2016 Ottawa-Carleton Student Northern Research Symposium Program

Hosted by the University of Ottawa

February 25, 2016
Time: 8:30 – 4:30
Desmarais Building, Room 12102

uOttawa

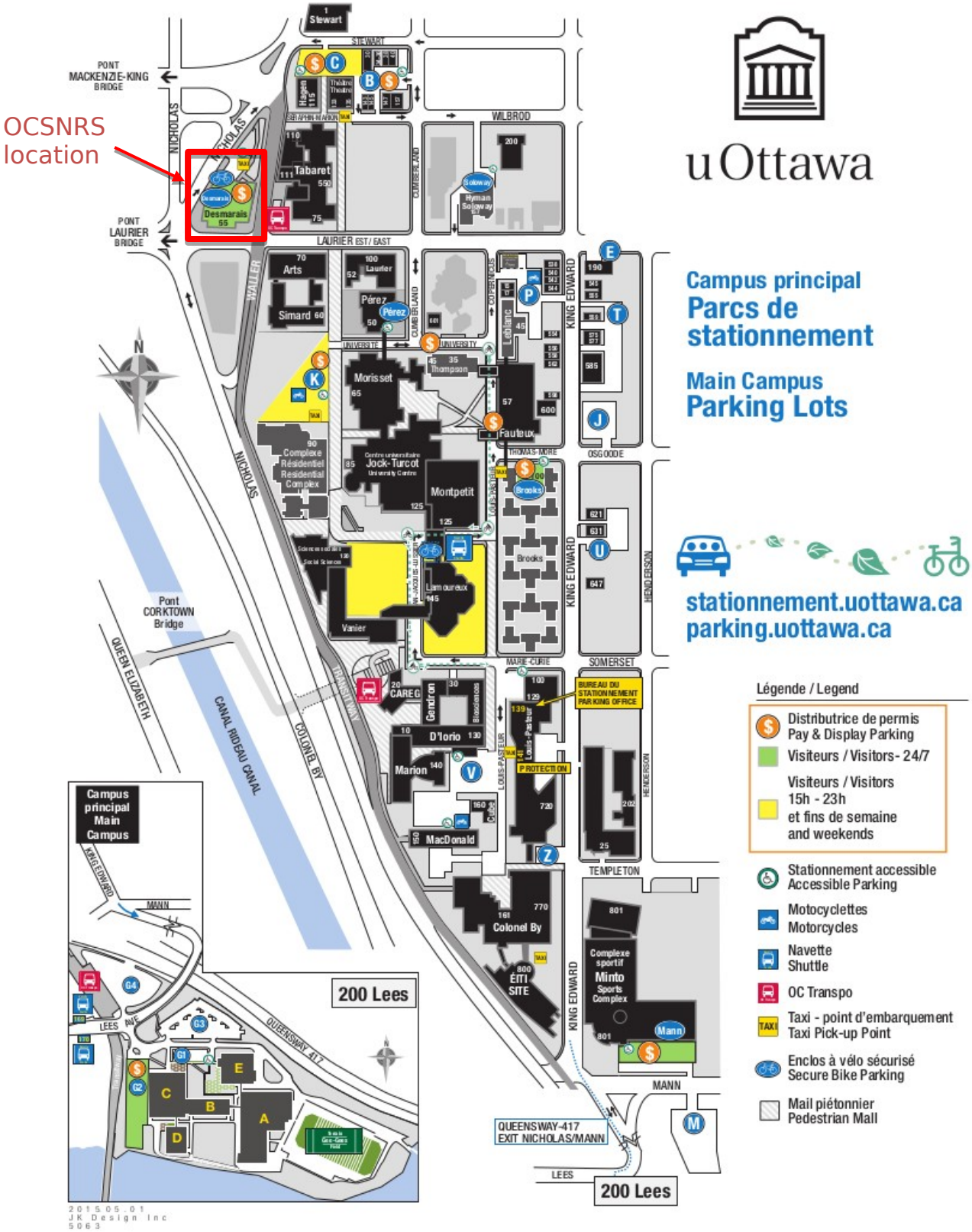
Each year, undergraduate and graduate students from Carleton University and the University of Ottawa participate in high-quality northern research studies, both in the natural and social sciences. As a platform to showcase our excellence and common interests, the University of Ottawa is please to host the 2016 Ottawa-Carleton Northern Research Symposium (OCSNRS).

Thursday, February 25th, 2016
Time: 8:30 – 4:30
Desmarais Building, Room 12102

RSVP is required.
Further details are available at: http://carleton.ca/northernresearch/ocsnrs/2016-ocsnrs/

The organizers would like to thank the Faculty of Arts, the Department of Geography, Environment and Geomatics, and the Geography Graduate Student Association at the University of Ottawa for providing financial support for the Symposium, Dr. Luke Copland for organizational support and aiding with communications at the University of Ottawa, and Dr. Derek Mueller and Zoe Panchen for website support and aiding with communications at Carleton University. We thank Dr. Alison Cook (Durham University) for providing our keynote address. Finally, we would like to thank Wesley Van Wychen (University of Ottawa), Julia Riddick (Carleton University), and Kathryn Lupton (University of Ottawa) for chairing sessions.

