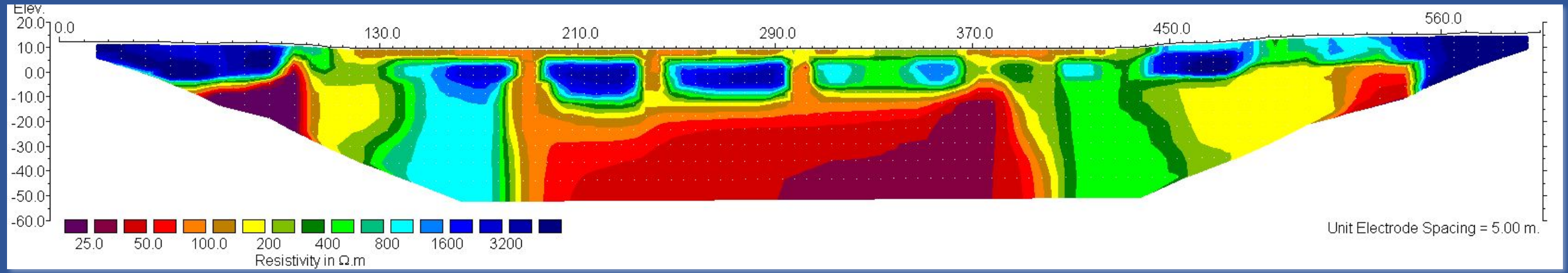


The Canadian Permafrost Electrical Resistivity Survey (CPERS) Database

Teddi Herring, University of Calgary

Antoni Lewkowicz, University of Ottawa

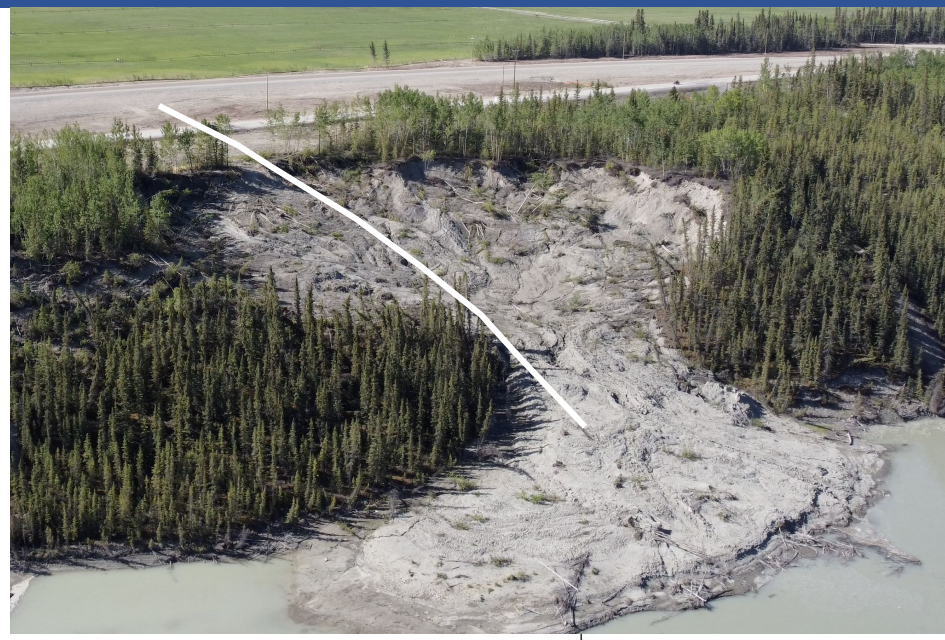
Electrical resistivity tomography (ERT)

