2017 Ottawa-Carleton Student Northern Research Symposium Program

Hosted by Carleton University

March 10th, 2017
Dunton Tower, Room 2017

Carleton UNIVERSITY

uOttawa

Each year, undergraduate and graduate students from the University of Ottawa and Carleton University participate in high-quality Northern research studies in a wide range of disciplines including natural and social sciences and humanities. As a platform to showcase our excellence, common interests and passion, Carleton University is pleased to host the 2017 Ottawa-Carleton Northern Research Symposium (OCSNRS). This one-day symposium is a great opportunity to foster discussions on many pressing northern issues and strengthen ties between students and researchers from the two universities.

Friday, March 10th, 2017
Time: 8:30 – 4:30
Dunton Tower, Room 2017
RSVP is required.

Further details are available at: http://carleton.ca/northernresearch/ocsnrs/

The organizers would like to thank the Department of Geography and Environmental Studies and the office of the Vice-President (Research and International) at Carleton University for providing financial support for the Symposium, Dr. Gita Ljubicic for organizational and website support and for aiding with communication at Carleton University, and Dr. Luke Copland for aiding with communications at University of Ottawa.

We thank Sira Chayer (Student on ice) for providing our keynote address. Finally, we would like to thank Alex DePaiva, Julia Riddick, Jill Rajewicz and Frankie Jean Gagnon from Carleton University for chairing sessions.

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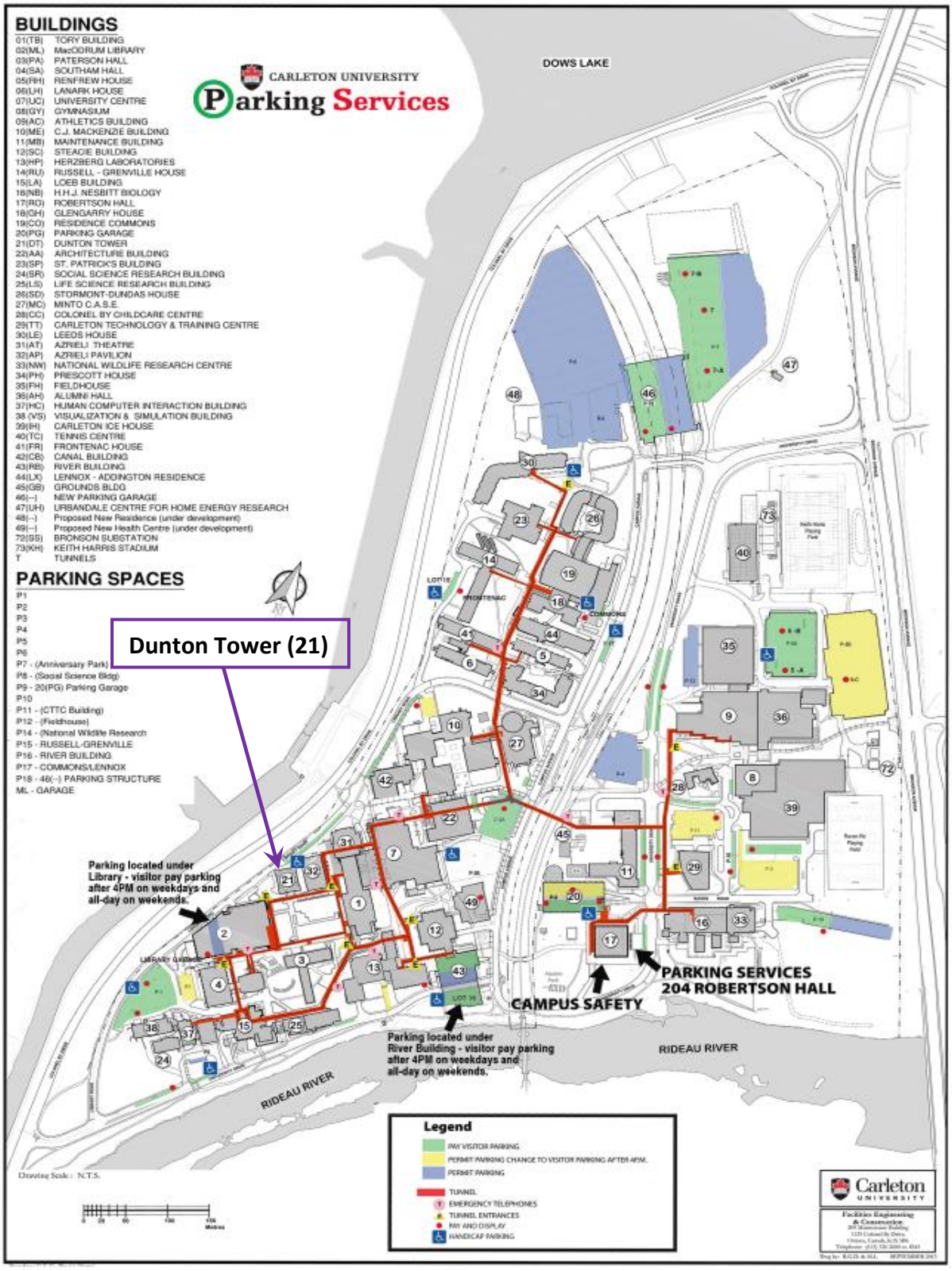

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2017 Ottawa-Carleton Student Northern Research Symposium

March 10, 2017

Dunton Tower, Room 2017, Carleton University

08:15 - 09:00	Registration	
09:00 - 09:15	Opening Remarks	
09:15 - 09:45	*Keynote presentation on creating the documentary "Breaking Ice: The Arctic Uncovered"*	Sira Chayer
09:45 - 10:00	**Break**	
Oral Presentations Session 1		**Presenter**
10:00 - 10:15	*Glacier surges and variability in ice dynamics on Axel Heiberg Island, Nunavut*	Dorota Medrzycka
10:15 - 10:30	*The influence of forest fires on metal loading to northern lakes*	Nicolas Pelletier
10:30 - 10:45	*High-Resolution Inter-Lake Assessment of Arcellinida (Testate Lobose Amoebae) as Bio-Indicators of Legacy Mine Contamination in the Yellowknife Region, NT, Canada*	Nawaf Nasser
10:45 - 11:00	*Integrated ITRAX-XRF and freeze coring as a method for high quality, rapid, and cost effective determination of baseline levels for elements of concern*	Braden Gregory
11:00 - 11:15	**Break**	
Oral Presentations Session 2		**Presenter**
11:15 - 11:30	*Tracking the Thule Inuit whaler's historical land occupation in the high Arctic using sterols and stanols*	Lauren Gallant
11:30 - 11:45	*Late Cretaceous dinoflagellate assemblages and paleoproductivity signals of the Kanguk Formation, Ellesmere Island, Nunavut*	Gregory Froude
11:45 - 12:00	*Distribution and Growth of Earth Hummocks in the Chuck Creek Trail Valley, Northern British Columbia, Canada*	Marjolane Verret
12:00 - 12:15	*Adjusting snowfall gauge data for wind-induced bias: A review of recent advances and the development of an R-based toolset*	Keegan Smith
12:15 - 13:45	**Lunch and Poster Presentations**	

