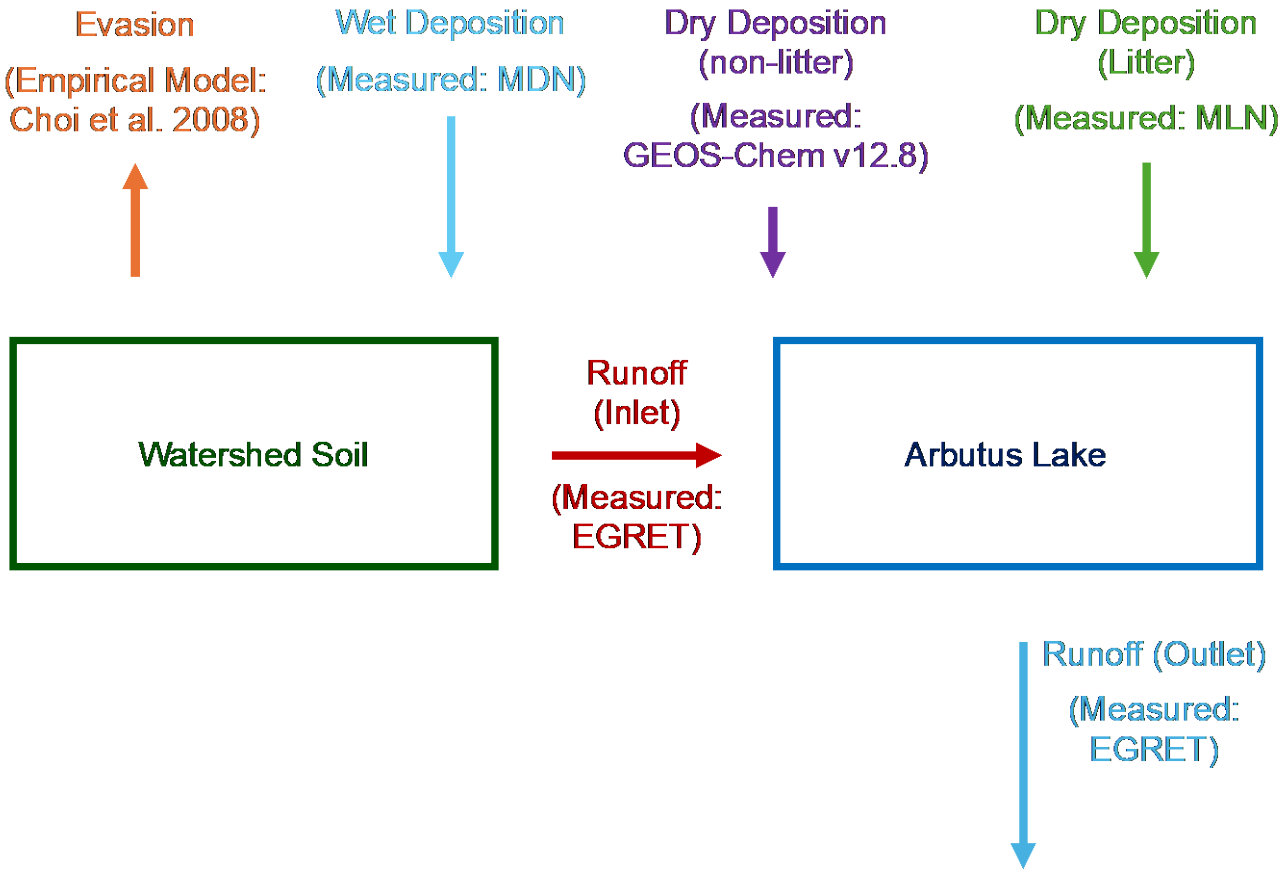
