Carbon and nitrogen dynamics along a hillslope flowpath

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INTRODUCTION & OBJECTIVES

Hyporheic flows serve as the biogeochemical link between terrestrial and aquatic ecosystems. These processes are not well understood in areas of continuous permafrost, and may play an important role in arctic nutrient cycles. As the climate warms, and the permafrost thaws, ancient organic carbon will become available for processing by microbes, for adsorption to soils or downslope travel (Neff et al. 2006). The flux of this new carbon may affect inputs into the atmosphere and Arctic Ocean (Shuur et al. 2008).

We investigated changes in the amount of carbon and nitrogen as water moved through hyporheic and surface flowpaths in an Arctic watershed in Eastern Siberia.

METHODS

Our study site was a beaded stream reach near the mouth of a small (4.6 km^2) subwatershed within the Kolyma river near Cherskii, Russia. Average pool size and run length were 50m^2 and 14m respectively. Some runs were very slow moving and others had strong discharge. Vegetation was mostly moss and grasses with Salix in wetter regions.

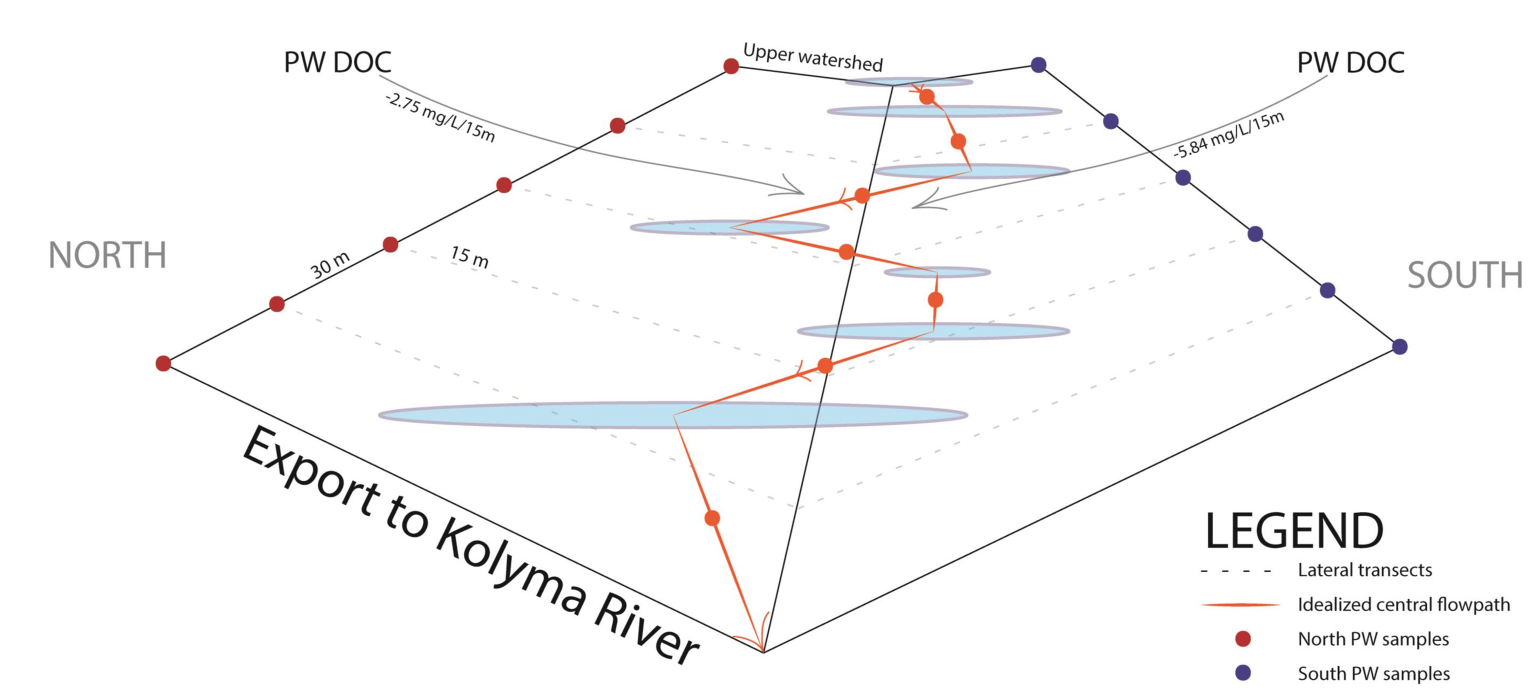

Figure 1. Model of study site and experimental design. We sampled pore water from piezometers at 7 points along 200m longitudinal transects approximately 15m north and south of the central flowpath. In the central flowpath we measured pore water in each run and surface water from each pool. All samples were analyzed for concentrations of dissolved organic carbon (DOC) and total dissolved nitrogen (TDN)