2016 Symposium Coordinators:
Jenna Joyce (MA Candidate, Dept. of Geography, University of Ottawa)
Email: jjoyc039@uottawa.ca
Annika Ogilvie (MSc Candidate, Dept. of Geography, University of Ottawa)
Email: aogil101@uottawa.ca
Catherine Glass (MA Candidate, School of Human Kinetics, University of Ottawa)
Email: cglas007@uottawa.ca


OCSNRS location
uOttawa
Campus principal
Parcs de stationnement
Main Campus
Parking Lots
stationnement.uottawa.ca
parking.uottawa.ca
Légende / Legend
Distributrice de permis
Pay & Display Parking
Visiteurs / Visitors- 24/7
Visiteurs / Visitors
15h - 23h
et fins de semaine
and weekends
Stationnement accessible
Accessible Parking
Motocyclettes
Motorcycles
Navette
Shuttle
OC Transpo
Taxi - point d'embarquement
Taxi Pick-up Point
Enclos à vélo sécurisé
Secure Bike Parking
Mail piétonnier
Pedestrian Mall
PONT MACKENZIE-KING BRIDGE
PONT LAURIER BRIDGE
NICHOLAS
WILBROD
LAURIER EST/ EAST
KING EDWARD
OSGOODE
SOMERSET
HENDERSON
TEMPLETON
MANN
Pont CORKTOWN Bridge
QUEEN ELIZABETH
CANAL RIDEAU CANAL
COLONEL BY
Campus principal Main Campus
200 Lees
QUEENSWAY 417
QUEENSWAY-417 EXIT NICHOLAS/MANN
LEES
2015 05 01
JK Design Inc
5063

2016 Ottawa-Carleton Student Northern Research Symposium Schedule

February 25, 2016 – Desmarais Building, Room 12102, University of Ottawa

8:30 – 9:15	Registration	
9:15 – 9:20	Opening remarks	
9:20 – 10:10	Keynote Address – Dr. Alison Cook	
10:10 – 10:30	***Break (Coffee, Tea and Light Snacks Provided)***	
Oral Presentations – Session 1 Chair: Wesley Van Wychen		
	Title	***Presenter***
10:30 – 10:45	The impact of Yukon's governance structure on First Nations' food security	Ainslie Cruickshank
10:45 – 11:15	Change and Economic Development in Arctic Canada: Pathways for Successful Development in Nunavut	Kathryn Lupton and Allison Holmes
11:15 – 11:30	Employment law in Nunavut: Exploring access to justice barriers in resolving workplace problems	Gloria Song
11:30 – 11:45	Une enquête sur les représentations de la Nation Crie de Wemindji quant au projet de la mine Éléonore	Mathieu Gauthier
11:45 – 12:00	Integrating Local Knowledge of Sensitive Ecologic and Socio-cultural Marine Areas in Arctic Canada	Natalie Carter
12:00 – 13:00	***Lunch Break (Light Lunch Provided)***	
Oral Presentations – Session 2 Chair: Julia Riddick		
13:00 – 13:15	Carbon-14 and Tritium as tracers of soil movement in earth hummocks: a case study from western Arctic Canada	Brittany Main
13:15 – 13:30	Glacier velocity monitoring in the Canadian Arctic: Where we were, where we are and where were going	Wesley Van Wychen
13:30 – 13:45	Marine nutrient subsidies to the terrestrial environment of common eider nesting islands in the Canadian Arctic	Nikolas Clyde
13:45 – 14:00	The blossoming of the Arctic: historic records used to predict the impact of climate change on Nunavut flowering and seed dispersal times.	Zoe Panchen
14:00 – 14:15	***Break***	
Oral Presentations – Session 3 Chair: Kathryn Lupton		
14:15 –	Alternative Energy in the Arctic: Lessons	Lawrence Keyte

14:30	learned from eight renewable energy case studies in Canada's North	
14:30 – 14:45	Repeated ERT surveys to monitor the permafrost conditions of two peatlands following wildfire, south-western Northwest Territories	Jean Holloway
14:45 – 15:00	Groundwater discharge in a permafrost watershed, Ogilvie River, Yukon Territory	Natalia Baranov
15:00 – 15:15	Vegetation cover and discontinuous mountain permafrost along elevation gradients, Yukon Territory, Canada	Zoé Kuntz
Poster Presentations – Session 4 (Coffee, Tea, Soft Drinks and Snacks Provided)		
15:15 – 16:15	Laser Scanning and Surveying of Permafrost Subsidence on Tundra and Man-made Surfaces	Christian Peart
	Quantifying fine-scale variability and heterogeneous patterns in permafrost terrain	Julia Riddick
	Multiscale Terrain Analysis for Modelling Snow Accumulation in the Apex River Watershed, Iqaluit, Nunavut	Keegan Smith
	Accelerated thinning of small alpine glaciers on Axel Heiberg Island, Canada, since 1959	Michael Hackett
	Estimating permafrost soil parameters using temperature time series data	Nick Brown
	Eyeliner Slumps: an introduction to a new periglacial feature	Taylor McWade
Photo Competition – Session 5 (Coffee, Tea, Soft Drinks and Snacks Provided)		
15:15 – 16:15	Photos submitted for the photo competition will be displayed in the conference room.	
16:15 – 16:25	Prizes will be awarded	
16:25 – 16:30	***Closing remarks***	
16:30	***Join us at Café Nostalgica for food and drink***	