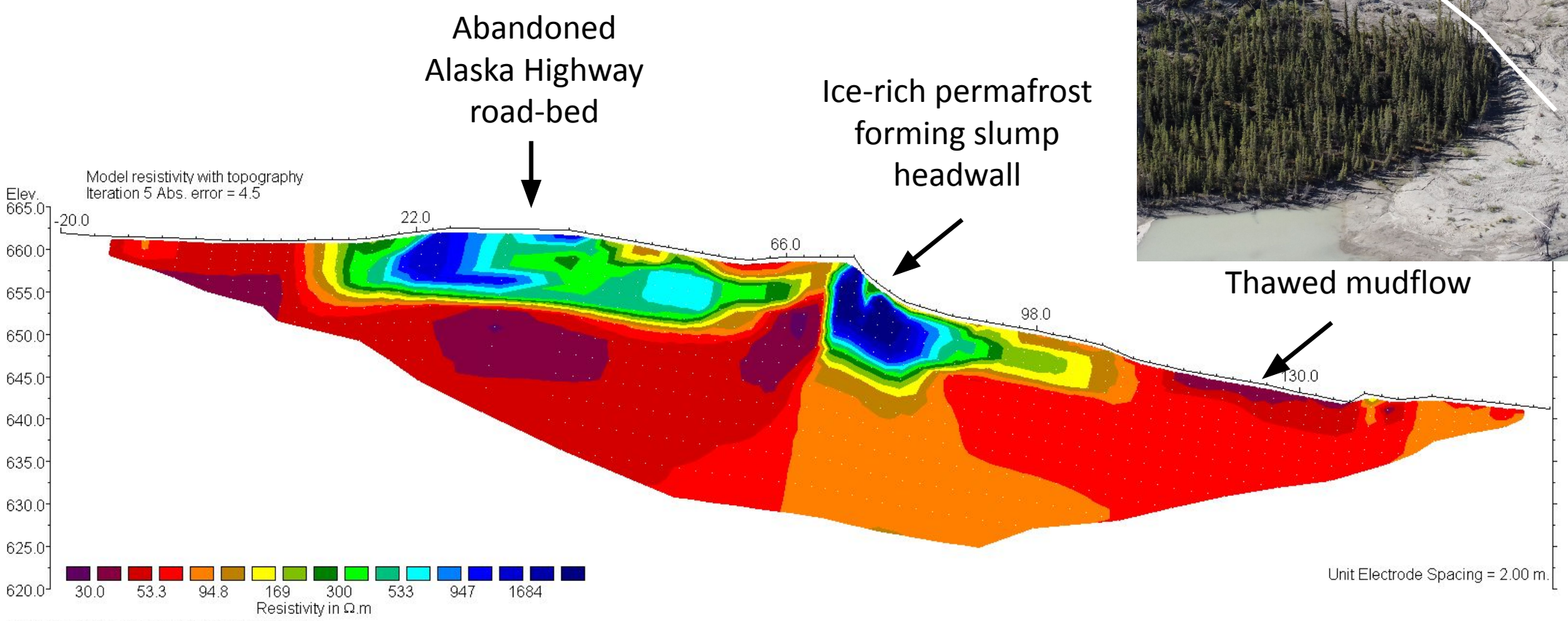
- ERT is a geophysical technique that uses small amounts of electricity to image the ground to depths of 5-50 m along a profile that is typically 50-500 m long.
- ERT is most useful as a complement to other ways of characterizing permafrost, such probing the active layer or measuring ground temperatures in a borehole.
- It extends knowledge of permafrost from a small area to two dimensions without any environmental disturbance or installations so it can be used at virtually any site, including in communities.
- Repeat ERT surveys are increasingly being used as a monitoring technique to measure permafrost change.

ERT survey across a gravel pad in Nain, Nunatsiavut

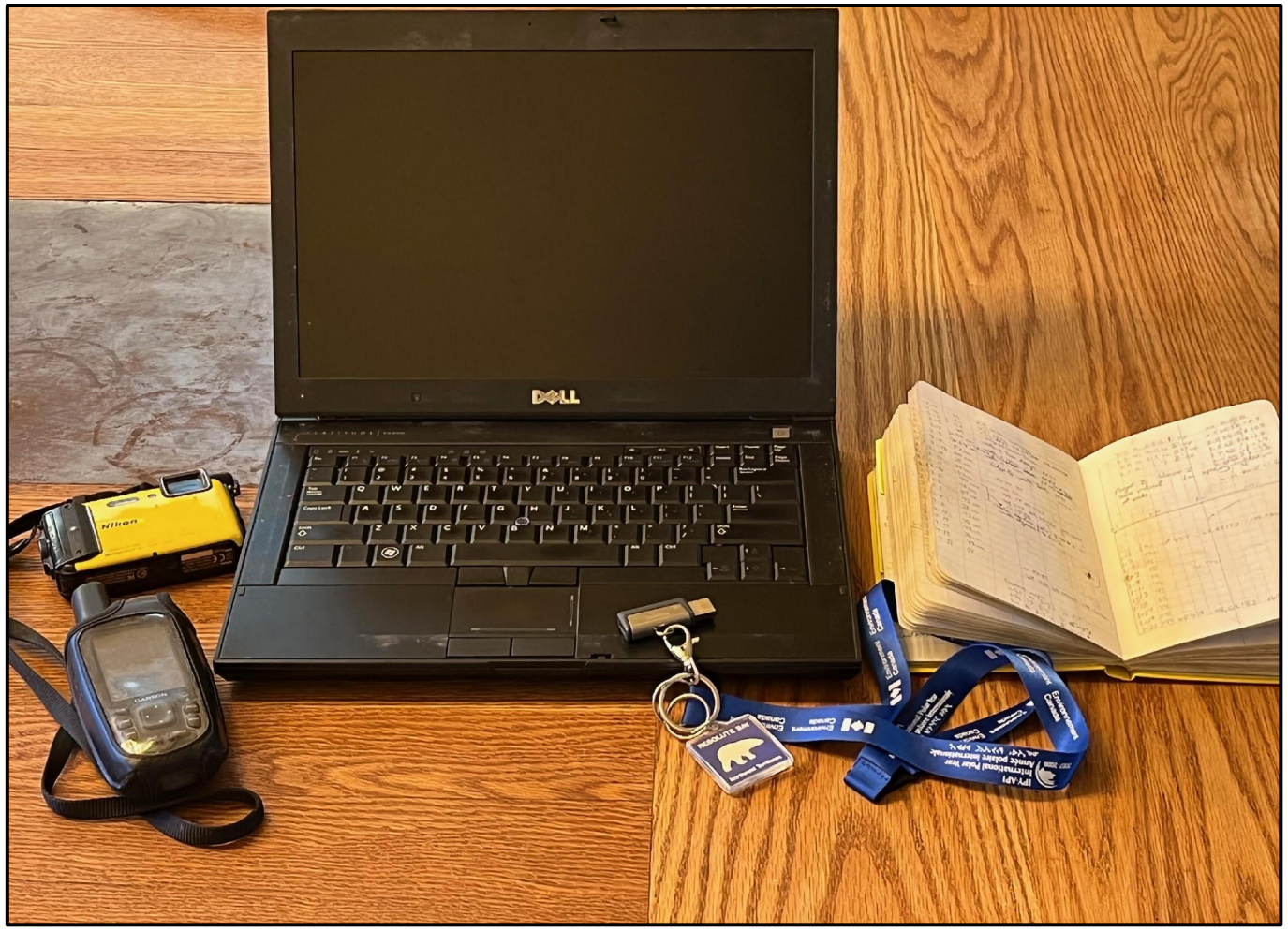
ERT survey beneath a building in Old Crow