RESULTS

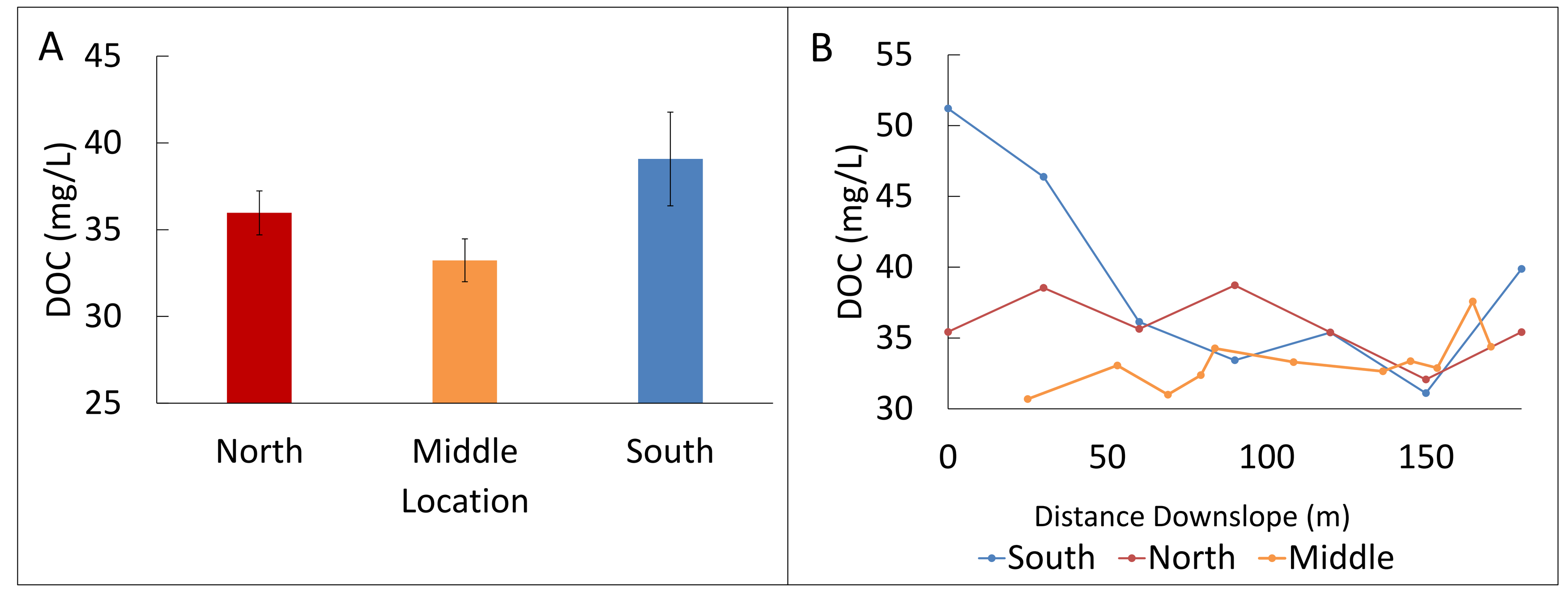

Figure 2. A) Pore water average DOC concentrations in south, middle and north longitudinal transects. North and south concentrations were significantly different than middle (ANOVA: $P < 0.5$) B) Compares longitudinal trends in south, north and middle transects for pore water DOC concentrations.

