



Łíídlı́ Kúé First Nation



**SCOTTY CREEK**  
Research Station

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# Scotty Creek Research Compendium

## 1.0 A

### 1.1 Abulu, Rachael –

*Affiliation: York University*

*Contact: [Rachael Abulu | LinkedIn](#)*

*Keywords: permafrost, degradation, discontinuous, paleolimnological, mercury, carbon, lakes, sediment, biogeochemical*

Rachael Abulu was a Master's student at York University focused on examining lake sediments as a potential sink for carbon and mercury accumulation released from permafrost degradation in discontinuous permafrost peatlands. She used paleolimnological methods to quantify long-term carbon and mercury burial in the sediments of 14 small lakes at/near the Scotty Creek Research Station. Her research contributes to our understanding of the role that abundant small lakes and ponds in warming high latitude regions play in global biogeochemical cycles.

### 1.2 Ackley, Caren –

*Affiliation: Wilfrid Laurier University*

*Contact: [Caren Ackley | LinkedIn](#)*

*Keywords: permafrost, degradation, wildfire, severity biogeochemical, soil, climate, conductivity*

Northern regions are experiencing rapid climate warming. As these regions warm, the occurrences of naturally ignited wildfires are increasing in frequency, severity and area burned, calling for a more thorough understanding of post-fire eco-hydrological impacts. Changes in runoff chemistry, and soil moisture and thermal regimes, have been attributed to the significant loss of organic matter (OM) and exposure of deeper soils, leading to enhanced permafrost degradation, ground surface subsidence and the conversion of peat landscapes from long-term C sinks to sources. However, low-severity wildfires often result in minor OM loss. Due to the significant and immediate threats posed to the health of ecosystems and

local communities, the impacts of large, high-severity burns have been a primary research focus while the implications of low-severity wildfires remain understudied...The higher thermal conductivity of wetter soils, enhanced by more consistent and uniform incident shortwave radiation resulting due to canopy removal, promoted deeper and more homogeneous ground thaw, releasing previously frozen permafrost porewater back into the soil solution. This study links biogeochemical and hydrological impacts of a wildfire to generate a more comprehensive understanding of how a permafrost plateau responds to a low-severity burn. Results suggests that post-fire changes in pore structure, runoff flowpath, and porewater chemistry were initiated by the incorporation of particulates from above-ground sources and augmented by abiotic forces.

### 1.3 Adams, Justin –

*Affiliation: Wilfrid Laurier University*

*Contact:*

*Keywords: soil, remote sensing, satellite, drought, agriculture, backscatter*

Monitoring soil moisture is important over agricultural regions for improving the skill of regional crop yield, flood and drought forecasting, and for assisting producers in making effective land-management decisions. Soil moisture data are available from Earth Observation missions, which use active (radar) and passive (radiometer) microwave remote sensing. To take full-advantage of these data it is necessary to obtain a realistic understanding of soil moisture errors (i.e. validation) and to develop methods to account for the inherent lack of sub-footprint variance associated with remote sensing data (i.e. scaling). The aim of this thesis was to address these issues through an analysis of in-situ and remote sensing datasets over an agricultural study region in Canada...A unique method is proposed to downscale SMOS observations using field-scale SAR retrievals prior to vegetation emergence. This resulted in considerable errors, but results using a soil model suggest promise for the method with improved backscatter modelling. Multi-temporal similarities are also compared over changing vegetation conditions during the growing season using coincident aircraft and satellite data. For corn and canola fields, SAR linear backscatter was significantly correlated with changes in brightness temperature, with implications showing potential of C-band SAR to characterize vegetation contributions (e.g. vegetation water content) to L-band brightness temperature.

## 1.4 Akbarpour, Shaghayegh –

*Affiliation: University of Waterloo*

*Contact: [Shaghayegh \(Shae\) Akbarpour | LinkedIn](#)*

*Keywords: water, modelling, climate, discontinuous, permafrost, hydrological functioning, drainage basin*

Shae was a PhD student of water resources engineering based at the University of Waterloo. Her research was focused on modelling the climate warming induced evolution of land covers in discontinuous permafrost regions of northwestern Canada. She used these modelling outcomes to investigate the effects of the land cover changes on the hydrological functioning of the drainage basins in these regions. Shae was also devising a land cover change model from different machine learning methodologies which can be used to predict the future evolution of land covers throughout the circum-polar region.

## 1.5 Auclair, Maude –

*Affiliation: Wilfrid Laurier University*

*Contact: [aucl9080@mylaurier.ca](mailto:aucl9080@mylaurier.ca)*

*Keywords: microtopography, permafrost, bog, hummock, wildfire, permafrost, radiation, talik, storage*

Maude examined how the microtopography of collapse scar bogs evolve as they slowly drain following the thaw of permafrost dams on their margins. Her preliminary work indicates that such bogs develop hummocky surfaces over periods of years to decades, and that the introduction of hummocks affect water flow and storage processes and pathways.



## 2.0 B

### 2.1 Bell, Mackenzie –

*Affiliation: Wilfrid Laurier University*

*Contact: bell9860@gmail.com, [Mackenzie Bell | LinkedIn](#)*

*Keywords: Indigenous, Jean Marie, First Nation, anthropogenic, traditional knowledge, Dene, climate change*

Across the globe climate change has become an issue of growing concern for both Indigenous and non – Indigenous peoples alike. In Northern Canada this narrative is no different. For Indigenous groups such as the Jean Marie River First Nation (JMRFN) anthropogenic climate change is not only a reality but is visible through their daily interactions with the environment around them. Additional insight pertaining to these climatic changes and their impacts can be found through analyzing the traditional knowledge systems of the JMRFN and how these before mentioned interactions have changed over time. This two-year participatory research project has investigated these observed changes to the environment, there impacts on traditional cultural activities and the overall health of the JMRFN community. The analysis of these climatic changes have been done in hopes of better understanding how local Dene knowledges, values and culture can be applied to create an effective climate change adaptation strategy for JMRFN. Additionally, this research hopes to demonstrate why current non – Indigenous, top-down approaches to environmental management and climate change adaptation planning can be ineffective and culturally irrelevant for Indigenous peoples.

### 2.2 Bender, William –

*Affiliation: Wilfrid Laurier University*

*Contact: bend2160@mylaurier.ca, [William Bender | LinkedIn](#)*

*Keywords: Remote sensing, thermokarst, mass movement, mapping*

Will Bender was an undergraduate co-op student, researcher and mapper with the NWT Thermokarst Collective and the Dehcho Collaborative on Permafrost (DCoP). Will is based in Waterloo but worked at the NWT GeoScience office in Yellowknife.

## 2.3 Berg, Aaron –

*Affiliation: University of Guelph*

*Contact: [aberg@uoguelph.ca](mailto:aberg@uoguelph.ca), 519-824-4120 ext. 58514, [Aaron Berg | LinkedIn](#)*

*Keywords: satellite, aerial, remote sensing, soil moisture, hydrology*

In subhumid to arid climates throughout the world, recharge to groundwater in urban areas is often found to be higher than pre-urbanization rates, despite an increased percentage of impermeable surfaces. Groundwater recharge in the city of Lethbridge is substantially higher than recharge rates prior to urbanization, resulting in the formation of perched water table conditions. High perched water table conditions, typically at depths between one and 2.5 metres, have created problems for the City and University of Lethbridge, including the increased occurrence of slope failures along nearby coulees. This study estimates of the volume of excess water available for groundwater recharge through the practices of urban turfgrass irrigation, and water storage. Between May and September, 1990-1996 irrigation was applied far above evapotranspiration demands, resulting in large volumes of water available for groundwater recharge in the Varsity Village subdivision of the City of Lethbridge. The relationship between the amount of water applied and the development of perched water table systems was strong enough that equations between inputs and water table depth could be derived, and used to predict water table elevation.

## 2.4 Branfireun, Brian –

*Affiliation: Western University*

*Contact: [bbranfir@uwo.ca](mailto:bbranfir@uwo.ca), 519-661-2111 ext. 89221, [Brian Branfireun | LinkedIn](#)*

*Keywords: catchment, hydrology, headwater, boreal, peatlands, MeHg*

The role of catchment hydrology and biogeochemistry in the production and transport of methylmercury (MeHg) was studied in a headwater catchment in the low boreal forest zone of the Precambrian Shield. A simple, catchment-scale model found that peatlands were large sources of MeHg, and lakes were large sinks. Sensitivity analysis revealed that the volume of runoff delivered to the peatland by the upland, peatland size, and pore water MeHg concentration in the peatland are important controls on catchment MeHg yield. Contemporary atmospheric deposition of MeHg was found to be insignificant compared to the sources of MeHg within the catchment.

## 2.5 Braverman, Michael –

*Affiliation: GHD Engineer / Wilfrid Laurier University*

*Contact: [Michael Braverman | LinkedIn](#)*

*Keywords: permafrost, degradation, thaw, peatlands, hydrological, model, mathematical, seismic line*

Permafrost is ground that remains at or below 0°C for at least two consecutive years (PIWP, 2012). In the continuous permafrost zone its thickness may exceed 300 m, in lower latitudes, permafrost thickness is progressively decreasing, its occurrence becomes discontinuous and eventually sporadic (PIWP, 2012). At the southern fringe of permafrost in northwestern Canada, just about few meters. In subarctic peatlands permafrost is one of the main elements governing the hydrological processes. Being very thin and with temperature just fractions of the degree below 0°C, it is very vulnerable to any changes in soil temperature and water content...Based on the conceptual model described in the first manuscript, we developed a mathematical model of the active layer and permafrost thaw which is described in the second manuscript. This model allows us to make a prediction of when the examined seismic line becomes free of permafrost free. We also demonstrated that seismic lines create a permanent link between previously disconnected hydrological units. A brief summary of the main research findings explaining how linear disturbances of peat plateaus contribute to permafrost degradation concludes the thesis. Furthermore, the final chapter identifies gaps in the existing body of scientific knowledge on the subject of permafrost degradation and presents recommendations on potential areas for future research.