Keynote Address

Ocean forcing of glacier retreat in the western Antarctic Peninsula

A. J. Cook[1,2*,] P. R. Holland[3], M. P. Meredith[3], T. Murray[1], A. Luckman[1], D. G. Vaughan[3]

1. *Department of Geography, Swansea University, Swansea, UK.*
2. *Department of Geography, Durham University, Durham, UK.*
3. *British Antarctic Survey, High Cross, Madingley Road, Cambridge, UK.*

*Correspondence to: alison.cook@durham.ac.uk

Interpreting the behaviour of the numerous glaciological features making up the Antarctic Peninsula Ice Sheet is critical for recognising responses to local and regional environmental changes. The glaciers that flow from the Antarctic Peninsula have undergone wide-scale change in recent decades. Of the 860 marine-terminating glaciers, 90% have retreated since the 1940s and mass loss has occurred through glacier thinning and acceleration, particularly following the demise of ice shelves. These changes have been widely attributed to a rapid rise in air temperatures over the latter half of the 20th century. However, distinct spatial and temporal patterns of glacier front changes have emerged that suggest that atmospheric temperature is not the primary driver of glacier mass loss throughout the whole region. I will present the distinct patterns of glacier front changes in the Antarctic Peninsula, followed by a focused look at the external controls behind these changes. For the first time a strong synchroneity between ocean temperatures and glacier front changes along the 1000 km western coastline has been identified. Glaciers discharging into the warm Circumpolar Deep Water in the south have experienced significant frontal retreat, while those terminating in cooler waters in the north

have remained stable. Furthermore, a warming at mid-ocean depths has been identified in the northern Bellingshausen Sea since the 1990s, coincident in time with widespread acceleration in glacier retreat. I will present our conclusions from these results and discuss whether these trends could be mirrored at northern high latitudes, in particular in the Canadian Arctic Archipelago.

Oral Presentations

The impact of Yukon's governance structure on First Nations' food security

Ainslie Cruickshank[1], Sonia Wesche[2], Geranda Notten[1]

[1]Graduate School of Public and International Affairs, University of Ottawa
[2]Department of Geography, Environment and Geomatics, University of Ottawa

Yukon First Nations rely on a mixed diet of traditional (wild) and store-bought food. Maintaining traditional food security requires harvesting rights and sustainable access to food sources from large areas of land. This research seeks to understand how much control Yukon's self-governing First Nations have over their traditional territories to ensure long-term, sustainable access to traditional food. Key factors include First Nations' involvement in: land use planning, assessment of proposed resource development projects, management of resource development projects, and management of fish and wildlife.

A review of academic literature and an analysis of land use planning and environmental and socio-economic assessment documents provided the foundation for participatory fieldwork. I conducted semi-structured interviews with Yukon Government officials and staff, board members from wildlife co-management bodies that

were developed following the 1990 signing of the Umbrella Final Agreement (UFA – the overarching Yukon Land Claims package), and members of Kluane First Nation (KFN) who are involved in the recently-developed local food security strategy.

Initial findings indicate that significant challenges exist in the areas of communications, transparency and interpretation between territorial governance bodies and local FirstNations. For example, differing interpretations of the UFA has resulted in management conflicts surrounding land, fish and wildlife. Perceptions vary as to whether the various governance bodies have sufficient decision-making power. Improved communication and increased transparency could improve the co-management of lands, fish and wildlife.

Change and Economic Development in Arctic Canada: Pathways for Successful Development in Nunavut

Kathryn Lupton[1], Allison Holmes[2], Jackie Dawson[2]
[1] University of Ottawa, Institute of the Environment
[2] University of Ottawa, Department of Geography

As the physical Arctic undergoes environmental change, interest in natural resource extraction, trade, transport, and tourism is rapidly increasing. This is particularly important for Inuit in Nunavut, since these investments may provide an opportunity for greater control over the decision-making processes that will shape the future of the territory. The Nunavut Act (1993) and the Nunavut Land Claims Agreement, settled in 1999, technically secure *de jure* sovereignty for Inuit; the Inuit and Land Claims Organizations, as well as the territorial government, were established to work *for* Inuit. However, the residents of some communities continue to feel that their needs and values are not being accounted for in the development process. As part of a five year project, entitled Change and Economic Development in Arctic Canada (CEDAC), this study explores the following questions: 1) what

does successful development look like to regional decision-makers, and 2) how are Nunavummiut communities implicated in these visions? Key informants from Inuit and Land Claims Organizations and the Government of Nunavut were interviewed and the data are being analyzed using a constant-comparative approach. The data will also be examined through the lens of the Nation-Building Framework, which has been refined through decades of research from the Harvard Project on American Indian Economic Development – since 1986 – and the Native Nations Institute – since 2001. A preliminary analysis suggests that, despite their differentiated roles, both governing bodies share a similar vision for the territory—a truly autonomous and sustainable Nunavut, where Inuit feel empowered to choose their own destinies. The main differences of opinion between the regional representatives lie in the question, “How do we get there?” The next stage of this project will build off of this analysis, undertaking two community case studies that will explore the role of local institutions and institutional networks in Nunavummiut community development.

