Methylmercury Export from a Headwater Peatland Catchment Decreased with Cleaner Emissions Despite Opposing Effect of Climate Warming

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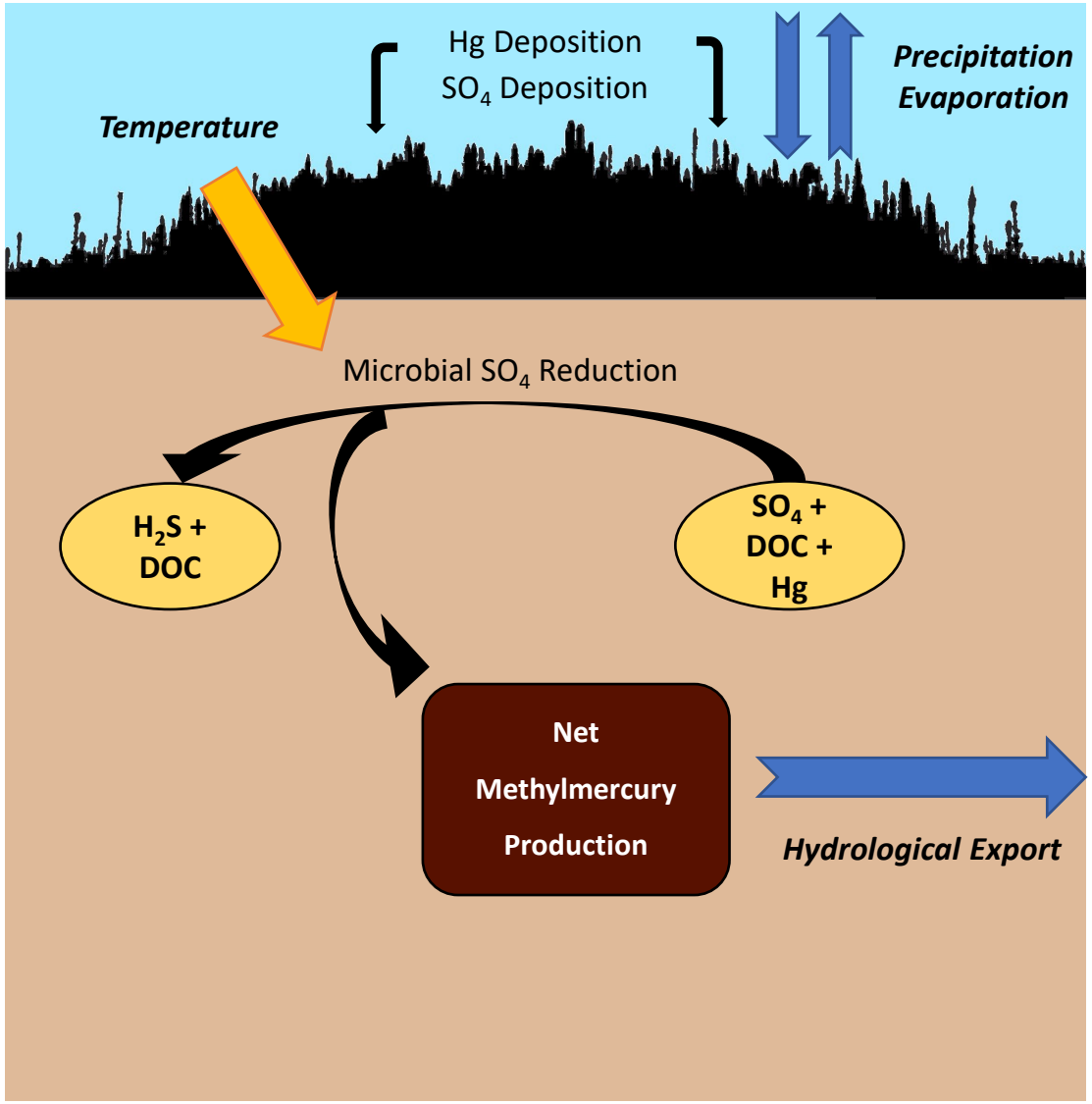
Introduction

