Thermokarst Lake Carbon Storage and Transport near Cherskiy, Northeast Siberia

Samuel L. Berman[1] Karen E. Frey[2] Claire G. Griffin[3] Nikita S. Zimov[4]

Graduate School of Geography, Clark University, Worcester, MA

Background

Thermokarst lakes develop in regions of ice-rich permafrost. Through thermal melting and erosion these lakes have come to cover 25-40% of the Arctic landscape. The continued warming of Arctic permafrost allows thermokarst lakes the capability of expanding physically and spatially. Current lakes and potentially future lakes act as channels for dissolved organic matter (DOM) containing high levels of previously frozen organic carbon. Therefore, these lakes act as a carbon sink affecting carbon storage and transport through their respective hydrological systems and eventually into mainstem river tributaries and the Arctic Ocean. As warming continues and permafrost continues to decay understanding how lake biogeochemistry is influenced is essential

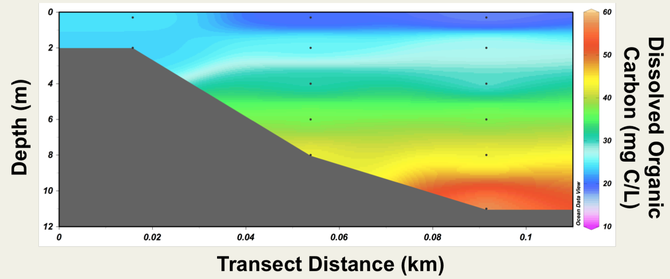
Our Study

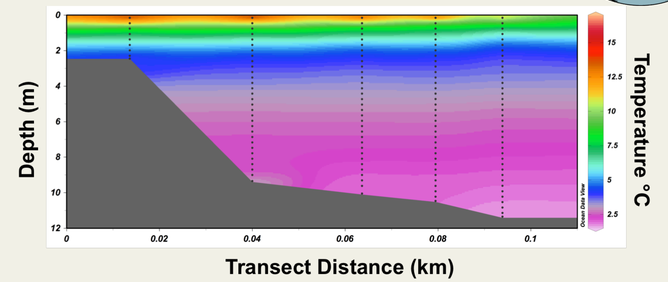
Our analysis of the Y4 watershed in Cherskiy, Northeast Siberia includes measurements of key indicators of lake biogeochemistry. Dissolved organic carbon (DOC) measurements give inference on how the geomorphology and slope characteristics of these lakes and surrounding area impacts carbon storage and accumulation, and how often deep stores in these lakes are brought to the surface and moved through the greater hydrologic system and transformed by microbial activity.

Methods

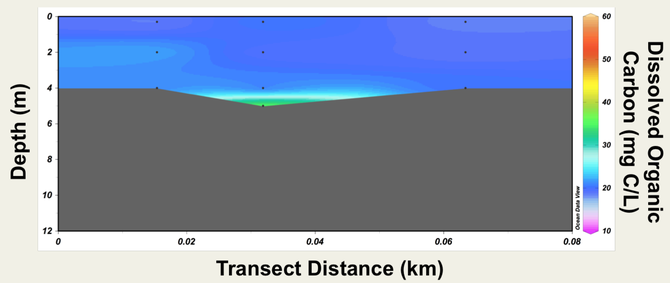
Transects were taken across each lake followed by point measurements for dissolved organic carbon at 2 m intervals and temperature at a high frequency aquired by a Castaway CTD. Ocean Data View software was used to interpolate between point measurements.