Oral Presentations Session 3		
13:45 - 14:00	*Identifying Drivers of Mercury Methylation Around Giant Mine, Yellowknife*	Mija Azdajic
14:00 - 14:15	*Improving Prediction of Pressured Ice in the Hudson Strait, Canada: an interdisciplinary analysis of resource ship besetments using ship voyage logs and hind cast modeling.*	Annika Ogilvie
14:15 - 14:30	*Tracking Iceberg Drift Patterns in Baffin Bay*	Abigail Dalton
14:30 - 14:45	*On Iceberg Severity Count Distribution and Implications of Exceptionality of Iceberg Survival for Modelling Approaches*	Ron Saper
14:45 - 03:00	**Break**	
Oral Presentations Session 4		
03:00 - 03:15	*Identifying the role and value of participatory mapping in an Inuit knowledge research context: A review of mapping practices and applications across the Canadian Arctic over the past forty years*	Alex Depaiva
03:15 - 03:30	*Institutions and Economic Development in Nunavut: A Dissertation Proposal*	Allison Holmes
03:30 - 03:45	*Culturally Safe Falls Prevention Programs for Inuvialuit Elders*	Julia Frigault
03:45 - 04:00	*Local and Traditional Knowledge indicators for tracking socio-ecological changes in Inuvialuit fishing livelihoods*	Iria Heredia
04:00 - 04:15	**Photo Exhibition and Last Chance to View Posters**	
04:15 - 04:35	**Awards**	
04:35 - 04:45	**Closing Remarks**	
16:45 - 19:30	**Informal Discussion and Beverages at Mike's Place**	

Poster Presentations	*Assessing the Impact of Historic Gold Mining Activities on the Toxicity of Lake Sediments in Yellowknife, NWT.*	Cynthia Cheney
	Distribution, source and cycling of organic carbon and nitrogen in the icy soils of University Valley (McMurdo Dry Valleys of Antarctica)	Benoit Faucher
	Impact of Shrub Cover on Leaf Litter Decomposition and Microclimate in Southern Arctic Tundra	Electra Skaarup
	High precision surveying of drifting icebergs and ice islands	Anna Crawford
	Glacier Velocity Variation and Surge Type Glaciers on Manson Icefield, Southeast Ellesmere Island 1993 - 2016	Danielle Halle
	Black Carbon in Arctic Air	Marianne Lahaie Luna
	Impact of climate change on flowering and fruiting times of Nunavut Arctic plants	Zoe Panchen
	An alternate method for sample preparation for radiocarbon (14C) dating of groundwater	Vladyslav Rayda
	Long Term Trends of Cadmium and Mercury in Arctic Air	Tannor Steudle
	Local and regional scale variability of snow depth, snow bulk density, and snow water equivalent in the Snare River basin, Northwest Territories: implication for sampling strategies	Derek Tokarski
	Influence of Vegetation Succession on Active Layer Thickness and Ground Temperatures (1978-2016), Illisarvik, Western Arctic Coast	Alice Wilson
	Spatial variability of carbon emissions within a drained lake basin and its surrounding tundra, Illisarvik, NT.	Andrée-Anne Laforce

Oral presentations

Session 1

Glacier surges and variability in ice dynamics on Axel Heiberg Island, Nunavut

Dorota Medrzycka and Luke Copland
Department of Geography, Environment and Geomatics, University of Ottawa

Glacier surging describes a cyclic ice flow instability caused by changes within a glacier system, with ice motion oscillating between long (decades to centuries) low-velocity quiescent periods, interspersed with short-lived (months to years) high velocity surge periods. Surges are characterized by a dramatic velocity increase by several orders of magnitude, of up to several kilometers per year. Surging appears to be triggered by a reorganization of the subglacial drainage system and/or basal thermal regime however, the exact mechanisms triggering and controlling glacier surges are still largely unknown. Surge-type glaciers are only found in specific glaciated regions, including the Canadian High Arctic, where 51 surge-type glaciers have been previously identified. However, recent observations indicate that this inventory is incomplete, and that glaciers likely experience a wide variety of flow instabilities beyond those traditionally assigned to surging. My research will produce an assessment of the variability in glacier dynamics in the Canadian Arctic and attempt to identify the factors driving these fluctuations in ice motion. Axel Heiberg Island was selected for this purpose as it offers a wide range of glacier types (from large ice caps to small mountain glaciers) spread over a varied landscape. Remote sensing will be used to assess variability in glacier motion and to provide insight into the controls on ice flow instabilities observed on the island. Optical satellite imagery (e.g. Landsat, ASTER) and air photos will provide information on the occurrence, magnitude, and duration of flow instabilities since the 1940s based on the observation of surge-specific features including rapid terminus advance, looped moraines, and heavy surface crevassing. Surface velocities and their variation through time will be determined from feature tracking on successive images from the 1970s onwards. This will provide an updated inventory of glaciers exhibiting ice flow instabilities, oscillating between faster and slower flow regimes, and the range of velocity responses occurring in this region.
This work will provide the first comprehensive analysis of surging and other ice flow instabilities in the Canadian Arctic, and will fill a major knowledge gap regarding the physical mechanisms which cause glaciers to oscillate between fast and slow flow regimes. Identifying the factors causing this variability in ice motion is important for a better understanding of how glacier dynamics might evolve in a changing (warming) climate. The long-term monitoring of the dynamics of Arctic glaciers is also crucial for accurate predictions of global sea level rise.