ERT survey at the retrogressive thaw slump in the Ibex Valley near Whitehorse in June 2024



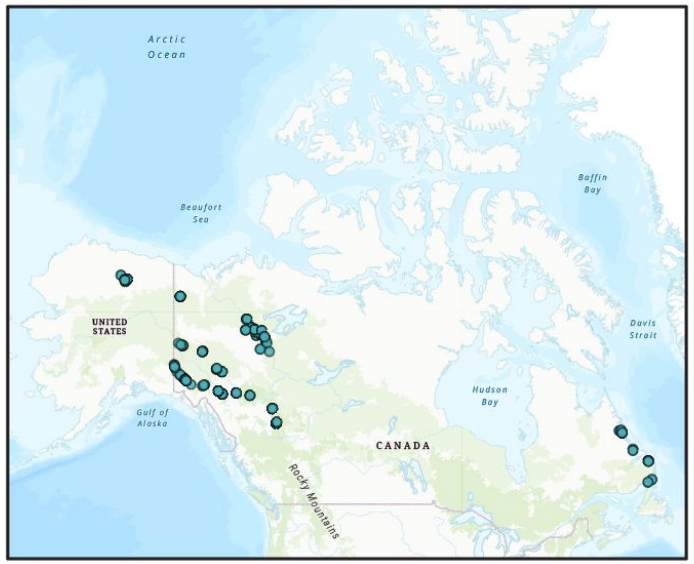


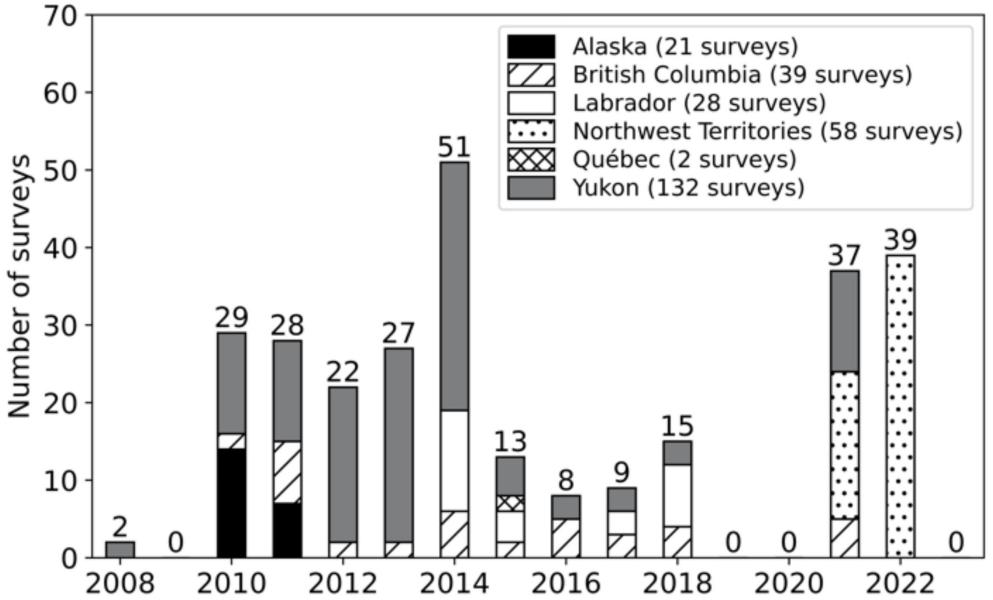
Motivation for a database



- Many ERT data are on personal computers and in the notebooks of individuals.
- They are inaccessible and at risk of being permanently lost.

CPERS database was created as a PermafrostNet project





Landform	Number of surveys
Active layer failure	2
Flat terrain (undifferentiated)	116
Flood plain	1
Ice wedge polygon	3
Lakeshore	2
Landslide (undifferentiated)	4
Lithalsa	3
Palsa	11
Peat plateau	56
Peatland (undifferentiated)	4
Retrogressive thaw slump	6
River channel	1
River terrace	4
Sloping terrain (undifferentiated)	49
Thermokarst mound	17
Undulating	1

