Water and Environmental Research Center
University of Alaska-Fairbanks

Annual Technical Report
2018

General Information

Products

Dean K., and S. Stuefer, 2018, Snowmelt Flooding trends in the North Slope of Alaska Kuparuk Watershed, American Water Resource Association Alaska Section Annual Conference, Anchorage, AK, April 10-12, 2018.

Dean, K.M., and S. Stuefer, 2019, Snowmelt hydrology of the Upper Kuparuk River. Poster presentation at Toolik All Scientist Meeting, 1 February 2019, Portland, OR.

Dean. K.M., and S. Stuefer, 2019, Snowmelt hydrology in the North Slope of Alaska case study: Upper Kuparuk River. Poster presentation at Western Snow Conference, 17 April 2019, Reno, NV.

Dean, Kelsey, 2019, "Snowmelt Hydrology in the Upper Kuparuk Watershed: Modeling and Observations." University of Alaska Fairbanks. M.S. Thesis

Gagne, K.R., and J.J. Guerard, 2018, Spectroscopic Characterization of Permafrost Natural Organic Matter Composition and Reactivity from a sub-Arctic Discontinuous Region. Poster presentation at American Geophysical Union Annual Fall Meeting, 13 December 2018, Washington, D.C.

Gagne, K.R., S. Ewers, and J.J. Guerard, 2019a, Permafrost Thaw Impact on Natural Organic Matter Photoreactivity and Chemical Composition, Oral Presentation at the University of Alaska Fairbanks Environmental Chemistry Symposium, 20 April 2019, Fairbanks, AK.

Gagne, K.R., and J.J. Guerard, 2019b, Spectroscopic Characterization of Permafrost Natural Organic Matter Composition and Reactivity from a sub-Arctic Discontinuous Region. Poster presentation at the University of Alaska Fairbanks Arctic Research Open House, 30 May 2019, Fairbanks, AK.

Stuefer, S., D. Kane, and K. Dean, 2019, Snow water equivalent data from the Upper Kuparuk River watershed, Arctic Alaska, 1997-2017. Arctic Data Center.

Stuefer S., K. Dean, and M. Rawlins, 2019. Freshwater flux to the Beaufort Sea from Northern Alaska. 22 Northern Research Basins Symposium and Workshop, Yellowknife, Canada, August 18-24, 2019

Information Transfer Program

There were no projects specifically focused on information transfer during this reporting period. However, a portion of the administrative component of the awards was generally allotted to information transfer, in the form of supporting the development and maintenance of the Institute website. Moreover, many of our information transfer-related activities were characterized as research. For instance, the project above list numerous conference proceedings and posters, as well as some project-related newsletters. These activities were considered to be an important component of the research project, but could certainly be considered to be information transfer related activities.

The NIWR website is linked directly on the Water and Environmental Research Center's front page and has been updated with the 2018 and newly awarded 2019 projects. The website will continue to grow, adding researchers and content as new projects are funded and current projects publish their results. The WERC NIWR website can be found at: http://ine.uaf.edu/werc/niwr/.

A two-sided glossy flyer was created in February 2019 for dispersal to stakeholders and legislators. The flyer contained information about WRRA /NIWR funded 2018 graduate student projects and showcased the upcoming 2019 projects. This flyer includes a brief statement of the critical water problem being researched and the scope and benefit of each project. The flyer was distributed to interested Alaskan stakeholders, Congressional offices in Washington DC, and legislators in Alaska.

Student Support

One Ph.D. graduate student and three M.S. graduate students were supported with project funding. Two undergraduate students participated in field work and one undergraduate student was mentored by the Ph.D. student.

Notable Achievements and Awards

Kristin Gagne, Best Graduate Student Presentation; University of Alaska Fairbanks Environmental Chemistry Symposium
Kelsey Dean was awarded M.S. degree in Water and Environmental Science, concentration area in Hydrology

Projects

A low-cost alternative to mitigate heavy metal and phosphorus contamination in water

Project Type: Annual Base Grant **Project ID:** 2018AK138B

Project Impact: Heavy metals and phosphate (P) are common contaminants associated with mining and agricultural practices. These contaminants are mitigated through a variety of processes that include chemical precipitation, membrane technologies, activated carbon, and biosorptive agricultural waste materials. Sawdust is a potential biosorbent for heavy metals and P that is both affordable and easily available. Recent studies have shown the utility of sawdust as a biosorbent to mitigate heavy metal contaminated water. However, there exists a knowledge gap in terms of applicability of sawdust produced from local Alaskan wood products for contaminant removal, specifically at colder temperatures. Other factors to consider for heavy metal adsorption include the effect of pH and temperature on the adsorption of heavy metals. The objective of this study was to provide an understanding of the effects of Alaskan sawdust on the biosorption of lead, cadmium, and P as common mining and agricultural contaminants in Alaska. A batch experimental study determined that sodium hydroxide treated Alaskan spruce sawdust was capable of adsorbing cadmium and lead at the temperatures of 4°C, 15°C and 30°C, respectively. This study will lead to the development of a low-cost method of mitigating contamination in drinking water, by maintaining low concentrations and/or appropriate EPA acceptable water quality limits. Such technology could also be useful for rural Alaskan water treatment applications.