Employment law in Nunavut: Exploring access to justice barriers in resolving workplace problems

Gloria Song[1], Sophie Theriault[1], Angela Cameron[1]

[1]Faculty of Law, University of Ottawa

While there has been much discussion on strategies for increasing employment opportunities for Nunavummiut, one important angle that has not yet been fully explored is whether workers in Nunavut can effectively resolve conflicts with employers within the current justice system. If a worker has an employment law claim, are they able to enforce their legal rights through the courts and tribunals?

This research paper reviews every published employment law case released from the Nunavut Court of Appeal, the Nunavut Court of Justice, and the Nunavut Human Rights Tribunal from April 1, 1999 (the creation of Nunavut) to September 30, 2015. Under this broad set of criteria, only a relatively small number of cases were found, raising the

question of why so few employment law claims have made their way through Nunavut's justice system. Less than a handful of these cases involved Inuit litigants, despite the fact that Inuit make up approximately 85% of the territory's population. A critical analysis of the employment law jurisprudence suggests there are significant barriers that may prevent the people of Nunavut from accessing justice for their employment law claims, including access to counsel. If left unaddressed, these issues may act as an obstacle to the integration and retention of Nunavummiut (especially Inuit) in the workforce. This research paper concludes that efforts must be made to improve the civil and administrative justice processes in Nunavut, and that further research should be conducted on the experiences of Nunavummiut in their attempts to access justice.

Une enquête sur les représentations de la Nation crie de Wemindji quant au projet de la mine Éléonore

Mathieu Gauthier[1]

[1]Département de développement international et mondialisation,

L'objectif spécifique de cette recherche est d'explorer la démarche de RSE, et plus spécifiquement l'implémentation de « l'accord de collaboration » qui a été élaborer entre la corporation minière canadienne Goldcorp et la Nation Crie de Wemindji situé au abords de la Baie-James. L'étudiant cherchera à savoir si l'accord Opinagow et les mesures concrètes par lesquelles il est mis en œuvre ont permis ou permettront de répondre aux attentes et besoins de la communauté locale. Pour ce faire, l'étudiant mènera une recherche ethnographique et participative où il s'intéressera aux représentations des membres de

la Nation Crie de Wemindji quant à leurs relations avec Goldcorp. Cette approche lui permettra de créer du savoir localement pertinent et d'une perspective autochtone dont le but sera de soutenir les initiatives d'auto-détermination de la Nation Crie de Wemindji et d'ailleurs dans le contexte du développement minier. L'objectif général de cette recherche est de contribuer de manière significative à la tâche critique de l'amélioration des politiques et des standards dans le secteur minier canadien. Ce projet de recherche permettra de contribuer à la littérature au sujet de la gouvernance corporative ainsi que sur la perspective autochtone dans le contexte mondialisé du développement minier.

Integrating Local Knowledge of Sensitive Ecologic and Socio-cultural Marine Areas in Arctic Canada

Natalie Ann Carter[1], Jackie Dawson[1]

[1]Department of Geography & Institute for Science, Society and Policy, University of Ottawa

Arctic waters are increasingly navigable due to climate change. Shipping corridors reduce the likelihood of marine incidents. Existing corridors do not adequately consider sensitive ecological and socio-cultural marine areas. To ensure safe Arctic shipping these knowledge gaps must be addressed. Our objectives are to: 1) create local marine use zones for integration into the northern marine transportation

corridors; and 2) explore the potential impacts of artic shipping on northern communities and ecology.

Participatory geographic information systems (PPGIS) workshops will be conducted (2 in Nunavut and 2 in North West Territories). Key informants will be purposively selected (9 Inuit and 12 non-Inuit per PPGIS) through community organization recommendations and snowball sampling. Inclusion criteria are: community residents; minimum 18 years old; men or women; actively spend time in and have current knowledge of marine areas; fluent in English.

Sensitive ecological and socio-cultural marine zones will be described. Seasonal calendars will be made using those descriptions. Using satellite images on a tabletop personal computer, participants will indicate the zones' location. A facilitator will enter the data using ArcGIS software. Shipping routes will be displayed on the maps. Potential impacts of shipping will be described and ranked. Discussions will be audio-recorded, transcribed, and thematically analyzed with a focus on maintaining the integrity of respondents' narratives. Season, region, and magnitude of impact of shipping will be analyzed. Mapping data will be analyzed using ArcGIS. Results will be validated and shared in each community. Outcomes will include maps, conference presentations, and peer-reviewed publications.

