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Introduction
Surface air temperatures in the Arctic have been increasing at approximately twice the global average, contributing to myriad changes including groundwater hydrology1. Wildfire frequency and intensity have also been increasing. During summer 2015, more area burned in the Yukon-Kuskokwim (Y-K) Delta than in the previous 74 years combined (Fig. 1).

Our project investigates if water bodies within burned and unburned sites across the Y-K delta receive different source waters and if they have difference levels of susceptibilities to drying.

Study Site

Figure 1. Satellite image of the Y-K Delta showing the study region and locations of 2015 and historical fires.

Approach
• 278 water bodies sampled during June and September 2016, July 2017, and July 2018 (Table 1).
• Water isotope ratios of waters from these water bodies were measured (LGR IWA-4E5P), and evaporation/inflow ratios were calculated using HydroCalculator Software2,3.
• Google Earth Engine (i.e. Water Occurrence Change Intensity4 data layer), and GIS techniques were used to extract water surface area, changes in water occurrence/presence (extent) and elevation5.

Results: Source Water Determination

Figure 2. Burned (blue diamonds) and unburned (red triangles) water body isotope ratios shown with the Global Mean Water Line (GMWL).

Figure 3. Probability distribution function for unburned and burned samples showing where water samples intersected with GMWL using an assumed LEL ratio of 5 for each sample.

Results: Satellite Remote Sensing

Figure 4. Relative change in water extent for burned and unburned lakes and ponds. More burned water bodies experienced drying. Results show how surface water has changed between two epochs: 1984-1999 and 2000-2015. Average changes were taken across homogenous pairs of months from each epoch6.

Results: Evaporation to Inflow (E/I) Estimates

Figure 5. Populations of all burned and unburned surface water bodies with E/I=0.3 and 1, indicating when evaporative losses are greater than 50% and 100% of inflow, respectively.

Table 1. Sample distribution for lakes, ponds, fens, streams, and rivers in burned and unburned locations.

Conclusions
• Burned water bodies receive source waters with different characteristics to unburned water bodies.
• Burned ponds and lakes experienced greater amounts of drying than unburned.
• Burned water bodies exhibited higher overall E/I ratios (red) and highest values (~1.8), indicating greater evaporation, or changes to hydrological flow-paths (i.e. infiltration) causing faster water loss.
• Future work includes:
  o Linking satellite-derived change with E/I and residence time estimates.
  o Determine differences in hydrology, surface area loss and E/I of 2015 and 1972 burned water bodies.

References

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