



ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Climate and disturbance-induced changes in mercury deposition in remote Australia

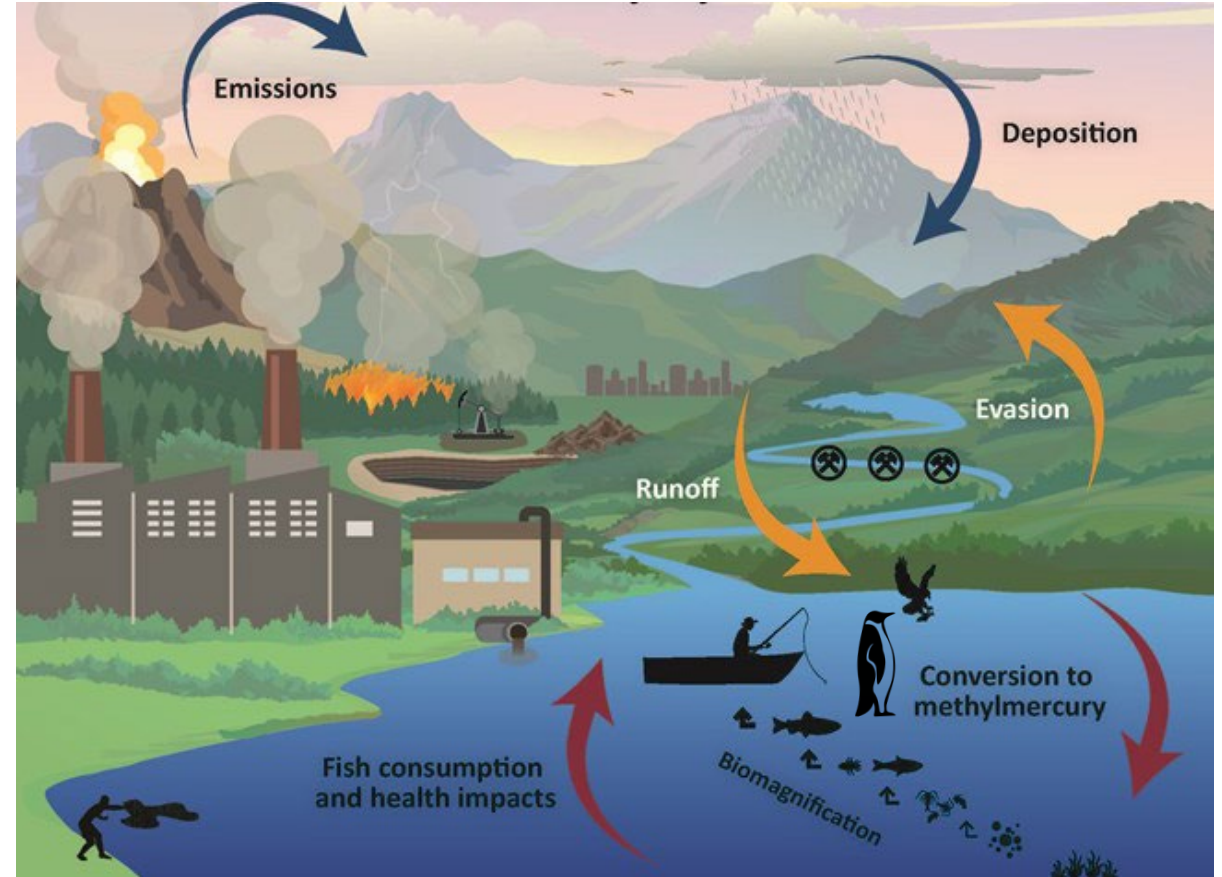
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The Mercury Cycle: differences between hemispheres

- Mercury has a natural global cycle
- Most Hg research is Northern Hemisphere-based
- Pollution trends and natural cycling processes are different between hemispheres
- Atmospheric transport between hemispheres is largely decoupled
- Hg transport models are mostly unable to reproduce observed Hg concentration at most land-based sites in the Southern Hemisphere

We need Southern Hemisphere-specific data to improve our modelling and inform policy gaps