## 2.6 Buston-White, Amber –

*Affiliation: Wilfrid Laurier University*

*Contact: [bust4730@mylaurier.ca](mailto:bust4730@mylaurier.ca), [Amber Buston-White | LinkedIn](#)*

*Keywords: wildfire, permafrost, thaw, hummock*

Amber examined how wetlands affect wildfire regimes in the Taiga Plains ecoregion, and how this might be changing with on-going permafrost thaw. Amber co-developed this project in collaboration with the Łíídlı́ Kúę First Nation while working at the LKFN office as a student intern for the summer term of 2023.

## 3.0 C

### 3.1 Carpino, Olivia –

*Affiliation: Wilfrid Laurier University*

*Contact: [ocarpino@wlu.ca](mailto:ocarpino@wlu.ca), [Olivia Carpino | LinkedIn](#)*

*Keywords: permafrost, thaw, climate, peatland, index map*

Northwestern Canada's subarctic is among the most impacted regions in the world as it is experiencing rapid climatic and environmental change. As a result, northwestern Canada has been experiencing region-wide permafrost thaw and disappearance, both of which are also occurring at unprecedented rates. Permafrost temperatures in the Taiga Plains have been warming steadily over the last several decades, which has been particularly detrimental across its lower latitudes of the discontinuous permafrost zone where the permafrost is already relatively thin and warm. These factors indicate that permafrost in the southern Taiga Plains may be in a state of disequilibrium with the current climate...This research first seeks to explore the trajectory of peatland landcover change following permafrost thaw by identifying unique landcovers that represent different thaw stages. Next, this research works to monitor peatland-dominated environments across the southernmost portion of the Taiga Plains by using near-annual imagery to quantify landcover changes that may be representative of permafrost thaw. Finally, this research aims to encapsulate the factors that contribute to permafrost presence or absence by proposing a permafrost index map across the southern Taiga Plains.

### 3.2 Chasmer, Laura –

*Affiliation: University of Lethbridge*

*Contact: [laura.chasmer@uleth.ca](mailto:laura.chasmer@uleth.ca), [Laura Chasmer | LinkedIn](#)*

*Keywords: regenerating, remote sensing, heterogeneous, jack pine, CO2*

Previously disturbed and regenerating forests make up a significant proportion of the North American land area, and therefore play an important role in the exchanges of heat and trace gases between the terrestrial biosphere and the atmosphere...This thesis dissertation presents new science on the use of airborne lidar for evaluating remote sensing products within heterogeneous and previously clearcut ecosystems. The goals of this thesis were to first understand the processes affecting CO<sub>2</sub> exchanges within a previously disturbed boreal jack pine chronosequence located in Saskatchewan, Canada and then to apply this

understanding to evaluate low resolution remote sensing data products from the Moderate Resolution Imaging Spectroradiometer (MODIS) using airborne lidar. The first objective of this dissertation examined the factors that control light use efficiency (LUE) within the jack pine chronosequence during dry and wet years. The second objective examined the importance of vegetation structure and ground surface elevation on CO<sub>2</sub> fluxes within a mature jack pine forest. The third objective developed and tested a simple model of lidar fractional cover and related this to the fraction of photosynthetically active radiation absorbed by the canopy (fPAR).

### 3.3 Coleman, Kristen –

*Affiliation: York University*

*Contact: [Kristen Coleman | LinkedIn](#)*

*Keywords: anthropogenic, aquatic, liminology, paleolimnology, ecology*

Although the magnitude of recent anthropogenic environmental change is unprecedented, humans have been leaving measurable footprints on the landscape prior to the era of industrialization. This thesis examines the long-term impacts of human activities on aquatic ecosystem by using limnological and paleolimnological approaches to examine: 1) the long-term impacts of a small oil and gas operation located in the Cameron Hills, Northwest Territories, on local aquatic ecology; and 2) the impacts of a Dorset Palaeoeskimo settlement on a nearby lake at Port au Choix, Newfoundland. In the Cameron Hills, water samples and dated sediment cores were analyzed in order to assess modern-day as well as long-term impacts of oil and gas activities on aquatic ecosystems. Both modern water chemistry and paleolimnological records provided evidence of catchment disturbance and localized acidification in lakes more closely associated with the oil and gas operations. Nonetheless, changes recorded in the sediment record suggested that recent climate warming is the dominant driver of changes in these lakes...Collectively, these studies demonstrate how paleolimnology can be used to increase our understanding of the impact of human activities on aquatic ecosystems in a variety of settings.

### 3.4 Cockburn, Jackie –

*Affiliation: University of Guelph*

*Contact: [jaclyn.cockburn@uoguelph.ca](mailto:jaclyn.cockburn@uoguelph.ca), 519-824-4120 ext. 53498, [Jaclyn Cockburn | LinkedIn](#)*

*Keywords: sediment, dynamics, snow-water equivalent (SWE), runoff, meltwater*

Suspended sediment delivery dynamics in two watersheds at Cape Bounty, Melville Island, Nunavut, Canada were studied to characterize the hydroclimate conditions in which laminated sediments formed. Process work over three years determined snow-water equivalence was the primary factor that controlled sediment yield in both catchments. Cool springs (2003, 2004) enhanced runoff potential and intensity because channelized meltwater was delayed as it tunneled through the snowpack and reached the river channel (sediment supply) within 1-2 days. In warm springs (2005), meltwater channelized on the snowpack and did not immediately reach the river bed (7-10 days). Sediment transport was reduced because flow competence was lower and sediment supplies limited. Sediment deposition in the West Lake depended on surface runoff intensity. Short-lived, intense episodes of turbid inflow generated underflow activity which delivered the majority of seasonal sediment. In 2005, runoff was less intense and few underflows were detected compared to the cooler, underflow dominated 2004 runoff season. As well, grain-size analysis of trapped sediment indicated that deposition rates and maximum grain-size were decoupled, indicative of varied sediment supplies and delivery within the fluvial system...Long-term climatic interpretations should be carefully assessed.

### 3.5 Connon, Ryan –

*Affiliation: Wilfrid Laurier University*

*Contact: [rconnon@wlu.ca](mailto:rconnon@wlu.ca), 867-688-7544, [Ryan Connon | LinkedIn](#)*

*Keywords: hydrology, climate, peatlands, permafrost, thaw, bogs, fens, plateaus, wetlands, storage*

Recent climate warming in northwestern Canada is occurring at an unprecedented rate in recorded history and has resulted in the widespread thaw of permafrost. Where present, permafrost exerts a significant control on local hydrology, and disappearance of permafrost threatens to change the hydrology of northern basins. In the peatlands that characterise the southern distribution of permafrost in low relief terrain, permafrost takes the

form of forested peat plateaus and is interspersed by permafrost-free wetlands (*i.e.* channel fens and flat bogs). Previous field studies have found that channel fens serve as the drainage network and route water to the basin outlet, whereas flat bogs have been viewed primarily as storage features. Wetland expansion in response to permafrost thaw can transform the primary hydrologic function of flat bogs from storage units to runoff-producing units by removing the relatively impermeable permafrost barrier that encompasses them. As a result, permafrost thaw has the potential to greatly increase the runoff contributing area when large storage features form hydrological connections with the basin drainage network. It has been well documented that permafrost thaw in this region results in the loss of forest and a concomitant expansion of wetlands, however the hydrologic response of these changes is poorly understood.

### 3.6 Coughlin, John –

*Affiliation: University of Waterloo*

*Contact: [John Coughlin | LinkedIn](#)*

John Coughlin joined the Scotty Creek research team in December, 2017 and brings a wide range of technical and research skills. When not at Scotty Creek he is at our office in Yellowknife where he lives.

### 3.7 Craig, James –

*Affiliation: University of Waterloo*

*Contact: [jrcraig@uwaterloo.ca](mailto:jrcraig@uwaterloo.ca), 519-888-4567 ext. 37554, [James Craig | LinkedIn](#)*

*Keywords: modelling, hydrology, numerical, analytical, permafrost, carbon, geothermal, infiltration, software, Raven*

Craig's expertise is in numerical and analytical modelling of water resource systems, with a focus on surface water hydrology, regional-scale groundwater flow, and subsurface heat transfer/phase change simulation. His research program bridges the divide between the fundamental and practical, with the goal of developing more robust, accurate, and practical modelling approaches that will be used to guide water management, operations, and policy. The core of Prof. Craig's research program, which advances the toolkit of hybrid analytical-numerical methods to address a diverse range of problems, complements his collaborative research and publications across a variety of fields, including discontinuous permafrost

hydrology, carbon sequestration, geothermal loop design, infiltration theory, and oil sands remediation. Prof. Craig is the lead software developer of the open-source Raven Hydrological Modelling framework (Raven) [raven.uwaterloo.ca], which has been adopted by organizations across Canada for water resources assessment, reservoir inflow forecasting, and flood forecasting.

## 4.0 D

### 4.1 Daly, Seamus –

*Affiliation: Wilfrid Laurier University*

*Contact: sdaly@wlu.ca, 867.688.2605, [Seamus Daly | LinkedIn](#)*

Seamus Daly is a Mapper for the Dehcho Collaborative on Permafrost (DCoP) and he is based in Yellowknife. He is also the manager of the Northwest Territories Thermokarst Mapping Project. His activities include spatial data management and analysis, and coordination of training for community Mappers on mapping techniques. Seamus's work is helping to improve the spatial data record relating to climate driven permafrost processes.