209 profiles

280 surveys

15 profiles with time-lapse data

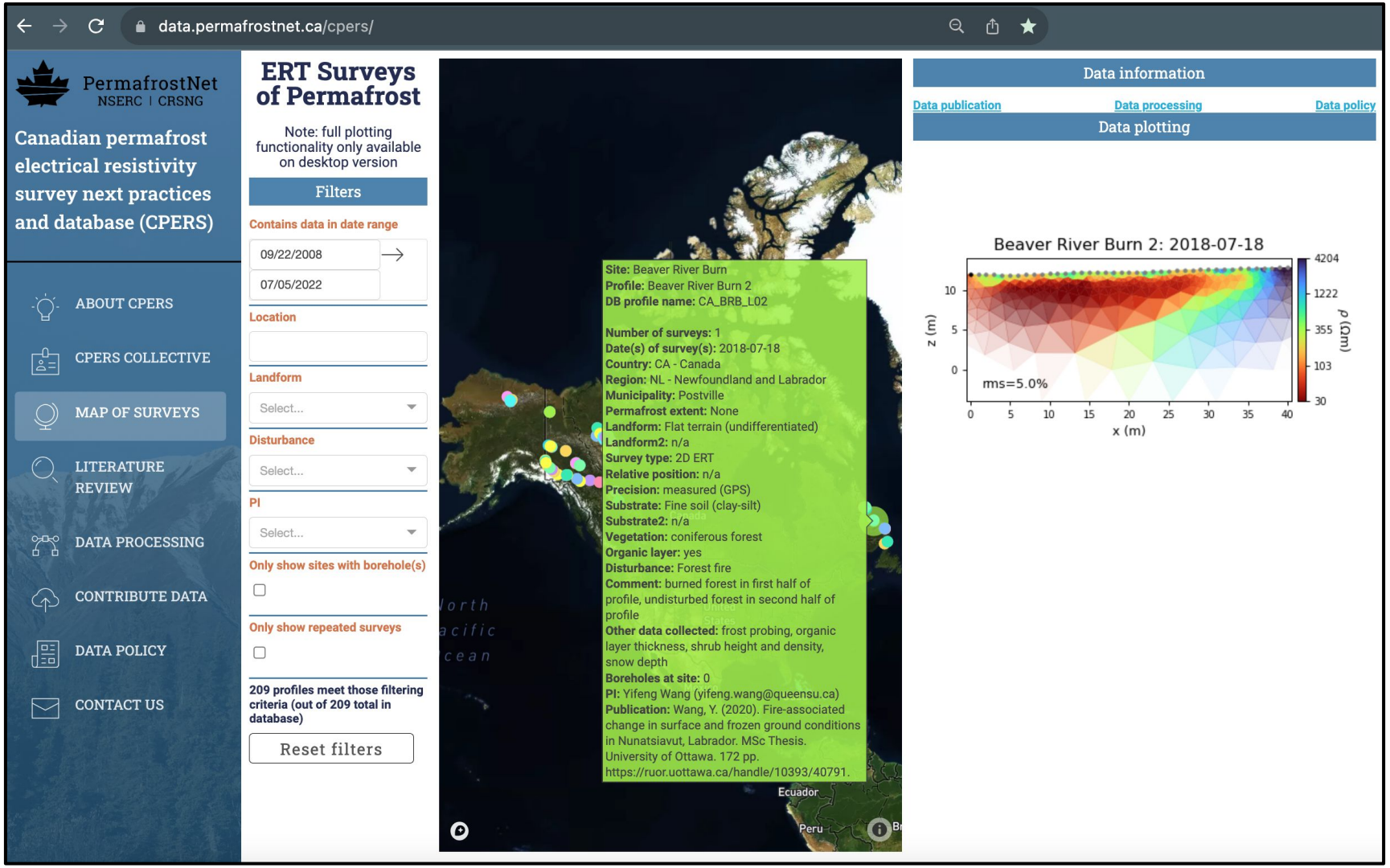
Datasets from 2008-2022

Populating the database relied on a network of willing contributors, from within PermafrostNet and from other researchers who support PermafrostNet goals.

16 landform types

Standardized metadata describing the landform, substrate, vegetation, organic layer, disturbace, etc. for each profile

Built an interactive web map



Archived the data

Nordicana D

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La base de données canadienne des relevés de résistivité électrique du pergélisol
The Canadian Permafrost Electrical Resistivity Survey Database (CPERS)

CPERS Collective

Résumé / Abstract

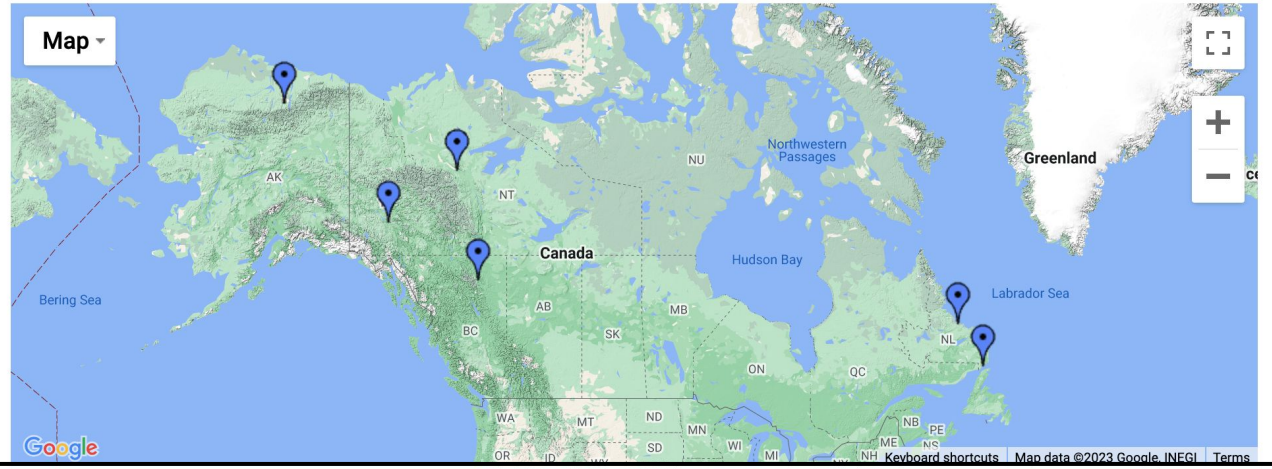
The Canadian Permafrost Electrical Resistivity Survey Database (CPERS) is a collection of electrical resistivity tomography (ERT) datasets collected in permafrost environments. The database currently contains sites in British Columbia, Newfoundland and Labrador, Northwest Territories, Quebec, Yukon, and Alaska. Each dataset provides information to interpret the presence and distribution of frozen and unfrozen ground along a profile where spatial extent and depth of investigation depend on the survey set-up. Metadata is currently available for 280 ERT surveys collected at 209 different profiles, with repeat surveys being conducted at 15 of those profiles. Raw ERT data is currently available for 123 surveys, while the remaining 157 datasets are currently embargoed and will be published within two years. Data were acquired between 2008-2022. Amalgamated site and borehole metadata are available as supplementary materials. This dataset will support a publication by Herring et al. (2023). The CPERS database project was funded by NSERC PermafrostNet. DATA POLICY: In order to use any of these datasets you MUST review and adhere to the CPERS data policy, which can be found at https://data.permafrostnet.ca/cpers/data_policy.html. ADDITIONAL RESOURCES: Please visit https://data.permafrostnet.ca/cpers/. This site includes an interactive map of survey locations where all datasets can be queried by several different parameters and processed data can easily be plotted. It also includes open-source ERT data processing tools and other helpful resources.