NPS Air resources Division



Using the past to understand the future

Proxies in sediment cores

1. Biological

Pollen = indication of past climate

2. Chemical

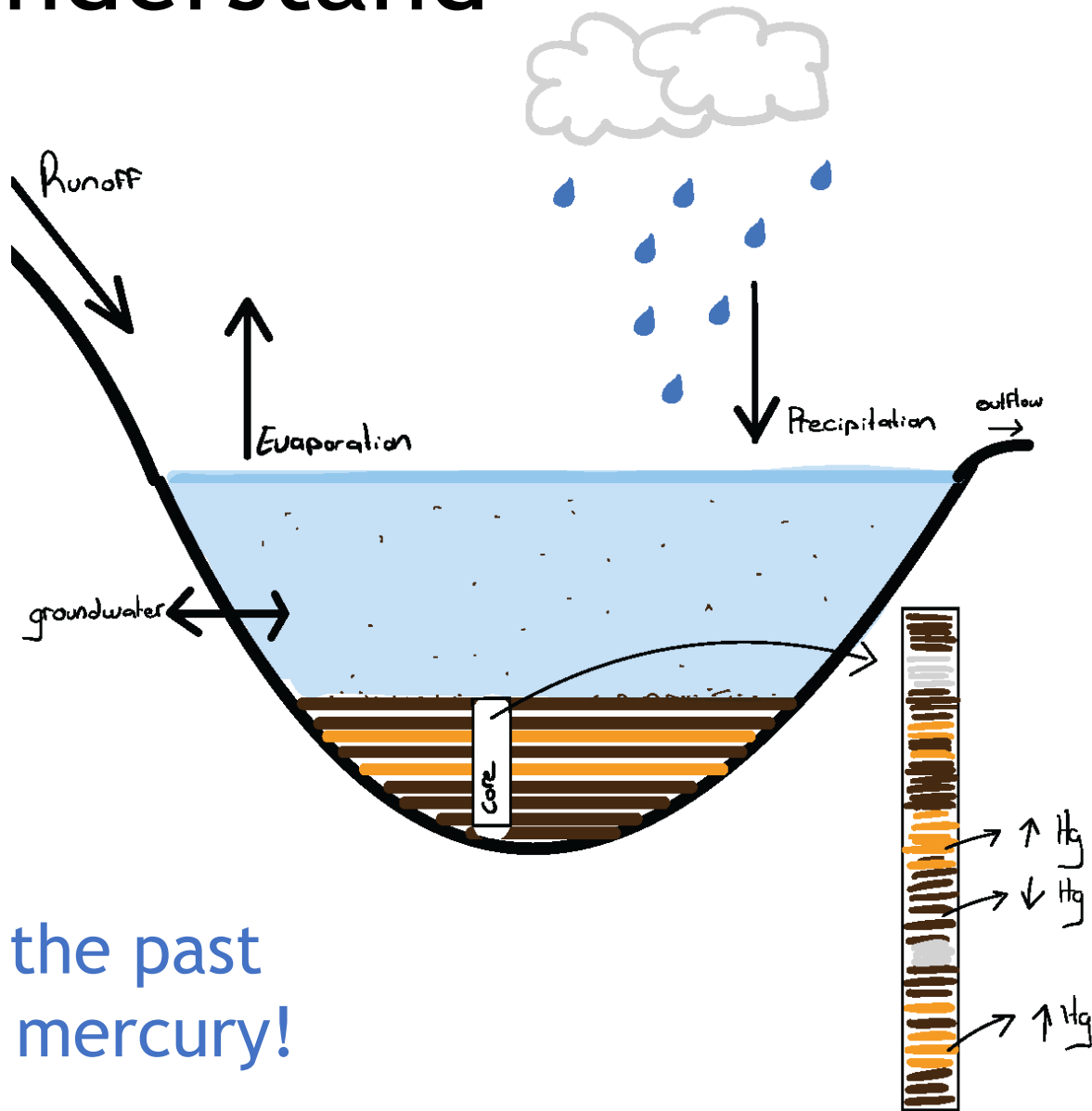
Mercury = pollution, climate etc

Carbon and Nitrogen = nutrient cycling