The influence of forest fires on metal loading to northern lakes

Nicolas Pelletier[1], Jesse C. Vermaire[2], John Chételat[3], Mike Palmer[1,4], Jody Pellisey[5], Boyan Tracz[5], Johanne Black[6] and Sjoerd van der Wielen[7]

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Heavy metals previously accumulated in soils and biomass can be remobilized by wildfires and deposited in aquatic environments by atmospheric transport or subsequent catchment erosion. Because wildfire frequency and intensity are predicted to increase in northwestern Canada in response to climate change, understanding the impact of wildfires on freshwater ecosystems will become increasingly important. Increasing concentrations of mercury have recently been reported in fishes in the Northwest Territories (Canada) and this rise could be attributed to increased atmospheric mercury deposition from long-range sources, changes in bioavailability of mercury from climate warming or remobilisation of previously deposited mercury. We explore the hypothesis that forest fires are a significant source of mercury to Northwest Territory lakes using a paleoenvironmental approach. We reconstructed mercury deposition history and forest fire history in 3 dated lake sediments cores and 2 dated peatland cores from the Great Slave Lake region in the southern Northwest Territories. Radioisotope dating methods (^{210}Pb and ^{14}C) were used in combination to build an age-depth model for each core. Wildfire history was inferred through macroscopic charcoal analysis and trace mercury concentrations in the sediments and peat were measured in laboratory. Time series analysis are used to determine the potential contribution of wildfire to mercury deposition. Whereas ombrotrophic peatlands solely record the influence of atmospheric depositions, lake sediments also record the effect of increased catchment erosion that usually follows a wildfire. Therefore, our data allows to distinguish the relative influence of different mercury transportation pathways to aquatic ecosystems through time.

High-Resolution Inter-Lake Assessment of Arcellinida (Testate Lobose Amoebae) as Bio-Indicators of Legacy Mine Contamination in the Yellowknife Region, NT, Canada

Nawaf A. Nasser[1], R.T. Patterson[1], J.M. Galloway[2], B.R.B. Gregory[1], A.L. Macumber[3], M. Palmer[1], H. Falck[4].
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[2] Geological Society of Canada, Calgary, 3303-33 Street NW, Calgary, AB, Canada
[3] School of Natural and Built Environments, Queen's University Belfast, Elmwood Avenue, Belfast, United Kingdom.
[4] Northwest Territories Geological Survey, 4601-B 52 Avenue, Yellowknife, NT, Canada

Gold mining was a major economic driver in the Northwest Territories (NT) between 1983 and 2004. However, mineral processing at several major mines, most notably Giant Mine (GM), left behind a legacy of arsenic (As) contamination in the surrounding Yellowknife Region (YR). While current remedial efforts are mostly focused on targeted sites of concern (e.g. mine sites), little attention was devoted toward assessing the extent of the As contamination and the impact it has had on lake systems within the YR. Recently, and for the first time in the NT, we investigated the potential of utilizing Arcellinida, a group of freshwater protists, as bioindicators for As concentration variability in the sediments of 59 lakes spanning a radius of ~30km around the GM. The results of this spatial survey provided insight on the sensitivity of Arcellinida to As by reveling a strong correlation between stress-tolerant taxa and high concentrations of total sedimentary As. In 2014, a set of surface sediment samples (n=32) was collected from new locations within the YR. The addition of these samples is critical for (1) determining the extent of the As contamination, (2) refining the quantification of the relationship between Arcellinida and As, and (3) confirming the reproducibility of the results. Results from this work will provide policy makers and mine developers around the globe with a robust and cost-effective tool for determining the intensity of As contamination and rates of remediation in impacted lake systems.

Integrated ITRAX-XRF and freeze coring as a method for high quality, rapid, and cost effective determination of baseline levels for elements of concern

Branden R.B. Gregory[1], R.T. Patterson[1], J.M. Galloway[2], N.A. Nasser[1], A.L. Macumber[3], H. Falck[4], A. Sexton[5]
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[5] TerraX Minerals Inc., 1605-77 Dunsmuir St., Vancouver, BC, Canada

To ensure sustainable resource development, the Northwest Territorial government established the "Mine Site Reclamation Policy", which stipulates that companies must present detailed mine site remediation plans prior to the initiation of mining operations. Defining baseline concentrations for elements of concern (EOC) is integral for returning impacted systems to their natural state. This is challenging due to naturally elevated concentrations of EOC in bedrock, the presence of contamination from historical mining practices, and the environmental response of natural systems to climate variability. Lake systems can be used to establish EOC baseline because they act as a regional sediment sink. However, the low sedimentation rate found in most subarctic lakes results in coarse temporal resolution (centuries) when using traditional geochemical analysis (e.g., ICP-MS) due to high weight-per-sample requirements. To resolve this issue of resolution, we combine freeze coring, a method that can reliably captures the sediment-water interface of lakes, with Itrax core-scanning X-ray fluorescence (Itrax-XRF), which can measure the geochemistry of sediments in intact cores at sub-mm resolution. In order for this technique to be relevant to policy makers and mine developers the semi-qualitative results obtained via Itrax-XRF analysis must be calibrated to obtain absolute values. To test calibration methods, one freeze core was recovered from Milner Lake, a lake adjacent to a prospective gold mine ~15 km north of Yellowknife. We tested linear and multivariate calibration models and comment on the relative merits of both techniques. The success of the calibration process will provide mine developers with a high quality, high resolution and cost-effective tool for determining baseline conditions prior to establishing any mining operation.

Session 2

Tracking the Thule Inuit whaler's historical land occupation in the high Arctic using sterols and stanols

Lauren R. Gallant [1]; Kathryn E. Hargan [1]; Linda E. Kimpe[1]; John P. Smol[2], and Jules M. Blais [1]
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Thule Inuit whalers often left evidence of their presence in the high Arctic in the form of Thule whale-bone houses. While the archaeological identification of these ancient pieces of whale bone allow us to determine where this nomadic population lived, the radiocarbon dates determined from these whale-bone fragments may be inaccurate by several hundred years; this creates uncertainty in our understanding of the presence and migration of the Thule people in the high Arctic. Consequently, we propose an analysis of lake sediments using sterols and stanols which carry a specific human-activity signature to pinpoint the arrival dates of the Thule people. The objectives of this project are to: (1) identify historical sites previously home to the Thule people through the fluctuations in the sterol and stanol profiles in lake sediment cores, and (2) determine the extent of chemical and biological changes to the lake systems impacted by the Thule people.

Lake sediment cores will be collected from two locations, Somerset Island and Bathurst Island, previously known to be home to the Thule people. We will collect samples from Thule-impacted and reference lakes identified in previous studies. Lake sediments will be radiometrically dated and analyzed for sterols and stanols as well as diatoms. We hypothesize that the presence of the Thule people will alter the concentration of coprostanol, the nutrient composition, and the diatom assemblage. Consequently, we predict that Thule-impacted lakes will have higher concentrations of coprostanol and nutrients and exhibit a marked shift in diatoms relative to reference lakes.