Citation des données / Data citation

CPERS Collective 2023. La base de données canadienne des relevés de résistivité électrique du pergélisol , v. 1.0 (2010-2022). Nordicana D121, doi: 10.5885/45855XD-DC9883ABD609428B.

CPERS Collective 2023. The Canadian Permafrost Electrical Resistivity Survey Database (CPERS), v. 1.0 (2010-2022). Nordicana D121, doi: 10.5885/45855XD-DC9883ABD609428B.

Carte de localisation / Location map



Described the database

Arctic Science

OPEN ACCESS | Data-paper

The Canadian Permafrost Electrical Resistivity Survey (CPERS) database: 15 years of permafrost resistivity data

Teddi Herring[a,b], **Antoni G. Lewkowicz**[a], **Alexandre Chiasson**[c], **Yifeng Wang**[a,d], **Robert G. Way**[a,d], **Joseph M. Young**[c], **Duane Froese**[c], **Sharon L. Smith**[e], **Brielle Andersen**[c], **Olivier Bellehumeur-Génier**[a,f], **Alexandre R. Bevington**[a,g], **Philip P. Bonnaventure**[a,h], **Maxime A. Duguay**[a,i], **Bernd Etzelmüller**[j], **Michael N. Gooseff**[k,l], **Sarah E. Godsey**[k,m], **and Christina M. Miceli**[a]

[a]Department of Geography, Environment and Geomatics, University of Ottawa, Canada; [b]Department of Civil Engineering, University of Calgary, Canada; [c]Department of Earth and Atmospheric Sciences, University of Alberta, Canada; [d]Northern Environmental Geoscience Laboratory, Department of Geography and Planning, Queen's University, Canada; [e]Geological Survey of Canada, Natural Resources Canada , Canada; [f]Transport Canada, Canada; [g]British Columbia Ministry of Forests, Canada; [h]Department of Geography and Environment, University of Lethbridge, Canada; [i]BGC Engineering , Canada; [j]Department of Geosciences, University of Oslo, Norway; [k]Department of Civil and Environmental Engineering, Penn State University, USA; [l]Department of Civil, Environmental and Architectural Engineering, University of Colorado Boulder, USA; [m]Department of Geosciences, Idaho State University, USA

Corresponding author: **Teddi Herring** (email: teddi.herring@ucalgary.ca)

Abstract

Permafrost landscapes are becoming increasingly susceptible to widespread thaw due to climate change. Collating historical and ongoing data are critical for assessing permafrost conditions and spatiotemporal changes. Electrical resistivity tomography (ERT) is a geophysical technique that has become standard practice for characterizing permafrost. However, resistivity data—particularly raw measurements—often go unpublished and unshared, resulting in missed opportunities for knowledge exchange and collaboration. To fill this gap, we created the Canadian Permafrost Electrical Resistivity Survey database and established clear guidelines for data archival and reuse. Here, we present the first release of the database, which currently houses 280 ERT datasets, including standardized metadata, collected between 2008 and 2022 in British Columbia, Labrador, Northwest Territories, Québec, Yukon, and Alaska. These data present unique opportunities to better understand spatial and temporal variability of permafrost conditions across North America.