Carbon-14 and Tritium as tracers of soil movement in earth hummocks: a case study from western Arctic Canada

Main, Brittany[1], D. Lacelle[1]
[1]Department of Geography, University of Ottawa K1N 6N5

Involuted soil horizons and buried organic matter in the active layer and near-surface permafrost provide evidence that soil movement or cryoturbation is occurring within the active layer in hummocky terrain. Though there is little evidence to support timescales of hummock formation, several development theories exist, including the

Convective Cell/Equilibrium Model and/or the Sudden Collapse Model. Cryoturbation in the active layer of permafrost-affected soils could have significant implications in sequestering carbon, including trace metals and contaminants that are absorbed onto the organic matter. Trenches were dug along a transect at two well-developed hummock sites in the Mackenzie Delta near Inuvik, NWT. Active layer and permafrost samples were analyzed for distribution of organic matter and tritium (3H), and carbon-14 (14C). Pending results aim to provide evidence relating to the Convective Cell/Equilibrium Model and/or the Sudden Collapse Model.

Glacier velocity monitoring in the Canadian Arctic: Where we were, where we are and where were going

Wesley Van Wychen[1,2], Luke Copland[1], David Burgess[2,1] and Laurence Gray[1]

[1] Department of Geography, University of Ottawa, Ottawa, Ontario, Canada
[2] Natural Resources Canada, Geological Survey of Canada, Ottawa, Ontario, Canada

Recent studies have placed an emphasis on determining glacier dynamics across the High Canadian Arctic, with the goal of improving the understanding of regional glacier velocity patterns and quantify rates of mass loss via calving (iceberg production). This presentation will provide a broad overview of previous studies that have utilized remote sensing imagery to derive glacier velocities or infer previous dynamic behavior in the Canadian Arctic and describe how the ability to resolve glacier dynamics from RADAR imagery has evolved into a quasi-operational program in recent years (post-2010). This presentation will conclude by describing how the launch of new remote sensing platforms (e.g. Sentinel 1a, Landsat-8) will provide further datasets that can be exploited to further our understanding of the future evolution of glacier dynamics in the Canadian Arctic.

Marine nutrient subsidies to the terrestrial environment of common eider nesting islands in the Canadian Arctic

Clyde, Nikolas[1,2], S. Iverson[1], K. Hargan[3], G. Gilchrist[1] and M. Forbes[2]

[1]Environment Canada, National Wildlife Research Centre, Ottawa, Ontario K1S 5B6

[2]Department of Biology, Carleton University, Ottawa, Ontario K1S 5B6
[3]Department of Biology, University of Ottawa, Ottawa, Ontario K1N 6N5

Nutrient fluxes across ecosystem boundaries can have pronounced effects on ecosystem dynamics, but these interactions can be difficult to untangle in complex systems. Island systems are ideal places to study nutrient subsidies as they have finite bounds and are separated by physical space. In particular, the arctic island archipelagos of Hudson Strait are severely nutrient limited, mostly undisturbed, and have been surveyed historically since the 1950's. This area harbors many species of seabird, including the Common Eider (*Somateria mollissima*), which nest in large colonies on offshore islands in this region. Through foraging on benthic invertebrates and returning to these colonies, these birds may be artificially providing marine nutrients to the terrestrial environment of their nesting islands through excretion, with possible large-scale bottom-up consequences on primary productivity, trophic structure, and overall biodiversity. Using freighter canoes and local Inuit guides we sampled vegetation, soil, and invertebrates on 25 islands and 6 mainland sites in the areas near Cape Dorset, Nunavut and Ivujivik, Quebec over the previous two summers (2014-15). Using stable isotope techniques, we aim to show the extent and level of nutrient subsidies to these colony islands is substantial, and has the potential to have ecosystem-level effects. We also aim to model basic habitat requirements across the Hudson Strait region. The Common Eider is a local and internationally relevant species that is harvested across the Canadian Arctic that is facing increasing predation pressure from Polar Bears (*Ursus maritimus*) due to cascading effects of climate change. This project is part of a multi-disciplinary research effort to investigate this trend and to attempt to predict possible outcomes, and is the result of collaborations with Environment Canada, Baffinlands Iron Mine, Oceans North, PEW charitable trust, Nunavut Inuit Wildlife Secretariat, Carleton University, many HTOs and communities in the Hudson Strait region, and the Canadian Museum of Nature.