Late Cretaceous dinoflagellate assemblages and paleoproductivity signals of the Kanguk Formation, Ellesmere Island, Nunavut

Gregory Froude and Claudia Schröder-Adams
Department of Earth Sciences, Carleton University

Past paleoceanographic research has centred on Cretaceous deposits of organic rich black shales located in low-to-mid latitude marine basins that are associated with Oceanic Anoxic Events (OAEs). These studies established that sea surface temperatures reached their maximum during the greenhouse conditions of the Cenomanian-Turonian boundary event (CTB), coinciding with OAE2. A younger OAE3 was recognized within the low latitude Atlantic and marginal basins, which occurred during the Coniacian-Santonian cooling trend. The response of Polar regions to Cretaceous carbon perturbations is less understood and paleotemperature data from the Arctic are scarce. Hence, in order to understand paleoceanographic dynamics in high latitudes, sediment samples were collected from the Kanguk Formation within the Sverdrup Basin at Slidre Fiord, Ellesmere Island. The Kanguk Formation at this locality represents a well exposed, conformable sequence of latest Cenomanian to Early Campanian marine bituminous deposits of dominantly claystone to siltstone. Thus, signals for the OAE2 and OAE3 were expected to be found within this exposure. Analysis of marine palynomorph assemblages have yielded the dinocysts *Chatangiella* sp. and *Heterosphaeridium difficile,* at the very base of this exposure. These taxa are respective indicators for the CTB and the end of the OAE2. Thus, indicating that the OAE2 is below the Kanguk Formation at this locality. Planktonic paleoproductivity signals, including possible signals for the OAE3, are being compared to benthic conditions as determined by benthic foraminifera abundances and composition, burial rates of total organic carbon (TOC), carbon isotope $\delta^{13}C_{org}$ signatures, and whole rock geochemistry data.

Distribution and Growth of Earth Hummocks in the Chuck Creek Trail Valley, Northern British Columbia, Canada

Marjolaine Verret and Denis Lacelle
Geography Department, University of Ottawa and CryoLab for Arctic, Antarctic and Planetary Studies (CLAAPS)

Cryoturbation has been shown to translocate surface organic-rich horizons deeper in the soils and as such is an important process for carbon sequestration in the active layer (e.g., Kaiser et al., 2007; Van Vliet-Lanoë, 2004). Hummocks, which are non-sorted patterned ground, are sub-meter to meter-scale circular to oval-shaped mounds found in fine-grained frost susceptible sediments. Although the origin of hummocks remains unclear (Kessler et al., 2001; Peterson et al., 2003), their development occurs by freezethaw processes and differential frost heave (e.g., Ballantyne, 1986; Lewis et al., 1993; Schunke & Zoltai, 1988; Van Vliet-Lanoë, 2004). This project examines the distribution, morphology (level of maturity) and internal structure of hummocks in the sub-alpine region of the Chuck Creek Trail Valley in the Tatshenshini-Alsek Provincial Park, northern British Columbia. The objectives are to: 1) describe the distribution pattern and level of maturity of hummock patches within the valley and explore environmental factors that control their distribution; 2) describe the distribution of organic carbon and type of organic compounds in hummocks of various maturity level; and 3) determine the age of soil organic carbon to infer soil movement rates in hummocks. The distribution, maturity and development of hummock fields are believed to be dependent on site specific characteristics like the nature of the sediment and water within it, the vegetation cover, the slope and the aspect, etc. Grain-size, gravimetric water content, organic matter content, carbonate content and type of organic carbon are all parameters that have been studied to understand the dynamics of the hummock fields. Dating of bulk organic matter will also be undertaken to test preexisting models. Overall, the thesis also addresses the role of hummocky cryosols in the carbon cycle within the context of climate change.

Adjusting snowfall gauge data for wind-induced bias: A review of recent advances and the development of an R-based toolset

Keagan Smith and Murray Richardson
Department of Geography and Environmental Studies, Carleton University

Snowmelt is the largest input to arctic hydrologic systems, but predicting snow storage is complicated by snow relocation over wind-exposed tundra landscapes. End-of-winter snow accumulation can be estimated by spatially-explicit snow transport modeling, forced with data from nearby meteorological stations. Unfortunately, measurements taken at these stations may substantially underestimate arctic winter precipitation, since snowfall gauges are prone to bias by several factors - especially wind-induced undercatch. Recently, intense study of this problem has provided several adjustment functions for improving the accuracy of solid precipitation measurements. This work presents a review of recent advances, and a comparison of adjustments applied to precipitation data at Iqaluit, Nunavut. The algorithms employed in this procedure were scripted in R to provide an open toolkit for researchers, with a simplified form presented here. Results include (1) a processed "reference" precipitation dataset for several winters in Iqaluit, (2) a dataset from a nearby smaller gauge, of a design commonly found at other monitoring stations, and (3) an assessment of several adjustment functions applied to measurements at the smaller gauge. This will conclude with a summary of the relative performances, complexities, and data requirements of these functions.

Session 3

On Iceberg Severity Count Distribution and Implications of Exceptionality of Iceberg Survival for Modelling Approaches

Ronald Saper and Derek Mueller
Department of Geography and Environmental Studies, Carleton University

The International Ice Patrol (IIP) tabulates the count of icebergs that drift south of 48°N latitude, a record reaching back to 1900. This measure of historical iceberg severity is relevant to offshore operations and transatlantic shipping to and from North American ports. The annual count is highly variable from year to year, and notoriously difficult to predict, although some models exist. My objective is to highlight that the annual count comprises only the tiny fraction of icebergs that survive the journey from distant Arctic sources, and to define model approaches that recognize the implications of survivor exceptionality and of historical distribution of the count.

I confirm the 1980 finding of Ebbesmeyer that the iceberg count is exponentially distributed using the extended cumulative record of the iceberg count to the present day. While Ebbesmeyer relied upon a specific stochastic model and some key assumptions, we use only the data record itself to confirm the fit to a negative exponential random pdf. Such a pdf implies certain models forms, and rules out others. I argue that the iceberg severity record is unlikely to explained by investigations which study typical icebergs or track them from their source. Instead, it is necessary to study survivors and track them backwards from 48°N to determine and model the circumstances resulting in their unexpected survival.

Improving Prediction of Pressured Ice in the Hudson Strait, Canada: an interdisciplinary analysis of resource ship besetments using ship voyage logs and hind cast modeling.