3. Physical

Grain size = hydrology

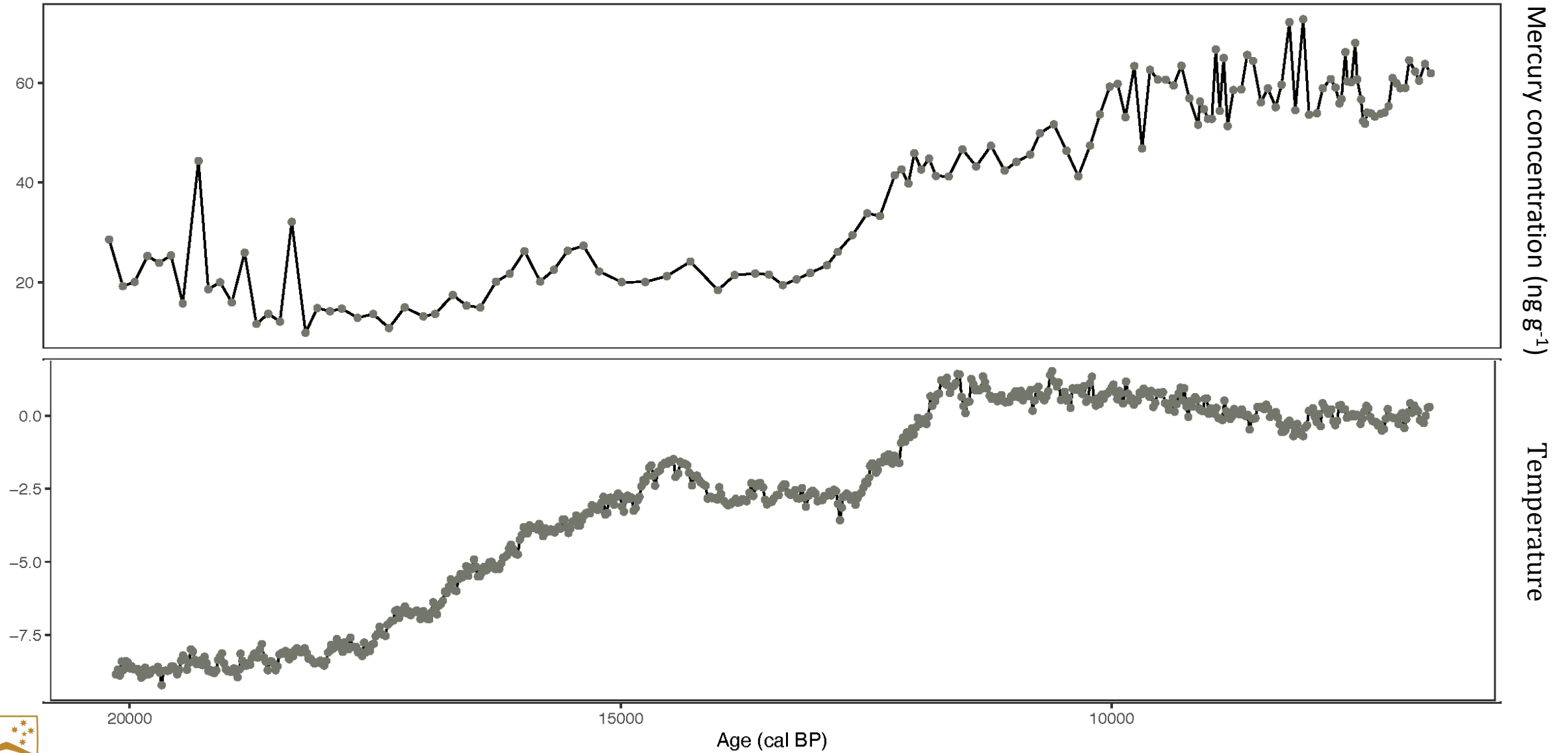
Mercury is a great proxy for understanding the past, but the past can also help us learn about mercury!



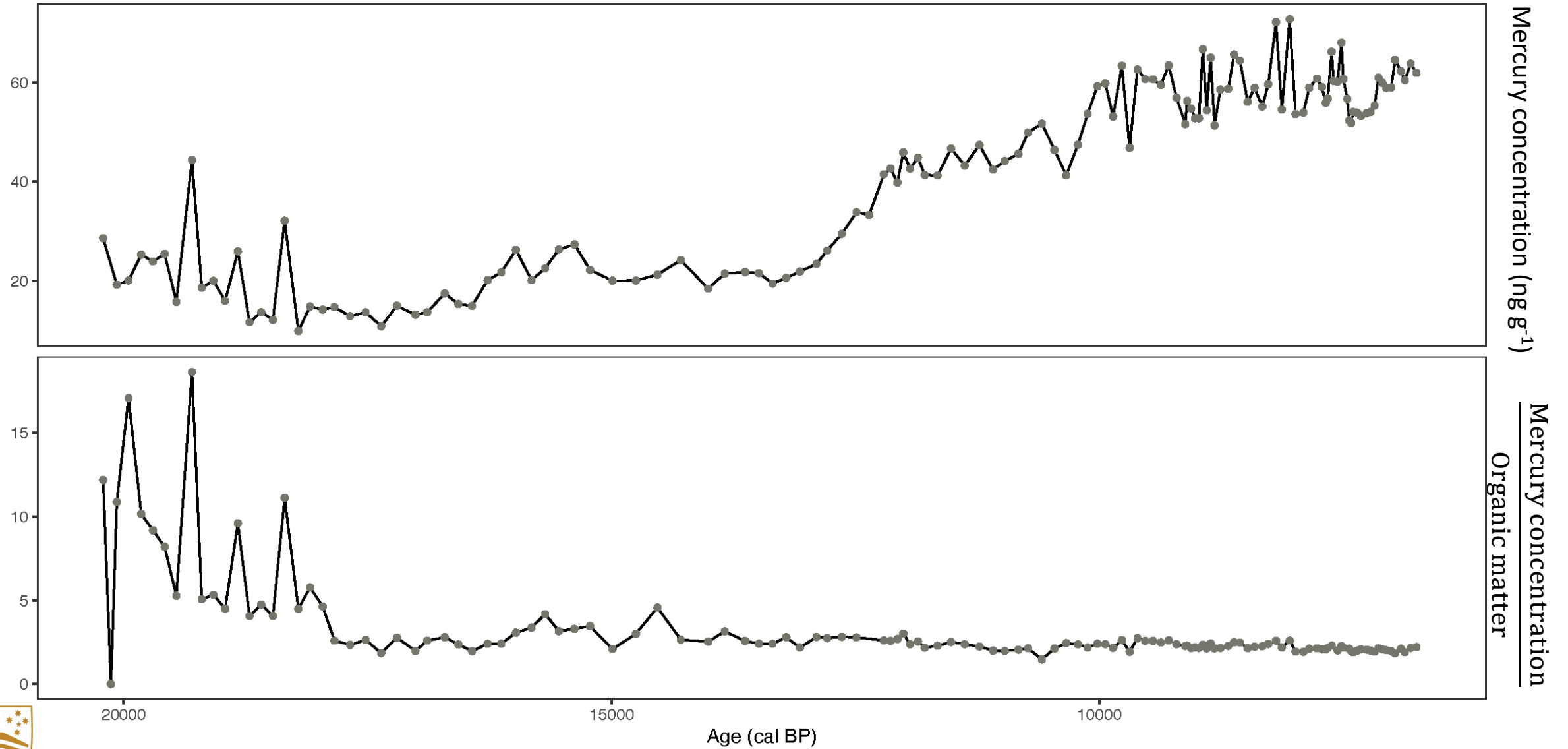
Blue Lake, Kosciuszko National Park Australia