### 4.2 Devoie, Élise –

*Affiliation: Queen's University*

*Contact: elise.devoie@queensu.ca, 613-533-6000 ext. 78316, [Élise Devoie | LinkedIn](#)*

*Keywords: hydrology, thermal, modelling, peatland, discontinuous, talik, degradation, thaw*

Hydrology and hydrological modelling in the far north is understudied, and many gaps exist in the current understanding and representation of northern thermal and hydrological systems. A combination of fieldwork and modelling was used to gain a better understanding of landscape evolution and thaw processes in the peatland-dominated discontinuous permafrost region of the Northwest Territories. Data collected at the Scotty Creek Research Station and modelling tools are developed and used to identify and quantify controls on isolated and connected talik formation in discontinuous permafrost peatland systems which include soil moisture, snow cover, surface temperature and subsurface lateral flow. The formation of a talik was shown to be a tipping point in permafrost degradation after which several positive feedback cycles led to more rapid permafrost loss.



### 4.3 Disher, Brenden –

*Affiliation: Wilfrid Laurier University*

*Contact: [Brenden Disher | LinkedIn](#)*

*Keywords: permafrost, hydrology, ecology, peatland, bog, succession, thaw, climate*

The loss of permafrost has produced a wholesale conversion from forest to wetland, and many studies have analyzed the effects of permafrost thaw-induced land cover change on the hydrology and ecology of landscapes within the Taiga Plains. The permafrost thaw driven areal shrinkage of forested plateaux and their replacement by treeless wetlands is well documented, and the co-occurrence of permafrost and black spruce forest cover is the basis for areal estimates of the former. However, field studies conducted at a peatland dominated landscape near Fort Simpson, NWT indicate that tree canopy may persist following the loss of permafrost and the gradual drying and succession of the previously treeless bog landscape...A total of four sites, each containing a bog, treed bog and peat plateau were chosen based on a supervised image classification completed within the basin. A geophysical investigation was completed to determine permafrost presence, depth of seasonal ice was measured along transects at each site, a series of wells were installed to measure hydrological response and discrete soil moisture measurements were taken immediately following snowmelt to characterize differences in moisture retention...Understanding the succession of northern landscapes due to climate warming provides an important step in predicting the trajectory of change in the north. This work provides new insights regarding the future of post-thaw landscapes within the Taiga Plains.

### 4.4 Dominico, Mason –

*Affiliation: Wilfrid Laurier University*

*Contact: [mdominico@wlu.ca](mailto:mdominico@wlu.ca), 705.498.7172, [Mason Dominico | LinkedIn](#)*

*Keywords: mass, energy, balance, permafrost, geophysical, thermal, micro-meteorological, remote sensing, climate, human, storage*

Mason examined the mass and energy balances of a permafrost body using geophysical, thermal, micro-meteorological and a remote sensing measurements and archived data. He was also examining how changes to these balances arising from climate warming and direct human disturbance will affect water flux and storage processes.

## 5.0 E

### 5.1 Egorov, Igor –

*Affiliation: National Research Council*

*Contact:*

*Keywords: permafrost, restoration, thaw, infrastructure, stabilisation, ground-freezing*

Igor's research developed advanced permafrost restoration and thaw mitigation systems, and evaluates the effectiveness of such systems for a wide range of applications. Such applications include protection of infrastructure and stabilisation of permafrost to increase slope stability. Much of the new knowledge, tools and methods developed in this project is targeted for the protection of transportation infrastructure in the NWT and elsewhere in the circum-polar region. Scotty Creek served as the main outdoor laboratory for the development and testing of these ground-freezing systems.

### 5.2 Elgie, Angela –

*Affiliation: Wilfrid Laurier University*

*Contact: [Angela Jean Hamilton | LinkedIn](#)*

*Keywords: seismic line, peatland, wetland, bogs, water, moisture, biodiversity, snowmelt*

Angela's research focused on the effects of a 1986 seismic line on the peatland wetland area at Scotty Creek. Three bogs were selected for their variability for her study of these effects. Through measurements of water levels, moisture, biodiversity, temperature, snow melt, water movement, and others the differences in values will outline the effects of the line.

## 6.0 F

### 6.1 Frederick, Ian –

*Affiliation: Wilfrid Laurier University*

*Contact: [Ian Frederick](#) | [LinkedIn](#)*

*Keywords: permafrost, thaw, hydrology, discontinuous, GIS, remote sensing, microtopography, wetland*

Ian assisted in research examining permafrost thaw induced landscape and hydrological changes in the discontinuous permafrost zone. He combined a range of GIS and remote sensing techniques to identify characteristics of permafrost distribution, microtopography, and wetland flow. Ian hopes this research will further the understanding of the impacts of ongoing permafrost thaw in the region.

## 7.0 G

### 7.1 Gibson, John –

*Affiliation: University of Victoria*

*Contact: [jjgibson@uvic.ca](mailto:jjgibson@uvic.ca) or [john.gibson@innotechalberta.ca](mailto:john.gibson@innotechalberta.ca), +1 (250) 721-7341, [John Gibson](#) | [LinkedIn](#)*

*Keywords: hydrology, geochemistry, Athabasca, oil sands, nitrogen, watershed, topography, thaw, ecosystems, storage*

Hydrology and geochemistry studies were conducted in the Athabasca Oil Sands region to better understand the water and nitrogen cycles at two selected sites in order to assess the potential for nitrogen transport between adjacent terrain units. A bog—poor fen—upland system was instrumented near Mariana Lakes (ML) (55.899° N, 112.090° W) and a rich fen—upland system was instrumented at JPH (57.122° N, 111.444° W), 100 km south and 45 km north of Fort McMurray, Alberta respectively. LiDAR surveys were initially conducted to delineate the watershed boundaries and topography and to select a range of specific locations for the installation of water table wells and groundwater piezometers. Field work, which included a range of physical measurements as well as water sampling for geochemical and isotopic characterization, was carried out mainly during the thaw seasons of 2011 to 2015...Climate change and development impacts may lead to significant

mobilization of nitrogen storages, although more research is required to quantify the potential effects on local ecosystems.

## 7.2 Gingras-Hill, Tristan –

*Affiliation: University of Waterloo*

*Contact: [tristangingrashill@gmail.com](mailto:tristangingrashill@gmail.com), [Tristan Gingras-Hill | LinkedIn](#)*

*Keywords: boreal, evapotranspiration, soil, TIN, vegetation, hydrogeochemical, storage*

Natural forest soils of the Western Boreal Forest rarely witness near-surface soil flushing events during the growing season due to the forest's excessive evapotranspiration demands and large unsaturated zone storage capacity. This leads to the accumulation of nutrients such as Soluble Reactive Phosphorus (SRP) and Total Inorganic Nitrogen (TIN) within the surface soils, increasing along a low-relief moisture gradient transitioning through upland forests, riparian zones and wetlands, influencing vegetation communities. In the post-mined landscape, decompressed overburden produce topographically elevated hillslopes with cover soils exhibiting poor transmissivity and hydrophobic properties, which are often subject to erosion...The objectives were to determine if topographically driven moisture-nutrient gradients were being formed and how this would influence vegetation colonization...Although our system demonstrated positive correlations of increased SRP on native species establishment, TIN availability demonstrated increased forb and non-native species colonization. This study demonstrates how current forested upland reclamation practices might influence other land units when re-initiating hydrogeochemical connectivity throughout engineered landscapes. This study also demonstrates how contributions from topographically elevated land units might impact vegetation communities downslope, which is crucial for re-establishing the resiliency of the landscape. Current forest upland and hillslope reclamation practices will likely need to be re-evaluated when considering landscape scale hydrogeochemical connectivity.

### 7.3 Gordon, John –

*Affiliation: University of Waterloo*

*Contact: john.gordon@usask.ca, [John Gordon | LinkedIn](#)*

*Keywords: mercury, permafrost, peat plateau, bog, fen, organic, hydrology*

Most recent publication,

In arctic and sub-arctic environments, mercury (Hg), more specifically toxic methylmercury (MeHg), is of growing concern to local communities because of its accumulation in fish. In these regions, there is particular interest in the potential mobilization of atmospherically deposited Hg sequestered in permafrost that is thawing at unprecedented rates. Permafrost thaw and the resulting ground surface subsidence transforms forested peat plateaus into treeless and permafrost-free thermokarst wetlands where inorganic Hg released from the thawed permafrost and draining from the surrounding peat plateaus may be transformed to MeHg. This study begins to characterize the spatial distribution of MeHg in a peat plateau–thermokarst wetland complex, a feature that prevails throughout the wetland-dominated southern margin of thawing discontinuous permafrost in Canada’s Northwest Territories. We measured pore water total Hg, MeHg, dissolved organic matter characteristics and general water chemistry parameters to evaluate the role of permafrost thaw on the pattern of water chemistry...We found that pore waters in poor fens contained elevated levels of MeHg, and the water draining from these features had dissolved MeHg concentrations 4.5 to 14.5 times higher than the water draining from the bogs. It was determined through analysis of historical aerial images that the poor fens in the toposequence had formed relatively recently (early 1970s) as a result of permafrost thaw. Differences between the fens and bogs are likely to be a result of their differences in groundwater function, and this suggests that permafrost thaw in this landscape can result in hotspots for Hg methylation that are hydrologically connected to downstream ecosystems.

## 7.4 Gosselin, Gabriel –

*Affiliation: Wilfrid Laurier University*

*Contact:*

*Keywords: biodiversity, wetlands, remote sensing, satellite, plant structure, polarimetric, characterization*

Wetlands fill many important ecological functions and contribute to the biodiversity of fauna and flora. Although there is a growing recognition of the importance to protect these areas, it remains that their integrity is still threatened by the pressure of human activities. The inventory and the systematic monitoring of wetlands are a necessity and remote sensing is the only realistic way to achieve this goal. The primary objective of this thesis is to contribute and improve the wetland characterization using satellite polarimetric data acquired in L (ALOS-PALSAR) and C (RADARSAT-2) band. This thesis is based on two hypotheses (Ch. 1). The first hypothesis stipulate that classes of plant physiognomies, based on plant structure, are more appropriate than classes of plant species because they are best adapted to the information content of polarimetric radar data. The second hypothesis states that polarimetric decomposition algorithms allow an optimal extraction of polarimetric information compared to a multi-polarized approach based on the HH, HV and VV channels (Ch. 3)...This thesis also examines the complementarity between the structural parameters and those related to the backscattered power, often ignored and normalized by most polarimetric decomposition...This thesis demonstrates that the Touzi decomposition parameters allow a better characterization, better separability and better classifications of wetlands plant physiognomic classes than HH, HV and VV polarization channels. The grouping of plant species into physiognomic classes is a valid concept. However, some plant species sharing a similar physiognomy, but occupying a different environment (high vs. low marshes), have presented significant differences in their scattering properties.