Annika Ogilvie and Jackie Dawson
Department of geography, University of Ottawa

Reductions in Arctic sea ice extent have facilitated an increase in shipping activity due to new possibilities for resource extraction, tourism, and shorter trade routes through the Northwest Passage. Despite warming, difficult ice conditions still present a significant threat to vessels navigating through Arctic waters. One of the most challenging ice conditions that ships can encounter is sea ice "under pressure". This ice occurs when winds, tides, or currents interact in regions where ice concentration is high and can cause all types of ships, including icebreakers, to become beset (i.e. stuck in ice). Pressured ice is difficult to predict and there are currently no reliable forecasting methods to aid in ship navigation. Improved forecasting of pressured ice is urgently needed as risks to ships include potential hull damage, sinking, and related financial, environmental, and crew safety implications. This study aims to improve understanding of the presence, formation, and impact of pressured ice ridges in the Hudson Strait, Canada where bulk carriers provide year-round service to the Raglan Nickel mine in Deception Bay, Quebec. The study involves an iterative two-step analysis of the 35 winter transits through the Hudson Strait between 2005 and 2016. First, an analysis of ship besetment events identified from historic ship logs were correlated with in-situ weather conditions during and prior to besetting events to identify possible factors influencing ridge development. Second, a pressured ice model developed by the National Research Council of Canada is used to hind cast historic besetment events thus enabling evaluation of the models effectiveness in predicting actual pressured ice events.

Tracking Iceberg Drift Patterns in Baffin Bay

Abigail Dalton & Luke Copland
Department of Geography, Environment and Geomatics, University of Ottawa

Tidewater glaciers drain a significant proportion of the Greenland Ice Sheet, and the ice caps of the Queen Elizabeth Islands, Nunavut, and provide the primary source of icebergs and ice islands (large tabular icebergs) in Canadian waters. The Canadian Ice Service produces charts which identify the presence of icebergs, but currently has little knowledge about the sources and sinks of icebergs in Canadian waters. To understand where these icebergs and ice islands originate from, where they drift to, how they deteriorate and the time scale of these processes, a series of satellite tracking beacons were deployed in summer 2016. These were helicopter-deployed from aboard the CCGS Amundsen, and provide near real-time (hourly) information concerning the movement of 13 icebergs and ice islands within Baffin Bay. Initial results show that, to date, the most active iceberg has drifted approximately 1600 km at a rate of about 14.6 km/day. Some of the icebergs have also exhibited a spiraling pattern as they drift west across Baffin Bay and are influenced by ocean currents and tides. Results from this work provide information about patterns of iceberg movement, including common areas where icebergs become grounded in relation to bathymetry.

Identifying Drivers of Mercury Methylation Around Giant Mine, Yellowknife

Mija Azdajic[1], Jules Blais[1], Alexandre Poulain[1]

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Mercury (Hg) is a global pollutant and potent neurotoxin that bioaccumulates in animal tissues of aquatic and terrestrial ecosystems in the form of monomethylmercury (MMHg). Microbial activity is the main driver of MMHg production, with sulfate reducing bacteria being important contributors. As such, predicting MMHg's fate in the environment is important for addressing ecosystem and human health concerns. The roasting of arsenopyrite in Yellowknife has created strong environmental gradients with respect to sulfate concentrations in lakes; which decrease with distance from the mine. Additionally, total Hg levels remain consistent; however, the ratio of MMHg relative to total Hg increases with proximity to the roasting stack. We hypothesize that the sulfate gradient is responsible for the pattern of Hg concentrations around Giant Mine. A factorial sampling design was developed to resolve whether sulfate or other environmental variables were affecting the production of MMHg in these lakes. This experimental approach is based on i) determining methylation and demethylation potentials in lake sediments using stable isotope analysis and ii) characterizing the microbial community structure in the same lakes using high throughput sequencing approaches. I will be presenting trends in concentrations of Hg in the lakes surrounding Giant Mine, and the variables that could be controlling the ratios of MMHg relative to THg. Additionally, I will discuss the variables controlling the microbial community structure around the mine.

Session 4

Identifying the role and value of participatory mapping in an Inuit knowledge research context: A review of mapping practices and applications across the Canadian Arctic over the past forty years

Alex dePaiva[1], Gita Ljubicic[1], Scott Mitchell[1] and Joel Heath[2]
[1]Department of Geography and Environmental Studies, Carleton University
[2]Arctic Eider Society, St. John's

Participatory mapping has had a long history in the Arctic, particularly since the Inuit Land Use and Occupancy Project (ILUOP) undertaken from 1973 - 75. Indeed, participatory mapping projects have been the foundation of comprehensive land claims, used to develop and improve natural resource management strategies, and for Inuit knowledge documentation. Despite its widespread use, there has been little critical assessment of the role and value of participatory mapping in an Inuit cultural context. In particular, we seek to investigate the role and value of participatory mapping for learning, documenting, and representing Inuit cultural and geographical knowledge. Undertaking a comprehensive literature review of the ways participatory mapping has been used across the Canadian Arctic has provided insight into trends in mapping methodologies, goals, and applications over the past forty years – from ILUOP till present. Findings indicate that participatory mapping methods have not shifted dramatically from ILUOP till present, with the dominant methodology of using paper maps with clear overlays and coloured markers still forming the foundation of how knowledge is recorded. Change has occurred however with the use of GIS as a tool for processing that information post-interview. Overall, participatory mapping has largely been adopted for achieving goals such as natural resource management, land claims, teaching, and interview facilitation. While using this approach for documenting information was viewed as an important role of participatory mapping in Inuit knowledge research, participatory mapping was also viewed as valuable for its role in the process of undertaking knowledge research, namely through interview facilitation. These findings help to provide insight into how participatory mapping approaches have evolved over time, and aid in our effort to compile lessons learned and best practices in ensuring mapping is undertaken in culturally appropriate and meaningful ways.

Institutions and Economic Development in Nunavut: A Dissertation Proposal

Allison Holmes and Jackie Dawson
Department of Geography, Environment and Geomatics, University of Ottawa

With the signing of the Nunavut Land Claims Agreement in 1993, the prospect of a Nunavut that prioritized Inuit values and perspectives and allowed for *de facto* Inuit self-government seemed to compensate for the relinquishing of land rights and title (Légaré, 2008). In spite of this apparent progress towards self-determination, major social and economic challenges persist today as consequences of a colonial past and present. With its establishment in 1999, the predominant dialogue explaining Nunavut's development pathway is that it is a young territory; it needs more time to grow and adapt to its contemporary institutional environment. Alternatively, it could also be argued that it is the imposed colonial institutions that inhibit social and economic growth within the territory. It is from this alternative perspective that the proposed study builds. The project will ask what institutional conditions foster successful and self-determined economic development in Canadian Inuit communities, and how do Inuit overcome institutional barriers or take advantage of opportunities to achieve economic success? The specific objectives are: 1) to explore the tension between imposed colonial institutions and traditional Inuit culture; 2) to identify institutional networks, barriers, and supports for community-driven business development in Nunavut; 3) to understand pathways to success within the contemporary institutional environment; and 4) to provide research results as knowledge for policy making. This study proposes to use a conceptual paper (1), social network analysis (2), and instrumental case studies (3) to meet these objectives and ultimately inform policy that can facilitate successful, self-determined economic development in Inuit communities.