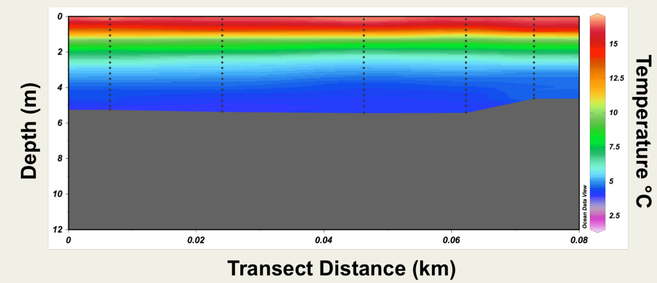
Grass Lake



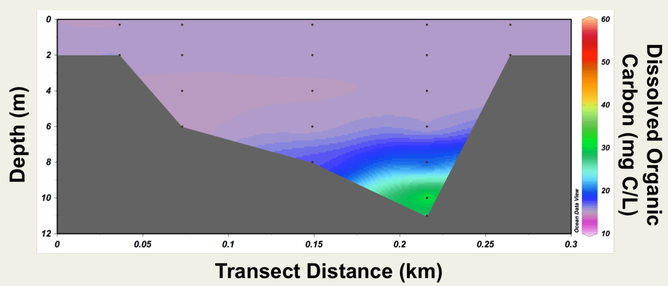


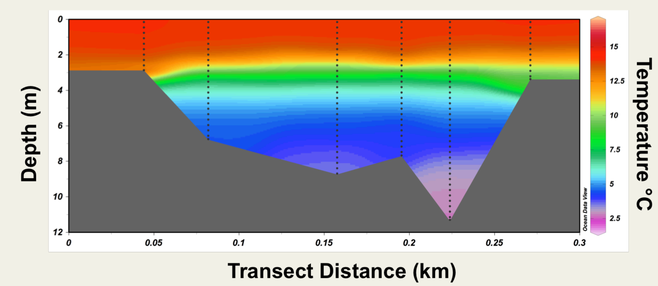
Windy Lake



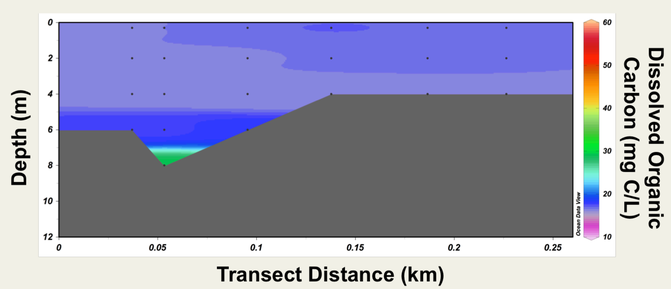


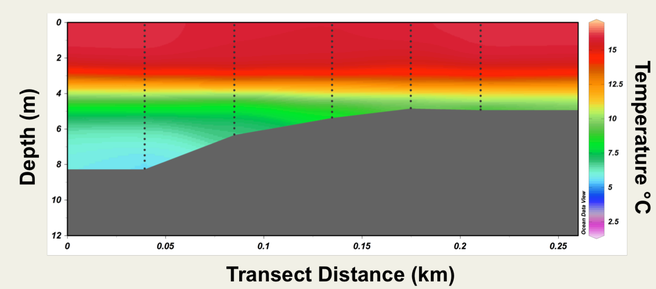
Schuch'ye Lake





Schady Lake





Y4 Watershed

Discussion

Intrinsic differences between the four lakes measured in the Y4 watershed have been highlighted. The most notable of which are seen in Grass Lake. Grass Lake is unique because a large ice wedge is attached to the lake, residing on the right side of the shown graph. This influences the temperature gradient in the lake shown by cooler temperatures closer to the ice wedge and warmer temperatures farther away. DOC concentration of Grass Lake is much higher when compared across the watershed. This is likely due to a combination of differences in runoff from the surrounding landscape, but also cooler temperatures influencing microbial activity that utilize DOC.

Conclusion

Surrounding landscapes are known to play an important role in carbon runoff into the hydrologic system. This study shows how DOC and temperature vary between lakes in the same watershed. Each of these lakes have difference bathymetric properties. Understanding how these physical properties influence chemical and biological parameters controlled by temperature and DOC is essential in knowing how warming will impact current thermokarst lakes, as well as future lake formations as a result of melting ice-rich permafrost.

Acknowledgments:

The Polaris Project (www.thepolarisproject.org

Affiliations:

Clark University [1,2]

University of Texas at Austin [3]

Northeast Science Station [4]