ArcticNet

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Arctic Change 2020 Conference Book of Abstracts

Compilation de Résumés pour la Conférence Arctic Change 2020

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ABSTRACTS

Oral Presentations

ID: 355

Spatiotemporal variability of surface water pCO_2 during the ice melt season in Hudson Bay, Canada

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Abstract: Hudson Bay is a subarctic/Arctic continental shelf sea that receives nearly one-third of Canada's river discharge and transitions from complete ice cover in winter to open water in summer. However, there have been few studies of air–sea CO_2 exchange in Hudson Bay, especially during the sea ice melt season. In fact, Hudson Bay has not been included in many global and Arctic-specific carbon budgets, which is a significant gap considering that the total area of this region (including Hudson strait) is about 16% of the total Arctic shelf area. In this study, the first spring and early summer measurements of pCO_2 and estimates of air–sea CO_2 fluxes in Hudson Bay and Hudson Strait showed that the area was mainly a sink for atmospheric CO_2, as a result of the dominance of sea-ice meltwater. We observed spatially limited pCO_2 supersaturation near river mouths and beneath sea ice. We calculated an average net CO_2 flux of about -5 mmol CO_2 m^{-2} day^{-1} (-3.3 Tg C; into the ocean) during the spring and early summer seasons and about -7.2 Tg C during the open water season. These estimates are larger than previous ones for Hudson Bay in the late summer and autumn seasons, although our data still indicate that the bay, on average, is a weaker CO_2 sink than most other Arctic shelf seas, largely due to the influence of river waters.

Session: MAR39 — Coastal oceanography of Hudson Bay and James Bay

ID: 51

Facing the challenge of permafrost thaw in Nunavik communities: high resolution permafrost maps, geotechnical characterization, and numerical modelling of impacts of climate change in support of land use planning

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Abstract: High-quality scientific information on permafrost properties and temperature regime, risk of occurrence of natural hazards, and expected timing of permafrost thaw is required to plan the growth of Nunavik communities and improve the quality of "urban" life, as the high growth rate of the population calls for housing expansion phases and improvement of public infrastructure. Under research contracts to Centre d'études nordiques from the Government

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of Quebec, particularly from the Ministère des Affaires Municipales et de l'Habitation, a major permafrost mapping program was implemented to provide knowledge in support to the Kativik Regional Government (KRG) and to the communities. A team of experts and students helped by local community members developed an innovative multi-technique approach to map permafrost. The methodology integrates interpretation of old and recent air photographs, remote sensing, the creation of digital elevation models, compilation of available geotechnical data from the grey literature, surficial geology mapping, sampling in soil pits, permafrost coring, geophysical surveys, geotechnical laboratory analyses of samples, and installation of thermistor cables and data loggers. All the observational and technological data were compiled in a GIS to produce four maps for each community: (1) a surficial geology map, (2) a permafrost condition map (based mostly on ground-ice content), (3) a map of potential for construction, and (4) a hazard risk assessment map. Local ground temperature data were used to calibrate community-scale numerical models to assess the probable rates of future permafrost thaw following greenhouse gas concentration scenarios RCP 4.5 and RCP 8.5. All the maps, updates, data tables, and scenarios for changes are publicly available and shared on a continuous basis with KRG and the communities and shall be used by the Government for policy-making. However, Inuit aspirations, culture and leadership remain keys in how to integrate geotechnical knowledge in planning a safe future for the communities.

Session: IHE21 — Arctic communities adapting to permafrost thaw

ID: 695

Arctic Fresh Inc.: a social enterprise responding to the growing, exorbitant cost of food in northern communities

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Abstract: Arctic Fresh is an Inuit owned Social Enterprise, with its head office based in Igloolik, Nunavut. It has been catering to customers located in Nunavut's Baffin region since 2016. We started as Recinos LTD and went through a name change to Arctic Fresh Inc in 2017. The company operates a variety of business lines including a state-of-the-art online grocery store, a sealift ordering service, a joint venture for construction projects (Arctic Fresh Projects), a joint venture between Arctic Fresh and Sysco to provide fresh foods to various mining companies such as Baffinland, a joint venture aviation company, and also a training and consulting arm. There are numerous other business opportunities that are currently being developed and hope to launch in Fall 2020. Arctic Fresh's social mandate is to fight food insecurity and build local capacity to empower individuals in communities. Arctic Fresh is committed by contributing to programs like the Igloolik food bank, Igloolik Elders society, school programs, Christmas "No one goes hungry" initiatives, and many more. Arctic Fresh also sponsors local harvesters' programs; these programs harvest local foods and distribute them to elders and people in need within the community. Arctic Fresh won the social enterprise of the year for the Arctic and also won the national social enterprise of the year for 2019 for their work in Nunavut. On www.arcticfresh.ca and www.sealift.arcticfresh.ca, which are the online grocery store and sealift ordering sites, Arctic fresh retails a wide range of perishable and non-perishable goods at affordable prices. This includes standard retail product lines including fresh fruits and vegetables, fresh and frozen meats, canned and frozen foods, as well as dairy products. On the sealift site specifically, there is a wide assortment of wholesale product options for customers looking to purchase large volumes of non-perishables for the year.

Session: NDP52 — Social Enterprise for Arctic Change

ID: 780

Incorporating Inuit knowledge and observations of ecosystem trends into northern contaminants research

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Abstract: The Northern Contaminants program has been working to develop new ways to incorporate Inuit knowledge into contaminants research. A partnership was formed with The Arctic Eider Society and the Sanikiluaq Hunters and Trappers Association to demonstrate how

the SIKU app could provide a way for Inuit to document environmental trends and indicators associated with seal and polar bear harvesting that could better inform contaminants research and the interpretation of lab results. Elder Peter Kattuk had already been noticing changes in the diets of seals, which was particularly relevant, as changes in the trophic level at which seals are foraging could have implications for contaminant uptake in both seals and polar bears, as well indicating larger ecosystem changes. A three-year pilot study is now underway with hunters in Sanikliuaq collecting observations around seal and polar bear harvesting year-round, and with data outputs being provided to inform analysis for core contaminants programs for ringed seal and polar bear. Information collected by Sanikiluaq hunters will be presented showing ecosystem trends and characteristics among seal diets, habitats, seasonal components, and other key parameters. These data will be used by core contaminant programs to inform the interpretation of trends in lab results, explanations for potential outliers, and other ways Inuit knowledge can inform contaminants research. Our goal is for contaminant sampling programs across the north to use SIKU to improve engagement with Inuit communities, replacing simplistic sampling sheets to better involve Inuit knowledge in contaminants research, and more generally helping improve links between Inuit knowledge, science, and implementation of the National Inuit Strategy on Research for the benefit of Inuit.

Session: KEP37 — How Inuit Qaujimajatuqangit (knowledge) fits into research

ID: 580

Spatial and temporal variability of ocean acidification in the eastern Canadian Arctic

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Abstract: The eastern Canadian Arctic is a key region connecting the High Arctic and the North Atlantic. Ocean acidification in the region is influenced by the pan-Arctic changes and the local drivers. The Arctic outflow through the Canadian Arctic Archipelago has a high content of Pacific Water with an inherently elevated concentration of dissolved inorganic carbon (DIC) with lower salinity, and is therefore more acidic, compared with the receiving Atlantic Water. The Pacific inflow is further modified with fluvial input, sea ice meltwater, terrestrial carbon, biological activity, and uptake of atmospheric CO_2 during the transit through Beaufort Sea and Canada Basin. These corrosive waters can be traced along Baffin Island Shelf/Slope to the south of Davis Strait. Temporal variation of Ω in the Arctic outflow hasn't shown a steady decrease for the past 20 years as observed in other regions. The unexpected decrease in DIC and alkalinity concentrations in the Arctic outflow was observed in 2013 and 2015. Corresponding lower salinity in these years implies dilution by the freshwater at the source region in the Arctic. The alkalinity to DIC ratio in low salinity waters contributes to the state of ocean acidification in the Arctic outflow, rather than anthropogenic CO_2 uptake. Sea floor methane seeps are widespread along continental margins of the Canadian Arctic. Methane seeps are perturbing the local carbonate system through the addition of CO_2 to the water column either directly or through microbial methane oxidation. However, no evidence of enhanced ocean acidification in the vicinity of these sites off Baffin Island and northern Labrador was observed. Instead, concomitant release of other elements, such as hydrogen sulfide ions, contributed to the increase total alkalinity, pH, and Ω, possibly to the benefit of calcifying organisms in an environment bordering on aragonite undersaturation.

Session: MAR40 — Air–Sea Gas Exchange and Biogeochemical Processes in Arctic Shelf Seas

ID: 219

Transforming community-driven science into a successful Arctic Inspiration Prize nomination

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Abstract: Since 2012, the Arctic Inspiration Prize (AIP) has been recognizing and promoting extraordinary and resourceful northern teams and their innovative projects taking place across the Canadian Arctic, from Yukon to Nunatsiavut. Each year, up to $3 million is awarded across three prize categories: one

$1 million prize, up to four prizes of up to $500 000, and up to seven youth prizes of up to $100 000. The AIP is having a far-reaching impact across the North and the South by bridging Indigenous knowledge with science to address issues facing northern communities. Many successful initiatives have received AIP funding to carry out their projects focused on community-driven research, science training for northern youth, sustainable northern housing, and the use of innovation, science, and technology for improving food security and health. This presentation will highlight the successful, community-driven science and research initiatives that have been spearheaded by AIP laureates and outline the steps needed to be part of a successful, collaborative, science-based AIP nomination.

Session: KEP38 — Arctic Inspiration Prize: Exploring the unique potential of Northern-led community science projects

ID: 651

Inhabiting Nunatsiavut seascapes and landscapes during the nineteenth century: new perspectives on Nunatsiavumiut involvement in the Moravian market economy

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Abstract: According to the studies of the archives, the establishment of missionary settlements of the Moravian Brethren in Labrador initiated significant changes in the subsistence activities of Nunatsiavumiut. For the Nunatsiavumiut participating in it, the new Mission-centered economic system implied a shift from a self-managed subsistence to one geared to produce surpluses of seal skins and blubber, fish, and furs that were exchanged to obtain manufactured goods and European food stuffs and raw materials. By the mid-19th century, this system implied an abandonment of communal winter residential patterns, weakening kin-based systems of social solidarity and reciprocity. This economy relied on inhabiting seascapes and landscapes whose annual dynamics revolve around seasonal cycles of freezing and thawing of snow and the sea ice, and migrations of land and sea mammals and fish migrations. The seasonal predictability of the seascape was affected by a cooling event (circa. 1815–1850), followed by a climate warming, increasing the economic precariousness of the families who accumulated debts to the Mission store during periods of scarcity. In that context, by shifting the focus away from the Moravian archives to the archaeological record of Inuit habitation, production, and consumption, this project seeks to contribute to a new understanding of the choices Inuit households made regarding their involvement in this market economy in the later nineteenth century. The excavation of the House 4 of South Aulatsivik 6 site (HdCi-20), located on South Aulatsivik Island (Nain, Nunatsiavut) showed that the structure displays hybrid characteristics evoking both a cabin and a semi-subterranean sod house. The faunal remains and the artifacts recovered on the site suggest that its inhabitants adopted non-specialized hunted activities and an opportunistic involvement in the colonial economy. Further research will precise the seasonality of the occupations of the dwelling and the habitat practices of the people who inhabited it.

Session: IHE12 — Spatial and temporal perspectives on climate changes and their implications for human resilience and adaptation in the Arctic

ID: 693

Using drone technology to investigate flight initiation distances of Common eiders to foraging polar bears

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Abstract: Polar bear (*Ursus maritimus*) predation of Common eider (*Somateria mollissima*) nests on Mitivik Island (Nunavut, Canada) has increased dramatically in recent years due to reductions in Arctic sea-ice. Although eiders have evolved high nest attendance rates to cope with their natural avian predators (e.g., Herring gulls, *Larus argentatus*), polar bears represent a novel predator archetype that eiders have relatively little evolutionary experience with. Eiders may be more vulnerable

to polar bear nest predation due to their inability to sense the specific predator cues indicative of nest discovery. We investigated the cues that influence eider flush initiation distance and flushing behaviours in response to novel polar bear predators. We collected drone video of polar bears foraging in the Mitivik Island eider colony in July 2017 and reviewed video for flushing eider females. We constructed path diagrams to examine the influence of predator characteristics and environmental variables on eider flush distance, style, and nest fate, including, polar bear travel and gaze direction relative to eider nest location, bear travel speed, number of gulls in the vicinity of the nest, neighbouring eider behaviour, and the visibility of the surrounding area to each eider nest. We reviewed 166.3 min of polar bear foraging from 11 to 20 July and recorded 200 observations of eider flushes from 193 individuals (seven repeats). Mean flush distance of eiders to polar bears was 9.1 ± 4.1 m. The most parsimonious path diagram included bear gaze angle, bear speed, gull presence, and eider viewshed. Nests that were predated by bears had shorter flush distances, but flush style did not statistically impact nest fate. Our results provide insight on the predator and environmental cues that inform eider nesting strategies in response to bears, and how those strategies influence eider nest fate.

Session: TER77 — Climate change and Arctic birds: unifying disciplines for assessing the risk to Arctic avian communities

ID: 632

Progress in detection and monitoring of transportation infrastructure in the Arctic based on satellite data

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Abstract: Environmental impact assessment of transportation infrastructure across the entire Arctic requires its consistent detection as a first step. Comparably high spatial resolution satellite data and free access are needed. Here, we review recent progress in monitoring the land surface close to Arctic coasts (focus region of HORIZON2020 Nunataryuk), specifically the distribution of human impacted areas including transportation infrastructure beyond of what is represented in databases such as OpenStreetMap. The analysis is based on Sentinel-1 and Sentinel-2. Both offer 10 m nominal resolution for specific bands and modes and are freely available across the entire Arctic. The multi-spectral information from Sentinel-2 is not only of value for discrimination of tundra types but also non-vegetated areas. The Synthetic Aperture Radar mission Sentinel-1 provides added value through representation of land surface structure features. A combination of both allows significantly improved characterization of landcover and land use over larger areas. The data set forms the basis for subsequent analyses of environmental change in the proximity of transport infrastructure. The added value of machine learning techniques will be discussed and results for the entire Arctic coastline (+100 km inland) presented. Further on, permafrost change information provided through the ESA CCI+ Permafrost project is combined with the new maps. The CCI+ Permafrost data sets cover 1997–2018 (annual values) for ground temperature, active layer thickness, and permafrost fraction with 1 km gridding.

Session: IHE20 — Northern Roads and Railways: Social and Environmental Effects of Transport Infrastructure

ID: 644

Governance of the CCPN, CCHAP, and ICBCM Programs: a discussion on strengths and challenges from the Liaisons' perspective

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Abstract: Communities, organizations, and residents in the north are being confronted by the impacts of climate change on a regular basis. Permafrost slumping, late freeze-up, earlier thaw, and decreased ice route safety during winter months are just a few examples of well-documented climate change impacts. Elders and Indigenous Knowledge/Inuit Qaujimajatuqangit holders have long understood and observed climate change impacts on the land. Climate change adaptation projects in the north must take into account the diversity of rich community perspectives, emerging science and policy

recommendations, as well as financial and logistical considerations that are unique to the Arctic environment. Mechanisms that support transdisciplinary and multi-sectoral collaboration are the key to effectively moving climate change adaptation projects forward in a way that is reflective of community voices and needs. The Climate Change Committees on Adaptation in each region/jurisdiction is one such mechanism. Each Committee consists of members representing each region/jurisdiction in a way of their choosing. Indigenous organizations, government departments, and community members are included. The Committee works collaboratively to deliberate the merits of proposed projects and provide feedback to applicants. This results in both improved project methodologies and the rethinking of project approaches that are more responsive to communities. These committees place priority on the community's engagement and voices in decision-making, encourages the strengthening of community capacity, and promotes the wide dissemination of communication of project results. This presentation will discuss strengths and challenges of current approaches and opportunities for improvement of making climate action funding more easily accessible to communities in northern regions/jurisdictions and to ensure that climate action projects within the north reflect the voices and needs of its communities.

Session: NPD74 — Perspectives on supporting and empowering northern communities in undertaking climate action

ID: 816

Glaciers and nutrients in the Canadian Arctic Archipelago

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Abstract: With over 300 tidewater glaciers, the Canadian Arctic Archipelago (CAA) is vulnerable to climate warming and is a hotspot for glacial retreat and meltwater runoff to the ocean. In contrast with Greenland and Antarctic systems, CAA glaciers and their impact on ocean processes remain largely unexplored. Here, we investigate how CAA glaciers impact macronutrient and micronutrient delivery to surface waters, and how these processes may be affected as glaciers retreat. We do this by comparing the nearshore coastal zone water column properties in a continuum of locations, spanning glaciated to non-glaciated, in Jones Sound. We found that surface waters of glaciated regions contain significantly more macronutrients (nitrogen, silica, and phosphorus) than their unglaciated counterparts as a result of upwelling driven by rising submarine discharge plumes. We observed this entrainment at deep (>200 m) and shallow (>30 m) grounding lines in the CAA. The strength of this upwelling appears to be driven by the volume of tidewater discharge. We also observed extremely high concentrations of micronutrient metals (iron and manganese) in glaciated sites, delivered via glacial discharge directly. We suggest that although glacier-driven upwelling is a significant source of limiting macronutrients to local surface plankton communities, direct glacial discharge is an important source of metal micronutrients that, given Jones Sound's important role in modifying water masses flowing into the North Atlantic, may have consequences for regional metal cycling. This work identifies mechanisms by which macronutrient and micronutrient delivery to local and regional marine waters may change as CAA glaciers continue to retreat.

Session: MAR45 — Ocean dynamics in the Arctic Ocean and connected waters

ID: 59

Regional permafrost assessment for supporting the Kugluk Territorial Park Access Road and Boardwalk Trail Construction, Kugluktuk, Nunavut

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Abstract: Significant damage is witnessed in Kugluk Territorial Park ATV trails such as disturbances of the vegetation cover, formation of mud puddles, multiple landslides, and intense gully erosion. The Government of Nunavut's Parks and Special Places (NP&SP) department and community leaders are working on building a suitable long-term access route to access the park area based on permafrost scientific knowledge. This collaborative research project aims to characterize the permafrost conditions along the new road corridor linking the Kugluk Territorial Park access road and boardwalk trail and supporting the community in planning and designing the new road concepts by suggesting mitigation techniques adapted to the local permafrost conditions. Other important objectives are to train local permafrost experts and to help the community in addressing its concerns with climate change, with an elders–youths knowledge transfer approach. Two light road infrastructures are being built; a summer gravel road in the form of a thin embankment to access the park and a wooden boardwalk trail locally designed to allow the circulation of ATVs and UTVs on the tundra within the park. The applied multi-technique research methodology includes high-resolution mapping of surficial geology and permafrost conditions, interpretation of high-resolution air photos and satellite imagery, digital surface model, ground penetrating radar surveys, permafrost coring, geotechnical laboratory analyses, ground temperature monitoring stations instrumentation, and regional geothermal modeling. Observations and results indicate that the dominant issue for permafrost stability and challenge for the roads construction is the presence of a dense network of 300 ice wedges and a wide thaw-unstable permafrost corridor crossing the future roads. Historical regional climate analysis shows warmer mean annual air temperature (+2 °C) since 1950, longer thawing season, and milder winters. A new mitigation technique expected to reduce ice wedge degradation under the summer gravel road has been suggested and discussed with the community.

Session: IHE21 — Arctic communities adapting to permafrost thaw

ID: 247

Northern Compass

Rebecca Bisson[1] and Karen Aglukark[1]

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Abstract: Northern Compass is the 2019 winner of the Arctic Inspiration Prize, million dollar category. Our vision is to dramatically increase achievement among Northerners (youth in Nunavut and the Northwest Territories) pursuing their education and career goals after high school, enabling them to become full participants in their communities and beyond. This vision aligns directly with the intention of Arctic Change 2020 to address the emerging global opportunities and challenges facing the region, as equipping young Northerners with the skills and opportunities relevant is essential to success. Northern Compass invests in youth across the North through a number of tailored supports and activities. These are led by a diverse team, and supported by a broad and growing base of project partners. Through collaboration partners can work together to fill the gaps that exist as young people navigate their choices and next steps after high school. Over time, this will increase the number of youth attending and graduating post-secondary school, and transitioning into career and roles of leadership in every sector. Our presentation shows how these collaborations and partnerships (between communities, supportive organizations, educational institutions, and employers) can combine to invest in equitable access to education and training and are imperative to the region's growth, health, and prosperity.

Session: KEP38 — Arctic Inspiration Prize: Exploring the unique potential of Northern-led community science projects

ID: 371

After allocation: using commercial fishing rights to develop Indigenous-run fisheries

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Abstract: When governments allocate commercial fishing rights to Indigenous groups, they generally do so with the understanding that Indigenous groups will be able to use allocated rights to diversify livelihood strategies, advance resiliency, and support self-determination. However, whether and how this is done remains

unclear. In the Arctic and elsewhere, where Indigenous groups have obtained or been allocated rights to fish commercially, the number of Indigenous fishers and Indigenous-run fishing boats remains disproportionately low compared with rights-held. In an attempt to understand how Indigenous groups can benefit from allocated fishing rights, and whether the intended goals of these allocations are met, we draw on evolving lessons learned from New Zealand, where Māori have held commercial fishing rights for almost 40 years. Many of these hold relevance to groups across Inuit Nunangat, especially those in early stages of developing fishing capacity and forming independent fisheries governance structures. We identify four key types of challenges that increase the risks Indigenous groups assume when using their rights to support Indigenous-led fisheries. These relate to: (1) equity in the distribution of fishing rights within Indigenous groups, and the responsibility leaders hold to manage a limited number of rights to benefit the collective; (2) access to the means of production, and the challenges Indigenous fishers face in obtaining capital to purchase a boat, gear, and hire labor; (3) access to markets, and the need for Indigenous groups to develop new market relationships to realize the benefits their rights are supposed to imbue; and (4) limited authority to govern harvest levels and spatial overlap with other resource use activities (mining, forestry, agricultural expansion, shipping, etc.), magnified by Indigenous groups' lack of research capacity. These challenges suggest that federal governments may need to allocate additional resources to support Indigenous fisheries, and we discuss mechanisms to do this.

Session: NDP51 — Northern engagement and resource management

ID: 307

Eggs in hot water, and how melting glaciers could allow Arctic cod larvae to survive extreme summer temperatures in northwest Greenland

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Abstract: Arctic cod (*Boreogadus saida*) eggs and larvae have narrower thermal tolerance than juveniles and adults. Understanding their response to increasing temperature is, therefore, crucial to forecast the species response to climate change. In this study, we investigated the relationship between sea surface temperature in fjords and coastal waters of Northwest Greenland in the summers 2017–2019 and the survival of Arctic cod early life stages over the hatching season. Warm years were associated with partial recruitment failures resulting from thermal stress to the eggs and larvae hatched late in the season. Using past environmental conditions, we forecasted an imminent decline in Arctic cod recruitment in the regions of Uummannaq and Disko Bay. Observations from fjords suggested that glacial meltwater could create a subsurface thermal refuge allowing Arctic cod larvae to survive despite extremely high summer sea surface temperature (ca. 10 °C). As the Greenland ice sheet is melting at an unprecedented speed, the mechanism underlying the "glacial meltwater summer refuge hypothesis" could curb some of the negative effects of ocean warming on the survival of young Arctic cod in northwest Greenland and other Arctic fjord systems.

Session: MAR41 — Greenland marine ecosystems

ID: 534

The ice factory of Hudson Bay: spatiotemporal variability of the polynya in northwestern Hudson Bay

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Abstract: Within the dynamic seasonal ice cover of Hudson Bay, there is a large latent heat polynya that forms throughout winter in the northwest as a result of strong northwesterly offshore surface winds. Polynyas are known to be biologically important and contribute to the regional ice mass balance, but the role of this

polynya in the Hudson Bay environment has yet to be studied. Using a thin-ice algorithm applied to the 16-year record of daily AMSR-E and AMSR-2 passive microwave observations, we examine the spatial and temporal variability of this polynya during winter. The polynya is observed to be present nearly every day during these 16 winters, although it is highly variable with a median size of 7178 km^2 and a maximum size of 63 923 km^2. The polynya promotes the formation of on average 89.9 km^3 of new ice during winter, which is 11.1% of the regional end-of-winter ice mass balance that forms over only 5.6% of the regional area. Offshore wind speeds are found to be significantly correlated with ice production: they explain 63.8% of the variance in ice production and for every 1.0 m s^{-1} increase, drive a 24.85 km^3 increase in ice production. Broadly, years with strong (weak) offshore winds are characterized by larger (smaller) polynyas and more (less) ice production, although there is a discrepancy between winters with persistent large polynyas and winters with small polynyas that undergo large, episodic openings. Spatially, ice production is focused in the southern end of the study region, south of Rankin Inlet, and concentrated in a narrow band along the landfast ice edge of northwestern Hudson Bay before declining moving offshore. Ultimately, the highly variable yet persistent polynya in northwestern Hudson Bay is shown to be driven by offshore winds and significantly contribute to the regional ice mass balance.

Session: MAR39 — Coastal oceanography of Hudson Bay and James Bay

ID: 101

Jumping species and borders: transmission of *Bartonella* spp. in a terrestrial Arctic ecosystem

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Abstract: *Bartonella* spp. are zoonotic, Gram-negative bacteria transmitted by direct contact with infected animals and hematophagous arthropod vectors. Three species of *Bartonella* (*B. vinsonii berkhoffii*, *B. rochalimae*, and *B. henselae*) were detected in the blood of live-trapped Arctic foxes, *Vulpes lagopus*, in the region of Karrak Lake, Nunavut. Avian nest fleas were identified as potential vectors for *B. henselae* and *B. vinsonii*, suggesting that Arctic foxes may be exposed while preying on migratory geese, their eggs, and their goslings. However, it is unknown whether nest fleas can maintain *Bartonella* spp. over the winter and if geese and rodents serve as migratory and reservoir hosts, respectively. Thus, we determined the prevalence and species of *Bartonella* in: (*i*) nest fleas collected from goose nests prior to the arrival of migratory geese in May and during peak incubation in June, (*ii*) snap-trapped Arctic rodents and associated fleas, and (*iii*) migratory geese shot upon arrival at the colony. Using polymerase chain reaction analyses, *Bartonella* spp. were detected in 46% of pooled fleas from nests in June ($n = 26$), 70% of pooled fleas from rodents ($n = 10$), 5% of rodents ($n = 21$), and 1% of geese ($n = 82$). *Bartonella vinsonii berkhoffii* was detected in a goose, *B. rochalimae* and *B. vinsonii berkhoffii* were detected in nest fleas, and *B. rochalimae* and *B. grahamii* were detected in rodent fleas. None of the pooled fleas from nests in May contained *Bartonella* DNA, suggesting that the bacteria may not overwinter and that annual reintroduction by migratory geese may be required. This study demonstrates that multiple species of *Bartonella* are present in the Karrak Lake ecosystem and that endemic species occur in Arctic rodents and rodent fleas. White geese and their associated fleas may represent an emerging mechanism of two-way transmission of *Bartonella* spp. between terrestrial Arctic and temperate ecosystems.

Session: IHE11 — Arctic One Health: Gathering and Mobilizing Multiple Knowledge Type for Healthy Animals, Communities, and Environments

ID: 201

The Yukon Youth Healthcare Summit: increasing Indigenous representation in healthcare fields through youth engagement

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Abstract: The Yukon Youth Healthcare Summit aims to increase the representation of Indigenous Yukoners in post-secondary education in healthcare-related fields. The project was awarded a 2019 Arctic Inspiration Prize in the youth category to address this critical need. The summits will expose Yukon youth to the healthcare professions available to them, inspire them to pursue post-secondary education, and support them through their journeys. This will be achieved through four, five-day Healthcare Summits for youth ages 14–18, in partnership with the Whitehorse General Hospital (WGH) and other organizations. Youth from communities across the territory who are interested in healthcare are encouraged to join us in Whitehorse to participate in a Summit in 2021. Their five days will be fun and engaging, making use of experiential learning through the Simulation Center at WGH and participating in the "Healthcare Fair" workshops hosted by healthcare professionals from diverse fields to provide insight into the paths through healthcare education. Participants will also have the opportunity to take a Standard First Aid certification course. This experience will demonstrate to students that higher education can lead to a meaningful career and encourage them to graduate from high school and pursue higher education.

Session: KEP38 — Arctic Inspiration Prize: Exploring the unique potential of Northern-led community science projects

ID: 423

Geohazards caused by massive ice below the Dempster Highway, Yukon: an overview and some possible adaptation approaches

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Abstract: The melt of massive ice (i.e., large masses of ground ice, including ice wedges, pingo ice, buried ice, and large ice lenses) can result in major damage to transport infrastructure and potentially serious geohazards. Such ground ice is present under the Dempster Highway, the first all-weather year-round road route connecting the Canadian road network with the Arctic Ocean, in Canada. Permafrost conditions were investigated underneath a 135 km section (from 65 to 200 km) of the Dempster Highway, where ongoing maintenance issues have been linked to permafrost thaw. Geophysical data, aerial imagery, and borehole information were combined with field investigation to identify geohazards and thaw-sensitive permafrost underlying the highway. The presence of 8–10 m thick ice-wedge complexes and buried glacial ice bodies were investigated through mapping of surficial geology, periglacial landforms, and features related to permafrost occurrence. Although some sites are currently impacted by the melt of massive ice such as ice wedges (e.g., 93, 116, and 123 km), other sites underlain by buried glacial ice may not become critical for several years or decades. The study results will be used to develop recommendations for Yukon Highways & Public Works regarding strategies to adapt to climate change for the highway, allowing Highways & Public Works to prioritize maintenance areas, develop remediation methods for high-risk highway sections, and implement monitoring approaches to have advance warning of the need for more aggressive responses. Similar approaches have been used along sections of the Alaska Highway, YT, which resulted in the implementation of remediation techniques, demonstrating potential transferability of the methodology to other location such as the Inuvik–Tuktoyaktuk Highway or arctic airports.

Session: IHE20 — Northern Roads and Railways: Social and Environmental Effects of Transport Infrastructure

ID: 398

Temporal trends in perfuoroalkyl acids concentrations and association with country foods consumption during pregnancy in Nunavik (Quebec, Canada)

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Abstract: Background: Currently used fluorotelomer alcohols (FTOHs) are transported to the Arctic and degraded in a number of perfluoroalkyl acids (PFAAs) that biomagnify in Arctic wildlife. **Objectives:** Using data from 279 pregnant Inuit women recruited as part of biomonitoring projects in Nunavik from 2004 to 2017, our objectives were to evaluate: (*i*) time-trends in plasma/serum PFAAs levels in pregnant Nunavimmiut women; and (*ii*) the associations of PFAAs levels with the consumption of country foods during pregnancy in 2016–2017. **Methods:** Individual blood sample were collected for PFAAs (perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanoic acid (PFBA), perfluorohexanoic acid (PFHxA), perfluorobutanesulfonic acid (PFBS), perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), and perfluoroundecanoic acid (PFUdA) analyses. Omega-3 and -6 polyunsaturated fatty acids (PUFA) were measured in red blood cell membranes. Their ratio was used as a biomarker of marine country foods consumption. Time-trends in PFAAs levels were evaluated using ANCOVA models. The associations between concentrations of PFAAs and country foods consumption were examined using multivariate regression models. **Results:** PFOS, PFOA, and PFHxS concentrations significantly declined in pregnant Nunavimmiut women between 2004 and 2017. Between 2011 and 2016–2017, PFNA, PFDA, and PFUdA maternal serum concentrations increased by 19%, 13%, and 21%, respectively. Ratios of serum/plasma levels of PFNA/PFOA, PFNA/PFOS, PFNA/PFHxS, and PFUdA/PFDA were significantly higher in pregnant women from Nunavik recruited in 2016–2017 compared with women from the Canadian Health Measure Survey Cycle 5, highlighting the distinct exposure profile in Nunavik. Finally, PFHxS, PFOS, PFNA, PFDA, and PFUdA levels in 2016–2017 were strongly associated with the omega-3/omega-6 PUFA ratio, indicating a positive association between marine country foods consumption and exposure to PFAAs. **Conclusions:** The exposure of pregnant women to long-chain PFAAs increased from 2004 to 2017 in Nunavik. Associations between the omega-3/omega-6 ratio and PFAAs concentrations highlights the importance of implementing additional strict regulations on PFAAs and their precursors to protect the high nutritional quality and cultural importance of country foods.

Session: IHEA13 — Evolving Perspective on Northern Contaminants Research

ID: 517

Slippery when frozen: observations of swash dynamics on ice-infested and ice-free beaches

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Abstract: Knowledge of empirical equations relating offshore wave conditions and nearshore dynamics are essential in coastal engineering and coastal risk assessments. Swash, which is the high-frequency component of coastal water levels, has been extensively studied on "warm" beaches (i.e., not affected by cryogenic processes). Several formulations have been suggested to estimate the maximum wave-runup extent on various beach types; this parameter allows the design of more efficient coastal adaptation strategies and planning. It is also essential for coastal early warning systems. Despite major scientific breakthroughs on coastal water level predictions in the last decades, only a few studies have focused on subarctic and Arctic coastal dynamics. On cold coasts, the presence of nearshore ice significantly modifies the physical processes and, therefore, can alter the efficiency of empirical predictors of coastal hazards. However, swash dynamics in such environment remains unexplored. In this study, we present a novel high-frequency analysis of swash dynamics on frozen beaches. Video recordings (4 Hz) took place on two beaches with contrasted morphodynamics (micro-tidal gravel andmeso-tidal sandy tidal flat) in the St. Lawrence Estuary. Wave-runup and setup were digitized on spatio-temporal images (timestacks) during warm (not frozen) and icy (frozen) conditions. Extracted time series of swash with semi-automatic detection algorithms were processed with spectral analysis. Offshore water levels and wave measurements were carried out during the video observations. Wave-runup statistical distributions and characteristics (swash height, skewness, and spectra) are discussed and empirical functions relating coastal

water levels and offshore forcing are proposed for frozen environments. Results indicate higher wave-runup excursions caused by lowered beach permeability due to high pore-ice saturation, promoting more overwash events and, therefore, erosion and flooding. This study has important implications for coastal management on subarctic and Arctic beaches, where sea-ice coverage reduction is significantly affecting coastal water level dynamics during storms.

Session: TER88 — Arctic Coastal Dynamics in a Changing Climate

ID: 418

Arthropod availability for arctic birds: could the risk be lower than expected?

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Abstract: Arthropods are a crucial food source for many arctic migratory birds. The phenology of arthropods is expected to change rapidly under a warmer climate, which could lead to a trophic mismatch between migratory insectivorous birds and their prey. Using data from 19 sites distributed across a large temperature gradient from the subarctic to the High Arctic, we investigated the effects of temperature on the phenology and biomass of arthropods available to arctic birds during their breeding season. We predicted that higher summer temperatures would be associated with an earlier peak in arthropod biomass as well as higher peak and seasonal biomass. As expected, arthropod biomass peaked earlier with higher temperatures across sites and years. However, we found only a 4-day shift in average peak date for an increase of 80 cumulative thawing degree-days. Moreover, the relationship we observed between temperature and arthropod biomass was not linear. Higher temperatures were associated with higher peak and seasonal biomass, but only under a relatively low temperature threshold. Over that threshold, the relationship between temperature and arthropod biomass no longer exists. Based on a space for time substitution and considering the combined effects of temperature on the phenology and biomass of arthropods, our study suggests that the risk of trophic mismatch could be lower than anticipated, especially for High Arctic birds feeding on a wide diversity of arthropods.

Session: TER77 — Climate change and Arctic birds: unifying disciplines for assessing the risk to Arctic avian communities

ID: 817

Establishment of an Indigenous-led protection for Weeneebayko within Na Taski Nan (western James Bay within the Mushkegowuk Traditional Territories)

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Abstract: The Omushkego have lived in Western James Bay and Hudson Bay since time immemorial. The Omushkego Traditional Territories cover 355 000 km^2, including a large portion of the James Bay Lowlands and beyond the coast into James Bay (Weeneebayko) and its islands. The territory is referred to as "Na Taski Nan" (Mother Earth — who takes care of her children). We have always fed ourselves from this rich area and find our well-being through the taking of food, medicines, water, fish, and animals. Although the Mushkegowuk have traditionally lived gently within our Traditional Territories, Na Taski Nan is now facing challenges that affect each and every citizen of this planet. The taking of resources buried for thousands of years, damming of rivers, cutting of forests, the appearance of toxic pollution from afar, and the changing climate have cumulatively created challenges the Omushkego must now navigate. The Mushkegowuk Nation has always maintained our inherent authority to take care of our Traditional Territories. We have a spiritual connection with the land and waters, by way of the natural laws (Creator's Laws) that were given to us since time immemorial. The waters and islands of western James Bay and Hudson Bay encompassed by Mushkegowuk Traditional

Territories, including Akimiski Island, are unceded Mushkegowuk lands and waters. These islands are still used today by the Omushkego as part of our Traditional Territories for harvesting and traditional practices. The Mushkegowuk Council has started working on the designation of an Indigenous-led marine protection for the western portion of James Bay. This would be a step towards reconciliation with the Omushkego Nations, allowing us to protect and steward our marine waters, islands, and coastlines as we have done since time immemorial. This presentation will focus on the first phase of the establishment of an Indigenous-led protected area for western Weeneebayko.

Session: KEP73 — Advancing conservation through partnerships in knowledge and governance — northern case studies

ID: 478

The Polar Code and the Arctic marine environment: assessing the regulation of the environmental risks of shipping

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Abstract: The International Code for Ships Operating in Polar Waters (Polar Code) adopted by the International Maritime Organization (IMO) in 2014/15 has established new vessel-source pollution prevention standards for Arctic waters and the Antarctic area. The Code's Part II consists of mandatory rules and guidance provisions on pollution prevention as an added layer of regulation for polar shipping. It is worth noting that the mandatory provisions of the Code concern pollution prevention from oil, noxious liquid substances carried in bulk, sewage, and garbage and do not include other pollution (e.g., noxious liquid substances carried in packaged form, grey water, air emissions) and broader risks posed by polar shipping (e.g., animal strikes, biofouling, importing exotic species through ballast waters, etc.). To understand the full scope of applicable environmental standards, it is necessary to explore other IMO environmental instruments that interface with the Polar Code to produce a systemic response to a wide range of environmental risks posed by polar shipping. Other IMO instruments support the Code through provisions that further nourish, supplement or facilitate the Code's provisions on pollution, thereby enlarging the scope of international regulations concerning the broader environmental risks posed by shipping. These instruments include mandatory (e.g., ballast water management and antifouling systems) and non-mandatory instruments (e.g., underwater noise and biofouling). As the volume of shipping increases, we can expect periodic reviews of international standards to respond to the changing environmental risk profiles, greater use of routeing and reporting measures, and possible scaling-up of international standards and further action by regional states. Research for this article was supported by the project "Safe Navigation and Environment Protection" of the Ocean Frontier Institute with support from the Canada First Research Excellence Fund. The full article on which this presentation is based is in print in The International Journal of Marine and Coastal Law (2020) 35: 533–569.

Session: NPD50 — Arctic Shipping — Risks and Benefits to Communities and Ocean Health

ID: 763

Eelgrass bed mapping with Landsat-8 Operational Land Imager and traditional ecological knowledge in Eeyou Istchee

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Abstract: The eastern coastline of James Bay (Eeyou Istchee) is known to be home to vast beds of *Zostera marina*, or eelgrass. These eelgrass beds provide a valuable food source for migratory waterfowl in the spring and fall, and contribute valuable ecosystem services such as sediment stabilization all along the coast. Despite recent reports from Cree communities that eelgrass bed health is declining, limited research has been performed to assess the spatial distribution of eelgrass within the bay. This study aims to address that issue by evaluating the capability of Landsat-8 Operational Land Imager (OLI) imagery to establish a baseline map of eelgrass distribution in 2019 in the relatively turbid waters of James Bay. Three images acquired on 16 September 2019 were mosaicked and classified using Random Forests into the following classes: Eelgrass, Turbid Water, High Turbidity Water, Shallow Clear Water, and Deep Clear Water. The corresponding overall classification accuracy was 99.24%, and the Producer's

and User's accuracy for the eelgrass class were 94.92% and 88.18%, respectively. The map was validated against 117 ground truth data that were obtained from both the eelgrass health and Hydro-Quebec research team. The resulting overall validation accuracy was 79.49%, indicating the potential of the Random Forests classifier to estimate baseline eelgrass coverage in James Bay using Landsat-8 imagery. We would like to thank the Cree experts who have helped the project by sharing their knowledge and assisting with field work and MITACS and Niskamoon Corporation for funding the project.

Session: TER91 — Comprehensive Research Program on the Coastal Habitat of Eeyou Istchee (Eastern James Bay, northern Quebec)

ID: 221

The effects of climate on barren-ground caribou populations: the importance of reaching calving ground

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Abstract: Climate is changing in the Arctic even more rapidly than elsewhere on earth, even as human industrial developments are expanding in remote Arctic regions. In tandem with these changes, many barren-ground caribou populations — of immeasurable importance to Arctic ecosystems and communities — have experienced significant declines. There is, therefore, great urgency in understanding drivers of change in caribou populations. Juvenile survival is known to shape population dynamics of ungulate species. In barren-ground caribou, synchronizing births in time and aggregating births in space is important for successful reproduction, through the dilution effect and shared vigilance, to face predation risk, and shared information on forage resource location. In this study, we examined the effects of environmental conditions on the ability to synchronize births and on the ability to reach the calving ground, in migratory caribou. We analyzed movement patterns and inferred calving date for 1402 female caribou from six herds in North America. We then linked these events to weather conditions throughout the year preceding calving. We found that weather conditions before and during gestation had contrasting effects on the ability to synchronize births with the other females of the herd. We also found that a failure to reach the calving ground at the right time is due to a combination of poor weather conditions during the previous winter and prior to migration departure. Our results suggest that weather influences not only the ability to synchronize births in time but also the ability to reach the calving ground, which could, in turn, affect population dynamics. This contributes to a better understanding of factors influencing barren-ground caribou population dynamics and points to insights that can be gained from large-scale, comparative analyses of the most widely ranging species in the Arctic.

Session: TER80 — Seasonal strategies of Arctic wildlife

ID: 646

Sociocultural determinants of alcohol and cannabis use and misuse among Nunavimmiut

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Abstract: Substance use and its intertwined problems are a major cause of concern for Nunavimmiut. Ongoing historical traumas and changes in the Inuit way of life have been identified as key factors in today's psychosocial problems. As culturally appropriate programs are needed to support public health and individual initiatives, this paper will investigate sociocultural determinants of substance use and misuse. In 2017, the Qanuilirpitaa? survey was conducted among a representative sample of Nunavimmiut aged 16 and over ($n = 1326$). Sociocultural factors, such as cultural identity, practice of land-based activities, involvement in community activities, social support, family, and community cohesion were documented. The frequency of alcohol consumption, binge drinking (five or more drinks in one occasion), cannabis use, and problematic use (CAGE and DAST-10 questionnaires) in the previous year were documented. Associations were tested by cumulative logit regressions. Higher scores of cultural identity were associated with lower alcohol consumption, binge drinking, and problematic alcohol use. Greater social support was associated with lower alcohol consumption and binge drinking. Greater family cohesion and involvement in community activities were associated with higher cannabis use, whereas family and community cohesion were associated with higher risk of problematic drug use. All associations were similar between sexes and age groups. High levels of cultural identity (pride in being Inuk, going on the land, and sharing) were identified as a protective factor for alcohol consumption, binge drinking, and risk of problematic use. Social support (someone to talk to, having a good time, and showing love) was a protective factor for alcohol consumption and binge drinking. Nunavimmiut using cannabis or at risk of problematic drug use were more involved in community life, probably representing contextual predictors of use or support rather than causal implications. The importance of Inuit culture and of community activities should guide the content and implementation of substance use programs in Nunavik.

Session: IHE14 — Health, Well-Being, and the Social Determinants of Health in the North

ID: 405

Dark diversity in the tundra: the source of future plant biodiversity change?

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Abstract: Tundra plant communities are responding as the climate continues to warm, with shifts in community composition and traits observed across many tundra sites. However, from where across the landscape new species come and how the larger species pool influences local-scale biodiversity change remains unknown. Traditional plant surveys often capture scales of only several square metres, leaving many unmonitored species that by chance could be absent in small plots. This so-called dark biodiversity could be a hidden source of future plant biodiversity change. Here, we bring together decades of monitoring observations with the first findings from the International Tundra Experiment Species Pool Protocol to reveal the magnitude of dark biodiversity in tundra ecosystems and the links between local compositional changes and the larger species pool. Across 14 sites including 29 vegetation types, we found that, on average, there are 30 species present within a 100 m radius of long-term monitoring plots, which have never been recorded inside the plots. The amount of dark diversity varied considerably among sites, as did the rate of species accumulation with distance across different landscapes. We are currently integrating the ground-based species pool and plot-scale community composition data with information on topography and microhabitats derived from aerial drone imagery. This combination will allow us to

determine which parts of the tundra landscape this dark diversity occupies — environmentally similar or more variable habitats, or the warmest microclimates. Understanding the relationships between the species pool, dark diversity and plot-scale diversity can help us find the hotspots of plant biodiversity across tundra landscapes and will improve predictions of future changes in the richness and composition of tundra ecosystems with warming.

Session: TER78 — Arctic plants in changing landscapes

ID: 357

Tundra change in Torngat Mountains National Park, Nunatsiavut, Canada

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Abstract: The eastern Canadian subarctic and Arctic are experiencing significant environmental change with widespread implications for the people, plants, and animals who live there. Here, we present multidisciplinary research of environmental change at the Nakvak Brook watershed in Torngat Mountains National Park of Canada, northern Labrador. We combined historical climate data with an annual record of the Normalized Difference Vegetation Index (NDVI) and shrub ring-width measurements to assess the response of ecological systems to regional climate warming. The NDVI time series indicates that the area has undergone a significant, positive trend in spectral greening over the past four decades. Analyses of shrub cross-sections suggest that greening has been driven by rapid shrub establishment and growth that began in the late 1990s during a period of warmer growing season temperatures. With the expectation of continuing climate change, loss of adjacent sea ice, and proximity to the forest–tundra ecotone, it is likely that the Torngat Mountains will continue to experience rapid environmental change in the coming decades.

Session: TER78 — Arctic plants in changing landscapes

ID: 719

Mobilizing freshwater data for decision-making and collaborative stewardship through DataStream's open data portal

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Abstract: Diverse water monitoring programs led by Indigenous and non-Indigenous governments, academic research groups, communities and watershed organizations are generating valuable information to track the health of Northern freshwater ecosystems. When brought together, data gathered through these programs can generate powerful new insights into environmental change across distances and timescales that are beyond the scope of any single monitoring initiative alone. However, finding ways to connect information gathered by a multitude of monitoring programs and research initiatives across sectoral and jurisdictional silos is a persistent challenge. When it comes to western scientific water quality data — which is one piece of the puzzle — open access tools like DataStream are transforming how this information can be mobilized to inform policy and decision-making around water management and stewardship. Designed with communities, researchers, and decision-makers in mind, DataStream is an open data platform that brings water quality monitoring results together in one place, in a consistent format — making it easier to share and access data, and connect results in meaningful ways. First launched in the Mackenzie River Basin in November 2016, DataStream is led nationally by The Gordon Foundation and carried out in collaboration with regional partners and monitoring networks, including the Government of the Northwest Territories, Mackenzie DataStream's founding partner. Today the platform hosts data collected by over 100 different monitoring groups and is continuing to grow and expand across the country.

Session: LTM03 — Digital tools & data management for long-term monitoring and decision making

ID: 25

Kangiqsualujjuaq (Nunavik, Canada): snow avalanches, urbanization, and climate change

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Abstract: Slope processes are active within rolling plateau landscapes of Nunavik, northern Québec, Canada. Escarpments are rare and short, but they are significantly steep. On 1 January 1999, a dreadful snow avalanche struck Kangiqsualujjuaq, one of the 14 Inuit villages in Nunavik; nine people died and 25 were injured. The research this event prompted highlighted that at least four snow avalanches have hit Kangiqsualujjuaq in the 1980s–1990s before this dreadful avalanche: collective memory have retained none of these events, as they caused limited damage. This village and its surrounding located within a glacial valley, in a periglacial environment, is experiencing significant population growth, as are other villages in Nunavik. As early as 1999–2000, there was a significant spatial reorganization of the village's infrastructure to avoid the impact of other snow-avalanche event. The main objective of this paper is to examine the village expansion in response to natural hazard processes and population growth, within an area constrained by permafrost thawing and steep slopes.

Session: IHE12 — Spatial and temporal perspectives on climate changes and their implications for human resilience and adaptation in the Arctic

ID: 675

Changes in the permafrost thermal regime of a lithalsa, a glaciofluvial delta and bedrock near Kangiqsualujjuaq, Nunavik

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Abstract: Permafrost is warming and thawing at varying rates in response to climate change in the circumpolar North, depending on the site characteristics and geological setting. Previously stable soils show subsidence under roads and houses. In Nunavik (northern Quebec), Inuit communities are growing and are planning the expansion of their infrastructure. Changing permafrost conditions must be taken into account, but the response of permafrost to warming is difficult to predict where permafrost is warm and may have began to thaw through its entire profile. Kangiqsualujjuaq is one Inuit community of Nunavik affected by this phenomenon. A surficial geology map, permafrost conditions map, construction potential map, and hazard risk assessment map were produced for the area as part of a bigger research project executed on behalf of the Ministère des Affaires municipales et de l'Habitation in Quebec. Such maps were made for 13 out of 14 Inuit villages in Nunavik, where permafrost is present. These tools provide high-resolution knowledge of ground conditions. Sixteen thermistor cables, extending to depths from 2.9 to 20.05 m, were installed in different surficial deposits and maintained by researchers from the Centre d'études nordiques around Kangiqsualujjuaq from the 1980s to the present. From the six cables that are still active, three were selected to assess the recent evolution of the thermal regime of permafrost in the extensive discontinuous permafrost zone. Recent ground temperatures recorded by these three cables, installed in bedrock, in a glaciofluvial delta (sand and gravel), and in a lithalsa (marine silts and clays), were examined. The bedrock site clearly reflects the air temperature fluctuations, whereas the sand and gravel site reveals a perched water table that delays winter freeze-back. Permafrost in the silty lithalsa has become isothermal and ground temperatures there are not responding to climate variations.