## 8.0 H

### 8.1 Hakobyan, Nanar –

*Affiliation: Wilfrid Laurier University*

*Contact: [nanar\\_hakobyan@gov.nt.ca](mailto:nanar_hakobyan@gov.nt.ca)*

*Keywords: remote sensing, Radar, permafrost, thaw*

Nanar is a researcher employed by the Western Arctic Centre for Geomatics (Government of the Northwest Territories). Her PhD research focused on developing and testing new remote sensing tools and monitoring programmes for the Northwest Territories using high resolution Synthetic Aperture Radar (SAR) and optical remote sensing data for detection, monitoring, and analysis of permafrost thaw impacts with a focus on the Dehcho region.

### 8.2 Haughton, Emily –

*Affiliation: Wilfrid Laurier University*

*Contact:*

*Keywords: discontinuous, permafrost, hydrology, snowmelt, snow water equivalent (SWE), storage*

In the discontinuous permafrost zone of northwestern Canada, snow covers the ground surface for over half the year, thus snowmelt constitutes a primary source of ecosystem moisture supply and strongly influences stream hydrographs. The peat landscapes along the southern limit of discontinuous permafrost are dominated by forested permafrost plateaus ( forest ), and treeless, permafrost-free wetlands ( wetland ). Permafrost-thaw induced transformation of this landscape has changed water flow and storage processes and therefore introduced new uncertainties on the region's water futures. Here, I a) characterize forest and wetland water storage and flow from snowmelt, and b) evaluate how permafrost thaw-induced wetland expansion at the expense of forest might affect the proportion of snowmelt that can contribute to basin runoff during the spring freshet of a 152-km<sup>2</sup> watershed in the southern Northwest Territories. Analysis of historical imagery suggests that wetland coverage within a 0.14-km<sup>2</sup> area-of-interest increased by approximately 7 % between 1977 and 2010. Over the 34-year period, total areal SWE decreased by 1.5 %, but the amount of SWE made available as runoff increased by 25%. The increased proportion of

the snow cover that contributes melt water to streams may be a factor contributing to the rising stream flows observed across the study region in the mid-1990s and early 2000s, given that there has been no concomitant increase in winter-time precipitation.

### 8.3 Hayashi, Masaki –

*Affiliation: University of Calgary*

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*Keywords: hydrology, groundwater, headwaters, watershed, aquifer, sediment, geology, storage*

Groundwater discharge in alpine headwaters sustains baseflow in rivers originating in mountain ranges of the world, which is critically important for aquatic habitats, run-of-river hydropower generation, and downstream water supply. Groundwater storage in alpine watersheds was long considered negligible, but recent field-based studies have shown that aquifers are ubiquitous in the alpine zone with no soil and vegetation. Talus, moraine, and rock glacier aquifers are common in many alpine regions of the world, although bedrock aquifers occur in some geological settings. Alpine aquifers consisting of coarse sediments have a fast recession of discharge after the recharge season (e.g., snowmelt) or rainfall events, followed by a slow recession that sustains discharge over a long period. The two-phase recession is likely controlled by the internal structure of the aquifers. Spatial extent and distribution of individual aquifers determine the groundwater storage-discharge characteristics in first- and second-order watersheds in the alpine zone, which in turn govern baseflow characteristics in major rivers. Similar alpine landforms appear to have similar hydrogeological characteristics in many mountain ranges across the world, suggesting that a common conceptual framework can be used to understand alpine aquifers based on geological and geomorphological settings. Such a framework will be useful for parameterizing storage-discharge characteristics in large river hydrological models.



## 8.4 Hayhurst, Taylor –

*Affiliation: Wilfrid Laurier University*

*Contact: hayh7270@mylaurier.ca, [Taylor Hayhurst | LinkedIn](#)*

*Keywords: remote sensing, burn severity, mapping, bog, fen, wetland, wildfire*

Taylor Hayhurst was an undergraduate student working with the Łı́ıdlı́ Kúę First Nation and researchers from NASA/ABOVE, the Government of the Northwest Territories and Forestry Canada on burn severity maps for Scotty Creek and the surrounding region. Taylor developed this project as part of her 4-month student internship at the Łı́ıdlı́ Kúę First Nation office in Fort Simpson in 2023.

## 8.5 Haynes, Kristine –

*Affiliation: Wilfrid Laurier University*

*Contact: khaynes@wlu.ca, 519.884.0710 x3847*

*Keywords: discontinuous, permafrost, thaw, peat plateaus, hummocks, wetland, climate, hydrology*

Northwestern Canada's discontinuous permafrost landscape is transitioning rapidly due to permafrost thaw, with the conversion of elevated, forested peat plateaus to low-lying, treeless wetlands...Ultimately, the ecohydrological feedbacks associated with climate-driven permafrost thaw has led to the expansion of treed wetlands in plateau-wetland complexes. Field research and aerial imagery analyses were conducted at the Scotty Creek Research Station, Northwest Territories to examine the development of hummock terrain over time and the resultant impacts on the hydrological response of wetlands connected to the basin drainage network. The area of peat plateaus underlain by permafrost declined between 2010 and 2018. The total area of hummock terrain increased in the basin in the same time period, with an overall decrease in the hummock perimeter-to-area ratio as small individual hummocks increased in size and aggregated into larger hummock complexes occupied by re-establishing trees. With the development and expansion of hummock terrain, the tortuosity of flowpaths draining wetlands increased. The average wetland water level recession constants following precipitation events became shorter over the 15-year period of record (2003-2017). The average time of water level rise in response to precipitation events decreased over time, as precipitation was directed quickly to runoff. As permafrost thaw reduces the cover of peat plateaus in exchange for increased wetland area, the presence of

treed wetlands appears to be transitioning plateau-wetland complexes into permafrost-free forest, facilitated by the growth of hummock terrain. Permafrost thaw-induced wetland transition triggers ecohydrological feedbacks with the potential to alter the availability and sustainability of freshwater resources.

## 8.6 Helbig, Manuel –

*Affiliation: Dalhousie University*

*Contact: Manuel.Helbig@dal.ca, [Manuel Helbig, Ph.D. | LinkedIn](#)*

*Keywords: CO<sub>2</sub>, climate, peatland, sink, warming*

Peatlands have acted as net CO<sub>2</sub> sinks over millennia, exerting a global climate cooling effect. Rapid warming at northern latitudes, where peatlands are abundant, can disturb their CO<sub>2</sub> sink function. Here we show that sensitivity of peatland net CO<sub>2</sub> exchange to warming changes in sign and magnitude across seasons, resulting in complex net CO<sub>2</sub> sink responses. We use multiannual net CO<sub>2</sub> exchange observations from 20 northern peatlands to show that warmer early summers are linked to increased net CO<sub>2</sub> uptake, while warmer late summers lead to decreased net CO<sub>2</sub> uptake. Thus, net CO<sub>2</sub> sinks of peatlands in regions experiencing early summer warming, such as central Siberia, are more likely to persist under warmer climate conditions than are those in other regions. Our results will be useful to improve the design of future warming experiments and to better interpret large-scale trends in peatland net CO<sub>2</sub> uptake over the coming few decades.

## 8.7 Hopkinson, Christopher –

*Affiliation: University of Lethbridge*

*Contact: c.hopkinson@uleth.ca, (403) 332-4586, [Chris Hopkinson | LinkedIn](#)*

*Keywords: aerial, model, glacier, remote sensing, wastage, DEM, degradation*

Three methods have been used to explore the volumetric change of glaciers in the Bow Basin above Banff for the years 1951 to 1993. Using aerial photography, the extent of glacier covers for the two years were mapped at a scale of 1:50,000. The first volumetric calculation of glacier loss was based on inventory criteria; the second a hypographic curve method based on Young's investigations in Mistaya Basin (1991) and the third stereo air photogrammetry and DEM comparisons using computer software...The proportions of

seasonal wastage contributions to the river flow were estimated using a multiple regression model of monthly average temperature and precipitation with snow course data as the antecedent condition determinant. This model was used to predict the shape of the glacier (ice and firn) melt hydrograph from June to September...For 1952 to 1993 at Banff, the average annual wastage/basin yield ration is found to be around 2.3%; for 1965 to 1992 (years of available data) at Lake Louise the same ratio is 4.5%. For the extremely low flow year of 1970 these ratios increase to 12.5% and 16.2% respectively. The proportion of flow derived from glacier recession in August of this year is estimated to be around 53% for Banff and 84% for Lake Louise. It is thought that the basin scale extrapolation may lead to under-estimations of wastage but the mass balance back-cast is more likely to preferentially weight wastage contributions toward the latter part of the time series.

## 9.0 K

### 9.1 Kaur, Simaranjit –

*Affiliation: Wilfrid Laurier University*

*Contact: kaur8330@mylaurier.ca, [Simaranjit Kaur | LinkedIn](#)*

*Keywords: wildfire, permafrost, peatlands, frost table, talik, thaw*

Simaran was an undergraduate student who used a combination of archived data from Scotty Creek and her own field measurements to examine the impacts of wildfire on active layer development and permafrost thaw. Simaran worked as an intern student at the Łíídlı́ Kúé First Nation in Fort Simpson for the summer (2023) term where she developed her project in close collaboration with LKFN community members.