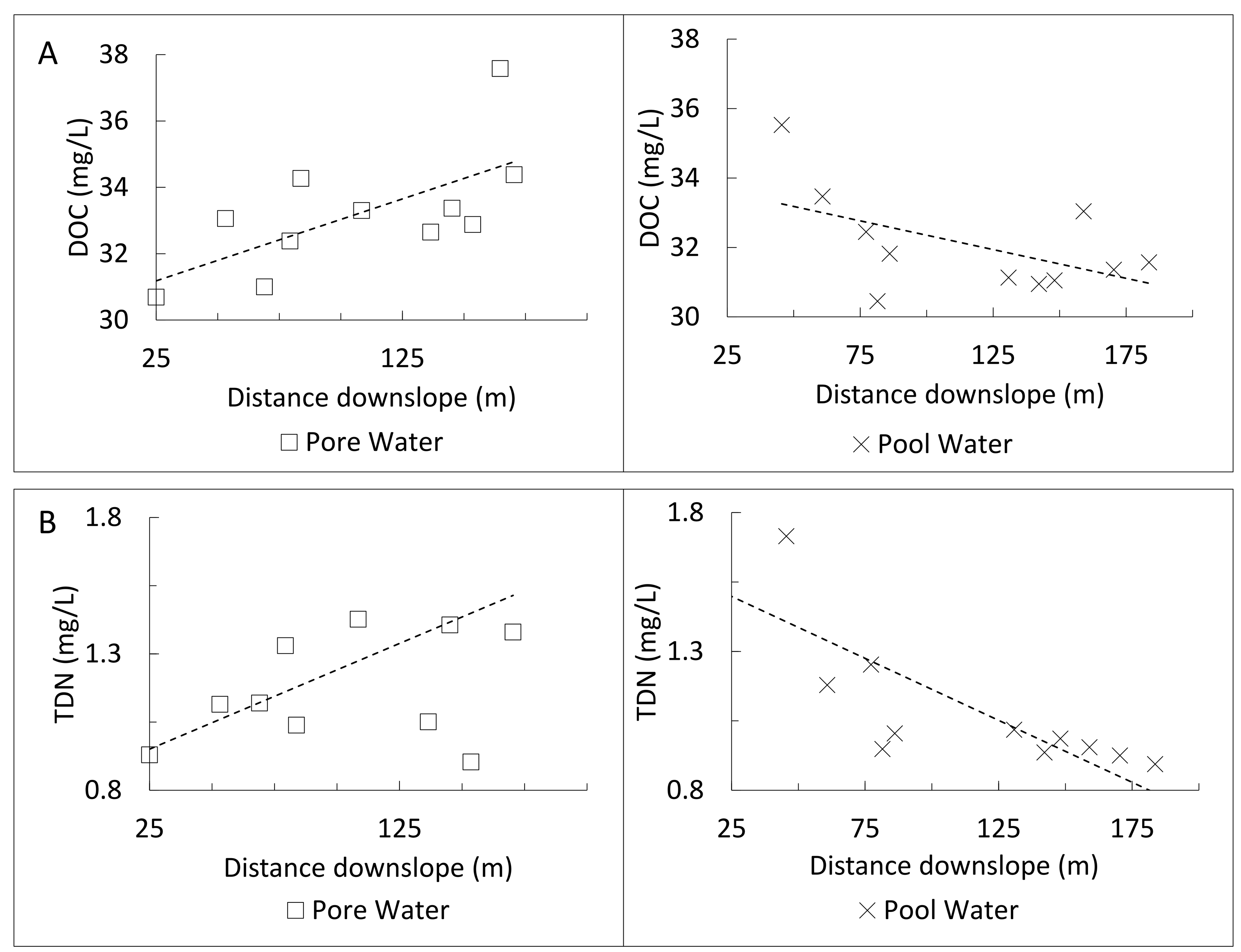

Figure 3. A) Pore and pool water DOC concentrations in middle transect. DOC is increasing in pore water and decreasing in pool water. B) Pore and pool water TDN concentrations in middle transect. Just like DOC, TDN is increasing in pore water and decreasing in pool water.