Session: TER79 — The Changing Arctic Cryosphere

ID: 125

The lifecycle of a talik: from formation to fen with an eye for function

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Abstract: Climate warming in fragile discontinuous permafrost peatlands is causing permafrost

loss and changes in ecosystem dynamics at an unprecedented rate. Although rates of permafrost loss and landscape change have been widely documented based on remote sensing and field measurements, the mechanisms of permafrost degradation remain under-studied. In the discontinuous permafrost region, the formation of a talik (perennially thawed soil) between the base of the active layer and the top of the permafrost table signals the beginning of permafrost degradation. A coupled mass and heat transfer 1-D finite volume model of cryotic soils identified soil moisture and surface temperature (a combination of surface albedo and incoming radiation) as the major drivers of talik formation, whereas advection through existing taliks accelerated permafrost degradation rates. Field data collected at the Scotty Creek Research Station is analyzed first to determine the changes in energy balance that accompany talik formation. Once formed, data from a talik connecting two bogs is analyzed over the course of the formation of a connection between these features to determine its thermodynamic and hydraulic function. The talik connects the bog to a network of connected bogs, increasing the hydrologic connectivity of the landscape. The transition from permafrost plateaux with connected collapse scar bogs to a fen network with isolated patches of permafrost is documented at the Scotty Creek Research Station, where permafrost can be found at varying stages of degradation. Regardless of the stage of talik formation, taliks act as reservoirs of thermal energy, and once formed they represent a tipping point for the underlaying permafrost, which will eventually degrade. The identified patterns of permafrost degradation point to a trajectory of thaw, clearing the path for predictions of thaw rates and subsequent expected changes in the hydrology and ecosystems in this landscape.

Session: TER76 — Permafrost and tundra soil processes in a warming climate

ID: 742

SmartICE: employing social enterprise for community safe ice travel

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Abstract: SmartICE is a pan-territorial social enterprise that empowers Inuit communities to adapt to unpredictable sea-ice travel conditions. Because of climate change, Inuit are increasingly concerned about their travel safety and the impacts that declining ice conditions are having on community wellbeing. SmartICE directly addresses this community priority by deploying specially designed technologies, such as the SmartQAMUTIK and SmartBUOY, which enable communities to monitor their own ice trails. Most importantly, Inuit Qaujimajatuqangit of sea ice is being combined with technical training for Inuit to operate and manage SmartICE services in their communities. Specifically, SmartICE is a work integration social enterprise with a social mission to directly support vulnerable youth who are facing exclusion from the labour market. For example, through its northern-based technology production centre (NPC) located in Nain, Nunatsiavut, Inuit youth trainees learn how to assemble the SmartBUOY, a stationary sea-ice thickness sensor for deployment in communities across Inuit Nunangat. Training is holistic, person-centered, and culturally responsive. The technical training components of the program are coupled with employment supports, social emotional skill development, and time spent engaging in traditional activities. In 2019, the NPC provided 4800 h of employment, together with 65 training and skills certificates for the 11 youth trainees. In the spirit of reconciliation and self-determination, and for SmartICE to be effective, Inuit are involved in all aspects of its operation and decision-making, from the board of directors to community operations. For example, in Nunavut where SmartICE is operational in 13 communities, 50 elders, and experienced ice users are involved in local management, while 33 Inuit youth were among 46 operators trained in technology systems and maintenance during this past ice season.

Session: NDP52 — Social Enterprise for Arctic Change

ID: 178

How Inuit Qaujimajatuqangit fits into Arctic char habitat research — a scientist's point of view

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Abstract: Inuit Qaujimajatuqangit (knowledge) can greatly contribute to the study of Arctic char (*Salvelinus alpinus*) habitat as it is an important food resource. In this project, elders and experienced hunters from the communities of Kangiqsualujjuaq, Tasiujaq, and Kangirsuk (Nunavik) were met to share their knowledge of Artic char habitat use in local river systems. From their experience of the land, elders and fishers (men and women) described many important aspects of the habitats used by char and their behavior. This information was then used to develop a preliminary model of spawning habitat preferences. Inuit Qaujimajatuqangit transmitted on the land by experienced Inuit provided additional temporal continuity in their observations. The added description of past events enabled the production of a more continuous evolution specific aspects, for example of trends in river flow. This information would be out of reach for scientists solely relying on short, sporadic field measurements. Their use of vast fishing territories brought knowledge of geographic areas that would not be accessible to the researchers during sporadic fieldwork. We collaborated with Inuit fishermen who conducted measurements of habitats used by Arctic char during the winter period. Through this collaboration, important seasonal habitat shifts were documented by the fishermen, while contributing to increase their confidence in scientific field work. The knowledge shared by elders through stories and anecdotes were of great interest to understand the Arctic char life cycle, for example, concerning the timing of migration according to their size or reproduction behaviors. The highlighting of complex relationships between fish and the environment, and the cultural teaching are parts of the major contribution of Inuit knowledge to this research on Arctic char habitat.

Session: KEP37 — How Inuit Qaujimajatuqangit (knowledge) fits into research

ID: 310

Modelling benthic communities in the Kitikmeot sea region, Canadian Archipelago

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Abstract: The Northwest Passage is an area of great importance as it makes the connection between the adjacent Beaufort Sea and the Baffin Bay for oceanographic characteristics but is also a maritime route of high value. In this area the fauna, especially the benthic community, is less studied compared with other Arctic regions. Benthic invertebrates play important roles in nutrient cycling, sediment oxygenation, and decomposition and are good indicators of climate or other changes. This project aims to evaluate benthic megafauna composition based on significant environmental drivers and then develop spatial predictive explanatory models of benthic communities to expand coverage of a section of the Northwest Passage, specifically across the Kitikmeot Sea region and Parry Channel. Results from previously collected samples suggest that biodiversity is higher in that area compared with the Beaufort Sea and Baffin Bay. We tested whether (1) spatial distribution and community composition of benthic fauna differed following a West–East gradient, i.e., forming an ecotone (transition area) between the Beaufort Sea and the Baffin Bay; (2) Pacific Ocean water influence through the Canadian Archipelago explains part of this gradient, if present, and; (3) terrigenous matter affects the distribution of species. Results showed that all hypothesis are confirmed. Generalized linear models (with R^2 up to 0.80) clearly displayed a transitional pattern of community distribution from Queen-Maud Gulf to Lancaster Sound. Victoria Strait and Peel Sound seem to be hotspots of megabenthic biodiversity showing that such models can be useful to target potential conservation areas. Moreover, results demonstrated that Pacific Origin water (traced with N/P ratio) and terrigenous matter (silicate concentrations) have an influence on the species distribution. Given that these two influencing factors are projected to be increasingly present in the Arctic they might have even more impact on benthic communities in the future.

Session: MAR71 — Species interactions in Arctic aquatic ecosystems

ID: 718

Key features of strong proposals for community-driven climate action

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Abstract: The governance model for Climate Change Preparedness in the North (CCPN) and Climate Change and Health Adaptation Program (CCHAP) has increased program effectiveness and helped to move the climate change adaptation agenda forward in the Northwest Territories (NWT) and across the north. Funding decisions are guided by the NWT Climate Change Adaptation Committee, which includes appointees from all eight regional Indigenous organizations. Committee input has strengthened funded projects and helped build the capacity of members and applicants. The Climate Change Community Liaison supports the development and review of proposals. The liaison has a unique vantage point to hear community concerns and work as a pathfinder to help them get information, find support and partners, and take action. The funding programs and Community Liaisons have been learning a lot over the three and a half years since this innovative funding partnership and governance model was implemented. This presentation will discuss the common gaps and issues that we have seen in some proposals to CCPN and CCHAP. Then, we will focus on solutions. Templates for project ideas and proposals have been revised to reflect lessons learned and provide better guidance to applicants. We will explore three key features of the strongest proposals we have received: a relationships-first approach to proposal development; having the right groups at the table and developing partnerships; and taking steps to ensure that the project makes a difference and leaves a positive legacy. We believe these approaches will strengthen the proposals that researchers develop in partnership with northern communities.

Session: NPD74 — Perspectives on supporting and empowering northern communities in undertaking climate action

ID: 746

Characterizing the hydrocarbon biodegradation and bioremediation potential on Canadian High Arctic beaches

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Abstract: Unprecedented sea ice loss is opening shipping routes in Canada's Northwest Passage, increasing the risk of an oil spill in the High Arctic. Some microorganisms can aid oil spill clean-up by metabolizing various oil compounds, known as hydrocarbon biodegradation, which can be enhanced by supplementing limiting environmental nutrients. However, hydrocarbon biodegradation potential on High Arctic beaches, where oil could persist in the event of a spill, remains largely unexplored. Using eight pristine High Arctic beaches, we characterized baseline environmental variables, microbial abundance, and community composition and screened for hydrocarbon biodegradation. We prepared baseline and nutrient-enhanced radiorespiration microcosms using fuel constituents, hexadecane, and naphthalene, and sacrificial microcosms using Bunker C fuel oil. We found similarities in organic matter, moisture content, total nitrogen and phosphorus, and cell abundances (105–108 cells/g sediment) across High Arctic beaches. Community composition was distinct across beaches and potential oil-degrading genera were detected at each beach but made up a small proportion of each community (<0.6%). Across microcosms, baseline biodegradation of hexadecane, naphthalene, and Bunker C was observed and improved by nutrients. This trend was greatest for hexadecane reaching 14.11% ± 4.55% from 3.23% ± 1.59% and naphthalene reaching 3.39% ± 3.27% from 1.92% ± 1.33%. Our results suggest High Arctic beaches harbour distinct microbial communities that may recruit low-abundant oil degraders to metabolize hydrocarbons that is improved by nutrients. By surveying High Arctic beaches for baseline and nutrient-enhanced hydrocarbon biodegradation potential, this work contributes to proactively developing relevant oil-spill remediation strategies in Canada's Northwest Passage.

Session: NPD50 — Arctic Shipping — Risks and Benefits to Communities and Ocean Health

ID: 749

Trends and effects of brucellosis in caribou and muskoxen from the

Kitikmeot and Inuvialuit regions, Canadian Arctic

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Abstract: *Brucella suisbiovar* 4 (BS4) is the cause of brucellosis in animals and people from the Arctic, where it is maintained by caribou and reindeer (*Rangifer tarandus* spp.) but can also be found in other terrestrial mammals like muskoxen (*Ovibos moschatus*). The objectives of this study were to summarize trends of BS4 in caribou and muskoxen of the Kitikmeot and Inuvialuit regions of the Canadian Arctic and explore health effects on caribou. We tested for *Brucella* antibodies in 209 Dolphin and Union (DU) caribou (2015–2019) and 188 muskox (2017–2019) blood samples of harvested and captured animals, and these results were combined with published data in caribou and muskoxen from these regions. In total, we considered data from 315 barren-ground (Bluenose East, Bathurst, Beverly-Ahiak herds; 2000–2014), 209 DU caribou (2015–2019), and 3353 muskoxen (1989–2019). The sample seroprevalence was relatively low in adult barren-ground caribou, ranging from 0.0% (CI 95%, 0.0–3.1) to 4.8% (CI 95%, 2.2–10.0) in different herds but was higher in adult DU caribou 15% (CI 95%, 10–21). Muskoxen was in general seronegative (Banks Island, Mainland) with the exception of Kent Peninsula, and Victoria island where it had an increasing trend from 0.5% (CI95%, 0.2–1.2) in 1989–2001, to 5.3% (CI95%, 3.3–8.5) in 2010–2016 and a further increase in 2017–2019. DU caribou that were exposed to BS4 at early Spring (April–May) had poorer body condition and were less likely to be pregnant. Further research will investigate the role of BS4 in caribou and muskox population dynamics.

Session: IHE11 — Arctic One Health: Gathering and Mobilizing Multiple Knowledge Types for Healthy Animals, Communities, and Environments

ID: 495

Mapping research on Inuit Traditional Ecological Knowledge of polar bear (*Ursus maritimus*) in the Canadian Arctic

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Abstract: In this study, we systematically review the literature containing Traditional Ecological Knowledge (TEK) about polar bear (*Ursus maritimus*) in the Canadian Arctic to identify how TEK (which is one aspect of Inuit traditional knowledge or Inuit Qaujimajatuqangit) has contributed to the published literature and shaped our understanding of Canadian polar bear subpopulations. We searched both the academic and grey literature using two online databases and categorized our findings by geographic and disciplinary focus, as well as by TEK subtype defined by Usher (2000). Of the total 53 documents retained for the final analysis, more than half of the documents focused exclusively on Nunavut; documents that included informal references to TEK were most prevalent. Usher's categories were disproportionately represented, suggesting that published polar bear research has not consistently engaged with Inuit cultural values about the environment and the knowledge system itself. The findings of this study suggest that there has been limited research that has directly and systematically synthesized polar bear TEK in the Canadian Arctic, and there are few studies from which insights for future polar bear subpopulation health can be obtained. As climate change continues, Inuit TEK about polar bears will evolve, meaning TEK documentation should be systematic and ongoing to be relevant for future decision-making. Ongoing efforts to explore how communities are documenting and transmitting TEK under these changing conditions are also needed.

Session: KEP35 — Community-based monitoring and knowledge co-production in wildlife research

ID: 617

Using social media to gather and share information on Mackenzie-Beaufort ice break-up

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Abstract: The spring ice break-up in the Mackenzie Delta and Beaufort Sea takes place in May–June every year. The timing of break-up and levels of spring freshet flooding are always on the minds of residents in the Mackenzie–Beaufort region during this season of rapid change. Since 2006, the Geological Survey of Canada has been distributing a spring ice break-up newsletter to inform the local community and stakeholders on the current ice conditions and water levels on a near-real-time basis. Three years ago, in collaboration with community members and other partners, the Joint Secretariat started a public Facebook group (Mackenzie–Beaufort Break-up). This was to allow for community co-production of knowledge and posting of observations in real-time during the break-up season. To date, a total of over 1100 people are registered for the group, with 61% (677) from the Mackenzie–Beaufort region and 73% from the Northwest Territories and Yukon. Membership grew by 43% from mid-April to mid-June 2020. Created and managed by northerners, this on-line group is a venue for sharing time-critical information among community members in the Delta region. The information is important to many people for real-time awareness of rapidly changing ice conditions, high water, and flooding. Photos, video, and other observations posted on the group have also provided additional information to validate interpretations of satellite imagery and real-time water-level data. With such a large membership across the region, the group forms an effective network for sharing situational awareness among community members and emergency managers on the break-up progression and flooding potential at any given time, as occurred during flooding in the Mackenzie Delta in 2020. For these reasons, this approach to break-up knowledge co-production may provide an example for similar initiatives in other regions.

Session: KEP33 — Communicating Arctic Science

ID: 672

Developing an evaluative framework of services in Nunavik, Quebec

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Abstract: From a social health determinants perspective, efficient community resources are a crucial capital for the development and wellbeing of the community's members. Institutions need to evaluate proposals to determine what resources to fund, and communities need to evaluate their resources to adapt and transform their services. However, if the fundamental evaluation criteria being used by the different parties are not adapted to the context and the needs of the specific environment, the evaluation may not only be irrelevant but can gear people in the wrong direction. This paper aims to present a culturally and contextually relevant evaluative framework to assess community resources in the 14 communities of Nunavik, Quebec. Data collection was carried out during the Qanuilirpitaa? 2017 Nunavik Health Survey, as part of the Community Component. Short structured interviews with representatives of 354 resources were conducted between July 2017 and March 2018 across Nunavik. Organizations, key individuals, or community initiatives that offered services or programs in the community were all considered a resource. Following an inductive qualitative analysis to identify criteria of success, we extracted perceived facilitators and challenges to achieving success, as described by informants. Using grounded theory and an ecosystemic model to layout proximal, medial and distal factors we developed a proposal for an evaluative framework. Indicators of success were organized

around three categories: (1) team efficiency and dynamics; (2) accessibility of the service; and (3) ability to impact clients, and collectivity. Lack of capacities and funding were the most discussed challenges for local resources. This evaluative framework suggests that the measures of success that are frequently used by funding organizations may not fully represent the potential of local resources. Culturally appropriate measures of successes may improve service delivery, and therefore, the social determinants of health that impact individual health and wellbeing.

Session: IHE14 — Health, Well-Being and the Social Determinants of Health in the North

ID: 46

Geomorphological controls over carbon distribution in permafrost soils: the case of the Narsajuaq river valley, Nunavik (Canada)

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Abstract: Soils in the northern circumpolar region play a central role in the global carbon cycle because the release of carbon through permafrost thaw and geomorphological disturbances can potentially cause a feedback on climate. However, large uncertainties in estimates of permafrost carbon stocks remain, mainly because of wide gaps in the spatial coverage of soil carbon sampling sites and the large mapping polygons used to upscale data. By combining mapping of landforms and knowledge of surficial geology to upscale soil carbon content measurements, we provide an assessment of soil total carbon content in the region of the Narsajuaq river valley (Nunavik, Canada) to generate the first high-resolution soil carbon estimate confirmed by field measurements in Nunavik. We estimate that the Narsajuaq river valley and the surrounding uplands have a weighted average of 3.4 kg C m^{-2} (0–100 cm), with 73% of the total carbon content stored in the top 30 cm. This carbon is mostly available for mineralization as the active layer of most sites was >40 cm, overall encompassing 88% of total carbon content contained in the first metre of ground. The results also indicate that the valley is a carbon hotspot in the region, containing 76% of the total carbon content (0–100 cm) of the study area. Although soil carbon estimates will always require field sampling, the geomorphological mapping approach can significantly improve carbon content estimates and provide better inputs for models.

Session: TER76 — Permafrost and tundra soil processes in a warming climate

ID: 376

Validating the North American ice service iceberg drift model for the Canadian Arctic

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Abstract: Icebergs calved from high-latitude glaciers and ice shelves pose a threat to marine navigation and offshore infrastructure at a time when Arctic shipping and resource exploration are increasing. Knowledge of the location of potential ice hazards is, therefore, critical to ensure safe and efficient operations. The Canadian Ice Service provides information on the observed and predicted distribution of icebergs in Canadian waters by combining iceberg observations with forecasts from the North American Ice Service (NAIS) iceberg drift model. The NAIS model estimates the forces acting on an iceberg to predict its position and velocity at future time steps. Widely used for the east coast of Canada, the NAIS model is largely unproven in the Arctic and suffers from insufficient validation due to a paucity of reliable in-situ observations of iceberg drift. In this study, we use the recently compiled Canadian Ice Service iceberg tracking beacon database to assess the skill of the NAIS iceberg model's predictions of iceberg drift. Hindcast simulations of the observed tracks of 24 icebergs for the period 2008–2018 were run using input from the GLORYS global ocean and ERA5 atmospheric reanalysis data sets. Preliminary results indicate the model produces realistic simulations of iceberg drift for Baffin

Bay and eastern Canada. Future work will focus on forcing the NAIS model with the new generation, high-resolution RIOPS ice-ocean model, and on quantitative assessments of error between observed and modeled drift tracks. This research will provide the first comprehensive validation of the NAIS iceberg drift model for the Canadian Arctic and contribute to ongoing efforts by the Canadian Ice Service and National Research Council of Canada to more accurately forecast the drift path of icebergs and improve safety in Arctic waters.

Session: MAR42 — Changes in the Marine Cryosphere

ID: 200

On the impact of climate change and river regulation in the Hudson Bay Complex's ocean properties and dynamics

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Abstract: The Hudson Bay Complex (HBC) is the outlet for many Canadian rivers, receiving ~900 km^3/year of river runoff. However, hydroelectric development and regulation have modified the temporal and spatial distribution of runoff entering the HBC. To understand the impacts and future of regulation in this region, the numerical ocean model (NEMO) ran under different Naturalized to Regulated River Runoff scenarios, is used to model future freshwater dynamics. Preliminary results show that the temperature of the HBC will warm over the next 50 years, with an annual averaged warming of ~1.5 °C between 2005 and 2070. Changing from naturalized to regulated river runoff has little impact on this warming, as it is driven by the climate signal. At the same time, future scenarios show that sea ice concentration and thickness in the HBC will significantly decrease over the next 50 years, driven by the climate change signal. HBC averaged reductions in sea ice between 2005 and 2070 will be ~20% in concentration and 0.15–0.2 m in thickness. Changing from naturalized to regulated river runoff is found to have little impact on the annually averaged sea ice changes. Lastly, we found that the HBC will likely freshen by 2070, with regulation playing a role through changing both the time of the discharge and the freshwater residence time. With regulated river runoff, the total mean salinity reduction is slightly larger (~0.3 g/kg), with no scenarios suggesting an increase in the HBC's salinity. The differences between the naturalized and regulated runs appear to be related to the timing of the discharge and the residence time for freshwater in the basin. Years of strong discharge add more freshwater to the HBC than can be exported through Hudson Strait, lowering the salinity, and increasing freshwater residence times, with the reverse occurring in years of weak discharge.

Session: MAR39 — Coastal oceanography of Hudson Bay and James Bay

ID: 664

Nunavik climate change committee on adaptation: takeaways after three years

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Abstract: Through the engagement, outreach and funding opportunities provided from the Climate Change Preparedness in the North (CCPN) and Indigenous Community-Based Climate Monitoring (ICBCM) programs over the past three years, a few priorities have come to the forefront for Nunavimmiut — particularly surrounding the issues of food security and on-the-land safety in relation to climate change. There have been a number of projects seeking to better understand and alleviate pressures on Arctic Char, a key species for Nunavik communities. These projects have taken a multitude of forms — from tracking the northern movement of beavers and studying their effects on fish populations and habitat, to trying to monitor the changes in rivers (temperature, depth, and flow) and making sure younger generations are aware of the way things used to be and the changes that are taking place. The sharing of knowledge with youth and between harvesters has also been an important component of several projects related to safety out on-the-land. In a region with limited cellphone coverage, communities have sought to increase the coverage of handheld radios for emergency communication and have explored means to share up-to-date observations of environmental conditions across Nunavik. In terms of program governance, a notable strength of

the Nunavik Committee has been the remarkable stability of its members. Challenges have primarily surrounded the local capacity to administer and manage projects and regional governance structures. With the current initiatives, along with others in development, it is hoped that there will be more capacity and better structures to encourage discussion, communication, and projects in the region. This presentation will elaborate on my work across Nunavik in the field of climate change adaptation and monitoring, drawing on experiences working with federal funders and community organizations to examine ways of supporting and empowering northern communities in undertaking climate action.

Session: NPD74 — Perspectives on supporting and empowering northern communities in undertaking climate action

ID: 777

Understanding the role of researchers in engaging and communicating sciences with Inuit youth

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Abstract: Over the past decade, Inuit and non-Inuit researchers have worked in partnerships to conduct research that better reflect local values and traditions, as well as give voice to non-Western knowledge systems. Recent studies indicate that there remains a gap in the approaches and tools used to reach Inuit youth. Although many researchers show a keen interest in engaging with Inuit youth, they often lack the resources and communication skills to do so. This study aims to (1) explore the role of researchers in engaging with Inuit youth and (2) assess different science communication methods. This study was conducted on a national scale using a mixed-methods approach to explore common and diverging perspectives of experts ($n = 30$) across Canada, including researchers, education specialists, members of Inuit organizations, public servants, and communication specialists. The overall approach consisted of assessing data derived from a comprehensive literature review (phase 1), semi-structured interviews (phase 2), and a modified Delphi study that included two rounds of an online survey (phase 3). Data collected were analyzed and coded based on most emerging themes using QSR NVivo v.12. Findings show that the role of researchers in engaging and communicating sciences with Inuit youth is to build relationships based on trust (key theme 1), to work in the spirit of co-creation when possible (key theme 2), to create opportunities for research capacity building (key theme 3), and to develop resources to support meaningful youth engagement in Arctic research (key theme 4). Participants in the study suggested that researchers should foster co-learning and use participatory approaches to engage and communicate sciences with youth. Also, researchers should recognize that youth have diverse interests and motivations. Moving forward, it will require more funding flexibility and science communication training to provide researchers with adequate tools and resources that will help support youth engagement.

Session: KEP33 — Communicating Arctic Science

ID: 790

Trends in food basket prices in Nunavut, Canada, between 2014 and 2018

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Abstract: Introduction: The price of store-bought food can influence consumer behavior, in turn impacting food security, diet, and non-communicable disease. The objective of this project was to examine, by region and year, descriptive and analytic trends in food basket prices in Nunavut, Canada. **Methods:** Food price survey data for 24 select grocery items from 2014 to 2018 were acquired from the Nunavut Bureau of Statistics. Yearly changes in the price of each item and the basket were calculated and statistically examined by community, region, and Nunavut overall. A repeated measures analysis of variance (ANOVA) test using the mixed models procedure was performed to ascertain whether region had a significant effect on the year-over-year change in price of the basket items. **Results:** Mean food basket prices reported for 2018 in the Qikiqtaaluk, Kivalliq, and Kitikmeot and for Nunavut were $174.56, $166.60, $181.15, and $174.13, respectively; these were 8.52%, 15.06%, 9.25%, and 10.66% higher than four years earlier; except for Kivalliq, these upticks track with the co-timed 9.39% rise in the

Consumer Price Index (CPI) for Iqaluit. At an $\alpha = 0.05$, the ANOVA's *F*-test results for fixed effects revealed neither region nor year was statistically significantly predictive of year-to-year change in basket items ($p = 0.18$ and 0.06); their interaction was also not significant ($p = 0.28$). **Conclusion:** The average food basket cost in two regions and overall in Nunavut rose approximately in parallel with Iqaluit's CPI from 2014 to 2018. Region, year, and their interaction were not significantly predictive of year-to-year changes in basket items. Future research should examine the affordability (price of the basket relative to income) over time in Nunavut as well as compare these data with provincial and (or) Canada-wide food basket prices.

Session: IHE24 — Building resilient and sustainable northern food systems: Research, knowledge, policy, and action

ID: 799

Regional Cooperation towards improved knowledge and actions on marine litter in the Arctic

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Abstract: Marine litter, particularly when made of plastic, is among the most pervasive problems affecting the marine environment globally, and is of increasing concern within the Arctic region. The Arctic Council, is now actively working on this issue, first through the release of the Desktop Study on Marine Litter, including Microplastics, in the Arctic (PAME 2019), and currently through development of a Regional Action Plan on Marine Litter in the Arctic, and a Marine Litter Monitoring Plan and Guidelines, to be finalized in 2021. The Protection of the Arctic Marine (PAME) and Arctic Monitoring and Assessment Program (AMAP) working groups are working jointly and with the input of experts from within each member states national networks, to contribute to this important work. Additionally, the Conservation of Arctic Flora and Fauna (CAFF) working group is developing on specific species monitoring frameworks for plastic pollution in biota. PAME's Regional Action Plan and the AMAP Monitoring Plan and Guidelines, once completed, will provide a basis for regional action to prevent and reduce the presence of marine litter in the Arctic environment, and promote harmonized methods for monitoring and reporting on volumes and characteristics of marine litter throughout the Arctic marine environment. Project leads will present an overview of the Arctic Council's state of knowledge on the scope of marine litter in the Arctic region, its effects the marine environment, and key knowledge gaps, as well as the status of the Arctic Council's current work under the AMAP, CAFF, and PAME working groups.

Session: NPD58 — Advancing International Collaboration for the Arctic Environment, Climate and People

ID: 105

What's new: Natsiq — Ringed seal monitoring program in Nunavik

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Abstract: Ringed seals (natsiq) have been harvested for thousands of years by Inuit, and today remain important culturally and as a subsistence food. Given broad concerns reported by Nunavik hunters and the general lack of data about ringed seals in Nunavik, the Nunavik Marine Region Wildlife Board (NMRWB), in partnership with three Nunavik communities and the Nunavik Research Center (NRC), initiated a ringed seal monitoring program to document and assess changes in seal health, distribution, and habitats in three Nunavik communities. This community-based project engages experienced hunters and youth in a transdisciplinary approach combining tissue sampling of landed seals and student activities such as in-class stomach content analysis and field-based educational activities. After a full year of activity working in their respective communities, the project partners will meet during a hands-on workshop held in Kuujjuaq to learn disease detection methods at the NRC, and more generally to plan the next steps of the program. The analysis done at the

NRC laboratory includes *Trichinella* and *Toxoplasma* testing. The NRC is equipped with sophisticated instrumentation allowing southern experts to train local workers in analysis that can be done in the North. Further to the lab part of the workshop, discussions with elders and representatives from the health sector will contribute to designing interviews to gather Inuit Knowledge on seals, including seal harvesting practices in Nunavik. In addition to providing training opportunities to allow Nunavimmiut to develop interest and capacity in laboratory work, wildlife research and wildlife management, this project contributes important baseline information on seal health, abundance and distribution in the Nunavik Marine Region (NMR). The knowledge and perspectives collected will inform wildlife management in the NMR as well as generate new information on safe consumption of seal meat to the Nunavik Regional Board of Health and Social Services (NRBHSS).

Session: KEP30 — Sharing Knowledge on Natsiq/Natsik (Ringed Seal) and Qilalugaq/Kilalugak (Beluga Whale) from Inuit and Scientific Perspectives in Inuit Nunangat

ID: 504

Kaapittiaq: producing "good coffee" for the Canadian Arctic

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Abstract: Pitquhikhainik Ilihainiq Inc. (PII) is a social enterprise founded in 2018 by the Nunavut non-profit organization Pitquhirnikkut Ilihautiniq/Kitikmeot Heritage Society. The company serves as an experiment in how locally-driven businesses can support their community's economic, social and research priorities by providing independent sources of funding for program development. The company accordingly donates 75% of its annual profits to Inuit culture and language initiatives, and seeks to build and support Indigenous business networks across the Arctic and beyond. PII's first commercial product is Kaapittiaq, an Inuit-branded line of coffee (www.kaapittiaq.ca). Kaapittiaq sources its green coffee beans through direct trade with Indigenous co-ops and growers worldwide, prioritizing purchase from businesses motivated by similar values and missions. Kaapittiaq translates as "good coffee" in the Inuinnaqtun language, a name that we strive to have qualify both its taste and social impact. A major drive behind Kaapittiaq as a company is to find a workable balance between local and global scales. This presentation will explore various innovations and strategies the company has used to support Inuit community and Arctic-based priorities, governance models and environmental values, while at the same time still being reliant on national markets and business guidelines, as well as the harvesting, shipment, and sales of products from around the world.

Session: NDP52 — Social Enterprise for Arctic Change

ID: 434

Indigenous knowledge on bearded seal (*Erignathus barbatus*), ringed seal (*Pusa hispida*), and spotted seal (*Phoca largha*) behaviour and habitat use near Utqiaġvik, Alaska

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Abstract: Indigenous knowledge (IK) can provide detailed baseline information on habitat use and behaviour for many species, information essential for management and conservation. As climate changes, the accessibility of significant species to Indigenous hunters for their food security may also change. To understand current habitat use and potential vulnerability to climate change, we documented IK on three locally important ice-associated seal species: bearded, ringed, and spotted seals in Utqiaġvik, Alaska, using semi-directed interviews. IK suggests ringed seals are associated with higher ice concentrations in winter than bearded seals, whereas both are associated with lower concentrations through summer and fall. Foraging behaviour indicates all three species have foraging hotspots that will be used over several days

by multiple individuals of the same species. The study also highlights the importance of inland water bodies and nearshore habitat and the potential to use this information to expand our understanding of foraging habitat. This study demonstrates how changes in ice concentrations may affects these seals differently and the importance of inland water bodies and nearshore habitat for the management and conservation of these species. Our study also demonstrates that IK can provide year-round information on species habitat use at a population level, expanding on existing satellite telemetry studies, and providing information that has yet to be documented.

Session: KEP35 — Community-based monitoring and knowledge co-production in wildlife research

ID: 354

Exploring the development and dissemination of health messaging for the Inuvialuit Settlement Region, Northwest Territories

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Abstract: Public health messaging addressing food and diet in Indigenous communities needs to balance the benefits and risks of consuming both market and country foods. Previous studies have identified community perspectives on food safety and quality utilizing a health communication and risk perception survey in the Dehcho and Sahtú regions of the Northwest Territories (NWT). Building on this research, this project aims to characterize messages on food safety and quality in the Inuvialuit Settlement Region (ISR) to further improve message communication in the region. As part of the Country Foods for Good Health: Developing a Country Food Database for the ISR study, located in Tuktoyaktuk and Paulatuk, NWT, this project sought to characterize how health messages related to food are developed and disseminated in the ISR from the perspective of key informants to inform the development of a messaging survey tool for the ISR. An in-person interview ($n = 1$; February 2020) and telephone interviews ($n = 13$; May–June 2020) were conducted with key informants about their involvement in developing and (or) disseminating health messages about the quality and safety of country foods and (or) store-bought foods in the ISR. Key informants interviewed were health practitioners ($n = 5$), government representatives ($n = 6$), and community program leads ($n = 3$) located in Inuvik, Tuktoyaktuk, Paulatuk, or Yellowknife. Interviews were analyzed using thematic analysis. Reflecting our project's community-based participatory approach, findings will be reviewed with our project partners prior to public communication. This presentation will, therefore, describe how the identified themes will support the creation of an ISR-tailored survey to identify community perspectives on food safety and quality. The findings will ultimately help develop more effective messaging for healthy food choices in the ISR.

Session: IHE24 — Building resilient and sustainable northern food systems: research, knowledge, policy, and action

ID: 133

Kugluktukmiut knowledge of Dolphin and Union caribou: partnerships, ecology, and co-management

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Abstract: Dolphin and Union (DU) caribou (*Rangifer tarandus groenlandicus* × *pearyi*, locally referred to as Island tuktu) were reassessed as endangered by the Committee on the Status of Endangered Wildlife in Canada in 2017. We started a collaboration among the Kugluktuk Angoniatit Association, Government of Nunavut, and the University of Calgary in 2017 to take a closer look at what Kugluktukmiut knowledge has to say about this herd. We used semi-structured individual interviews, focus groups, feedback sessions, and participatory activities to purposefully engage 33 knowledge keepers over 3 years from 2018 to 2020. We also summarized a traditional knowledge study started by the Government of Nunavut in 2003 with 15 Kugluktukmiut and 15 Ekaluktutiakmiut. The results from these studies provided critical insights into the abundance and distribution

trends of DU caribou and brought forward Kugluktukmiut concerns and co-management recommendations for the herd. Key findings demonstrate that the cumulative DU caribou distribution is much broader than it is today and that seasonal distribution and migration is perhaps more variable than previously thought. In addition, we highlight the importance of involving knowledge keepers from across the DU caribou range to understand the full life-history of DU caribou and to develop effective herd-level conservation approaches. This work has resulted in four presentations and one report for the co-management partners and three community presentations. Our study's collaborative research process has created opportunities to have more traditional knowledge and community member voices available at co-management and consultation meetings. Moving forward, traditional knowledge research should continue to have a sustained focus on community partnerships, and it would be valuable to widen the research scope to include other communities and perspectives within the DU caribou range.

Session: KEP73 — Advancing conservation through partnerships in knowledge and governance — northern case studies

ID: 740

Growing community knowledge infrastructure

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Abstract: Community knowledge infrastructure is built to be owned, operated, developed, and shared by local organizations. It is built with the knowledge that to be effective and continue to be valued, it must serve multiple needs within a community and allow for storing, connecting, and learning from diverse forms of knowledge in a variety of formats. Built from the ground up to serve as community knowledge infrastructure, the open-source Nunaliit atlas framework has been co-designed over the past 15 years with a global group of Inuit and other Indigenous community knowledge holders and researchers, other supportive researchers, and organizations at all scales and across a large number of disciplines. It is used by community organizations, governments, and academics for mapping traditional knowledge, documenting languages and their connections, exploring digital collections of artworks and cultural heritage objects, local planning and decision support, hunter safety, visualizing research networks and licensing, exploring connections to place in multi-media, and many more applications. In a few cases, these uses have been converging in local community deployments where the same system, effort, and local expertise is being applied to multiple community-directed projects. This has allowed important holistic views of community knowledge, focused views related to specific topics, and sharing of the valuable skills and time of local experts. I will highlight some examples of infrastructures moving beyond single projects and into the realm of community infrastructure and show some of the advantages of contributing to the growth of community knowledge infrastructure when planning projects.

Session: LTM03 — Digital tools and data management for long-term monitoring and decision making

ID: 180

Weather, water, ice, and climate information (WWIC) use in Antarctica

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Abstract: People living in Antarctica use weather information every day to schedule activities and minimize risk to human safety. Planning and undertaking of operations including aviation, shipping and resupply, station maintenance and ground travel (foot/vehicle), field work, and science projects are highly dependent on suitable weather conditions, and poor weather means tasks and outdoor activities are often delayed or cancelled. Tailored weather services assist task prioritisation and increase efficiency and safety. Countries' National Antarctic Programmes manage their Antarctic and sub-Antarctic research stations, and dedicated weather and forecasting services range from provision through the countries' National Weather Service, through contracted private weather providers, and through to no provision of a tailored weather service. Tailored forecasts and weather-related risk information is emailed, radioed, displayed on electronic notice boards, or available on internal

station intranet sites. Many research stations have automatic weather stations that provide real-time weather observations that is accessed regularly by expeditioners in their planning and weather decision-making. Within the Australian Antarctic Program, during the busier summer period (October to March) forecasters are deployed to Antarctic stations and on the icebreaker to facilitate operations. Location, task specific, and daily station forecasts are provided, and morning weather briefings are tailored to user requirements. Pilots, operations co-ordinators, boating teams, field workers, and ships masters are able to interact with the forecasters and build strong relationships that provide a high level of service. During winter (April to September) daily forecasts are not available and expeditioners rely on internet websites and graphical models with minimal assistance. Other National Antarctic Programs (e.g., United States) provide year-round tailored forecasting services. The Australian Antarctic Program provides a case study demonstrating the many opportunities available to improve tailored weather services for Antarctic users, beyond advancing forecasting models.

Session: NPD61 — Tailoring polar weather, water, ice, and climate information and services to address diverse user needs

ID: 222

Do interannual variations in environmental conditions affect the recruitment of adult Arctic cod

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Abstract: Arctic cod (*Boreogadus saida*) is by far the most abundant forage fish species in Arctic seas and plays a pivotal role in the transfer of energy between zooplankton and higher trophic levels. Therefore, population dynamics of Arctic cod have cascading effects on the rest of the Arctic marine ecosystem. Climate change has already started to affect the recruitment of age-0 Arctic cod in the Canadian Arctic Ocean. Earlier ice breakup, warmer sea surface temperatures, and enhanced plankton production improve larval survival by allowing age-0 Arctic cod to reach larger prewinter sizes. Favorable environmental conditions can result in a ten-fold increase or more in biomass of age-0 Arctic cod at the end of their first summer. Yet, it is unknown how this enhanced larval survival affects the rest of the Arctic cod population and if it results in greater recruitment into the adult population. Greater larval Arctic cod recruitment could increase density dependent mortality due to greater competition for resources once juvenile fish leave the epipelagic layer to overwinter with their adult congeners at depth. Here, we test whether ice breakup date, sea surface temperature, and plankton production during the larval phase increase recruitment of adult Arctic cod. We rely on hydroacoustic surveys conducted from 2006 to 2019 to estimate the biomass of adult Arctic cod in the Beaufort Sea and Baffin Bay and on satellite measurements to document environmental variables.

Session: MAR43 — Fish and zooplankton in the central Arctic Ocean — current status of knowledge and new discoveries

ID: 227

Observing boundary layer diurnal water vapour cycles with DIAL and GNSS in Iqaluit, Nunavut

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Abstract: Atmospheric water vapour is one of the most important gases in Earth's atmosphere. It is the dominant gas in the greenhouse effect and its diurnal cycle is an essential component of the hydrological cycle. High-quality water vapour (WV) measurements are critical inputs for Numerical Weather Prediction (NWP) models. Forecasting is particularly difficult in the Arctic due to its unique and often extreme weather. Increased human activity in the Arctic requires improved forecasting to aid in navigation, transportation, security, and search and rescue operations. Accurate measurements of the diurnal

WV cycle can improve precipitation rate and cloud type predictions that are key components of NWPs. Total column diurnal WV cycles, usually calculated with Global Navigation Satellite System (GNSS) instruments, have been the focus of most previous diurnal WV studies; water vapour Differential Absorption LiDARs (DIALs) are well-suited to providing height-resolved diurnal cycles in the boundary layer due to their high vertical and temporal resolution. In this study, we use the novel Vaisala pre-production DIAL, installed in Iqaluit, Nunavut (63.75N, 68.55W), to calculate seasonal height-resolved diurnal WV cycles in the boundary layer. We also calculate the surface and total column WV diurnal cycles using co-located surface station and GNSS measurements. We find that the DIAL diurnal cycle magnitudes agree well with the surface station measurements, yet the phases of the cycle change with altitude. In the summer, all instruments observe a strong 24 h cycle. As the seasons change from summer to winter, the 24 h cycle weakens and the 12 h cycle begins to dominate in all instruments. The preliminary data from the Vaisala DIAL is promising and provides valuable new insights into the Arctic hydrological cycle. Future work will include case study comparisons with the Canadian NWP model to assess the model's ability to resolve rapid changes in diurnal water vapour.

Session: TER83 — Views of the Arctic atmosphere: long-term changes and current perspectives

ID: 806

Yukon Soaps Company creates regenerative economic opportunities

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Abstract: Over the last one hundred years, the economy in the Mayo region has been primarily built on large scale resource extraction that has focused on extracting profit (through gold or other mineral resources) to the detriment of the land, culture, and community well-being. Joella strives to shift that way of thinking by providing economic opportunity grounded in Northern Tutchone systems and values, with the aim to benefit the land, culture, community well-being, and economic opportunity equally. This way of thinking provides an alternative way forward from the mining and resource development economies that dominate in the small town of Mayo, Yukon. Although there is a desire to cultivate alternative economic models, there is currently a lack of opportunity for Indigenous people to be engaged in regenerative economies that support Dun Ke and traditional ways of knowing. Mayo is a small community in the central Yukon and has a lack of physical space for people to grow their own ideas, specifically in natural product development. Few opportunities exist for makers and creators to share and learn knowledge related to plants, harvesting and healing the spirit in a regenerative way. The natural world is full of innovation and by mimicking the natural processes of plants such as the growth cycles of forests (the planting of seeds, the growth and development of plants, and the return of nutrients to the earth as they mature) the Yukon Soaps Company aims to help shape the skills needed to diversify, build, and give back to the economy of the region.

Session: NDP52 — Social enterprise for Arctic change

ID: 202

A long-term perspective on permafrost thaw slump disturbances on Arctic upland lakes in the Mackenzie Delta region (Northwest Territories, Canada)

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Abstract: Arctic landscapes are being rapidly transformed in response to thawing permafrost. Retrogressive thaw slumps are a spectacular form of permafrost thaw that commonly develop on the shorelines of lakes in areas of ice-rich permafrost. Thaw slumps pose a risk to surface water quality from increased ionic concentrations, decreased organic matter and nutrients, and in the case of highly active thaw slumps, enhanced turbidity. In the summer of 2017, we re-surveyed 60 upland lakes in the Mackenzie Delta region of the western Canadian Arctic that were originally sampled in 2005/2006, to assess trends in decadal water quality changes along a gradient of thaw slump disturbances. Regional water chemistry trends are remarkably similar

between 2005 and 2017, and lakes that had stable thaw slumps in both 2005 and 2017 do not show any evidence of changes in water quality conditions that would indicate chemical recovery. This provides further evidence that recovery trajectories following slump stabilization can take decades. We also used paleolimnological techniques in a subset of the 60 lakes to extend the limnological record further back in time. In particular, we evaluated the potential for loss-on-ignition (LOI) analysis to be used as a rapid proxy for reconstructing thaw slump activity. Our results provide a temporal context to understand how Arctic lakes are changing in response to climate warming and permafrost thaw.

Session: TER76 — Permafrost and tundra soil processes in a warming climate

ID: 145

Spring melt pond fraction variability in the Canadian Arctic Archipelago from RADARSAT-2

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Abstract: Melt ponds form on the surface of Arctic sea ice during spring, influencing how much solar radiation is absorbed into the sea ice-ocean system, which, in turn, impacts the ablation of sea ice during the melt season. Accordingly, melt pond fraction (fp) has been shown to be a useful predictor of sea ice area during the summer months. Sea ice dynamic and thermodynamic processes operating within the narrow channels and inlets of the Canadian Arctic Archipelago (CAA) during the summer months are difficult for model simulations to accurately resolve. Additional information on fp variability in advance of the melt season within the CAA could help constrain model simulations and (or) provide useful information in advance of the shipping season. Here, we use RADARSAT-2 imagery to predict and analyze peak spring fp and evaluate its utility to provide predictive information with respect to sea ice area during the melt season within the CAA from 2009 to 2018. The temporal variability of RADARSAT-2 fp over the 10-year record was found to be strongly linked to the variability of mean April multi-year ice area with a statistically significant detrended correlation (R) of $R = -0.89$. The spatial distribution of RADARSAT-2 fp was found to be in excellent agreement with the sea ice stage of development prior to the melt season. RADARSAT-2 fp values were in good agreement with the peak fp observed from in situ observations but were found to be ~0.05 larger compared with peak MODIS fp observations. Statistically significant detrended correlations between RADARSAT-2 fp and summer sea ice area were found for several regions within the CAA. Our results show that RADARSAT-2 fp can be used to provide predictive information about summer sea ice area for a key shipping region of the Northwest Passage.

Session: MAR42 — Changes in the marine cryosphere

ID: 757

Arctic seasonal models: evidence for hierarchical temporal processes in food webs

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Abstract: Arctic wildlife and ecosystems are strongly impacted by strong seasonality. However, new advances in theoretical tools are required to integrate this strong variability across space and time. Temporal networks offer a promising approach to build models of species interactions in Arctic communities to incorporate seasonal variation in these interactions. We are building a temporal network for the food web on Bylot Island over 26 years across summer and winter. Key features of these networks are

the timing of arrival and departure of migrating species (e.g., snow geese) and the timing of availability of resources (e.g., goose eggs and multi-annual lemming cycling). We find evidence for a hierarchy of temporal variability at the sub-seasonal (within a season), seasonal (between seasons), annual (within a year), and multi-annual (across multiple years) scales. Using multi-scale wavelet methods, we are identifying network metrics to characterize couplings in species interactions at different temporal scales with implications for community stability. Our preliminary results highlight the need for building food webs in the Arctic at multiple temporal scales that represent how species interact in strongly seasonal environments to understand how multiple rewirings of food web interactions contribute to the persistence of Arctic communities.

Session: TER80 — Seasonal strategies of Arctic wildlife

ID: 774

Lessons learned from the Anguniaqvia niqiqyuam Marine Protected Area: the benefits of community involvement and TK inclusion in the development, management, and monitoring of MPA in Canada's Arctic

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Abstract: The Anguniaqvia niqiqyuam Marine Protected Area (ANMPA), designated in 2016, is Canada's second Arctic MPA, and is the first with a conservation objective (CO) based solely on Traditional Knowledge (TK). The objective of the TK CO is "to maintain the habitat to support populations of key species including beluga whales, Arctic char, and ringed and bearded seals". The knowledge and guidance of Inuvialuit organizations and especially the community of Paulatuk were integral to the designation of the MPA and are now are full partners in the management and monitoring of the ANMPA. The ANMPA working group (ANMPA WG) was established in September of 2018 to increase community involvement and the use of Inuvialuit TK in MPA management activities. Over the past year, the ANMPA WG has been busy drafting the ANMPA monitoring plan. The draft monitoring plan seeks to generate realistic data and outcomes against which future monitoring results can be evaluated. This presentation will explore the development of the ANMPA and associated monitoring and management plans and highlight the benefits of having community participation from start to finish. Comparisons will be drawn between the processes employed in development of the first monitoring and management plans for the first Arctic MPA, the Tarium Niryutait MPA (TNMPA) and those employed in the development of the ANMPA plans. In closing, the ANMPA working group will express their opinions on how to best ensure Inuvialuit community priorities and TK are incorporated into the process for establishing, managing, and monitoring MPAs in the Inuvialuit Settlement Region (ISR).

Session: KEP73 — Advancing conservation through partnerships in knowledge and governance — northern case studies

ID: 79

The history of the law regulation of Russian Arctic oil development

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Abstract: In 1719 under Peter I the Act "About the establishment of the Berg-collegium to monitor ore and minerals" (hereafter — the Act), the Berg-collegium, was created. For example, it was responsible for oil reserve confirmation and provided tax exemption to start an oil business. By the Act the Mining Regalia was established, it declared the exclusive public property rights in subsoil resources and defined other core principals of the mining industry: any form of property on extracted oil, freedom of search for oil, mining royalties, rational development, and protection of oil fields. Thus, in 1745 the Berg-collegium gave permission to F.S. Pryadynov to open the first oil-refinery plant in Russia on the Ukhta river, where he extracted oil and produced kerosene. In the 18th century the Mining Regalia and the Mining Freedom were abolished by the Ekaterina II Manifesto of 1782 (hereafter — The Manifesto). The Manifesto permitted private property on mineral resources and allowed the search for oil only on one's own land. Later, the provisions on oil field development, including rules for oil field auction, were codified and amended in the Mining Charter of the Code of

Laws of the Russian Empire. The Ukhta region remained the main oil-producing region in the Russian Arctic. However, oil extraction was not profitable because the issues of crude oil transportation logistics from Ukhta to places of trade was not solved by that time. The main options were rail transportation and shipping. The 20th century saw a complete change in Arctic oil development. The private property on land and mineral resources was revoked, and the mining industry was nationalized and united under the Supreme Council of National Economy. The Mining Law was accordingly revised. The law on off-shore oil and gas exploitation was implemented. At that time many producing oil and gas fields in the Russian Arctic were found.