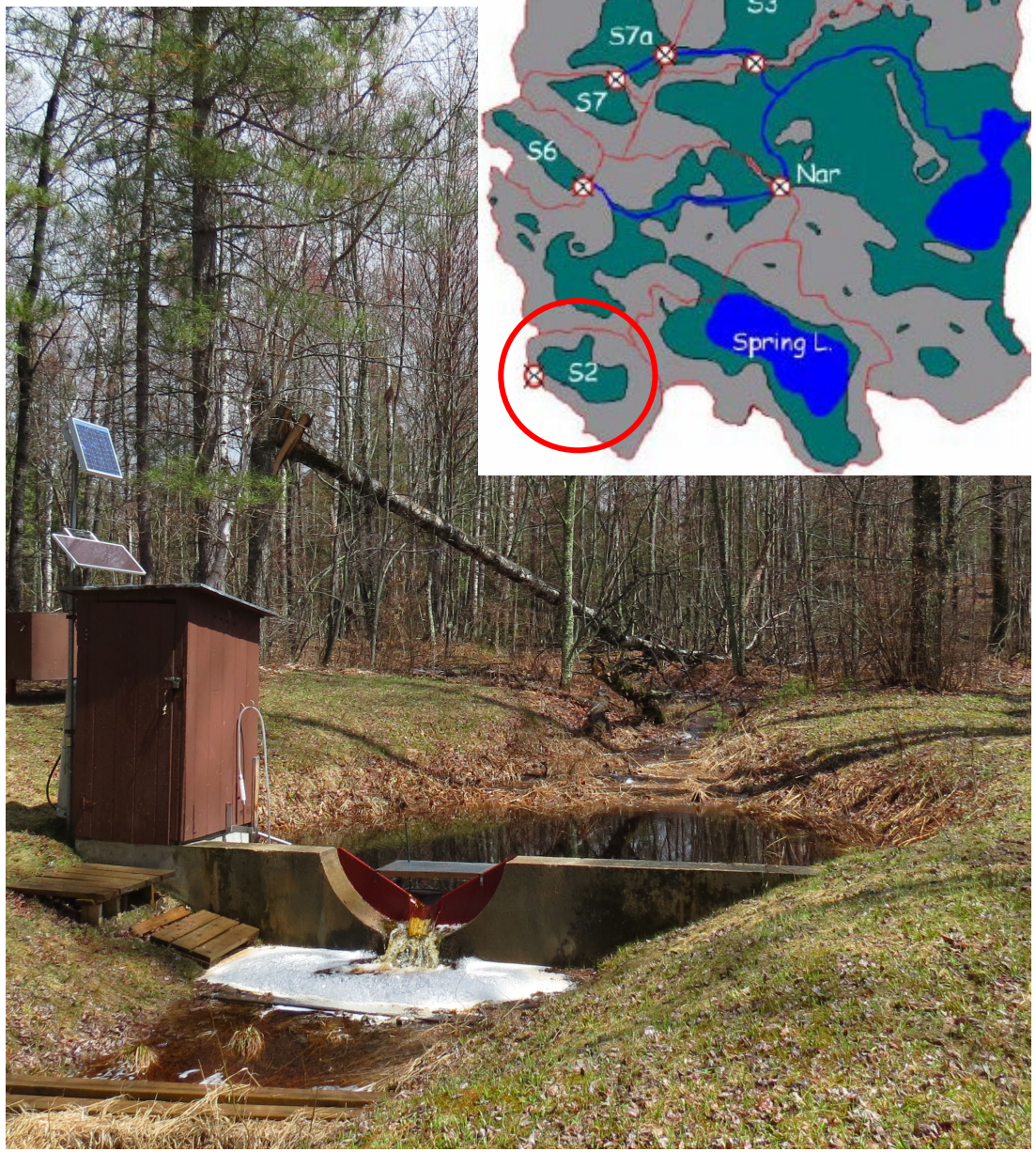
- Peatland-rich catchments are often sources of MeHg to downstream ecosystems
- Export of Hg from peatlands tied to biological, geochemical, hydrological, and climatic processes
- Climate change may impact Hg cycling/export due to interactive effects with temperature and hydrology
- Unravelling how Hg export is changing due to potentially compounding disturbances is challenging