Blue Lake cont..



Blue Lake cont...

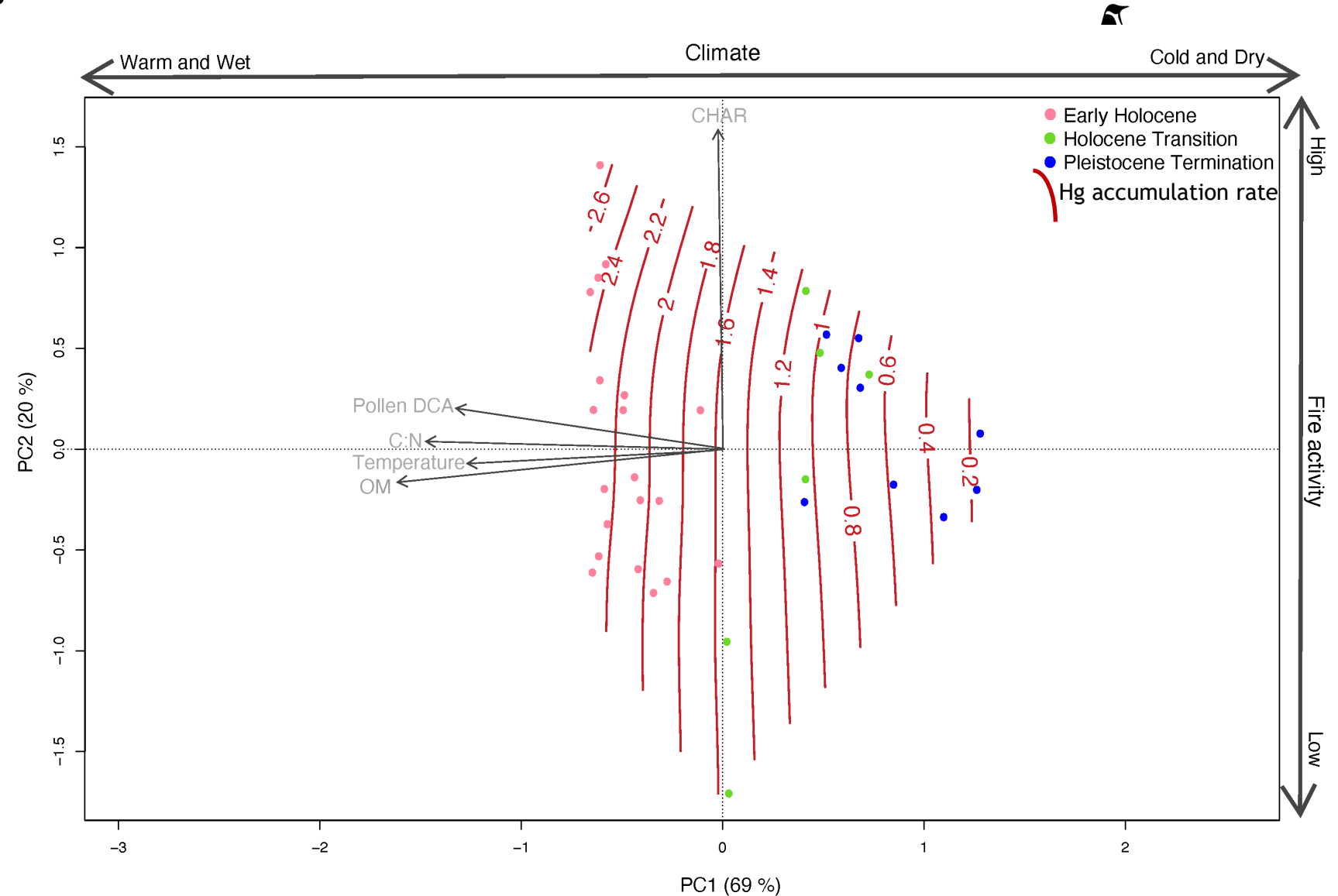


Blue Lake cont...

