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Patterns in DOC Concentration and Composition in Tundra Watersheds in the Kolyma River Basin

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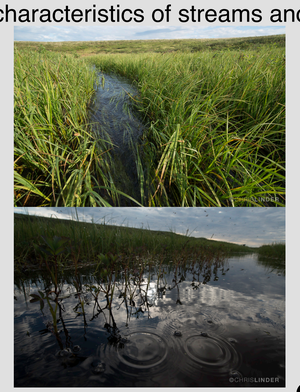
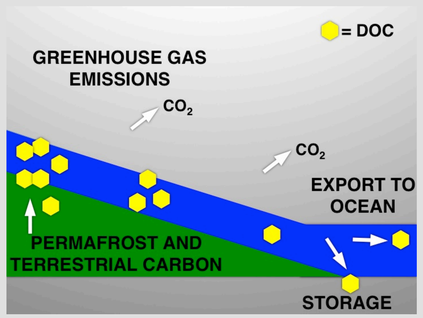
Introduction

- Tundra streams transport and process terrestrial carbon
- Permafrost thaw may increase carbon input to streams
- The fate of this carbon will depend on physical and biological characteristics of streams and may affect greenhouse gas emissions

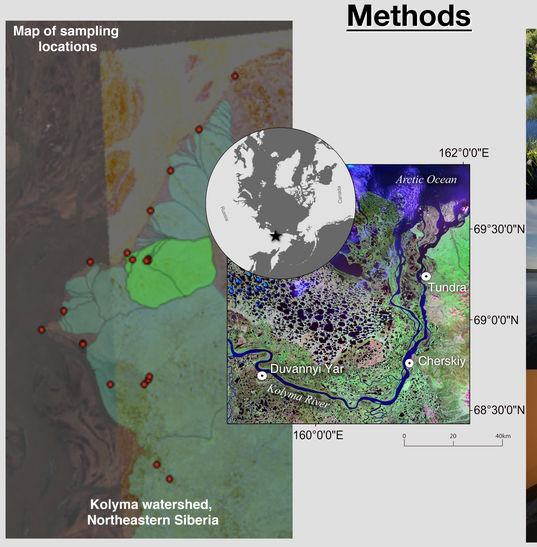


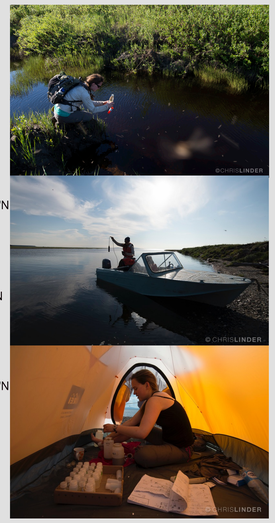


Objectives

- To examine spatial variation in quantity and chemical profile of dissolved organic carbon (DOC) in streams in the Eastern Siberian Arctic
- To assess the relative importance of photodegradation and microbial processing in riverine carbon breakdown

Methods





- Water samples were collected from 10 watersheds ranging in area from 4.6 km^2 to ~680000 km^2 and analyzed for DOC, total dissolved nitrogen (TDN) and UV absorbance.

Water from three locations ranging from upland stream to mainstem of the Kolyma River was incubated in light and dark, with and without sterilization.

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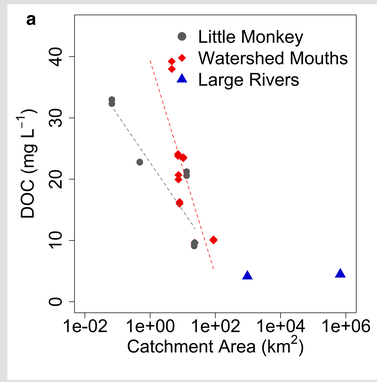
Watershed Results

