

NSERC PermafrostNet Themes





Characterisation of permafrost





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Characterisation of permafrost

Sub-theme: Data handling

- Teddi Herring (PDF) Canadian permafrost ERT survey next practices and database
 - · Creation of ERT dataset from Yukon and integration in a new database of ERT surveys
- Michel Paquette (PDF) Permafrost information network of ground observations
 - Data publication process and guidance, expert analysis of the ground ice map of Canada

The NSERC PermafrostNet Data Publication Handbook NSERC PermafrostNet

Sub-theme: Ground-ice characteristics

- Alexandre Chiasson (PhD) Permafrost conditions in the Mackenzie valley and glacial lakes Mackenzie and McConnell
 - · Datasets on ground ice conditions, ground ice maps based on terrain and thermokarst classification
- Mohammad Gamshad (PhD) Ground ice of the eastern Canadian polar deserts
 - Ground ice distribution in polar deserts, polar desert response to climate change using climatic simulations
- Tabatha Rahman (PhD) Permafrost and ground ice conditions in the Hudson Bay Lowlands
 - Creation of datasets of Ice volume, ice type and distribution in the Hudson Bay lowland
- Joe Young (MSc to PhD) Syngenetic permafrost of unglaciated Yukon
 - Ground ice distribution mapping and mass wasting potential



Characterisation of permafrost

Sub-theme: Innovation

- Zakieh Mohammadi (Msc to PhD) Strength and consolidation behavior of permafrost
 - · Thaw settlement and consolidation tests used to predict thaw settlement properties of permafrost
- Khatereh Rgh (PhD) Geomechanical properties of thawing permafrost
 - Creation of a geotechnical layer of the ground ice map of Canada and integration of geotechnical properties of permafrost in PINGO.

Outcomes:

Permafrost data collection from discontinuous permafrost to the High Arctic

Data publication guidelines and queryable data products

Scaling solutions for permafrost properties and mapping



Permafrost exposure coring near Inuvik. Photo: A. Alvarez





Monitoring of permafrost change



Trevor Lantz



Antoni Lewkowicz



Monitoring of permafrost change

- Theme goals are to identify and quantify permafrost change in Canada, including its regional variation and land surface expression.
- Very active area of research internationally, especially in relation to remote sensing and AI (deep learning).
- 5 HQP active; 2 to be recruited for 2022. HQP projects (1 PDF, 4 PhD, 2 M.Sc.) involve observation/monitoring and ultimately, synthesis.
- Partners include Aurora Research Institute, Gwich'in Renewable Resources Board, CCRS, NTGS, Yukon U.
- Regular monthly meetings, including guest lectures (e.g., Genevieve George, Lingcao Huang).



Monitoring of permafrost change

- Field data (including airborne remote sensing data) are vital contributions that will complement the large number of datasets being developed internationally.
- Broad range of techniques being employed to assess change, including optical remote sensing, SAR and community-based monitoring. Similarly broad range of backgrounds in HQP.
- The theme feeds into PermafrostNet by demonstrating ongoing environmental change, by involving communities and northern partners in observations and through the planned post-doctoral synthesis of disparate datasets to develop a national model of thaw sensitivity.



Current Student Research



Grant Francis. Tracking permafrost landscape change with high resolution satellite imagery.

Fereshteh Ghiami-Shomami. Interpreting ground temperature and subsidence for better quantifying permafrost change.

Usman Iqbal Ahmed. - Airborne InSAR to monitor permafrost thaw near linear infrastructure.

Emma Street. Indigenous Knowledge of permafrost processes in the Beaufort Delta Region.

Hana Travers-Smith. Determinants of surface water dynamics in the western Canadian Arctic and Subarctic.





Prediction of permafrost change



Claude Duguay



Joe Melton



Prediction of permafrost change

- Projects are well underway
 - Develop new high-latitude specific land cover types for CLASSIC – Rose Lefevbre, (MSc start May 2022)
 - Excess ice simulation by CLASSIC Amene Sharifi (PhD)
 - Thermokarst lake ice mapping Maria Shaposhnikova
 MSc completed Sept 2021!
 - Optimizing soil carbon simulation Charles Gauthier, MSc
 - Machine learning based ground ice mapping Bingqian Zhang, PhD
 - Quantify confidence in permafrost simulations Hannah MacDonell, MSc (PhD option)
 - Permafrost climate services Galina Jonat, PhD

Prediction of permafrost change

Maria's MSc thesis:

- Applied a temporal deep learning approach to thermokarst lake ice mapping (bedfast and floating ice) from SAR imagery, generated ice-regime maps, and analyzed changes over a 29-year period (1993-2021) in Old Crow Flats, Yukon
 - Well done Maria!

Our projects

- improve the representation of permafrost change in models;
 - Amene, Charles, Rose, Bingqian
- integrate information from observations (Theme 1/2) into new products/knowledge;
 - · Bingqian, Charles, Amene, Maria, Galina, Hannah
- provide informative projections of permafrost change that are well characterized in terms of uncertainty and contribute to understanding of hazards and adaptation (Themes 4/5);
 - Hannah, Galina, Charles, Amene, Rose
- and contribute to Next Practices around presenting and producing permafrost projections
 - · Galina, Hannah





Hazards and impacts associated with permafrost thaw



Pascale Roy-Léveillée



Jocelyn Hayley



Hazards and impacts associated with permafrost thaw

- Range of permafrost hazards studied
 - Mass-movements
 - Flooding
 - Biogeochemical cycling (mercury)
 - Changes in water quality
 - Terrain and vegetation changes in traditional territories
- New PostDoc!:
 - Permafrost Sci & Eng research in the context of permafrost hazard management



Hazards and impacts associated with permafrost thaw

What we contribute:

- Better understanding of stakeholder needs in relation to research (past and future directions)
- Improved knowledge, detection, and prediction of hazards in ways that support stakeholders

How we are connected to other themes:

- Integrate knowledge from themes 1-3
- Produce tools and knowledge that support theme 5





Adaptation to permafrost thaw







Ryley Beddoe



Adaptation to permafrost thaw

Quick Glance

- Purpose: Theme 5 goals are to provide practical approaches to mitigating thaw and on managing the changing hydrologic regime near infrastructure
- Activity: 6 Active HQPs, 15 affiliated HQPs, partner organizations, and support networks, etc.
- Staying Connected: Regular weekly meetings (during term), varying from guest lectures (partners, academics, HQP), informal discussions and chats.



Adaptation to permafrost thaw

Fieldwork!

Mayo area



Snow compaction to reduce ground temperatures, central Yukon







Maintenance costs of highways built on permafrost



\$4M for 0.5 km of thermosyphons, Alaska Highway

Yukon

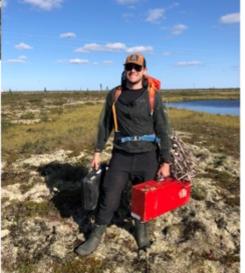


Adaptation to permafrost thaw



Fieldwork!

Hudson Bay Railway with Arctic Gateway Group







End