Developed open-source data processing tools

github.com/teddiherring/CPERS/blob/main/data_processing_CPERS.ipynb

Files

main

Go to file t

- LICENSE
- README.md
- data_processing_CP...
- data_processing_CP...
- environment.yml

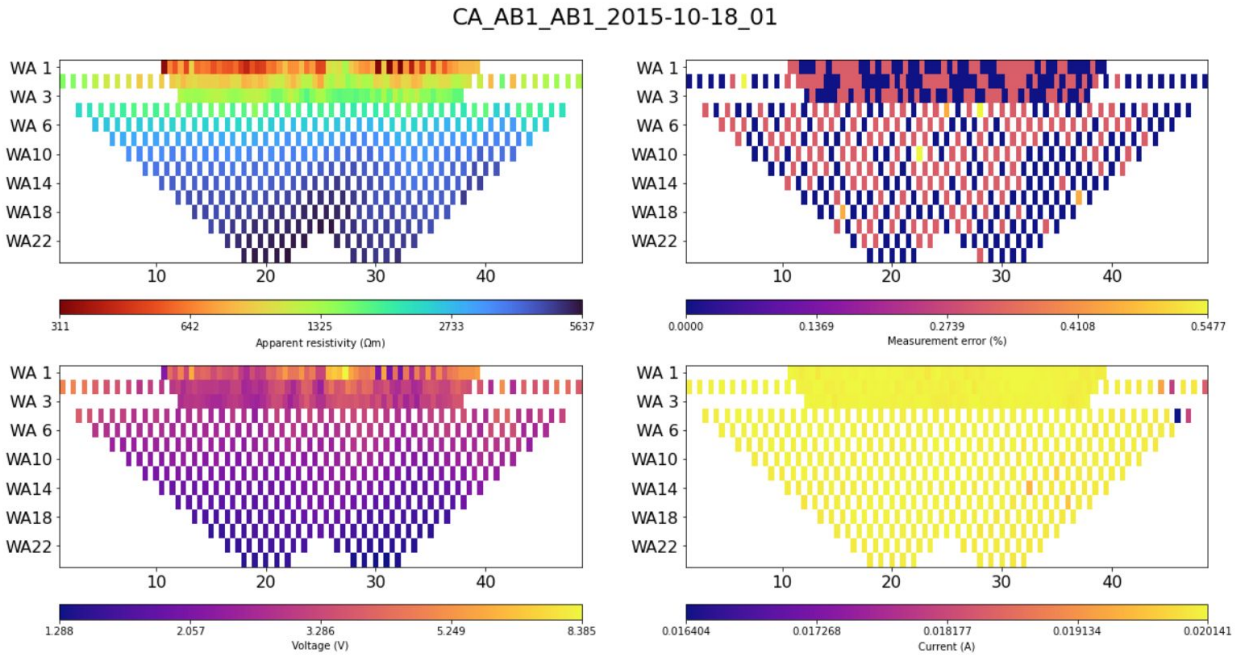
CPERS / data_processing_CPERS.ipynb ↑ Top

Preview | Code | Blame | 1052 lines (1052 loc) · 296 KB | Code 55% faster with GitHub Copilot | Raw

```
for a in ax.flat:
    a.tick_params(axis='both', which='major', labelsize=fs2)

plt.suptitle('%s'%(survey_name),fontsize=fs, y=0.95);

plt.savefig('observed_data.png',format='png',bbox_inches='tight')
```



Initial large-scale interpretations

Large-scale assessment of permafrost conditions using the Canadian Permafrost Electrical Resistivity Survey (CPERS) database

Teddi Herring[1], Antoni G. Lewkowicz[2], Robert G. Way[3], Yifeng Wang[3], Alexandre Chiasson[4] & Duane Froese[4]

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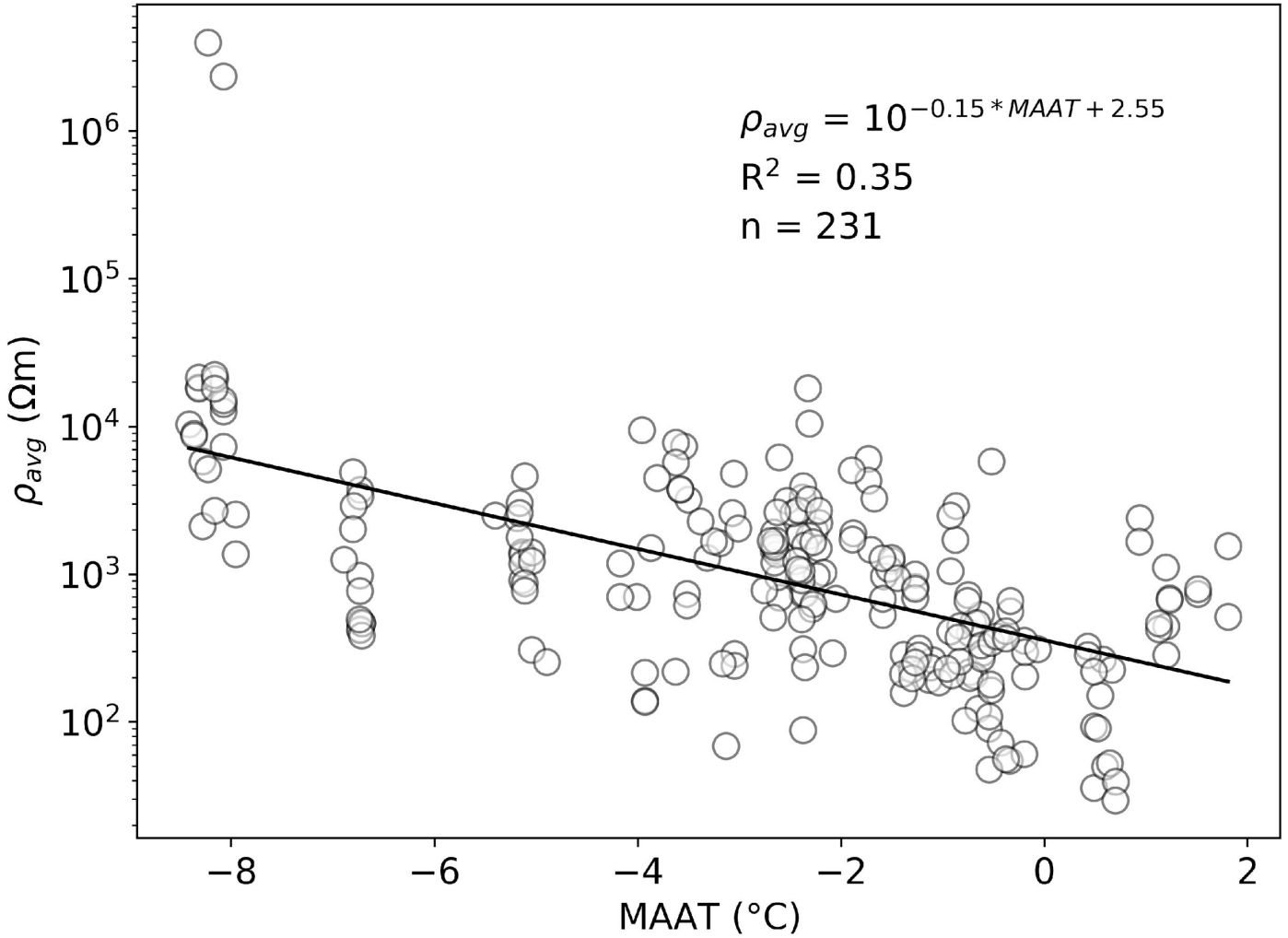
[2]*Department of Geography, Environment and Geomatics, University of Ottawa, Ottawa, Ontario, Canada*