Mercury increases as temperature, C:N, organic matter, and pollen increase

Charcoal was not correlated with any other proxy in this study

Mercury is indirectly related to climate

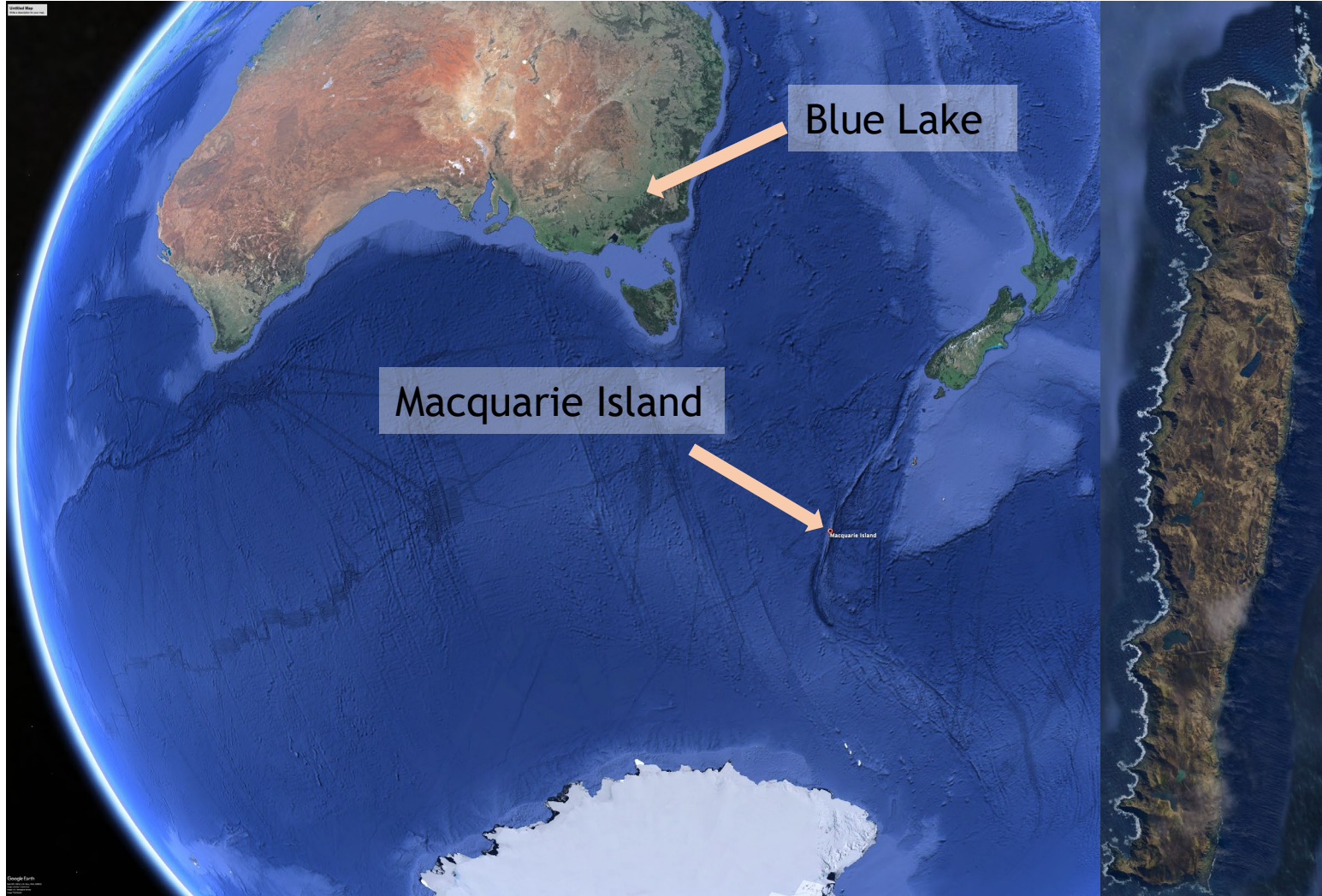


Blue Lake Summary

- Hg in Blue Lake reflects changes in the catchment
- Indirectly related to climate: increased warming and precipitation
- It is important to understand Hg's relationship with climate, soil processes, and the environment
- Erosion and landscape disturbance in a warming climate is important for Hg research



