Following Carbon from Land to Water

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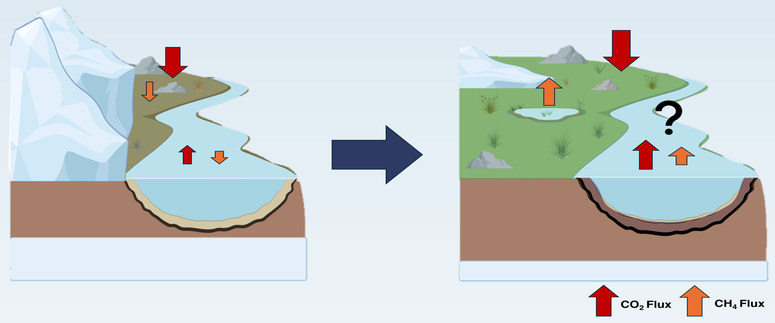
Stream carbon dioxide emissions are important to the overall watershed carbon balance in deglaciated landscapes. These fluxes are driven by water turbulence as well as inputs from the surrounding landscape. As the climate continues to warm, we expect these fluxes to increase.

Glacial Retreat is Changing Landscapes

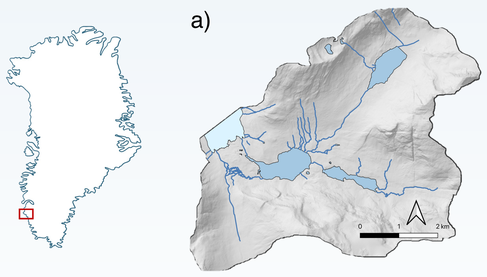
- Increasing temperatures are accelerating glacial retreat
- Glacial retreat exposes landscapes to vegetation colonization and erosion, fundamentally altering carbon cycling in these catchments.

Aims:

1) What are the drivers of CO_2 and CH_4 emissions in a recently deglaciated stream network?
2) What is the importance of stream CO_2 emissions to the net watershed CO_2 budget?



Methods



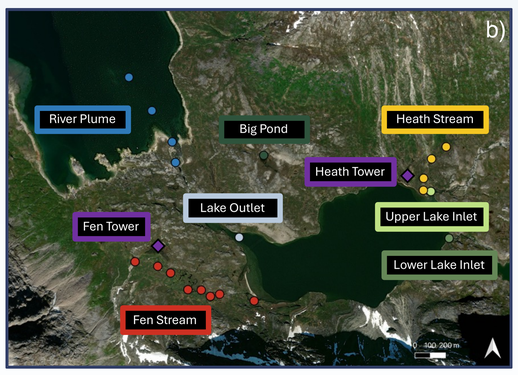
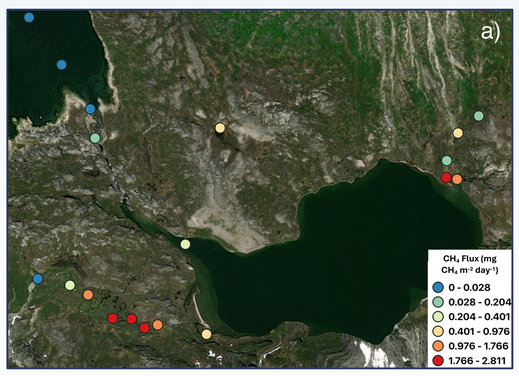


Fig. 1. **a)** Hillshade of the Kangerluarsunnguaq (Danish: Kobbefjord) catchment with lakes, streams, and the ocean. DEM from Porter et al. (2023). **b)** Sampling sites (dots) grouped and labeled by sampling location including the River Plume (blue), upper lake inlet (light green) lower lake inlet (dark green), lake outlet (gray), heath stream (yellow) and fen stream (red) and EC towers (purple diamonds).