The blossoming of the Arctic: historic records used to predict the impact of climate change on Nunavut flowering and seed dispersal times

Zoe Panchen[1], Root Gorelick[1]

[1]Department of Biology, Carleton University

Phenology is the timing of nature’s periodic events such as flowering and seed dispersal times and is often influenced by seasonal temperatures. Herbarium specimens (pressed plants) are collected in flower or fruit and hence provide historical phenology records. Herbarium specimens have been collected from across Nunavut since 1897 but the sample size is too small at any one location for a localised phenology-climate change analysis and hence a pan-Canadian Arctic analysis must be undertaken. I determined the flowering and seed dispersal times over the past 120 years of 23 common Nunavut plant species from the collection date on herbarium specimens. The specimens’ flowering and fruiting times were associated with monthly temperatures in the year of collection. I ran statistical models at different spatial scales to determine which monthly temperatures influence flowering and seed dispersal times. I ran regression models to determine species’ phenological sensitivity to temperature as a predictor of phenological responses to climate change. June mean temperatures have the strongest influence on flowering time and July mean temperatures on fruiting time. Some Arctic plants species phenologically respond to temperature changes more than others. The diversity in Arctic plant species phenological responses to temperature has climate change implications for Arctic ecological communities including plant species community composition, plant species competition and pollinator and herbivore interactions. The use of historic data for phenology-climate change research is at the mercy of the whims of the herbarium specimen collectors, the challenges of which on a temporal and spatial scale will also be discussed.

Alternative Energy in the Arctic: Lessons learned from eight renewable energy case studies in Canada's North

Lawrence Keyte[1], David Cherniak[2], Vincent Dufresne[3], Alexandra Mallett[4], Stephan Schott[4]

[1]Polar Knowledge Canada
[2]Natural Resources Canada
[3]Carleton Sustainable Energy Research Centre, Carleton University
[4]School of Public Policy and Administration, Carleton University

Carleton Sustainable Energy Research Centre recently published a report commissioned by Polar Knowledge Canada, titled *Report on the State of Alternative Energy in the Arctic*. As part of the report, a series of eight case studies were undertaken in order to provide a snapshot of renewable energy and energy efficiency projects in operation and under development in Canada's North. Interviews were conducted with project champions, government program managers, industry, utilities and involved community members, which complemented a review of relevant planning reports and studies. Canada's three northern territories are represented in the case studies, as well as Nunavik and Nunatsiavut.

The research reveals a wide diversity of financial and social drivers behind these alternative energy projects, and a range of barriers and outcomes as projects move from development stage to implementation. Regional trends, factors for success, and lessons learned are summarized. Financial factors affecting project outcomes include innovative financing models, independent power producer pricing mechanisms, carbon pricing, and local economic development. Social factors include the desire for energy autonomy, the degree of Indigenous ownership, alignment with traditional values and cultural identity, the relation between local energy systems and resilience, and the role of policy in driving successful projects. Lessons learned from these pan-northern Canadian case studies may be applied by other communities and organizations when developing alternative energy projects.

Repeated ERT surveys to monitor the permafrost conditions following wildfire, south-western Northwest Territories

J. Holloway[1] and A. Lewkowicz[1]

[1]University of Ottawa, Department of Geography

Ecosystem-protected permafrost in the discontinuous zone covers millions of square kilometres worldwide and is particularly sensitive to climate and environmental change as it is just below 0°C, thin, and usually cannot be re-established after disturbance. One widespread form of disturbance in this region is forest fire. The extensive fires of 2014 in the south-western NWT provide an experimental framework to examine how permafrost responds to natural surface disturbance over a wide range of environmental and geomorphological conditions. 15 sites were established along a 300km latitudinal gradient, and a peatland was identified as an area of interest because disturbance may result in long-term carbon emissions. Changes at the sites were examined using climate and ground temperature monitoring and direct current electrical resistivity tomography (ERT) as well as using low-altitude aerial photographs taken from an unmanned aerial vehicle (UAV). These sites represent areas with different surficial and permafrost conditions, and repeated ERT surveys and continued monitoring should elucidate how these conditions are affected by disturbance. The significance of this research is that it will identify how forest fire, in addition to climate variables, will influence permafrost loss in the discontinuous zone. Understanding how permafrost is affected by a changing climate is necessary to establish the impact of positive-feedbacks, specifically how much carbon is being released as permafrost thaws.

Groundwater discharge in a permafrost watershed, Ogilvie River, Yukon Territory

Natalia Baranova[1] and Ian Clark[1]

[1]Department of Earth and Environmental Sciences, University of Ottawa

Recent changes in the hydrological regime of the permafrost watersheds have been observed and variable trends include increasing or decreasing overall stream discharge, earlier timing of the spring freshet and in some cases increase in groundwater baseflow. The groundwater cycling in the permafrost watersheds is not well understood.

This study examines upper Ogilvie River, a permafrost watershed in central Yukon. The objective of the study is to correlate groundwater recharge and discharge with geological, cryological and meteorological controls, to understand the contribution of groundwater to discharge, and to examine potential groundwater recharge pathways. The groundwater and other components of the annual hydrograph are characterized using geochemical tracers, stable isotopes ($\delta^{2}H$, $\delta^{18}O$, and $\delta^{13}C$), and radioisotopes (^{14}C and tritium). Preliminary analysis of the 2014 and 2015 data shows that there are potentially two groundwater components thought to be shallow groundwater, unfrozen throughout the year and potentially limited to the talik areas, and deeper groundwater sustaining the streamflow through the winter. Groundwater is recharged by a mix of snow melt and rain water (based on the local meteoric water line) with potential favouring of rain water (based on ^{3}H). Groundwater tritium concentrations similar to the natural regional precipitation point to short residence times of the groundwater.