Research Objective

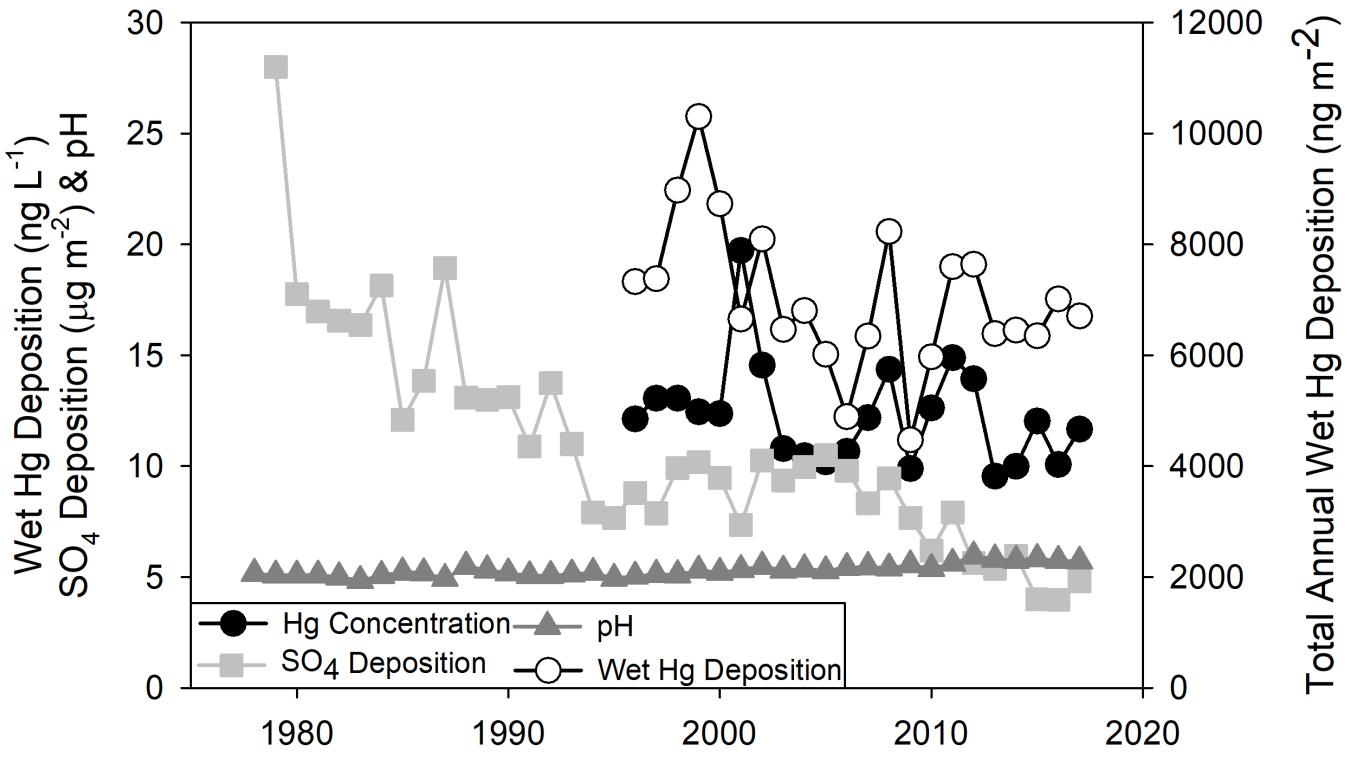
Elucidate how the combined impacts of changing atmospheric deposition (cleaner air) and climate are impacting Total-Hg and MeHg export from a mixed-forest headwater catchment

