Fire effects on greenhouse gas emissions from wetlands in the Yukon-Kuskokwim Delta, Alaska

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BACKGROUND

- Climate change is increasing both fire frequency and fire intensity, especially in Arctic regions.
- Fires may impact aquatic ecosystem processes by altering carbon & nutrient inputs, hydrologic flow-paths and microbial processes.
- Arctic freshwater systems are known hotspots of greenhouse gas (GHG) emissions, so changes in patterns of GHG production and losses in response to fire may have important impacts on global climate.
- Here, we measured CO_2 and CH_4 fluxes from aquatic ecosystems in the Yukon-Kuskokwim (YK) Delta in southwest Alaska along a landscape gradient (high to low elevation).
- Specifically, we aimed to examine if catchments impacted by fire during the summer of 2015, display significant differences in GHG fluxes (CH_4 & CO_2) from aquatic systems Also, if fire has caused longer terms shifts to patterns of GHG production and loss.

METHODS

- Field fluxes were measured in triplicate using a Los Gatos Research Ultraportable GHG analyzer (LGR) and floating chamber (Figure 1), at plateau ponds, channel fens, bogs, and lowland ponds in sites that had burned in 2015, as well as from similar sites where there have been no recorded fires for 75+ years.
- At each site, we measured water temperature using a YSI multimeter; as well as thaw depth at the edge of the pond and 2m from the edge.
- Sediments from 5 sites were incubated anaerobically in mason jars (Figure 1). Headspace gas samples were collected from jars several times over 26 days to estimate GHG production.

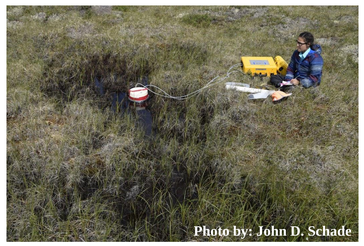


Figure 1, Examples of aerobic incubation jars and collecting GHG flux using LGR in a channel fen site.

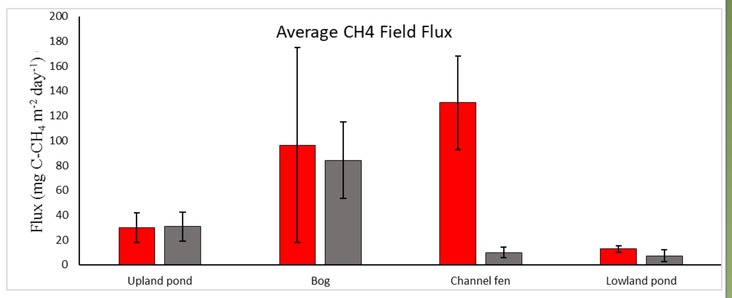


Figure 2. *In situ* CH_4 & CO_2 flux (±SE) from burned/unburned ponds, bogs and channel fens.

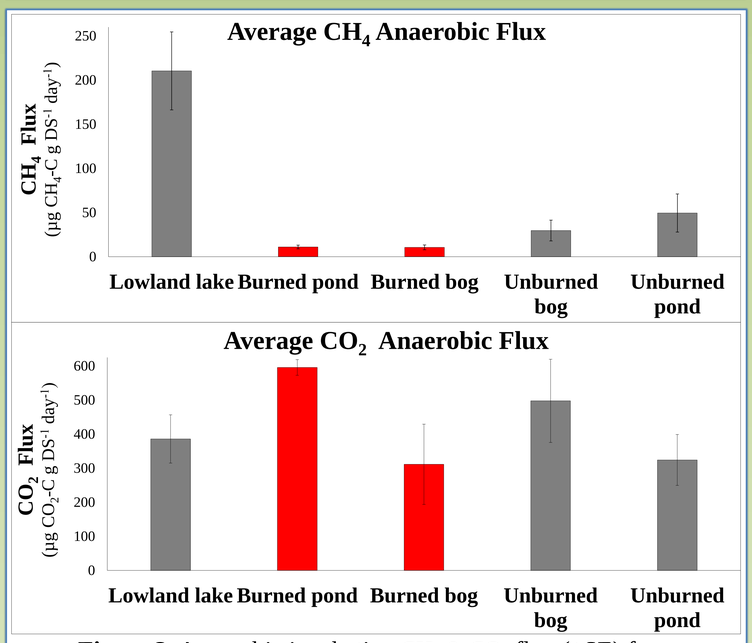
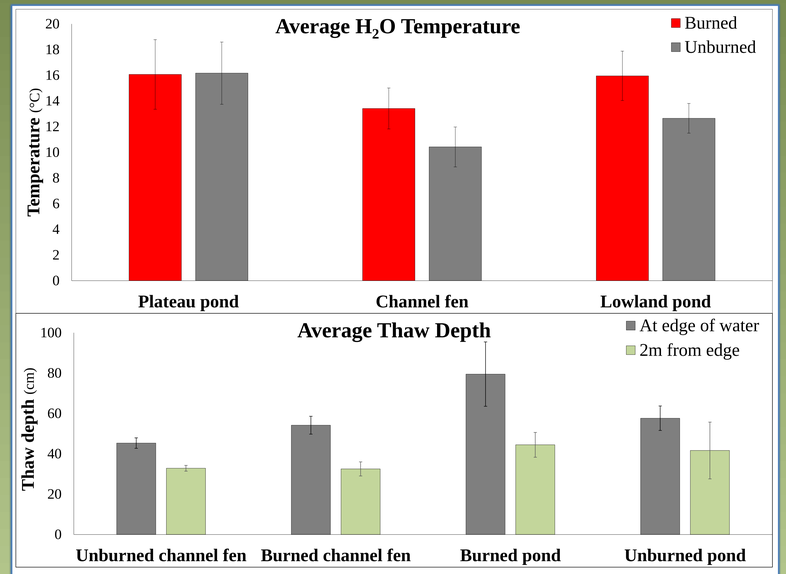


Figure 3, Anaerobic incubation CH_4 & CO_2 flux (±SE) from burned/unburned lake, pond, and bog sediments.



Figures 4 & 5, Average surface water temperature and average thaw depth measurements (±SE).

DISCUSSION

- We found substantially **higher *in situ* fluxes** of both CO_2 and CH_4 in channel fens in burned sites (Figure 2), possibly due to increased inputs of nutrients and organic matter following a burn.
- The 2015 fire caused persistent **deeper thaw depths** at pond and fen edges (Figure 5). In fens, this may have increased the availability of labile carbon for microbial processes, possibly explaining increased CH_4 flux.
- Channel fens are **projected to increase** by ~3% in the Arctic, and perhaps even more with an increase in fire frequency/severity (Chasmer et al., 2012). This, combined with increased CH_4 flux, suggest fires may create a positive feedback on climate change.
- Future research will focus on potential drivers of burn response in channel fens.

ACKNOWLEDGEMENTS

- This work was funded by NSF as part of the Polaris Project (thepolarisproject.org; NSF-1044610). Much appreciation to the Polaris Project Principal Investigators, WHRC staff & researchers, and the 2017 Polaris Project student cohort.