Vegetation cover and discontinuous mountain permafrost along elevation gradients, Yukon Territory, Canada

Zoé Kuntz[1], Antoni Lewkowicz[1]

[1]Department of Geography, University of Ottawa

Air temperature is the main driver for permafrost occurrence regionally. It is also a limiting factor for vegetation growth at high latitudes and elevations. In turn, vegetation cover affects energy exchange between the air and the ground surface and thus the probability of permafrost being present. At high elevations in northern regions where tundra dominates, permafrost may be continuous, but as one descends, air temperatures generally increase enabling shrub and then tree growth. Permafrost begins to break down spatially until it may occur only in isolated patches.

This study seeks to better understand the relationship between permafrost, elevation and vegetation cover, and to test the hypothesis that changes in mountain permafrost distribution and characteristics occur at vegetation type boundaries, as they do in latitudinal permafrost.

Electrical resistivity tomography (ERT) profiles were completed at vegetation transitions on selected Yukon slopes in July 2015 near Whitehorse and Dawson. An ABEM terrameter LS was used with electrodes spaced at 2 m in 160-280 m long Wenner arrays. Organic layer thickness and vegetative species composition were recorded along each profile. Ground-truthing via frost probing, and ground temperature data aided in the analysis of profiles.

Preliminary results indicate that changes in permafrost distribution and characteristics do not consistently occur at vegetation type boundaries. Rather, small scale changes in microtopography and shrub patch distribution, potentially creating protected hollows favouring snow accumulation, may be of greater importance to

permafrost distribution and characteristics than the transition from one vegetation type to another.

Poster Presentations

Laser Scanning and Surveying of Permafrost Subsidence on Tundra and Man-made Surfaces

Peart, C[1]., Gruber, S[1]., Heim, L[1]., & Cornelissen, G.[2]

[1]Department of Geography & Environmental Studies, Carleton University, Ottawa, Canada
[2]Sub-Arctic Surveys Ltd., Yellowknife, Canada

With global temperatures increasing, there is a greater probability of the degradation of permafrost. Few methods currently exist to accurately quantify ground subsidence related by the thaw of permafrost with surveying equipment and terrestrial laser scanning (TLS). With modern technologies it is possible to measure smooth surfaces (e.g., a road) within a few millimeters of accuracy. However, in the natural environment it is not so simple. Vegetation or any surface cover can interfere with the accuracy of the actual surface.

A Leica MultiStation (MS50) was used to survey locations in the Northwest Territories (Yellowknife and near Lac de Gras) during the summer of 2015 (June-August). The results (point clouds) from the MS50 give a x,y,and z coordinate of the point. With the results the elevation (z coordinate) is known, which can give a representation of the surface. Over time if there is a change in elevation with repeat scans of an area then subsidence is likely probable.

The primary objective of this study was to formulate an understanding of how well the repeat measurements worked on manmade surfaces and tundra environments. The use of the computer programs R, Python, and ArcMap were used to calculate the

repeatability of scans and point measurements. The uncertainty range was in the millimetres for repeat scans of Highway 3 just outside of Yellowknife. Possible subsidence was detected over a two month period of Highway 3.

Quantifying fine-scale variability and heterogeneous patterns in permafrost terrain

Julia Riddick[1], Stephan Gruber[1]

[1]Department of Geography and Environmental Studies, Carleton University

Surface and subsurface conditions in permafrost terrain control ground temperature. When one temperature series represents a large area with undetermined variability, it becomes hard to pinpoint the relation between surface conditions and ground temperature. One data series applied to a large area introduces a random component of whether that one sample truly represents the population mean.

This research aims to describe and understand local variability of these conditions at a fine scale. Here, “fine scale” is defined by a 15 m by 15 m area. The method is to select four points within a site that are representative of the variation found there and one data logger is installed 10 cm below the surface at each point. Any difference in temperature between the four loggers at a site can be attributed specifically to the surface and subsurface conditions above them.

One month of temperature data has shown variation within fine-scale sites, as well as between sites of differing terrain types. This temperature variability indicates that a single measurement is not a sufficient representation of the population mean, and extrapolating this one measurement over a large area, for the purpose of modeling,

might render incorrect results. This becomes problematic when that data is used to describe and predict temperature change over time.

Multiscale Terrain Analysis for Modelling Snow Accumulation in the Apex River Watershed, Iqaluit, Nunavut

Smith, Keegan[1], M. Richardson[1], and J. Shirley[2]
[1]Department of Geography and Environmental Studies, Carleton University, Ottawa, Ontario, K1S 5B6
[2]Nunavut Research Institute, Iqaluit, Nunavut, X0A 0H0

Quantifying snowmelt runoff is vital to Arctic hydrology and water resource management. An accurate estimate of the end-of-winter snow distribution is an effective predictor of spring meltwater availability, but wind redistribution is complex due to interactions between wind and the rugged topography of southern Baffin Island. This research seeks to quantify the relationship between snow accumulation and terrain variables for the Apex River watershed (ARW) near Iqaluit, Nunavut.