1. Small CH_4 Fluxes Relative to Overall Budget



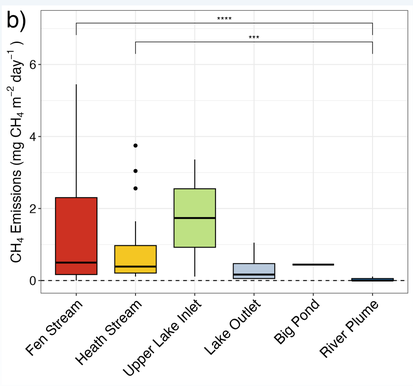
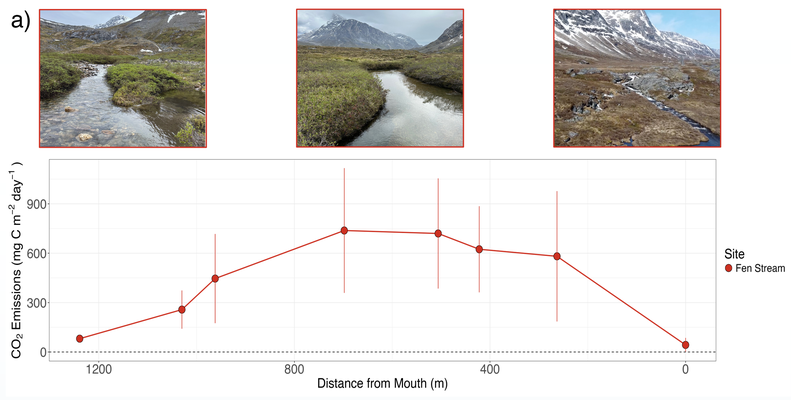
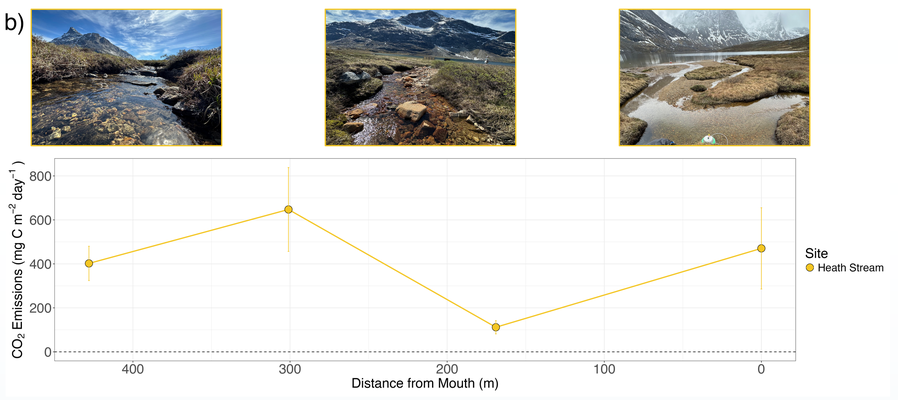


Fig. 2. **a)** Average CH_4 flux (mg CH_4 m^{-2} d^{-1}) for each sampling location. Color scale indicates flux size with blue indicating relatively smaller fluxes and red indicating relatively larger fluxes. **b)** Boxplot of CH_4 flux (mg CH_4 m^{-2} d^{-1}) grouped by sampling reaches. Brackets indicate significant differences between groups

2. Variable CO_2 Fluxes Reflect Landscape Connectivity





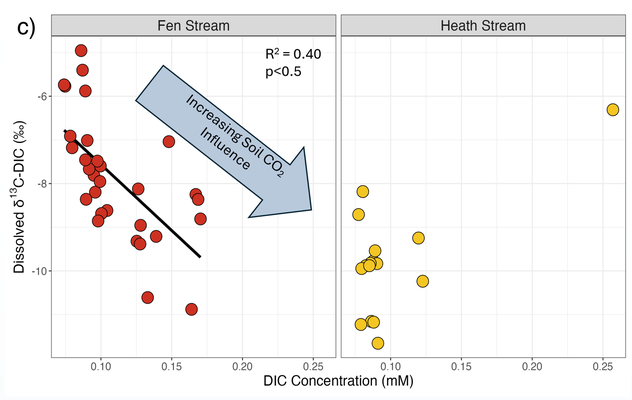
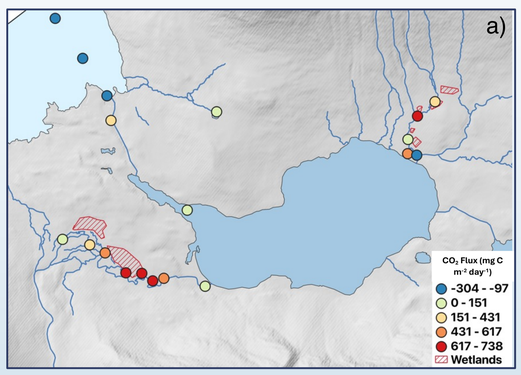