## 9.2 Korosi, Jennifer –

*Affiliation: York University*

*Contact: jkorosi@yorku.ca, (416)736-2100 x 22491, [Jennifer Korosi | LinkedIn](#)*

*Keywords: lakes, anthropogenic, acidification, climate, species, pollutants, zooplankton, paleolimnology*

Freshwater lakes in the Canadian Maritime provinces have been detrimentally influenced by multiple, often synergistic, anthropogenically-sourced environmental stressors. These include surface-water acidification (and a subsequent decrease in calcium loading to lakes); increased nutrient inputs; watershed development; invasive species; and climate change...several lakes in southwestern Nova Scotia, especially those in Kejimikujik National Park, have undergone surface-water acidification (mean decline of 0.5 pH units) in response to local-source SO<sub>2</sub> emissions and the long-range transport of airborne pollutants. There has been no measureable chemical or biological recovery since emission restrictions were enacted. Lakewater calcium (Ca) decline, a recently recognized environmental stressor that is inextricably linked to acidification, has negatively affected the keystone zooplankter *Daphnia* in at least two lakes in Nova Scotia (and likely more), with critical implications for aquatic food webs. A consistent pattern of increasing planktonic diatoms and scaled chrysophytes was observed in lakes across Nova Scotia and New Brunswick, suggesting that the strength and duration of lake thermal stratification has increased since pre-industrial times in response to warming temperatures (~1.5 °C since 1870). These include three lakes near Bridgewater, Nova Scotia, that are among the last known habitat for critically endangered Atlantic whitefish (*Coregonus huntsmani*). Overall, these studies suggest that aquatic ecosystems in the Maritime Provinces are being affected by multiple anthropogenic stressors and paleolimnology can be effective for inferring the ecological implications of these stressors.

## 10.0 L

### 10.1 Langford, Joelle –

*Affiliation: Western University*

*Contact: [Joelle Langford | LinkedIn](#)*

*Keywords: permafrost, degradation, model, groundwater, thaw, microtopography, wetlands*

Permafrost covers approximately 24% of the Northern Hemisphere, and much of it is degrading, which causes infrastructure failures and ecosystem transitions. Understanding groundwater and heat flow processes in permafrost environments is challenging due to spatially and temporarily varying hydraulic connections between water above and below the near-surface discontinuous frozen zone. To characterize the transitional period of permafrost degradation, a three-dimensional model of a permafrost plateau that includes the supra-permafrost zone and surrounding wetlands was developed. The model is based on the Scotty Creek basin in the Northwest Territories, Canada. FEFLOW groundwater flow and heat transport modeling software is used in conjunction with the piFreeze plug-in, to account for phase changes between ice and water. The Simultaneous Heat and Water (SHAW) flow model is used to calculate ground temperatures and surface water balance, which are then used as FEFLOW boundary conditions. As simulating actual permafrost evolution would require hundreds of years of climate variations over an evolving landscape, whose geomorphic features are unknown, methodologies for developing permafrost initial conditions for transient simulations were investigated. It was found that a model initialized with a transient spin-up methodology, that includes an unfrozen layer between the permafrost table and ground surface, yields better results than with steady-state permafrost initial conditions. This study also demonstrates the critical role that variations in land surface and permafrost table microtopography, along with talik development, play in permafrost degradation. Modeling permafrost dynamics will allow for the testing of remedial measures to stabilize permafrost in high value infrastructure environments.

## 10.2 Leonard, Eric –

*Affiliation: Wilfrid Laurier University*

*Contact: [leon1000@mylaurier.ca](mailto:leon1000@mylaurier.ca)*

*Keywords: permafrost, hydrology, response unit, groundwater, thaw, connectivity*

Eric studied how thawing permafrost could lead to increased connectivity between and within hydrologic response units (HRUs) via new or reactivated groundwater pathways. He identified and characterized major HRUs based on physical, hydrologic, and hydrogeologic properties, as well as compared how they may change in varying permafrost settings.

## 10.3 Liu, Michelle –

*Affiliation: University of Waterloo*

*Contact:*

*Keywords: permafrost, subgrade, thaw, capacity, thermo-physical, infrastructure*

Permafrost has long been considered to be a stable subgrade in the design and construction of roads in high latitude/altitude regions. However, as permafrost thaws, it loses its bearing capacity, and as a result, the overlying road surface to cracks, ruts, or even collapses. Michelle's study aims to quantify the thermo-physical properties of selected road surface types widely used in the NWT and evaluate their capacity to insulate and protect the underlying permafrost. Her project will also include recommendations for reducing damage to road surfaces due to permafrost thaw for a wide range of conditions.

## 11.0 M

### 11.1 Mack, Mikhail –

*Affiliation: Wilfrid Laurier University*

*Contact: [Mikhail Mack](#) | [LinkedIn](#)*

*Keywords: discontinuous, permafrost, thaw, peatland, basin, runoff, tasseled cap*

The hydrological implications of discontinuous permafrost thaw in peatland-dominated basins are not well understood. While there is evidence suggesting that permafrost-thaw-driven land cover change increases annual runoff and the runoff ratio in the Taiga Plains of northwestern Canada, few studies have evaluated the impact on small to medium-sized basins ( $< 10^5$  km<sup>2</sup>) outside this ecoregion. Here, we assess runoff, runoff ratio, and precipitation trends for 34 peatland-dominated basins, of which 28 are in the discontinuous and sporadic permafrost zones and 6 in adjacent permafrost-free environments.

While no statistically significant annual runoff, runoff ratio, or precipitation trends were found in the Angling River basin, some evidence suggests a recent increase in runoff ratio. Overall, between 1980 and 2019 we found statistically significant increases in annual runoff and runoff ratio in Jean-Marie River, however, elevated annual runoff and runoff ratios exclusively occurred from 1996 through 2012. Since 2012, annual runoff and runoff ratios have not been substantially different than those before 1996. Although we found evidence of permafrost thaw in the Angling basin, slopes of Tasseled Cap indices indicated that vegetation growth and tundra greening were the main land cover changes. While in Jean-Marie, slopes of Tasseled Cap indices demonstrated a mixture of wetting, drying, and vegetation growth, processes associated with permafrost-thaw-related disturbances.

## 11.2 MacLean, Alex –

*Affiliation: Wilfrid Laurier University*

*Contact: amaclean@wlu.ca, [Alex MacLean | LinkedIn](#)*

*Keywords: vadose, headwater, basin, runoff, snowmelt, rainfall, water-table, precipitation, technology, equipment, instruments*

This research investigates the importance of the vadose zone in a small headwater basin (Harp 4-21) in the Canadian shield with respect to the generation of stream runoff quantity and quality during episodic rainfall and snowmelt events. The study focused specifically on: firstly the effect of variable antecedent moisture conditions on water-table and stream response, secondly, the significance of the stored vadose water in water extracted from a rising water-table, and thirdly the significance of preferential flowpathways in the vadose zone as a means of rapidly rotating, stored vadose water to the stream during runoff events...Results obtained from the near-stream and lower slope reaches of the hillslope transect indicated that soil water content in the vadose zone is maintained at a high level of saturation by shallow water-table depths. Further analysis of simultaneously measured soil water content and depth to water—table data clearly showed that the existence of a thick essentially saturated zone overlying the water table (capillary fringe) was responsible for the large and rapid water-table responses observed during many of the nine studied precipitation events. On a basin scale, the seasonal variability of the area in which the capillary fringe extended to the ground surface was largely responsible for the observed trend in basin yield (runoff volume/ rainfall volume) for the nine runoff events...The rapid routing of stored near-stream capillary fringe vadose water through preferential pathways (macropores, soil pipes) was a significant source of runoff to the stream during runoff events.

## 11.3 Mai, Julie –

*Affiliation: Helmholtz Centre for Environmental Research*

*Contact: juliane.mai@uwaterloo.ca, [Juliane Mai | LinkedIn](#)*

*Keywords: mathematical, computation, model, hydrologic, analysis, processing*

In my research, I use my mathematical background to contribute to improvements in computational models to better understand environmental issues, with specific focus on hydrologic and land-surface models applied across scales. I have made contributions in the field of model calibration, sensitivity analysis, and uncertainty analysis which are methods



assisting model development and application. I am also interested in improving the realism of the processes implemented in these models through the development of novel models and modeling guided by data-driven models. My vision is to make data available to everyone. Therefore, I focus on creating tools that facilitate the distribution of data through end-user focused portals. I created the data dissemination platforms.

## 11.4 Mastej, Elzbieta –

*Affiliation: Wilfrid Laurier University*

*Contact: [emastej@uoguelph.ca](mailto:emastej@uoguelph.ca)*

*Keywords: climate, warming, discontinuous, permafrost, thaw, anthropogenic, peatland, regeneration, snowpack, ground-freezing*

Northwestern Canada is one of the most rapidly warming regions on Earth. The southern limit of the discontinuous permafrost zone is highly sensitive to small climatic fluctuations and presently experiencing a rapid landscape change due to accelerated permafrost thaw, which is further exacerbated by anthropogenic disturbances such as seismic exploration. Recent research has begun to examine both natural and mechanical approaches to minimize permafrost loss, although the utility of such methods in peatland environments is not well understood. This study explored the efficiency of natural and artificial ground cooling processes in a peatland environment by evaluating snow exclusion and thermosyphon methods. Ground-freezing devices have been used at the Scotty Creek Research Station in the Northwest Territories, Canada, since 2013 for experimental studies on permafrost stabilization and regeneration...We are proposing that systematic monitoring of snowpack development and decay can be used as a proxy for ground thermal profile evaluation. This study supports the feasibility of low cost, readily deployable ground freezing systems that can mitigate permafrost thaw and improve the adaptability of engineering designs to changing environmental conditions.