Session: NDP51 — Northern engagement and resource management

ID: 411

Structure of microbial communities during ice-opening in the Hudson Bay

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Abstract: The ice-free season in Hudson Bay increased by more than 3 weeks between 1981 and 2010 and this trajectory is likely to continue. This is of concern due to the influence on the timing of access to light and nutrients used by phytoplankton. As phytoplankton are the base of the food web, the early loss of ice and the extension of the ice-free period is likely to influence the timing and composition of all planktonic communities. During the 2018 BaySys campaign onboard the CCGS Amundsen, we sampled microbial eukaryote, bacteria, and archaea assemblages using 18S rRNA and 16S rRNA down the water column at 11 stations during spring at the time of the opening of the Northwestern Hudson Bay polynya. Preliminary results show the development of strong stratification in open water stations, resulting in pronounced gradients of salinity, temperature, and nutrients from the under ice to open water stations. The stratification was associated with the development of a subsurface chlorophyll maximum (SCM). We then compared the distribution and composition of microbial communities with environmental parameters through multivariate analysis to identify spatial patterns and factors potentially controlling the distribution of the microbes. The recent spring bloom history and associated trophic interactions were deduced from the dominant microbes in the system. Microbial eukaryote community structure reflected compositional changes and transition from an autotrophic community under the ice to a heterotrophic community in the open water. Picoeukaryotes represented by Chlorophyta were predominant at surface and SCM under the ice, but sharply decreased in open water in correlation with the development of a heterotrophic community dominated by *Gyrodinium* and choanoflagellates. These results will provide insight into the response of microbial communities to early seasonal ice reduction in a changing Hudson Bay.

Session: MAR39 — Coastal oceanography of Hudson Bay and James Bay

ID: 823

An educational game on our changing environment

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Abstract: Springbay Studio seeks to communicate scientifically valuable information to the public about the changing polar regions in a creative format. Through the medium of games, youth everywhere can interact and play with important concepts. iBiome-Changing Ice lets users play with climate change scenarios, set personalized goals to reduce individual eco-footprints, and provides features to track real-world impacts via AR technology. In this presentation, we will demonstrate how kids can build beautiful ecosystems in the polar regions, from the Tundra, Arctic, Boreal Forest, to the Antarctic. They can play mini-games on permafrost, feedback loop, and study the melting Arctic ice cap. With the engaging experience, kids gain knowledge on why the permafrost is thawing, and how our lifestyles contribute to climate change. More importantly, kids are inspired to reduce their own eco-footprint, and become the change they want to see. We will invite the scientists who helped us in developing the

content of this game to be part of the presentation, such as Cassandra Debets, a professor at University of Manitoba, Marc-André Ducharme from ArcticNet. Along with the pre-recorded demonstration, attendees will have a chance to experience firsthand with the free demo of this game online for a limited time after the presentation, thus increasing audience engagement. Attendees will walk away understanding how Arctic research and knowledge can be communicated in an interactive format to educate future generations to help Northern communities to fight for climate change and for shared future. iBiome-Changing Ice teaches us how our modern lifestyle leads to environmental challenges, and why our conveniences threaten the traditional lifestyle for Indigenous people far up North. In this way, Springbay Studio is seeking collaboration and partnership with the northern communities. Please find the iBiome-Changing Ice app trailer here: https://youtu.be/aggkRUl839Y.

Session: KEP33 — Communicating Arctic science

ID: 215

Hydrodynamic sorting and degradation of permafrost organic matter in the nearshore zone of Herschel Island (Yukon, Canada)

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Abstract: Thermal erosion of permafrost coasts delivers large quantities of organic carbon (OC) to arctic coastal waters. Although deposition of permafrost OC in nearshore sediments potentially attenuates the "permafrost carbon feedback", continued resuspension of sediments by waves, storms, and currents potentially enhances greenhouse gas production in the nearshore zone. Recent studies, focusing on bulk sediments, suggest that permafrost OC derived from coastal erosion is predominantly deposited in the nearshore zone. However, hydrodynamic gradients in the coastal zone allow sorting processes to strongly influence the OC distribution and fate, which cannot be assessed by using bulk sediment approaches. Here, we study soils and sediments fractionated by density (1.8 g cm^{-3} cutoff), separating the organic from the mineral-associated fraction, and size (63 μm), separating sand-associated from silt and clay-associated OC. We sampled sediments along a transect from an active retrogressive thaw slump at the coast of Herschel Island — Qikiqtaruk (Yukon, Canada), to the nearshore zone, towards an offshore sedimentary basin. Each sediment fraction was analysed for its elemental content (total organic carbon (TOC), total nitrogen (TN)), carbon isotope signature ($\delta^{13}C$, $\Delta^{14}C$), molecular biomarkers (n-alkanes, n-alkanoic acids, lignin phenols, and cutin acids), and mineral surface area. Preliminary data show that the OC partitioning between the sediment fractions changes considerably over the transect, suggesting that hydrodynamic sorting processes take place. Additionally, the OC characteristics of the fractions are significantly different from each other. For example, the low-density organic fraction shows a slightly less degraded signal than the high-density silt- and clay-associated OC fraction in several molecular biomarker proxies, and has a higher average TOC/TN ratio (24 ± 3 versus 12 ± 2). We aim to disentangle sorting processes and degradation mechanisms of permafrost OC along this transect of fractionated soils and sediments in the nearshore zone, and give new insights into pathway of this material upon erosion.

Session: TER88 — Arctic coastal dynamics in a changing climate

ID: 658

A comparative analysis of perceived impact of permafrost thaw in Svalbard and orthwest Greenland

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Abstract: Permafrost thaw is a growing issue of concern in communities across the Arctic. Communities associate different kinds of impacts and risk with permafrost thaw, and have different ways of dealing (or not dealing) with it, on various levels (individual, institutional, policy, and scientific). This paper presents a framework to connect three domains: the institutional level, individual perception, and the scientific. The empirical material include a survey and

qualitative interviews from Longyearbyen on Svalbard, Norway, and Qeqertarsuaq and Qaanaaqin Greenland. Preliminary results illustrate a lack of connection between perceptions of permafrost thaw impacts and risk, the institutional responses, and related adaptation and mitigation strategies across the study sites.

Session: IHE21 — Arctic communities adapting to permafrost thaw

ID: 42

Understanding the winter ecology of reindeer on an ecosystem level

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Abstract: Winter is the period of greatest food stress for reindeer who, although migratory across the landscape, remain within the Arctic throughout the year. The low quality and abundance of forage in their environment often leaves them in a calorie deficit, yet this is not the only challenge they face during this season. Human infrastructure such as mines and roads cause a loss of forage, both due to their physical structure and from subsequent avoidance behaviour shown by the animals. Climate and snow also play an important role, influencing the movement of reindeer and, at times, creating impenetrable barriers between them and their ground-lying food. Past research has delved deep into the impacts of these factors considered in isolation, yet a wider ecological view of the system is needed to understand their cumulative and integrated effects. In this study, both novel field data from northern Sweden as well as results from past studies have been used to construct an interactive model. This model, cycling through 50 years in a hypothetical landscape, includes climatic, biotic, and abiotic factors, comparing and contrasting these aspects of the environment and their impact on reindeer survival to allow for a more comprehensive understanding of the winter ecology of reindeer.

Session: TER80 — Seasonal strategies of Arctic wildlife

ID: 545

Protecting Thaidene Nene: forging new partnerships to create an Indigenous protected area

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Abstract: Thaidene Nëné, established in August 2019, is 26 374 km^2 Indigenous protected area that encompasses a national park reserve, territorial protected area, and a future territorial wildlife conservation area. The park complex was established 50 years after it was initially proposed by Parks Canada. It wasn't until Aboriginal and treaty rights were recognized and affirmed under section 35 of Canada's Constitution Act in 1982; the diamond staking rush in the Northwest Territories that began in 1989; and the evolution in federal and territorial parks and protected areas laws and policies driven by Indigenous political activism that the Łutsël K'é Dene First Nation decided to re-initiate talks with Parks Canada, with the Government of the Northwest Territories joining negotiations after devolution, to enter into a partnership to protect Thaidene Nëné. The presentation will begin by providing some background information on the people, place, and park. Followed by a brief introduction on the emergence of Indigenous Protected and Conserved Areas (IPCAs) in Canada. We will then discuss how the First Nation built new partnerships with crown governments and environmental non-governmental organizations to realize Thaidene Nëné, with a focus on three major innovations — the creation of a trust fund to fund the management and operations of the park; Indigenous, federal, and territorial operations; and the co-governance relationship that has been developed based on the terms of the park establishment agreements.

Session: KEP73 — Advancing conservation through partnerships in knowledge and governance — northern case studies

ID: 626

Quantifying Arctic marine-terminating glacier contributions to the ocean

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Abstract: We quantify, for the first time, the ice discharge contribution of every glacier in the Arctic (excluding the Greenland Ice Sheet) to the ocean, also known as frontal ablation. Frontal ablation occurs from the combination of ice flow into the ocean, and ice gain/loss from terminus advance/retreat. This is needed to quantify the relative importance of mass loss from surface mass balance (i.e., snowfall minus meltwater runoff) vs mass loss to the ocean to better constrain glacier contributions to sea level rise, map iceberg production patterns, and improve understanding of ice-ocean interactions. We calculate frontal ablation by combining glacier velocity, thickness, and terminus-position observations derived from satellites and airborne campaigns from 2000 to 2020. Ice velocity is derived from the NASA ITS_LIVE mission, which uses Landsat 5, 7, and 8 imagery to quantify ice motion. Images from the same satellites are used to quantify glacier terminus changes from 2000 to 2010 and from 2010 to 2020. Glacier thickness observations are derived from airborne campaigns including NASA's Operation IceBridge, and, where thickness observations are not available, we use model outputs. These observations are combined along manually drawn flux gates in a custom python script to quantify frontal ablation for the 1444 marine-terminating glaciers in the northern hemisphere. Average pan-Arctic frontal ablation for 2000–2020 is -79 ± 30 Gt a^{-1}, of which terminus retreat accounts for approximately one third. The regions with the most discharge in ascending order are Svalbard, Russia, Alaska, Greenland (excluding the ice sheet), Canada, and Iceland/Jan Mayen. We find that 110 glaciers ceased to be marine-terminating between 2000 and 2020. The 40 glaciers with the highest frontal ablation rate contribute ~50% of total pan-Arctic frontal ablation, whereas the 284 biggest contributing glaciers (20%) account for 90% of total Arctic frontal ablation.

Session: MAR42 — Changes in the marine cryosphere

ID: 182

Intensive field courses within the framework of Russian-Norwegian research-based education in Cold Regions Engineering (RuNoCORE) project

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Abstract: The rational development of Arctic infrastructure poses new challenges for humanity. There is a need for a sufficient number of highly qualified specialists who will work there in the future. This will lead to the sustainable development of the Arctic territories. Specialists should have not only good theoretical background but also practical knowledge of working in the Arctic. Unfortunately, the number of field courses is decreasing every year. Russian-Norwegian research-based education in Cold Regions Engineering (RuNoCORE; 2018–2021) involves academic staff from the two largest universities in Norway and Russia — Norwegian University of Science and technology (NTNU) and Lomonosov Moscow State University (MSU) for the development two intensive courses in Russia. The first course takes place every year in January in Zvenigorod (50 km from Moscow), in the area of seasonal frost. Target groups are Master's and Bachelor's students. The purpose of this course is to get acquainted with methods of winter fieldwork, which are used in geotechnical surveys in cold regions. As part of this course, students study geophysical methods, site drilling, landscape mapping, and frost heaving at different sites. Students learn to integrate various methods and correctly interpret the results, maintain technical documentation, and reporting of results. The second course is in September in the area of sporadic permafrost. The field course in the Vorkuta area (coal-mining town in the Komi Republic, Russia) and Hanovey test site (located in 31 km from Vorkuta) was established to provide education for Master's and PhD students to meet the unique challenges of design, construction, and operations in cold regions. Students learn different methods of permafrost survey (geophysical survey, site drilling, landscape mapping, field and laboratory testing of frozen soil, and inspection of northern infrastructure facilities). Partners from industrial companies are engaged in fieldwork and involved in the teaching of students.

Session: TER89 — Integrating science and engineering education for challenges to northern infrastructure under a changing climate

ID: 825

Condition and diet of ninespine stickleback (*Pungitius pungitius*) populations in Arctic streams

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Abstract: This project aims to explore the factors affecting the condition and diet of ninespine stickleback (*Pungitius pungitius*) populations in Arctic streams of the Greiner Lake watershed near the hamlet of Cambridge Bay, Nunavut. Ninespine stickleback are highly abundant in the Arctic. It is understood they are generalists and feed primarily on aquatic invertebrates, but their ecological role within Arctic food webs is not well defined, especially in streams. This research aims to address this knowledge gap. The length-weight relationships of ninespine stickleback populations from a variety of Arctic streams are compared with the environmental data collected from these streams to determine what variables are correlated with greater stickleback condition. Gut-content analysis is also being conducted on the stickleback to compare invertebrate structures identified from within their digestive tracts to the populations of macroinvertebrates collected from streams. This method will be paired with DNA metabarcoding of stickleback stomachs and stable isotope analysis of stickleback tissue for a robust diet analysis to determine what macroinvertebrates they are eating, and if they show preference towards specific macroinvertebrate prey. Statistical methods such as selectivity indices, stable isotope bivariate analysis, as well as principal component analysis will be used to determine if diet is associated with specific benthic macroinvertebrate taxa. The research proposed here is part of a multithematic study with the aim of developing a multi-trophic understanding of food-webs in the Greiner Lake watershed in the wake of a rapidly changing Arctic climate. As climate change progresses, benthic invertebrate community structure will be affected, which may subsequently affect ninespine stickleback diet and condition. Understanding the condition and diet of the ninespine stickleback is important because they are a food source of Arctic char, and their full ecological role is not well understood.

Session: TER84 — Climate-driven pressures on Arctic freshwater biodiversity: ecological responses and consequences

ID: 647

The Yamal Obskaya — Bovanenkovo railway and Nenets reindeer herders: three decades of shared territory

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Abstract: In central Yamal peninsula, which is permafrost area, both natural and anthropogenic changes have occurred during the past 40 years. Bovanenkovo Gas Field was discovered in 1972. The construction phase of a 572 km long railroad from Obskaja to Bovanenkovo began in 1987. As the Soviet Union collapsed in 1993, the building process ceased in Paijuta (189 km). In 2007 railway construction restarted and in 2012 the Bovanenkovo gas field was in production. We have studied gas field development, effects of the railway, and natural changes in the region and the cumulative impacts on Nenets reindeer herding. The traditional landuse in the Yamal is reindeer herding practiced by nomadic Nenets herders. The hydrocarbon industry is presently the source of most ecological changes in the Yamal peninsula and socio-economic impacts experienced by migratory herders who move annually between winter pastures at treeline and the coastal summer pastures by the Kara Sea. Nenets managing herds of reindeer have proven able to adapt in responding to a broad range of intensifying industrial impacts at the same time as they have been dealing with symptoms of a warming climate and thawing permafrost. The railway goes across migration routes of the Nenets families; it goes through precious reindeer pastures and causes many limitations and difficulties for nomads to perform their seasonal migrations in the tundra. Some groups of Nenets reindeer herders have changed their routes of migrations; however, many others have continued to follow their old ways, but with many difficulties and limitations. The

contemporary history of the Yamal peninsula shows that reindeer herders did not isolate themselves from the new changes in the tundra, but tried: (1) to develop new networks of their communication with railway workers; and (2) to build business to get some money, petrol, or even for buying basic food supplies and bread on the tundra railway stations.

Session: IHE20 —Northern roads and railways: social and environmental effects of transport infrastructure

ID: 427

Do as the Romans do: identifying the viral "Romans" of freshwater Arctic lakes

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Abstract: Polar aquatic ecosystems are dominated by microbial communities, and viruses are a major component. Viruses affect the aquatic microbiome by regulating the size of host populations, driving community evolution, and shunting the circulation of energy through trophic webs, which ultimately impacts biogeochemical processes. Because of rapid mutation rates and horizontal gene transfer, viral communities tend to be genetically diverse, and only a few viral genotypes appear to have global distributions. In cellular communities, metabolic capacities usually mirror environmental conditions; thus, closely related species can often be found in similar environments. As viruses lack an independent metabolism and mutate regularly, would viral communities from similar environments also be akin? In this study, we aimed to identify sub-communities of viruses that may be omnipresent in Arctic freshwaters. We sampled at the northernmost frontier of Canada on northern Ellesmere Island, Nunavut, where the effects of climate change are already evident and will continue to accelerate as Arctic temperatures continue to rise. We selected three lakes within a 100 km range that had comparable environmental conditions in their fresh and oxygenated surface waters: freshwater Ward Hunt Lake, meromictic Lake A, and the Milne Fjord epishelf lake. Because the viral communities of these ecosystems are essentially undescribed, we used shotgun sequencing in a metagenomic approach to generate a comprehensive assessment of the double-stranded DNA virus diversity and genetic potential. Although the viral community structures differed among lakes, specific sub-communities were common to all three lakes. Analysis of these communities indicated the environmental factors that favoured their presence. Further investigation into these core viral communities may reveal specific genes related to mechanisms of infection or auxiliary metabolic genes.

Session: TER84 — Climate-driven pressures on Arctic freshwater biodiversity: ecological responses and consequences

ID: 243

Population genomic structure and hybridization in the Glaucous Gull (*Larus hyperboreus*)

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Abstract: Climate change poses a significant threat to the future of Arctic ecosystems. To effectively conserve Arctic species, genetically differentiated populations must be defined for adaptive and neutral genetic variation to be appropriately managed. This project examines population genetic differentiation in Glaucous Gull (*Larus hyperboreus*) — a circumpolar Arctic species — and assesses hybridization between Glaucous Gull and three closely-related species. Glaucous Gull is a valuable species, biologically and culturally. As apex predators, Glaucous Gulls develop high levels of toxins in their tissue and, therefore, are excellent bioindicators of the long-range transport of contaminants in the Arctic. Glaucous Gulls also hybridize with other white-headed gull species where breeding ranges overlap. Although the International Union for Conservation of Nature (IUCN) currently lists the Glaucous Gull as Least Concern, declines have been reported across their range in Arctic Canada. Currently no fine-scale population genetic information exists for this

species, and management units have not been delineated. Double digest restriction-site associated DNA sequencing was conducted on 59 Glaucous Gull, 18 American Herring Gull (*Larus smithsonianus*), six European Herring Gull (*Larus argentatus*), and 15 Glaucous-winged Gull (*Larus glaucescens*) sampled across the North American and European Arctic. Despite the geographic distance between sampling locations, STRUCTURE and principal component analysis (PCA) suggest only weak population differentiation between sampled European and Canadian colonies of Glaucous Gull. Interspecific analyses using 2145 loci show that Glaucous Gull and Glaucous-winged Gull are genetically distinct species but that Glaucous Gull and the two species of Herring Gull are only weakly differentiated. Several sampled individuals may represent hybrids between Glaucous Gull and other species. Detailed information on population genetic structure and hybridization will help conservation practitioners effectively manage the long-term persistence of Glaucous Gull populations. Proactive management strategies for this species will benefit both Glaucous Gull and the entire Arctic ecosystem.

Session: TER77 — Climate change and Arctic birds: unifying disciplines for assessing the risk to Arctic avian communities

ID: 605

Erect shrubs do not change total soil carbon content but increase carbon reservoir turnover in a High Arctic tundra

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Abstract: Substantial work has investigated abiotic factors and plant functional traits that have promoted northward range shifts of erect shrub species over the last decades in response to climate change. Yet, little is known about the feedback effects of these species on Arctic ecosystem functioning, especially the extent to which they modify soil organic carbon sequestration and cycling. In this study conducted along two alluvial fans of Bylot Island Qarlikturvik valley, organic carbon content was analyzed in soils sampled outside and beneath *Salix richardsonii* patches localized in both high and low fertility conditions. We hypothesized that increasing shrub cover, which is assumed to increase fresh energy-rich organic matter input and decrease soil fertility, would trigger preferential mining of inert millennial soil carbon reservoir. Elemental analysis of soil samples revealed that soil total organic carbon content did not differ between sites located outside and beneath *S. richardsonii*, nor between low and high fertility condition zones. However, the presence of *S. richardsonii* did increase soil fine particulate and recalcitrant organic matter content under high fertility conditions. Stable isotope analyses further showed that *S. richardsonii* also increased the input of ^{13}C-poor organic matter and decreased C:N ratio under both low and high soil fertility conditions. These results indicated that increasing erect shrub abundance can lead to greater carbon sequestration by increasing the proportion of stable organic matter content in Arctic tundra soils, but that such processes may depend on the level of soil fertility. When soil fertility is low, higher plant nutrient demand is satisfied by mining recalcitrant organic matter. Lastly, we showed that the soil bank mechanism framework represents an adequate scheme to provide novel insights into potential ecosystem-level impacts of ongoing Arctic shrubification.

Session: TER78 — Arctic plants in changing landscapes

ID: 249

Model evaluation of the Canadian Arctic Archipelago's carbon sink

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Abstract: The Arctic Ocean, including the Canadian Arctic is expected to face massive changes in its sea-ice properties. With sea ice having a huge effect on the air–sea gas exchange, the evaluation of the carbon sink in the Canadian Arctic is challenging and important for future predictions of atmospheric CO_2, ocean acidification, and its impacts on the local marine life. In recent years, estimates and empirical models for ocean properties influencing the air–sea flux of CO_2 based on observations were developed. However, observations carry seasonal biases and empirical models are designed based on spatially and temporally limited observations. To obtain a more comprehensive understanding of the Canadian Arctic, the numerical model North Atlantic Arctic – Canadian Ocean Ecosystem model – Canadian sea-ice-biogeochemical model (NAA–CanOE–CSIB) within the Nucleus for European Modelling of the Ocean (NEMO) framework is applied. The aim is to evaluate the seasonal and inter-annual variability for the last two decade and to assess empirical approaches for carbon uptake from a modelling perspective.

Session: MAR40 — Air–sea gas exchange and biogeochemical processes in Arctic Shelf Seas

ID: 614

Determinants of iron deficiency and anemia among Nunavimmiut: results from the Qanuilirpitaa? 2017 Nunavik Health Survey

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Abstract: Although the prevalence of iron deficiency (ID) and anemia are of the lowest in Canada, both have been common issues in the Canadian Arctic. ID and anemia can have negative impacts on cognitive and immune system functioning, physical performance, and quality of life. ID, nutrient deficiencies, and inflammation can all cause anemia. Distal causes including social determinants of health can also contribute to ID and anemia. This study aims to determine the main distal (modifiable) and proximal (biological) protective and risk factors of hematological and iron statuses among Inuit adults (16 years and older) in Nunavik. We used data from the Qanuilirpitaa? 2017 Nunavik Inuit Health Survey ($n = 1267$). Venous blood was analysed for several relevant biomarkers including hemoglobin (Hb), serum ferritin (SF), *Helicobacter pylori* serology, blood selenium, and mercury. Sociodemographic, food security, anthropometric, dietary, and health data were also collected. Multiple linear and logistical regressions were used to assess correlates of Hb and SF by age and sex groups. Women of childbearing age had high prevalence of iron deficiency anemia (14%), whereas Hb concentrations were lower and the prevalence of anemia unrelated to ID was higher (25%) in adults after 49 years of age. A higher socioeconomic status was associated with higher Hb and SF among women of childbearing age. Blood selenium was associated with higher SF among younger adults. *Helicobacter pylori* was associated with lower SF among younger men, and with lower Hb among younger women. Among older adults, food insecurity was associated with lower SF. Finally, obesity was associated with higher SF among all except older men. Protective and risk factors for ID and anemia vary according to age and sex groups and highlight the need for targeted interventions. High prevalence of anemia in older Inuit adults warrants further investigation, as it represents a significant public health issue.

Session: IHE14 — Health, well-being, and the social determinants of health in the North

ID: 560

Environmental correlates of diversity in diatoms, benthic macroinvertebrates, and fish of North American Arctic rivers

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Abstract: Climate change is an ongoing threat to Arctic freshwater biodiversity, but impacts vary depending upon the organism group and the strength of its response to climate-related drivers. As part of the first assessment of the state of Arctic freshwater biodiversity by the Arctic Council's Circumpolar Biodiversity Monitoring Program, we evaluated alpha diversity of diatoms, benthic macroinvertebrates, and fish in relation to environmental drivers in North American Arctic rivers. Macroinvertebrate diversity declined strongly with increasing latitude from 48°N to 82°N, and was closely linked to latitudinal declines in temperature. In contrast, diatom and fish diversity peaked around 70°N without a clear latitudinal decline. Diatom diversity was related to bedrock geology and temperature, whereas fish diversity was related to glaciation history. In sites with both diatom and macroinvertebrate data, temperature, precipitation, geology, calcium, and substrate size were important environmental correlates, although diatom taxa were most strongly associated with water chemistry, whereas macroinvertebrate composition related most strongly to precipitation and temperature. This large-scale study provides the most substantial integration and analysis of river diatom, macroinvertebrate, and fish data from the North American Arctic to date. The findings of the study suggest that macroinvertebrates will show the strongest response to climate-related shifts in temperature, and should therefore be considered a priority indicator of change in these systems. However, significant gaps exist in spatial and temporal data coverage. These gaps could be reduced by improving collaborative efforts between the USA and Canada to harmonize future monitoring.

Session: TER84 — Climate-driven pressures on Arctic freshwater biodiversity: ecological responses and consequences

ID: 28

Modeling methylmercury bioaccumulation in the Beaufort beluga food web

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Abstract: Mercury can pose risks for marine ecosystem health in the Canadian Arctic. Rapid changes in the Arctic climate may have affected mercury transport and bioaccumulation in Arctic species in many different ways, and the causes of observed historical trends in beluga mercury are still unclear. The goal of this study is to better understand how climate and ecological influences have interacted to drive Beaufort Sea beluga mercury concentrations. As a first step to achieving this goal, we parameterize an ecosystem model for simulating mercury bioaccumulation through the Beaufort beluga food web. We present preliminary results exploring how simulated mercury levels in Beaufort Sea beluga respond to climate-driven ecological changes. We construct scenarios of these changes (such as food web structure and dynamics, migration timing, etc.) based on previously documented observational data. The results of this work will provide new insights into the relative strength of influence that different climate-driven scenarios result in. The modeling tool developed here can be further used for a holistic analysis of how environmental change affects the mercury levels in the beluga food web by altering the physical environment and food web structure.

Session: IHEA13 — Evolving perspective on northern contaminants research

ID: 678

Introduction to perspectives on supporting and empowering Northern communities in undertaking climate action

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Abstract: Partnerships between Canadian Federal departments, formalized through a memorandum of understanding, have allowed for innovative climate change adaptation program delivery in Canada's North, including the development of a unique governance structure consisting of regional Climate Change Committees for Adaptation (C3A), made up of key Indigenous and Northern stakeholders. These committees have enabled three funding programs, housed within Crown-Indigenous Relations and Northern Affairs Canada and Indigenous Services Canada, to improve their understanding of northern priorities, reduce the number of committees needed for multiple funding programs, and streamline collaborative decision-making that is reflective of these northern priorities. Through the introduction of this innovative shared governance structure between the three programs, we can see how direct and personal linkages to Northern communities have fostered an environment of support, cooperation, and resiliency. As part of this innovative governance approach, a network of externally-based Community Liaisons was established across the North to provide support to communities accessing funding and to these governance committees. These Community Liaisons provide critical insight into adaptation and monitoring needs and priorities of communities, and help to reduce the barriers that Northern and Indigenous communities face when trying to access federal funding. Their efforts in linking Northern communities and organizations with the federal funding programs has not only greatly increased the Federal Government's ability to deliver their services across Northern regions, but has resulted in improved resiliency of Northern communities against a changing environment. This presentation will provide further details on this shared program delivery approach and set the stage for individual presentations by Community Liaisons from across the north to further explore the successes, challenges, and lessons learned that have been experienced through the formative years of this system.

Session: NPD74 — Perspectives on supporting and empowering northern communities in undertaking climate action

ID: 575

Communicating Arctic science in the classroom — taking the time to listen and learn

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Abstract: As scientists working in the North, we have all developed a keen sense of the need for consultation and full project engagement with Northern communities. This on-going feedback is fundamental to ensure that our scientific work is properly aligned with the concerns of those living in the North. Meetings with Hunters and Trappers Organizations, Hamlet Councils, community members, and elders often provide the basis for project design, implementation, and delivery. However, a key ingredient to any project is the engagement of youth. The excitement and enthusiasm of the youth often inspire us to think outside of the box to deliver our science in a meaningful way to them. Although classroom visits are designed to be interactive and fun, there is always a push to help the kids to better grasp the scientific concepts we are studying. In the end, however, it is often us who come away with an enlightenment and the feeling of being much more informed. This past March 2020, just days prior to a worldwide pandemic-related shut down, we had the pleasure of participating in a consultation tour of four communities in the Inuvialuit Settlement Region. This talk will focus on one particular element of the tour: the time spent "listening and learning" from the youth. In the North, climate change drives environmental alterations that are so rapid that, even in their short lifetime, children are able to use their keen observation skills and inquisitive nature to witness and discover things for themselves. The ability for children to communicate their own observations of changes happening all around them with such passion and knowledge often left us awestruck. This talk aspires to convey the importance of mutuality in learning, a practice

crucial to the delivery of a scientific message that is more appealing to younger generations.

Session: KEP33 — Communicating Arctic science

ID: 820

Pikialasorsuaq, Government of Greenland initiatives

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Abstract: Pikialasorsuaq is an area of sea between latitude 75°N and 79°N, between northwest Greenland and northeast Nunavut, Canada. Due to the combination of sea currents and predominant winds, the area is a polynya, free of ice where the surrounding area is normally ice covered during winter. That combination makes conditions favorable for an exceptional biological production, making it the most biologically productive sea area in the Arctic. Many express concerns over the future of the area due to human-induced changes occurring and possibly occurring in the future. The Danish Centre For Environment And Energy (DCE), in 2017, identified Pikialasorsuaq as a unique ecosystem due to the biological productivity, critical for a number of populations of birds and marine mammals, and an associated hunters' culture. The Inuit Circumpolar Council's (ICC) Pikialasorsuaq commission, also in 2017, published a report based on extensive consultations with Inuit and local communities in and around the area. The report delivers recommendations on management, identification of the area and travel for people living in the area. Both the DCE and ICC highlight that an administrative area larger than just Pikialasorsuaq, cross-border cooperation, and an efficient monitoring system must be considered for possible management planning. In this presentation, the Ministry of Science and Environment, Government of Greenland, will describe the legal framework and sharing of responsibilities between the Kingdom of Denmark and Government of Greenland, regarding environmental monitoring and conservation, harvest and involvement of right-owners and stakeholders, under which the Ministry is working. Likewise, the ongoing work on living up to the advice given by ICC and DCE, as mentioned before, and finally, the initiatives to ensure participation of as many interests as possible, in a possible future planning and management of the area will be presented.

Session: KEP73 — Advancing conservation through partnerships in knowledge and governance — northern case studies

ID: 546

Beluga harpoon tagging: a new tool for marine conservation based on Inuvialuit knowledge and western science

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Abstract: Telemetry is a powerful tool for collecting data on the movement ecology of marine mammals, and has been used to support marine spatial planning efforts in the Canadian Arctic. However, methods for marine mammal tagging remain controversial. For beluga whales in particular, state-of-the-art tagging requires live capture, handling, and invasive attachment methods, as well as a large crew and significant logistical effort. Capture constraints and seasonal/site feasibility also result in sampling bias toward narrow demographics (e.g., size and sex). Following several major community engagement events, Inuvialuit identified collecting updated movement data for Eastern Beaufort Sea (EBS) beluga whales as a research priority in response to concerns over climate change and increased vessel traffic. Community members challenged the research team to develop an alternative to the live-capture tagging method that would be less invasive and hunter-deployed, yet still return valuable movement and dive data. Specifically, a harpoon deployment method with single subdermal

toggle anchor was identified as appropriate in the Inuvialuit context due to knowledge and skills developed and maintained through traditional beluga harvesting practices. We adopted a co-design approach to developing the new harpoon tagging method using both western science and Inuvialuit knowledge, including mixed approaches to collaboration between scientists and Inuvialuit partners. Examples include establishing a project-level steering committee, hosting task-oriented workshops, developing new tools and approaches while on the land, conducting field pilots with experienced beluga harvesters, and hiring Inuvialuit knowledge-holders to lead on key technical aspects of the project going forward. In this talk, we discuss specific benefits of adopting a co-design approach to innovation, and show examples of novel data generated from a new tool that has the potential to fill spatiotemporal knowledge gaps in the movement ecology of EBS belugas and support future marine conservation planning and management efforts.

Session: KEP35 — Community-based monitoring and knowledge co-production in wildlife research

ID: 179

1st year of FROZEN CANOES: developing interdisciplinary and complementary graduate level courses

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Abstract: In Canada and Norway, there is a need for multidisciplinary, highly skilled practitioners in science and engineering related to cold regions to design sustainable infrastructure in a context of climate change. Construction techniques commonly used in other parts of North America and in Europe cannot simply be applied to transportation infrastructure in cold climate environments. Knowledge of the key science foundation for frost action and permafrost is required to adequately address the needs of industry and academic research. By sharing expertise from different science and engineering research environments, and industry, we will improve our capacity to respond to future cold region issues. Funded by the Research Council of Norway, the FROZEN CANOES research partnership (i.e., landscape and infrastructure dynamics in frozen environments undergoing climate change in Canada, Norway, and Svalbard) aims to develop a high-quality research-based course package that draws on geoscientific and engineering knowledge. The first FROZEN CANOES graduate course took place in fall 2019 at the Norwegian University of Science and Technology (NTNU) in Trondheim. This course disseminated knowledge on frost action physics, which is the basis of all analysis of soil and road pavement behavior in cold regions. Twenty-six graduate students and professionals in engineering and geosciences from Canada, Norway, Sweden, and Russia participated. The program consisted of two online modules followed by a two-week intensive, residential course. This specific format was chosen to give time for students to focus on field aspects and modelling exercises during the intensive course. The next courses will be on High Arctic permafrost geotechnics and geohazards in Longyearbyen, Svalbard and advanced permafrost engineering applied to transportation infrastructure in Yukon, Canada.

Session: TER89 — Integrating science and engineering education for challenges to northern infrastructure under a changing climate

ID: 803

Narwhal grouping pattern inferred from telemetry data

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Abstract: Narwhals are currently managed in Canada as different stocks. The interactions between the management stocks, as well as the degree of cohesiveness within each stock, are still uncertain. Narwhal management stocks range in size from 10 000 to 50 000 individuals. These stocks contain small mixed sex and age-class clusters containing up to 25 narwhals that are part of large herds of several hundred individuals. Although the snap-shot composition of narwhal clusters and herds has been examined, their stability remains unknown. We equipped seven pairs of narwhals coming from the same clusters with satellite transmitters to investigate the stability of their clusters. During the summer (August–October), pairs of narwhals spent 16.7% (range: 1.1%–44.4%) of their time within 5 km of each other. One pair of narwhals split at least five times for a maximum of 14 days and merged back together from distances of more than 200 km during the 80 days that they were tagged (from 3 August to 22 October). Another pair of narwhals was separated for more than a month and by more than 500 km during the fall migration before they met back on their wintering grounds. This study suggests that narwhals can form long-lasting bonds and that narwhal grouping patterns are flexible. Complementary methods, such as mark-recapture analysis, will help to address the stability of narwhal clusters and stocks.

Session: MAR71 — Species interactions in Arctic aquatic ecosystems

ID: 795

Revisiting traditional knowledge holder interviews exploring social-ecological change on Kendall Island in the Inuvialuit Settlement Region of the Northwest Territories, Canada

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Abstract: The global pandemic has largely halted in-person qualitative research in Northern communities, resulting in the postponement of many research programs. These circumstances, however, have also generated a renewed focus on working with existing data sets. The benefits of this are multifold, in that revisiting such data sets offers an opportunity to thoroughly report on results that were not published prior and, therefore, may not be readily available for application in research and management. Furthermore, adequately reporting qualitative findings can help reduce community fatigue by clearly identifying research questions that have been explored with community members in the past. The cancellation of our 2020 field season encouraged us to revisit a project from 2012, the findings of which were briefly described in a technical report but were never published in full detail. This project was a collaboration between the Inuvialuit Hunters and Trappers Committee, the Inuvialuit Regional Corporation, and the Department of Fisheries and Oceans, during which six Inuvialuit elders and seasonal residents of Kendall Island (a traditional whaling camp in the Mackenzie Delta) were interviewed about localized climate change impacts among other topics (e.g., beluga and fish health). All interview participants were seasoned beluga and fish harvesters, some possessing over 50 summers of experience at Kendall Island. Interviews were conducted during a five-day elder and youth field camp and were facilitated by a local project coordinator with the support of several youth research assistants and an Inuvialuktun translator. Interview audio was later transcribed, verified by participants, and analyzed using NVivo software in 2012 and again in 2020. Interview findings highlight the critical importance of Kendall Island to participants and provide insight into baseline and changing social and ecological conditions at this site. During this presentation we share key project findings and their implications, which we are presently summarizing in a forthcoming manuscript.

Session: KEP35 — Community-based monitoring and knowledge co-production in wildlife research

ID: 697

Coastal margin seaweeds: influence of glacial melt on intertidal algal community structure and their environmental drivers

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Abstract: High-latitude coastal ecosystems, such as those found in the Gulf of Alaska (GOA), are experiencing a dramatic change in environmental conditions due to climate warming. Alaskan glacier discharge rates have doubled in the past decade and have modulated downstream temperature, salinity, nutrient, and sediment stratification profiles in coastal embayments. These fast-changing environments are, thus, predicted to influence the biological response and ecological function of primary producers in local communities. Here, we examine the intertidal community structure with a focus on seaweeds and their accompanying environmental drivers at nine watersheds in two regions, which are separated by approximately 1000 km. Each watershed spans a gradient of 0%–60% glacial coverage. Intertidal quadrat surveys and biomass collections, along with environmental monitoring of salinity, temperature, dissolved oxygen, turbidity, and nutrient loading were completed from April to September 2019 in each watershed. Biological community structure and variance was analyzed in relation to the local environmental spatiotemporal profiles. We found spatial coverage of primary producers to be negatively correlated with salinity, whereas primary producer biomass was positively correlated with turbidity. In general, there was an increasing percent coverage and contribution trend occurring with increasing glacial coverage, except at one non-glacial watershed that had larger than expected turbidity values given the relative watershed size. There was likely local circulation and oceanic influences that influenced the variable response of different seaweeds between regions. Nonetheless, increased glacial melt from climate change has the potential to impact future seaweed demographics and accelerate transition in downstream estuarine communities as we see a shift from glacial to non-glacial ecosystems.

Session: MAR49 — Macrophytes in northern waters: current distribution, future changes, and economic possibilities

ID: 834

Better Hearing in Education for Northern Youth (BHENY)

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Abstract: Hearing loss is an important health concern in the Canadian Arctic. In 1996, the World Health Organization identified the Indigenous population in Canada's High Arctic as having one of the highest rates of hearing loss in the world. Children with hearing loss are at risk for difficulties in communication, learning, and social development. Better Hearing in Education for Northern Youth (BHENY) was the recipient of the 2015 Arctic Inspiration Prize. This initiative was a multipronged approach to address the hearing needs of children living in the Canadian Arctic and raised awareness of the deleterious effects of hearing loss. Critical to BHENY's success was the collaboration and support received by the Departments of Health and Education in Nunavut. The initial focus of the BHENY initiative was to implement soundfield amplification systems in elementary classrooms in the Qikiqtaaluk Region of Nunavut. These systems allow for improved hearing for all children in a classroom. To ensure sustainability, a model for professional development, training for educators, and ongoing support for school staff was developed in collaboration with northern educators. Following the success of BHENY, the Nunavut Department of Education implemented soundfield systems in all classrooms across all regions of Nunavut. Another phase of the BHENY project was to assist in improving the service delivery of hearing health care services across Nunavut. Through a collaboration with the University of Ottawa, BHENY team members, and the Nunavut Department of Health, prevalence rates of hearing loss and data on hearing aid use was obtained for school aged children. This research represents the most comprehensive research to date on the hearing status of children in Nunavut. This is an important step in driving policy change for the delivery of hearing health care services to this region.

Session: KEP38 — Arctic Inspiration Prize: exploring the unique potential of Northern-led community science projects

ID: 396

The 1H-NMR molecular composition of dissolved organic matter in Baffin Bay

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Abstract: Marine dissolved organic matter (DOM) is the largest reduced pool of actively cycling carbon in the oceans. Despite the importance of DOM for the ocean carbon and nitrogen cycles, we lack a detailed understanding of the molecular composition of DOM. The composition of DOM is especially important in determining its biological cycling within the rapidly changing Arctic ocean. Due to the high concentration of salts in seawater relative to DOM it is difficult to analyze the molecular composition of seawater with conventional chemical — or size — fractionation methods. Here, we present the molecular composition of total seawater DOM from Baffin Bay, via the use of a novel 1H nuclear magnetic resonance (1H-NMR) spectroscopy water suppression technique for aqueous organic samples. These include the most total seawater 1H-NMR data for any ocean region, allowing us to create a comprehensive "map" of DOM composition in Baffin Bay. We will discuss these data in the context of unique DOM sources (advected, autotrophic, glacial, and sea-ice) and microbial recycling of DOM with water mass advection. Overall, this research will provide a better understanding of the composition and cycling of DOM in the Canadian Arctic.

Session: MAR40 — Air–sea gas exchange and biogeochemical processes in Arctic Shelf Seas

ID: 629

Epidemiological situation of dog bites and related human exposures to rabies in Nunavik, Québec (2008–2017)

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Abstract: In northern Québec, Arctic rabies is still endemic with cases being identified, in different animal species, almost every year. With regards to the important role they play in Inuit communities, dogs represent a meaningful source of exposure for humans, mainly through bites. The purpose of the present study was to investigate dog bite occurrence in Nunavik through the analysis of the public health board database for reported bites. Three hundred and twenty cases of animal-to-human bites were recorded from 2008 to 2017, of which 293 were dog bites (92%). Bite occurrence increased significantly during the study period, especially since 2013. Forty-five percent of all bites were seen in children under 15 years old. Males were generally over-represented compared with females (sex ratio = 1.63) and the age distribution in victims were different between the two (median age for males = 22 y.o vs.median age for females = 12 y.o). Fifteen rabid animals were identified in this study, of which nine were dogs. The multivariate analysis conducted revealed that children (<15 y.o) are more likely to be bitten by dogs (OR = 2.32, p <0.05) and more often injured in the head and/ or the neck (OR = 3.67, p = 0.05). Our study is the first to look into dog bites occurrence in Nunavik. Results reflect the necessity for an integrated, multidisciplinary approach to reduce risk for human and public health at the human–dog interface.

Session: IHE11 — Arctic One Health: gathering and mobilizing multiple knowledge type for healthy animals, communities, and environments

ID: 393

Small modular nuclear reactors (SMRs) and hydrogen as part of climate change solutions in the Arctic: challenges and opportunities

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Abstract: Many Arctic communities in Alaska, Greenland, the Canadian Arctic, and large portions of the Russian Arctic live in "off-grid settlements" that rely on diesel for their energy needs. Altogether, over 1500 communities with a total population exceeding 1.5 million inhabitants rely on locally generated power. The latest research demonstrates that in Canada, 25% of all remote communities can supplement diesel electricity generation with renewables, whereas in Alaska, this number is 15%. Russia is employing nuclear energy solutions for securing a reliable electricity supply to remote Arctic settlements to meet household and industrial energy demands. In Canada, the deployment of small modular nuclear reactors (SMRs) in the Canadian Arctic as part of the decarbonization strategy has entered the political debate. Transitioning to sustainable energy solutions in

the remote off-grid Arctic communities would require investing in targeted energy solutions, including nuclear and renewable generating capacity, including energy storage and back-up capacity while protecting the rights of Indigenous communities. The purpose of this article is to study the challenges and opportunities of SMRs and hydrogen as part of the transition to a carbon-free future in the Arctic. I use publicly available data and interviews with key stakeholders. The results of the study provide a holistic picture, including the cost structure of the deployment of SMRs and hydrogen solutions in the off-grid Arctic settlements.

Session: NPD72 — Energy transitions in the north

ID: 640

Design and test of an UAV-based ice-penetrating radar system for iceberg thickness measurement

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Abstract: Approaches to monitoring the physical characteristics of the Arctic are evolving quickly with advancing technologies. In particular, uncrewed aerial vehicles (UAVs) are increasingly ubiquitous, especially for applications with payloads such as optical and multi-spectral sensors. Here, we focus on the first prototype of a novel UAV-based ice-penetrating radar (IPR) system built and operated to remotely assess the physical characteristics of large ice-bodies such as icebergs and ice-islands in the context they can pose a significant threat to marine infrastructure, and are of scientific interest in understanding a rapidly changing Arctic. The design steps and initial results of what is to our knowledge the first iceberg survey with an UAV-IPR are presented. First, we developed a simple, ray-based radar forward model, "IPRForward", to synthesize idealized IPR transects across various simplified iceberg shapes and patterns. This gave us insights as to what to expect with actual data, and also provided indications as to how the iceberg surface geometry might influence the measurements. Second, we adapted the IceRadar system, which is a roving IPR regularly used for land-based glaciers, such that it could be carried and operated from the UAV platform; adaptations were made in terms of weight, volume, and geometry as well as with antenna configuration. We also discuss the challenges of operating the UAV system in an offshore environment (as opposed to land-based) and present some of the associated radar data obtained in the field.

Session: LTM10 — Applications of unmanned vehicle systems in Arctic research and monitoring

ID: 141

When Arctic migratory species connect tundra with the rest of the globe: the case of Bylot Island

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Abstract: Numerous migratory bird species benefit from the productivity and the lower predation risk provided by the Arctic tundra in summer to breed and raise their young. However, at the end of the summer they leave the tundra and often travel thousands of kilometres to reach diverse habitats such as the grasslands of South America, the shorelines of the Atlantic coast, and the upwelling zones in West Africa. Habitats used as stopover sites and overwintering areas by Arctic species face multiple anthropogenic and environmental stressors. The conditions encountered by birds in their overwintering areas may have direct and delayed repercussions on their reproduction and survival. To adequately anticipate the effects of global change on Arctic biodiversity, it is, therefore, essential to consider the location and the type of habitats used by migratory species during their entire annual cycle. Our objective is to define a method to characterize a global migration network of a High Arctic tundra community, focusing on the Bylot Island tundra (Nunavut, Canada) as a case study. We consider 35 species, of which 28 are migratory bird species. Data come from species distribution maps (BirdLife International), bird-watching (Ebird), banding recoveries, and tracking devices deployed at the study site on various species. By gathering these data, we locate terrestrial and marine ecoregions of the globe visited by migratory species during winter. We link Bylot food web with visited ecoregions to define a global migration network. This method presents the

number, the type, and the distribution of ecoregions that an Arctic ecosystem is connected to. The network properties are used to locate regions across the globe with a high conservation value for Arctic biodiversity. Representing Bylot Island migration network is a first step in assessing Arctic ecosystems sensitivity to environmental changes happening to distant, but connected locations.

Session: TER80 — Seasonal strategies of Arctic wildlife

ID: 630

Student success in Makkovik, Nunatsiavut

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Abstract: Quality education in remote areas of Canada's north is an important factor in community resilience, sustainable development, and Inuit self-determination. However, schools in northern communities face challenges that include high dropout rates, teacher retention, and the incorporation of curricula and pedagogies that are both culturally and linguistically relevant. The National Strategy on Inuit Education calls for Inuit specific education research and capacity building (2011) and the Forum on Research in Inuit Education (2013) identified strengths and research priorities in Inuit education. Building on research into the foundations of student persistence and success in Inuit Nunangat, this is a case study with the community of Makkovik, Nunatsiavut. In addition to publicly available school information, the study included a focus group with educators and individual interviews with Elders, parents, and recent graduates. The research revealed that most youth complete grade 12 and there is a high rate of post-secondary enrolment and completion. The ways in which education is valued, the expectations community members have of students, and the strategies and supports that are in place for the many educational challenges that exist, all point to a "culture of education". The community's narratives highlight the important roles that both parents and teachers have in this milieu. The research offers further clues as to the ways in which this culture of education is embedded in all aspects of community life and how students stay motivated in their academic persistence.