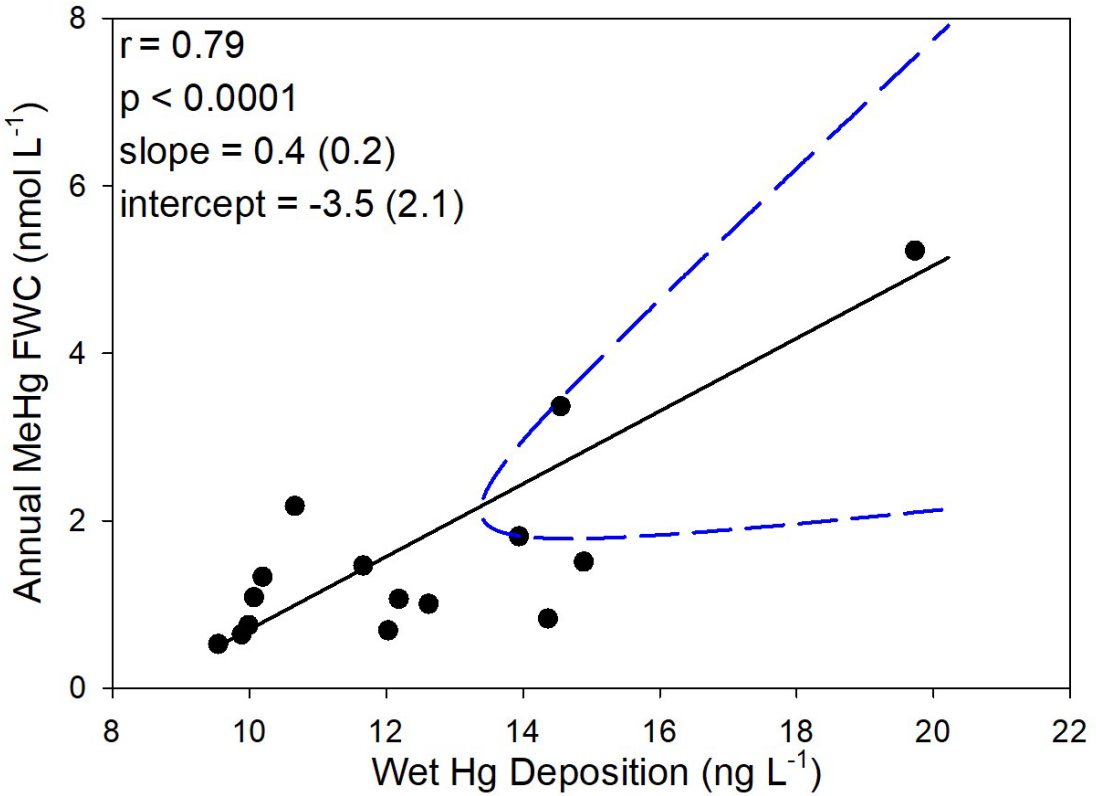
Study Site and Methods



- Catchment and regional hydro-climatology measured since 1961
- Atmospheric mercury and ion deposition measured since 1990s
- Streamwater chemistry (incl. THg & MeHg) collected 12-24x per year 2000 - 2017
- Combination of hierarchical partitioning regression and Demming regression used to determine important drivers of Hg export