Culturally Safe Falls Prevention Programs For Inuvialuit Elders

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With the growing global rate of fall-related injuries and fatalities among senior populations (Semonin-Holleran, 2015), it is clear that falls prevention programs are needed. Research has shown that these programs are beneficial to the elderly; however, scholars have failed to account for the influence of the Inuit social determinants of health have on the likelihood Inuit Elders experiencing fall-related injuries. The ways in which falls prevention programs can be made culturally safe [i.e., reflective of participants' experiences and of the contextual perspectives that may influence their day-to-day lives (Giles, Hognestad, & Brooks, 2015)] has also escaped academic attention. By using an exploratory case study methodology, I sought to understand which Inuit social determinants of health stakeholders in Inuvik, NWT believed most affected the likelihood of Inuvialuit (i.e., the group of Inuit who live in the area) Elders' falls. I also sought to co-determine (with the participants) the elements that would make falls prevention programs culturally safe for this population. Through the application of a community-based research approach, a postcolonial lens, and the use of participant observation and semi-structured interviews, 14 participants (i.e., 8 Inuvialuit Elders, and 6 local falls prevention programmers) were able to provide information that critiqued dominant Western discourses of health-related programs and care. The Inuvialuit Elders were also provided the opportunity to reaffirm their power with regard to their personal health and well-being. Finally, discussions with the participants revealed that they supported the idea of cultural safety; however, they also felt that their community provided strong programming.

Local and Traditional Knowledge indicators for tracking socioecological changes in Inuvialuit fishing livelihoods

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Given the vulnerability of northern ecosystems and communities, socio-ecological changes in the Mackenzie Delta region of the Western Arctic have a significant impact on Inuvialuit fishing livelihoods. Local and traditional knowledge offers an effective mechanism for monitoring change and helps us to better understand their significance. Drawing on an analysis of peer-reviewed and grey literature, and qualitative interviews conducted with 10 fishers from the communities of Aklavik and Inuvik, we examine how Inuvialuit fishers track and understand change in the Delta. The themes covered in this research relate to a) determining the local importance of Mackenzie Delta fisheries for Inuvialuit subsistence and livelihoods, b) documenting Inuvialuit knowledge about change regarding fish habitat and fishing conditions based on past and present observations on the land, and c) identifying how fishers track and monitor changes in the Delta. On that base, we identify a range of temporally- and seasonally-sensitive indicators used by local fishers. Preliminary findings indicate that multiple changes are occurring in the Delta, more specifically during the summertime. Changes are observed in water temperature, water levels, slumps, fish quality and delta-reliant wildlife populations (e.g. beavers). The LTK indicators of change are relevant to the specific place-based context, but may also provide a comparative framework for connecting disparate local knowledge contexts and assessing change at broader scales.

Poster presentations

Assessing the Impact of Historic Gold Mining Activities on the Toxicity of Lake Sediments in Yellowknife, NWT.

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Mining operations can be a driver of economic success for a community, but once operations cease, a legacy of contamination is typically left behind. Such is the case at Giant Mine in Yellowknife, NWT. Operating from 1948-2004, Giant Mine released 20,000 tonnes of particulate arsenic trioxide to the atmosphere, which was consequently deposited onto the landscape surrounding the mine lease territory. In Pocket Lake, located 1 km downwind from the roasting stack, a functional loss of cladocera was recently reported, with no recovery seen in lake sediment records. In this follow-up study, we examine the cause of this extirpation event by quantifying total arsenic concentrations in porewater using ICP-MS analysis, comparing these concentrations with microbial bioavailabilty and quantifying the microbial oxidative stress response within the system. Preliminary data suggest that bioavailable arsenic may be contributing to an oxidative stress response, potentially leading to the loss of daphnia viability in Pocket Lake. Building a case for a multi-trophic level response to contaminant exposure will further increase our understanding of the impact of mining operations on the surrounding landscape, as well as help predict what conditions are needed to expect a recovery in this ecosystem.

Distribution, source and cycling of organic carbon and nitrogen in the icy soils of University Valley (McMurdo Dry Valleys of Antarctica)

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Between 2009 and 2013, 16 ice-bearing permafrost cores were collected from 10 polygons along the floor of University Valley (McMurdo Dry Valleys of Antarctica) and were subsequently analysed in order to assess the geochemical properties of the valley's icy soils and ground ice. Elemental analysis showed that icy soils located in the seasonally non-cryotic zone (NCZ) of the valley contained (on average) twice as much organic carbon (1.19 mg C/g-1) as the ice cemented permafrost soils sampled in its perennially cryotic zone (PCZ). It also showed that nitrogen accumulation in the icy soils was a result of atmospheric fallout and chemical weathering of mineral soils. Isotopic analysis showed that the organic matter contained in the valley's icy soils are mostly derived from the deposition and burial of cryptoendolithic communities living in the adjacent sandstone valley walls. Dissolved organic carbon (DOC) concentration measures indicated that soils containing the highest amounts of DOC were enriched in 13CDOC relatively to soils with low DOC concentrations. This indicated that microbial activity in soils was the highest during past super interglacial periods. A soil habitability index calculation from Stoker et *al*. (2010) was used to establish that soils located in the NCZ were more habitable than soils sampled in the PCZ and also presumably more habitable than soils at many Mars landing sites.

Impact of Shrub Cover on Leaf Litter Decomposition and Microclimate in Southern Arctic Tundra

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Previous experimental and observational studies have provided evidence at warmer temperature in the arctic may spark a transition from tundra to shrubland ecosystem types. This shift has the potential to modify a range of ecosystem processes including the cycling of organic carbon through the soil system. In my study, I have used the leaf litterbag technique to investigate seasonal and spatial influences on decomposition dynamics. This method can be used to determine whether winter activities (eg. Freeze-thaw processes, prolonged microbial activities due to thermal insulation of an enhanced snowpack), influence decomposition processes, as has been suggested by previous studies. Additionally, analyzing decomposition processes of sites with different microclimates (tall shrub, medium shrub, low shrub), will aid in determining how shrub expansion could influence decomposition processes. Successfully relating microclimate differences with litter mass loss will add to the bigger picture of understanding how a warming climate influences nutrient cycling.