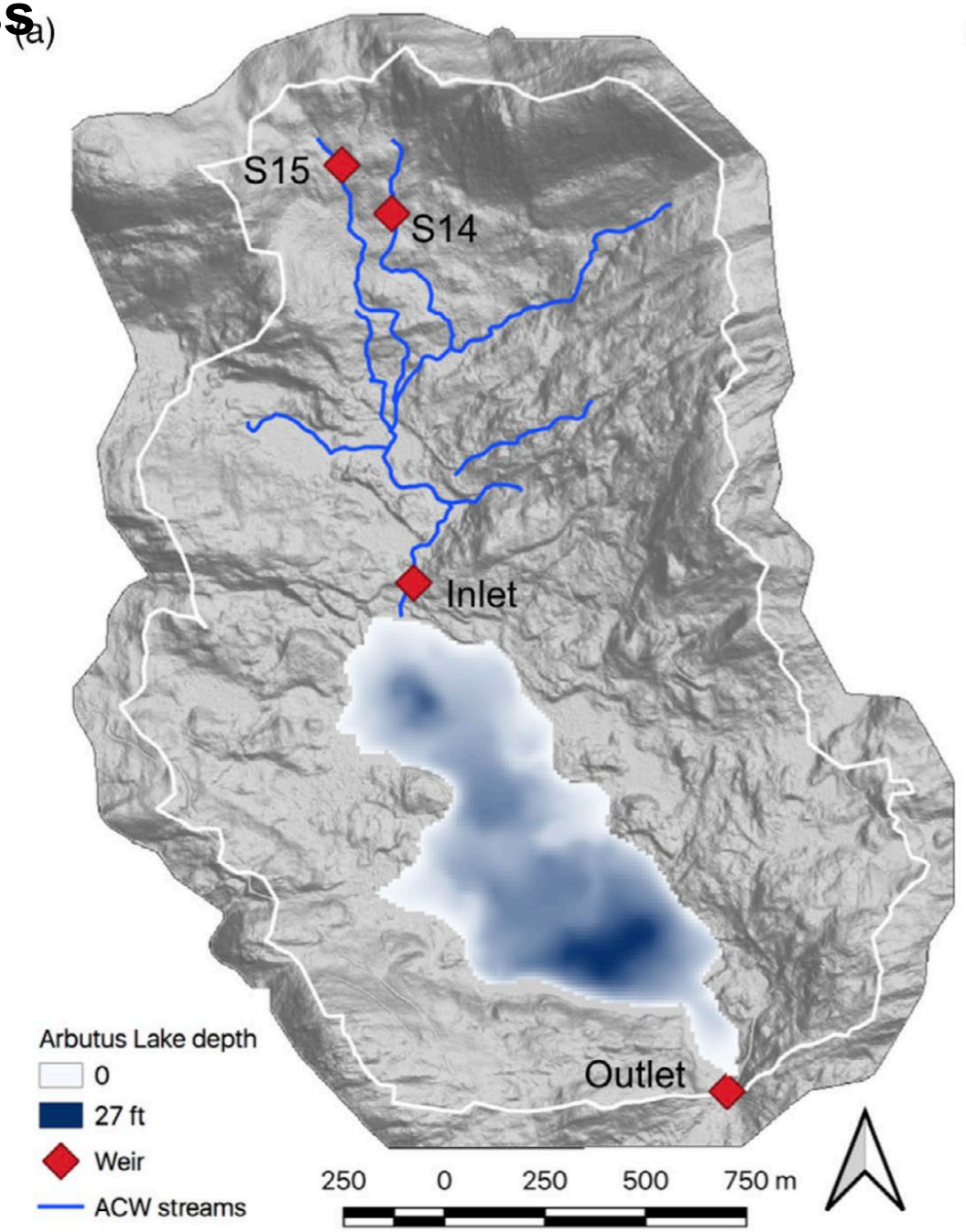