Remote area to remote area, Macquarie Island



David takes photos CCL: <https://bit.ly/3tFiesk>



Macquarie Island Conservation Foundation



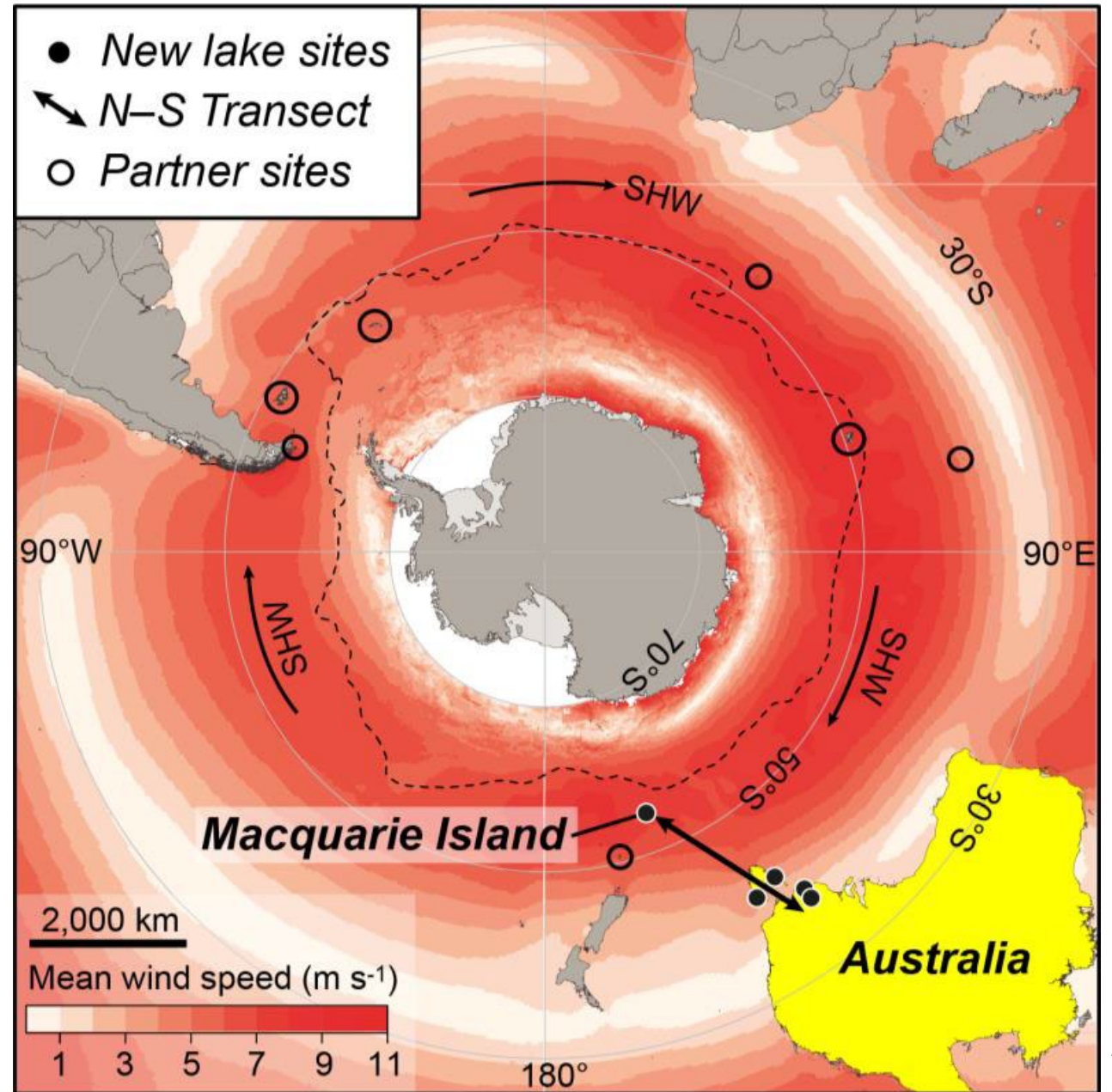
Research Questions

Part 1

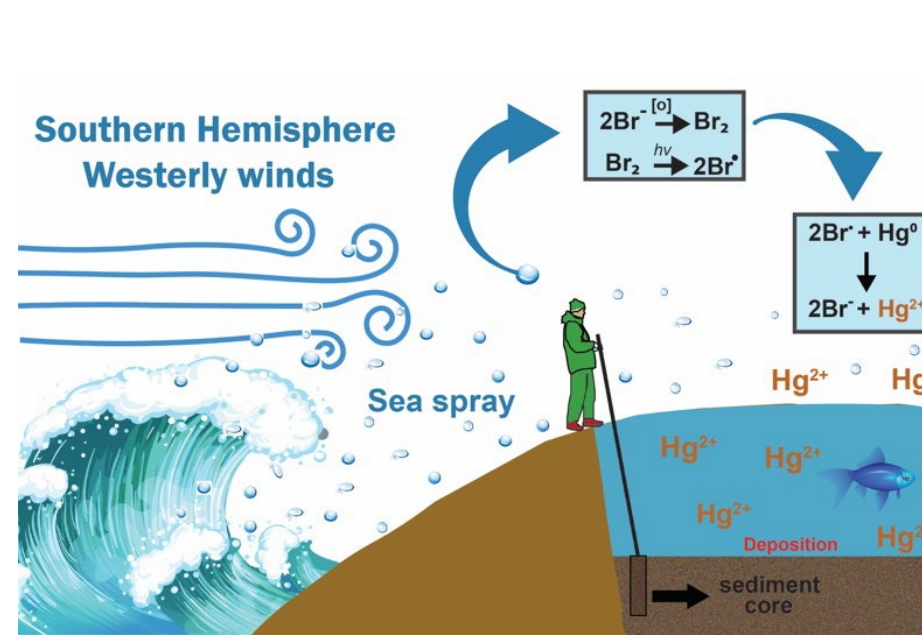
- a) How have toxic metal (mercury, arsenic, lead, and cadmium) concentrations in lake sediment records changed throughout time on a transect from Southeast Australia to the Southern Ocean islands?