How do nitrogen and phosphorous affect glacier algae growth and snowmelt in an Alaskan watershed?

Project Type: Annual Base Grant **Project ID:** 2018AK141B

Project Impact: Light absorbing particles (LAP) on glacier surfaces absorb solar energy that is converted to heat that melts or sublimates snow and ice crystals. Increasingly recognized as among the most important LAP, glacier snow and ice algae have been shown to reduce albedo on glaciers in southcentral Alaska, Europe, the Himalaya, and Greenland. Despite their importance, little is known about the ecology of their distribution and abundance, factors that determine where and how many algae exist, and hence the magnitude, extent, and timing of their effects. We investigated the limiting role of Nitrogen and Phosphorous in determining snow and glacier ice algae abundance on Eklutna Glacier, an Alaskan glacier with over a decade of continuous glaciological research. We fertilized plots, monitored them with interval photography, and at the season’s end used a very high-resolution satellite image (0.5 m pixel) to calculate an algae abundance index. Results showed a stronger effect on melt for N+P than P alone, and that the 150 m2 area differed significantly from a random sample surrounding the experiment. Moreover, the mean algae abundance index for P-only addition plots did not differ from a random sample surrounding the experiment; however, the mean algae abundance index of N+P addition plots was significantly higher than the mean outside the experimental area. We take this as evidence that Eklutna Glacier’s algae-based ecosystem is N-limited. If other glacial systems are N-limited also, then, given increasing aerosol deposition of N from anthropogenic sources, glacier wastage through algal effects will likely increase over time.

Photochemical Reactivity of Sub-Arctic Permafrost Natural Organic Matter and its Implications of Surface Water Biogeochemistry

Project Type: Annual Base Grant **Project ID:** 2018AK140B

Project Impact: This study assessed two questions: 1) what are the composition and photoreactivity of permafrost natural organic matter (NOM) released into surface waters upon thaw, and 2) how does permafrost organic matter influence surface waters in a residential watershed. The investigation of Question 1 determined that aliphatic chemical compounds do not leach out of soil into surface waters and that the chemical composition and photoreactivity of permafrost are heterogeneous down the depth of the core as well as within the same watershed. A few trends were observed in chemical characterization as the carbon age increased: carbohydrates decreased with age and aromatics increased with age. The decrease in carbohydrates is indicative that older material could have been more processed prior to freezing. The increase in aromatics with depth differs from the few previous studies elsewhere that observed permafrost has decreased aromaticity compared to the active layer. The primary findings thus far for Question 2 concern photoreactivity and seasonality. First, the chemical composition and photoreactivity of the sampled boreal forest sub-Arctic NOM is different than that of the reference material of microbial derived or terrestrial derived organic matter. As for seasonality, winter NOM has minimal natural •OH production in the presence of light. Finally, addition of dissolved iron to NOM solutions did not increase rates of photochemical •OH promotion. This indicates that either iron complexation was not increased in lake NOM to increase the lake's NOM reactivity to •OH production, or that other interactions with iron were preventing •OH enhancement.

Snowmelt Hydrology in the Upper Kuparuk Watershed, AK: Observations and Modeling

Project Type: Annual Base Grant **Project ID:** 2018AK139B

Project Impact: Arctic Alaska has been warming at a rate two times greater than the global average. The timing and magnitude of snowmelt runoff is impacted by this warming and changes in precipitation, permafrost, and snow cover. Snowmelt spring floods are the largest hydrologic event of the year in many Arctic Alaska river systems. Research focused on hydrology in the Upper Kuparuk River watershed, where long-term air temperature, precipitation, and streamflow measurements were used to provide exploratory statistical analysis and hydrologic modeling. While no statistically significant trends in snow accumulation and snowmelt runoff were identified during 1993-2017, observations highlight large year-to-year variability and include extreme years. Snow water equivalent ranged from 5.4 to 17.6 cm (average 11.0 cm), peak snowmelt runoff ranged from 3.84 to 50.0 cms (average 22.4 cms) and snowmelt peak occurrence date ranged from May 13 to June 5 for the Upper Kuparuk period of record. The spring of 2015 stands out as the warmest, snowiest year on record in the Upper Kuparuk. Further investigation into snowmelt included the analysis of remote sensing snow data and application of the Snowmelt Runoff Model (SRM). The MODIS snow product MODSCAG was successfully used to create accurate snow depletion curves for the Upper Kuparuk and improve hydrologic modeling using SRM. Testing SRM in the Upper Kuparuk provided insights and a set of recommendations for improved snowmelt runoff forecasting and hydrologic modeling in Arctic Alaska.