## 11.5 Mathieu, Elyse –

*Affiliation: Wilfrid Laurier University*

*Contact: [elyse.mathieu@canada.ca](mailto:elyse.mathieu@canada.ca), 825-510-1210, [Elyse Mathieu | LinkedIn](#)*

*Keywords: warming, climate, permafrost, thaw, wildfire, snow water equivalent (SWE), talik, burn, peat, snowmelt, storage, energy*

During the past century, the highest rates of warming have occurred at latitudes above 60°N, where air temperatures have risen at twice the rate of other regions. In northwestern Canada, this warming has coincided with an increase in the frequency, size and severity of wildfires. The influence of such fires on the trajectory of on-going permafrost thaw is not well understood. As a consequence, the combined impacts of climate warming induced permafrost thaw and possible feedbacks arising from wildfires cannot be properly assessed. This study examines the impact of a 2.7 ha low-severity wildfire (July 2014) on water and energy flow processes that affect the timing and magnitude of ground thaw, including seasonal ground thaw, talik development and permafrost thaw. By comparing the end-of-winter snow water equivalent (SWE), rate of snowmelt and surface energy balance one year post-fire (2015) on an adjacent burned and unburned portions of a forested permafrost peat plateau as well as ground thaw and soil moisture three years post-fire (2015-2017).

This study showed that a fire can change the amount of snow accumulation, the rate of its melt and disappearance, and the rate and pattern of ground thaw, which collectively alter key water flow and storage processes throughout the burned area.

## 11.6 McManus, Allison –

*Affiliation: Wilfrid Laurier University*

*Contact: [Allison McManus | LinkedIn](#)*

*Keywords: boreal, warming, climate, species, eriophyoid, shrubs, physiology, morphology, energy, permafrost, thaw, active layer*

Canada's northern boreal forest has faced significant climate warming over the past century. This change can have direct and indirect effects on forest dynamics, including altering the disturbance patterns of herbivores and changing the abundance of natural enemies. Warmer air temperatures can impact the distribution and survival of arthropods, both novel species and resident natural enemies. Gall-inducing mites are a resident natural enemy in high latitude forests and have been shown to drive dramatic reductions in gas-exchange rates in infested plants. Physiological reductions in plants can directly affect the shrub energy balance and underlying soil processes. This can have major implications in permafrost-dominated environments.

This study examines the potential impacts of a gall-inducing Eriophyoid mite, *Vasates oldfieldi*, on *Betula* shrub energy inputs to the ground surface. This study will 1) quantify how shrubs are physiologically and morphologically responding to galling herbivory; 2) determine if galling on shrubs influences the shrub-soil energy balance; and 3) quantify the implications of this for active layer thickness, and consequently the potential for this biotic process to impact localized permafrost thaw...

The results from both seasons indicate a compensatory response in the galled shrubs resulting in increased stomatal conductance, altering available soil moisture below galled shrubs, and changes in aboveground canopy structure, resulting in decreased amounts of incident solar radiation below the infested shrub, cooling the soil surface. As a result, there is a decrease in active layer thickness under galled shrubs.

## 11.7 McPhee, Michael –

*Affiliation: Wilfrid Laurier University*

*Contact: [mcph4170@mylaurier.ca](mailto:mcph4170@mylaurier.ca)*

*Keywords: permafrost, thaw, remote sensing, traditional knowledge, mass wasting*

Michael's research contributes to the Dehcho Collaborative on Permafrost (DCoP). He works closely with the Dehcho First Nations to determine the best possible permafrost thaw adaptation and mitigation strategies based on the Dene language (Dene Zhatie) and traditional knowledge. He is also working with other DCoP community-based investigators toward the development of a research framework rooted in Dene values and traditional livelihoods. As part of this initiative, he is also co-developing with DFN partners, a regional podcast which aims to provide a forum for dialogue on climate change knowledge and adaptation, and to connect local communities with larger audiences.

## 11.8 Meyer, Joshua –

*Affiliation: Wilfrid Laurier University*

*Contact: [meye4880@mylaurier.ca](mailto:meye4880@mylaurier.ca)*

*Keywords: peatland, thermos-physical, hydrology, bog, wetland, wildfire*

Joshua examined the impact of fire on the hydraulic and thermo-physical properties of peat. He used a combination of field measurements at Scotty Creek and laboratory analyses at the University of Waterloo. Joshua worked as an intern student at the Ł'íidlı́ Kúé First Nation in Fort Simpson for the summer (2023) term where he developed his project in close collaboration with LKFN community members.

## 12.0 N

### 12.1 Nolan, Lauren –

*Affiliation: University of Victoria*

*Contact: [Lauren Nolan | LinkedIn](#)*

*Keywords: coding, archive, technology, data*

Lauren Nolan is the Coder for the Dehcho Collaborative on Permafrost (DCoP) and she is based in Yellowknife. She also took on a leadership position in the development and organisation of the on-line data archive for the Scotty Creek Research Station. She developed code so that the archive can be queried efficiently and works with researchers and community members to customise the data archive to meet their diverse data needs.

## 13.0 O

### 13.1 Olefeldt, David –

*Affiliation: University of Alberta*

*Contact: [olefeldt@ualberta.ca](mailto:olefeldt@ualberta.ca), 780-248-1814, [David Olefeldt | LinkedIn](#)*

*Keywords: waterborne, organic carbon, peatland, permafrost, thaw, hydrology, catchment*

Both quantity and composition of waterborne transport of dissolved organic carbon (DOC) from peatlands has been hypothesized to be affected by permafrost thaw. Changes in DOC can impact the carbon (C) balance of peatlands directly, but also the carbon balances and metabolism of downstream aquatic environments. In this study I have investigated the DOC export from different peatland types in the Stordalen catchment of northern Sweden (68.20N, 19.03E). The research was performed at various spatial and temporal scales in order to assess the importance of peatland permafrost thaw for both peatland and catchment DOC export. In the Stordalen catchment, peatland permafrost thaw leads to the conversion of palsas (a rain-fed peatland type with a permafrost core) into bogs dominated by Sphagnum mosses or into fens of varying nutrient status depending on their hydrological setting. The palsas were found to have low DOC export rates, at between 2.5 and 3.5 g C m<sup>-2</sup> yr<sup>-1</sup>, and its composition characterized by several bulk DOC indices was of poor substrate quality for microbial degradation. The DOC export from the bogs was not found to differ in quantity to that of the palsas, but its DOC composition had lower aromaticity

and a larger fraction derived from microbial sources. Snowmelt runoff occurred early on the palsa and bog, and mass flux at this time of years was responsible for >70% of the annual DOC export – causing the palsas and bogs to significantly affect catchment DOC export patterns during early snowmelt runoff, despite covering.

## 14.0 P

### 14.1 Persaud, Bhaleka –

*Affiliation: Wilfrid Laurier University*

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*Keywords: climate, species, warming, permafrost, thaw, precipitation, ecosystem, remote sensing, lake, energy*

Climate change is putting many of the Northwest Territories (NWT) ecosystems, its people and animal populations at risk due to accelerated warming, permafrost thaw, and changing precipitation regimes. As the NWT continues to warm, at disproportionately higher rates when compared to the rest of Canada, threats to the stability of NWT's ecosystems are expected to increase...Hence, the overarching goal of this research is to enhance and improve the understanding of historical surface climate variables trends and patterns (air temperature, precipitation, and shortwave radiation) and its implications at local and regional scales in the continental NWT by using interpolated, reanalysis and remote sensing climate data.

Long-term changes in SSR in the NWT will have an impact on the seasonal and annual energy balance of the region's lakes. The impact of SSR changes on lake energy balances will have a wide range of consequences, particularly for NWT communities that rely on lakes for their transportation networks. These networks are already being adversely impacted by climate change-driven alterations in warming lake ice phenology.

Improved understanding of how local and regional climate has changed in the NWT will inform policymakers in their efforts to develop and improve climate adaptation and mitigation policies in local communities across the territory.

## 14.2 Pietroniro, Al –

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*Keywords: soil moisture, precipitation, runoff, remote sensing, model, hydrology*

Soil moisture status prior to a rainfall event has been recognised as an important component in watershed runoff generation. It is well understood that, when a soil is wet, direct runoff from a particular rainfall event will be greater than when the soil is dry. Soil moisture estimates are an intermediary step between the rainfall and runoff processes and are only used as a means of establishing a rainfall runoff relationship. This implies that any errors in rainfall-runoff modelling process are in fact disguised and adjusted for in the soil moisture accounting. Remote sensing provides a unique tool because discrimination of soil moisture patterns can be estimated in both time and space and can provide a unique time series of soil moisture changes (Engman 1990). Recent research into active microwave remote sensing has demonstrated the feasibility of obtaining spatial and temporal soil moisture maps...Preliminary techniques for the identification of various soil moisture levels on a field-by-field basis throughout the basin are presented. A similar experiment was conducted in the fall of 1991 and in this case, C-band nadir data were acquired before a rainfall event in order to attempt to determine antecedent conditions for input into a distributed hydrologic model. The results of statistical models were applied to bare fields throughout the region to generate soil moisture distribution maps. The feasibility of deriving basin wide soil moisture maps and the possibility of using such maps for modelling hydrologic events and for estimating soil antecedent conditions for flood forecasting are discussed.

## 14.3 Prowse, Terry –

*Affiliation: Environment and Climate Change Canada*

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*Keywords: lake, winter, radiation, oxygen depletion, model*

The composition, timing and duration of winter lake cover are shown to produce significant spatial and temporal variations in the radiation received at the surface of the water column, and are linked to the timing and rate of oxygen depletion of a temperate lake. In particular, the first snowfall to accumulate on the ice cover reduces radiation input to nearly zero and coincides with the initiation of the linear phase of oxygen depletion. Ablation of the

snow cover in spring results in increased radiation receipts and oxygen levels. A simple model shows that the conversion of snow to white ice, which normally occurs during the midwinter period, increases radiation receipts and oxygen levels. Manipulation of the cover by artificially induced slushing is suggested as a management technique in the control of winter oxygen deficits.