Aims

- Analyze Trends in Fluxes
- Construct Mass Balances
- Compare with Regional Fish Monitoring Records

Watershed/ Lake Mass Balance



Inputs

Wet and Dry Deposition

Inlet Flow

Non-Channelized Flow

Outputs

Outlet Flow

Evasion

Lake-Watershed Mass Balance

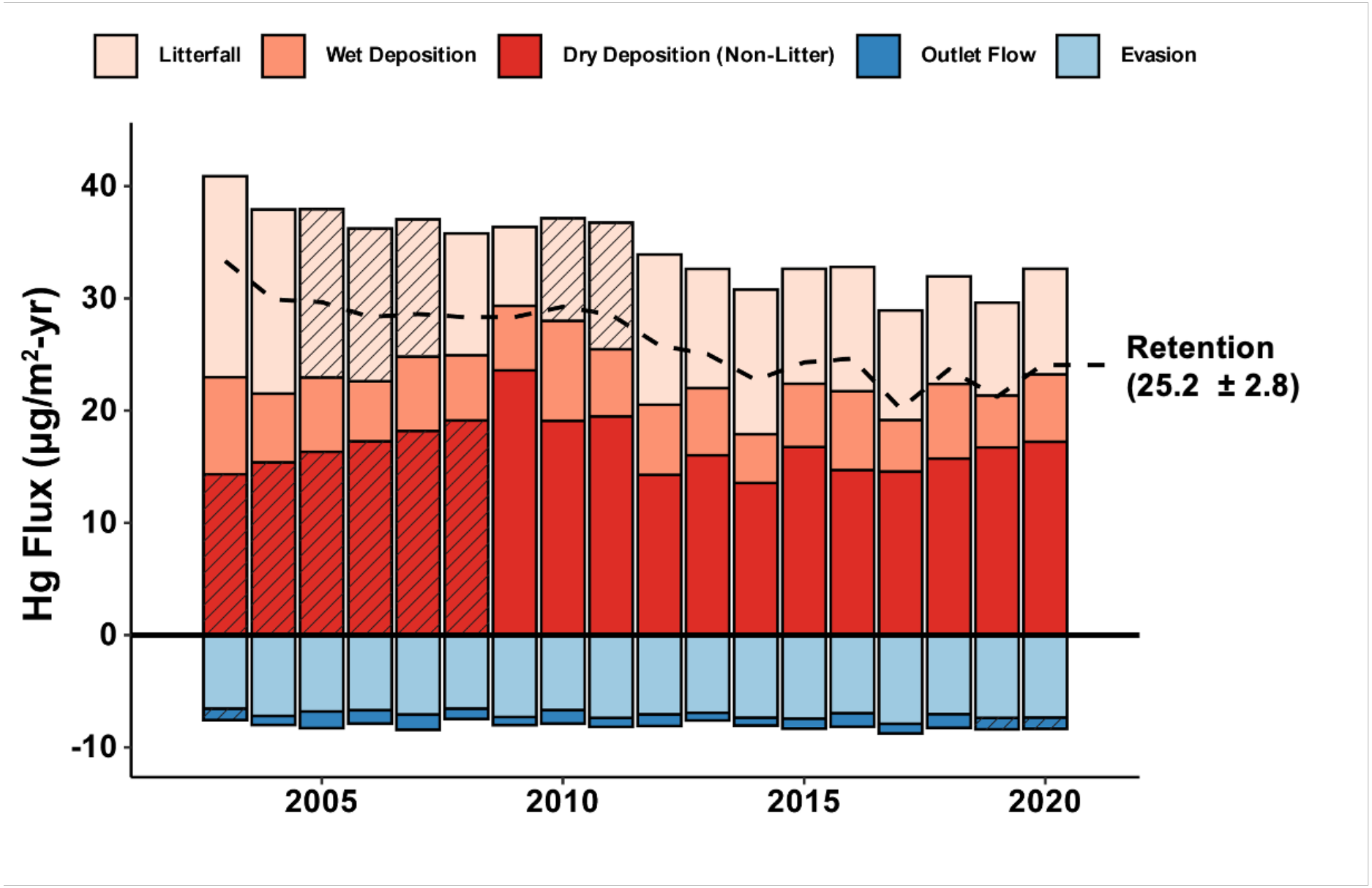
- 2.19 kg (622 μg/m^2) Hg introduced from 2003 to 2020