Cleaner Air

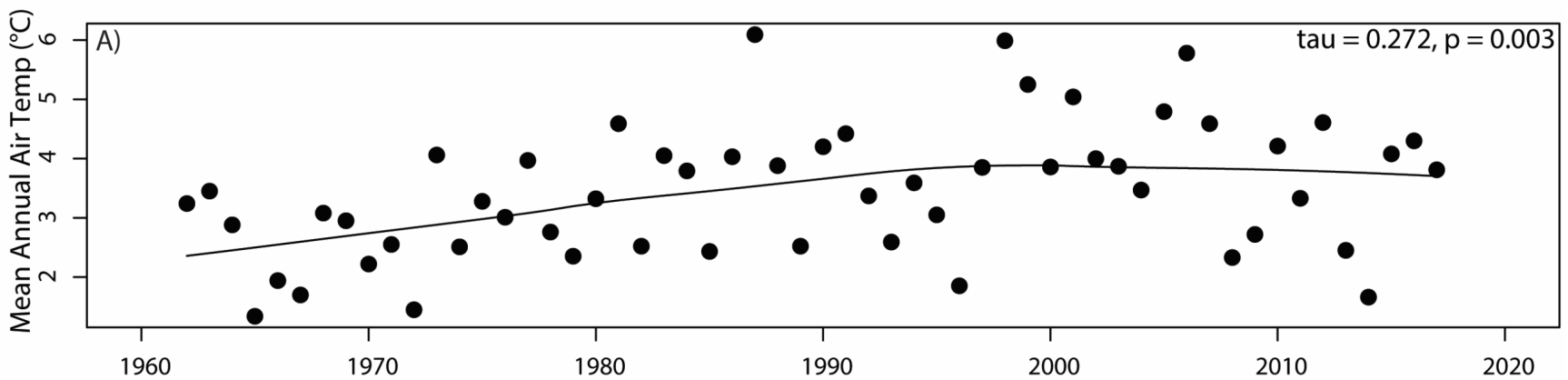


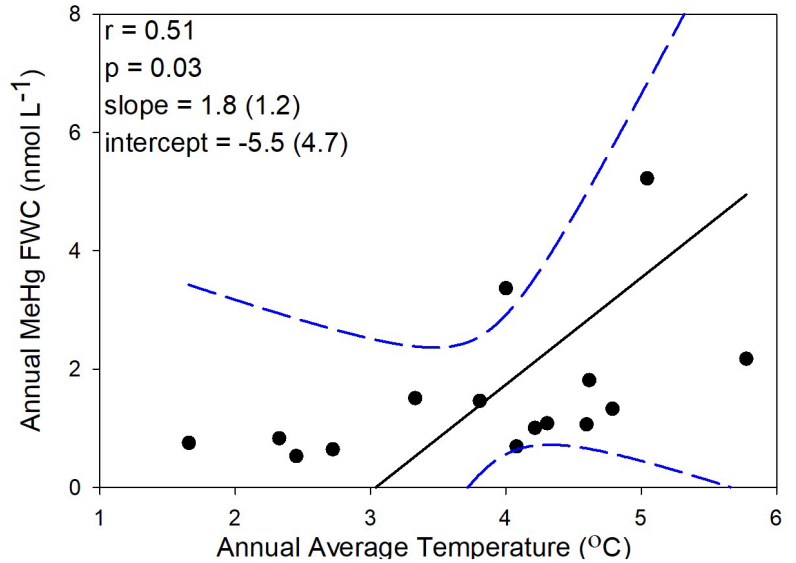


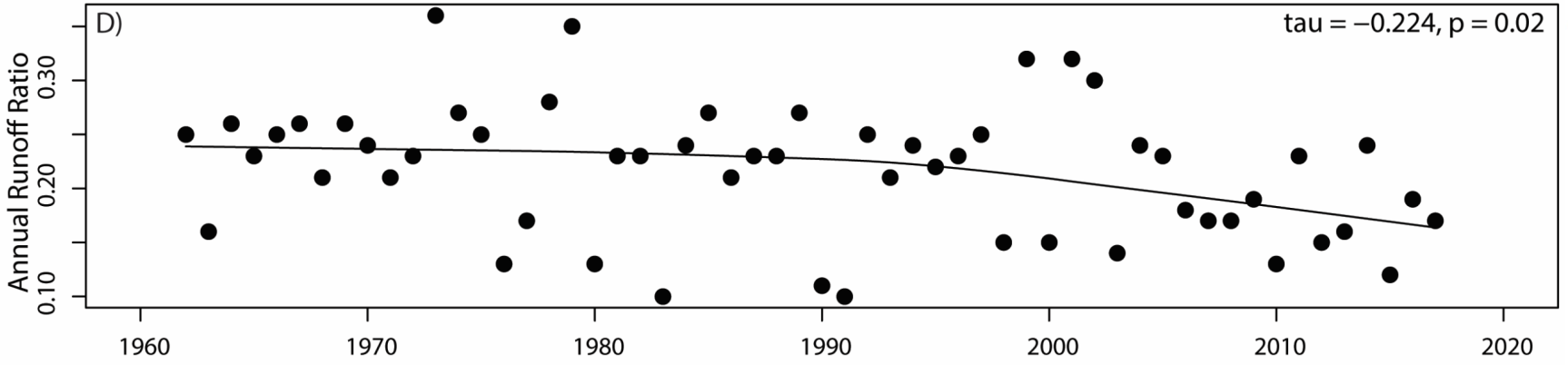
No sig. relationship with SO_4 because largest decline occurred before study