Terrain variables were calculated by digital terrain analysis performed on a 1-metre resolution DEM of the ARW, while end-of-winter snow distribution was determined through spatially intensive field surveying during the spring of 2015. High-resolution surveys were conducted repeatedly within a small lake basin, while a single broader-scale survey was conducted along five parallel 10 km transects across the entire ARW.

The relationship between snow water equivalent (SWE) and terrain variables was investigated by Random Forest, a machine-learning algorithm. Snow distribution was then modeled using both multivariate linear regressions and terrain-driven cluster analysis. The cluster analysis indicated the presence of two main “populations” of SWE – a majority of the catchment was covered by shallow snow, while a smaller fraction consisted of deep “drift”. Drift areas were found in local topographic lows and areas with steep slopes – especially slopes in the lee of the prevailing winter wind.

These results suggest that stratified snow surveys will be required for future predictive end-of-winter snow mapping. This information can be incorporated into guidelines for hydrological monitoring practices as part of our partnership with the Nunavut Research Institute.

Accelerated thinning of small alpine glaciers on Axel Heiberg Island, Canada, since 1959

Michael Hackett[1,2], Laura Thomson[1] and Luke Copland[1]
[1]Department of Geography, Environment, and Geomatics, University of Ottawa, Canada.
[2]MSc in Geography

To assess the magnitude of recent glacier changes in the Canadian Arctic, we conducted an oblique aerial photographic survey in summer 2015 of Baby Glacier and Trent Glacier, two small alpine glaciers on Axel Heiberg Island. Using structure from motion photogrammetry, along with ground control points we created a high-resolution DEM and orthophoto of the glaciers. To quantify volume changes over time, the new DEM was differenced from a series of DEMs created from historical aerial photography and modern satellite imagery. Area change was measured by outlining the glaciers manually against a 1959 air photo, as well as ASTER imagery from 2001 and 2006, and the 2015 orthophoto. In addition, a ground-penetrating radar survey was conducted on Baby Glacier in May 2015 to determine ice thickness, which can be used to project the future evolution of Baby Glacier under a warming climate.

Overall, both glaciers have reduced in area, have retreated 130-150m at their terminus positions, and reduced in volume. A prominent nunatak at the upper extent of the glaciers has become much more exposed, indicating that ice loss has occurred across the entire elevation range. This study has also demonstrated that the structure from motion technique can provide precise DEMs of an area from oblique air photos, which greatly facilitates the collection of topographic data compared to previous photogrammetric techniques that required nadir (vertical) photos as inputs.

Estimating permafrost soil parameters using temperature time series data

Brown, N.[1] Gruber, S. [1]

[1]Carleton University, Department of Geography and Environmental Studies

As permafrost approaches 0°C, the sensitivity of temperature measurements to the continued addition of heat decreases as more and more of the added energy is used to melt ice. The change in sensitivity depends on the freezing characteristic curve and ground ice content which are not known a priori. It is therefore difficult to meaningfully compare rates of permafrost change for sites with differing ground temperatures.

Previous research has demonstrated that relevant soil properties can be estimated using ground temperature data and optimization algorithms. However, these methods require an initial guess of the values of soil properties. If the initial guess is not sufficiently close to the correct values, the algorithm will not converge on an appropriate

estimate. The choice of an initial guess requires a lot of manual fine-tuning, so applying the technique to many locations is unrealistic. An improved method to estimate soil properties from temperature data would make it easier to monitor the consequences of permafrost change.

I will investigate the use of a global minimization algorithms to estimate soil properties. These do not require an initial guess; instead, they search through all possible solutions and yields the solution that best fits observations. I will evaluate the quality of soil parameter estimates obtained using such an algorithm: when are they appropriate and where do they fail? I will apply the estimates to field sites to evaluate how much heat gain or ice loss is taking place in permafrost and where rates of change are the greatest.

Eyeliner Slumps: an introduction to a new periglacial feature

Taylor McWade[1], Stephan Gruber[1]

[1]Department of Geography and Environmental Studies, Carleton University

In the Lac de Gras region of the Northwest Territories a new periglacial feature was found during summer fieldwork (2015). This feature is referred to as an Eyeliner slump and it is currently defined as a slow mass wasting event with a continuous depression situated several meters from the headwall that outlines the length of the slump. It is hypothesized that this feature is linked to changing conditions in ground ice at depth (subsurface change) and changes in active layer depth (surface change).

This research aims to describe and understand the geomorphological processes associated to an Eyeliner slump. There are several working hypotheses on the formation, geomorphology, temporal variability, and the relation to location and changes in ground ice content.

Quantitative and qualitative data has been extracted from 152 known features in the Lac de Gras region. This was done with the aid of aerial photographs of the region, as well as a LiDAR dataset and an extracted hill shade layer of the area of study. More work will follow to assess the temporal aspect of these features by means of a comparison of present day conditions to historical airphotos.