- 0.45 kg (128 μg/m^2) re-emitted to the atmosphere (~20%)

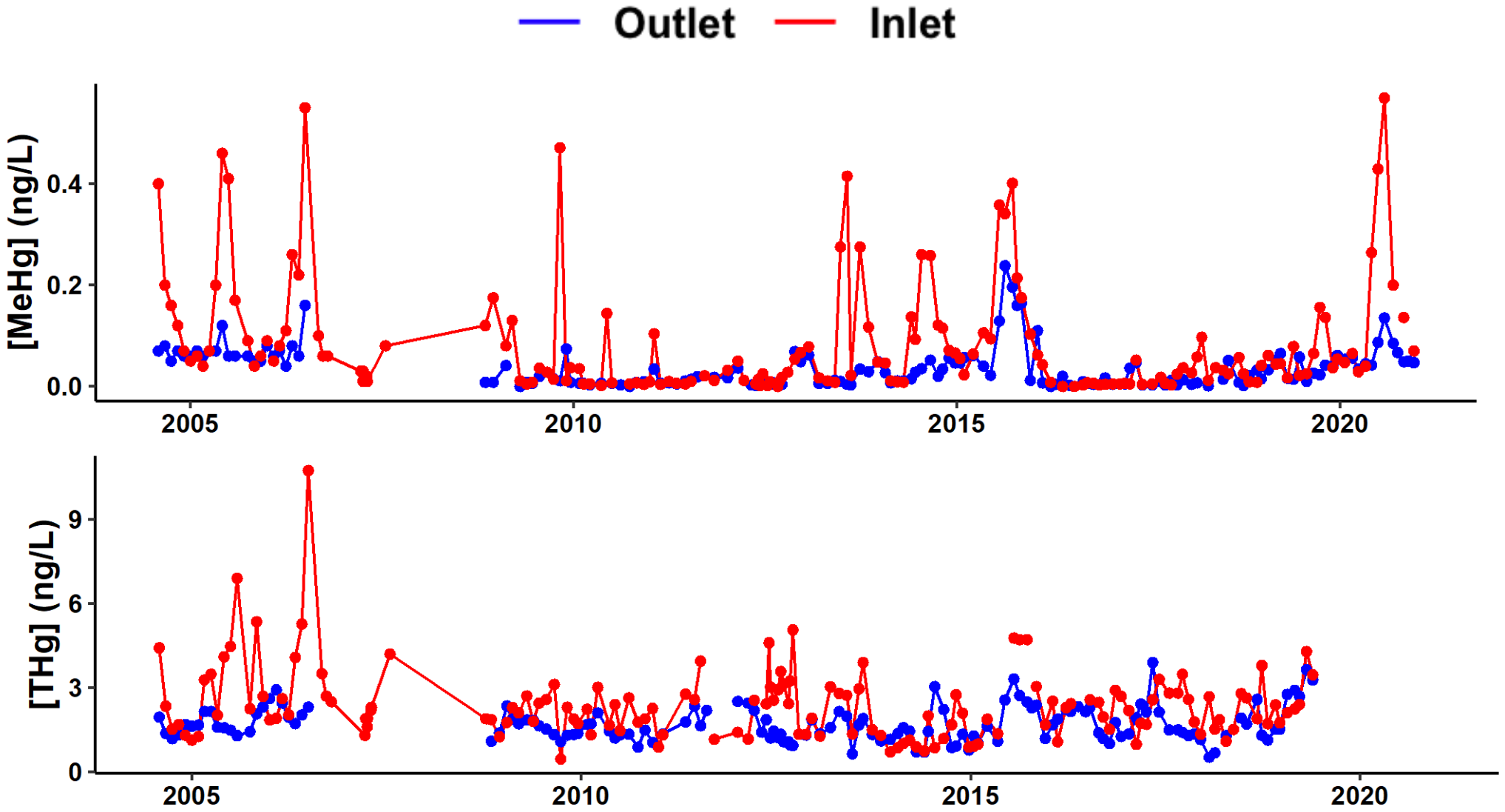
- 0.06 kg (18 μg/m^2) retained in lake sediments or discharged from lakes (~6%)