Session: IHE28 — Mapping the landscape of Inuit Education

ID: 792

Community sea-ice safety mapping through co-designed geospatial education

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Abstract: Earth observation satellites capture information that is critically important to the understanding and monitoring of rapidly changing sea-ice conditions. Interpretation of both radar and optical imagery, integrated with in-situ observations and Inuit Qaujimajatuqangit (IQ), can inform communities of hazardous ice conditions and features at local to regional scales. Although sea-ice data are collected, mapped, and shared by government agencies, their focus is primarily on shipping, not snowmobile travel. SmartICE has created an initiative to enable their local operators to conduct ice condition analyses with remote sensing data and techniques to augment community sea-ice knowledge and observations, with the goal of producing frequent community-relevant sea-ice travel safety maps. These maps will be owned by, and shared within, the communities. A training program and curriculum are being co-created to build local expertise in remote sensing interpretation and digital mapping skills. Inuit epistemology and social values lead the development. Informed by workshops that document local Inuit sea-ice knowledge and terminology, the curriculum development takes a Two-Eyed Seeing approach to weave technology and remote sensing learning with existing sea-ice IQ. The instructional design is informed by learning preferences and values documented in a preliminary workshop with operators, and is iterative in nature, incorporating the development and testing of active learning elements to ensure there are multiple pathways to engage and secure learning. Concepts and terminology are expressed through digital animations and innovative tactile models

where possible, which ultimately may support remote sensing education in a broader context. Communities in the pilot project include Nain (Nunatsiavut) and Mittimatalik (Nunavut); however, the long-term goal is to implement the program and increase the scope of operator expertise across Inuit Nunangat. This will require extensive community engagement to ensure the curriculum and learning remains locally relevant and culturally contextualized.

Session: NPD61 — Tailoring polar weather, water, ice, and climate information and services to address diverse user needs

ID: 431

Historical northern hemisphere snow cover trends and projected changes in the CMIP6 multi-model ensemble

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Abstract: An ensemble of six observation-based products were used to produce a new time series of historical northern hemisphere snow extent anomalies and trends; a subset of four of these products were used for snow mass. Trends in snow extent over 1981–2018 are negative in all months, and exceed -50×103 km^2/decade during November, December, March, and May. Snow mass trends are approximately −5 Gt/year or more for all months from December to May. The observational ensembles were used to evaluate historical simulations from models participating in the 6th phase of the World Climate Research Programme Coupled Model Inter-comparison Project (CMIP6). Overall, the CMIP6 multi-model ensemble better represents the snow extent climatology over the 1981–2014 period for all months, correcting a low bias in CMIP5. Simulated snow extent and snow mass trends over the 1981–2014 period are slightly stronger in CMIP6 than in CMIP5, although large inter-model spread remains in the simulated trends for both variables. There is a single linear relationship between projected spring snow extent and global surface air temperature (GSAT) changes, valid across all CMIP6 shared socioeconomic pathways. This finding suggests that northern hemisphere spring snow extent will decrease by about 8% relative to the 1995–2014 level per °C of GSAT increase. The sensitivity of snow to temperature forcing largely explains the absence of any climate change pathway dependency, similar to other fast response components of the cryosphere such as sea ice and near surface permafrost.

Session: TER79 — The changing Arctic cryosphere

ID: 721

Plant phenology and productivity is mediated by tundra microclimate

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Abstract: Tundra ecosystems are responding as the Arctic warms, leading to greening observed in satellite and ecological monitoring data. The resulting increased growth of plants (i.e., plant productivity) may be altering vegetation–carbon interactions. Up to a third of the world's soil carbon is stored in high-latitude frozen soils, and tundra vegetation protects those frozen soil carbon stores from thaw. Thus, tundra vegetation change may influence carbon losses and potentially amplify global climate feedbacks. Recent research suggests that tundra plant responses to warming are mediated by microclimate — the landscape-level local climate conditions in which plants grow. Plants in warmer and wetter microclimates could take advantage of longer growing periods, leading to increased plant productivity. If microclimate is a major driver of the effects of warming on tundra plants, we need additional landscape-level information to make accurate future projections of Arctic vegetation change. Funded by a 2020

Natural Environment Research Council UK – Canada Collaboration Bursary, we conducted a "remote field season", working with existing drone, time-lapse camera (phenocam) and airborne hyperspectral data from the NASA Arctic Boreal Vulnerability Experiment project and High Latitude Drone Ecology Network collaboration and comparing those data with satellite data from 2020. We found that microclimate can be used to predict patterns of plant productivity across the landscape on Qikiqtaruk — Herschel Island (YT, Canada). On south-facing slopes, leaves emerged earlier. In the wetter parts of the landscape, leaves senesced later and the overall greenness was higher. Microclimates and microtopography explained variation in satellite observations of the start and end of the growing season and peak greenness (normalized difference vegetation index) among years. Our results highlight that landscape variation in microclimate and microtopography are important controlling factors of plant phenology and productivity. Thus, future analyses of Arctic greening trends should account for landscape context and, in turn, the consequences of vegetation change for Arctic carbon stores.

Session: TER78 — Arctic plants in changing landscapes

ID: 299

Inuit knowledge and research

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Abstract: Lucy Grey is the Inuit Research Advisor for Nunavik and shares her experience working with researchers in the region (Filmed in English with Inuktitut subtitles). She explains that historically, Inuit have been left out of research and that their knowledge has been considered "anecdotal". Research approaches are evolving, and finally Inuit are starting to be able to take a more active role in research. She describes two research projects involving successful collaboration with Inuit to create knowledge that is beneficial to their communities (Nutaratsaliit qanuingisiarningit niqituinnanut and Qanuilirpitaa? 2017). Even with good relationships between scientists and Inuit, Western researchers can still have their own biases that affect how they interpret the data, so it is very important to consider Inuit knowledge and perspectives in every step of the research process. Ultimately, when Inuit knowledge and scientific knowledge are merged, they give everyone a better understanding of our world.

Session: KEP37 — How Inuit Qaujimajatuqangit (knowledge) fits into research

ID: 363

Pteropod shell dissolution in Amundsen Gulf

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Abstract: Increasing atmospheric CO_2, cold water temperatures, and freshwater inputs all contribute to enhanced acidification in Arctic waters. However, ecosystem effects of ocean acidification in the Arctic Ocean are highly uncertain. We assessed the distribution and shell condition of the pteropod *Limacina helicina*, in the Amundsen Gulf in August 2014 and 2017. The majority of individuals were located between 25 and 100 m depth, corresponding to upper halocline water of Pacific origin. In both 2014 and 2017, >85% of *L. helicina* assessed ($n = 134$) displayed shell dissolution and advanced levels of dissolution occurred at all stations. The severity of dissolution was not significantly different between 2014 and 2017 despite the presence of larger individuals that are less prone to dissolution, and higher food availability that can provide some physiological benefits in 2014. The majority of dissolution was observed on the first whorl of the shells strongly indicating that damage was initiated during the larval stage of growth in May or early June when sea ice is still present. Evidence of shell repair was present in 2014, likely supported by abundant food availability in 2014 relative to 2017. The proportion of damaged *L. helicina* collected from coastal embayments and offshore stations is higher than in

other Arctic and temperate locations indicating that exposure to corrosive waters is spatially widespread in the Amundsen Gulf region, and periods of exposure are extreme enough to impact the majority of the population. Consequences of potential population-level effects were considered by assessing the presence of *L. helicina* in coastal fish diets and the level of biological impact observed provides a forewarning for sensitive life stages of other marine species.

Session: MAR40 — Air–sea gas exchange and biogeochemical processes in Arctic Shelf Seas

ID: 754

Should we expect shift in beluga habitat use in the context of climate change — case of inshore Mackenzie Estuary and Tarium Niryutait Marine Protected Area

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Abstract: Qilalugaq — beluga whales, are an important resource for Indigenous communities in the Inuvialuit Settlement Region (ISR). Every summer, the Eastern Beaufort Sea (EBS) beluga whale population forms large clusters inshore the Mackenzie Estuary and the Tarium Niryutait marine protected area (TNMPA). Belugas are usually found in shallow turbid water under low winds, low salinity, and warm sea surface temperature, potentially using them for scraping off moulted skin, feeding, predator avoidance, and as a thermal advantage for calves. These areas are facing increasing biogeochemical and physical stress due to climate change, with unknown impact on summer beluga habitat and habitat use. This project, guided by ISR community perspectives and supported by the Inuvik community, aims at providing a meaningful understanding of how belugas interact with their inshore summer environment. Following a knowledge co-production framework, traditional ecological and local knowledge (TE/LK) and Western science will complement each other. As belugas use resources differently depending on habitat characteristics, a resource selection function (RSF) model has been chosen to measure habitat selection and assess preferences. A total of 611 beluga inshore observations were collected from aerial surveys conducted over three days, from 21 July to 2 August 2019. Satellite-derived surface seawater properties, including temperature, suspended particulate matter, and chlorophyll-*a* concentration, were extracted from resampled 250-m resolution Aqua MODIS imageries and used as environmental predictors. Due to current pandemic restrictions, only secondary sources of TE/LK on beluga habitat have been explored to date, and ethically approved re-analysis of TE/LK projects has been envisioned. Co-interpretation of the RSF outputs with Inuvik knowledge holders is anticipated to make a broader sense of the outcomes, building on each other knowledge. Ultimately, our findings could be used to improve predictions of belugas responses to rapid environmental changes and for enhancing the future management of the TNMPA.

Session: KEP30 — Sharing knowledge on Natsiq/Natsik (ringed seal) and Qilalugaq/Kilalugak (beluga whale) from Inuit and scientific perspectives in Inuit Nunangat

ID: 439

What is needed to ensure Inuit students are taught by Inuit educators?

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Abstract: The importance of Inuit educators in schools in Inuit Nunangat is well-known; however, currently the demand for Inuit teachers exceeds the supply of Inuit teacher education graduates, so Inuit students could pass through their schooling without working with an Inuit teacher. The majority of Inuit teachers are in the lower grades in primary school or, in some cases, teaching in high school with primary-level qualifications. In spite of the development of innovative programs (e.g., the Inuit Bachelor of Education at Memorial University) evidence continues to highlight the urgent need to recruit, train and hire more Inuit into teaching and leadership positions across Inuit Nunangat. This is the subject being explored by a research project entitled "Effective teachers for successful students: An investigation into the preparation and resiliency of Northern educators". This project

will compile information on what Inuit educators identify as essential features of existing teacher education programs, how existing teacher education programs could be reformed to meet their needs, and what reforms in schools/school boards are needed to assist them in their positions. This session will present a draft survey for Inuit educators and Inuit teacher education students, to request feedback on the types of questions that are needed. The surveys asks questions on factors influencing what brings Inuit into the education profession, how Inuit teachers are trained and what supports/professional learning are needed to ensure retention and the progression of Inuit teachers into leadership positions in schools. Our hope is that this research will illuminate ways to better support Inuit teacher and administrator participation and advancement in schools, and to develop/reform Inuit-specific Bachelor of Education programs, graduate programs and professional learning for Inuit educational leadership.

Session: IHE28 — Mapping the landscape of Inuit education

ID: 724

New and emerging trends in Arctic policies and strategies

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Abstract: Internationally, the Arctic Council uses the findings of the working groups to inform their policy recommendations. However, policy decisions are generally the responsibility of the individual Arctic states, raising questions as to how the Arctic states see the relationship between science and policy. The presentation is based on the research findings from the recently-published analysis: "Arctic Policies and Strategies — Analysis, Synthesis, and Trends" from Heininen, Everett, Padrtova, & Reissell. The analysis provides a comparative, deep, systematic analysis of policies of the Members, Observers, Permanent Participants of the Arctic Council, and the Arctic Council chairmanship programs and ministerial declarations. The report aims to: (*i*) understand how perceptions of the Arctic have changed; (*ii*) understand how different actors behave, address, and prioritize issues around relevant factors; (*iii*) identify the common interests of, and dynamics of the interplay among stakeholders; (*iv*) determine policy consistency and implementation, identify new and emerging trends, and discuss them with narratives of Arctic governance and geopolitics. In particular, the presentation focuses on the role of science in the Arctic state and Observer state strategies and compares the strategies with regards to identified research priorities, research funding, and the role of traditional knowledge. Moreover, it considers the extent to which the documents make the connection between science and decision-making.

Session: NDP69 — Science-policy in the North: Pathways from research to decision-making

ID: 132

Arctic climate extremes are increasing and constraining expected higher plant reproductive success in a warmer climate

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Abstract: The increase in frequency and severity of climate extremes are now recognized as part of contemporary climate change. Arctic plant reproductive success is predicted to increase from its currently low levels as the climate warms. However, climate extremes and the subsequent carry-over effects from year to year add complexity to this prediction. Multiple Arctic trophic levels experienced reproductive failure in 2018, an extremely cold year. We analysed a unique long-term record of seed viability from warmed and ambient plots at Alexandra Fiord, Ellesmere Island, that started in 1993 and included 2018 and 2019, an extremely warm year. July is the principle month for plant growth and reproduction and we found that Canadian High Arctic July positive and negative temperature anomalies have increased significantly in magnitude and frequency since 1977. Woody species seed viability is significantly higher in warmed than ambient plots, whereas the opposite is true for forbs species. In 2018, seed viability of woody plants in ambient plots was significantly lower than normal but comparable with past years for forbs. Not all species recovered to normal seed viability levels in 2019. Since 1993, some species' seed viability has significantly increased with the warming climate. We found two contrasting strategies for timing of seed germination and

seedling vigour that may affect reproductive success in climate extremes. Our study highlights the potential for increased plant sexual reproductive failure with increasing climate extremes and provides some rational for Arctic shrubification in a warming climate. However, we suggest that poor seed viability in cold years could constrain shrubification and allow forb species an opportunity to establish on bare tundra.

Session: TER78 — Arctic plants in changing landscapes

ID: 639

Potential impacts of sea ice and ship traffic change to caribou sea ice crossing areas surrounding King William Island, Nunavut, Canada

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Abstract: Caribou (*Rangifer tarandus*, tuktuit in Inuktitut) use sea ice to facilitate movements that fulfill their ecological needs. Ship traffic is growing in the Kitikmeot region of Nunavut, and ice-strengthened ships can disrupt sea ice by breaking it apart. This project explored priorities identified by community members in Uqsuqtuuq (Gjoa Haven, NU) concerning changes in sea ice and ship traffic in five caribou crossing areas surrounding King William Island (KWI). Using Canadian Ice Service ice charts and Canadian Coast Guard ship traffic data, the timing of freeze-up, break-up, length of open water season, and ship transit was assessed for each crossing area. Preliminary results were discussed in workshops in Uqsuqtuuq in September 2018. Uqsuqtuurmiut (people of Uqsuqtuuq) knowledge of caribou habitat guides our integrative environmental analysis of crossing areas that are important to support seasonal movement of caribou on and off KWI. This project demonstrates how seasonal freeze-up and break-up transitions can affect caribou movement, behaviour, and survival in their use of sea ice habitat. Considerable interannual sea ice variability is present in all crossings, with no significant trends detected over time. However, the timing of ship voyages in the five crossing areas appear to be independent of local sea ice conditions, and are most likely to impact caribou use of sea ice habitat in the southern crossing area between KWI and Adelaide Peninsula. Our analysis shows the importance of mixed methods guided by Inuit knowledge to assess the complex interplay of caribou (among other wildlife), sea ice, and ship traffic in the context of climate change and increasing marine transportation.

Session: KEP35 — Community-based monitoring and knowledge co-production in wildlife research

ID: 514

Biophilic healthy Arctic buildings through adaptive high-performance envelopes

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Abstract: This research focuses on developing adaptive high-performance envelopes to enable biophilic healthy buildings in Arctic climates responding to occupants' wellbeing needs for relationships with the outdoor nature and to energy efficiency requirements. Building envelopes are the main element connecting indoors to the extreme cold weather and drastic seasonal photoperiods of arctic climates that must address occupants' photobiological (light-related) and psychological wellbeing needs in terms of positive relationships with nature and proper lighting qualities and darkness at the proper time of the day. Northern Canada's building practices have not yet properly addressed occupants' photobiological–psychological wellbeing. This study develops a fundamental adaptive envelope model based on biophilic and photobiological factors for arctic buildings that could address occupants' wellbeing combined with energy efficiency through efficient positive connections with outdoor climates. Biophilia characterizes human–nature relationships in architecture

affecting psychological wellbeing. Healthy lighting responds to occupants' photobiological wellbeing relating to the color temperature and intensities of lighting impulses during the day. The proposed adaptive envelope system includes efficient window sizes to optimize biophilic indicators, dynamic-colored-insulated shading panels to control photobiological lighting factors, and a thermal buffer system made of a glazing exterior skin to improve thermal/energy performances. Experimental methods with physical scale models and imagery techniques were used to evaluate and optimize healthy lighting performance of shading panels of the proposed envelope systems. Numerical models were developed to optimize biophilic and thermal performance indicators of the proposed envelope configuration. Results of experimental/numerical evaluations indicate biophilic, lighting, and thermal efficiencies of the proposed adaptive envelope to promote biophilic healthy indoor environments in a case study of an office in Northern Canada compared with conventional façade systems. Outcomes of this research could enlighten architects, developers, and policymakers regarding Arctic occupants' wellbeing and the potential of adaptive envelopes to address psychological–photobiological needs and energy requirements in Northern climates.

Session: IHE14 — Health, well-being and the social determinants of health in the North

ID: 123

Peat bog and lake sediment archives reveal a lagged response of Taiga Shield lakes to diminishing atmospheric Hg and Pb pollution

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Abstract: North American regulation of anthropogenic emission sources over the last three decades successfully reduced atmospheric concentrations of lead (Pb) and mercury (Hg) over the continent, including northern Canada. However, the response of northern lakes to diminishing atmospheric deposition of Pb and Hg remains unclear. One uncertainty resides in our inability to model the transport of legacy pollutants sequestered in catchments toward aquatic ecosystems. Our objective was to evaluate individual and cumulative impacts from long-range and local pollution sources and the role of catchment processes on Hg and Pb fluxes in subarctic lakes. We deconstructed the metal fluxes obtained from the records of environmental archives collected in the subarctic Taiga Shield and Taiga Plains ecoregions near Yellowknife (Northwest Territories, Canada). The combination of records from five peat bogs (atmospheric processes records) and five lake sediment (atmospheric and catchment processes records) allowed us to distinguish the atmospheric and catchment-based influences on Hg and Pb fluxes over the last 2000 years. A long-range pollution signal was evident in the lake sediment and peat bog records after CE. ~1800, with additional influence from local mining after ~1950. The Hg and Pb fluxes to the lakes of the Canadian Shield lakes have increased over the last 20 years despite declining atmospheric deposition, which was recorded by peat bogs from the same area. The increasing Hg and Pb fluxes in Shield lakes are attributed to lithogenic sources and the remobilisation of legacy anthropogenic Pb and Hg. The decreasing influence of the same sources in Taiga Plains lakes suggests the action of processes specific to the Shield catchments. This study indicates that anthropogenic Hg and Pb from some subarctic lake catchments in the Northwest Territories will likely continue to be transported to lakes for decades after the reduction of atmospheric pollution, with climate change potentially contributing to this effect.

Session: IHEA13 — Evolving perspective on Northern Contaminants Research

ID: 375

The movement ecology of Arctic cod and Polar cod in a warming world: critical synthesis of current literature

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Abstract: Understanding the movement dynamics of Arctic fish species is critical for monitoring and mitigating climate change impacts on marine food webs. Through synthesizing current literature, a state of knowledge can be identified, and priority research areas established. We conducted a critical synthesis and meta-analysis of current literature on the movement ecology of two circumpolar Arctic gadids, *Boreogadus saida* (Arctic cod) and closely related *Arctogadus glacialis* (Polar cod/Ice cod). Diverse region and season-specific movement and migrations patterns were identified, notably associated with spawning and feeding, sea ice, size segregation with depth, predators, and competitors. The majority of the movement literature to date has focussed on *B. saida* compared with the rarely studied *A. glacialis*, despite both species being considered critical in Arctic food webs. Most studies were not directly focussed on understanding the movements of circumpolar Arctic gadids but provided indirect evidence of movement behaviour, such as distribution and abundance estimates, and identification of cod in the diets of tracked marine mammals. We critically examine data deficiencies in the literature in the context of understanding and modeling climate change impacts on these species' movement ecologies. Large gaps in understanding of horizontal movements make measuring climate impacts challenging, compared with vertical movements that have received greater focus. The disparity in regional data collection across the Arctic currently provides greater predictive power for movement models focused on European and North American Arctic regions (29% and 86% of articles, respectively), relative to the logistically challenging Central Arctic Ocean and Russian–Siberian Arctic shelves (both 7%). Further, we explore the region-specific negative and potential positive impacts of climate change over short- and long-term scales. We highlight applications of promising and underutilized toolsets, showcased from a recent increase in research articles particularly impactful for understanding the movements of circumpolar Arctic gadids in the context of climate change.

Session: MAR43 — Fish and zooplankton in the central Arctic Ocean — current status of knowledge and new discoveries

ID: 609

Sociocultural factors in relation to mental health within the Inuit population of Nunavik

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Abstract: Mental health has been identified by Inuit Tapiriit Kanatami — the national organization of Inuit in Canada — as one of the Inuit health priorities. Building on the social determinants approach, this study aims to identify sociocultural factors associated with mental health among Inuit of Nunavik. Three self-reported mental health indicators from the 2017 Nunavik Inuit Health Survey were used: past-week depressive symptoms (continuous score on the Short Form of the Center for Epidemiologic Studies Depression Scale, CESD), and lifetime suicidal ideation and attempts (two yes/no questions). Numerous sociocultural factors (e.g., cultural identity, ability to practice traditional activities, social support, family and community cohesion) were documented using questionnaires. Associations of these factors with indicators of mental health were tested using weighted multivariate regressions for the whole population and for men and women specifically, adjusting for age and socioeconomic factors. Higher CESD score and increased rates of suicidal ideation and attempts were associated with younger age. In bivariate analyses, numerous sociocultural factors were associated with lower CESD score as well as lower rates of suicidal ideation and attempts. In multivariate analyses, lower CESD score was specifically related to more frequent hunting and fishing for both men and women, to higher social support for women and higher family cohesion for men. In a similar way, higher community cohesion was associated with lower

rates of suicidal ideation among men and women, and with lower rates of suicidal attempts among women. Understanding of associated sociocultural factors, general and specific to Inuit culture, may provide a unique opportunity to address the mental health issues in a culturally sensitive manner and offer new preventive avenues. In the future, temporal evolution of the associations and contribution of other individual and contextual conditions need to be examined to fully understand a hypothesized causal pathway.

Session: IHE14 — Health, well-being and the social determinants of health in the North

ID: 677

Spatial variation in mesopelagic sound scattering layer density within the Arctic Ocean

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Abstract: Mesopelagic fish and zooplankton form deep scattering layers (DSL) in most oceans of the world. Spatially extensive (up to tens of kilometres) DSL have recently been documented in the High Arctic using hydroacoustic instruments. Despite increased knowledge of the distribution of mesopelagic layers in the Arctic, the drivers of their density and distribution remain unknown. Here, we document the density, spatial, and vertical distribution of DSL in several regions of the Arctic Ocean to test the hypothesis that the intrusion of Atlantic water is the main driver of the backscatter intensity (a proxy for density) of mesopelagic organisms in Arctic seas. We analyzed acoustic data collected between 2015 and 2020 north of Svalbard, in the Fram Strait, in the Beaufort Sea, in Baffin Bay, and in the central Arctic Ocean. DSL were present in all regions. The acoustic density varied across Arctic seas and was generally higher in areas with strong Atlantic water inflow than anywhere else. We suggest that the sustained and enhanced advection of warm water masses into the Arctic Ocean could lead to regional increases in the density of mesopelagic organisms.

Session: MAR43 — Fish and zooplankton in the central Arctic Ocean — current status of knowledge and new discoveries

ID: 752

An emerging Arctic research data infrastructure: socio-technical systems development through the Canadian Consortium for Arctic Data Interoperability

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Abstract: The Canadian Consortium for Arctic Data Interoperability (CCADI) brings together multiple organizations to facilitate data sharing among diverse groups of data providers and users. This takes the form of facilitating information discovery, establishing sharing standards, and enabling interoperability among existing data infrastructures. As CCADI enters its second phase of development a multi-tier data network and platform (system) is emerging through design, co-production, and iterative and adaptive processes. This system is well-positioned to support evidence-based decision making on northern, national, and global issues. Bringing together scientific, Indigenous, and operational data requires appropriate mediation and representation strategies and associated technologies. In this presentation, we present and discuss the current status of the CCADI system. This includes, but is not limited to, the description of foundational protocols (standards, conventions, policies etc.), technologies and methods used to serve data, integration and analysis tools, and innovative methods for making data understandable and usable by a wide range of different

audiences. We conclude the presentation with a critical analysis of the socio-technical nature of the system and the processes used to develop the CCADI system. Technical obstacles are prominent; however, co-producing solutions that involve many actors at multiple organizational and geographical scales prove both challenging and rewarding.

Session: LTM03 — Digital tools & data management for long-term monitoring and decision making

ID: 366

Towards holistic and integrated energy systems planning: linking innovation, economics, and policy for sustainable energy systems in Northern remote communities

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Abstract: Indigenous peoples in Northern remote communities are experiencing some of the worst catastrophic effects of climate change, given that the Arctic region is warming twice as fast as the rest of the world. Paradoxically, this increasing temperature can be attributed to fossil fuel-based power generation on which the North is almost totally reliant. At the moment, diesel is the primary source of energy to majority of Arctic communities. In addition to greenhouse gas and other airborne pollutant exposure, this situation increases the risk of oil spills during fuel transport and storage. Moreover, shipping fuel is expensive and ice roads are harder to maintain as temperatures rise. As a result, Northern governments are burdened by rising fuel prices and increased supply volatility. In an effort to reduce diesel dependence, this work explores novel holistic approaches on how to link policy, clean energy innovations, and robust energy modeling techniques to help build more resilient and cost-effective energy systems for the Canadian Arctic region and remote communities in general. In particular, a multi-objective energy system model has been developed to determine the optimal configuration of integrated electrical and thermal energy systems for Northern remote communities in Canada. The modeling technique presented demonstrates multiple pathways (and trade-offs) in achieving financial savings while reducing environmental emissions and diesel dependence. Ultimately, insights and real-world applications have been synthesized to provide coherent recommendations on strategies to address the trilemma of challenges relating to energy security, energy affordability, and environmental sustainability, along with meaningful propositions towards Indigenous-led energy projects. The formulated recommendations from this study also support the policy work of Pembina Institute in the Indigenous Off-Diesel Initiative (IODI) program of Natural Resources Canada, which will also be part of the presentation.

Session: NPD72 — Energy transitions in the North

ID: 283

Population living on permafrost in the Arctic

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Abstract: Permafrost thaw is a challenge in many Arctic regions, modifying ecosystems and affecting infrastructure and livelihoods. There has been no demographic study on the population on permafrost. We present the first estimates of the number of inhabitants on permafrost in the Arctic Circumpolar Permafrost Region (ACPR) and project changes as a result of permafrost thaw. We combine current and projected population at the settlement level with permafrost extent. Key findings indicate that 65% of the settlements within the ACPR are on permafrost, accommodating 5 million inhabitants, of whom 1 million live along a coast. Climate-driven permafrost projections suggest that by 2050 42% of the permafrost settlements will become permafrost-free due to thawing. Among the settlements remaining on permafrost, 42% are in high hazard zones, where the consequences of permafrost thaw will be most severe. In total, 3.3 million people in the ACPR currently live in settlements where permafrost will degrade and ultimately disappear by 2050.

Session: TER79 — The changing Arctic Cryosphere

ID: 700

Ilisaqsivik Society and Tukumaaq Inc.: self-determination as an operating model and an outcome

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Abstract: Incorporated in 1997, Ilisaqsivik is a community initiated and community-based Inuit organization and Canadian Charity located in Clyde River, Nunavut. Ilisaqsivik is governed by the community and for the community by a community board of directors. Ilisaqsivik is an organization of Inuit who are rebuilding their community and their future. In reality, Ilisaqsivik is the beating heart of the community — doing whatever is needed and doing it in a way that works for Inuit. Ilisaqsivik's programs are wide-ranging and often unprecedented — everything from building their own community's library to running a school breakfast program, from Inuktitut-language counselling to a Heritage and Research Centre. Ilisaqsivik's work has a common thread — increasing well-being and personal potential across Nunavut. Ilisaqsivik runs over 60 programs across Inuit-led focus areas such as health, skills training, language, counselling, and Elder knowledge. Many of their initiatives have grown into significant entities in their own right, like their social enterprise division Tukumaaq Inc., incorporated in October 2008, that is building long-term, self-sustaining income to support Ilisaqsivik's charitable programming. Tukumaaq owns and operates Clyde River's new hotel, and a media centre, as well as manages a second community hotel, and provides community Internet and cell phone services. This model allows Ilisaqsivik to have a social entrepreneurial arm that generates profit while also contributing to local economic development through employment, training opportunities, and tourism. Ilisaqsivik's goal with Tukumaaq is that all profits generated will go towards supporting Ilisaqsivik's charitable operations. In their presentation, Malcolm Ranta and Jakob Gearheard, current and former Executive Directors of Ilisaqsivik and Directors of Operation of Tukumaaq, will tell the story, including challenges, successes and lessons learned, of why and how the social enterprise Tukumaaq Inc. got started, and how it is having positive impacts in the community of Clyde River.

Session: NDP52 — Social enterprise for Arctic change

ID: 468

Variation in the reproductive traits and population dynamics of benthic invertebrates across the Arctic polar front

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Abstract: Rates of warming in the high northern latitudes are among the highest globally. One of the most striking manifestations of this warming is the dramatic reduction in summer sea ice extent and thickness over the past few decades. Despite climate-induced changes in the ocean and sea-ice environment of the Arctic being well documented, we know little about the effects of directional forcing on the persistence and distribution of species. Here, we examine the reproductive traits and population dynamics of two locally dominant seafloor invertebrates (the bivalve *Astarte crenata* and sea star *Ctenodiscus crispatus*) across a north–south transect that intersects the polar front in the Barents Sea. Both species present large oocytes indicative of lecithotrophic or direct larval development, but we find no evidence for differences in the size frequency distribution of oocytes between 74.5° and 81.3° latitude. However, despite gametogenic maturity, we observed low frequencies of certain size classes in populations that may be owed to episodic recruitment failure. We suggest recruitment may be periodic in *A. crenata* when conditions are favourable. The absence of certain size classes in *C. crispatus* and increased pyloric caeca indices at, and north of, the polar front, indicate episodic recruitment failure and that food uptake is greater in these locations, respectively. Interannual variation in the quantity and quality of primary production, linked to changes in the extent and thickness of sea ice, are likely to drive these patterns in the physiological fitness and structure of benthic invertebrate populations.

Session: MAR71 — Species interactions in Arctic aquatic ecosystems

ID: 169

Hudson Strait inflow: structure and variability

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Abstract: Hudson Strait is the main pathway of heat, mass, and freshwater exchange between Hudson Bay, the Arctic, and the North Atlantic. Flow in the strait can be separated into a baroclinic outflow on the southern side of the strait, directed towards the Labrador Sea, and a barotropic inflow on the northern side, directed towards Foxe Basin and Hudson Bay. The Hudson Strait inflow waters affect the physical, biological, and biogeochemical systems of the Hudson Bay Complex (HBC), of which the livelihoods of the many Indigenous communities that surround the HBC depend. It is thought that the inflow waters are sourced from Baffin Bay, via the Baffin Island Current, as well as waters from the Labrador Sea. Knowing the properties of the inflowing waters will help our understanding of water mass transformations occurring in the bay due to tidal mixing, continental runoff, and sea ice growth and melt. We present data from two synoptic surveys of the properties and geostrophic flow across Hudson Strait from 2008 to 2009, as well as data from four moorings, one deployed on the southern side to map the outflow, and three deployed on the northern side of the strait to capture the inflow. We present the first year-round measurements of the Hudson Strait inflow. The inflow is a weakly stratified, saline flow, with a less pronounced seasonal cycle compared with the outflow. Shear is small along the northern coast, with seasonality in the inflow being present throughout the water column. Source waters of the inflow stem from mainly Arctic Water in the Baffin Island Current, with small contributions from Transitional and West Greenland Irminger Waters. Pathways of the Hudson Strait inflow continue to remain an area of speculation, although we show that inflow waters do enter northern Hudson Bay.

Session: MAR39 — Coastal oceanography of Hudson Bay and James Bay

ID: 26

Sources of methylmercury to ringed seal foodwebs of Lake Melville, Northern Labrador

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Abstract: Communities along the shores of Lake Melville, which is a large estuarine fjord, are concerned about increases in methylmercury (MeHg) in traditionally harvested foods due to hydroelectric power developments. Modelling predicts that MeHg in Lake Melville's foodweb will increase by 1.3- to 10-fold with the construction of the Muskrat Falls hydroelectric power plant along the Churchill River, which supplies 60% of Lake Melville's freshwater inputs. To assess the impact of hydroelectric power production on Lake Melville's food web, we have been measuring total mercury (THg), MeHg, and carbon (C), and nitrogen (N) isotopes in plankton, lower foodweb organisms, and seals spanning a freshwater to marine gradient since 2013. This is a community-based monitoring project that includes collaborations with the Nunatsiavut government and community members of Happy Valley Goose Bay, Northwest River, and Rigolet. During traditional harvests, liver and muscle from 97 seals, including 13 adults and 52 juveniles have been collected, which is important as juveniles are preferentially consumed in this region. Average MeHg in muscle (geometric mean =0.12 μg/g ww) and liver (geometric mean = 0.13 μg/g ww) were below subsistence guidelines of 0.25 μg/g (ww); whereas 16% ($n = 7$) of juvenile and 62% ($n = 8$) of adult muscle samples were above subsistence guidelines, and 29% ($n = 15$) of juvenile and all ($n = 13$) of adult liver samples surpassed subsistence guidelines. For plankton and lower foodweb organisms, sampling has been conducted annually since 2016 during Lake Melville's highest productivity season along a

transect from freshwater to marine influenced regions. Plankton results show higher levels of THg and MeHg at inland sites influenced by freshwater from the Churchill River compared with more marine sites. Relationships between Hg and C & N isotopes in the complete foodweb will be presented to gain an understanding of the influences of terrestrial and marine Hg sources.

Session: IHEA13 — Evolving perspective on Northern Contaminants Research

ID: 488

Quantification of the mixing depth in the Barents Sea

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Abstract: Understanding how the mixing environment is driven by the wind, oceanography, and sea ice is key to predicting the transport of heat and nutrients in the changing Arctic. Turbulent mixing drives nutrient and carbon cycling and productivity in the region, as well as feedback effects on sea ice extent and thickness through heat fluxes. Much of the turbulent mixing of nutrients and heat up to the surface is done in the mixing layer, the highly energetic surface region where wind drives turbulent mixing at levels greatly elevated from the background level at deeper depths. However, there is a lack of understanding of the controlling factors on the depth of this mixing layer in Arctic waters. The Barents Sea is undergoing rapid change due to Atlantification as sea ice retreats. Here, we use data collected using a freefall turbulence probe during the interdisciplinary Arctic PRIZE cruises in the Barents Sea region in the spring and summer of 2018. During this period the Barents Sea became virtually ice free, and we quantify the relationship between wind, stratification, sea ice, and mixing depth. Winds are the primary driver of mixing depth, with stronger winds increasing turbulent energy input to the water column. Current literature suggests that broken sea ice cover increases the efficiency of this transfer in comparison with open water, whereas 100% cover reduces it. Stratification of the water column reduces the mixing depth for a given turbulent energy input. These findings allow the mixing depth to be estimated in areas without direct observations. They have also increased our understanding of the drivers and effects of changes to mixing depth as the Arctic transitions to a reduced sea ice state, as well as the link between the mixing depth and nutrient fluxes to the surface that fuel summer plankton blooms.

Session: MAR45 — Ocean dynamics in the Arctic Ocean and connected waters

ID: 21

The joint roles of freshwater and vertical mixing on the seasonal halocline in the Canada Basin: 1975 versus 2006–2012

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Abstract: Upper-ocean stratification impacts the exchange of heat, energy, and moisture between the atmosphere, sea ice, and the deeper ocean. A number of seasonal processes that control upper-ocean stratification are changing in response to Arctic sea ice retreat over the past several decades, including seasonal freshwater input and wind-driven vertical mixing. However, the exact manner by which these processes change under different sea ice conditions or how they impact the structure and strength of the upper-ocean stratification is currently unresolved. We examine two data sets of full-year, below-ice observations collected in the Canada Basin during 1975 as a part of the Arctic Ice Dynamics Joint Experiment (AIDJEX) and during 2006–2012 using the Ice-Tethered Profiler (ITP) instrument system. We compare the upper-ocean seasonal evolution for these two time periods that are associated with different sea ice conditions to identify signatures of changes to seasonal surface processes and their impact on the upper-ocean stratification. A simplified, mathematical framework allows us to quantify the impact of two factors that affect upper-ocean stratification: (1) the amount of freshwater input

to the surface and (2) the vertical distribution of the freshwater through the water column. The concentration of freshwater closer to the surface, without changes to the freshwater input, plays a vital role in explaining the stronger upper-ocean stratification in the 2006–2012 ITP data than in the 1975 AIDJEX data. This may indicate a decrease in the effectiveness of wind-driven vertical mixing in regions of the Canada Basin that are transitioning from multi-year to first-year sea ice.

Session: MAR45 — Ocean dynamics in the Arctic Ocean and connected waters

ID: 441

Infrastructure implications from intensified permafrost thaw-driven mass wasting

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Abstract: The Dempster Highway connects the communities of the Beaufort Delta region, Northwest Territories (NWT) to southern Canada. In the NWT, the highway traverses fluvially incised glaciated terrain consisting of fine-grained ice-rich tills, creating conditions that favour retrogressive thaw slump (RTS) development. Over the past two decades, climate warming and intensified rainfall have accelerated the growth of RTS in this region. Small and shallow slope-side disturbances have rapidly increased in size by orders of magnitude, indicating that a critical terrain stability threshold has been crossed, where evacuation of slope materials has stimulated feedbacks perpetuating thaw-driven mass wasting. Understanding processes, feedbacks, and trajectories of change are of particular relevance because RTS are increasingly affecting the Dempster Highway. Long-term monitoring of an RTS located 800 m upslope of the Dempster Highway (28.5 km) that initiated circa 2002, indicated signs of stabilization. LiDAR and unmanned aerial vehicle surveys showed minimal volumetric growth between 2011 (25 900 m^3) and 2015 (33 400 m^3). However, in 2017, over 20 000 m^3 of slump colluvium was transported up to 300 m downslope, arriving within 200 m of the highway embankment. Evacuation of materials resulted in a four-fold increase in scar volume to 136 500 m^3 by 2018 and formation of a second ice-rich headwall, which has coalesced with the smaller upper headwall creating a ground ice exposure >20 m height. Trail cameras show that material evacuation in summer 2019 occurred as pulses with several distinct flows overriding the 2018 debris. Rapid enlargement of this disturbance has increased the potential for large magnitude thaw-driven flows and risk to the Dempster Highway. Field monitoring has informed the establishment of a real-time surveillance system by Department of Infrastructure to manage these risks. This case study highlights the importance of permafrost monitoring programs and strengthening linkages with infrastructure managers to identify and manage risks posed by thawing permafrost.

Session: TER89 — Integrating science and engineering education for challenges to northern infrastructure under a changing climate

ID: 471

Current and future habitat suitability and abundance of kelps in the eastern Canadian Arctic

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Abstract: Global change is expected to expose long stretches of coastline and shallow waters that, heretofore, were considered inhospitable to kelp forests due to the presence and thickness of ice. To better understand the current distribution of kelp forests in the eastern Canadian Arctic, kelp were sampled for percent cover and

species identifications along coastal regions in this area. This was supplemented with occurrence records from global biodiversity databases, searches in the literature, and museum records. This information was used to develop an ensemble model to predict habitat suitability and a random forest model to predict abundance for functionally similar kelp genera and families: *Agarum*, *Alaria*, and Laminariales. These modelling approaches were then forced using environmental data from 2050 to 2100 based on the RCP 8.5 emission scenario. Both modelling approaches showed that the potential extent of Arctic kelps is much larger than the current sampled sites. The models also agree that kelp distributions in the eastern Canadian Arctic are likely to expand in the future under the RCP 8.5 emissions scenario. However, there were differences between modeling approaches for both current and future projections for all kelp species. Notwithstanding model-specific variation, it is clear that kelps are likely widespread throughout the area and are likely contributing significantly to the functioning of the Arctic ecosystem now and will continue to do so into the future. Results from this study emphasize the need for the collection of additional data on species densities and distributions to better tune models for more accurate projection of current and future kelp abundance in the eastern Canadian Arctic.

Session: MAR49 — Macrophytes in northern waters: current distribution, future changes and economic possibilities

ID: 436

(Rail)roads and Arctic communities: a social science overview

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Abstract: In many parts of the Arctic, modern transport infrastructures are few and far between. This results in inconveniences for residents and visitors alike, but at the same time enables the continuation of subsistence and cultural practices in relatively undisturbed natural environments. In other words, Arctic roads and railroads can have positive or negative social and cultural consequences for Indigenous and non-Indigenous residents of the North, but they are certainly not neutral elements of the built environment. Recent years have seen increased economic and geopolitical arctic interests by outside players. The realization of these interests typically involves the construction of new or the upgrading of existing transport infrastructures in the Arctic. One of the questions resulting from these developments is whether these roads and railroads will benefit local residents or whether they will be used more or exclusively for transporting Arctic resources south. This presentation is based on a literature review of the known impacts of roads and railroads in the North, as well as on data collected in the course of the Austrian Science Fund project "Configurations of Remoteness" and the H2020 project "Nunataryuk", and the research plan of the forthcoming European Research Council project "Building Arctic Futures: Transport Infrastructures and Sustainable Northern Communities" (INFRANORTH). The goal is to explore the relationship between arctic communities and transport infrastructures, as well as to lay the ground work for comparative research on the social impacts of roads and railroads in other remote regions of the globe.

Session: IHE20 — Northern roads and railways: Social and environmental effects of transport infrastructure

ID: 414

Western section of the Baikal–Amur railway under the influence of climate warming and multidirectional permafrost dynamics: environmental and economic consequences

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Abstract: The climate of the mountainous landscapes of eastern Siberia has been dramatically changing over the past thirty years. Different regional climate components change at different rates (air temperature, snow, and wind). In different mountain zones, the climate changes synchronously, despite the high variability of landscapes. Permafrost dynamics are different at different depths and show different long-term and short-term apparent trends. Long-term trends will determine the location of the permafrost and affect engineering design decisions. Short-term trends determine the activity of hazardous processes (thermokarst, heaving, and ice formation) and affect the economic cost of

maintaining of existing facilities. Short-term trends can be opposite to climatic trends. For example, in the Chara Region, over the past 5–7 years, against the background of the general warming of the climate, the permafrost has become colder in the valleys and warmer in the watersheds. The main environmental consequences of the operation of the railway infrastructure are the more frequent fires caused by sparks from the pipes of diesel locomotives. The importance of the operation of the railway infrastructure is to provide the local population with food, ensuring their work in transport enterprises. The Baikal–Amur Railroad has a strategic importance. The state responsible persons plan to expand the railroad capacity in the coming years, despite the serious costs of engineering protection from dangerous geocryological processes.

Session: IHE20 — Northern roads and railways: Social and environmental effects of transport infrastructure

ID: 487

How well is research serving Nunavummiut? Research trends in Nunavut (2004–2019)

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Abstract: The Nunavut Research Institute (NRI) has been responsible for developing, facilitating, and promoting scientific research in Nunavut since 1994. Under Nunavut's Scientists Act, one of the NRI's core tasks is assessing and issuing research licenses to ensure that research is a resource for the wellbeing of Nunavummiut (people of Nunavut). To administer the research license application, review, approval, and reporting process the NRI maintains a research licensing database for all natural, health, and social science (including studies of Inuit knowledge, culture, and language) research activities undertaken in Nunavut. The NRI partnered with university researchers through a Social Sciences and Humanities Research Council Partnership Engage Grant (2019–2020) to undertake the first systematic review of research trends in Nunavut using its licensing database. This review was an important opportunity to: (*i*) update the licensing database technology to improve operational efficiency; (*ii*) edit records to ensure completeness and consistency; and, (*iii*) assess trends in research over the past 16 years (2004–2019) related to research teams, locations, timeframes, and topical focus. In our presentation we will discuss key findings, including that: annual licenses issued are increasing over time; natural/physical sciences and remote field work continue to dominate research activities; research is most intensely focused in the Qikiqtani (Baffin) region; Iqaluit, Pond Inlet, Pangnirtung, and Arviat are most involved in social science and Inuit knowledge research; licensed research activities are predominantly led by southern universities; Inuit-led and other small Nunavut organizations carry the burden of license review; and communities such as Resolute Bay and Grise Fiord experience a disproportionately high number of license review requests. The foundation created by this analytical review helps to identify ways to improve Inuit engagement in research, make research results more accessible to Nunavummiut, reduce community research fatigue, and encourage research on issues that are priorities for Inuit.

Session: NDP69 — Science-policy in the North: Pathways from research to decision-making

ID: 684

Area and volume changes of Adams Icefield from 1948 to 2019, Axel Heiberg Island, Nunavut, Canada

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Abstract: There has been a marked increase in melt season length over the past two decades on glaciers and ice caps within Canada's Queen Elizabeth Islands (QEI). Prior to the year ~2000 (1958–1995) land ice was in a state of slightly negative mass balance (-11 ± 11.5 Gt year^{-1}), but recent Gravity Recovery and Climate Experiment satellite measurements suggest that mass losses between 2003 and 2015 averaged

-33 ± 5 Gt year^{-1}. Despite these losses, there is a lack of information concerning how a warming climate is affecting small ice bodies, which are considered sensitive indicators of change due to their short response time. In this study, we describe the use of historical and contemporary aerial photographs, high resolution optical satellite imagery, and ground penetrating radar (GPR) surveys to determine area, thickness, and volume changes of Adams Icefield within Expedition Fiord, Axel Heiberg Island, over the past six decades. Historical (1959) and contemporary (2019) digital elevation models (DEMs) were created via aerial photo surveys using Structure-from-Motion photogrammetry. Volume changes derived from multiple DEM of difference maps were validated using ~36 years of in-situ mass balance measurements from Baby Glacier (an ice body within Adams Icefield) collected intermittently between 1959 and 2019 and a 2014 GPR survey. Results from this study illustrate a steady increase in area loss prior to the year ~2000 (1948–1999: 0.62 km^2 = 0.01 km^2 year^{-1}), followed by a rapid increase in area loss over the past two decades (2000–2019: 0.80 km^2 =0.04 km^2 year^{-1}). As a result, Adams Icefield is now losing ice cover four times quicker than prior to the year 2000, leading to significant thickness and volume changes as well. As a result, it is unlikely that this ice mass will survive until the end of the 21st century.

Session: TER79 — The changing Arctic Cryosphere

ID: 800

Cultivation and contemplation: opportunities and challenges to growing food in the Northwest Territories

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Abstract: In Canada's Northwest Territories (NWT), climate change is impacting the access and availability of traditional foods that are critical for community health and well-being. As a result, communities across the NWT are turning to small-scale agriculture to ensure access to fresh, healthy food, and build a sustainable food system. The expansion of local agriculture, as complementary to traditional community foods, requires pragmatic discussions to explore the best way forward for development with consideration of both social and ecological factors. Here, we highlight several ongoing projects and collaborations that approach integrating agriculture into the local food system in the NWT from social and ecological perspectives to support a vibrant and sustainable northern food system. Sustainable community agriculture involves ensuring that ecosystem services are maintained upon cultivation, with this in mind we present soil carbon data from partnered communities and explore the suitability of these soils for agriculture as well as the potential trade-off of soil carbon losses under cultivation. In addition to the need for ecological sustainability in northern agriculture, we discuss community-driven innovative ideas and thoughtful actions of community partners to produce food in a more sustainable way. Finally, we summarize work being conducted with local producers in the NWT to build a supportive network to ensure knowledge and training is available and that food produced in the NWT can be distributed, sold, or shared with other communities in the region. It is hoped that through the interdisciplinary and collaborative nature of this work, policy and actions can be developed that will build a sustainable food system that supports food sovereignty for northern communities, resilient agroecosystems, and the development of models and knowledge that can be applied in other regions around the world.

Session: IHE24 — Building resilient and sustainable northern food systems: Research, knowledge, policy and action

ID: 828

Spatial drivers and characteristics of terrestrial dissolved organic matter in the Peel River watershed

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Abstract: Climate warming in the western Canadian Arctic exceeds the global average. This leads to thawing of permafrost soils and subsequent mobilization of its organic matter (OM) pool. Part of this mobilized terrestrial OM enters the aquatic system as dissolved organic matter (DOM) and is laterally transported. Mobilized DOM is an important source of nutrients for ecosystems as it is available for microbial breakdown, and the consequent turnover of the dissolved organic carbon (DOC) fraction of DOM serves as a potential source of greenhouse gases. We are beginning to understand spatial controls on the DOM release; however, uncertainty in identifying different sources of permafrost DOM and in DOM changes during transport still exists. In the summer of 2019 a unique expedition, traversing the Peel watershed (Yukon Territory, Canada) was accomplished. This expedition allowed for sample collection in a wide range of tributaries ($n = \sim$100); representing watersheds varying in size, topography, geology, land cover, permafrost extent (continuous and discontinuous) and thermokarst activity. In addition, we sampled along the river's main-stem ($n = \sim$17), covering approximately 700 km of its course. We assessed the DOC quantity (<0.1 to ~30.0 mg/L) and quality, the latter using Δ^{13}C-DOC, Δ^{14}C-DOC and optical properties including components modeled with excitation–emission matrices–parallel factor. A range of further parameters was assessed to gain insight into differential source contribution and localization within the watershed. Large differences in DOM contributions were observed between alpine and subalpine uplands and lower river reach permafrost lowlands. These insights together with available spatial data sets contribute to an understanding of permafrost–DOM dynamics and are of great value in up-scaling pan-Arctic carbon and nutrient fluxes and budgets.