My Master of Science research project began in the summer of 2015 at Daring Lake in Canada's Northwest Territories, 300 km NE of Yellowknife and roughly 70 km north of the treeline. In August 2015, 600 litterbags with birch shrub leaf liter were set out on the surface and 10cm below the surface at 5 replicated plots in 3 locations representing different birch shrub coverage. At each location, we instrumented 1 plot with soil thermocouples to continuously monitor soil temperatures throughout the winter. Other soil microclimate characteristics were measured manually in the summer and included: temperature, moisture, thaw depth and Leaf Area Index. A subsample of litterbags were collected in early spring (May 2016) and summer (August 2016) to assess relative mass and nutrient loss. Additionally, lab analyses are currently being conducted to quantify mass loss in controlled temperature and moisture conditions (to simulate autumn mass loss as a potential contributor to winter mas loss) and also to quantify DOC production via a leaching study.

Preliminary results suggest that the majority of mass loss occurred during the cold season (including late August 2015 – early Spring 2016) rather than during summer 2016. Further analysis will reveal how microclimate characteristics vary between sites with different levels of shrub coverage and interact to influence the observed mass loss rates.

High-precision surveying of drifting icebergs and ice islands

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Offshore industries operating within Canadian waters are often in the vicinity of hazardous icebergs and ice islands (large, tabular icebergs). However, precise mass estimates are difficult to obtain and drift and deterioration models are inadequately validated due to a lack of iceberg or ice island deterioration data.

Field trials were conducted offshore Newfoundland and Labrador from the CCGS *Amundsen* in April 2015 to compare the precision of terrestrial laser scanning (TLS) and aerial structure-from-motion photogrammetry (SfM) for iceberg and ice island surveying. Repeat surveys with a vessel-mounted Optech Ilris-HD laser scanner and helicopter-borne aerial photography were conducted for SfM 3D point cloud generation. A precision assessment was conducted by comparing all points clouds associated with a particular technique and field target in CloudCompare (V. 2.6.2) software. Outputs were used to calculate the minimum magnitude of deterioration (T_{mag}) which must occur before confident detection by a survey technique.

The quality of deployed GPS unit was a key determinant of T_{mag}. The SfM T_{mag} values were between 2.5 m and 0.40 m when associated with the deployment of lower-quality tracking beacons and dual-frequency GPS units, respectively. Mass estimates differed between surveys by 4% for SfM surveys with the high quality GPS units. T_{mag} and mass estimate results decreased in quality with TLS surveying.

We have successfully applied both SfM and TLS surveying to free-drifting icebergs by correcting for survey target movement. Researchers can now use the T_{mag} values in their study of iceberg or ice island deterioration for industrial or other research applications.

Glacier Velocity Variation and Surge Type Glaciers on Manson Icefield, Southeast Ellesmere Island 1993 - 2016

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Strong summer warming has been known to be a dominant factor influencing the mass balance of glaciers in the Canadian Arctic since the start of the 21st century, but little is currently known about the variability in velocity of these glaciers.

The study is therefore assessing the factors that control glacier motion in the Canadian Arctic, with a particular focus on surge-type glaciers. Manson Icefield has been chosen as the study location, since it contains a high percentage of tidewater glaciers and many have previously been observed to surge. Using feature tracking of repeat pairs of Landsat and RADAR imagery, the evolution in velocity of glaciers across Manson Icefield has been quantified on an almost annual basis since 1993. This provides information on the spatial and temporal distribution of glacier surges, and information on where along the length of a glacier the surges initiate. Preliminary results have captured the motion of Mittie and Clarence Head South glaciers in their active and quiescent phases, with peak velocities of > 1 km yr^{-1} recorded on Mittie Glacier in the early to mid-2000s.

Black Carbon in Arctic Air

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Black carbon is a significant greenhouse gas, which contributes to climate change and in high enough concentrations can cause detrimental effects to human health. The purpose of the study is to determine the dominant source of black carbon in Canada's Arctic air in order to obtain a better understanding of its origins and to aid in the creation of policies to better regulate their emissions. Samples of black carbon from Canada's Arctic were analysed using filter paper in order to evaluate the origin of the black carbon. To determine whether its source is anthropogenic or natural, the C^{14} content was evaluated. C^{14} is produced during natural combustions of biomass and is not present during the combustion of petrochemical substances. Therefore, the filter papers were combusted at different temperatures, their gasses collected and then graphitized in order to properly determine their isotopic components.

The results for the analysis will be further discussed.

Impact of climate change on flowering and fruiting times of Nunavut Arctic plants

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Arctic temperatures are rising at a rate double the global average. Flowering and fruiting times (phenology) are often sensitive to temperature and, as the climate warms, the phenology is expected to advance. There are few studies on the impact of climate change on Nunavut Arctic plant phenology. My objectives were to study changes in Nunavut Arctic plant phenology and phenological temperature-sensitivity of Nunavut Arctic plants. As a first step, I compared flowering times of 20 species common to Iqaluit, Baffin Island and Lake Hazen, Quttinirpaaq National Park, Ellesmere Island. Secondly, to assess the impact of climate change, I used meteorological data and three sources of phenological data (i) 20years of phenological monitoring at Tanquary Fiord, Quttinirpaaq National Park; (ii) herbarium specimens of 23 species collected from across Nunavut over 120 years and; (iii) phenology of six species along an elevation gradient at Lake Hazen. Most Nunavut Arctic plants I studied are responding to the rising temperatures of climate change and I suggest this is through phenotypic plasticity in the short term and evolutionary adaptation in the long term. Later-growing-season phenological events are advancing more than earlier-growing-season events, reflecting Nunavut's pattern of later-growing-season temperatures rising more than earlier-growing-season temperatures. There were inter-species and inter-regional differences in phenological temperature-sensitivity and I suggest this could lead to altered ecological community structure. My findings were consistent at different spatial scales, from microclimates to Nunavut's 2.1 million km^2; at different temporal scales from the 20years to 120years and using the three different data sources.

An alternate method for sample preparation for radiocarbon (^{14}C) dating of groundwater

Vladyslav Rayda, Lihu Yang, Xiaolei Zhao, Ian Clark.

Radiocarbon from Dissolved Inorganic Carbon (DIC) and Dissolved Organic Carbon (DOC) can be used to date old groundwater. (Kalin, R. M. 2000). Traditionally, the DIC is extracted from groundwater by reacting the DIC species with acid to obtain gaseous CO_2. The CO_2 is then converted to pure carbon by the process of graphitization at high temperature in the presence of iron catalyst (Kitagawa et al, 1993). Similarly, the DOC can be extracted from groundwater by several different methods including UV photo-oxidation, wet oxidation, freeze-drying, evaporation in air, evaporation in nitrogen, and evaporation under a vacuum. All of these methods result in the isolation of DOC in form of gaseous CO_2 that is later turned into pure carbon using the graphitization method before the radiocarbon analysis in the Accelerator Mass Spectrometer (AMS) is possible Brock et al, 2010). The extraction and preparation of samples using the graphitization method is lengthy and requires extensive labor. (Pohlman et al, 2000)

Barium carbonate ($BaCO_3$) can also be effectively used for analyzing $\Delta^{14}C$ according to a preliminary study conducted in the A.E. Lalonde AMS Laboratory at the Advanced Research Complex of Earth and Environmental Sciences of the University of Ottawa. This method of sample preparation is unsophisticated, less labor intensive, and is expeditious when compared with the traditional graphitization method. Because of the simplicity of sample preparation, it is possible to isolate DIC in groundwater directly in the field which provides a significant advantage when working in remote locations such as the Upper Ogilvie River, Yukon Territory. This study focuses at the feasibility of obtaining accurate groundwater ages from samples obtained in remote locations using $BaCO_3$ as the carbon source for radiocarbon dating.