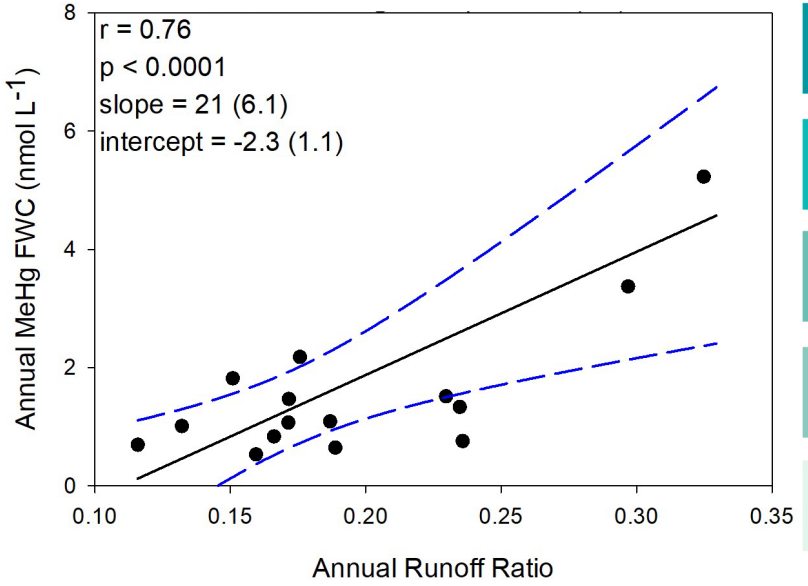
Positive relationship with precipitation Hg conc. suggests as atmospheric Hg declines, so will streamwater MeHg conc.

Climate Change





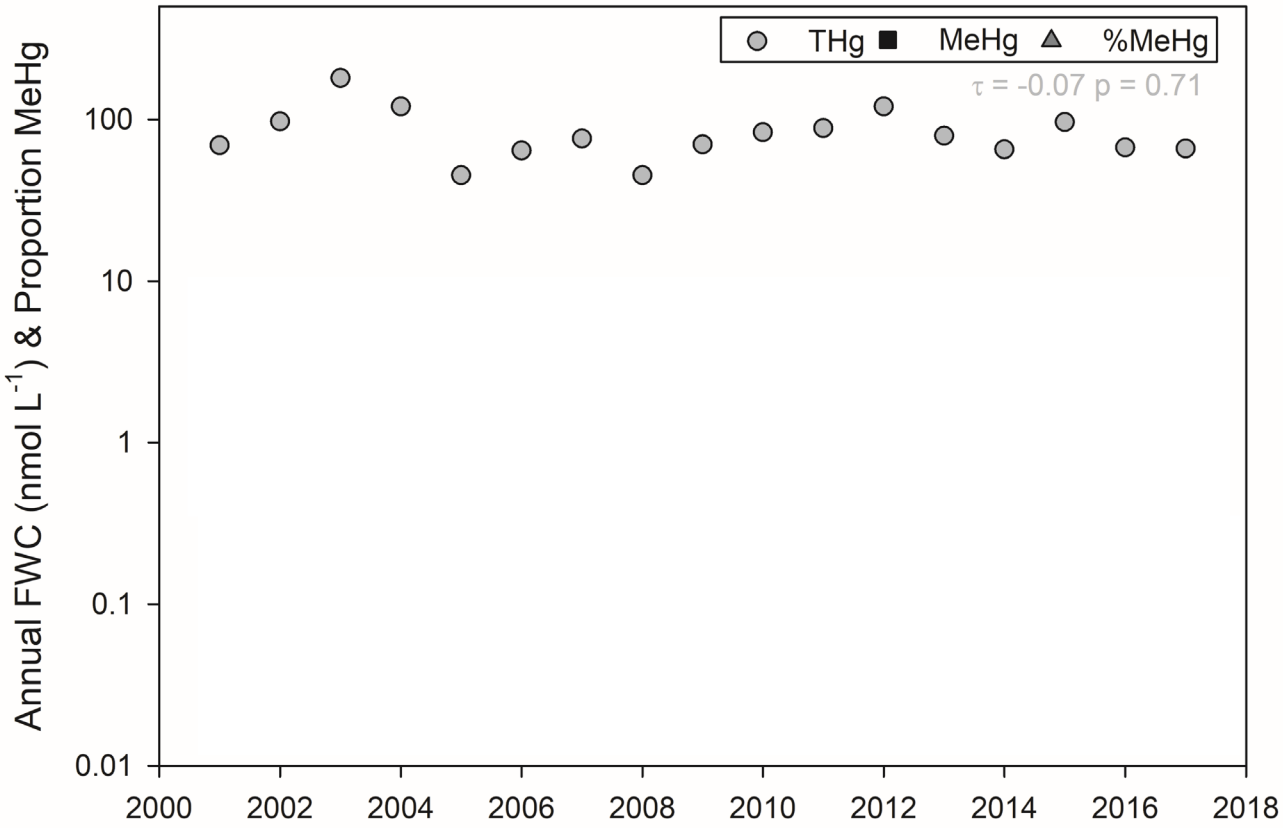




As air temperature increases, streamwater MeHg conc. is impacted by divergent processes, ↑ air temp. & ↓ runoff ratio