Session: TER75 — Carbon cycling in Arctic freshwater systems

ID: 189

Habitat coupling within the lower Churchill River, Manitoba

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Abstract: Habitat coupling is the transfer of nutrients, organic matter, and species between adjacent habitats or energy pathways. Estuaries are transition zones between freshwater and marine habitat resulting in energy exchange between these systems. They offer flexibility for freshwater and marine species to acquire resources from both sources. The objective of this study was to quantify the proportion of freshwater vs. marine resources in the diet of mobile consumers (fishes and seals) within the lower Churchill River area over time. Stable isotope analysis provides a time- and space-integrated understanding of trophic relationships. Liver (short-term) and muscle (long-term) were collected from eight different fish species during July 2019 and hair (short-term) and muscle from harbour seals in 2016. We used δ^{34}S values from liver/hair and muscle in a Bayesian mixing model to determine freshwater nutrient versus marine nutrient use across species. Freshwater-derived nutrients mainly contributed to the diets of lake whitefish and suckers (91.0%–92.0%), whereas marine-derived nutrients were nearly-exclusive in capelin, fourhorn sculpin, Greenland cod, and harbour seals (65.1%–99.4%). Cisco and northern pike had similar contributions from both freshwater and marine-derived nutrients in their diet (49.1%–55.6% freshwater). The majority of fish species liver values had lower freshwater proportions in their diet. For example, northern pike had a higher contribution of marine nutrients in their liver (74.8%) compared with their muscle (44.4%). The lower freshwater values in the liver data shows that certain species may take advantage of a short-term marine energy pulse during the summer period. This project will provide a greater understanding of the community structure, spatial coupling, and food web structure of mobile consumers and could be applied to other studies examining the ecological role of top predators within the estuary.

Session: MAR71 — Species interactions in Arctic aquatic ecosystems

ID: 559

Encouraging collaborative permafrost research through multidisciplinary training programs

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Abstract: An increasing recognition of recent and anticipated climate change in the Arctic has led to a growing interest in the thermal and geomorphic response of permafrost. Rising ground temperatures and thawing ground ice have the potential to destabilize the surface and threaten the integrity of northern infrastructure. Greater collaboration is required between engineers and scientists to create a common language in which to improve the performance of infrastructure under future climatic conditions. Despite increasing encouragement for multidisciplinary frameworks, researchers and professionals are rarely provided the opportunity to work together. Networking is often limited to conferences, but university-led field courses are beginning to encourage the attendance of both students and practitioners. In June 2019, the Sentinel North strategy at Université Laval ran a graduate level course on permafrost engineering applied to transportation infrastructure. The six-day program, hosted at the Aurora College campus in Inuvik, NT, provided the basic principles for effective site investigation, design and management of linear infrastructure, while instilling a scientific context to the challenges of building on permafrost. Professors Chris Burn and Guy Doré supervised thirty students and practitioners from a variety of academic backgrounds and career levels. Course delivery included field excursions along the Inuvik-Tuktoyaktuk Highway, allowing participants to observe permafrost degradation and management strategies discussed during classroom lectures. As a young professional, PhD student, and MSc student involved in northern infrastructure projects, we found the course enabled us to initiate a multidisciplinary dialogue about the potential environmental and socio-economic impacts of permafrost thaw, appreciate alternative approaches to complex problems, and re-evaluate the engineering applications of our study designs. Although there is no panacea for permafrost landscapes in transition, these training events encourage the dissemination of knowledge and the cooperation of people engaged in permafrost activities.

Session: TER89 — Integrating science and engineering education for challenges to northern infrastructure under a changing climate

ID: 511

Eastern Beaufort Sea and Western Hudson Bay beluga trends in contaminants: does local context mean different outcomes for the same project?

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Abstract: Marine mammals across the Arctic, such as the beluga whale, provide staple food items for many Inuit communities. Hunting methods and preferences of each community have adapted to the environment and biological diversity around them as well as cultural preferences. Such diversity can be observed between Canadian Arctic regions. For example, the Inuvialuit in the west who hunt from the Eastern Beaufort Sea (EBS) beluga population and Inuit from the east who hunt from the Western Hudson Bay (WHB) population have differing practices in beluga hunting and food preferences. Where Inuit in Arviat do not commonly consume beluga meat, Inuit in the Inuvialuit Settlement Region widely consume it and prepare it in many different ways. Both Inuit cultures and regions hold great depth in knowledge on belugas based on traditions that are shaped to local circumstances. Both regions also hunt from two of Canada's largest beluga populations. Of the two, the EBS beluga are extensively studied when compared with the WHB beluga, which has had minimal beluga monitoring programs. Each region has had separate sampling programs on beluga harvests over the last several decades and have collected

standardized information on morphometrics and contaminants data such as total mercury. This historical data combined with the regional differences in food practices could exemplify how similar sampling programs can translate into different applications of the results. We would also expect different messaging and overall conclusions for each region. These differences in regional contexts in relation to historical mercury data will be explored in this presentation.

Session: KEP30 — Sharing Knowledge on Natsiq/Natsik (Ringed Seal) and Qilalugaq/Kilalugak (Beluga Whale) from Inuit and Scientific Perspectives in Inuit Nunangat

ID: 785

SIKU: the Indigenous knowledge social network, a summary of progress a year since public launch

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Abstract: SIKU, the Indigenous Knowledge Social Network, is an online platform and mobile app designed by and for Inuit. SIKU provides a wide variety of tools supporting Inuit self-determination in research, education, and environmental stewardship while providing full ownership, access, and control over their data. Across Inuit Nunangat, community members, Indigenous organizations, and researchers are increasingly using SIKU to implement their own community-driven research and stewardship programs, leveraging the wide variety of tools and services for weather, dangerous ice, and environmental monitoring. This presentation will report growth in usership and content creation since SIKU's launch in December 2019, and future development towards empowering conservation economies across northern communities. The Arctic Eider Society has maintained engagement with SIKU's growing user base through remote engagement during the pandemic through initiatives like the 2020 Goose Watch Competition (27+ Inuit communities) and community-driven stewardship efforts, including the Pond Inlet Pilot program and Qikiqtait project. The latter involved over 100 community members documenting 1500 hunting trips and 2000+ posts crowd-sourced baseline data for a resource inventory while contributing substantially to food security and local incomes during the pandemic in an accountable, equitable and actionable way with long-term benefits for the community. Efforts are ongoing to develop similar programs with regional Inuit organizations in communities across Inuit Nunangat. New features will be showcased including a new GPS interface with offline maps, charts, and ice imagery, as well as upcoming concepts for sharing Inuit arts and craft stories that can be linked to their respective harvesting stories (e.g., seal products to seal hunting stories), supporting local entrepreneurs, and helping document conservation economies. We will conclude with a call for additional input towards ways that SIKU can best facilitate the parallel needs of individual contributors, projects, communities, and Indigenous organizations for the long-term benefit of Inuit self-determination.

Session: LTM03 — Digital tools & data management for long-term monitoring and decision making

ID: 313

Lateral and vertical organic matter dynamics in an Arctic lagoon system

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Abstract: Increasing warming causes severe environmental changes in the Arctic coastal zone such as longer open water periods and rising sea levels. These processes intensify the erosion of permafrost coasts and lateral transport of sediment and organic matter (OM). Lagoons play a particularly important role in the transfer process of terrestrial OM but have been rarely investigated in the Arctic. Here, we studied a lagoon system along the Arctic Yukon coast to better understand the lateral pathways of OM from land to sea and its deposition dynamics over time. We sampled terrestrial, lagoon, and marine sediment to track OM along a land–lagoon–ocean transect and took short cores to assess OM

deposition dynamics. Samples were analyzed for total organic carbon and nitrogen (TOC, TN), stable carbon and nitrogen isotopes ($\delta^{13}C$, $\delta^{15}N$), as well as grain size and surface area. We further analyzed the shoreline change rates of the lagoon from the 1950s to 2018 and coupled it to sedimentation rates derived from $^{210}Pb/^{137}Cs$ dating. Turbidity was estimated in the lagoon surface water using Landsat imagery for the main wind directions. Our results show that OC concentrations significantly decrease along the land–lagoon–ocean transect. Currents potentially removed large portions of eroded OM, especially under easterly winds, which is indicated by elevated suspended particulate matter concentrations. In contrast, OM can get buried quickly, which is indicated by high OM contents in deeper lagoon sediments. Coastal erosion rates in the lagoon increased drastically since the 1970s and correspond with increasing sedimentation rates, suggesting a direct relationship between environmental forcing and OM deposition dynamics in the lagoon. We conclude that lagoons are a crucial transfer zone between land and ocean, which can substantially influence OM pathways. Under current environmental change scenarios in the Arctic, the role of lagoons may become more important as gateways of OM from land to sea.

Session: TER88 — Arctic coastal dynamics in a changing climate

ID: 34

Case studies as a tool to co-develop climate services

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Abstract: Climate change adaptation is becoming increasingly important as extreme events across the globe are on the rise. In this context, there is a need for actionable information that increases the understanding of human–climate interaction, enhancing adaptive capacity. Case studies have been used to characterize vulnerability in the social and climate fields. Despite being criticized for lacking a rigorous approach and systematic definition, case studies are prescriptive and prioritize practical knowledge. Thus, they are increasingly used in the climate services field to provide descriptions of particular extreme weather and climate events of interest for stakeholders (e.g., affecting their businesses or activities) that occurred in the past over a specific location and time. The H2020 project Advanced Prediction in Polar regions and beyond: modelling, observing system design and LInkages associated with a Changing Arctic climaTE (APPLICATE) applies a transdisciplinary approach for the co-production of climate services in Polar regions and beyond. The approach relies on the collaboration among climate scientists, stakeholders (through the User Group, which includes representatives of the project target groups) and experts from other disciplines, including social sciences, communication, and policy experts. The project's transdisciplinary process engages stakeholders by raising awareness on climate change, involves them in a knowledge exchange and co-learning process through participatory processes, and empowers them through the co-development of case studies and tailored knowledge. APPLICATE case studies cover a wide range of relevant topics, including how Arctic sea ice changes affect mid-latitude weather and how this impacts economic activities such as energy production and demand or transport (www.applicate.eu/outreach/case-studies). Other topics are addressed to improve the preparedness of local populations to deal with catastrophic events such as landslides or wildfires. This information is communicated to various audiences, including decision- and policy-makers, to help them better grasp the possible impacts of climate change in the Arctic and elsewhere, enhance knowledge uptake, and support climate change adaptation.

Session: NPD61 — Tailoring polar weather, water, ice, and climate information and services to address diverse user needs

ID: 30

Latitudinal patterns in intertidal ecosystem structure in West Greenland suggest resilience to climate change

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Abstract: Global warming occurs at elevated rates in the Arctic. Continued warming is predicted to cause ecosystem-wide cascading effects as boreal species expand into the region. However, current species distribution and knowledge of drivers affecting community structure are largely unknown, and little is, therefore, known about the resilience of Arctic marine ecosystems to environmental change. The West Greenland coast is north–south-oriented, which provides an ideal setting to study the impact of climate change on ecosystem dynamics and species distribution. We used this coastline to investigated latitudinal changes in the rocky intertidal ecosystem along 12° of latitude, from the subarctic to High Arctic (60°–72°N). Using 320 cleared quadrats we quantified patterns in rocky intertidal assemblage composition, biomass, and coverage in six regions. We related the level and variation in assemblage composition, biomass, and coverage to multiple latitudinal-scale environmental drivers. We show that across all latitudes, the intertidal assemblage is dominated by a core of stress-tolerant foundation species, and we describe the effects of the investigated environmental drivers, and demonstrate that although mean biomasses decreased >50% from south to north, local biomass in excess of 10 000 g ww m^{-2} is found even in north Greenland, demonstrating the patchiness of this habitat. The results, furthermore, show that the effect of small-scale variation in environmental characteristics may be of same magnitude as large-scale variation. Hence, using the latitudinal gradient in a space-for-time substitution, our results suggest that although climate modification may lead to an overall increase in the intertidal biomass in north Greenland, it is unlikely to drive dramatic functional changes in ecosystem structure in the near future. Our data set provides an important baseline for future studies to verify these predictions for Greenland's intertidal zone.

Session: MAR41 — Greenland marine ecosystems

ID: 539

Nunami Sukuijainiq: a land-based ecological research and education program for communities and researchers to share, collaborate, and have fun!

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Abstract: NUNAMI SUKUIJAINIQ ("Our Science on the Land") is a program of science land camps that are one-week expeditions to study local environmental issues identified by the host community while training youth in natural sciences. The NUNAMI SUKUIJAINIQ program developed from a previous collaborative and community-based research project called Imalirijiit ("Those who Study Water"). Imalirijiit was started by Kangiqsualujjuaq (Nunavik) community members and university-based researchers to monitor the water quality of the George River and foster environmental stewardship of its watershed. Motivated by the success of the Imalirijiit camps, community members wanted to start a new Arctic ecology education program focused on broader community interests, including marine edible resources, lake and river hydrology, winter ecology, and Arctic char. NUNAMI SUKUIJAINIQ was, therefore, designed for Inuit youth across Nunavik, weaving traditional and local knowledge with western science to better understand the changing environment together, to stimulate and nurture Inuit youth's interest in science-related careers, and to build trusting relationships between the community and researchers. The participants include Elders, local guides and coordinators, youth, and researchers who work jointly to train Inuit youth in environmental data collection. The NUNAMI SUKUIJAINIQ science camps are a place for communities and researchers to learn from each other and to do collaborative science. We aim to inspire and support other Indigenous communities who want to start their own programs based on northern-led community engagement and researchers' commitment to studying local environmental issues and having fun together! The presentation will include a short video about the project as well as video clips from different participants describing their experiences and perspectives.

Session: KEP38 — Arctic inspiration prize: Exploring the unique potential of Northern-led community science projects

ID: 652

Tracking thaw slump geomorphology and associated impacts on downstream carbon and nitrogen concentrations using integrated remotely piloted aircraft system surveys and in-situ chemical analyses

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Abstract: Ice-rich permafrost landscapes are sensitive to ongoing changes in climate. Permafrost retrogressive thaw slumps (RTSs) represent one of the more abrupt and prolonged disturbances, which occur along Arctic river and lake shorelines. These features impact local travel and infrastructure, and there are concerns regarding associated impacts on biogeochemical cycling. Here, we couple remotely piloted aircraft systems (RPAS) surveys with sediment and water analyses to monitor RTS geomorphology during 2016–2019 and the biogeochemical influence of the largest active RTS along the Old Crow River in Old Crow Flats, Yukon, Canada. RPAS surveys revealed that 29 174 m^3 of sediment was exported during the initial evacuation in June 2016 and an additional 18 845 m^3 continued to be exported until June 2019. Greater sediment export (8236 m^3) occurred during the warmer and drier summer 2017 compared with summer 2018 (6872 m^3). However, the fewer rain events during August 2017 were of higher intensity and concentrated within shorter time frames compared with less intense rain events occurring at a higher frequency during 2018. RPAS-derived multispectral and thermal data layers were used to distinguish geomorphic zones that have variable influence on sediment transport, establishment of vegetation, and biogeochemical properties within the RTS. Dry carbon and nitrogen content (%) varied among classified zones and was used to estimate the nutrient mass mobilized to the Old Crow River at the time of each RPAS survey. Chemical analysis of water sampled from up and downstream of the RTS revealed that aquatic mobilization of nutrients is highly episodic and dependent on high-river discharge events or stream runoff from the RTS. Approaches utilized here maximize the utility of multispectral and thermal data sets for identifying RTS geomorphological properties. Integrated in-situ biogeochemical measurements refine our knowledge of the associated impacts on downstream environments.

Session: LTM10 — Applications of unmanned vehicle systems in Arctic research and monitoring

ID: 334

Radarsat-2 derived glacier velocities and dynamic discharge of the Canadian High Arctic from 2008 to 2020: what have we learned?

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Abstract: Radarsat-2 imagery collected each winter from 2008/2009 to 2019/2020 is used to quantify and characterize the variability of glacier motion and discharge of the major marine-terminating ice masses of the Queen Elizabeth Islands (Devon, Ellesmere, and Axel Heiberg Islands) in the Canadian High Arctic. Our results show that there is little variability in terms of ice motion for the majority of the glaciers within the region. For most of the glaciers that did experience variable rates of glacier flow, these variations can be explained by previously identified cyclical dynamic processes (i.e., surge- or pulse-mechanisms). However, this record of ice motion indicates that the ice flow rates of the Trinity, Wykeham, and Belcher Glaciers continue to accelerate, and that the process driving this acceleration is likely linked to external conditions (i.e., climate-induced dynamic thinning). This is significant given that our estimates of ice loss via discharge to the ocean indicate that these three glaciers are important contributors to overall mass loss via calving (~50% of regional ice loss via discharge is channeled through the Trinity

and Wykeham Glacier alone). In this presentation, we will describe what we have learned about glacier dynamics in the Canadian Arctic from this catalogue of ice motion, highlight the work that remains to be done, and discuss how this program is likely to continue within the context of the Radarsat Constellation Mission that is expected to provide the bulk of future synthetic-aperture radar data that enables this work.

Session: TER79 — The changing Arctic Cryosphere

ID: 584

Arbovirus surveillance in the North American Arctic: California serogroup virus activity in mosquitoes and first detection in Simulioidae

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Abstract: An expected consequence of climate warming in the Arctic is an expansion of the geographic distribution of biting insects and associated vector-borne diseases. In 2019, we established an arbovirus surveillance program in sentinel communities across the Canadian Arctic and Alaska to detect the presence of California serogroup viruses in hematophagous insects. Here, we report the detection of RNA of California Serogroup viruses in mosquitoes captured predominantly in Kuujjuaq (northern Québec, Canada). We also report, for the first time in North America, the presence a California serogroup virus RNA in Simulioidae. These results highlight the importance of long-term arbovirus surveillance to monitor the changing impact of vector-borne disease on human and animal health in the Arctic.

Session: IHE11 — Arctic One Health: Gathering and mobilizing multiple knowledge type for healthy animals, communities, and environments

ID: 95

The non-formation of the North Water Polynya Ice Arch

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Abstract: The North Water (NOW), situated between Ellesmere Island and Greenland in northern Baffin Bay, is the largest recurring polynya in the Canadian Arctic. Historically, the northern border of the NOW is defined by an ice arch that forms annually in Kane Basin, which is part of the Nares Strait system. In 2007 the NOW ice arch failed to consolidate for the first time on record. The non-formation of the NOW ice arch occurred again in 2009, 2010, 2017, and 2019. Satellite advanced very high resolution radiometry data shows that large floes broke off from the normally stable landfast ice in Kane Basin for each of these years, impeding ice arch formation. A closer analysis of a 2019 event in which 2500 km^2 of ice sheared away from Kane Basin indicates that significant tidal forces played a role. The evidence suggests that thinning ice from a warming climate combined with large amplitude tides is a key factor in the changing ice dynamics of the NOW region. The non-formation of the NOW ice arch results in an increased loss of Arctic Ocean multiyear ice through Nares Strait.

Session: MAR42 — Changes in the marine cryosphere

ID: 154

Species responses to climate change modify benthic biogeochemical cycling

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Abstract: Polar ecosystems are rapidly transforming in response to anthropogenic climate change, but how changing environmental conditions affect functionally important aspects of organism behaviour has received little attention. Here, we determine the bioturbation behaviour and associated nutrient concentrations for five functionally contrasting benthic invertebrate species from the Arctic (bivalve *Astarte crenata*, sea star *Ctenodiscus crispatus* and polychaete

Pectinaria hyperborea) and Antarctic (bivalves *Aequiyoldia eightsi* and *Laternula elliptica*) under present (1 °C/410 ppm atmospheric [CO_2]) versus future (year 2100) (2.5 °C/550 ppm atmospheric [CO_2]) environmental conditions. Both *Astarte crenata* and *Ctenodiscus crispatus* exhibited mixed responses in sediment reworking (bioturbation) and ventilation (bioirrigation) when subjected to future environmental conditions. *Pectinaria hyperborea* and *Laternula elliptica* responded weakly to increased warming and acidification, whereas *Aequiyoldia eightsi* demonstrated an increased rate of burial and bioturbation behaviour with a coinciding greater drawdown of nutrients into the sediment. Despite great interspecific variability in the strength of responses, we show that projected changes in environmental conditions alter the rate of burial, bioturbation, and bioirrigation of polar organisms, with concomitant effects on biogeochemical performance. Our observations indicate that even under a conservative climate scenario for the year 2100, species and context-specific changes in the mediation of important ecosystem processes are likely.

Session: MAR71 — Species interactions in Arctic aquatic ecosystems

ID: 107

Rethinking the science-policy interface through community-based research on Indigenous water governance in Yukon

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Abstract: Arctic Indigenous peoples are increasingly exercising their rights and responsibilities to protect the lands and water within their territories. The value of Indigenous knowledge systems for informing environmental decision-making is also acknowledged. However, present understandings of the role of Indigenous peoples and governments at the science-policy interface are limited by narrow framings of Indigenous Knowledge as a supplement to Western science and seek to "integrate" Indigenous Knowledge into Western resource governance regimes. More holistic approaches are needed to understand Indigenous knowledge as complete bodies of knowledge that are also the basis of Indigenous legal and governance systems that have existed since time immemorial. I argue that community-based research methods represent an approach to knowledge co-production that can support Indigenous governments and their self-determination in environmental governance processes. I draw on research on Indigenous water governance conducted in partnership with Carcross/Tagish First Nation in Yukon and British Columbia to illustrate how knowledge co-production in North–South partnerships can inform environmental decision-making. In particular, I discuss how this research has helped to identify critiques of present water governance arrangements that flow from modern land claim agreements and to articulate Tagish and Tlingit water laws as the basis for water governance. Finally, I discuss some of the challenges related to conducting community-based research and potential ways to overcome them.

Session: NDP69 — Science-policy in the North: Pathways from research to decision-making

ID: 599

A long-term, 1 km resolution daily meteorological data set for modeling and mapping permafrost in Canada

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Abstract: Climate warming is causing permafrost thaw and there is an urgent need to understand the spatial distribution of permafrost and its potential changes with climate. This study developed a long-term (1901–2100), 1 km resolution daily meteorological data set in Canada for modeling and mapping permafrost at high spatial resolutions. The data set includes eight climate variables (daily minimum, maximum, and mean air temperatures, precipitation, vapor pressure, wind speed, solar radiation, and downward longwave radiation) and is suitable for driving process-based permafrost models. The data set was developed based on four coarser gridded meteorological data sets for the historical period. Future values were developed using the output of a new Canadian regional climate model under medium-low and high emission scenarios. These data sets were down-scaled to 1 km resolution using the

re-baselining approach based on the WorldClim2 data set as spatial templates. We assessed the accuracy of the generated data set by comparing it with climate station observations across Canada and a gridded monthly anomaly time series data set. The accuracy of the data set is similar to or better than the four coarser gridded data sets. The errors in long-term averages and average seasonal patterns are small. The error occurs mainly in day-to-day fluctuations; thus, the error decreases significantly when averaged over 5 to 10 days. The data set can easily be updated when new or improved source data sets are available. The method can also be used to generate similar data sets for other regions, even for the entire global landmass.

Session: TER83 — Views of the Arctic atmosphere: Long-term changes and current perspectives

Posters

ID: 543

Promoting Arctic occupants' well-being through biophilic intermediate spaces

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Abstract: This research discusses biophilic developments of high-performance intermediate spaces as a promising architectural solution to promote Arctic occupants' wellbeing and improve building performance through efficient positive indoor–outdoor connections. Occupants' relationships with natural patterns outside buildings, such as airflow and daylighting, are recognized as biophilia considered as an important factor for wellbeing, especially in Arctic climates. The extreme cold weather and strong seasonal photoperiods, i.e., day/night cycles, in Arctic climates could, however, negatively impact occupants' health and limit outdoor activities and exposure to nature. This research aims at developing configurations of intermediate spaces based on biophilic indicators to enable efficient positive indoor-outdoor connections that address Arctic occupants' wellbeing and optimize energy-efficiency factors in relationships with the Arctic nature. Intermediate spaces are transient/habitable in-between systems connecting indoors to outdoors through deeper sequential spatial organizations. The research, first, articulates a fundamental biophilic wellbeing framework for Arctic occupants' connections with the local nature in terms of thermal and indoor air quality requirements affecting physiological responses, lighting requirements affecting photobiological responses, and biophilic features of relationships with natural systems affecting psychological responses. The design framework for intermediate spaces is, then, developed to explore configurations and typologies that could address the biophilic wellbeing framework in Arctic buildings. The promising typologies of intermediate spaces are optimized and adapted for Canadian Arctic buildings to offer efficient indoor–outdoor connections in terms of occupants' well-being and energy requirements in relationships with nature. The research combines a scoping literature review, focused-group-discussions with local people, and survey of existing Arctic building practices to develop the biophilic wellbeing model and architectural framework. Typologies of intermediate spaces are optimized through experimentations with scale models and numerical methods with simulated environments. The research outcomes could inform architects and decision-makers regarding the potential of the developed intermediate spaces to promote Arctic occupants' wellbeing and building performance.

Theme: Inuit Health Education and Adaptation

ID: 449

Late Pleistocene–Holocene ecological succession in marine mollusc communities in the Canadian Arctic Archipelago

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Abstract: This paper examines (1) the structure of shallow water (*Astarte* spp. – *Ennucula tenuis*) association on sand and gravel substrates; (2) an *Astarte* spp. – *Hiatella arctica* association on muddy

substrates; (3) a *Hiatella arctica – Portlandia arctica* association on muddy substrates; (4) a *Macoma calcarea – Ennucula tenuis* association on mixed substrates of stones, sand, and mud; and (5) a *Buccinum hydrophanum – Ariadnaria* (*Trichotropis*) *borealis* association on muddy substrates. Throughout the study area, fossiliferous sediments situated above the Holocene marine limit provide evidence of the presence of bivalve molluscs that inhabited marine environments beyond the margins of late Pleistocene ice sheets and local ice caps. Bivalve taxa recorded in these sediments include *Astarte* spp., *Chlamys islandica*, *Hiatella arctica*, *Macoma* spp., and *Mya truncata*. Radiocarbon dates obtained on the shell materials range from 47.8 to 22.9 ka BP. Glaciers advancing seawards to their Last Glacial Maximum limits ca. 20 ka BP on the adjacent continental shelf displaced these molluscs. Information regarding the postglacial repopulation of the continental shelf and fjords of the Canadian Arctic Archipelago is based on radiocarbon dates derived from mollusc shells recovered from raised marine sediments at or below Holocene marine limit. The pattern of postglacial succession of molluscan faunas begins with *Portlandia arctica* and *Thyasira* sp., followed by *Hiatella arctica* and *Mya truncata*, followed by *Astarte* spp. and *Macoma calcarea*, and finally, *Ciliatocardium* (*Clinocardium*) *ciliatum*, *Serripes groenlandicus*, *Mya pseudoarenaria*, and various gastropods. The most commonly recorded mollusc species in the modern benthos were established in continental shelf and fiord habitats of the Canadian Arctic Archipelago during the period ~11.6–4 ka BP.

Theme: Marine

ID: 698

Characterization of host-microbial interactions in gills in wild Arctic charr populations

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Abstract: Arctic char (*Salvelinus alpinus*) is a key species in the North because it is widespread in the Canadian Arctic and it is the main source of protein and polyunsaturated fat acids for the Inuit people. Nowadays, this species is facing multiple stressors such as water chemistry modifications, the bioaccumulation of pollutants, and the migration of pathogen populations that affect their health and productivity. The microbiota (e.g., microbial community living in the body surface of its host) is known to play an important physiological role and constitutes the first immune barrier to the host. The main objective of this research is to study the diversity of host-microbial interactions in gills (including viruses) in arctic and subarctic populations of *Salvelinus alpinus*. As the commensal bacteria of the microbiota seem to contribute to the health of the host by providing protection against infection by pathogens we want to study the consequences of disturbances in natural environments on the complex relationships existing between Arctic char and its gill microbiota. Then, because it also appears that the host has an influence on the structure of its microbiota, we want to determine if the genotype of *Salvelinus alpinus* influences the recruitment of microbial communities. To identify variation in microbiota composition and functional activity across populations, we sampled seven populations at different latitudes in the Canadian Arctic and we extracted RNA from 120 gills for 1 6s RNA sequencing and from five gill samples from Cambridge Bay (Nunavut) to perform RNA-seq meta-transcriptomic sequencing. Finally, we performed GBS sequencing on host populations to compare genetic structure (SNP) with microbiota phylogeography to determine if there is an influence of the environment or of the genotype.

Theme: Marine

ID: 729

Distributions of dissolved trace metals in surface waters of Baffin Bay in the Canadian Arctic

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Abstract: This study investigates the distributions of essential micro and macronutrients in surface waters (<500 m) of Baffin Bay during summer 2019. Transects across major inlets and outlets of the Bay, including Davis and Nares

straits and Jones and Lancaster sounds, are presented. A dissolved iron (DFe)-, and dissolved manganese (DMn)-rich, but macronutrient deplete, influx along the eastern side of Baffin Bay, is associated with the northward flow of relatively warm and saline Western Greenland Current (WGC) waters. The WGC may be enriched in DFe and DMn due to contact with shelf sediments and delivery of crustal material related to glacial wasting. Conversely, Baffin Island Current waters flowing North to South along the western side are less enriched in these metals but higher in macronutrient concentrations owing to the nutrient-rich Pacific component of Arctic Water entering Baffin Bay from the Canadian Arctic Achipelago. Dissolved bioactive elements such as cadmium (DCd), copper (DCu), nickel (DNi), and zinc (DZn) are more concentrated in the Pacific component of Arctic Water. These metals have higher concentrations in the north and east of Baffin Bay proximate to inflows of Arctic Water at Lancaster and Jones sounds and Nares Strait. Additionally, the concentration of lead (DPb) is significantly higher in southern Baffin Bay, as a result of anthropogenic Pb, related to its use in gasoline in the last century, in Atlantic Water. By taking into account the differing concentrations of the aforementioned metals, these micronutrients (e.g., Fe, Mn, Zn) and potential toxins (e.g., Cd, Cu) may be employed as geochemical tracers. The interplay between biogeochemical and physical processes on the resulting spatial distributions of trace elements and dominant source and sink terms are discussed.

Theme: Marine

ID: 372

An updated wind–wave climatology for the Southern Beaufort Sea under declining Arctic sea ice cover

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Abstract: Declining Arctic sea-ice cover and increases in fetch are increasing the risk of wave-driven coastal erosion along the Canadian Beaufort Sea coastline. Wave action along the MacKenzie Delta and surrounding coastal areas is typically driven by strong, persistent easterly wind forcing, particularly from mid-summer to mid-fall when extended episodes of open water are present in the southern Beaufort Sea. Delayed freeze-up attributed to climate change extends fetch through October, under an increasingly baroclinic atmospheric environment arising from delayed freeze-up that may enhance storm development and commensurate impacts on shorelines. This can result in enhanced rates of coastal erosion during intense storms, transport and deposition of coastal sediments in nearshore areas, and impact sea ice growth during freeze-up. We present an updated wind-wave climatology for 1999–2018, covering a period of negative trends in seasonal sea ice cover and increasing persistent fetch in the southern Beaufort Sea. Gridded wind–wave reanalysis data from the Meteorological Service of Canada (MSC-50 Beaufort Sea Wind and Wave Reanalysis (Oceanweather Inc.)) was retrieved at a 2.5 km resolution (0.1°) for the continental shelf area near the MacKenzie Delta and the community of Tuktoyaktuk, Northwest Territories. The wind data were analyzed into long duration events with steady wind directions (within a 22.5° directional quadrant). The effects of large wave episodes arising from extended periods of easterly and northwesterly wind forcing into shallow waters (<20 m) were investigated by using a first-generation wave model (Sverdrup–Monk–Bretschneider method) to determine two-dimensional wave spectra (frequency-direction) that arise when wind forcing reaches a saturation level (i.e., fetch and wind produce a fully developed sea). This will provide insight into future wind–wave development extrema, and their potential impact on the physical environment.

Theme: Marine

ID: 611

Using small lakes across the Northwest Territories to predict changes to carbon chemistry with a warming climate

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Abstract: Unprecedented warming across the circumpolar north is rapidly altering the carbon

cycle across many surface waters that act as biogeochemical hotspots across these cold landscapes. Continual subsurface warming, permafrost degradation, and changes to the amount and timing of precipitation can alter the amount and form of carbon transported across the terrestrial–aquatic interface. In terms of carbon fate, it is important to determine the processes responsible for dictating whether these lakes and ponds act as carbon sources or sinks, and what relationships can be used to predict the drivers of these processes. However, little data exists for areas of the Precambrian taiga shield and tundra in the Northwest Territories (NT), Canada. The objective of our research is to use a "space-for-time" approach to understand how small lakes and ponds in the NT will evolve with a warming climate, specifically in terms of carbon sources and eventual fate with respect to the atmosphere. We sampled a series of lakes along a latitudinal gradient in the NT (Yellowknife, Wekweètì, and Daring Lake) in late summer for general water chemistry parameters, nutrients, carbon chemistry (dissolved organic and inorganic carbon), dissolved organic matter (DOM) characterization, (UV-absorbance and elemental ratios), dissolved gases (carbon dioxide, and methane), and stable isotopes of water. Preliminary results indicate water chemistry in lakes near Yellowknife are much different than either Wekweètì or Daring lake, and that carbon dioxide in Yellowknife lakes are super-saturated, but not at Wekweètì and Daring Lake. These latitudinal differences are explored and compared with DOM chemistry and hydrology to help determine how a warming climate may impact carbon sources and fate in northern aquatic systems.

Theme: Terrestrial

ID: 621

Arctic change revealed by satellite — data collections of ESA DUE GlobPermafrost and ESA CCI + Permafrost

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Abstract: A Permafrost Information System (PerSys) based on satellite data has been set up as part of the ESA DUE GlobPermafrost project (2016–2019, www.globpermafrost.info). This includes a data catalogue as well as a WebGIS, both linked to the Pangaea repository for easy data access. The thematic products available include InSAR-based land surface deformation maps, rock glacier velocity fields, spatially distributed permafrost model outputs, land surface properties and changes, and ground-fast lake ice. Extended permafrost modelling (time series) is implemented in the new ESA CCI+ Permafrost project (2018–2021, http://cci.esa.int/Permafrost), which will provide the key for our understanding of the changes of surface features over time. Special emphasis in CCI+Permafrost is on the evaluation and development of land surface models to gain better understanding of the impact of climate change on permafrost and land–atmosphere exchange. Additional focus is on the documentation of kinematics of rock glaciers in several mountain regions across the world supporting the International Permafrost Association (IPA) action group "kinematics as an essential climate variable". We will present the Permafrost Information System including the time series (2003–2017) of the first version of ground temperatures and active layer thickness for the entire Arctic from the ESA CCI + Permafrost project and results from the latest update (extension to 1997–2018). Ground temperature is calculated for 0, 1, 2, 5, and 10 m depths and has been assessed based on a range of borehole data. A survey regarding data repositories containing relevant borehole data has been conducted. The records have been evaluated for the project and harmonized. In addition, the resulting database will be eventually made publicly available.

Theme: Terrestrial

ID: 236

Taking into account sea ice spatial heterogeneity at the subgrid scale has effects on 1D-modeled phenology of phytoplankton but not on primary productivity or community structure

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Abstract: Despite the importance of light under the sea ice for biogeochemical modeling in polar seas, the representation of the under ice light field is often inadequate and at best oversimplified. Usually, in coupled sea-ice/ocean models a grid cell with a sea ice concentration varying between 0% and 100% is associated with a homogeneous underwater light field that would be a simple function of the ice cover. Researchers proposed using a heterogeneous underwater light field at the subgrid scale instead, to mirror the heterogeneity of sea ice. Due to non-linearities in biological responses to light availability, the averaged light limitation on primary production thus obtained is not equal to the light limitation derived from mean irradiance. We tested this approach with the MIT general circulation model (MITgcm) coupled to a biogeochemical-ecosystem module, but implemented in a one-dimensional water column framework specific for coastal Baffin Bay. The interest of our model is that it includes 33 phytoplankton types. The emergent numerical phytoplankton community structure involves a diversity of functional groups and class sizes. We show the changing community and richness over the growing season. We ran two simulations: with and without the subgrid scale spatial heterogeneity of sea ice. The results show a noteworthy change in phenology. The start of the bloom peak is delayed by one week although the start of the bloom development is not. Primary productivity is decreased by only 2% as annual primary productivity is limited by the nutrient pool. There was no clear change in the emergent numerical phytoplankton community structure in terms of functional groups, class sizes, or richness.

Theme: Marine

ID: 473

Impacts of climate change and local anthropogenic activities in Antarctic Peninsula lakes

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Abstract: The rapid climate warming that has taken place around the Antarctic Peninsula during the 20th and 21st centuries has occurred simultaneously with the intensification of human activities, including scientific research. Although it is often assumed that bases and research activities have negligible effects on the natural environment, this hypothesis is rarely tested. We assessed trajectories over the past century in seven lakes on Fildes Peninsula (King George Island), the site of six permanent bases, using a paleolimnological approach, to study the effects of climate change and anthropogenic activities on their chemistry and biota. In this study, we focus on photosynthetic assemblages in five lakes near stations and those of two control lakes. Pigment and diatom diversity in sediments were analyzed by high performance liquid chromatography and microscopy and geochemical sediment composition by X-ray fluorescence core scanning. Our results suggest a strong temporal structure in the composition of primary producers, with similar trajectories in all lakes as of ~1990 CE. As such, shifts in phytoplankton do not appear to be driven primarily by anthropogenic activities in stations near the lakes, and, thus, are likely due to another factor such as increasing temperatures. However, relationships existed between phytoplankton composition and total biomass and some heavy metals common in gasoline and diesel (i.e., Zn, Cu, and Ni) and, therefore, associated with transportation, heating, and power generation in stations. This was particularly true in two lakes nearest bases, one of which has known issues with contamination (Hotel Lake). Moreover, for one of these lakes (Las Estrellas), diatom species composition revealed metal-pollution tolerant diatom species as well as significant correlations between Zn and the abundance of these species. We conclude that while climate change plays an important role in structuring changes in these maritime Antarctic lakes, anthropogenic contamination from scientific research stations cannot be dismissed.

Theme: Terrestrial

ID: 477

Towards a better understanding of Nunavik's coastal dynamics

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Abstract: Nunavik — Quebec territory located north of the 55th parallel — has very important coastal ecosystems and morphologies due to the ongoing context of post-glacial emergence. This leads to a decrease in relative sea level; an uncommon feature of Arctic and subarctic coastlines. Despite a generally increasing exposure to coastal hazards along Canada's Arctic coastline, contrasting coastal dynamics can be observed in Nunavik, which affects coastal zone management and decision-making under uncertainty. Acquiring new knowledge to develop an environmental sensitivity index for the coasts of Nunavik is critical for coastal communities. Effective coastal environmental conservation planning is necessary to ensure the protection of the Nunavik communities. This requires a better understanding of coastal systems and their sensitivity to environmental and anthropogenic pressures in a context of expanding industrial development. This presentation introduces an extensive research program being conducted by the Université du Québec à Rimouski (UQAR) and Laval University, in partnership with the Centre d'expertise en gestion des risques d'incidents maritimes (CEGRIM) and Quebec ministries. The objectives of this project are to: (1) calculate shoreline changes in the communities of Nunavik and selected macroregion (e.g., the coast between Kuujjuarapik and Umiujaq) for the period 1950–2010; (2) identify and map coastal sediment cells; (3) update the preliminary coastal classification for the entire area, integrating hydro- and morphodynamic data; (4) characterize coastal ecosystems by remote sensing; and (5) develop an environmental sensitivity index.

Theme: Terrestrial

ID: 239

Recent changes in vegetation productivity on the Bathurst caribou range

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Abstract: Remote sensing indicates that vegetation productivity has increased across nearly half of the Bathurst caribou range in central Northwest Territories from 2000–2017. Some of the strongest greening trends are occurring at the forest–tundra transition zone, an important feeding area for caribou in late summer, but the changes in plant communities and vegetation growth patterns underlying this rise in productivity are unknown. In situ evidence from other northern regions has found that shrubs are expanding across the tundra. A greater abundance, density, or distribution of shrubs can have an enormous influence on both abiotic and biotic processes, and is potentially a factor contributing to the Bathurst caribou herd's 99% decline in recent decades. Our field investigation is using dendrochronology to compare patterns of dwarf birch (*Betula glandulosa*) and willow (*Salix* sp.) growth between areas of the herd's late summer range where productivity has increased and areas that have not significantly changed in recent decades. Here, we present some early comparisons of shrub distribution, abundance, and cover metrics between the two types of sites, and also share a broader snapshot describing plant communities and species abundances. Our findings suggest that tall shrub cover is greater at greening sites, despite no difference in shrub density or relative proportion of dwarf birch to willow from sites where productivity has not changed. These results will inform upcoming research into the climate sensitivity of erect deciduous shrubs in central northern Canada, and will ultimately provide insight into changing vegetation patterns as they may affect available forage for barren-ground caribou.

Theme: Terrestrial

ID: 97

Foxes (*Vulpes* spp.) as intermediate hosts for *Toxoplasma gondii* in northern Canada

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Abstract: In changing northern ecosystems, understanding the mechanisms of zoonotic pathogen transmission, including the coccidian parasite *Toxoplasma gondii*, is essential to protect vulnerable animal and human populations that live in these regions. As sentinel species, foxes give us a better idea of *T. gondii* distribution and help us understand how it persists in this ecosystem. The objectives of our research are to generate baseline data on *T. gondii* among foxes across northern Canada and understand the trophic relationships between foxes and their prey species. Red (*Vulpes vulpes*) and Arctic fox (*Vulpes lagopus*) carcasses ($n = 736$) were collected by local trappers and collaborators from Labrador, Québec, northern Manitoba, Nunavut, and the Northwest Territories during winters of 2015–2019. *Toxoplasma gondii* DNA was detected in heart and brain using magnetic capture PCR. An enzyme-linked immunosorbent assay was performed on heart fluid to detect evidence of previous exposure to the pathogen. We are reconstructing the diet of Nunavik foxes for a year by measuring stable isotopes ratios of C and N in hair and muscle samples to link prey with status of infection. The overall *T. gondii* tissue prevalence was 28% ($n = 179/662$, 95% CI: 23–31) in foxes, compared with a seroprevalence of 35% ($n = 236/668$, 95% CI: 31–40). A significant difference in the tissue prevalence of *T. gondii* in foxes from eastern and western Nunavik in northern Québec was observed: 20% ($n = 33/165$; 95% CI: 14–28) compared with 51% ($n = 38/75$; 95% CI: 36–70), respectively. Stable isotope mixing model analysis showed that infected foxes have a higher probability to consume marine food sources and snow geese (*Chen caerulescens*) compared with non-infected foxes. Our study sheds new light on the current status of *T. gondii* in wildlife in northern Canada, informing future risk assessments and predictive models to determine the potential human and animal health risks associated with *T. gondii* infection.

Theme: Inuit Health Education and Adaptation

ID: 812

Spatial and temporal patterns of wolf (*Canis lupus*) occurrence along the western coast of Hudson Bay

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Abstract: Wolves (*Canis lupus*) are keystone ecological species across most of their range, driving top-down impacts on their prey. Wolves are also important culturally and economically in the North as a species trapped throughout much of its range. Understanding the ecology of wolves is particularly important at a time when many caribou herds are a serious conservation concern. This research is part of the International Student-Led Arctic Monitoring & Research (ISAMR.net) collaboration that engages youth in science. We documented the occurrence of wolves in Wapusk National Park along the Hudson Bay coast of Manitoba from 2012–2020 using $n = 15$ PC-900 Reconyx trail cameras deployed around the perimeter of three field camps. During this period, we collected 170 855 photos from all cameras and of these 2% ($n = 3575$) were of wolves, of which there were 406 unique occurrences (each separated by at least one hour). Each occurrence was associated with 12 unique photos on average (min = 1, max = 119). Our findings indicate that wolves are well established in Wapusk National Park, with numerous occurrences of wolves at all field camps in all eight years of this study. The majority (73%) of wolf occurrences were between 19:00 and 7:00. During the study period, total annual wolf occurrences increased over time. Wolves were by far the most common (78% of occurrences) at the most southern field camp (Owl River Camp, associated with tree cover), lowest (2% of occurrences) in the most northern camp (Nester One Camp, tundra area), and moderate (20% of occurrences) in the middle camp (Broad River Camp, mix of tundra and tree cover). This study will be linked with our on-going work on caribou ecology and conservation.

Theme: Terrestrial

ID: 170

Tularemia in terrestrial and marine Arctic ecosystems

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Abstract: *Francisella tularensis* is a serious vector-borne bacterium that infects a range of avian and mammalian hosts, including people. It is transmitted among hosts via direct contact with infected individuals (bodily fluids and consumption of infected carcasses), bites from hematophagous arthropods, and through contact with contaminated water sources. Little is known about the mechanisms of transmission in aquatic and terrestrial environments in the Arctic. Rodents are theorized reservoirs in the Arctic and outbreaks in southern Canada have resulted in high mortality for rodent hosts. Thus, scavengers and predators may be ideal sentinels for *F. tularensis*. In marine ecosystems, *F. tularensis* can survive for multiple weeks and has been detected in invertebrate filter feeders. We identified seroprevalence in predators occupying high trophic levels in terrestrial and marine Arctic ecosystems (Arctic foxes and polar bears) and active infection/seroprevalence in primary prey species (snow geese, rodents, and seals) to determine whether diet plays a role in transmission. Furthermore, qPCR was used to determine the prevalence of *F. tularensis* in mosquitoes and fleas to identify potential vector species. Serum samples from 158 Arctic foxes trapped between 2014 and 2019 and 100 polar bears trapped between 2015 and 2017 were screened using a microagglutination test (MAT). Seroprevalence was 22% (95% CI: 16–29) for foxes, 60% (95% CI: 50–69) for bears and 1% for harvested ringed seals ($n = 99$; 95% CI: 0–6). Mosquitoes ($n = 12\,542$), fleas in nests (*Ceratophyllus vagabundus*; $n = 294$), fleas on geese (*Ceratophyllus vagabundus*; $n = 126$), fleas on rodents (*Amalaraeus dissimilis*; $n = 115$), rodents ($n = 21$), and geese ($n = 82$) were negative for *F. tularensis* DNA. This study provides supporting evidence that *F. tularensis* circulates in terrestrial and marine ecosystems. Future studies should continue to investigate sources of transmission in Arctic ecosystems and determine whether infection impacts the survival and reproductive success of predators and scavengers in the Arctic.

Theme: Inuit Health Education and Adaptation

ID: 679

Climate-related drivers cause divergent temporal trends in arctic char mercury concentrations from paired Lakes on Melville Island, Nunavut

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Abstract: The Cape Bounty Arctic Watershed Observatory includes two adjacent, geologically similar lakes (West and East), which are currently undergoing climate-driven changes. Summers over the period 2007–2012 were unusually warm and resulted in regional changes in ice duration, hydrology, and permafrost degradation. Both catchments have experienced permafrost degradation; however, West lake has also undergone multiple sub-aqueous slumps (beginning in fall 2008), leading to a sustained increase in turbidity and resultant decrease in fish body condition. This provides the unique opportunity to understand the potential impacts of permafrost degradation and other climate effects on mercury (Hg) concentrations of Arctic char (*Salvelinus alpinus*), an important subsistence food source across the circum-Arctic. Our objectives were to (1) Assess temporal trends (2008–2019) in char Hg concentrations, and (2) determine potential

mechanisms driving any observed trends. We found that between 2008 and 2019, there was a significant decrease (R^2adj. = 0.72, p^2adj. = 0.59, $p = 0.004$). We determined that fish growth (age-at-size) was the best predictor of length-adjusted [Hg] in East lake (R^2adj. = 0.68, $p = 0.002$), such that faster growing fish have lower [Hg] (somatic growth dilution). In addition, mean summer air temperature from the previous year was significantly correlated with length-adjusted [Hg] in East lake, which in a model together with growth explains 76% of the variability (R^2adj. = 0.76, $p = 0.006$). However, the best predictors of length-adjusted [Hg] in West lake were carbon (R^2adj. = 0.66, $p = 0.005$) and nitrogen (R^2adj. = 0.47, $p = 0.02$) stable isotope ratios, indicating a shift in diet likely due to the profound increase in turbidity. This work demonstrates the difficulty of predicting trends in Arctic fish Hg under a changing climate, as there are myriad interacting climate-related drivers.

Theme: Terrestrial

ID: 463

Prototype framework for deep learning driven semantic segmentation of Arctic seabed imagery

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Abstract: The reliable mapping of the Arctic seabed is a prerequisite for marine spatial planning and environmental management. Underwater imagery (UWI) is one of the most common methods for mapping the seabed. The main advantage of this method is its simplicity, which enables rapid and cost-effective collection of large amounts of data. However, only a small part of information from UWI archives is being used due to labor-intensive and time-consuming effort, often requiring expert knowledge. Thanks to progress in deep learning (DL) methods, with convolutional neural networks demonstrating state-of-the-art in semantic segmentation tasks, new opportunities for automated large-scale analysis of seabed images have emerged. Although some tools exist for intermediate steps, multi-disciplinary teams still lack a unified framework, which could provide fast and reliable semantic segmentation and automate quantitative measurements for classes of interest. To address this issue, we present a prototype segmentation framework tested on the UWI imagery material collected from the upper subtidal zone of central Spitsbergen, Arctic. The system consists of two main layers: a user-friendly web front-end, based on industry leading React framework, and a back-end, relying on TensorFlow Serving API, responsible for managing and serving of DL models. A pilot experiment was conducted using two large 2D mosaics of a seabed transect, stitched from UWI video material, containing 3 classes — pebbles, tube dwelling polychaetes, and Ophiuroidea. Mosaic-based 2-fold cross-validation results revealed a high overlap between ground truth and predicted masks according to similarity coefficients — Dice of 0.86 and 0.84 as well as Jaccard of 0.77 and 0.72 for binary (Ophiuroidea detection) and multiclass segmentation tasks, respectively. Effective, accurate and fast segmentation of the seabed mosaic can be achieved if sufficient training annotations are available for the DL model. Further development is envisaged to enable tweaking capabilities for segmentation results as the post-processing phase.