Part 2

- a) Are changes in mercury accumulation rate over time in Macquarie Island lacustrine ecosystems attributable to changes in the Southern Hemisphere Westerly Winds, anthropogenic pollution or catchment disturbances?



Mercury and Change: feral rabbits, winds, and the anthropocene



Stronger southern hemisphere westerly winds since the 1950's = Potential increase in Hg via sea salt spray from Br



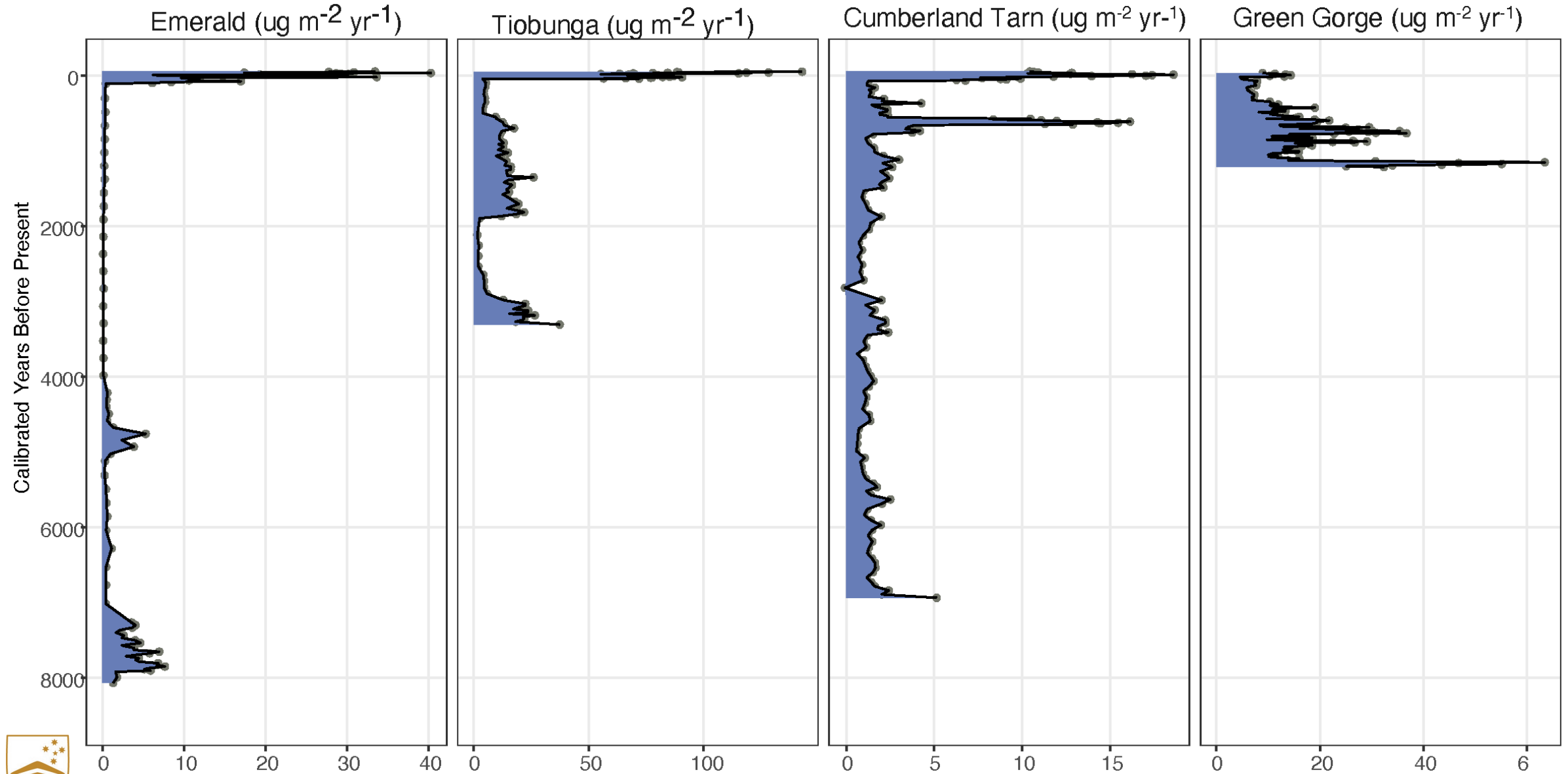
Island-wide erosion from feral rabbits in the 1900's = Potential increase in Hg from organic matter input and disturbance