Mercury through time

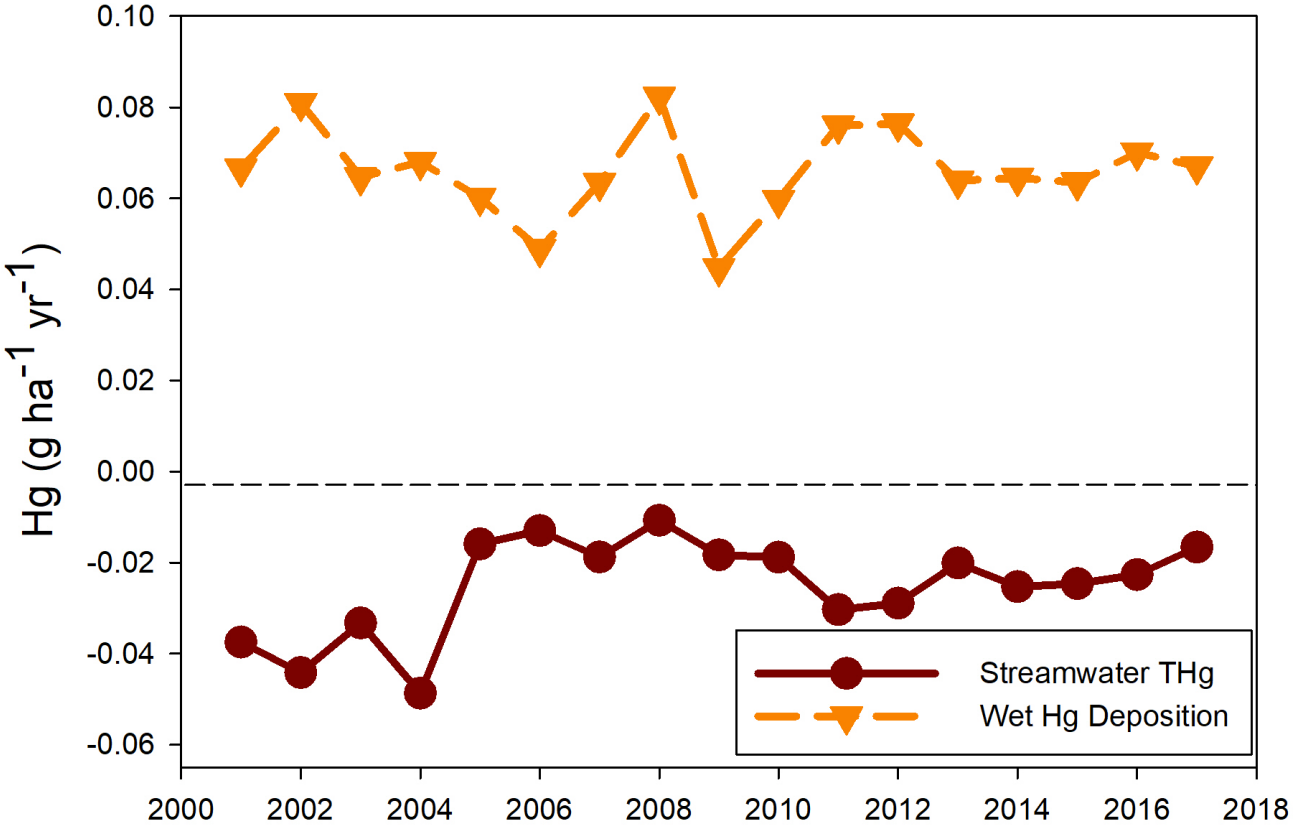
- No clear trend in THg conc. and other unmeasured factors drove its variation