Theme: Long-Term Monitoring and Data Management

ID: 623

Runoff and sea-ice melt/brine distributions drive seasonal CO_2 and calcium carbonate saturation variability in Hudson Bay

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Abstract: We present the first observations of dissolved carbon-dioxide (CO_2) and calcium carbonate ($CaCO_3$) saturation state in Hudson Bay during Winter and Spring, based on discrete observations from February–April 2017 and June–July 2018. The distributions of CO_2 and $CaCO_3$ saturation corresponded well with distributions of freshwater (runoff and sea-ice melt)

and brine as interpreted from $\delta^{18}O$ — salinity pairs. $CaCO_3$ under-saturation and CO_2 super-saturations were more pronounced in runoff-rich waters, and deep waters. Seasonal and spatial differences in runoff chemistry also influenced the degree of CO_2 and $CaCO_3$ saturation in the coastal domain and $CaCO_3$ saturation relative to previous studies conducted during summer and fall, likely related to seasonal differences in runoff, ice melt, and brine distributions.

Theme: Marine

ID: 264

Sea ice drives kelp forest depth distribution in northern Hudson Bay

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Abstract: Arctic and subarctic regions are experiencing rapid sea ice loss leading to increased light levels and temperatures in the benthic environment. It is hypothesized that ultimately these processes will lead to an increase in benthic primary production. This study tests this hypothesis focusing on the depth distribution of kelp around Southampton Island in northern Hudson Bay, Canada. The region provides a perfect environment to test the hypothesis as it is surrounded by coastal polynyas to the west and south, a late melt-out pack ice cover to the north, and limited land-fast ice zones that produce benthic habitats with a wide range of open water periods with light (OWL). Video surveys conducted in the summers of 2018 and 2019 were analyzed to determine the kelp density, canopy height, and to identify the depth extent of the 50%, 10%, and 1% kelp forest density. The kelp forest was primary composed of perennial species with the high canopy dominated by *Saccharina latissima*, *Alaria esculenta*, *Laminaria solindungula*, and the low canopy by *Agarum clathratum*. The forests extended from 4.6 to 50 m depth with the maximum density between 4.6 and 26.6 m depth. The depth extent of the 50% and 10% kelp density around the Island was explained by the length of the OWL and earlier break-up date, both of which increase light availability. Despite more extensive sea ice conditions near Southampton Island, local kelp forests were found to grow disproportionally deeper relative to other locations in the northern hemisphere. The latter is likely explained by the clearer waters around Southampton Island. Our results suggest that the loss of sea ice may lead to an increase in kelp distribution with the secondary effect of increasing the local biodiversity via an expanding benthic habitat.

Theme: Marine

ID: 475

Influence of nordic seas dynamics on the Atlantic water propagation and its impacts on sea ice concentration

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Abstract: Enhanced intrusion of warm and saline Atlantic Water (AW) to the Arctic Ocean (AO) in recent years has drawn wide interest of the scientific community owing to its potential role in “Arctic Amplification”. Not only the AW has warmed over the last few decades, but its transfer efficiency has also undergone significant modifications due to changes in atmosphere and ocean dynamics at regional to large scales. The Nordic Seas (NS), in this regard, play a vital role as the major exchange of polar and sub-polar waters takes place in this region. Further, the AW and its significant modification on its way to AO via the Nordic Seas has large scale implications on, for example,deep water formation and air–sea

heat fluxes. Previous studies have suggested that a change in the sub-polar gyre dynamics in the North Atlantic controls the AW anomalies that enter the NS and eventually end up in the AO. However, the role of NS dynamics in resulting in the modifications of these AW anomalies are not well studied. In this study we show that the NS are not only passive conduit of AW anomalies but the ocean circulations in the NS, particularly the Greenland Sea Gyre (GSG) circulation can significantly change the AW characteristics between the entry and exit point of AW in the NS. Further, it is shown that the change in GSG circulation can modify the AW heat distribution in the NS and can potentially influence the sea ice concentration therein. In view of the above and the intensifying atmospheric forcing in the NS, potentially strengthening the NS circulation, it is likely that the NS will play a more prominent controlling role in the variability of the Arctic climate by influencing deep water formation, sea ice concentration, and freshwater budget in this region.

Theme: Marine

ID: 108

Facing the challenge of permafrost thaw in Nunavik communities: high-resolution permafrost and geotechnical conditions mapping to support land-use planning

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Abstract: High-quality scientific information on permafrost properties and temperature regime, risk of occurrence of natural hazards, and expected timing of permafrost thaw is required to plan the growth of Nunavik communities and improve the quality of "urban" life, as the high growth rate of the population calls for housing expansion phases and improvement of public infrastructure. Under research contracts to Centre d'études nordiques from the Government of Quebec, particularly from the Ministère des Affaires Municipales et de l'Habitation, a major permafrost mapping program was implemented to provide knowledge in support to the Kativik Regional Government (KRG) and to the communities. This research focuses on mapping permafrost conditions and land use potential conditions in thirteen Inuit communities in Nunavik. A team of experts and students helped by local community members developed an innovative multi-technique approach to map permafrost. The methodology integrates interpretation of old and recent air photographs, remote sensing, the construction of digital elevation models, compilation of available geotechnical data from the grey literature, surficial geology mapping, sampling in soil pits, permafrost coring, geophysical surveys, geotechnical laboratory analyses of samples, installation of thermistor cables, and data loggers. All the observational and technological data were compiled in a GIS to produce four maps for each of the communities: (1) a surficial geology map, (2) a permafrost condition map (based mostly on ground-ice content), (3) a map of potential for construction, and (4) a hazard risk assessment map. The results indicate preferential areas for the construction of buildings and infrastructure on permafrost as well as areas considered sensitive to climate change. These mapping results can be used to guide decision-making to long-term development plans for the Inuit communities in Nunavik. All the maps, updates, data tables, and scenarios for changes are publicly available and shared on a continuous basis with KRG and the communities.

Theme: Inuit Health Education and Adaptation

ID: 58

Pride in polar research

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Abstract: Inclusivity, equity, and diversity benefit all of Polar research, helping the community to realize its full potential. Pride in Polar Research (PiPR) was established when an early career researcher reached out to the community ahead of the POLAR2018 conference in Davos, seeking solutions to the isolation and discrimination issues they faced as a queer and intersex scientist. What began as a plea to other members of the community to be more visible by wearing rainbow badges quickly developed into a group actively working to combat biases through community development and education. PiPR is inclusive, welcoming all Sexual Orientation, Gender Identity, Gender Expression, and Sex Characteristics identities (LGBTQIA + and others). Since the first meeting in Davos, attended by >30 conference participants, PiPR has received support from the Scientific Committee on Antarctic Research, International Arctic Science Committee, and other organizations, established Twitter (1400+ followers) and Facebook (200+ followers) accounts, and a moderated mailing list (100+ members), becoming an internationally recognized network. PiPR is working to establish a more formal structure and is cooperating with Women in Polar Science, Minorities in Polar Research, other intersectional groups and allies across academia to build on its initial successes. Beyond supporting, connecting, and raising the visibility of members of our community, PiPR will produce resources intended to improve equity, diversity, and inclusion within Polar research. One priority is to provide practical advice to individuals and groups organizing workshops, conferences, fieldwork, etc., on how best to be as inclusive and welcoming as possible, given the many different barriers that members of the PiPR community face worldwide.

Theme: Knowledge Exchange and Co-production

ID: 280

The state of knowledge of grizzly bears in northern Manitoba

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Abstract: Grizzly bears have been observed increasingly often in northern Manitoba, likely originating with the established populations in Nunavut and the Northwest Territories. We summarize and present all known documented observations of grizzlies in northern Manitoba verified from direct observations, remote camera observations, government agency reports, first author's field notes, volunteered observations, media and social media reports, published literature, and the Hudson's Bay Company Archives. We recorded total of 159 observations, with most since 1980. Spatially, these observations are from the southern Arctic, Hudson Plains, and Taiga Shield ecozones, and span from the Nunavut border to the south shore of the Nelson River. Grizzly bears were historically present in northern Manitoba, although in very low densities. The frequency of observations per decade increased markedly since 1990, notwithstanding the recent introduction of remote cameras and non-uniform search efforts that were higher along the Hudson Bay coast and in areas with more human activity. Most observations were along the Hudson Bay coast and all confirmed observations were of single bears, suggesting that the present population is likely maintained by dispersal from the population to the north. The observations and patterns documented here are broadly consistent with what is known about the species' ecology in similar habitats, but they do not represent the full dimensions of the species' ecology and distribution in northern Manitoba. Understanding grizzly bear distribution and demographics in the portion of Manitoba's grizzly bear range north and west of Churchill will be critical for more accurately assessing the status, trends, and population dynamics of grizzly bears in the province.

Theme: Knowledge Exchange and Co-production

ID: 70

Understanding lake response to permafrost thaw in the Dehcho region of the Northwest Territories

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Abstract: Lakes at the southern limit of permafrost are highly sensitive to climate warming. In the southern Northwest Territories (NT), permafrost is typically restricted to forested patches, or peat plateaus, that are elevated above the surrounding wetlands. As mean annual air temperatures approach 0 °C, permafrost thaw results in the waterlogging of soil and transition of forested plateaus to wetlands. As the proportion of wetlands in the catchment increases, the routes for the export of terrestrial carbon to enter lakes also increases, which can result in "browning" of the water. Lake browning can impact lakes in many ways, for example, by reducing the amount of light that can penetrate into the water column, which, in turn, can impact lake food webs. The research presented here focuses on 16 small lakes in the Scotty Creek basin, within the Dehcho region in the southern NT, and aims to answer two questions. First, how have lakes changed in this region and when did these changes begin? To answer this question sediment cores were collected to reconstruct environmental histories of a select few lakes in the Scotty Creek basin over the past several hundred years. Second, do current landscape characteristics (e.g., proportion and type of wetlands) impact current lake conditions (e.g., the amount of dissolved organic carbon)? To answer this question landscape characteristics were analyzed using satellite imagery, and lake water samples were collected and analyzed. Here, preliminary results will be presented that begin to answer these questions. This research will contribute important advancements in our understanding of how permafrost thaw impacts lakes and how they will change in the future.

Theme: Terrestrial

ID: 92

Refuge islets: High Arctic nesting birds select safe neighborhoods

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Abstract: Climate warming can lead to significant changes in the Arctic landscape with cascading effects on species interactions. Predation by Arctic fox, a key tundra predator, can have strong effect on the distribution and reproductive success of Arctic-nesting birds. Habitat structure such as lakes, rivers, ponds, and complex water channels can generate physical barriers constraining movements of foraging foxes. Birds nesting on islets located within such structures could reduce or eliminate the risk of predation on eggs and offspring. The main goals of the study were (*i*) to locate and characterize islets in the landscape of Bylot Island (Nunavut) and (*ii*) to identify criteria used by birds when selecting an islet to nest. A total of 344 islets were characterized by their distance to the shore and their water depth within our study area (1600 km^2) and 25% were used at least once during year 2018 and 2019 by one of the three focal nesting species (Cackling geese, Glaucous gulls, and Red-throated loons). Water depth surrounding the islets and distance to shore influenced islet selection by all species. Above a threshold distance, islets were selected according to water depth, which likely reflects the biomechanical constraints of foxes (i.e., jumping distance and leg length). The next step will be to assess the sensitivity of anti-predation refuges to warming-induced landscape transformation and the potential cascading effects on Arctic biodiversity.

Theme: Terrestrial

ID: 167

Surprising dominance of the kelp *Agarum clathratum* on north Baffin Island: characterization of its distribution and depth limitations

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Abstract: Kelp play an unknown role in the ecology of Arctic coastal ecosystems, but our knowledge of their diversity and distribution is slowly emerging. However, as in lower latitudes, one species, *Agarum clathratum*, is often considered a minor player in these communities, usually described as a less competitive species that is restricted to greater depths. However, our recent observations in northern Baffin Island revealed that *A. clathratum* can dominate rocky bottoms there, even in shallow areas. We documented the abundance and distribution of *A. clathratum* in this area using underwater video cameras to characterize the seafloor at multiple depths (2 m to 43 m) at 39 sites along the southern shore of Eclipse Sound (Baffin Island, Nunavut). We evaluated the substratum type, the cover of different kelp species, and the abundance of sea urchins. *Agarum clathratum* was present in 80% of the areas analyzed, whereas only 47% had other species of kelp present. It was found at high cover (>50%) at depths between 5 and 21 m, and the maximum depth at which it was observed was 37 m. In contrast, other kelp species were less abundant and only found at depths <10 m. Sea urchins were usually present and, at times, abundant, but never at the levels seen in subarctic regions. These initial results suggest that *A. clathratum* is the competitively dominant kelp species in High Arctic environments. Further knowledge of the ecology of this species is key to a better understanding of its present and future role in the changing Arctic.

Theme: Marine

ID: 140

Scoping review: The occurrence of dog bites in Northern Indigenous communities

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Abstract: Many northern Indigenous communities have relied on dogs to hunt, travel or protect their belongings and families over the years. But this ancient partnership has often been profoundly affected by colonization, settlement, democratization of snowmobiling, and other socio-cultural and environmental changes. Despite those recent (and sometime rapid) changes, dogs still play an important role in many of northern Indigenous populations. This relationship brings significant benefits to humans; however, it can also increase exposure to certain risks to public health, like dog bites. We conducted a review of the scientific literature (scoping review) to document the state of knowledge regarding the occurrence of dog bites in the specific context of northern Indigenous communities and in comparison with other contexts (like southern, urban, or non-Indigenous ones). We also aim to identify the factors that would be associated with an increased risk of bites in this particular context and the main knowledge gaps about this subject. The search was done using seven bibliographic databases and included only the original studies. Nine articles were selected for the analysis. Although this is a recent topic of interest in research and that evidence is still scarce, our results suggest that Indigenous people living in these communities are at higher risk of dog bites than the rest of the population. Several individual and environmental factors that may increase the risk of biting were suggested, including cultural and organizational barriers to dog management and lack of access to veterinary services. This literature review highlights the context particularities, the data heterogeneity, and the significant lack of knowledge about the occurrence of bites in northern Indigenous communities, making it difficult to develop animal health and public health interventions.

Theme: Inuit Health Education and Adaptation

ID: 339

Genetic structure of Arctic char (*Salvelinus alpinus*) populations and their local adaptation to the contrasting marine environments of the southeastern Arctic

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Abstract: The Arctic char (*Salvelinus alpinus*) is an anadromous salmonid of great importance for traditional fisheries in the Inuit communities of northern Canada. Arctic char are known to migrate to coastal feeding areas in proximity to their natal rivers, which could indicate a potential for local adaptation to marine as well as freshwater conditions. In an effort to develop biologically significant management units for Arctic char in the southeastern Canadian Arctic, we assessed genetic population structure and adaptation at a local and regional scale: 650 individuals were sampled from 23 localities in Nunavik (Quebec), Baffin Island (Nunavut), and northern Labrador, and around 18 000 single nucleotide polymorphism markers were obtained using genotyping-by-sequencing. Fish harvested in different rivers sharing an estuary could generally not be distinguished, suggesting a high level of gene flow inside a catchment area. Patterns of genetic diversity show signs of hierarchical genetic structure, with the broader level of structure dividing the study area in four major regions with extent roughly matching the oceanographic basins around Nunavik (Hudson Bay, Hudson Strait, Ungava Bay and Labrador Sea). As the environment is highly contrasted between those regions, natural selection could play a role in structuring Arctic char populations. The association between genetic markers and environmental factors were tested using both monogenic (e.g., Baypass, latent factor mixed model) and polygenic (e.g., redundancy analysis) methods to identify potential targets for local adaption. These results will inform local and regional decision makers about conservation of Arctic char stocks in Nunavik.

Theme: Marine

ID: 112

Predicting permafrost probability in a variable boreal environment utilizing a multiple logistic regression model, Whatì, Northwest Territories, Canada

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Abstract: For remote communities in the discontinuous permafrost zone access to current permafrost distribution information for hazard assessment is a considerable challenge. In this study we apply established analytical methods to illustrate a time- and cost-efficient method for conducting community-scale permafrost mapping in the community of Whatì, Northwest Territories. A binary logistic regression model (BLR) was created using a combination of field data, digital-elevation-model-derived variables and remotely sensed products. Independent variables included vegetation, topographic position index (TPI), and elevation breaks used as categorical inputs. The dependent variable is sourced from approximately 140 physical checks of permafrost presence/absence sampled across the variable boreal–wetland environment. Vegetation was shown to be the strongest predictor of permafrost in the model. The model predicts 50.0% of the vegetated area is underlain by permafrost with a model accuracy of 91.4% and an agreement between model and ground truthing points of 72.8%. Compared with existing permafrost products this value (50.0%) is on the lowest edge of Whatì's current classification (extensive discontinuous), illustrating that there could be less permafrost than presumed. The model was perturbed to explore potential changes in ecosystem brought on by disturbance, demonstrating that when coupled with predicted future climate change the area will likely fall outside of its current permafrost classification. This model provides considerably more permafrost distribution information for the area of Whatì than any other product currently available and is able to inform future planning and development.

Theme: Terrestrial

ID: 556

Forensic disaster analysis and climate change in the North American Arctic

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Abstract: Forensic Disaster Analysis (FDA) research focuses on the root causes of disaster risk and occurrence. It has grown from an acknowledgement that much disaster risk research focuses more on emergency

management and reconstruction than on addressing disaster risk through sustainable development. In understanding risk, FDA considers not just physical "trigger" events, but longer sequences of events that give rise to disaster risk for particular groups of people in periods of apparent normalcy, as well as the factors that affect how the event is experienced and responded to. Essentially, FDA conceptualizes disasters as socially constructed phenomena. Although disasters are often understood as acute events, there is a growing recognition that disasters are slow-onset phenomena, resulting from long-term, socially constructed processes, and human actions and choices. In the North American Arctic, environmental degradation and climate change (sometimes also called "creeping environmental problems") intersect with other processes including colonization, marginalization, histories of forced relocations from traditional homelands, sedentarization, residential schooling, and cultural assimilation. For people living in the Arctic, climatic change is characterized by temperature increases, reduction in sea ice extent and thickness, permafrost thawing and reduced snow cover. The specific experiences of these changes for Arctic populations are constructed by, and inseparable from, these other long-term, socially constructed processes. The applicability of FDA to the study of the intersecting drivers of disaster in an Arctic context is apparent, and this presentation will explore how it might be approached.

Theme: Inuit Health Education and Adaptation

ID: 596

Changes in the permafrost thermal regime of a lithalsa, a glaciofluvial delta and bedrock near Kangiqsualujjuaq, Nunavik

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Abstract: Permafrost is warming and thawing at varying rates in response to climate change in the circumpolar North, depending on site characteristics and geological setting. Previously stable soils show subsidence under roads and houses. In Nunavik (northern Quebec), Inuit communities are growing and are planning the expansion of their infrastructure. Changing permafrost conditions must be taken into account, but the response of permafrost to warming is difficult to predict where permafrost is warm and may have began to thaw through its entire profile. Kangiqsualujjuaq is one Inuit community of Nunavik affected by this phenomenon. A surficial geology map, permafrost conditions map, construction potential map and hazard risk assessment map were produced for the area as part of a bigger research project executed on behalf of the Ministère des Affaires municipales et de l'Habitation in Quebec. Such maps were made for 13 out of 14 Inuit villages in Nunavik, where permafrost is present. These tools provide high-resolution knowledge of ground conditions. Sixteen thermistor cables, extending to depths from 2.9 to 20.05 m, were installed in different surficial deposits and maintained by researchers from the Centre d'études nordiques around Kangiqsualujjuaq from the 1980s to the present. From the six cables that are still active, three were selected to assess the recent evolution of the thermal regime of permafrost in the extensive discontinuous permafrost zone. Recent ground temperatures recorded by these three cables, installed in bedrock, in a glaciofluvial delta (sand and gravel), and in a lithalsa (marine silts and clays), were examined. The bedrock site clearly reflects the air temperature fluctuations, whereas the sand and gravel site reveals a perched water table that delays winter freeze-back. Permafrost in the silty lithalsa has become isothermal and ground temperatures there are not responding to climate variations.

Theme: Terrestrial

ID: 595

Investigating the composition of subglacial carbon pools and the subglacial microbial alteration of organic matter beneath a High Arctic glacier

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Abstract: Glaciers contain potentially distinct freshwater sources of organic matter (OM) that can be released and exported to downstream

aquatic ecosystems upon thaw. In subglacial environments, OM is incorporated in basal ice from overridden soil and vegetation during glacial sliding. Supraglacial OM is derived from wind-deposited materials (soot and sediments) and microbial assemblages in snow, meltwater streams, and cryoconite holes, and can enter the subglacial environment through surface streams terminating in crevasses or moulins. At the bed, subglacial microbial metabolism can alter the supraglacial OM concentration and lability before it is exported in subglacial runoff. Likewise, OM released subglacially can be microbially transformed in situ, shaping the bioavailability of subglacial OM exported downstream. Investigation of subglacial carbon pools and in situ microbial organic carbon transformations is, therefore, needed to obtain a baseline understanding of the subglacial processes shaping OM composition in subglacial runoff. Basal ice samples, subglacially stored meltwater samples and a supraglacial sample were collected in May 2018 from Sverdrup Glacier, a tidewater glacier in the Canadian High Arctic. Organic carbon and major nutrient concentrations, as well as bacterial abundance were measured to provide a baseline chemical and microbiological assessment of these different endmembers. Fluorescence spectroscopy and ultra-high resolution mass spectrometry (FT–ICR–MS) were used to characterize the nature of glacial dissolved organic matter (DOM) in these different carbon pools. A parallel factor analysis model suggests that subglacial DOM is predominantly microbially derived. Finally, 120-day-long incubations of debris-rich and -poor basal ice meltwater with and without labile carbon (acetate) amendments are used to explore how subglacial microbial communities utilize labile and in situ carbon. Future work will characterize microbial community composition in the subglacial samples and community responses to the incubations using 16S rRNA gene sequencing. Understanding the biogeochemical controls on DOM composition in subglacial runoff may provide insight on its ecological function in downstream ecosystems.

Theme: Terrestrial

ID: 308

Spatial variations in seasonal thaw rates on a subarctic peat plateau

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Abstract: Much of Canada's subarctic is experiencing significant landcover transformation as a result of a warming climate. Permafrost thaw-induced landcover changes in the sporadic discontinuous permafrost zone (SDPZ) have altered the hydrologic response of basins in this region through increasing hydrological connectivity of the landscape. It has been well-documented that the observed changes in landcover and permafrost thaw rates are connected; however, it is unclear why these landscape-wide changes occur at different rates. To understand these changes, an isolated permafrost-cored peat plateau was selected and intensively studied at the Scotty Creek Research Station in Northwest Territories, Canada. This plateau is bounded by four permafrost-free terrain features, including a linear disturbance, channel fen, lake, and bog. This research aims to (1) quantify the present volume of the permafrost body, (2) investigate how the permafrost body has changed from 2010 to 2019, and (3) compare the relative influence of adjacent permafrost-free wetland and collapse-scar features on the thaw rates observed. To estimate changes in the areal extent of the permafrost body high-resolution satellite imagery and LiDAR-derived products were used. Changes in the thickness of the permafrost body were estimated through comparison of 2010 and 2019 geophysical surveys and near-surface measurements. Results from remotely sensed imagery and geophysical surveys indicate that the spatial extent of the permafrost body has receded both laterally and vertically. Collocated geophysical surveys from 2010 and 2019 suggest that previously where values of 5000 Ωm extended to depths of approximately 10 m, presently extend to depths of approximately 9 m. Preliminary estimates of volumetric change of the permafrost body from 163×103 m^3 to 139×103 m^3, representing a decrease of ~14% since the 2010 baseline. This study improves the understanding of the patterns of permafrost thaw and provides insight into the boundary conditions between permafrost and non-permafrost terrain in the SDPZ.

Theme: Terrestrial

ID: 831

Spring supply and transfer of essential fatty acids to zooplankton in Tuvaijuittuq, a multiyear ice ecosystem

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Abstract: Essential fatty acids (EFA) are critical for the survival and development of all Arctic animals, from zooplankton to bears. The Tuvaijuittuq marine protected area was established to protect one of the few remaining areas where old, multiyear sea ice (MYI) persists. Little is understood about the effects the loss of MYI will have on marine food webs in this area. We investigated the essential fatty acid content in primary producers found in surface water, MYI and first year ice (FYI), as well as in sympagic and pelagic zooplankton during the 2018 Multidisciplinary Arctic Program Last Ice field season in the Lincoln Sea, within what is now the Tuvaijuittuq MPA. Surface water had lower proportions of EFA than both FYI and MYI. We also investigated both stable and compound specific isotopes (CSIA) to help determine the food web structure. EFA levels were somewhat elevated in FYI compared with MYI, and could be indicative of more advanced algal growth. Ice-associated amphipods *Apherusa glacialis* and *Gammarus wilkitzkii* generally had lower proportions of total EFA and much lower levels of 22:6n-3 compared with pelagic zooplankton. Ctenophore fatty acid signatures had the highest proportion of 22:6n-3 but were extremely variable. CSIA showed that $\delta^{13}C$ isotopic signatures for EFA were always more depleted than non-EFA in zooplankton, and could be an indication of potential EFA limitation in early spring. Overall, our results indicate that sympagic and pelagic sources of EFA are likely distinct, and provide insight into the energetic contribution of MYI to Arctic marine food webs during the spring. Building upon these findings will be critical in determining what the effects of continued ice loss could mean for food webs in MYI ecosystems.

Theme: Marine

ID: 157

Spatial patterns of benthic functional food web structure relative to food supply in the Canadian Beaufort Sea

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Abstract: Loss of sea ice due to climate change is predicted to favour pelagic over benthic production in Arctic shelf ecosystems. Consequent changes to the quality and quantity of organic matter reaching the seafloor will likely affect spatial patterns of benthic biodiversity and food web structure. Here, we used biomass-weighted diversity measures based on taxonomic composition, trophic functional traits, and stable isotope ratios ($\delta^{15}N$ and $\delta^{13}C$) to assess spatial variability in food web diversity across the Canadian Beaufort Sea and Amundsen Gulf (down to 500 m). Initial results suggested linear indices of benthic food availability and habitat (sedimentary and bottom-water characteristics) did not predict trophic trait compositions. However, evidence from trophic trait analyses suggested communities at the shelf edge may maintain relatively high trophic trait diversity to exploit pulsed food inputs associated with dynamic shelf break hydrography, even if such food web diversity is not reflected in the stable isotopic diversity of the community. Findings are based on benthic fish and invertebrates collected during the first comprehensive offshore ecosystem assessment in the western Canadian Arctic (BREA-MFP, 2012–2014). We demonstrate the utility of combining multiple measurements of diversity to provide insight regarding functional responses to physical habitat features.

Theme: Marine

ID: 550

Using targeted metabolomics and ecological niche modelling to understand plant resilience at a permafrost anomaly on Cornwallis Island, Nunavut

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Abstract: Understanding the physiological mechanisms of cold-adapted and Northern species will help to predict how they will fare in the face of changing climates. We are using a novel approach, correlation of metabolomics data with ecological climate change predictions to investigate responses of species to changing temperatures. During a botanical field survey near Resolute in the Summer of 2019, we observed a break in the permafrost with central temperatures up to 10 °C warmer than the surrounding area and plant species that differed significantly from the surrounding plant communities. We hypothesized that this anomaly represents a small-scale model of the effects of warming on plant biodiversity in the area. Our objectives were to (1) determine community composition at the anomaly and adjacent environment; (2) perform Maxent ecological niche modelling of the species under RCP 2.6 and 8.5 projected to 2050 and 2070; (3) use targeted metabolomics studies to characterize plant growth regulator (PGR) profiles of the species; and (4) determine relationships between summary statistics from the models (e.g., skew, kurtosis, mean, median, standard deviation of individual change points), PGR profiles and species abundance at, and adjacent to the anomaly. Species that were found to have higher kurtosis values and a more negative skew, indicating a shift towards greater distribution of suitable habitat under changing climate, were also found to be present at highest abundance at the warmest points in the anomaly. Those found to be adjacent to the anomaly showed a lesser association between density at the anomaly and the models. PGR profiling identified several species with significantly modified indoleamine content, a novel class of stress-mediating PGR. Follow-up studies will examine uptake and localization of PGRs identified as important through quantum dot imaging and identification of potential biomarkers of climate change resilience through untargeted metabolomics.

Theme: Terrestrial

ID: 159

Measurable levels of short-chain chlorinated paraffins (SCCPs) in western Hudson Bay fishes, but limited biomagnification potential from fish to seals

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Abstract: Despite having similar physicochemical properties to other legacy persistent organic pollutants, short-chain chlorinated paraffins (SCCPs) have received considerably less attention in Arctic contaminant monitoring studies. In the present study, we quantified the tissue concentrations of SCCPs (C10–C13) in several Arctic marine fish (capelin, sand lance, cisco, sculpin, Greenland cod) and invertebrate (amphipods) species from western Hudson Bay, Canada. We further evaluated the biomagnification of SCCPs between small pelagic fish and piscivorous fish and between prey fish and ringed seals. Fish and amphipod species were collected in 2014, and ringed seals in 2016 and 2017, by community members near Arviat, Nunavut. All samples were analyzed for SCCPs at the National Laboratory for Environmental Testing in Burlington, Ontario. Average concentrations of ΣSCCPs in Arctic marine fish and amphipods varied from 244 to 687 ng g^{-1} lipid weight (lw). Concentrations of ΣSCCP in sculpin were similar to those of legacy polychlorinated biphenyls (ΣPCBs) and organochlorines (ΣOCs) previously measured in these same samples. Yet, for capelin, sand lance and cisco, ΣSCCP concentrations doubled those of ΣPCB and ΣOC, and for Greenland cod ΣSCCP were about three times higher. The range of biomagnification factors (BMFs) for SCCPs from zooplankton to fish was 0.09–1.84, from small pelagic fish to piscivorous fish was 0–2.59, and from small pelagic fish to seal was 0.07–0.11. For the pelagic food web, including capelin, Greenland cod, sand lance, and ringed seal, the trophic magnification factor (TMF) was slightly

above 1. Thus, despite relatively high tissue concentrations of SCCPs in most fish species, low fish-to-marine-mammal BMFs and a relatively low pelagic food web TMF suggest limited biomagnification of SCCPs in this Arctic food web.

Theme: Inuit Health Education and Adaptation

ID: 743

Monitoring the soil microbiotic communities of five distinct tundra habitats of the greater wapusk ecosystem in the hudson bay lowlands, Manitoba, Canada

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Abstract: The permafrost active layer thickness (ALT) is expected to increase as the climate warms and permafrost decays. Although some predictive models relating ALT to surface level indicators, such as plant cover or soil moisture, do exist, the relationship between the soil microbial communities and ALT is not well understood. The first step in evaluating the relationship requires the characterization and quantification of changes in both the microbiome and ALT at the same locations, over time. This work is particularly relevant in areas experiencing an increase in fires, and thus vegetative regeneration, such as Wapusk National Park in Manitoba, Canada. In this study, a selection of subarctic sites representing the five most common habitat types on the Hudson Bay coast were studied from 2014 to 2019. At each site, two parallel 50 m transects 10 metres apart were run and flags were placed at 2 m intervals. At each flag, ALT was measured twice using a steel probe, and categorical ground cover percentage estimates within 1 x 1 m quadrat were recorded for all vegetation types. Also, at two randomly selected flags on each transect, species-level percentages and soil microbial communities were measured. Soil microbial 16S rRNA genes were analyzed with qPCR and Next Generation Sequencing (NGS). qPCR results were subject to trend analysis as well as multi-factor ANOVA. NGS sequences for both bacteria and fungi were evaluated for alpha and beta biodiversity. Results indicate that tundra habitats are distinct in their composition of the five dominant groups of bacteria: Verrucomicrobia, Bacteroidetes, Actinobacteria, Acidobacteria, and Alphaproteobacteria. Additionally, the composition of each tundra habitat's microbiota is changing over time. This work complements the rapidly evolving pool of knowledge about soil microbial communities around the world. Future work will include the evaluation of families of genes known to influence carbon and methane metabolism.

Theme: Terrestrial

ID: 500

Mapping research on Inuit traditional ecological knowledge of polar bear (*Ursus maritimus*) in the Canadian Arctic

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Abstract: In this study we systematically review the literature containing Traditional Ecological Knowledge (TEK) about polar bear (*Ursus maritimus*) in the Canadian Arctic to identify how TEK (which is one aspect of Inuit traditional knowledge or Inuit Qaujimajatuqangit) has contributed to the published literature and shaped our understanding of Canadian polar bear subpopulations. We searched both the academic and grey literature using two online databases and categorized our findings by geographic and disciplinary focus, as well as by TEK subtype defined by Usher (2000). Of the total 53 documents retained for the final analysis, more than half of the documents focused exclusively on Nunavut; documents that included informal references to TEK were most prevalent. Usher's categories were disproportionately represented, suggesting that published polar bear research has not consistently engaged with Inuit cultural values about the environment and the knowledge system

itself. The findings of this study suggest that there has been limited research that has directly and systematically synthesized polar bear TEK in the Canadian Arctic and there are few studies from which insights for future polar bear subpopulation health can be obtained. As climate change continues, Inuit TEK about polar bears will evolve, meaning TEK documentation should be systematic and ongoing to be relevant for future decision-making. Ongoing efforts to explore how communities are documenting and transmitting TEK under these changing conditions are also needed.

Theme: Knowledge Exchange and Co-production

ID: 367

Retrogressive thaw slump growth in the Peel Plateau, Northwest Territories observed using Planet CubeSat images

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Abstract: In a rapidly changing climate, retrogressive thaw slumps have evolved as increasingly large and dynamic thaw-driven mass wasting features particularly common in ice-rich, glaciated permafrost terrain. Slumps have been expanding in number and size in many Arctic regions due to increases in temperature and rainfall, including the Willow River study area. We assembled a three year (2017–2019) time series of 3 m resolution Planet CubeSat images to document the growth of 31 slumps larger than 0.5 ha within the Willow River watershed of the Peel Plateau, Northwest Territories. Active slump areas were derived for 18 summer dates using adaptive near-infrared thresholding and validated using unmanned aerial vehicle surveys conducted on two dates. Over three summers, slump area increased on average by 59% and mean headwall retreat was 8.7 m/year. An analysis of historical aerial photographs within the 50 km^2 study region found that the number of larger (>1 ha) active slumps declined from 1950 ($n = 5$) to 1974 ($n = 4$) and 1985 ($n = 2$), but then dramatically increased by 2017 ($n = 24$). In contrast with higher-Arctic permafrost where slump expansion is being driven by warmer summers, long-term slump activity in the study region appears to be controlled primarily by precipitation, which favours slump initiation and the evacuation of thawed sediments from the slump floor. Anomalously mild winters during the 2017–2019 Planet image time series may also pre-condition permafrost for more rapid warming and thaw. Terrain characteristics within headwall retreat zones derived from a 2 m Arctic digital elevation model support previous studies showing that slump growth in this region is more likely to occur at mid-elevations and slopes, and on east or southeast facing aspects. Variability in three year areal growth among the 31 slumps was found to be positively related ($R^2 = 0.5$) to the antecedent (2013–2017) depth of slump terrain removal, an indicator of a slump's capacity to remove sediment to sustain growth.

Theme: Terrestrial

ID: 195

An analysis of active layer variability and change in the Mackenzie Valley, Northwest Territories between 1991 and 2014: an ecoregional assessment

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Abstract: Active layer thicknesses (ALTs) from sites along a transect through the Mackenzie Valley, Northwest Territories, Canada were analyzed to explore variation in thickness within and between ecoregions. At an ecoregional scale the relation between ALT, latitude, freezing and thawing degree-days, and snowfall were examined to determine the presence of trends among ecoregions. Site specific variables including dominant vegetation type, n-factors and substrate were explored to explain spatial variability in ALT within ecoregions. Generally, ALT increases moving southward through the encompassing ecoregions with the northernmost ecoregion having the thinnest mean ALT (68 cm) and the southernmost having the thickest (126 cm). This follows climatic trends in air temperature that warms moving south. ALT within ecoregions also showed high variability within all the sampled ecoregions due to site specific variables

(vegetation, snow cover, and substrate). Most notably, sites with shrubs such as willow had thicker than average active layers due to the warmer overall ground conditions and the ability to retain snow cover in winter. Substrate and ground ice content was also an important factor in determining the range and year to year variability in ALT and subsidence at sites. For the northern sites the driving influence for ALT is climate and is therefore sensitive to climate shifts. For the more southern sites ALT is largely a product of the ecosystem; therefore, disturbance rather than changing air temperature will likely have a larger impact on ALT due to surface modification.

Theme: Long-Term Monitoring and Data Management

ID: 149

Permafrost data: a new web platform for the sharing of permafrost research in Nunavik in support of the development of northern villages

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Abstract: Despite the abundance of permafrost research produced in the 14 communities of Nunavik, there are no resources available to centralize and disseminate the results of these studies and make them easily accessible to users. Access to this rich diversity of data is limited and it has not been used to its full potential. Facing numerous land-use planning constraints imposed by permafrost and the technical and cultural challenges of integrating permafrost expertise into community development, knowledge sharing obstacles must be overcome. The isolation of Inuit communities, the improvement of the Internet network and the increase in popularity of the Web over the last decade in Nunavik justify the need for a Web platform that improves accessibility to permafrost research results. To this end, significant efforts into developing means of knowledge transfer and its appropriation by the communities, as well as for its use by public decision-makers, consultants, and contractors are now undertaken. The methodological approach to build a web-based platform is first developed and tested with the community of Salluit where permafrost challenges are particularly acute. It will be extended to the other communities of Nunavik. Using ArcGIS Online, the Web apps are designed to allow the visualization of maps (e.g., surficial geology, permafrost conditions, and construction potential), climate and ground temperature data, geotechnical data, introduction to basic permafrost concepts, documents available for download, and links to other relevant resources for land use planning on permafrost. Above all, the approach includes bidirectional interfaces that make room for improvements proposed by the communities. Research results are shared in an easily accessible and open access manner, using tools that are simple to use for everyone involved in construction and land use planning as well as by an inquisitive public.

Theme: Long-Term Monitoring and Data Management

ID: 760

Population-specific thermal tolerance and cardiorespiratory performance of wild Arctic char in a rapidly warming Arctic

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Abstract: The Canadian Arctic is warming at nearly three times the average global rate. High water temperatures are known to constrain the exercise physiology and migration of temperate salmonids in a population-specific manner. However, we know alarmingly little about Arctic char migratory and thermal physiology, especially at the population level. Thus, predicting the impacts of environmental challenges associated with climate change is difficult. Consequently, we investigated the cardiac thermal tolerance and aerobic capacity of adult Arctic char (~3.5 kg) from four populations in the Kitikmeot Region of Nunavut. Two of these populations undertake short migrations (30 km), more challenging migrations, and likely encounter greater thermal variation. In general, during acute warming heart rate typically reached a peak at 17–21 °C, before declining and

becoming arrhythmic at 21–24 °C. The temperatures at which these heart rate limitations occurred as well as maximum oxygen uptake and aerobic capacity at 10 °C were all lowest in Arctic char from a population with mild migratory conditions and were greatest in char with the longest, most difficult migration. Furthermore, relative heart mass tended to be greater in Arctic char from populations with more strenuous migrations. This pattern of differences suggests that Kitikmeot Arctic char may be physiologically adapted to their local migratory environments. Such physiological differences together with local environmental differences will likely make some populations more vulnerable to climate change than others, necessitating population-specific management actions.

Theme: Terrestrial

ID: 406

Evaluating the role of a "trigger tributary" on temporal variation of ice-jam induced flooding at the Peace–Athabasca Delta

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Abstract: Concern for water security has grown during the past half century at the Peace–Athabasca Delta (PAD; northern Alberta). Widespread perception is that flood frequency and water-levels have declined since the W.A.C. Bennett Dam was installed at the headwaters of the Peace River, but records remain too short and sparse to characterize the role of climate variation. The unregulated Wabasca River is a key "trigger tributary" for the generation of ice-jams on the Peace River that flood the PAD. Rapid melt of thick snowpack in the Wabasca catchment produces high spring discharge that promotes ice-jam flooding of the PAD. Therefore, reconstructing past variation in high spring discharge events for the Wabasca River and comparing them with multiple paleohydrological records at the PAD is critical to understanding the role of upstream climate on observed lake drawdown in the PAD. Using paleolimnological techniques on sediment cores collected in September 2019 from several oxbow and upland lakes, we will generate information on the timing and magnitude of hydrological changes within the Wabasca watershed. We anticipate that the records from flood-prone oxbows will identify patterns and trends in spring discharge, whereas upland lakes will track change in lake water balance in response to local climate. Early results from one oxbow lake record reveal marked variations in inorganic and organic matter content and grain size composition, reflecting intervals of more and less frequent flooding throughout time. The upper portion of the sediment record in both oxbow lakes reveals a distinct trend towards less frequent flooding, indicative of less frequent high spring discharge events. The information generated on temporal patterns of variation in high spring discharge events from the Wabasca River watershed can be used to guide a federal action plan and improve stewardship decisions at the PAD.

Theme: Terrestrial

ID: 29

Dynamic of the coastal forest tundra in the Nain region (Labrador): Spatiotemporal analysis of *Larix laricina* and *Picea* sp.

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Abstract: Significant environmental and social changes have taken place in northern Labrador since the settlement of the Thule people (the ancestors of the Inuit) during the Medieval Warm Period (≈AD 1000). In fact, the combination of climatic changes over the last millennium and the anthropogenic activities (e.g., wood cutting) likely affected the distribution and abundance of tree species. The eastern larch (*Larix laricina*) and the spruce (*Picea glauca* and *P. mariana*) characterize the forest tundra of Nain (Labrador) and were impacted at the level of the stand itself as well as the level of the regional landscape. Recent studies have shown that changes in territoriality and the adoption of European housing practices by the Thule–Inuit

post-contact society (i.e., after contact with Moravian missionaries in 18th century) increased the harvesting of wood from the forest tundra of Nain (north-central Labrador) for use in heating and construction. Locally, this led to the opening of the landscape, and to the replacement of spruce by eastern larch. My research project is focused on the dynamics of the spatiotemporal distribution of larch and spruce in the Nain region and its archipelago. Intrasite spatial analysis (wood harvesting at the site), as well as regional spatial analysis of the distribution and abundance of larch and spruce, are carried out according to a landscape ecology approach. The methodology also includes multispectral remote sensing, dendrochronological, and paleoecological analyses. The objectives of the study are to: (1) document the spatiotemporal distribution of eastern larch and spruce in the Nain region, (2) identify and date the main events affecting the evolution of forest tundra, and (3) assess which types of distribution patterns resulted from the different types of disturbance (anthropogenic and natural).

Theme: Inuit Health Education and Adaptation

ID: 826

Climate-change induced landscape alterations cause severe lake oligotrophication in Northern Scandinavia

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Abstract: Long-term monitoring has shown that many lakes in the Arctic/alpine ecoregion of Sweden have experienced dramatic declines (3%–4% per year on average) in total-phosphorus (TP) concentrations since the late 1980s, forcing many of these lakes into ultraoligotrophic conditions. We hypothesized that the increased greening of catchments, due to increased vegetation growth in the region (i.e., greening), can explain a large share of the observed declines in surface water TP concentrations. We used two approaches to do so: (1) quantify the greening of these landscapes and the onset/duration of the growth season using remote sensing data (Normalized Difference Vegetation Index), and (2) analyze shrub vegetation data from ongoing monitoring programs. Results show that there are strong correlations between the loss of surface water phosphorus and the greening of catchments and shrub vegetation development, respectively. These findings show that the climate-induced vegetation development leads to a sequestering of phosphorus in terrestrial habitats and the oligotrophication of lakes. The ongoing severe oligotrophication of these lakes will negatively affect the production of algae, invertebrate consumers, and ultimately fish. Our findings also stress the need for monitoring to detect these changes and suggest that surface water oligotrophication may be ongoing in large parts of a greening Arctic.

Theme: Terrestrial

ID: 430

Vegetation response to climate change and subsequent impacts on net ecosystem exchange, Axel Heiberg Island, Nunavut

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Abstract: Arctic flora is highly sensitive to local environmental factors and is especially vulnerable to change as the Arctic warms at twice the global rate. These changes have already been observed in the Arctic, but it is still uncertain how vegetation will respond to warming and increased water availability in terms of biogeochemical cycling, biomass production, and net ecosystem exchange (NEE). This study seeks to understand the relationship between terrestrial ecosystems in the Canadian High Arctic and atmospheric CO_2 budget, and how these will evolve in a warming climate. A mixed-method approach will be used to determine the distribution and abundance of various tundra vascular plant communities on Axel Heiberg Island, ascertain their specific contribution to atmospheric CO_2, and their future growth, emission, and uptake rate. The proposed work includes developing a Normalized Difference Vegetation Index trend map to determine the distribution of ecological niches, and Leaf Area Index, crucial for developing an NEE model. Historical climate data collected by a network of weather stations at Expedition Fiord, Axel Heiberg Island, will be used for the NEE model to understand future contributions to atmospheric CO_2. It is

hypothesized that under a warmer and wetter climate (and shift from polar semidesert to wetland conditions), ecosystem transpiration will increase and incite higher carbon emissions to the atmosphere. Conversely, warmer and drier areas such as hillslopes will experience net carbon uptake from the atmosphere. Overall, it is hypothesized that the Expedition Fiord area exhibits a heterogenous landscape of carbon sources and sinks. The results of this work will help elucidate the relationship between NEE, land cover, surface balance energy, and permafrost degradation in the terrestrial high Arctic, which will better inform how carbon fluxes contribute to the feedback mechanism of climate warming in the Arctic.

Theme: Terrestrial

ID: 494

The Beaufort Sea Beluga Habitat Program 2020 — a success story in a pandemic!

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Abstract: The Beluga Habitat Program in the Mackenzie Estuary uses coastal observatories (seabed moorings with acoustic recorders and weather stations) to investigate the influence of environmental parameters on beluga habitat use, assess underwater noise/vessel impacts, and monitor indicators of change (e.g., ocean waves, salinity, temperature, and turbidity). Each summer, scientists from Fisheries and Oceans Canada in Winnipeg, MB, and Natural Resources Canada in Dartmouth, NS, join locally trained technicians from the Aurora Research Institute (ARI) and community members from Aklavik, Inuvik, and Tuktoyaktuk, NT, to deploy and recover scientific instruments. This on-going project is a key part of the of the Tarium Niryutait Marine Protected Area monitoring program. The COVID-19 pandemic put the 2020 program at risk due to travel restrictions and social-distancing measures; however, co-management partners supported the continuation of the project if it could be adapted to follow public health guidelines. In response, several video-conference meetings were held between all partners to create a plan for community-led implementation. The moorings were redesigned for easy deployment by people of varying experience levels. Mooring components were shipped to ARI in Inuvik, where technical staff assembled them and programmed instruments with instruction via Zoom and printouts. The field component was supported by Joint Secretariat staff and the Munaqsiyit Program, in partnership with the Aklavik and Inuvik Hunters and Trappers Committees. A local outfitter was hired to provide research support services and coordinated closely with the project leads. Following several group video-conferences, field teams were able to successfully deploy and recover the instruments in two separate locations, retrieving critical data needed to support long-term monitoring. The successful delivery of the 2020 field program is owed to the cumulative involvement of Northerners in this project through the years and the adaptability of project partners.

Theme: Knowledge Exchange and Co-production

ID: 151

Early career scientist input to peer-review: case studies from an APECS-led group review of the IPCC reports

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Abstract: The production of new scientific knowledge and its dissemination to society and stakeholders, is systematically associated with the publication of articles or reports, which are reviewed and endorsed by scientific experts before publication. The role of early career scientists (ECS) in the peer-review process remains minor despite the strong academic credentials possessed by ECS. Such engagement in the peer-review process represents a valuable opportunity for ECS and the scientific community as a whole. During May and November 2018, the Association of Polar Early Career Scientists (APECS) led a group of 174 ECS to review the first and second-order drafts of the Intergovernmental Panel on Climate Change (IPCC) "Special Report on Ocean and Cryosphere and in a Changing Climate (SROCC)", ultimately published in 2019. This opportunity provided a robust platform for ECS to understand the overall review process and editorial activities related to authoritative publications such as those produced by the IPCC. After a short presentation of APECS, we present the methodology, results, and lessons learned from these group reviews. Altogether, data from participant surveys on their experience and analysis of their comments demonstrate that ECS are competent reviewers, comparable with more experienced researchers.