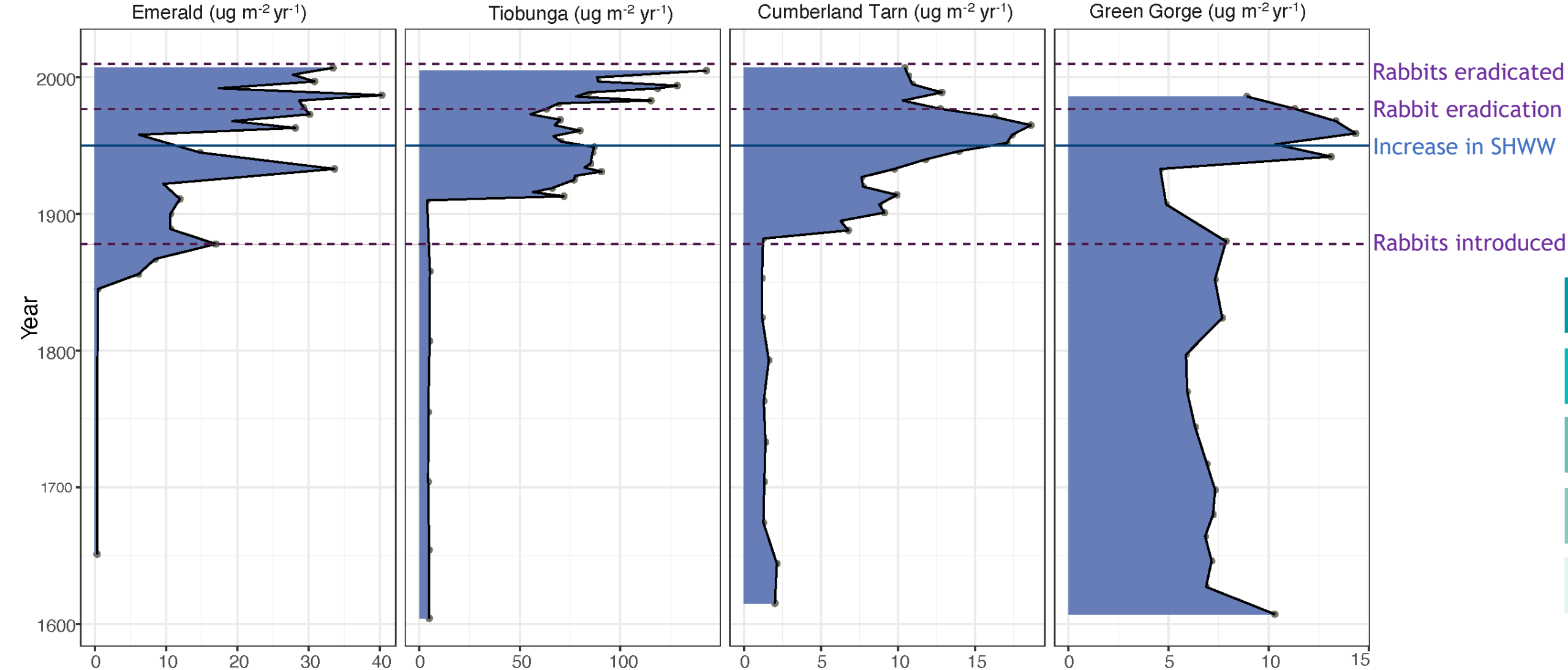
Increased atmospheric release of Hg and other metal pollutants in the SH since the 1900's = long-distance transport of Hg to southern ocean islands, potentially exacerbated by SHWW



Macquarie Island Mercury Accumulation Rate



Macquarie Island Mercury Accumulation Rate



There is confounding data on increases in Hg since the Anthropocene, often assumed to be atmospheric fallout from industrial activities and not landscape disturbance-related



Take-aways

Mercury is a great proxy to help us learn about the past

The past can help us understand how mercury might respond to various climate and pollution scenarios

The Southern Hemisphere is full of remote and unique environments sensitive to change and disturbance.

These ecosystems are vulnerable, and understanding Hg in these environments is important!





Questions?

This research is funded under an ARC project, “Long range toxic metal pollution in Australia and the Southern Ocean” in collaboration with: The Australian National University (ANU), The Australian Nuclear Scientific Technology Organisation (ANSTO), The University of Tianjin (TJU, China), and The British Antarctic Survey (BAS). Margot is supported by an AINSE PGRA scholarship.