## 15.0 Q

### 15.1 Quinton, William –

*Affiliation: Wilfrid Laurier University*

*Contact: wquinton@wlu.ca, 519.884.0710 ext. 3281, [William Quinton | LinkedIn](#)*

*Keywords: runoff, hummock, hillslope, hydrology, active layer, water table, discharge, flow, peatland, chemical. storage*

Runoff processes at three hummock-covered hillslopes within a 95 ha catchment (Siksik Creek) in the tundra region of the Canadian western Arctic were studied for three years (1992-1994). Measurements over the study included all hydrological inputs, monitoring of active layer and water table depths, chemical tracer-based measurements of subsurface flow velocities, continuous and spot measurements of surface and subsurface discharges, detailed mapping of the hummock distribution and soil types, and continuous gauging of the main stream channel. Tundra is a heterogeneous medium in both horizontal (due to the presence of periglacial features such as mineral earth hummocks) and vertical (due to abrupt changes in hydraulic conductivity with depth) directions...the presence of mineral earth hummocks on hillslopes increases the tortuosity of flowpaths in the IHZ, and as a result the residence time of runoff on hillslope is increased...also reduce the volume of runoff reaching the streambank during a runoff event, as a small amount of runoff in the IBZ flows into the hummocks. The presence of hummocks also enhances runoff from hillslopes by displacing the saturated layer of the interhummock zone upward where the hydraulic conductivity can be orders of magnitude higher. The near-stream area has a large impact on hillslope runoff and streamflow because of its location in the basin (surrounding the stream channel), and its deeper peat accumulation (and therefore greater water storage capacity)...the duration of the spring runoff period (high flow rates), and the nature of its adjustment to the summer regime (low flow rates) varies among the hillslopes.



## 16.0 R

### 16.1 Rezanezhad, Fereidoun –

*Affiliation: University of Waterloo*

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*Keywords: hydrology, peat, porosity, computation, conductivity, moisture*

The hydraulic conductivity of unsaturated peat soil is controlled by the air-filled porosity, pore size and geometric distribution as well as other physical properties of peat materials. This study investigates how the size and shape of pores affects the flow of water through peat soils. In this study we used X-ray Computed Tomography (CT), at 45 $\mu$ m resolution under 5 specific soil-water pressure head levels to provide 3-D, high-resolution images that were used to detect the inner pore structure of peat samples under a changing water regime...We quantify the pore structure of peat soil that affects the hydraulic conductivity in the unsaturated condition, and demonstrate the validity of our estimation of peat unsaturated hydraulic conductivity by making a comparison with a standard permeameter-based method. Estimates of unsaturated hydraulic conductivities were made for the purpose of testing the sensitivity of pore shape and geometry parameters on the hydraulic properties of peats and how to evaluate the structure of the peat and its affects on parameterization. We also studied the ability to quantify these factors for different soil moisture contents in order to define how the factors controlling the shape coefficient vary with changes in soil water pressure head. The relation between measured and estimated unsaturated hydraulic conductivity at various heads shows that rapid initial drainage, that changes the air-filled pore properties, creates a sharp decline in hydraulic conductivity. This is because the large pores readily lose water, the peat rapidly becomes less conductive and the flow path among pores, more tortuous.

## 17.0 S

### 17.1 Schincariol, Robert –

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*Keywords: fluid, perturbation, wavelength, remote sensing, plume, instability*

Interfacial or fingering instabilities have been studied recently in relation to contamination problems where a more dense plume is enclosed by and is moving along in a body of less dense fluid. Instabilities can play an important role in the mixing or dispersion process. Through the use of a variable density flow and transport code, we were able to study how the style of interfacial perturbation controls the pattern of instability development. Whether initial perturbations grow or decay depends mainly on the wavelength of the perturbing function. A critical perturbation wavelength must be exceeded for a perturbation to grow; otherwise the perturbation simply decays. Our work confirms earlier analyses that suggest that all stratified systems are inherently unstable, given some spectrum of the perturbing waves that exceed the critical wavelength. By implication, Rayleigh number stability criteria are inappropriate for evaluating the dense plume problem. Our study also demonstrates how numerical errors in a mass transport code can serve as a perturbing function and lead to the development of instabilities. However, these instabilities are not physically realistic and are essentially uncontrollable because their character depends on the extent to which numerical errors develop, as evidenced by the grid Peclet and Courant numbers.

### 17.2 Sioui, Miguel –

*Affiliation: Wilfrid Laurier University*

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*Keywords: traditional knowledge, mayan, spiritual, Indigenous, geography, responsibility-based thinking, culture, policy*

For millennia Indigenous peoples throughout the Americas have had spiritual relationships with their lands and the beings on them...My doctoral research describes the land ethos of the residents of the Mayan community of Xuilub (Yucatan), Mexico, and explains how it is understood and put into practice by its members. This project, informed by

postcolonial theory, Indigenous geographies, and Indigenous knowledges (IKs) research, is part of a broader attempt to decolonize colonial histories and understandings about Indigenous peoples and their relationships with their territories. Through experiential learning and interviews over five trips to the area from 2014-2016, I have come to understand the Mayan land ethos as being part of the land. I argue that this land ethos is guided by the cultural precept of 'responsibility-based thinking.' This ethos reflects a non-hierarchical view of the place of humans within a larger society (or Circle) of all beings on the land, and speaks to the importance of ceremony, offerings, and reciprocal relationships. Furthermore, this worldview is not static, but is well suited to integrating new knowledges and innovations and adapting to changing social and environmental conditions, and is strongly connected to cultural identity and place...This dissertation contributes to broader scholarly efforts to achieve deeper understandings of IKs, from a more Indigenous-centred research approach (and research questions), with the ultimate goal of expanding the disciplinary perspectives of postcolonial scholarship and Indigenous geographies. Such a responsibility-based mindset has the potential to enhance current mainstream (rights-based) environmental policy frameworks.

### 17.3 Stone, Lindsay –

*Affiliation: Wilfrid Laurier University*

*Contact:*

*Keywords: permafrost, degradation, discontinuous, wetland, bog, fen, discharge, storage, precipitation, basin*

Permafrost degradation in the peat-rich southern fringe of the discontinuous permafrost zone is producing substantial changes to land cover with concomitant expansion of permafrost-free wetlands (bogs and fens) and shrinkage of forest supported by permafrost peat plateaus. Predicting discharge from headwater basins in this region depends on understanding and numerically representing the interactions between storage and discharge within and between the major land cover types, and how these interactions are changing. To better understand the implications of land cover change on wetland discharge, the hydrological behaviour of a channel fen in the headwaters of Scotty Creek, Northwest Territories, Canada, dominated by peat plateau-bog complexes, was modelled using the Cold Regions Hydrological Modelling platform for the period of 2009 to 2015...Reductions in permafrost extent decreased total annual discharge from the channel fen by 2.5% on average for every 10% permafrost loss, due to increased surface storage capacity, reduced

runoff efficiency and increased landscape ET. Runoff ratios for the fen hydrological response unit dropped from 0.54 to 0.48 after the simulated 50% permafrost area loss, with a substantial reduction from 0.47 to 0.31 during the snowmelt season. The reduction in peat plateau area also resulted in decreased intra-annual variability in discharge, with higher low-flows and small increases in subsurface discharge, and decreased peak discharge with large reductions in surface runoff. The current trend of increasing discharge observed in the Scotty Creek basin may not be permanent, as this model shows that a completely connected sub-basin results in decreasing channel fen discharge with further land cover change.

## 17.4 Smart, Jessica –

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*Keywords: anadromous, char, knowledge, salmon, temperature, climate, lake, ice, fishing*

This thesis documents and examines recent changes observed in anadromous Arctic char (*Iqalukpik*) (*Salvelinus alpinus*) in Ulukhaktok, Northwest Territories, Canada, including how these changes are being experienced and responded to by community members. Ulukhaktomiut identified a need to document their knowledge and observations of Arctic char to help inform comanagement. The analysis of 20 semi-structured interviews with Ulukhaktomiut revealed six main concerns about Arctic char linked to changes arising in the local environment: (1) presence of salmon, (2) increasing temperature, (3) inconsistent sea and lake ice conditions, (4) changing weather patterns, (5) fluctuating water levels, and (6) the recent presence of tunicates in the ocean. Ulukhaktomiut respond to these changes at the individual and community levels, including altering fishing practices and temporarily halting commercial fishing. The results show that Ulukhaktomiut are astute observers of their local environment and are able to share highly detailed knowledge and observations of Arctic char. Environmental changes are emerging quickly, and there is a great deal of uncertainty among Ulukhaktomiut about why these changes are occurring and what impact they may have on Arctic char. Fisheries management structures will need to be flexible and responsive to ongoing local observations and the best available science to sustain a viable Arctic char fishery now and into the future.

## 17.5 Sonnentag, Oliver –

*Affiliation: University of Montreal*

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*Keywords: boreal, peatland, code, fen, energy, carbon, remote sensing, shrub, model, hydrology, topography, wetland, ecosystem*

In this research, a recent version of the Boreal Ecosystem Productivity Simulator (BEPS), called BEPS-TerrainLab, was adapted to northern peatlands and evaluated using observations made at the Mer Bleue bog located near Ottawa, Ontario, and the Sandhill fen located near Prince Albert, Saskatchewan. The code was extended and modified with a major focus on the adequate representation of northern peatlands' multi-layer canopy and the associated processes related to energy, water vapour and carbon dioxide fluxes through remotely-sensed leaf area index (LAI) maps. An important prerequisite for the successful mapping of LAI based on remote sensing imagery is the accurate measurement of LAI in the field with a standard technique such as the LAI-2000 plant canopy analyzer. As part of this research, a quick and reliable method to determine shrub LAI with the LAI-2000 instrument was developed... This research suggests that future peatland ecosystem modelling efforts at regional and continental scales should include a peatland type-specific differentiation of macro- and mesoscale topographic effects on hydrology, to allow for a more realistic simulation of peatlands' soil water balance. This is an important prerequisite for the reduction of currently existing uncertainties in wetlands' contribution to North America's carbon dioxide and methane annual fluxes from an ecosystem modelling perspective.