Fig. 3. **a)** Average CO_2 flux (mg CO_2 m^{-2} d^{-1}) across the fen stream reach and **b)** heath stream reach. Images show landscape characteristics at specific sampling locations. **c)** DIC concentration (mM) versus the δ^{13}C-DIC (‰) in the fen stream (red) and heath stream (yellow). Black line indicates significant correlation.

3. Turbulence and Dissolved CO_2 Important Drivers



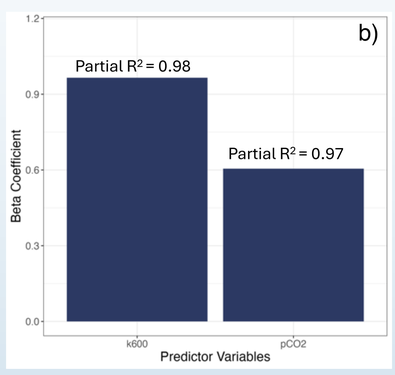
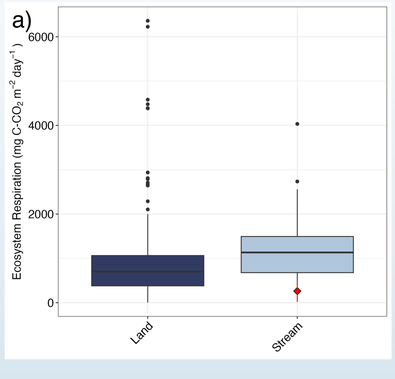


Fig. 4. **a)** Average CO_2 flux (mg CO_2 m^{-2} d^{-1}) for each sampling location. Color scale indicates flux size with blue indicating relatively smaller fluxes and red indicating relatively larger fluxes. Red shaded areas show wetlands. **b)** Beta coefficients for k600 (i.e., turbulence) and pCO_2 and their respective partial R^2 values.

4. Stream Fluxes Important for Watershed Carbon Budget



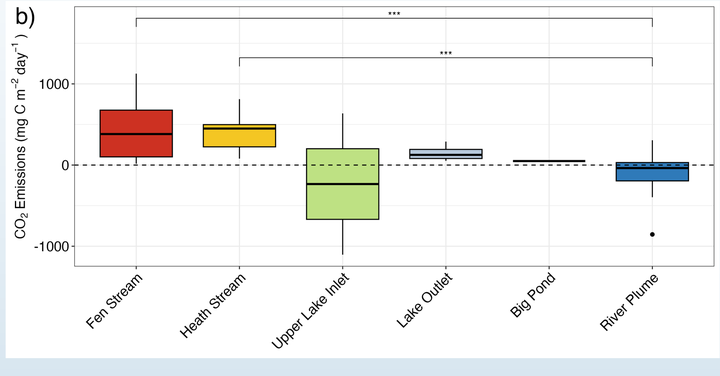


Fig. 5. Boxplots of **a)** ecosystem respiration (mg CO_2 m^{-2} d^{-1}) measured from eddy covariance tower partitioned between land (dark blue) and stream (light blue). Red diamond is the average flux measured for this study. Average CO_2 flux (mg CO_2 m^{-2} d^{-1}) for each sampling location and **b)** CO_2 flux (mg CO_2 m^{-2} d^{-1}) grouped by sampling reaches. Brackets indicate significant differences between groups

Land Gratitude

I acknowledge that we gather, work, and present on the ancestral and traditional territories of the Kalaallit. I honor the enduring relationship that Kalaallit communities have to this land, its waters, and its ice. We recognize that Greenland land is and has always been Kalaalit land, governed by customary laws, collective rights, and deep cultural heritage. We acknowledge the ongoing legacies of colonialism, and we commit to acting with respect, equity, and support for Greenlandic self-determination. I express my gratitude to Kalaallit Peoples past, present, and future for their stewardship of this place.

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