Mercury through time

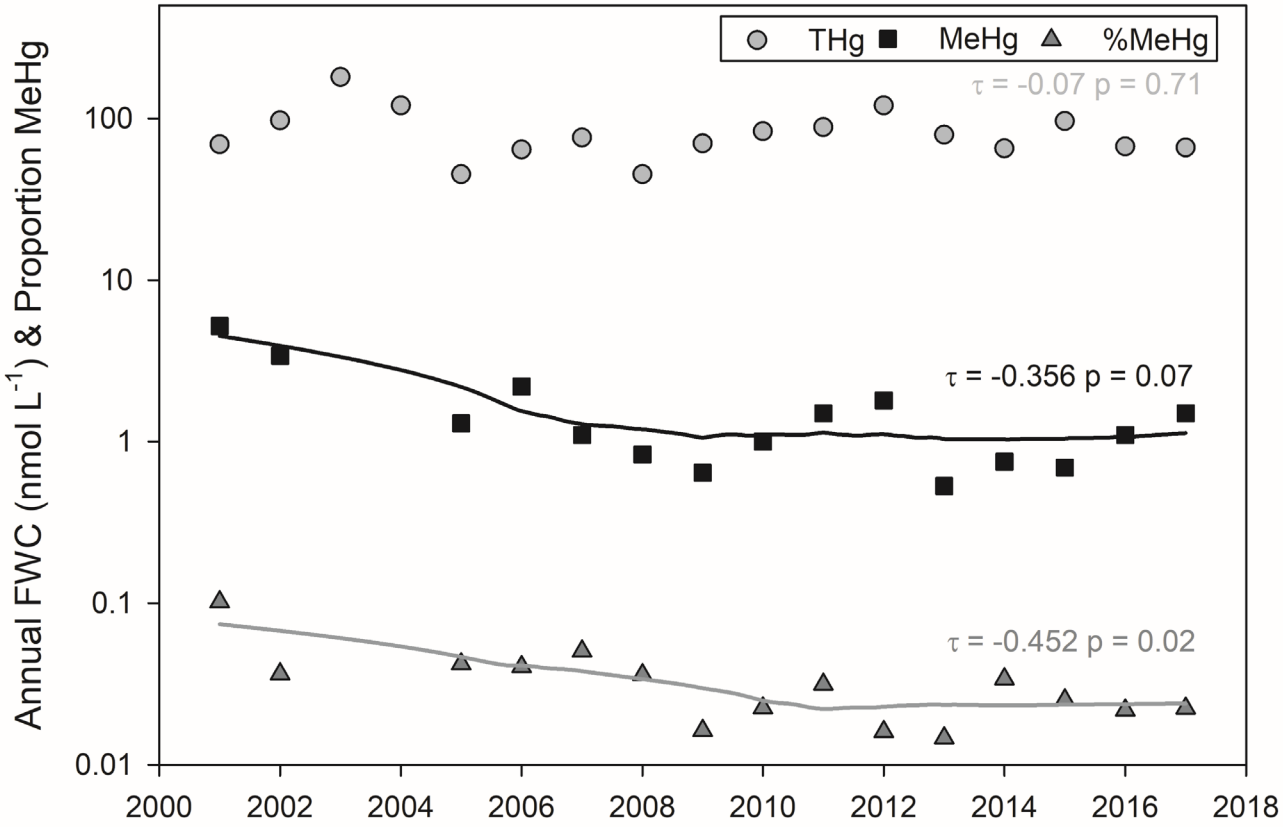
- No clear trend in THg conc. and other unmeasured factors drove its variation

- Unlikely that anthropogenic Hg will completely flush from catchment since Hg deposition is nearing pre-industrial levels



Mercury through time

- No clear trend in THg conc. and other unmeasured factors drove its variation
- It is unlikely that anthropogenic Hg will completely flush from catchment since wet Hg deposition is nearing pre-industrial levels
- MeHg conc. and %MeHg significantly declined from 2000 – 2017
- Combined impacts of ↓ wet Hg. deposition conc. and runoff ratio offsets ↑ air temp.



Implications

- We may never (in relevant time scales) fully “flush” anthropogenic Hg from peatland-rich catchments
- The strong correlation between precipitation Hg deposition conc. and annual MeHg conc. suggests rapid uptake by resident microbial communities of wet Hg deposition
- While past declines in wet Hg deposition conc. and runoff ratio have offset increased MeHg due to temperature, we may pass a limit where this is no longer true
- These insights would not be possible without long-term consistent monitoring of a comprehensive array of environmental and chemical factors

Thank you

Questions?

Interested in exploring the intersection of mercury and ecohydrology, come work with me!

Contact me: colinmcc@nipissingu.ca or @Colin_PRM (twitter)

Water Resources Research

RESEARCH ARTICLE
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