[3]*Department of Geography and Planning, Queen's University, Kingston, Ontario, Canada*

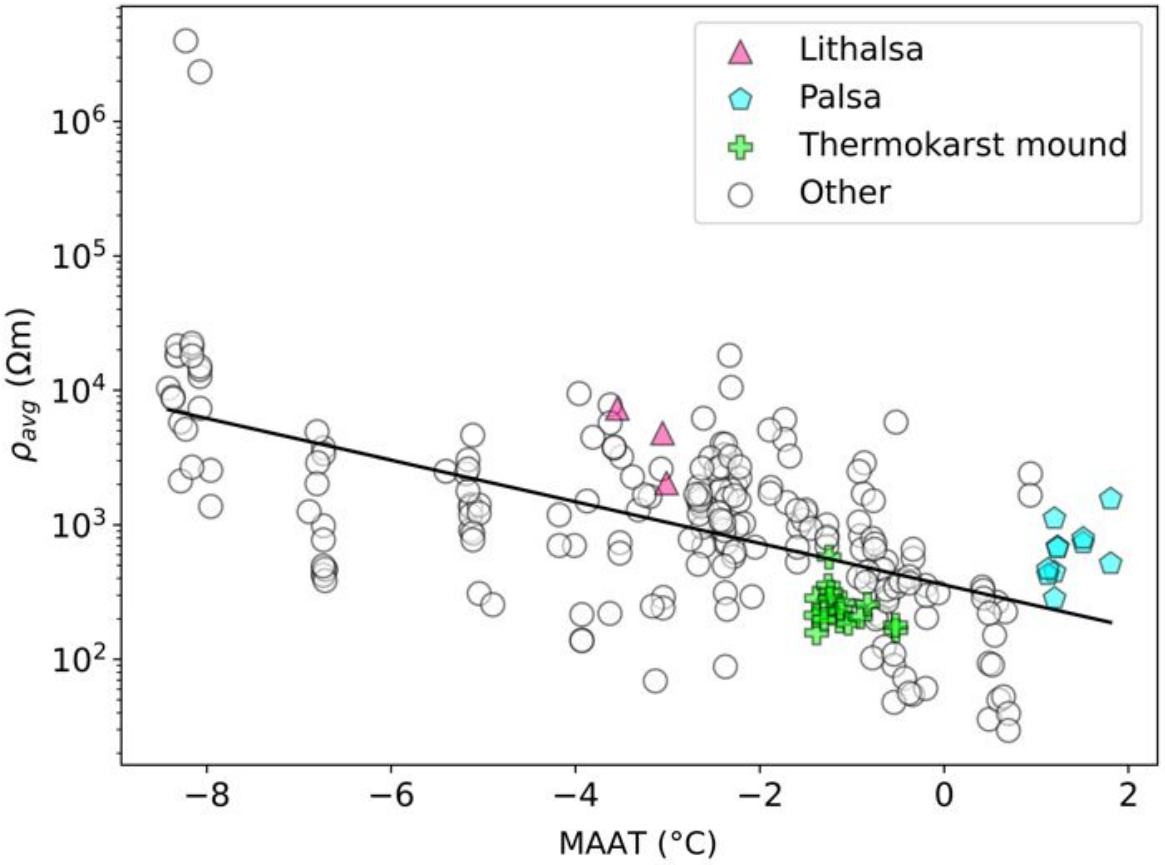
[4]*Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada*