Figure 1: C and N Correlations with Watershed Area



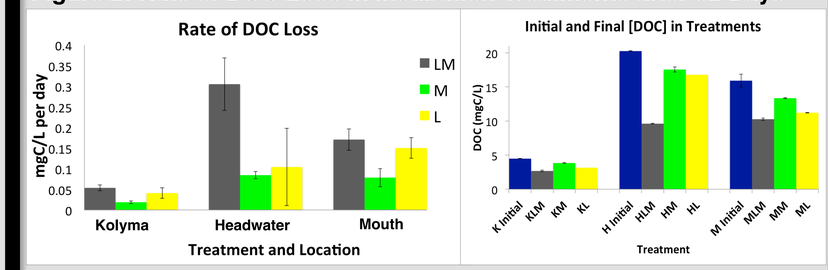
DOC, TDN, and C:N all decreased with increasing watershed area (Little Monkey: r^2 = 0.82, 0.79, and 0.75, $p < 0.05$; Watershed Survey: r^2 =0.58, 0.46, and 0.43, $p < 0.05$)

Note on Large Rivers:
Data from the Suharna watershed (~960 km^2) and the Kolyma watershed (~680000 km^2) mouths suggest an asymptotic relationship for [DOC], [TDN], and C:N with increasing drainage area.

No correlation between log of watershed area and $SUVA_{254}$ or S_R was found.

Incubation Results: DOC Concentration

Figure 2: Rate of DOC Loss in Incubation Treatments after 32 Days

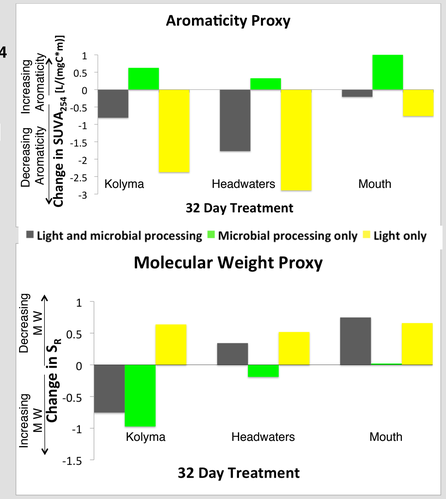


- Photodegradation and microbial processing combined lost highest percent of DOC
- Photodegradation resulted in faster DOC loss than did microbial processing, consistent with Cory et al. (2014), who found photochemical processing accounts for 70 to 95% of total DOC loss in Alaskan tundra inland waters
- Results are also consistent with Mann et al. (2012), who found ~30% of Kolyma water DOC was lost over 28 days through biological pathways, whereas >29% DOC was lost over 14 days through photochemistry

Incubation Results: Chemical Composition

$SUVA_{254}$ and the slope ratio (S_R) between $S_{275–295}$ and $S_{350–400}$ are accepted proxies for aromaticity and molecular weight (M), respectively.

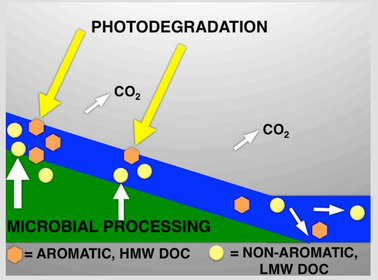
Figure 3: Changes in $SUVA_{254}$ and S_R during Incubations.



- Photodegradation decreased aromatic and high molecular weight carbon (consistent with Mann et al. 2012)
- Microbial processing targeted non-aromatic and low molecular weight carbon
- The combined treatment showed a greater photodegradation effect

Conclusion

- Results suggest that organic carbon is processed in streams during transport, and is likely lost to the atmosphere as CO_2
- Decrease in C:N with watershed area is consistent with photodegradation and/or C limitation of microbial processing
- Microbial processing targets small, non-aromatic carbon, while photodegradation targets large, aromatic carbon
- Since DOC's chemical profile remains constant down flowpaths, the two mechanisms balance in situ



Future Work

- How will earlier river ice breakup or permafrost thaw influence the role of light and microbes in processing of DOC?
- How much DOC loss in Kolyma watershed streams is caused by priming of microbial carbon processing by light?

Works Cited

Cory, R. M., Ward, C. P., Crump, B. C., & Kling, G. W. (2014). Sunlight controls water column processing of carbon in Arctic fresh waters. *Science, 345*(6199), 925-928.

Mann, P., Davydova, A., Zimov, N., Spencer, R., Davydov, S., Bulygina, E., Zimov, S., Holmes, R. (2012). Controls on the composition and lability of dissolved organic matter in Siberia's Kolyma River basin. *Journal of Geophysical Research: Biogeosciences (2005–2012), 117*(G1).