- 1.68 kg retained in soils (76%)

- 2% soil increase/yr

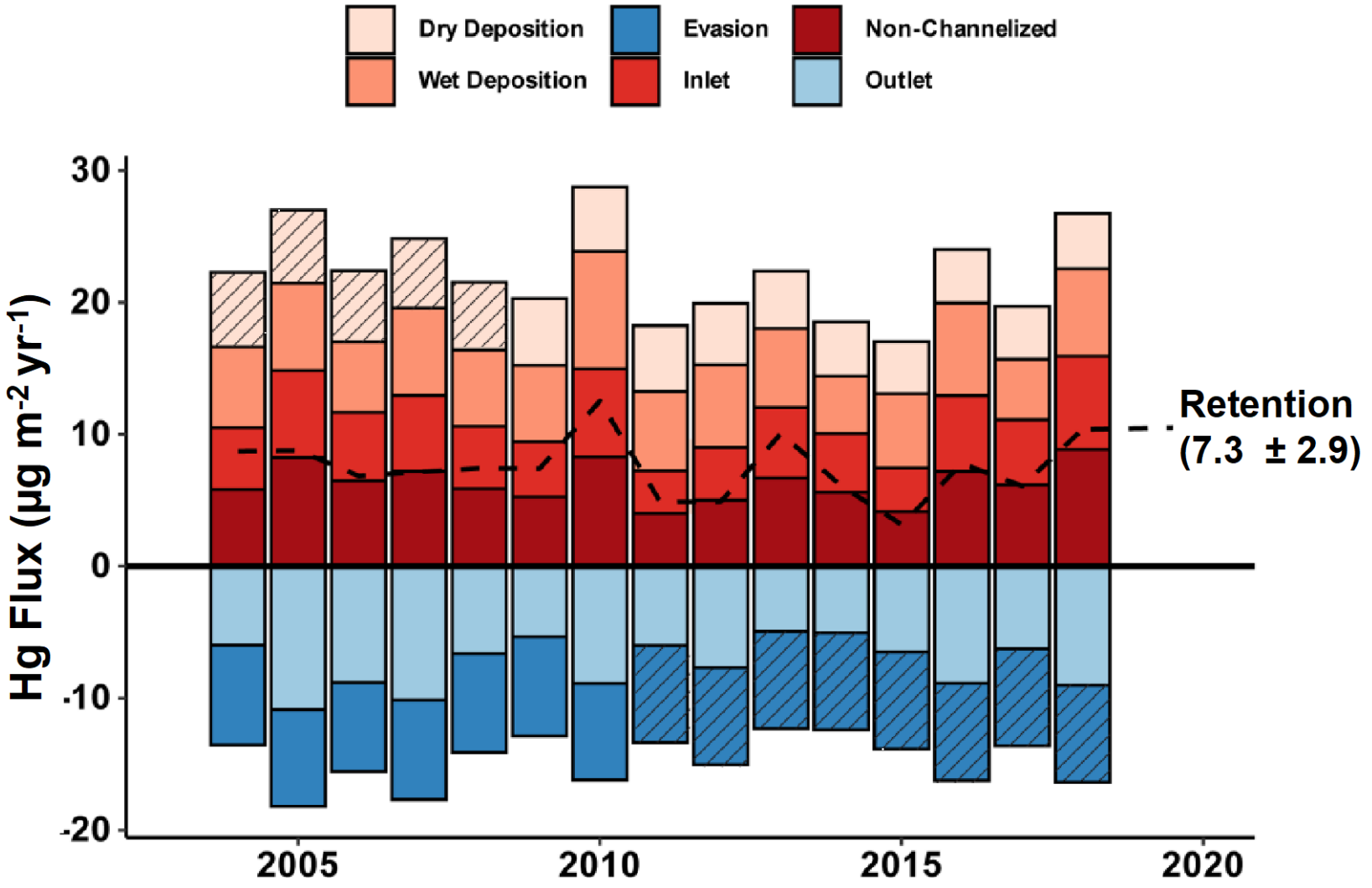


Stream Fluxes



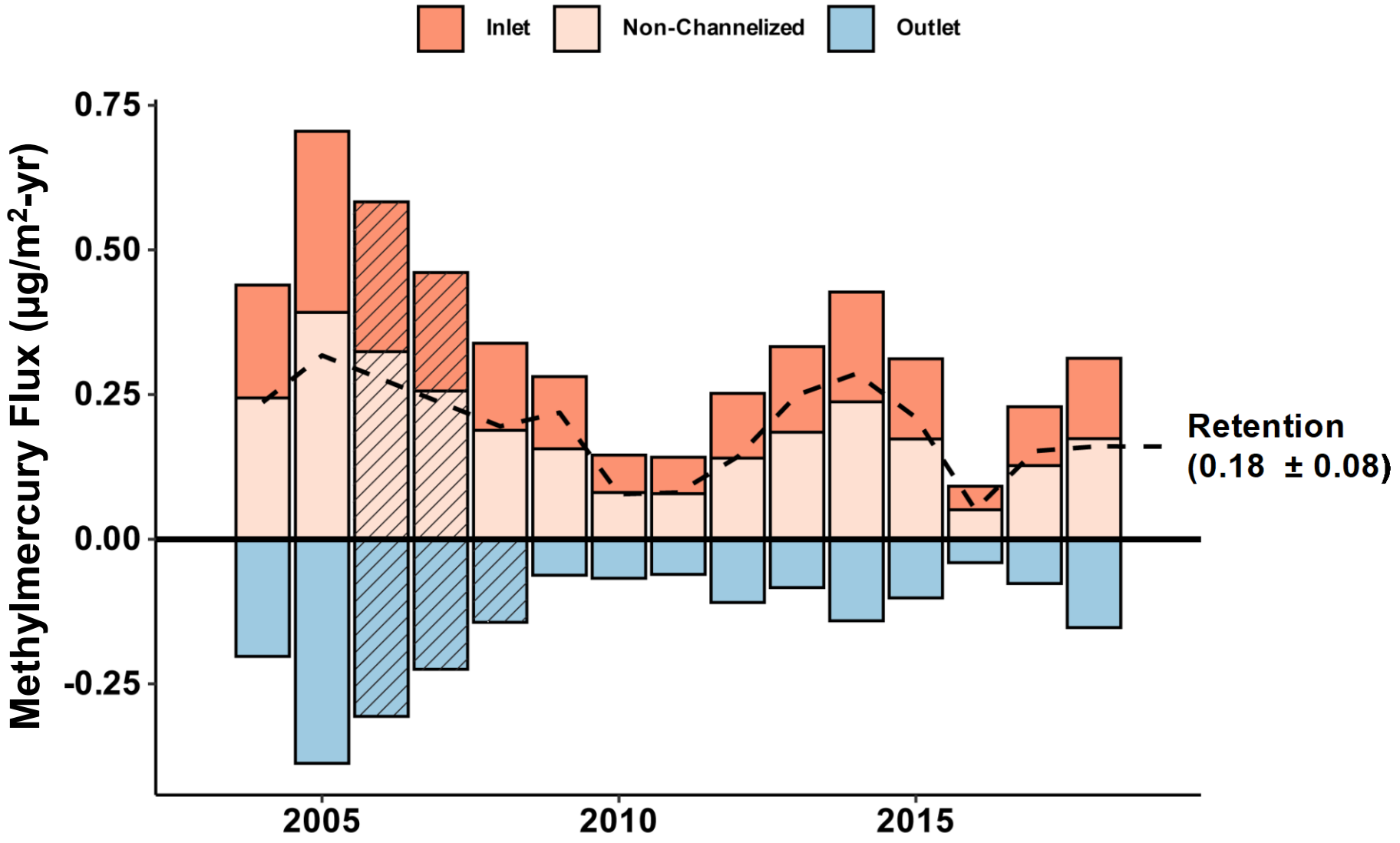
Lake Mass Balance

- Lake is a net sink for mercury
- 3.5 g/yr is thought to be retained by sedimentation
- Flow-normalized concentrations and fluxes showed decreases early in the records, but have been increasing since 2010
- Could indicate increases from browning or climate-related changes