## 17.6 Soulis, Ric –

*Affiliation: University of Waterloo*

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*Dr. Ric Soulis (1949-2018), a professor of engineering at the University of Waterloo, was a long time collaborator of the Scotty Creek Research Group. Always available to discuss ideas both hydrological and philosophical, Ric is sorely missed.*

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*Keywords: radar, remote sensing, model, ice pack, balance, probabilistics*

Use of radar imagery for the real-time modelling of ice motion is limited by the lack of methods for the efficient automatic processing of the imagery. Normally an image must be segmented into detailed ice types to provide the ice properties required for motion modelling.

This is particularly important for the calculation of ice strength. This requires significant effort and involves the processing of large quantities of data. Also, motion models do not exploit the information about ice pack geometry that is obtainable from an image.

A momentum balance ice motion model is extended to use local estimates of the air drag coefficient rather than the commonly used regional value. The local mode of the direction of the floe edges in the vicinity of a nodal point is used to detect the predominant direction of ice pack roughness relative to wind direction. This information is used to adjust the regional drag coefficient to a local value.

The procedures are compared using X-band SLAR imagery of the southern Beaufort Sea taken during March 1983. A finite element implementation of the momentum balance equation is used to estimate motion over a four-day period. Model displacements produced using ice concentrations estimated by the power law method compare favourably with displacements estimated using standard probabilistics methods. Displacement errors are reduced considerably when local air drag coefficients are used.

## 18.0 T

### 18.1 Tank, Suzanna –

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*Keywords: Mackenzie Delta, lakes, dissolved organic carbon, bacteria, carbon cycling, food web structure, carbon dioxide*

Dissolved organic carbon (DOC) is a key regulator of aquatic ecosystems, and the primary substrate for aquatic bacteria...This study assessed how variations in DOC source regulate the composition of the within-lake pool, drive bacterial metabolism and the contribution of bacterial biomass to higher trophic levels, and affect CO<sub>2</sub> flux from Delta lakes. DOC-specific tracers showed macrophyte-derived DOC to comprise less than 15% of the DOC pool in macrophyte-rich lakes, despite macrophyte C levels 7-12-fold greater than total DOC...Accordingly,  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ , and fatty acid biomarkers demonstrated that zooplankton from macrophyte-rich lakes receive a greater proportion of their biomass from bacterial organic matter than zooplankton from other lake types. At the same time, however, experiments indicated that the high pH resulting from rapid photosynthesis in macrophyte-rich lakes can decrease the rate of bacterial metabolism over the short-term,

and increase CO<sub>2</sub> respiration at the expense of bacterial biomass production. In contrast, DOC-specific tracers indicated that thermokarst-derived DOC accumulates in lakes. Incubation experiments and in situ surveys revealed thermokarst DOC to be a relatively poor bacterial substrate, which resulted in proportionately more CO<sub>2</sub> respiration...Moreover, multi-year surveys demonstrated that thermokarst lakes exhibit high levels of CO<sub>2</sub> emission, despite clear undersaturation in other lakes, presumably because permafrost-derived DOC was largely respired by bacteria. Understanding the divergent roles played by the contrasting sources of DOC to Delta lakes both adds insight to the functioning of other lake regions, globally, and helps clarify the effect of climate-induced changes in DOC on northern lakes.

## 18.2 Thomson, Iain –

*Affiliation: Wilfrid Laurier University*

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*Keywords: permafrost, thaw, seismic, hydrology, geophysical, thermal, model, mass*

Iain's research examined the rates and patterns of permafrost thaw below seismic lines, and the impacts of such thaw on the hydrological interaction between seismic lines and the surrounding landscape. He used a combination of archived geophysical, thermal and hydrological data along an intensively studied seismic line, as well as modelling approaches to simulate coupled thermal and mass transfer into and along the line.

## 19.0 V

### 19.1 VanOpstal, Stacey –

*Affiliation: Wilfrid Laurier University*

*Contact: [Stacey Van Opstal | LinkedIn](#)*

*Keywords: black spruce, root, energy, active layer, thaw, permafrost, degradation*

Stacey's research examined the role of black spruce root networks in the redistribution of energy into and from the active layer, and the relative importance of the root network and the soil matrix in providing energy into the ground to thaw the active layer and degrade the underlying permafrost. She now works with the City of Hamilton, in Hamilton, Ontario.

## 19.2 Veness, Tyler –

*Affiliation: Wilfrid Laurier University*

*Contact: [Ty Veness | LinkedIn](#)*

*Keywords: canopy, shrub, active layer, thaw, permafrost, seasonal*

At Scotty Creek, Tyler studied the influence of tree-canopy, shrub-canopy and ground surface properties on the rate and spatial pattern of seasonal active-layer thaw. His work helped to improve our understanding of and ability to predict areas of preferential permafrost thaw. Tyler is now a Senior Planning and Program Advisor with Alberta Environment.

## 20.0 W

### 20.1 Williams, Tyler –

*Affiliation: Wilfrid Laurier University*

*Contact: [Tyler Williams | LinkedIn](#)*

*Keywords: discontinuous, permafrost, thaw, seismic, hydrology, ecology, thermal, peatlands, corridor, model, active layer, subsidence, moisture, wetland, talik*

Within the zone of discontinuous permafrost, existing linear disturbances such as winter roads and seismic lines created corridors which altered the hydrology, ecology, and ground thermal regime of peatlands...In a peatland environment 50 km south of Fort Simpson, NWT, we studied these disturbances using a combination of ground thermal modeling and field measurements, which included analysis of active layer development, permafrost thaw, ground surface subsidence, and changes in hydrology. Field and modeling results suggest a strong relationship between the ground surface soil moisture and permafrost thaw, where increases in soil moisture following disturbance are the likely cause of deepening active layers and talik development. Permafrost thaw induces ground surface subsidence, which feedbacks positively to thaw by further increasing the soil moisture and thus the thermal conductivity near the ground surface. Abandoned winter roads and cutlines do not appear to be regenerating permafrost, and in many cases have altered the land cover type to resemble that of a bog or fen. Subsidence alters the topography of the plateau, developing a fill and spill regime that allows disturbances to be hydrologically connected with adjacent wetlands along saturated surface flow paths during periods of high water availability. The degree of initial disturbance is an important control on the extent of



permafrost thaw and thus the overall recovery of the linear disturbance. Low impact techniques that reduce damage to the ground surface and maintain original surface topography are required in order to minimize the impact of these linear disturbances.

## 20.2 Wright, Nicole –

*Affiliation: Simon Fraser University*

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*Keywords: hillslope hydrology, subsurface runoff, water balance, frost table, ground heat flux, surface energy balance, radiation budget, permafrost, organic soils*

Water and energy fluxes from a treed peat plateau in a wetland-dominated discontinuous permafrost basin near Fort Simpson, NWT, Canada, were examined to determine the factors controlling runoff generation from peat-covered permafrost slopes....runoff accounted for approximately half of the moisture loss from the peat plateau, most of which occurred in response to snowmelt inputs...The timing and magnitude of runoff was found to be dependant on the amount of water input, antecedent moisture conditions, the saturated hydraulic conductivity of the soil, and frost-table depth. The distribution of frost-table depths on the peat plateau was examined over four consecutive years (2003-2006) at a variety of spatial scales...Frost-table depths were highly variable over relatively short distances (0.25-1 m), and the spatial variability was strongly correlated to soil moisture distribution, which was partly influenced by lateral flow converging to frost-table depressions. On an inter-annual basis, thaw rates were temporally correlated to air temperature and the amount of precipitation input. Simple simulations show that lateral subsurface flow is governed by the frost-table topography having spatially variable storage that has to be filled before water can spill over to generate flow downslope...The plateau tree canopy reduced the amount of energy available for ground thaw by 14% in summer, when compared to the tree-less wetland. The ground heat flux (' $Q_g$ ') was 54% greater than at the bog, largely because the plateau had a much steeper soil temperature gradient than the bog, and the bog released a large fraction of ' $Q^*$ ' as latent heat of evaporation (' $Q_e$ ').

## 20.3 Wright, Stephanie –

*Affiliation: Queen's University*

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*Keywords: climate, wildfire, discontinuous, thaw, permafrost, hydrology, Taiga Plains, thermokarst, wetland, basin, precipitation, connectivity, carbon, groundwater, peatland*

Rising air temperatures, intensifying wildfire activity, and human disturbance are driving rapid permafrost thaw across the subarctic, particularly for thaw-sensitive discontinuous permafrost. The Taiga Plains and Taiga Shield ecozones of northwestern Canada have experienced rapid and widespread permafrost thaw over recent decades, creating significant community concerns and knowledge gaps. In direct response, this review: (1) outlines the observed thaw-induced changes in landcover, hydrology, and water quality; (2) discusses the underlying drivers and mechanisms of these changes; and (3) identifies knowledge gaps to guide future research in the discontinuous permafrost zone of the Taiga Plains and Shield (study region). In the Taiga Plains, permafrost is mainly associated with peatlands where its thaw increases the extent of thermokarst wetlands at the expense of treed peatlands underlain by permafrost. This thaw-induced landcover change enhances the hydrologic connectivity of the landscape, which increases basin-scale runoff and annual streamflow, and enables wetland drainage such that permafrost-free treed wetlands develop...Permafrost thaw also increases the connectivity between surface water and groundwater, leading to increasing winter baseflows and possibly icing (aufeis) development...The thawing of peatlands will likely increase the transport and concentrations of dissolved organic carbon and metals bound to organic compounds, including methylmercury...The greatest knowledge gaps across the study region surround the evolution of thaw-activated groundwater flow systems and the consequences for wetland biogeochemistry, the rates and patterns of permafrost thaw, contaminant transport, and streamflow of larger river systems. This synthesis...informs future research directions in the study region but extends to similar subarctic peatland and Shield environments common throughout the circumpolar north.