Long Term Trends of Cadmium and Mercury in Arctic Air

Tannor Steudle

For the Past 25 years scientists have studied pollutants in subarctic air and the effects of these pollutants on the ecosystem and indigenous people. Mercury and Cadmium are both pollutants that are introduced to the biosphere by anthropogenic and natural sources or by recycling. Jack's initial research and publications used arctic air samples collected from the Canadian Radiological Monitoring Network from the Arctic sites, Resolute (74.7_N, 95.0_W, elevation 64m) and Coral Harbour (64.2_N, 83.3_W, elevation 59 m), in Nunavut, Canada. These findings show decreasing levels of Cadmium and Mercury in arctic air particulate.

My role with Jack is to help him further study his initial findings. We have been studying sample from Arctic peat core, provided by Brittany Gelinas, for levels of Mercury and Cadmium. Peat is a deposit of partially decomposed vegetable matter. Since organic matter accumulates over a long period of time we can use the plant remains to model past environments. We used to various standards diluted in HNO3 to concentrations of 0. 5, 1 , 2, and 4 ppb and placed them in mass spectrometer. Currently we are still working through the data but it looks like our findings support Jack's initial research.

Local and regional scale variability of snow depth, snow bulk density, and snow water equivalent in the Snare River basin, Northwest Territories: implication for sampling strategies

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End of year, basin-wide, snow water equivalent (SWE) is an important hydrologic variable for use in hydro-power management. For large basins, SWE is often estimated using a sparse network of snow survey sites. In northern basins increasing the number of sites to improve SWE estimates can be costly. In this study, historical snow surveys (1978-2016) conducted by the NWT Power Corporation across the ~15,000 km^2 Snare River basin near Yellowknife, NWT at a network of ten survey sites were analyzed to identify local and regional scales of variability in SWE, snow depth, and snow bulk density. Snow regimes were found to differ significantly between sites above vs below treeline. The coefficient of variation of SWE in sites above treeline was 0.74 compared with a much lower value of 0.28 below.

The regression R^2 between snow depth and SWE above treeline was 0.91 compared to 0.55 below. Considering the time required to perform a snow depth measurement compared to a density measurement, optimal sampling ratios were computed. Above treeline a ratio of 10:1 depth to density measurements was found to be optimal while below treeline the ratio was 5:1. Finally, on a larger regional scale, above treeline sites were poorly correlated to each other while below treeline sites correlated well. Above treeline sites consistently contributed approximately three times the error to basin wide SWE estimates than sites below. Therefore, sampling strategies can be designed to efficiently use the differences between in-site variations and between-site variations in different terrain types.

Influence of Vegetation Succession on Active Layer Thickness and Ground Temperatures (1978-2016), Illisarvik, Western Arctic Coast

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There are numerous thaw lakes and drained thaw lake basins in Canada's western Arctic coastlands. The majority of the drained lakes formed catastrophically. Permafrost and vegetation have subsequently developed in these lake basins. Illisarvik is a long-term research site, experimentally drained by Dr. J. Ross Mackay in 1978. The purpose of our research was to analyze change in active layer thicknesses and ground temperature that have occurred in response to vegetation development within the basin. Annual monitoring in August of thaw depth and ground temperatures, and of snow depth in April has been accompanied by assessment of vegetation establishment in the lake basin from 1978-2016. The basin has three primary vegetation units: willows around the former lake edge and towards the topographically sheltered north side of the basin; graminoids in southern and central portions; and bare ground in the middle of the lake basin. Characteristic snow depths in the units and in tundra surrounding the basin are 60, 40, 20, and 20 cm respectively. Snow depths in the willows are continuously increasing while the other vegetative units have no change. In the past 20 years, active layer thickness in the willow unit has increased by about 20 cm, not changed in the grass unit, was disrupted by flooding in the bare ground area and increased up to 5 cm in the surrounding tundra. Where permafrost has established throughout the talik, temperatures have increased by 1 to 1.5 °C in willow areas since 2003 in association with increased snow depth. The mean annual ground temperature in the surrounding tundra is -6.8 °C, while in the basin it is about -3 °C where the former talik has frozen through. The basin is not continuing to cool towards tundra ground temperatures due to growth of vegetation and associated increases in snow depth.

Spatial variability of carbon emissions within a drained lake basin and its surrounding tundra, Illisarvik, NT.

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In 1978, a small thermokarst lake known as Illisarvik on Richards Island (NT) was drained. Since then, vegetation succession and permafrost growth have been monitored and have demonstrated great spatial variability throughout the basin. This study aims to relate vegetation and soil conditions to the spatial variations in summer CO_2 and CH_4 emissions in this environment to better understand the interaction of these controls on carbon fluxes from Arctic sites. The field site covers a 500 m x 350 m area where ten vegetation units including one unvegetated area on the shoreline of a pond were selected to represent the spatial variability of the basin. A static, non-steady state chamber system was used to measure CO_2 and CH_4 emissions from collars with and without aboveground vegetation in each vegetation unit. Microclimate characteristics including thaw depth, soil moisture and near surface soil temperature were monitored. Radiocarbon dating of the gas fluxes was also done to help understand the source of carbon released from these soils. We hypothesized that carbon emissions associated with heterotrophic and belowground autotrophic respiration will be greatest in areas that are moist and warm with deep active layers in areas with taller vegetation. Thaw depth was deepest (> 100 cm) at sites with willows (both tall and low willow shrubs) and the bare sand at the shoreline. However, emissions of CO_2 were greatest at the wet sedge sites and the dwarf shrub tundra site where thaw depths were less. CO_2 emissions at all sites were greater with aboveground vegetation intact. As expected, CH_4 emissions were greatest at the wettest sites dominated by sedges. The age of the carbon in emitted CO_2 at each site was modern except for the one shoreline site without vegetation where carbon was dated as 2000 BP. These results add to our knowledge of the functioning of a post-drainage Arctic ecosystem and its possible impacts on the climate through greenhouse gas emissions.