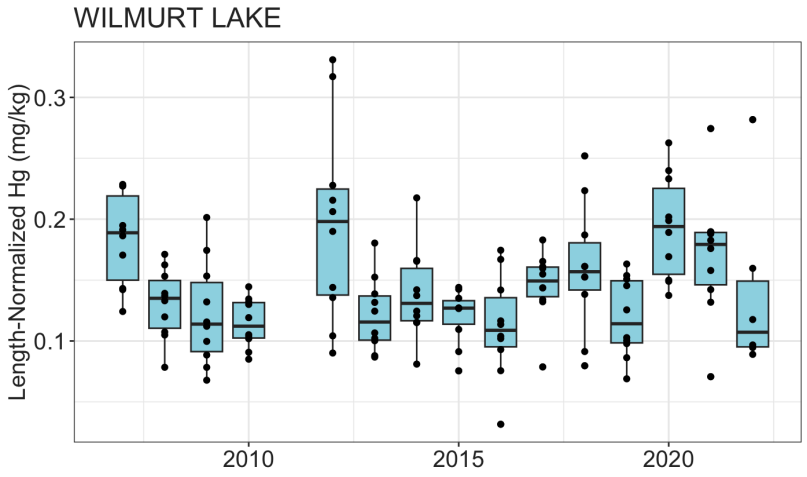


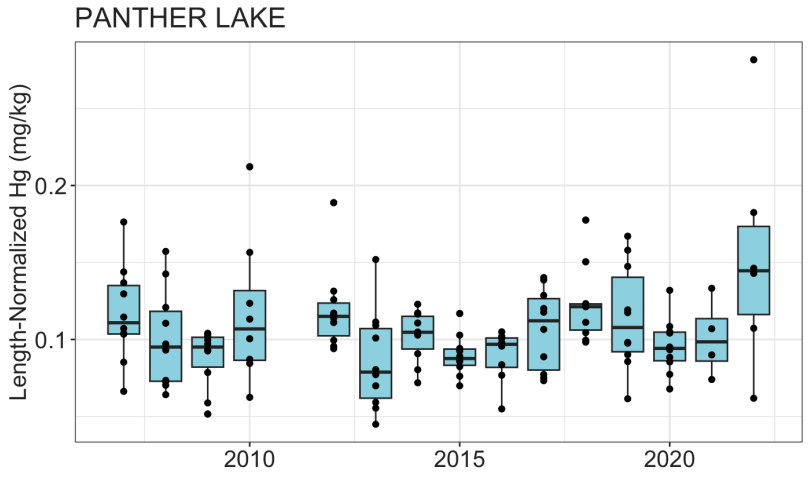
Lake MeHg Mass Balance

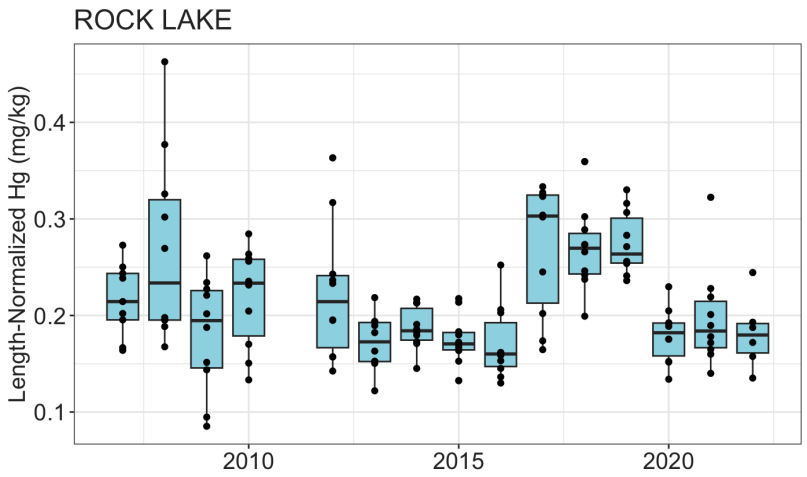
- Lake is a net sink for MeHg
- 87 µg/yr is thought to be retained by sedimentation/ demethylation
- Flow-normalized concentrations and fluxes showed decreases early in the records, but have been increasing since 2010
- Could indicate increases from browning or climate-related changes

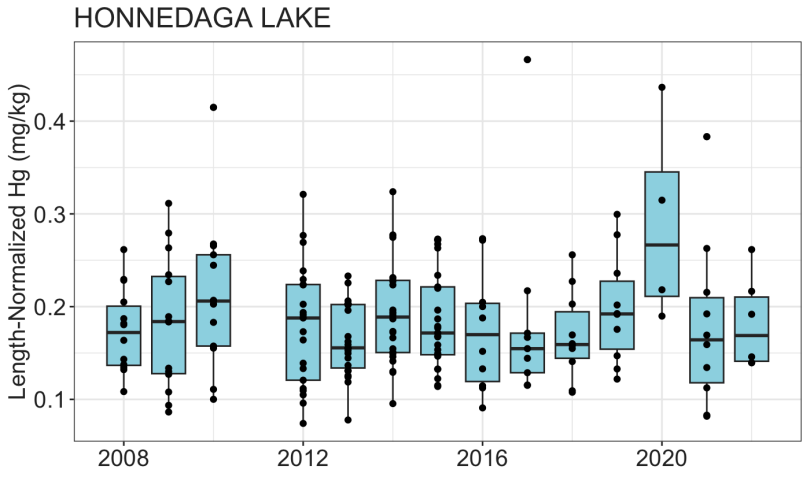