Theme: Knowledge Exchange and Co-production

ID: 450

New observations of macrobenthos communities in outer Frobisher Bay, Nunavut

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Abstract: We present new observations of macrobenthos community structure in outer Frobisher Bay based on: (1) the analysis of seabed video imagery acquired in 2016 and 2018; and (2) the analysis of Agassiz trawl samples acquired in 2016 and 2018. Seabed imagery consists of 267 images acquired in 2016 at 10 stations over a depth range of 98–191 m, and 358 images acquired in 2018 at eight stations over a depth range of 112–498 m. Seven Agassiz trawl samples were acquired over a depth range of 150–493 m. Benthic macrofauna observed in seabed images were identified to the level of classes of organisms (e.g., *Echinoidea* (sea urchins)). Macrobenthos recovered in trawl samples were identified to the lowest possible taxonomic level. Cluster analysis based on presence/absence data derived from seabed imagery was employed to classify benthic communities. Wet weight biomass was determined for all organisms recovered in trawl samples. Pie charts displaying the relative proportions of biomass contributed by various classes of organisms to total biomass at each sampling station are presented to facilitate inter-site comparisons. Three species associations were identified in the 2016 seabed imagery data acquired in the vicinity of the middle islands: (1) sea anemones, sea urchins, barnacles; (2) brittlestars, starfish, soft corals, sponges; and (3) *Mya truncata*, the crinoid *Heliometra* sp., ascidians, erect bryozoans. Four species associations were identified in the 2018 seabed imagery data acquired along the southern coastline of the outer bay: (1) cerianthid anemones, infaunal bivalves; (2) sea anemones, sea urchins; (3) brittlestars, starfish, sponges, ascidians, tubiculous polychaetes; and (4) soft corals, the crinoid *Heliometra* sp., erect bryozoans. Crinoids, sea

urchins, soft corals and sponges dominate the community biomass in Agassiz trawl samples. Benthic macrofauna communities will be mapped to the surficial geological units identified in the bay to define seabed habitats.

Theme: Marine

ID: 297

The role of hummocks in re-establishing black spruce forest following permafrost thaw

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Abstract: Northwestern Canada's discontinuous permafrost landscape is transitioning rapidly due to permafrost thaw, with the conversion of elevated, forested peat plateaus to low-lying, treeless wetlands. Increasing hydrological connectivity leads to partial drainage of previously-isolated bogs, which have been observed to subsequently develop hummock microtopography. However, the role of microtopographic features in the future trajectory of the transitioning landscape is unclear, including their potential controls on tree re-establishment. To understand the role of hummocks in landscape change, research was conducted at the Scotty Creek Research Station, Northwest Territories, to measure hummock and black spruce tree physical characteristics, and to assess tree and hummock spatial coverage in peat plateaus, collapse scar bogs, and the advanced transitional feature known as treed bogs. Canopy coverage in all land forms and wetland hummock areal coverage was assessed using a LiDAR (Light Detection and Ranging) canopy gap fraction model and multispectral imagery. Hummocks, which are not underlain by permafrost but contain seasonal ice, support the establishment of black spruce trees due to favourable soil moisture conditions. Hummock flank moisture in treed bogs is intermediate between those of dry peat plateaus and inundated collapse scar bogs. Black spruce trees on peat plateaus and in treed bogs are significantly taller and of greater circumference than those in collapse scar bogs. The spatial distribution of hummocks and canopy coverage of black spruce trees in treed bogs collectively suggest that these features may play an important role in the advanced stages of permafrost thaw-driven transition of the discontinuous permafrost landscape.

Theme: Terrestrial

ID: 381

In silico species distribution modelling of *Vaccinium* species and their response to climate change

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Abstract: The Inuit Nunangat is experiencing climate change at about twice the rate of other parts of the world. The genus *Vaccinium* includes berries that are a traditional food source for Inuit and Indigenous communities. Our objective was to predict the impact of climate change on habitat suitability of three *Vaccinium* species: two species with primarily northern distributions (*V. uliginosum*, *V. vitis-idaea*) and one species with a primarily southern distribution (*V. oxycoccos*). We used Maxent ecological niche modelling under RCP 2.6 and 8.5 projected to 2050 and 2070, for species occurrences reported from the Global Biodiversity Information Facility (GBIF) database as well as in-house collections, along with WorldClim bioclimatic variables, soil properties, vegetation coverage, and topography. Modelling of southern species showed a significant contraction in suitable habitat, whereas northern species were more stable in the overall amount of suitable habitat by 2070. The impacts on habitat near the US border and the interior plains including Alberta, Saskatchewan, and Manitoba seemed most devastating. In contrast, the amount of suitable habitat in the arctic tundra (i.e., Inuit Nunangat) showed an overall increase. These results suggest that wild northern berry harvest will remain secure over the next couple of decades, whereas the southern species raised concern. Although all three species depended highly on maximum temperature of growing season and elevation, the species experiencing the greatest decrease in suitable habitat were most dependent on precipitation. Based on these data, we hypothesized that the difference in climate change resilience found between species may be due to differences in plant growth regulator profiles. The predictive analysis will

inform future studies to identify and quantify the metabolites that perceive and respond to environmental cues in *Vaccinium* species, thereby improving our understanding of climate change resilience in the genus.

Theme: Terrestrial

ID: 153

Building strong Arctic policy by incorporating international economic trade into Intergovernmental Panel on Climate Change (IPCC) reports

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Abstract: Climate change presents significant risks to the international trade and supply-chain systems with potential effects for both regional and global economies. For example, settlement and cracking due to permafrost thaw at the Iqaluit Airport has required significant resurfacing and reparation, causing disruptions to air transport that is vital for mineral exploration and the regional economy. Conversely, reductions in sea ice is making Arctic maritime trade routes a new possibility, providing more efficient east–west transport options, and reducing costs per ship. Intergovernmental Panel on Climate Change (IPCC) reports are considered the leading source of relevant climate change information and underpin how international climate policies and agreements are negotiated. Here, we assess how trade is treated in recent IPCC assessment and special reports using a quantitative text analysis. Results indicate that international trade has not been given considerable attention in recent IPCC assessments, as keywords associated with trade appear in limited ways. The words "product" and "transport" appear most frequently, but are often referring to emissions associated with transportation or global food systems. Other economic sectors are largely absent, as well as risks from climate related trade disruption. In the Special Report on the Ocean and Cryosphere in a Changing Climate, the highest co-occurrence of trade-related keywords focused on impacts of increased shipping activities in the Arctic, but trade as a general theme did not emerge beyond this example. Given the importance of trade to economic growth, we recommend that additional attention be paid to the interactions of climate impacts and risks on trade, and related economic issues, in future IPCC assessment and special reports. To achieve this, there must be efforts to increase the base of scientific literature focused on climate change and international trade as well as increased effort made among IPCC lead authors to review literature on economic trade that may lie outside conventional climate change scholarship.

Theme: Northern Policy and Development

ID: 425

Community-based research on migratory fish in the lower Mackenzie River watershed

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Abstract: Migratory species can present challenges for studying shifts in the distribution, abundance, and accessibility of fish and wildlife, especially in remote regions. One such species, łuk dagaii (broad whitefish; *Coregonus nasus*) is central to subsistence fisheries throughout the rapidly-warming Mackenzie River Delta, and access to these fishing practices is important for food security for Gwich'in communities. As such, Gwich'in fishers have raised concerns about how climate change and proposed development may affect this important species. To address these questions, we established a monitoring program on łuk dagaii in the lower Mackenzie River, as a partnership between Gwich'in harvesters, Renewable Resource Councils, the Gwich'in Renewable Resource Board, and external researchers. Initiated in 2017, this ongoing program is designed to detect changes in fish migration timing, abundance, and population demographics, and has contributed additional insights on habitat use for this species. Here, we describe the community-based structure of the monitoring program and highlight findings from the first years of the project. We have identified varied and sometimes extensive migrations within łuk dagaii captured in the

subsistence fishery, indicating that watershed impacts in multiple geographic regions may impact the population. We also present spatial patterns in size-at-age, catch rate, and migration timing across four sampling locations throughout the lower Mackenzie River watershed. The spatial and temporal extent of this sampling would not be possible without the community-based nature of this program. Additionally, we believe that this project highlights several of the benefits of community-based monitoring programs, such as incorporating the insights from Gwich'in knowledge holders in study design and reducing the need for travel by personnel outside of the region.

Theme: Knowledge Exchange and Co-production

ID: 455

SIOS data management system for long-term observations on Svalbard

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Abstract: Svalbard Integrated Arctic Earth Observing System (SIOS) is an international consortium to develop and maintain a regional observing system in Svalbard and the surrounding waters. Within SIOS, researchers can cooperate to access instruments, acquire data, and address questions that would not be practical or cost-effective for a single institution or nation alone. The purpose of SIOS is to improve the Earth Observing System for Svalbard, to integrate the data from the distributed research infrastructure, and to maintain systematic and sustainable measurements over a long period. SIOS focuses on processes within and interactions between the different spheres in earth system science. The observing system is built around "SIOS core data" — long-term data series collected by SIOS partners. The partners commit to continuing their long-term monitoring and making their data available to others, thus reducing the need for duplication of data collection. The core data can then be used as the basis for innovative research initiatives. SIOS Data Management System (SDMS) is dedicated to harvesting information on historical and current datasets from collaborating thematic and institutional data centres and making them available to users. A central data catalogue is linked to the data repositories maintained by SIOS partners, that manage and distribute data sets and their associated metadata. The integrity of the information and harmonisation of data is based on internationally accepted protocols assuring interoperability of data, standardised documentation of data through the use of metadata, and standardised interfaces by data systems through the discovery of metadata. By these means, SDMS is working towards FAIR data compliance (making data findable, accessible, interoperable and reusable), among other initiatives through the H2020 funded ENVRI-FAIR project (http://envri.eu/envri-fair/). The status of the SDMS and its relation to Arctic, European, and global data management frameworks are presented.

Theme: Long-Term Monitoring and Data Management

ID: 216

Permafrost measurements best practice: GCW's contribution to standardization of global observations

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Abstract: The Global Cryosphere Watch (GCW), in the context of the framework of the World Meteorological Organization, published the Measurement of Cryospheric Variables, Volume II of the Guide to Instruments and Methods of Observation in 2018, in which best practice for observations of snow parameters was included. As a follow-up effort, measurements best practices for the other cryosphere components are under development, including permafrost and seasonally frozen ground. The measurements best practice for permafrost aims to define reference methods for the configuration and ongoing

operation of stations for in situ observations in high mountains and polar regions. It will address gaps in the existing permafrost monitoring systems, define methods for improving traceability and comparability, recommend instrumental characteristics, and provide measurements uncertainty evaluation. A further objective is to support capacity building of countries in terms of developing a permafrost observation network. A Task Team within the framework of GCW was established, to lead the development and publication of a complete guide to the measurements of permafrost variables. The documents in preparation will be coordinated with the ongoing revision of Products and Requirements of the Global Climate Observing System Permafrost Essential Climate Variable, including existing variables measured by the Global Terrestrial Network for Permafrost. Furthermore, the needs of developing Essential Arctic Variables and Shared Arctic Variables identified at the Arctic Observing Summit are considered. The work will be based on existing methodologies, promoting and recommending methods to improve data reliability and traceability, and also for the implementation of new stations.

Theme: Terrestrial

ID: 232

Determination of wind from radar wind profilers in the presence of bird clutter using machine learning

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Abstract: Radar wind profilers (RWP) play an important role in measuring tropospheric winds. At all latitudes, bird migration seasons can severely compromise wind profile measurements. This masking of the wind signal in the returns is called clutter. Current wind processing techniques are capable of predicting accurate wind velocities, but they tend to perform poorly in the presence of severe bird clutter. This situation often leads to erroneous or missing wind data. We have studied if machine learning techniques can be used to retrieve wind signals from bird-contaminated measurements. Large numbers of different bird species migrate to Nunavut. Measurements obtained from different sites in the arctic reveal complex bird migration patterns occurring in many directions. When these migrations occur in the vicinity of a wind profiler, bird clutter severely contaminates the wind data. The project was carried out in two phases, using measurements obtained by the RWP operated by the Federal Office of Meteorology and Climatology, Payerne, Switzerland. In the first phase of our study, a Convolutional Neural Network (CNN) was implemented to distinguish bird-contaminated data from uncontaminated data. The CNN model performed with an accuracy of 87%. The classified data was then used for phase two of the project where another CNN model was implemented for a regression task. The regression task was divided into several experiments in which the performance of the CNN model was assessed by training the model using different kinds of RWP samples. The results obtained showed that the CNN model was capable of determining radial wind values with a mean absolute error of 0.6 m/s from samples contaminated with bird clutter. These results suggest that machine learning techniques could be used to overcome the barriers faced by the current signal processing techniques in the presence of bird contamination in RWP measurements.

Theme: Terrestrial

ID: 797

A critical discourse analysis of the policies regarding wild food in the Northwest Territories

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Abstract: The food system for northern Indigenous communities has two main components: the traditional food system and the market food system. Policies over the past two decades have been designed and implemented to strengthen the market food system, primarily in the form of subsidies such as Nutrition North Canada. In comparison, the traditional food system, which has already been weakened by the

exacerbating effects of climate change, has received not nearly as many resources. In the post-devolution era of the Northwest Territories (NWT), new institutions such as Indigenous self-governments are creating their own climate change adaptation strategies to increase access to traditional foods. This project aims to identify all of the policies that have jurisdiction over wild food in the NWT to understand how a food processing facility can be leveraged within the current policy framework to increase food access. Legislated acts and regulations were identified using a title screening process through the territories' legislative website. Additional policies and governmental documents were identified through following any external cross-references within the policy documents. A pragmatic approach was used with Fairclough's critical discourse analysis to answer the following question: how do the identified discourses represent the social actors implicated in wild food policies, and how does this compare with the discourses of the institutions involved in operating these policies? Preliminary findings have revealed there are more institutions operating policies with jurisdiction over wild food than what was first expected. In addition, the power of Indigenous self-governments to influence wild food policy is held not within their self-government agreement, but rather their land claim agreement. Understanding the discourses surrounding wild food policies will highlight the power differences between Indigenous and non-Indigenous institutions, reveal policy restrictions on traditional food, and ratify the sovereignty of Indigenous self-governments.

Theme: Northern Policy and Development

ID: 827

Mapping historical changes to alpine extent and treeline ecotones across the greater Mackenzie Mountains, Northwest Territories

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Abstract: The Mackenzie Mountains ecoregion is currently experiencing increased climate warming that is expected to have substantial impacts on its ecosystems. Although warming trends are complex and spatially heterogenous, changes are projected to be greatest in high-latitude and high-altitude environments. Ecosystem responses to warming include increased shrub growth/expansion and the movement of trees higher into the alpine. The expansion of shrubs and trees will have impacts on environmental and ecosystem processes such as nutrient cycling, hydrologic processes (e.g., snow trapping), climate feedbacks related to changing vegetation functional groups (e.g., albedo, photosynthetic, and respiratory processes), and changes to suitable habitat for important species, such as northern mountain caribou that rely on high-elevation alpine plateaus for calving. To characterize changes to alpine extent and treeline ecotones across the Mackenzie Mountains, we compared 1940s historical aerial photographs acquired over select sites with high-resolution unmanned ariel vehicle (UAV) and satellite imagery collected in 2019. Air photos and UAV imagery were processed using structure from motion to derive image mosaics and canopy structural variables, such as tree heights and density. Image product comparisons were validated with in situ photographs (oblique and downward photographs) acquired in the fall of 2019. Preliminary results demonstrate altitudinal increases to the treeline (i.e., trees are growing further into the alpine) with overall increases to tree density within alpine treeline ecotones. Characterizing changes to additional functional groups, such as shrubs and lichens, are currently being explored. Documenting changes to the composition and extent of calving plateaus is critical to our conservation efforts.

Theme: Long-Term Monitoring and Data Management

ID: 161

Numerical investigation of storm surges in the Beaufort Sea considering the ERA5 reanalysis, sea ice, and driftwood lines

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Abstract: Storm surge is a significant contributor to flood and erosion risk to coastal

communities on the Beaufort Sea. Projected climate change effects include accelerated coastal erosion, relative sea level rise, declining sea ice cover, shorter ice season duration, and will exacerbate the vulnerability of coastal communities to storm surge hazards. The lack of continuous, long-term tide gauge records and high-quality atmospheric datasets have been barriers to reliable storm surge modelling and analysis in the region. The role of regional sea ice in attenuating, and (or) amplifying storm surge hazards has also been largely unstudied. Fifty historical storm surge events were identified from an analysis of tide gauge records at Tuktoyaktuk, NWT, Canada, and simulated using a numerical hydrodynamic model of the Beaufort Sea and Amundsen Gulf. The quality of the ERA5 reanalysis for use in driving storm surge models for the Beaufort Sea was assessed by comparison with weather station observations. ERA5 surface pressures and wind speeds were generally in close agreement with measurements, except for peak wind speeds, which were systematically under-predicted. Compensation for this bias, by calibrating the model air-sea drag coefficient, resulted in accurate simulations of peak storm surges. The surface drag parameterization in the model was then modified to account for the effects of ice on air-sea momentum transfer. Future open-water scenarios yielded up to three times the storm surge magnitude compared with present-day ice conditions. Several historically significant storm surge events were not captured on tide gauge records. A model hindcast of the 23 Aug. 1986 event revealed good agreement with the peak storm surge inferred from driftwood line surveys, demonstrating the value of non-conventional water level observations for storm surge analysis. Inclusion of driftwood line surveys in an extreme value analysis of storm surges dramatically altered the probability distribution, with implications for flood risk assessments.

Theme: Terrestrial

ID: 518

Landscape change in a warming north — observations of thawing permafrost in the Far North Ontario portion of the Hudson Bay Lowlands from remote sensing

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Abstract: Permafrost is warming in the Canadian Arctic and subarctic as a result of higher air temperatures, leading to various changes across the landscape including and perhaps as a result of permafrost thaw. In the Hudson Bay Lowlands (HBL), the world's second largest peatland and host to North America's lowest latitude continuous permafrost, permafrost thaw has been observed in the field and via remote sensing. The scale of these observations, however, is modest in comparison with the vastness of the HBL, and it is unsuitable should the need for terrain vulnerability assessments be required for large areas. This research investigates whether indices of greening, browning, and wetness (calculated in Google Earth Engine) can help identify areas of rapid permafrost degradation in the Hudson Bay Lowlands of Far North Ontario. We used 30 m resolution Landsat timeseries data from Google Earth Engine to examine greening and browning trends using the Normalized Differential Vegetation Index, to estimate changes in surface wetness using Normalized Differential Water Index, and run landscape classification around the communities of Fort Severn and Peawanuck. In areas where considerable change was detected, we used finer scale imagery (Planet Labs) to visually assess the potential distribution of permafrost thaw features. This knowledge can help to develop terrain vulnerability assessments in areas where there is little data on permafrost conditions and can also inform on the potential subsequent changes in environmental conditions as a result of permafrost thaw that effect the biogeochemical cycling of constituents such as carbon and mercury.

Theme: Terrestrial

ID: 638

Late Holocene changes to sea-surface conditions in the North Water Polynya inferred from organic-walled dinoflagellate cyst assemblages

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Abstract: Recent climate warming has resulted in a rapid decline of Arctic sea-ice thickness and extent. Polynyas — areas of open water in regions with high sea-ice concentrations — are unique ecosystems that are particularly sensitive to changes to the cryosphere and oceanography. The formation of the North Water (NOW) Polynya, in northern Baffin Bay, relies on both local and regional ice and ocean conditions, but in recent years the configuration and extent of its open waters has become more variable. Here, we present the results of dinoflagellate cyst (dinocyst) assemblage analysis and an index based on modern analogue locations, conducted on a sediment archive covering the last ca. 3800 years, from the central region of the NOW. The objective is to understand the long-term variation of sea-surface conditions in the NOW and place recent (the last 50 years) changes within the context of natural climate variability. From ca. 3800 to 2500 years BP our results indicate a relatively stable NOW Polynya with a long open-water season, followed by gradual sea-surface cooling and increased sea ice influence from ca. 2500 to 1500 years BP. From ca. 1500 to 156 years BP the assemblages indicate further sea-surface cooling and a shorter open-water season; however, from 1965 to 2009 CE there is a shift of one to two orders of magnitude higher contributions of autotrophic taxa and dinocyst fluxes that would suggest a return to longer open-water conditions. The last six years of our record (2009 to 2015 CE), indicate more stratified waters likely from increased input of glacial runoff and Arctic sea-ice melt into the NOW region. This study shows that the NOW Polynya responds sensitively to climate changes and that recent Arctic warming was associated with a rapid transition in sea-surface conditions in the NOW compared with the last ca. 3800 years.

Theme: Marine

ID: 661

Landscape controls on fluvial carbon export across High Arctic headwater streams

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Abstract: Stream runoff is an important conduit of carbon to the Arctic Ocean. Water from snowmelt, rainfall runoff, and glacier melt is transported downslope across a mosaic of landscapes differing in terms of the surficial geology and vegetation. Carbon in stream runoff is thought to be a product of both the source and pathway of the water through the watershed. A warming Arctic is expected to increase precipitation and glacial mass loss, which in turn will lead to increases in annual river runoff. Currently, data characterizing organic and inorganic carbon contributions from the Canadian Arctic Archipelago are sparse, despite the region contributing a significant amount (20%–30%) of annual river freshwater flux to the Arctic Ocean. This research characterizes both the concentration and relative amounts of dissolved (organic and inorganic) carbon across Arctic headwater streams to understand the roles of glaciers, geology, and vegetation cover on carbon transfer from High Arctic watersheds to the ocean. Datasets of water chemistry data from the outlet of roughly 175 locations across Axel Heiberg Island and the Sabine Peninsula are analyzed. A Normalized Difference Vegetation Index is created for each study location to characterize vegetation within each watershed, whereas geologic substrate and presence of permafrost disturbances are also characterized within each watershed. We hypothesize that glacial presence will increase the amount of inorganic carbon present in streams due to increased mechanical weathering from glaciers themselves and increased chemical weathering from the availability of freshly ground sediment. Furthermore, carbonic acid from respiration in soils, plant litter, and (or) leached material in vegetated areas will regulate the export of organic and inorganic carbon, whereas occurrence of vegetation and geologic substrate chemical weathering reactions will also regulate DIC export.

Theme: Terrestrial

ID: 548

How is human sewage affecting Arctic amphipods in Nunavut's capital?

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Abstract: The Arctic climate is warming at a faster rate than any other region in the world leading to many anticipated changes. In Nunavut's capital, Iqaluit, amplified warming, and an increasing population, which can promote the introduction of contaminants through municipal wastewater effluent, are two factors that have the potential to affect marine organisms found in the area. This study investigated the potential effects of contaminants on the temperature tolerance and body condition of a gammarid amphipod, *Gammarus setosus*. We tested the thermal tolerance, using a critical thermal maximum (CTmax) protocol, and the body condition of *G. setosus* collected at varying distances from the wastewater effluent within Koojesse Inlet near Iqaluit was used as a measure of anticipated stress. The CTmax at all sites was over 31 °C, whereas the temperature in their natural environment only reached 13 °C during the study period. The CTmax of *G. setosus* was significantly different at sites nearest the wastewater output compared with a reference site outside of Koojesse Inlet and other sites within Koojesse Inlet. The findings of this study showed that *G. setosus* are capable of surviving acute temperatures well above the observed temperatures in the field, suggesting that this species is not vulnerable to anticipated warming temperatures. Body condition was lowest at the site nearest to the wastewater output and highest on the wastewater flats near the low tide zone, however statistical significance was not observed in post hoc tests. The proximity to wastewater effluent, however, appears to induce a change in their physiological state, as determined by body condition and the CTmax, suggesting an adverse effect of exposure to wastewater effluent in *G. setosus*.

Theme: Marine

ID: 194

Cold and colder: extreme seasonality in thermokarst lake viral communities

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Abstract: Global warming conditions are causing significant changes in subarctic landscapes, including thawing of ice-rich permafrost and the expansion of thermokarst lakes and ponds. These aquatic ecosystems are rich in organic matter and shallow, yet during the summer their water columns are highly stratified with a warm, well-oxygenated layer at the surface and a cool, anoxic layer at the bottom. During the winter, their water columns are isolated by snow and ice and become entirely anoxic, favouring methanogenesis and the production of greenhouse gases. Through their well-known wide-ranging impact on their host, viruses affect food chains, microbial population composition, and biogeochemical cycles. Viral diversity, however, is still poorly understood, and the impact of viruses on northern ecosystems is still largely undocumented. The present study addresses the question of how depth-dependent and seasonal changes in the thermokarst pond environment affect viral diversity and community structure. We produced metagenomes from water samples taken between 2015 and 2017 in a thermokarst pond in northern Quebec. The resulting viral assemblages contained numerous previously unknown strains, and we identified two distinct communities: a more variable annual community found at the surface during the summer and a perennial community found in the anoxic water layer. We also compared the communities to other permafrost and northern lake metagenomes to assess their uniqueness. These data result in the most comprehensive portrait of viral diversity in thaw ponds to date and move us closer to the ultimate elucidation of viral ecology in this environment of global importance.

Theme: Terrestrial

ID: 516

Lichen forage requirements of pregnant caribou over winter

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Abstract: Rapid warming in arctic and subarctic regions is leading to extreme ecosystem shifts. Many of these regions are dominated by lichen mats, which are a fundamental food source for caribou in the winter. With continued warming, shrubs across the tundra are expanding their ranges northward, experiencing elevated growth rates and overall biomass. This is concerning as shrubs quickly outcompete lichen mats once they establish by altering the light, moisture, and nutrient conditions. Losing lichen mats in the arctic and subarctic is detrimental to caribou (*Rangifer tarandus*) since it will reduce the forage availability in the winter when physiological stressors are high due to harsh weather and pregnancy in female caribou. In this study, we will estimate the daily energetic costs of individual caribou throughout the winter. Using parameter estimates from published studies, we will derive the cost of movement, weather coping, and pregnancy. Then we calculate how much star-tipped reindeer lichen (*Cladonia stellaris*), a dominant ground species in eastern North America, that caribou theoretically need to eat to maintain body condition throughout its pregnancy. Early results suggest that a pregnant caribou would have to eat roughly 7 kg of lichen per day to maintain its body mass in mild winter weather. Our findings will have important implications for the number of caribou a particular region could support as the landscape continues to change.

Theme: Terrestrial

ID: 767

Assessing lichen distribution patterns across Torngat Mountains National Park in northern Labrador, Canada, using unmanned aerial vehicle data and object-based land classification

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Abstract: Numerous studies using remote sensing techniques have demonstrated a decline in the distribution and abundance of lichens in northern Canada and Alaska due to the impacts of climate change. Lichens are climatically sensitive components of the tundra vegetative community, as well as an important source of winter forage for caribou (*Rangifer tarandus*). In this study, we conduct a supervised object-based land classification on imagery acquired from unmanned aerial vehicle (UAV) surveys to characterize lichen cover at three northern Labrador study sites, Nakvak Brook, Torr Bay, and Komaktorvik River, representing a latitudinal gradient in and around Torngat Mountains National Park, Canada. We predict that the high-resolution UAV data will yield accurate and precise detection of lichen cover across the three sites in and around Torngat Mountains National Park. Insight into the distribution of lichens across this region will provide important baseline information against which to assess the associated impacts to the endangered Torngat Mountain caribou.

Theme: Terrestrial

ID: 547

Estimation of maximum lake depth from the surrounding topography: towards a regional assessment of the occurrence of taliks below Arctic lakes

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Abstract: In continuous permafrost regions, taliks (areas of unfrozen ground), are mainly found beneath large and deep lakes (>2 m depth) that do not freeze to their bottom. Open taliks connected to regional groundwater can affect the development of mine projects due to these potential pathways for contaminant transport. It is therefore important to determine which lakes are potentially underlain by open taliks, especially where lakes are used for mine waste disposal. As a first-order estimate, the potential for talik occurrence can be assessed based on the maximum lake depth of large lakes. For regional studies, maximum lake depth may be estimated

with topographic variables from the surrounding landscape. This approach assumes that common geological processes form the landscape and the lakes, such as glacial processes. This study explores, for the first time, the use of a high-resolution elevation model (ArcticDEM) to extract topographical variables surrounding lakes in Nunavut to run predictive models of maximum lake depth. Lakes in the area of Rankin Inlet with known maximum lake depth ($n = 102$) are used to assess maximum depth for all 17 145 lakes in a 5000 km^2 area near the community. We use stepwise regression to explore the topographical variables and Pearson's partial correlation coefficient to understand the relationship of a given variable to maximum lake depth. Among the eight variables considered within a buffer relative to lake size, lake area, median slope, maximum elevation, and mean elevation were the only significant explanatory variables ($p < 0.05$). For the simplest and best model (least variables), lake area and median slope explained 79% of the variance in maximum lake depth. Known maximum depth of lakes near Baker Lake and in the Kitikmeot region ($n = 173$) were utilized to further validate the initial model and to identify any local to regional model differences.

Theme: Terrestrial

ID: 673

Surface features of the cold/temperate transition zone on White Glacier, Axel Heiberg Island, Nunavut

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Abstract: White Glacier is a polythermal valley glacier found in the Canadian Arctic (~79°N, 90° W). This site has six decades of mass balance monitoring, recent ice-penetrating radar data, and structural models in the form of digitized historic topographic maps (1960) and modern Structure from Motion photogrammetric products (2014, 2018, 2019). Given the context of a warming Arctic, White Glacier presents the opportunity to describe how land-terminating glaciers in the Canadian Arctic Archipelago are responding to disequilibrium. Being polythermal, White Glacier has a thermal transition zone (TTZ) where the thicker, temperate basal ice, close to 0 °C, along the glacier trunk meets cold-based ice well below freezing temperatures at the terminus. We observe how the terminus has changed over various temporal scales and characterize the glacial structures distinct to the TTZ. The surface elevation models are used to measure surface thinning and retreat, and we compare the change to surface ablation measurements to isolate elevation change associated with ice advection down. Furthermore, we use strain field measurements at the terminus in conjunction with the radar data to tie the expressed surface structures to englacial form, bed topography, and ice dynamics. Preliminary results show that thrust fault-like structures, clearly expressed at the surface, are likely stagnant and are being exposed through ablation, having been formed englacially during a more active period. Furthermore, bands consisting of tight collections of crevasse traces with no apparent periodicity are also being exposed as ice along the trunk thins. It is unclear how these band features formed, but they are consistent with compressive flow regimes at the TTZ developing progressively up-glacier as the terminus thins and retreats. Considering the number of similar glaciers found in the Arctic, understanding structural evolution at White Glacier will build knowledge about the response of polythermal glacier dynamics to widespread thinning and retreat.

Theme: Terrestrial

ID: 720

Physical and chemical characteristics of 172 lakes and ponds on Baffin Island, Nunavut

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Abstract: Freshwater lakes and ponds are generally accepted to be "sentinels of change" as they reflect and magnify changes at the landscape scale. Monitoring of these systems can provide an early warning of the effects of anthropogenic pressures (e.g., climate change), especially in the Arctic. Baffin Island is Canada's largest island, and despite the numerous limnological studies carried out around the island, such as those on Nettilling Lake, it is well established that regionally there is a gap in water chemistry data. In this study, we investigated the physical and chemical characteristics of 172 lakes and ponds through lake

surveys (2005–2018) in five regions: Pond Inlet ($n = 50$), Auyuittuq National Park ($n = 4$), Iqaluit ($n = 71$), Kimmirut ($n = 10$), and Meta Incognita Peninsula ($n = 37$). Surveyed sites were generally found within the tundra ecoregion (96.5%) and were underlain by igneous geology (70%). Most study sites were small water bodies (75%, ≤10 ha) at low elevation (66.3%, <200 m a.s.l.) near the coast (99.4%, within 50 km). Sites across Baffin Island varied greatly in water pH (range: 3.4–8.26) and organic content (DOC range = 0.16–44.25 mg/L), but are nonetheless characterized as diluted (conductivity: median = 44.65 μS/cm and mean = 63.43 μS/cm) and nutrient-poor (ultra-oligotrophic, max TP = 0.15 μg/L). The KIM region had the highest concentration and variation in conductivity, DIC, Mg, Ca and TP. In contrast, sites within PIL had higher DOC and NH_4 concentration. Multivariate analysis of water chemistry parameters indicated the following drivers: (*i*) potential influence from sea spray through a negative correlation between elevation and distance to coast with conductivity, Cl and Na, and (*ii*) influence of limestone geology on water conductivity and pH. Results from this study help fill knowledge gaps in water chemistry on Baffin Island and can further assist environmental assessments of aquatic systems in the Canadian Arctic.

Theme: Long-Term Monitoring and Data Management

ID: 501

Observation and modelling of baroclinic tides in the Greenland Sea

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Abstract: Although recent studies have found increasing vertical mixing and penetration of warm intermediate Atlantic water (AW) to the surface, particularly in the Eurasian Basin and Barents–Kara Sea region, a major part of the Arctic Ocean (AO) is thought to be quiescent with weak vertical mixing in the interior. This protects upper ocean fresh and cold waters and sea ice from warm and saline AW. In most of the regions in the Arctic Basin, the shear-driven vertical mixing across the halocline is negligible and vertical mixing is primarily driven by the double-diffusive process. The weak shear-driven mixing in the region is mainly attributed to the weak internal wave field; however, some observations showed enhanced mixing over steep topography associated with tidally generated internal waves. In this study, we show that the internal tide is an important source of vertical mixing in the Greenland Sea. Results from year-long velocity observation from acoustic Doppler current profiler moorings show the energetic internal tides in the continental shelf and slope of north Greenland Sea (~80°N) and moderate internal tides in the southern side (~70°N). We set up a high-resolution (2 km) numerical model regional oceanic modeling system to understand the spatial distribution of internal tide energy and their generation mechanism in the basin. The combination of strong barotropic tides, steep topography, and stratification leads to efficient internal tide generation in the shelf-slope region in the northern Greenland Sea. Our results suggest that the internal tides are likely to play an important role in the vertical distribution of watermass in the Greenland Sea. In a warming Arctic scenario, changing water mass characteristics and stratification in the AO may significantly modify the internal tide induced mixing processes and its implications in the future.

Theme: Marine

ID: 287

Expedition Arctic Botany: online Arctic science collaboration and community

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Abstract: The Canadian Museum of Nature's National Herbarium of Canada, a public archive of over one million preserved wild plant and lichen specimens, represents a 200+ year collaboration among thousands of collectors and curatorial staff, in support of nature research, education, and inspiration. It is also the world's most comprehensive archive of Canadian Arctic flora. Whereas this vast resource physically resides in Gatineau, Quebec, Sitka Foundation

funding recently made it possible to image over 120 000 Arctic specimens and publish them on the internet, where they can be accessed by worldwide stakeholders in Arctic knowledge. The task of making this online resource searchable — mainly by transcribing terms that appear on specimen labels — is now itself a vibrant science communication initiative shared by museum staff and about 2500 individual collaborators across 21 time zones, via Expedition Arctic Botany (EAB): a Notes from Nature project on the Zooniverse Platform (www.zooniverse.org/projects/cmnbotany/notes-from-nature-expedition-arctic-botany). By examining specimen images, and completing three- to five-task transcription workflows, collaborators interact directly with content on Arctic vascular plants, lichens, geography, and (or) collectors, according to their interests, and engage in fun and productive information exchange as the database grows. Through the associated discussion forum (over 2500 threads as of 31 August 2020) participants ask and answer questions not only about the tasks, but also about the content, elevating the quality of data and stories the collection can share. Although the COVID-19 pandemic restricts traditional museum programming and volunteerism, the EAB network expands. The project offers students curriculum-relevant experiences with real-life science, social science, and career-exploration applications, and a virtual environment in which to contribute meaningful volunteer hours. Similarly, the project has become part of global corporate volunteer platforms in nature-linked industries. As its inaugural year draws to a close, the EAB team reports on project successes, challenges, and discoveries.

Theme: Knowledge Exchange and Co-production

ID: 400

Plant productivity is not always limited by nitrogen in Arctic alpine tundra

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Abstract: It is considered that the lack of mineral nitrogen in the soil limits the productivity of plants in the tundra. At the same time, global warming may cause higher soil nutrient availability due to increased decomposition rates and mineralization of soil organic matter. In this study, we aimed to assess how an increased supply of nitrogen affects plant biomass in two contrasting vegetation types in alpine tundra. The study was conducted in the Khibiny (Russia: 67° 44′N, 33°43′E; 620–630 m a.s.l.). We applied NH_4NO_3 (10 g N/m^2) to experimental plots of shrub heath (soil that has a low level of mineral nitrogen) and graminoids meadow (soil that contains a significant amount of nitrate and ammonium nitrogen throughout the growing season). In 2020, we studied the stocks of aboveground plant biomass and litter at sites where nitrogen was applied during 0 (control), 1, 2, 3, and 4 consecutive years. We found that nitrogen application to the shrub heath did not cause an increase of aboveground plant biomass and litter. At the same time, the annual growth of shrubs on experimental sites increased by two times compared with the control and reached a maximum by the third year of nitrogen application. This indicates that plant growth in the shrub heath is limited not by nitrogen availability, but by other factors, such as low air and (or) soil temperature or phosphorus availability. The opposite results were obtained for the graminoids meadow: nitrogen application increases the aboveground biomass and annual growth by two times and the stocks of litter by 1.5 times compared with the control. This reaction of graminoids can be explained by their opportunistic life strategy, but it remains unclear why plant productivity in the nitrogen-rich meadow was more limited in nitrogen availability than in the nitrogen-poor shrub heath. This study was supported by grant MK-207.2019.5.

Theme: Terrestrial

ID: 440

Partitioning different components of beta-diversity reveals plant and soil fungal association in a subarctic tundra

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Abstract: Fungi living in soils are diverse taxonomically and functionally and play a pivotal role in the fundamental function of the soil ecosystem. Studies based on recently developed DNA technologies have shown that beta-diversity of soil fungi well correlated with the beta-diversity of plants. On the other hand, the Arctic ecosystem is experiencing remarkable vegetation shifts such as a shrub encroachment with ongoing climate warming. Such drastic plant replacement with its functional exchange could affect the soil fungal community composition. We thus aimed to reveal soil fungal beta-diversity with a change in vascular plant community beta-diversity in a subarctic ecosystem. This study applied the partitioning method for beta-diversity. The method can divide beta-diversity into two components due to species turnover or species lost. We further subdivided those components into some according to species life-form type (i.e., shrub, graminoid, or forb). By comparison of the fungal beta-diversity to the divided components of plant beta-diversity, we clarified the response of soil fungal diversity to change in plant community beta-diversity due to different species dynamics or functional exchange. As a result, fungal beta-diversity strongly responded to the turnover component with the functional exchange of plant beta-diversity. And fungal beta-diversity showed a stronger correlation with turnover and nestedness component due to graminoid or forb species than that of shrub species. Our results thus indicate the importance of graminoids and forbs diversity, not only the gamma diversity but also the alpha diversity, for the maintaining of soil fungal beta-diversity. It suggests that shrub encroachment with climate change would homogenize soil fungal diversity.

Theme: Terrestrial

ID: 643

Studying rare occurrences: long-term phylogenetic monitoring of the bacteria *Erysipelothrix rhusiopathiae*, an emerging health threat in Arctic wildlife during mortality events

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Abstract: In recent years, *Erysipelothrix rhusiopathiae*, a zoonotic bacterium characterized by its adaptability and its wide range of host species, has emerged as a health concern in Arctic wildlife. It has been associated with abnormal mortalities and disease syndromes in muskoxen, caribou, and Arctic foxes. Rare occurrences, such as mortality events or the finding of a fresh carcass from a diseased animal, are very difficult to study, more so in the remote Arctic. Here, we present the results of an ongoing long-term passive monitoring of *E. rhusiopathiae* that started with an investigation of several muskox mortalities in the Arctic Archipelago between 2009 and 2013. This monitoring is sustained through collaboration with multiple partners and opportunistic sampling. It has allowed us to assemble a unique library of over 80 *E. rhusiopathiae* bacterial isolates from a broad range of free-ranging mammal species (Bovidae, Cervidae, Phocidae, Canidae). Geographically, our repository covers an extensive area ranging from Alaska to the Kitikmeot region and south to British Columbia, Alberta, and Prince Edward Island. Using whole genome-sequencing and phylogenetic analyses, we map spatial and temporal relationships between the different strains of *E. rhusiopathiae*. An important finding was the isolation of a single strain on three neighboring islands in the Arctic Archipelago (Banks, Victoria, and Prince Patrick Islands) collected during separate muskox mortality events (from 2010 to 2017) and in four different species (muskox, Peary caribou, ringed seal, and Arctic fox). This is in sharp contrast with other areas where strain diversity

was higher, even during single mortality events. Our results bring new insights into the epidemiology of *E. rhusiopathiae*, in particular regarding strain diversity and persistence in different regions. We further discuss the relationship between our strains and those isolated from domestic animals and from a case of human infection in an Arctic community.

Theme: Long-Term Monitoring and Data Management

ID: 479

Lichens and allied fungi of Nunavut: establishing a baseline in a changing environment

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Abstract: The territory of Nunavut was created in 1999. It is the largest province or territory in Canada (area = 2 093 190 km^2) and it encompasses the majority of the Canadian Arctic. Arctic regions are among the most rapidly changing on the planet due to climate change, so understanding the composition and distribution of Arctic lichens, in the past and present, is essential to documenting change in the future. Scientists at the Canadian Museum of Nature are leading a research program focused on developing a better understanding of Canadian Arctic lichens and vascular plants through floristic and systematic studies. The results will serve as a basis for biodiversity, ecological, conservation, and environmental impact studies. A focus on the lichens and allied fungi of Nunavut was initiated when lichens were added to the program in 2016. Since then, four expeditions have been completed, targeting widespread localities throughout Nunavut. Results from these recent trips are presented, highlighting new and interesting species discovered.

Theme: Terrestrial

ID: 314

Living on the edge: benthic communities near retreating glaciers

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Abstract: The melting and retreat of Arctic glaciers are prime consequences of climate change in the European Arctic, Spitsbergen. The coastal seascapes are freeing from glacials at a rate of 500 m per year, whereas the duration of coastal ice has decreased from 7–9 to 2–3 months in the late winter. Deglaciation of Spitsbergen causes the formation of new habitats not previously accessible. There were observed changes in increased biomass and biodiversity, as well as sublittoral communities moving towards shallower waters, where ice scouring was a limiting factor. Yet, enhanced melting and retreat of the glaciers cause intensive sedimentation of mineral matter and freshwater inflow into the fjords. As a result, macrophyte expansion lowers as a euphotic zone decreases and larger sedimentation rates favor suspension-feeding over deposit-feeding organisms. The aim of this study was to compare the structure of benthic communities of upper sublittoral near the retreating glaciers with ice-free areas. An underwater video survey was carried out during 2018–2019 summer months in four bays: Adriabuka and Burgerbukta in Hornsund, and Gipsvika and Borebukta in Isfjorden. In total, 2.8 h of video material were collected using a remotely operated vehicle and a “drop-down” video camera from the polar yacht Magnus Zaremba and RV Oceania. Video footage was transformed into 148 video mosaics that were used for visual analysis. Overall, 43 biological features were identified to the lowest possible taxonomic level. The results showed that benthic communities near the glacial mainly consist of mobile fauna and tube dwellers with relatively low diversity, whereas in ice-free areas communities are more diverse and consist of mobile, sessile, and burrowing benthos. Underwater imagery proved to be a reliable method for the characterization of benthic communities in the upper sublittoral, where access for large research vessels is limited due to floating ice and steep slopes.

Theme: Marine

ID: 183

When Arctic migratory species connect the tundra with the rest of the globe: the case of Bylot Island

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Abstract: Numerous migratory bird species benefit from the productivity and the lower predation risk provided by the Arctic tundra in summer to breed and raise their young; however, at the end of the summer they leave the tundra and often travel thousands of kilometres to reach diverse habitats such as the grasslands of South America, the shorelines of the Atlantic coast, and the upwelling zones in West Africa. Habitats used as stopover sites and overwintering areas by Arctic species face multiple anthropogenic and environmental stressors. The conditions encountered by birds on their overwintering areas may have direct and delayed repercussions on their reproduction and survival. To adequately anticipate the effects of global change on Arctic biodiversity, it is therefore essential to consider the location and the type of habitats used by migratory species during their entire annual cycle. Our objective is to define a method to characterize a global migration network of a high Arctic tundra community, focusing on the Bylot Island tundra (Nunavut, Canada) as a case study. We consider 35 species, of which 28 are migratory bird species. Data come from species distribution maps (BirdLife International), birdwatching (Ebird), banding recoveries, and tracking devices deployed at the study site on various species. By gathering these data, we locate terrestrial and marine ecoregions of the globe visited by migratory species during winter. We link the Bylot Island food web with visited ecoregions to define a global migration network. This method presents the number, the type, and the distribution of ecoregions that an Arctic ecosystem is connected to. The network properties are used to locate regions across the globe with a high conservation value for Arctic biodiversity. Representing the Bylot Island migration network is a first step in assessing Arctic ecosystems' sensitivity to environmental changes happening to distant but connected locations.

Theme: Terrestrial

ID: 296

Paraglacial and paraperiglacial landform–sediment assemblages of the Grays Bay Road corridor region, NU, and implications for climate-resilient infrastructure

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Abstract: Knowledge of permafrost conditions is required to develop climate-resilient northern infrastructure and to identify potential geohazards. Where present, permafrost constitutes a landscape foundation. Its stability and integrity are controlled by ground temperatures, surficial and bedrock materials, and ice contents, which are, in turn, a function of landscape history. The effects of permafrost thaw include decreased load bearing capacity, ground surface settlement, and increased transport of sediment and water (melted ice). In rapidly changing northern climates, these adjustments to thaw can be major geohazards for northern infrastructure, but with differential effects due to the often-heterogeneous distribution of surficial materials. Development of climate-resilient northern infrastructure can benefit from a holistic land system approach that attempts to understand how a landscape was formed by investigating the collection of landforms and sediments within it. Our research considers paraglacial and paraperiglacial landform-sediment assemblages (not landforms or sediments in isolation) that constitute the landscape of northern Slave Geological Province and attempts to link them to the processes that formed them. The ultimate goal is to enable inferences on past and future landscape evolution supported by process-form models established from contemporary examples, in a region where very little is known about permafrost conditions. Here we present newly mapped landform–sediment assemblages and patterns in their spatial distribution for 72% of the 1600 km^2 area that is within 5 km of the proposed Grays Bay Road corridor. In combination with sparse sedimentological and cryostratigraphic records, we develop a set of preliminary landform–sediment assemblages. One notable landform–sediment assemblage is glaciofluvial deposits over massive ice, dissected by ice-wedge polygons. Exhibiting long-term creep, this assemblage likely has the highest potential for thermal

adjustment, and it represents a substantial potential geohazard in this region that needs to be considered in planning climate-resilient infrastructure.

Theme: Terrestrial

ID: 704

Snow cover trends from the Arctic and Antarctic and the role of sea ice as a driver

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Abstract: In polar, coastal regions snowfall is predicted to increase under warming conditions as reduced sea ice increases open water area and evaporation potential, thereby creating conditions that would facilitate precipitation. Differences in geography provide a framework in which to examine present and future controls on snowfall at both poles. Synoptic-scale atmospheric patterns control moisture transport pathways in the Dry Valleys region, Antarctica, and appear to influence whether sea ice conditions play a role in precipitation. When air masses are transported over the dry West Antarctic Ice Sheet, more moisture is lost than when it is transported across the Ross Sea. In the Arctic, however, there is an increasing fraction of locally derived moisture as sea ice declines. We discuss trends in snowcover and snow persistence in the McMurdo Dry Valleys, Antarctica, from 25 years of automated weather station measurements and 10 years of photographs. The data are discussed alongside Arctic observations of precipitation and its drivers. In the Dry Valleys, change point analyses and Mann–Kendall trend detection revealed precipitation increased by 3 mm water equivalent (w.e.) a^{-1} from 1995 to 2009, then decreased by 1 mm w.e. a^{-1} through 2017. In contrast, photographs showed a tripling of the average fraction of days with snow on the ground after 2011, primarily during the spring and fall. Snow persistence has been increasing across all seasons, but most notably in the fall. In agreement with previous Antarctic studies, regression analyses revealed no correlation of snow cover or snow volume with sea ice extent or mean temperatures that contradicts Arctic observations of increased snow as sea ice declines.

Theme: Terrestrial

ID: 491

Long-term data reveal responses to ongoing oligotrophication in subarctic lake food webs

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Abstract: Climate change is progressing faster in polar areas than anywhere else on earth, causing vast changes, e.g., vegetation cover and nutrient cycling. Many Swedish lakes show a widespread, long-term (since the early 1990s) decline in total phosphorus (TP), with levels successively declining to only a few μg/L in subarctic lakes. As P is frequently limiting primary production, these declines can have severe consequences. We studied oligotrophication effects on lake assemblages and food webs by combining long-term monitoring data of water chemistry and biological assemblages with stable isotope analysis of time series of Arctic char and benthic invertebrates from five Swedish subarctic lakes. For most lakes, phytoplankton biomass was surprisingly unaffected. Yet, in several of the lakes we observed a strong increase in the biomass of the planktonic mixotroph *Pseudopedinella* in recent years. In two lakes we found a 50% decline in biomass of profundal benthic invertebrates, indicating that the importance of pelagic seston to the benthos is varying among lakes. One lake showed significant declines of δ13C values in Arctic char, whereas littoral invertebrates showed increasing trends. This likely implies that char have been forced out in the pelagic by competing fish species; however, observed food web responses where lake-specific and complex interactions among species, trophic levels, and benthic-pelagic coupling were likely overriding the expected impacts. In conclusion, although food web responses were lake-specific, changes in species composition and biomass were found in all lakes.