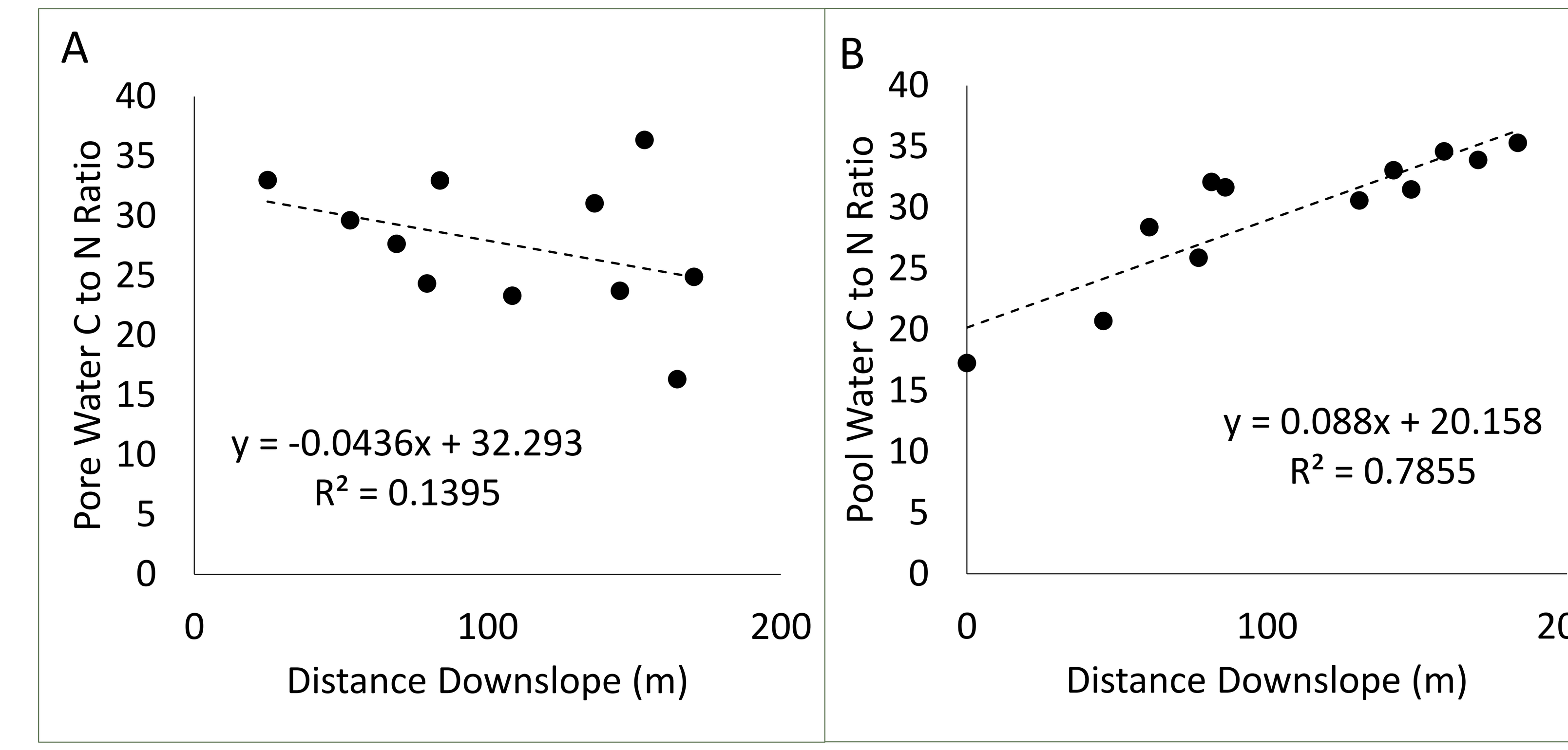

Figure 4. A) Carbon to nitrogen ratio in pool water going downslope. B) Carbon to nitrogen ratio going downslope.

CONCLUSIONS

- Pore water DOC concentration decreased 13 percent on average. Meaning that an average of 4.3 mg/L of DOC was either respired as CO_2 by microbes or adsorbed to soil.
- Pore water DOC may be increasing down the center of the flow path because of inputs from thaw depth. Thaw depth is about 40 percent deeper in second half of middle flowpath on average.
- Pool water DOC decreases downslope. DO readings were less than saturated, suggesting low productivity and that DOC inputs likely come from permafrost thaw.
- Pool water TDN suggests that nitrate is being used rapidly downslope. $R^2 = 0.6987$
- C:N ratio increase in pool water likely because TDN is used more rapidly than DOC. Nitrogen is likely a limiting nutrient.

ACKNOWLEDGEMENTS & REFERENCES

- Neff et al. 2006 *Seasonal Changes in the age and structure of dissolved organic carbon in Siberian rivers and streams.* Geophysical Research Letters, Vol 33, L23401, Doi: 10.1029/2006GL028222
- Shurr et al. 2008 *Vulnerability of Permafrost Carbon to Climate Change: Implications for the Global Carbon cycle.* Bioscience, 58 (8): 701-714. Doi: 10.1641/B580807

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