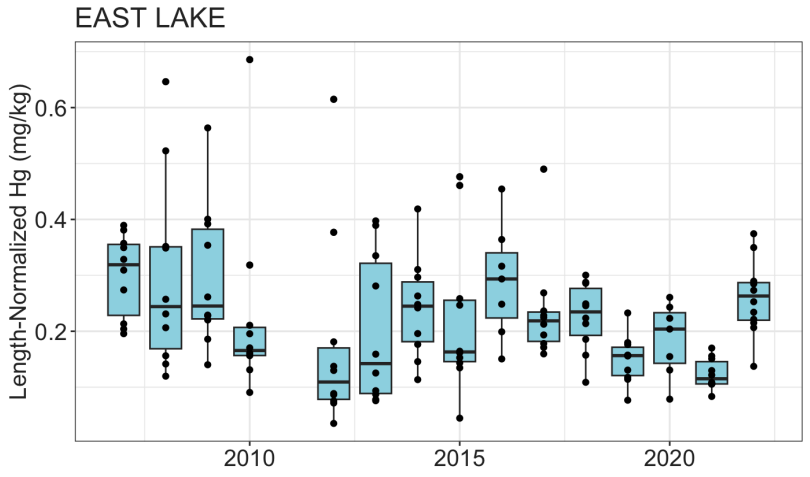
Brook Trout Records











- Fish concentrations are in wet weight and length-normalized by lake and year
- No clear trends in fish mercury

Conclusions

- Declines in atmospheric mercury are observed, in line with the short lifetime in the atmosphere
- Stream fluxes are much more variable and potentially impacted by changes in climate and soil chemistry
- Fish are highly variable and power analysis suggests longer records will be needed to observe statistical changes