Theme: Long-Term Monitoring and Data Management

ID: 146

Facilitators and barriers related to seniors' food (in)security in Inuit Nunangat: a scoping review protocol

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Abstract: High food insecurity levels documented among Inuit in Northern Canada are a cause for public health concern. National household food insecurity levels documented in 2014 were 12.8% compared with 59.3% in Nunatsiavut, an Inuit region in Canada, with significant disparity reported between communities within the region. Much research has taken place on many of the factors influencing food (in)security and associated health outcomes, including factors specific to Inuit communities located in food systems with unique environmental, socio-economic, and cultural contexts. Yet few studies have examined which factors are most critical among sub-groups thought to be more vulnerable to food insecurity in Inuit communities. Understanding population-specific factors and sub-group vulnerability is important for developing evidence-based policies to address food insecurity. To explore factors influencing food (in) security among a vulnerable group such as Inuit seniors, we are conducting a scoping review following PRISMA-ScR guidelines. We searched seven databases for published research articles using keywords and subject headings representing the concepts "food (in)security" and "Inuit Nunangat". After removing duplicates, two reviewers independently followed a two-step screening process. All titles, abstracts, and full texts were screened for sources that analyzed relationships between at least one barrier or facilitator and at least one element of food (in) security. Data specific to seniors will be extracted and analyzed thematically to characterize our theoretical understanding of which elements of food (in)security have been studied for Inuit seniors and which facilitators and barriers have been reported. Considering the paucity and disparate nature of food (in)security literature about Inuit seniors, this review fills a critical knowledge gap supporting action on this topic. Results from this review will inform multivariable statistical analyses of an existing dataset on Inuit seniors food insecurity in two Nunatsiavut communities, a group identified by project partners at the Nunatsiavut Government as vulnerable to food insecurity in their region.

Theme: Inuit Health Education and Adaptation

ID: 753

The McGill Arctic Research Station's automatic weather station network: results and reflections from 15+ years of data collection

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Abstract: Automatic weather stations (AWS) and associated meteorological instruments play an increasingly critical role in documenting climate warming in the Arctic, and they inform a wide and diverse range of scientific studies that require an understanding of local climatic conditions that cannot be accurately measured by remote sensing techniques. To understand local climate and climate variability in an area that encompasses both glacier and tundra environments, a network of five AWS was established in 2003 at Expedition Fiord, west-central Axel Heiberg Island near the McGill Arctic Research Station. The stations are located along an ocean-tundra-glacier transect, spanning an elevation change of ~1500 m over a lateral distance of ~30 km. Each AWS is designed to record hourly air temperature, relative humidity, solar radiation, barometric pressure, wind speed and direction, and snow depth. Three stations also record soil temperatures at 10 and 50 cm beneath the ground surface. Four of the five AWS remain in operation, with one station having a near-complete (>95%) record since installation in 2003. This research presents the regional variability of AWS observations in the context of topography and continentality. Of particular note are the variable temperature lapse rates and the strong temperature inversions observed during the winter months. The results of this initiative have resulted in a long-term (15+ years) climate record that captures small-scale climatic differences as a function of elevation and coastal proximity in the Expedition Fiord area. The initiation and maintenance of the AWS network has benefitted and supported key evidence for numerous studies in the region, including studies of permafrost, seasonal Arctic lake ice variability, regional

vegetation assessments, zoological investigations, and glacier mass balance studies. More broadly, the network fills an important gap in AWS measurements for this region of the Canadian high Arctic and will continue to inform future research.

Theme: Long-Term Monitoring and Data Management

ID: 634

Analysis of polar stratospheric cloud events during the record ozone-loss winter of 2020: comparison of starphotometer (columnar-aerosol) retrievals with ground- and satellite-based retrievals over Eureka, Nunavut

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Abstract: The winter of 2020 was quite active in terms of the presence of polar stratospheric clouds (PSCs) over the PEARL (Polar Environment Atmospheric Laboratory) site at Eureka, Nunavut. PSCs act as agents in the removal of ozone; the unprecedentedly strong ozone hole measured over Eureka during March of 2020 was associated with a significant presence of PSCs over Eureka. The most prevalent PSCs were captured by a variety of satellite- and ground-based sensors. We employed ground-based starphotometer and CRL [CANDAC Rayleigh-Mie-Raman Light Detection and Ranging (LiDAR)] retrievals, satellite-based elastic LiDAR profiles, satellite-based Doppler LiDAR (Aeolus), Microwave Limb Sounder, and aerosol modelling simulations to investigate the detailed dynamics of the PSC events and associated ozone dynamics during the most intense PSC and ozone loss period of 16–21 March 2020. A preliminary analysis of the results, including the characterization of the PSCs as possible supercooled ternary solutions, and Level 1b fine-mode sub-micron aerosols will be presented.

Theme: Terrestrial

ID: 88

Communicating marine food web change using an interactive visual website — co-development of materials with Inuit partners in Qikiqtarjuaq

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Abstract: Climate change threatens Inuit food systems at the ecosystem level potentially through cascading changes that affect the abundance of culturally important species, such as narwhal, Arctic char, and seal. To better understand these changes at a broad scale we are co-developing an ecosystem model of western Baffin Bay (representing food web interactions from algae to marine mammals) to project future scenarios and predict changes in species availability and accessibility, in collaboration with Inuit partners in Qikiqtarjuaq, NU, Canada. Yet, we anticipate that the complexity of ecosystem responses to these co-developed scenarios may present a challenge to effective communication of project results to community members. With this in mind, we aim to build an interactive website that will emphasize visual representation of the results. Such a tool is better adapted to Inuit ways of knowing that prioritize knowledge exchange through observation and storytelling. The website will include the modelled marine food web and interactive infographics showing the different co-developed scenarios (e.g., effects of increasing temperature on narwhal abundance). In English and Inuktitut, these visuals will be coupled with plain text descriptions of project methodology and results (e.g., what is a food web). During the workshops with local partners (e.g., hunters, hamlet office), that are already in place for the core project, we will work together to co-construct the website and validate its

efficacy at conveying information before launching to a broader audience. We will also engage local and international artists, youth, and teachers in website development, bringing together art, science, and education. The website will expand the knowledge mobilisation of the core project in a clear, visual way, providing a tool to support informed decision making regarding co-developed scenarios and related adaptation plans. The graphical materials created for the website can be used for educational purposes and shared through other communication channels.

Theme: Knowledge Exchange and Co-production

ID: 225

Using hydrogen stable isotopes for tracking movement of a terrestrial mammalian carnivore in the western Canadian Arctic

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Abstract: Naturally occurring patterns of stable isotopes in earth ecosystems have been widely used to understand migratory connectivity, dispersal movements, and geographic origins of various species, such as bats, birds, insects, fish, and marine mammals. Hydrogen stable isotope ratios (δD) of metabolically inert tissues (e.g., hair, feathers, claws, and horns) of wildlife can provide information on animal movements and origin because the hydrogen isotope signature (reflecting food and water intake) is related to broad-scale geographic patterns of δD in precipitation. The hydrogen stable isotope values of precipitation and animal keratinous tissues are strongly correlated for some terrestrial species (particularly birds), but there have been fewer studies on terrestrial mammalian carnivores, especially in Arctic regions. We aimed to evaluate the feasibility of using δD measurements of wolverine (*Gulo gulo*) hair to infer geographic origin and distance travelled by individuals in arctic and boreal environments. The wolverine hair samples were obtained from carcass collection programs in the Yukon, Northwest Territories and Nunavut and hair snag traps in British Columbia, Canada. Preliminary results showed a strong correlation between the δD in wolverine hair ($n = 47$) and δD in precipitation. Spatial modelling, using the IsoriX package in R, generated estimates of geographic origin for each wolverine, which were then compared with the known capture locations of the animals. The distance between the capture location and the modelled area of geographic origin was determined to examine its potential as a relative metric of distance travelled between the assumed period of hair growth and date of animal capture. This on-going research will assess if δD values in hair provide useful information on the origin and movements of wolverine, a species that is sparsely distributed and may travel long distances.

Theme: Terrestrial

ID: 226

From collective action problems to solutions: Arctic communities addressing climate-related local health impacts

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Abstract: Climate change impacting human health around the Arctic, as well as people and communities responding to and managing these health impacts at the local level, have been increasingly examined. The rapid and creeping changes in the climate manifest locally and

combine with ongoing climatic patterns, including seasonality, variabilities, and oscillations, and their associated health challenges. Taken together, these climate-related temporalities intersect with the time scales for community action health initiatives, exposing deep-rooted and chronic social vulnerabilities. This confluence of environmental and social processes carries consequences on health acutely and throughout the life cycle. In the Arctic — and often as a result of inadequate and non-inclusive action by formal institutions such as governments and businesses, especially those based outside the Arctic — local organizations are designing and leading initiatives to conduct environmental monitoring and responses to identify, understand, and address associated health risks in their communities. These initiatives offer the potential for locally and culturally relevant production of knowledge and action, but they also suffer from classic collective action problems associated with being highly local non-profit organizations that are often informal and have limited resources and authority to encode and enforce decisions. Using examples from Alaska, Finland, Kalaallit Nunaat (Greenland), and Norway, we indicate potential solutions to the collective action problems faced by local initiatives responding to health impacts associated with climate temporalities including but not limited to climate change, with the aim of supporting their effectiveness and self-sustainability. We suggest which solutions may be most effective for different climate influences and temporal scales, indicating (1) where further study is needed to discern the most promising collective action solutions and (2) those that are particular to the Arctic or can potentially be generalized to other geographic regions.

Theme: Northern Policy and Development

ID: 459

Using hydrodynamic and bathtub water-level models to assess the current and future storm surge flooding in Tuktoyaktuk

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Abstract: Arctic warming is leading to an increased reduction in sea ice, with models for 2100 indicating a reduction in the Arctic sea ice area from 43% to 94% in September and from 8% to 34% in February. The increase of the sea-ice free season duration will result in more exposure of the coasts to wave action, with changing climate also modifying the contribution of terrestrial erosion processes. Coastal erosion can also be increased by warmer seawaters and sea-level rise, with more frequent storms and associated surge events leading to the increase in flooding. During the short open water season (June to October) there has been an increase coastal storms (wind speed > 36 km/h and surge level > 1.5 m), and this has led to an increment in coastal erosion and flooding. This work focuses on the Hamlet of Tuktoyaktuk (Northwest Territories, Canada), where extensive ultra-high-resolution surveys with unmanned aerial vehicles (UAVs) have been conducted, allowing for the generation of orthophoto mosaics, digital surface models (DSM), derived land use, and geomorphological and socio-economic activity maps. DSMs, bathymetry, and meteorological data are used as inputs for flood modelling in MOHID Water software. Validation is conducted using tide gauge and Differential Global Positioning System data from 2019, with the boundary conditions obtained from the FES2014 tide model (Finite Element Solution). Both approaches run on LiDAR data from 2004 and the UAV DSMs for direct comparison. This research is done in cooperation with the Hamlet, with the results being provided as a tool for strategical spatial planning, culminating in more resilient mitigation and adaptation measures to climate change. This research is funded by the European Commission H2020 project NUNATARYUK and by the Climate Change Preparedness in the North Program.

Theme: Terrestrial

ID: 353

Methods used to bring together Indigenous and scientific knowledge in environmental research: preliminary results of a scoping review

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Abstract: The bringing together of Indigenous Knowledge (IK) and western scientific knowledge (SK) bases has become a topic of interest within both academic research and Indigenous communities. In the areas of wildlife and resource management for example, the bringing together of IK and SK has raised considerable interest for its potential to increase understanding and provide insights into complex phenomena such as the effects of climate change and variability on wildlife. Although most studies to date that have engaged some approach in bringing together IK and SK report on the contribution made towards understanding a specific topic, very few report on the challenges and limitations of the approach and methods used. Furthermore, many different methodological approaches and techniques have been developed and used in different regions around the world and the number of techniques continues to grow. The lack of previous attention given to the evaluation of approaches used to bring knowledges together presents a unique opportunity to identify, explore, and critically examine the variety of techniques. Furthermore, it provides strong rationale to then select, apply. and review an appropriate approach in practice. This project is first employing a scoping literature review to identify, review, and synthesize published literature on methods used to bring knowledges together. It will then select, apply, and review the use of one method to bring knowledges together with an existing dataset. This presentation and poster focus on the first phase of the research project, the scoping literature review of methods used to bring SK and IK together as represented in the published literature. The analysis will identify the various types of approaches and methodological techniques employed in addition to geographic, temporal, topic of focus, and other patterns evident in the literature gathered.

Theme: Knowledge Exchange and Co-production

ID: 235

Characterizing 3D vegetation cover and lichen volume using in situ structure from motion processing

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Abstract: Field measurements of the vertical and horizontal distribution of low-lying northern vegetation can be tedious to acquire for large sampling efforts. Point sampling frames are typically used and are labour intensive particularly for large point densities. This is amplified in northern environments related to logistical challenges associated with site access. In this research, we examine the potential for in situ-based structure from motion processing with digital camera imagery to capture 3D representations of plots. Plots were analyzed to estimate 3D vegetation cover and lichen volume using machine learning and point cloud metrics. Plots were acquired in the Northwest Territories for two study areas: (1) Tuktoyaktuk Peninsula for 3D vegetation cover and (2) along the Ingraham Trail outside Yellowknife for lichen cover and volume. Results showed good agreement with point frame estimates, but accuracy decreased for plots with greater vertical structure and canopy closure. For lichen cover and volume, results were also compared with visual estimates. Consistent with other studies, point intercept lichen cover and volume was strongly related to visual estimates. This approach has been developed to support scaling analysis with airborne drone and satellite image data. It is expected to enhance data collection for monitoring northern vegetation response to climate change.

Theme: Terrestrial

ID: 291

Active layer thermal dynamics in different vegetation communities in the High Arctic

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Abstract: The uppermost portion of soil that seasonally thaws and overlies permafrost is referred to as the active layer. Variations in the timing of

thaw and active layer depth across the landscape have important implications for hydrological processes and biogeochemical cycling. Furthermore, the active layer's structural integrity and susceptibility to disturbance are affected by freezing and thawing of the soil. The thermal dynamics of the active layer (e.g., rate and depth of thaw) depend on surface cover, soil characteristics, and thermal interactions with the atmosphere. Due to variations in surface-subsurface heat exchange caused by differences in vegetation, soil moisture, and snow cover, it is hypothesized that active layer thermal regimes are different across vegetation classes in a given High Arctic landscape. To investigate the role of different vegetation classes on active layer thermal regimes, soil temperature data were collected from three classes (polar semi-desert, mesic, and wet sedge) between 2012 and 2019 at the Cape Bounty Arctic Watershed Observatory on the south-central coast of Melville Island, Nunavut. This data will be used to calculate commonly cited thermal metrics, such as degree-days and n-factors, which will be used in thermal modelling (e.g., TTOP, Stefan model) to determine whether significant thermal differences exist between and within vegetation classes. Preliminary results indicate seasonal differences in temperature profiles of active layers across varying vegetation classes and substantial differences at each site during the period of data availability. The goal of this research is to provide a better understanding of active layer thermal regimes in varying vegetation community types, that can in turn be used to model spatial distributions of hydrological and biogeochemical processes, permafrost degradation, and landscape stability in the High Canadian Arctic.

Theme: Terrestrial

ID: 80

Arctic Ocean mid-winter phytoplankton growth revealed by autonomous profilers

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Abstract: It is widely believed that during winter and spring, Arctic marine phytoplankton cannot grow until sea ice and snow cover start melting and transmit sufficient irradiance, but there is little observational evidence for that paradigm. To explore the life of phytoplankton during and after the polar night, we used robotic ice-avoiding profiling floats to measure ocean optics and phytoplankton characteristics continuously through two annual cycles in Baffin Bay, an Arctic sea that is covered by ice well into July. We demonstrate that net phytoplankton growth occurred even under 100% ice cover as early as February, and that it at least partly resulted from photosynthesis. This highlights the adaptation of Arctic phytoplankton to extreme low-light conditions, which may be key to their survival before seeding the spring bloom. The net accumulation under low light also points to weak herbivorous grazing during winter and early spring. We will speculate on the role of seasonal variations in grazing activities as a determining factor of phytoplankton phenology in Arctic marine ecosystems.

Theme: Marine

ID: 469

Gametogenic processes consistent in dominant infaunal bivalves from the Arctic under ambient and environmental-future climate change scenarios

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Abstract: Rates of change in the high northern latitudes are amongst the highest globally. In response, Arctic marine ecosystems are having to rapidly adapt to this regional intensification

of environmental change. Despite this, little is known about how modifications to the marine environment affect the reproductive processes of benthic organisms. Shifts in species reproductive ecology may influence their entire life cycle, and ultimately, determine the persistence and distribution of taxa. Here, we investigate whether the combined effects of warming and ocean acidification based on a near-environmental future scenario will affect reproductive processes in two locally dominant infaunal bivalves (*Astarte crenata* and *Bathyarca glacialis*) from the Barents Sea. Both species exhibit large oocytes indicative of lecithotrophic or direct larval development after ~4 months exposure to ambient (2 °C) and near-future (3–5 °C, ~550 ppm (CO_2)) conditions, but we find no evidence that this environmental setting affects the proportion of oocytes observed in a particular size range. Whilst our observations suggest these gametogenic processes might be resilient to global changes, we acknowledge the successful progression of gametogenesis under experimental conditions does not ensure comparative success in natural populations. Instead, we suggest that feeding ad libitum, which is common practice in a laboratory setting, compensates for increasing metabolic costs associated with environmental change. We discuss our findings in the context of changing food availability in the Arctic.

Theme: Marine

ID: 566

Examining the spatial habitat heterogeneity of two Arctic fjords

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Abstract: High spatial heterogeneity in the environment can lead to high biological diversity. Unfortunately, a large portion of Canada's coastal regions have not been mapped, yet alone had their marine habitat characterised at sufficient resolutions to enable monitoring of habitat. Fjords are common geological features along our coasts that can host high habitat complexity owing to their complex topography, interaction with currents, and natural gradients in water column properties (e.g., temperature, salinity, oxygenation). Fjords can also host deep-water species, many of which are slow growing taxa particularly vulnerable to anthropogenic influences, and whose location in coastal fjords bring them in closer contact to human activities. Multibeam data were collected over many years in two Arctic fjords, Southwind Fjord and Pangnirtung Fjord, on Baffin Island, Nunavut, by the Geological Survey of Canada and ArcticNet onboard the RV Nuliajuk (EM-2040) and CCGS Amundsen (EM-302). Bathymetry and backscatter rasters were created using the QPS hydrographic software suit. The open source "Bathymetry- and Reflectivity-Based Approach for Seafloor Segmentation" within the HydrOffice toolset is explored to create an object-based seafloor classification. The output is compared with more traditional pixel-based unsupervised approaches using secondary derived terrain features. Environmental characteristics and heterogeneity are compared within as well as across the two fjords. The resulting seafloor classification will be used to inform the acquisition of benthic videos in 2021, enabling biological characterization of the identified seascapes as well as investigation of biodiversity spatial patterns.

Theme: Marine

ID: 385

Sediment composition and lithofacies along the Coronation Fjord (Baffin Island, Nunavut, Canada)

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Abstract: The sedimentary dynamics of Coronation Fjord (Baffin Island, Canada), is influenced by a large outlet tidewater glacier of the Penny Ice Cap (PIC). Although the modern glaciomarine processes that operate in this fjord have been previously documented, there is less clarity regarding long-term changes in sediment composition and lithofacies along the fjord. In this context, two sedimentary cores (AMD18-02PC and AMD19-12PC) sampled along of Coronation Fjord were studied to document sediment composition and lithofacies and reconstruct long-term

changes in sediment transfers from the PIC. Measurement of the physical grain size and mineralogical properties allowed for the reconstruction of the variability of detrital inputs over time. Preliminary results show a contrast in lithofacies between cores from the ice-distal (02PC) and ice-proximal (12PC) settings. The mineral composition of core 02PC, collected in a well-laminated basin, is dominated by K-feldspar, plagioclase, quartz, chlorite, and biotite, and is characterized by three lithofacies from the base to the top: stratified mud with ice-rafted debris (IRD; 228–80 cm), sandy mud rich in carbonates (80–48 cm), and bioturbated mud (48–0 cm). The development of cross-lamination and inclined and sharp bedding suggest that sediment transfers were likely controlled by glacial lake outburst flood and turbidity currents derived from the melting of the PIC, adjacent slopes, and neighboring fjords (Pangnirtung and Maktak). Instead, core 12PC, collected on the levee of an ice-proximal channel, is characterized by a homogeneous mineral composition, a laminated mud lithofacies interspersed with fine silt and disseminated IRD (601–480 and 260–120 cm). This lithofacies is interpreted as a product of suspension settling and muddy density flows from turbid meltwater plumes related with the PIC dynamic. Ongoing radiocarbon and paleomagnetic analysis will allow these lithofacies to be placed in a precise chronological framework, to interpret the influence of climate change on the Holocene sedimentary dynamics of the PIC.

Theme: Marine

ID: 835

Temporal variability of heavy metal concentrations in sediments of two Arctic fjords

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Abstract: The global-warming related melting of the Arctic glaciers can increase the supply of pollutants that have accumulated on their surfaces for last few decades. The increase in pollutant loads e.g., heavy metals, can have a negative effect on the ecosystem (bioaccumulation). Sediment cores were collected from Hornsund and Kongsfjorden fjords (Svalbard) to retrieve the history of marine sediment pollution by heavy metals. The sampling stations were located close to the glacier fronts and in the central part of the fjords. The sediment layers were dated using the ^{210}Pb method. Heavy metal concentrations and ^{206}Pb/^{207}Pb ratios were calculated by inductively coupled plasma mass spectrometry and atomic absorption spectroscopy. The concentrations of individual heavy metals were: Pb 6.8–30.4 mg kg^{-1}, Cd 0.14–0.53 mg kg^{-1}, Zn 53.8–93.7 mg kg^{-1}, and Cu 16.1–67.4 mg kg^{-1}. Fjord sediments were slightly enriched in heavy metals. The enrichment factors (after normalization to Fe/Al concentration) ranged from 0.8 to 2.4 for Pb, from 0.9 to 4.7 for Cd, from 0.8 to 1.4 for Zn, and from 0.7 to 2.4 for Cu. The ^{206}Pb/^{207}Pb isotopic ratios ranged from 1.16 to 1.21 (natural regional ^{206}Pb/^{207}Pb > 1.22), suggesting diverse but significant input of anthropogenic origin Pb. Although anthropogenic share of metal concentrations measured at the glacier fronts were not particularly elevated, heavy metal loads delivered from the glaciers were significant due to very high sediment accumulation rates. This suggests that glaciers can be important secondary sources of pollutants to the Arctic fjords. The research was financed by the National Science Center grant 2015/17/B/ST10/03390. We thank Jolanta Walkusz-Miotk, M.Sc. for heavy metal concentration measurements.

Theme: Marine

ID: 771

Sightings of beluga whales with satellite-linked transmitter scars in two populations

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Abstract: The beluga whale population in Cumberland Sound, Baffin Island, Nunavut, is an isolated population, remaining within a small geographic area year-round. The population was commercially exploited for several decades until the 1960s, reduced from over 8000 whales to its current size of approximately 1400 whales. The population is still harvested by the local Inuit community of Pangnirtung and has been federally listed as threatened. Satellite tagging

programs and a new photographic identification program have been utilized to monitor this population, document movements, and estimate abundance. Satellite tagging occurred from 1998 to 1999 and 2006 to 2008, using instruments fitted by wire to three pins inserted through holes punched through the blubber, several inches below the dorsal ridge. The photographic identification program has been operating from 2017 to 2019 using a DJI Phantom 4 drone to take aerial photographs. In 2019, there was an opportunistic sighting of a beluga whale with presumed satellite-tag scars. Recaptures of satellite-tagged whales in other populations, including a whale sighted in 2019 in Churchill, have documented small scars extending from where the pins were inserted to indentations in the dorsal ridge with a V-shape denoting where the pins exited the skin. The whale photographed in Cumberland Sound, however, had three circular scars on either side of its dorsal ridge, presumptively where the pins had originally been placed, indicating that the tag did not migrate out and may have been lost soon after implantation. The whale appeared to be in good health and was photographed with a 1-year-old calf. The whale would have been tagged at least 11 years prior to being photographed, which demonstrates the longevity of scarring in belugas. It also demonstrates site fidelity in Cumberland Sound belugas given the close proximity between tagging sites and the location where the whale was photographed at least 11 years later.

Theme: Knowledge Exchange and Co-production

ID: 343

Application of artificial substrate samplers to assess roles of hydrological processes on enrichment of metals of concern across lakes of the Peace-Athabasca Delta

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Abstract: The cultural and ecological integrity of the Peace-Athabasca Delta (PAD), a 6000 km^2 floodplain landscape located in northern Alberta, may be threatened by multiple stressors, including climate change, upstream river regulation, and oil sands development. These concerns motivated the Mikisew Cree First Nation to petition in 2014 to enlist Wood Buffalo National Park (WBNP), which contains ~80% of the PAD, as a UNESCO World Heritage Site in Danger. In response, the 2017 UNESCO report as well as the 2019 WBNP Action Plan include recommendations to establish and expand the scope of monitoring regimes in the PAD. To address this need, we deployed artificial substrate samplers in ~50 lakes for the duration of the ice-free seasons of 2017 and 2018. We assess the accrued biofilm-sediment mixture for enrichment of metals of concern above pre-industrial levels determined from analyses of sediment cores in the PAD. Preliminary data exploration reveals no marked enrichment of most metals from 2017 to 2018 in lakes across the delta that were flooded by either the Peace or Athabasca river. Thus, river floodwaters are not implicated as a pathway of metal enrichment from upstream development. Substantial enrichment is almost exclusively observed for biologically active metals (Cd, Cu, Zn) at productive, closed-drainage lakes, suggesting biological uptake complicates comparisons of organic-rich biofilm-sediment mixtures to sediment-derived baselines. Overall, artificial substrate samplers offer a unique advantage of recording metals accumulation over a known time period, and these results lend confidence to their ability to monitor for enrichment of biologically inert metals, including those related to oil sands development (e.g., Ni, V), in flood-prone lakes characteristic of the PAD.

Theme: Long-Term Monitoring and Data Management

ID: 807

Methods for estimating Arctic cod physical limits and preferences when faced with climate change stressors

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Abstract: Cardio-respiratory performance of Arctic cod embryos were assessed under a multi-

stressor context of high temperature and ocean acidification conditions in the laboratory. Embryos were incubated at water temperatures of 1.0 and 3.5 °C and acclimated to three pH treatments: 8.0 (control), 7.7, and 7.5. At 50% embryo development, specific respiration rates were measured for embryos acclimated to all treatments. Only embryos acclimated to 3.5 °C were measured for specific respiration rates at 75% development and assessed for heart rate (fH) performance at 80% development. Respiration rates were measured using a Loligo® Systems microplate system. Heart rate was assessed during an acute temperature challenge. During the challenge, the temperature was increased from −1.5 to 7.5 °C at a rate no faster than +1.0 °C/15 min and fH was measured at each temperature increment. There was no significant difference in specific respiration rates among embryos acclimated to the three pH groups at either temperature (1.0 and 3.5 °C) at 50% embryo development ($p = 0.20$ and $p = 0.90$, respectively), or among embryos at 75% development acclimated to 3.5 °C ($p = 0.84$). There was also no significant difference in respiration between the two test temperatures (1.0 and 3.5 °C) for any of the pH treatments of 8.0, 7.7, and 7.5 ($p = 0.84$, $p = 0.24$, and $p = 0.97$, respectively). There also appears to be no difference in the effect of an acute temperature challenge on fH of embryos acclimated to 7.5 and 8.0 pH incubated at 3.5 °C. The current study demonstrates methodology to provide insight into the physical limits of an ecologically important Arctic marine fish species under various stressors of climate change. Future work will use these techniques to estimate cardio-respiratory performance of sablefish embryos acclimated to various water temperatures. Sablefish are an economically valuable species with little information known about their physical limits.

Theme: Marine

ID: 813

Physical dynamics regulating unfrozen water content in differing peat types, and its effect on microbial respiration: insights into winter carbon loss in boreal Canada

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Abstract: Arctic and boreal peatlands represent an immense terrestrial carbon store (roughly 455 Pg), and their contribution to a shifting global carbon cycle is uncertain. Although we know that Arctic warming enhances carbon release during the thaw season by stimulating microbial decomposition of soil organic matter, terrestrial carbon loss during the winter months is a key component of the carbon cycle in Arctic and subarctic peatlands that has been overlooked. This microbial-mediated carbon cycling during the freezing season takes place in the unfrozen part of the active layer during freeze-back and may also be allowed in frozen ground by water that persists in a liquid state below 0 °C. This research investigates microbially mediated carbon loss in frozen peat types and organic soils. Core samples from permafrost and active layer were collected in four high-latitude Canadian landscapes: Churchill, Manitoba; Peawanuk, Ontario; Blackstone uplands, Yukon; and Old Crow Flats, Yukon. Preliminary data on microbial community structure has revealed noticeable differences in community composition both between sample sites, as well as amongst active layers and permafrost. Incubations at a range of sub-zero temperatures will allow an examination of greenhouse gas (GHG) production potential of various frozen peats. Unfrozen water content characteristic curves will be produced using H2-NMR in a temperature-controlled environment for peats with a range of sub-zero greenhouse gas production potential. Accompanied by chemical and hydrological data, further microbial community profiling will be conducted post-incubation to characterize the bacterial, archaeal, and fungal lineages responsible for the sub-zero GHG production. This study will provide insight in the relation between unfrozen water content and microbially mediated GHG production at sub-zero temperatures and aid in upcoming evaluations on global carbon budgeting.

Theme: Terrestrial

ID: 613

Availability of light at the bottom in coastal waters using satellite data: a pan-Arctic perspective

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Abstract: The Arctic Ocean is changing rapidly, opening new realms for transportation, exploration, and exploitation. This change will affect the Arctic biodiversity by introducing invasive species and other anthropogenic stressors. A significant part of the Arctic flora and fauna are restricted to the coastal areas and are driven by primary producers. The changing climate has resulted in early break-ups and late freeze-ups, which has changed the light dynamics in the water column affecting the primary producers significantly. In this study, we developed an operational process chain to calculate the magnitude of photosynthetically available radiation (PAR) reaching the bottom of the littoral zone using data from the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor onboard Aqua satellite. The long-term objective is to assess the trends in PAR, reaching the sea bottom at the pan-Arctic scale over the last two decades. The major difficulties in estimation of PAR in the coastal Arctic waters arise due to the presence of sea-ice and extreme solar-zenith angles. Therefore, we have used the radiative transfer model to estimate PAR below the sea surface using as input, among others, the cloud optical thickness and the surface albedo. These inputs are estimated using MODIS observations. Next, the satellite-derived downwelling diffuse attenuation coefficient is used to compute the PAR reaching the sea bottom. The estimated PAR values are validated with the in situ data available in a few coastal sites in the Arctic. The results show a significant impact of cloud shadow and increased turbidity on the availability of light in the coastal zone of the Arctic Ocean.

Theme: Marine

ID: 561

Knowledge co-production of Arctic char (*Salvelinus alpinus*) in the Amundsen Gulf, western Canadian Arctic

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Abstract: Inuit in the western Canadian Arctic have observed rapid changes in the health and movement of Arctic char (Iqalukpik, *Salvelinus alpinus*), a valued species for subsistence and commercial fishing. Inuit in Ulukhaktok, Northwest Territories, have identified a need to better understand these changes. To date, most climate change research in the Arctic has been guided by Inuit knowledge and observations or western science, with fewer studies equally engaging both knowledge systems. The proposed research will draw upon Inuit traditional ecological knowledge (TEK) and results from scientific research to co-produce knowledge about Arctic char movement ecology and health. It is anticipated that drawing on both knowledge systems will provide a more complete understanding of Arctic char's responses to changing environmental conditions and the likely responses necessary for people to adapt to such changes. Specific objectives include: (1) document Inuit TEK of anadromous Arctic char movement ecology and health; (2) co-produce knowledge among Inuit and scientists to better understand changes in Arctic char and the char fishery; and (3) examine if and how the changes in movement ecology and health are affecting Inuit–Arctic char interactions, and characterize the adaptive strategies employed to manage these conditions. TEK will be recorded through participatory mapping and semi-structured interviews with key knowledge holders in Ulukhaktok. Concurrently, quantitative data on individual fish movement patterns have been collected using acoustic telemetry. The research approach is informed by a pilot study conducted in February 2019 with Inuit knowledge holders and a pre-research consultation visit in February 2020. The expected results are intended to improve our understanding of the movement ecology and health of Arctic char. The documentation and dissemination of knowledge on changes in Arctic char and experiences of Ulukhaktokmiut to such changes could be incorporated into a future iteration of the Ulukhaktok Char Management Plan.

Theme: Knowledge Exchange and Co-production

ID: 55

Archival fieldwork: new Arctic plant biodiversity data from backlogged

specimens in the National Herbarium of Canada

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Abstract: Plant and lichen collections deposited in herbaria around the world underpin our knowledge on species distribution and taxonomy, but time and resource constraints often limit their ability to identify, prepare, and (or) digitize these specimens. As a result, backlogs of material not yet part of the active collection can accumulate. Although these lots may be safely stored and preserved, the biodiversity data represented by the specimens remains locked away and invisible to users of both physical and virtual (on-line) collections. Botany staff at the Canadian Museum of Nature's National Herbarium of Canada have been working to process the backlogged collections of three prominent Arctic botanists: Dr. Sylvia Edlund, Margaret Oldenburg, and Dr. Nicholas Polunin. Together, these three lots of over 10 000 specimens represent 28 years of collecting effort between 1933 and 1991. These specimens, collected across the Canadian Arctic ecozone, include species occurrence information from locations not visited since, as well as specimens from well-botanized sites where repeatedly collected species can support temporal understanding of species distribution and phenology. We conducted archival searches, interpreted field notes, communicated with collectors' relatives to fill in missing label data, and identified or confirmed each specimen. Completed batches were then mounted and digitized by co-op students and herbarium volunteers, with help from project funding earmarked for backlog reduction. Here we present this project and the floristic results from these efforts, and place these important collections in historical context.

Theme: Terrestrial

ID: 175

Deep ocean fluorescent dissolved organic matter reactivity in the western Arctic Ocean

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Abstract: In the deep ocean, the abundance and composition of fluorescent dissolved organic matter (FDOM) are controlled by aerobic microbial mineralization and mixing processes that remain poorly understood. In this study, the composition of FDOM was examined using excitation-emission matrices and parallel factor analysis. One of the four validated components corresponded of the in situ FDOM sensor excitation and emission wavelengths, confirming the FDOM sensor is suitable for FDOM tracking in the western Arctic Ocean. The main water masses in deep Arctic Ocean show distinct characteristics in FDOM and apparent oxygen utilization (AOU). For example, the average FDOM intensity and AOU levels for Pacific winter water (PWW) were 0.34 Raman Unit (R.U.) and 98.0 $\mu mol \cdot kg^{-1}$, and 0.16 R.U. and 61.6 $\mu mol \cdot kg^{-1}$ in Atlantic waters. A comparison of FDOM mineralization between water masses will be discussed.

Theme: Marine

ID: 420

Landscape-related ground ice variability on the Yukon coastal plain inferred from computed tomography and potential implications on lateral permafrost carbon release

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Abstract: Warming in the Arctic causes strong environmental changes with permafrost degradation being among the most striking effects. Active layer deepening and permafrost erosion can result in the mobilization and lateral transport of organic carbon (OC) that potentially alters carbon cycles in the Arctic substantially. Although the understanding of ground ice

contents and permafrost OC release is improving, still little is known of permafrost OC release rates, lateral transport pathways, and its driving mechanisms on a landscape scale. In this study we investigate ground ice characteristics and OC composition of the most dominant landscape units of the Yukon coastal plain. In total, 12 permafrost cores were taken from moraine, lacustrine, fluvial, and glaciofluvial deposits with a SIPRE corer. Ground ice and sediment contents were analysed using computed tomography and k-means classification. Active layer and upper permafrost were subsampled to analyse OC contents and isotopes of bulk material and a leaching-incubation experiment was conducted with active layer and permafrost sediments to assess potential dissolved OC export and degradation rates. Preliminary results show that ground ice contents vary significantly between landscape units; ground ice contents in permafrost average 72.4 vol.% with the highest contents in moraines (78.3 vol.%) and lowest contents in fluvial deposits (53.2 vol.%). We expect highest dissolved OC leaching and loss rates from permafrost in contrast to active layer and from fluvial and lacustrine deposits, as they simply contain more OC. Yet, lateral OC transport is more likely for landscapes with a topographic gradient such as ground ice-rich moraines. We conclude that due to the high ground ice contents on the Yukon coastal plain, substantial changes of the permafrost landscape will occur under current warming trends. This will include subsidence, abrupt erosion, changes in hydrology, and OC degradation processes, which will differ between landscape units.

Theme: Terrestrial

ID: 668

Changes and conditions in the timing to the onset of spring snowmelt in the western Canadian Arctic

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Abstract: There is a common consensus that climate warming across the Arctic will trigger earlier snowmelt onset in the spring; however, recent studies have suggested that, at least in some cases, the resulting snowmelt runoff is not occurring earlier. This raises questions about the timing to the onset of spring snowmelt and how the rate of snowmelt has changed. Snowmelt is controlled by the full surface energy balance, which is affected by a variety of factors including air temperature, precipitation, incoming solar and longwave radiation, wind speed, and relative humidity. To date, however, there is little information on the changes in these factors and the resulting changes in the rate of snowmelt over the last few decades. Trend analysis of hydrometeorological dataset series reveals that the mean onset of snowmelt and the end of snowmelt has shifted earlier by 15 and 14 days, respectively, over the 1999–2016 period. Trend significance was determined using the nonparametric Mann–Kendall trend test, accompanied by Theil Sen's slope, a robust slope estimator for the determination of trend magnitudes. The results indicate an increasing spring air temperature, precipitation, wind speed, and relative humidity have resulted in changes in snowmelt. On the contrary, a decrease of 6.6 $W \cdot m^{-2}$ downward incoming solar radiation trend to previous studies of higher levels of radiative energy over the tundra would suggest a degree of change in cloud cover. Being able to attribute snowmelt onset to those drivers that are changing as the high latitudes warm allows for better prediction of the melt season dynamics and the climatological processes.

Theme: Terrestrial

ID: 660

Remote sensing of turbidity plumes in glaciated and ice-free fjords of Svalbard (Arctic)

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Abstract: This work is aiming to map turbidity plumes in glaciated and ice-free fjords of Svalbard through the application of in situ surveys and optical satellite imagery. The Arctic region is undergoing a rapid warming process,

where enhanced melting of the ice increases freshwater intake into the marine environment, thus influencing the external supply of suspended solids and nutrients. In turn, the increase of water turbidity alters the changes in the underwater light climate. Both processes significantly affect pelagic communities and benthic habitats. On 22–30 July 2019, several field campaigns have been organized over the fjords of Svalbard to measure remote sensing reflectance (Rrs) and water turbidity. For the mapping of turbidity plumes MultiSpectral Instrument onboard Sentinel-2 satellite data have been used, whereas Sea Surface Temperature (SST) was derived from Landsat 8 satellite images. Results will show the variations of Rrs under different turbidity ranges. Both variables will be used to validate Sentinel-2 MSI satellite data for the upscaling spatial patterns of turbidity in the fjords. In addition, thermodynamic exchanges across ice-ocean boundary layer will be investigated using SST maps. A special attention will be dedicated to discuss the differences and relationship between water turbidity and SST in glaciated and ice-free fjords.

Theme: Marine

ID: 318

Marine spatial planning as an approach to engage Inuit communities in shipping governance

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Abstract: As sea ice recedes, the last decade has witnessed increasing human activities in the Canadian Arctic, placing immense pressures on Arctic ecosystems, infrastructure development, and northern communities. For instance, increasing accessibility to natural resources have contributed to the rapid development of Arctic marine shipping activities, generating some benefits to Inuit communities, but also creating challenges and risks in regard to potential effects on the environment and on Inuit subsistence activities. In the context of increased shipping, it is important to rethink marine governance approaches with the goals of involving Inuit and of identifying and applying Inuit ontologies and cultural values regarding the marine environment. As defined by UNESCO, Marine Spatial Planning (MSP) is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives. UNESCO also developed a step-by-step approach toward ecosystem-based management. Based on the analysis of policies, preliminary attempts, and current practices, this poster will provide an exploration of the potential to adopt MSP as an approach to support Inuit's engagement in governing Arctic marine shipping activities. This poster will argue that MSP is ideally situated to tackle the specific challenges of the cultural, social, and environmental contexts of the Canadian Arctic and potentially to incorporate Inuit ontologies to shipping governance. MSP will be analyzed from three perspectives: (1) appropriately incorporating Inuit knowledge through data and spatial analysis tools; (2) recognizing Inuit rights in marine spaces; and (3) improving the level of Inuit participation in the decision-making process. Overall, MSP can work as a collaborative approach for managing Arctic marine shipping activities. The benefits of using the MSP framework in Arctic shipping governance will also be elaborated.

Theme: Northern Policy and Development

ID: 570

Community and students: outcomes on two arctic initiatives

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Abstract: The Alaskan Arctic is a science-rich region with compelling natural landscapes, ecosystems, and people. Arctic science, however, is often not communicated outside the walls of research institutions and public knowledge of the Arctic is poor. Within the research community, there is also an increasing emphasis on inclusion of Traditional Ecological Knowledge and more broadly of Indigenous Knowledge as a means to "co-produce knowledge" alongside western science methods; however, this hasn't been carried over into culturally responsive outreach and engagement activities implemented in Alaska schools with Indigenous students. In this presentation, we will share outcomes from two initiatives that provide a nexus between these issues and activities that specifically target

to engage and educate K-12 teachers, students, communities, and researchers on the Arctic. The first project, The Arctic in the Classroom program. partners scientists, educators, and communities to improve Arctic education by facilitating successful citizen science projects and community-based monitoring to support the collaboration of students, teachers, and researchers in Arctic communities. The second activity, a workshop on Culturally Responsive Outreach to Indigenous Alaska K-12 Students, reviewed and created new guidance on culturally responsive instructional strategies to assist researchers in improving the cultural responsiveness of the outreach activities they plan and implement in Alaska communities. Both activities demonstrate successful science collaborations and communications.

Theme: Knowledge Exchange and Co-production

ID: 489

Lake depth, but not watershed size, affects snowmelt runoff retention in thermokarst lakes: implications for northern lake studies

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Abstract: Snow represents roughly half of the Arctic's annual precipitation, typically resulting in the largest water input event for lakes every spring, but little is known about how much lake water is replaced by snowmelt runoff. To estimate how much lake water is replaced by snowmelt runoff, we applied a two-component mixing model to water isotope samples taken before and after snowmelt from 17 lakes between Inuvik and Tuktoyaktuk, Northwest Territories, Canada. We also obtained isotope samples from two adjacent lakes and their outflows every few days throughout the snowmelt period to more accurately determine when snowmelt runoff began mixing with water beneath the lake ice. A range of 1%–43% of lake water was replaced by snowmelt runoff across the 17 lakes, with an average of 17.4%. Deeper lakes experienced significantly less snowmelt replacement than shallower lakes. Snowmelt runoff (~0 °C) is less dense than the lake water (<4 °C), allowing the snowmelt runoff to flow beneath the lake ice and out of the lake with minimal mixing with pre-snowmelt lake waters, resulting in less mixing in deeper lakes. Lake watershed area was not correlated with the amount of snowmelt replacement, suggesting that the amount of snowmelt runoff supplied to a lake does not affect the amount of snowmelt runoff retained in the lake. Therefore, assigning importance to either snowmelt or rainfall runoff for a lake's water balance based on the isotopic signature of the lake's water source is not justified. At the two lakes where isotope samples were taken every few days, snowmelt runoff was observed beneath lake ice between 7 and 13 days after outflow from the lake began, however we estimated that only 8% of snowmelt runoff was available to bypass the lakes by flowing over the lake ice.

Theme: Terrestrial

ID: 251

Iceland as a therapeutic landscape: white wilderness spaces for well-being

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Abstract: Therapeutic landscapes are reputed to have a lasting repute for realizing healing. Traditional therapeutic landscapes have recognized natural environments as often sought-after places for well-being. Such places promote wellness via their close encounter with nature, facilitating relaxation and restoration, and enhancing a combination of physical, mental, and spiritual healing. The physical environment of Iceland is explored through a case study approach, primarily employing data from the field notebooks of post-secondary students travelling in Iceland, as well as the authors' ethnographic field experience in Iceland. Iceland is examined using both a traditional understanding of therapeutic landscapes, as well as the contemporary understanding of the coloured landscape. In addition to the colour white, reflected in the glacial ice, moving water, and geothermal steams, black and various other colours in combination are discussed. The implications of climate change on these therapeutic landscapes are discussed from a range of perspectives, including health, sense of place, and quality of life.

Theme: Northern Policy and Development

ID: 103

Pingo distribution in the Tuktoyaktuk Coastlands, Northwest Territories, Canada

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Abstract: Pingos are an integral part of the permafrost landscape of the Tuktoyaktuk Coastlands, southern Beaufort Sea coast, western Arctic Canada, which is also affected by on-going sea-level rise. Approximately ~1450 pingos were mapped in the region from aerial photographs. Via open-data desktop geobrowsers using very-high resolution digital elevation data and colour satellite imagery, we mapped nearly 2820 pingo-like features in the region and confirmed over 2350 pingos. This area contains the highest concentration of pingos (average of 0.15 km^{-1}) in North America, about 5% of which are in a state of collapse. Pingos reside in an area of about 18 500 km^2. Occurring at elevations from sea level to about 60 m asl, only ~5% are situated on the modern Mackenzie Delta. Most are within the Tuktoyaktuk Coastlands where glacial and postglacial sediments veneer Pleistocene interglacial sands. Pingos are most concentrated within the Low Involuted Hills, Kugmallit Plain, and Tununuk Low Hills, where Holocene thermokarst lacustrine basins are most abundant. Unlike pingos of the Arctic Coastal Plain, Alaska, many pingos of the Tuktoykatuk Coastlands are situated near the modern coastline as result of on-going relative sea-level rise. Through coastal erosion, many lakes containing Holocene-age pingos now drain directly into, or are connected to, the Beaufort Sea. Although lake drainage can initiate pingo growth, coastal erosion is a rapid mechanism for pingo degradation. Thus, the rate of pingo loss along the coast likely exceeds that of pingo formation. Our georeferenced database improves the geological context for pingos in the Tuktoyaktuk Peninsula region. The catalogue of pingos, collapsed forms, and other pingo-like forms provides a means to assess associated morphologies, and to monitor responses associated with changes in climate and the coastal zone.

Theme: Terrestrial

ID: 241

Baculum and testes growth in bearded seals (*Erignathus barbatus*) in Hudson Bay, Canada

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Abstract: Comparing reproductive morphology of closely related species and among populations can provide insight into the evolution of mating strategies. The bearded seal is a widely distributed species for which relatively little is known about reproductive behaviour and mating systems. Using tissue samples from Inuit subsistence harvests, we examined body growth and bacular and testicular allometry in bearded seals from Hudson Bay, Canada, to investigate reproductive ecology at the southern extent of their range. Asymptotic body lengths were 230.8 and 232.7 cm for males and females, respectively, indicating a lack of sexual dimorphism. In immature seals, growth of baculum length and width were hyperallometric whereas growth of testes length was isometric. Growth of both baculum and testes was isometric in mature seals. Relative baculum and testes lengths of adults bearded seals were 8.6% and 2.7% of body length, respectively. Among Phocid seals, bearded seals appear to have smaller relative testes size, suggesting a comparatively low degree of multi-male mating and little post-copulatory sperm competition. Compared with bearded seals from Alaska and Svalbard, Hudson Bay bearded seals had proportionately longer bacula (by approximately 2% of body length). Selection for longer bacula in Hudson Bay bearded seals may be an indication of a higher degree of female choice through multi-male mating. Environmental and ecological characteristics are known to influence life-history strategies, including mating systems. In Hudson Bay, unstable spring sea-ice conditions may influence bearded seal mating systems by limiting the ability for males to successfully defend territories, resulting in greater movements and greater opportunities for females to mate with multiple males. Representing the extreme southern distribution for bearded seals, Hudson Bay may foretell selection pressures that seals at higher latitudes will soon face.

Theme: Marine

ID: 392

Radiocarbon (^{14}C) and stable carbon (^{13}C) isotopic measurements of dissolved inorganic carbon (DIC) in Baffin Bay seawater

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Abstract: The oceans store around half of the anthropogenic carbon dioxide (CO_2) emitted by fossil fuels in the form of marine dissolved inorganic carbon (DIC). At ~38 000 gigatons of carbon, the DIC reservoir is the largest ocean carbon reservoir. The Arctic Ocean is a region that is both chemically and ecologically sensitive, and the impacts of climate change on the marine carbon cycle of this region is poorly constrained. Baffin Bay is a marginal sea of the North Atlantic Ocean that is responsible for providing cold surface water into the Labrador Sea. This process is critical for North Atlantic deep-water formation and the "engine" that drives global meridional overturning circulation. To date, the residence time of Baffin Bay waters remains an area of scientific debate, with wide ranging ventilation ages reported between 77 and 1450 years. The goal of this study is to determine the distribution of stable carbon (δ^{13}C) and radiocarbon (Δ^{14}C) isotopic values of DIC throughout the Baffin Bay region. Our ultimate goal is to use this data to constrain physical oceanographic parameters of Baffin Bay such as circulation rates and a confident ventilation age, and to characterize DIC sources and cycling in the region. New DIC δ^{13}C and Δ^{14}C data collected aboard the CCGS Amundsen in July 2019 will be discussed. These results will provide a greater understanding of the Arctic marine carbon cycle, the physical circulation of deep Baffin Bay water, and the amount of anthropogenic carbon sequestered in the Arctic.

Theme: Marine