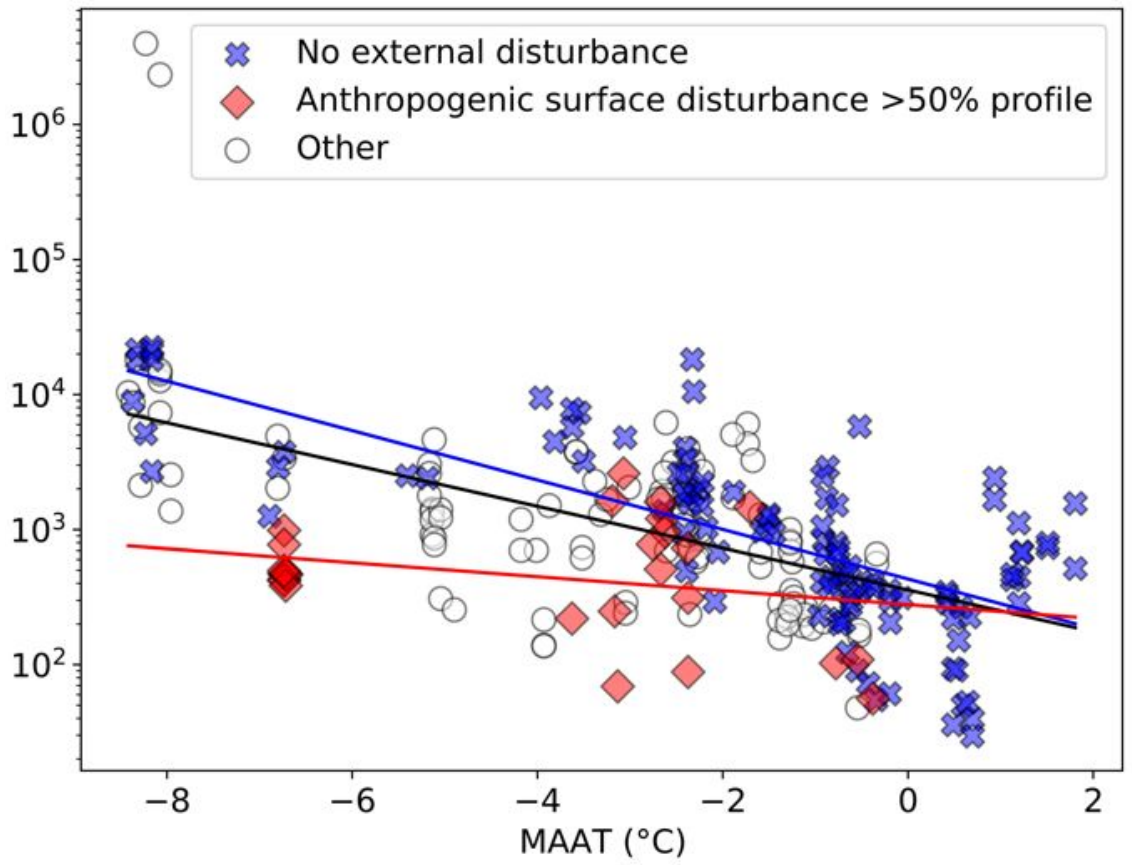
ABSTRACT

Electrical resistivity tomography (ERT) is a geophysical technique that is commonly used to investigate permafrost conditions because the resistivity of earth materials tends to increase greatly when they are frozen, particularly if they are ice-rich. Despite the increasingly widespread use of ERT for permafrost applications over the last 20 years, data sharing in Canada and most other countries has been limited. We created the Canadian Permafrost Electrical Resistivity Survey (CPERS) database as a platform for standardized and accessible sharing of historical and current ERT datasets collected in permafrost environments. Individual researchers from several Canadian institutions have already contributed 280 ERT datasets and associated descriptive, standardized metadata. These datasets were collected between 2008 and 2022 from sites in British Columbia, Labrador, Northwest Territories, Québec, and Yukon, as well as Alaska. Here, we used the published datasets to examine relationships between permafrost resistivity, climate data, and site conditions, including landform type, disturbance, and near-surface substrate. The findings show an inverse relationship between mean annual air temperature and permafrost resistivity, with variability controlled by site conditions. These analyses demonstrate the utility of the CPERS database for examining large-scale trends in permafrost conditions across northern North America, a usefulness that will increase in the future as additional datasets are incorporated.



Initial large-scale interpretations





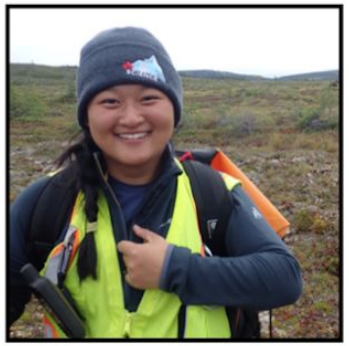
Modified from Herring et al. (2024). ICOP Proceedings

CPERS version 2.0 is under development

- Call for additional submissions of data went out in September 2024.
- Metadata for 181 new surveys received to date.
- Web-site and Nordicana D publication will be updated.

Major contributors to CPERS 1.0

Alex Chiasson



Yifeng Wang

Robert Way

Joe Young

Duane Froese

With field and project support from Alejandro Alvarez, Brielle Andersen, Olivier Bellehumeur- Génier, Alexandre Bevington, Philip Bonnaventure, Maxime Duguay, Bernd Etzelmüller, Michael Gooseff, Sarah Godsey, Christina Miceli, Sharon Smith, Casey Buchanan, Alain Cuerrier, Frédéric Dwyer-Samuel, Benoit Faucher, Luise Hermanutz, Zoé Kuntz, Caitlin Lapalme, and Allison Rubin.

Nick Brown

Etienne Godin

PermafrostNet
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Digital Research Alliance of Canada

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