Initial outcomes of the Canadian Permafrost Electrical Resistivity Survey (CPERS) database project

Teddi Herring[1,2] and Antoni G. Lewkowicz[1]

[1]University of Ottawa, Department of Geography, Environment and Geomatics
[2]University of Calgary, Department of Civil Engineering

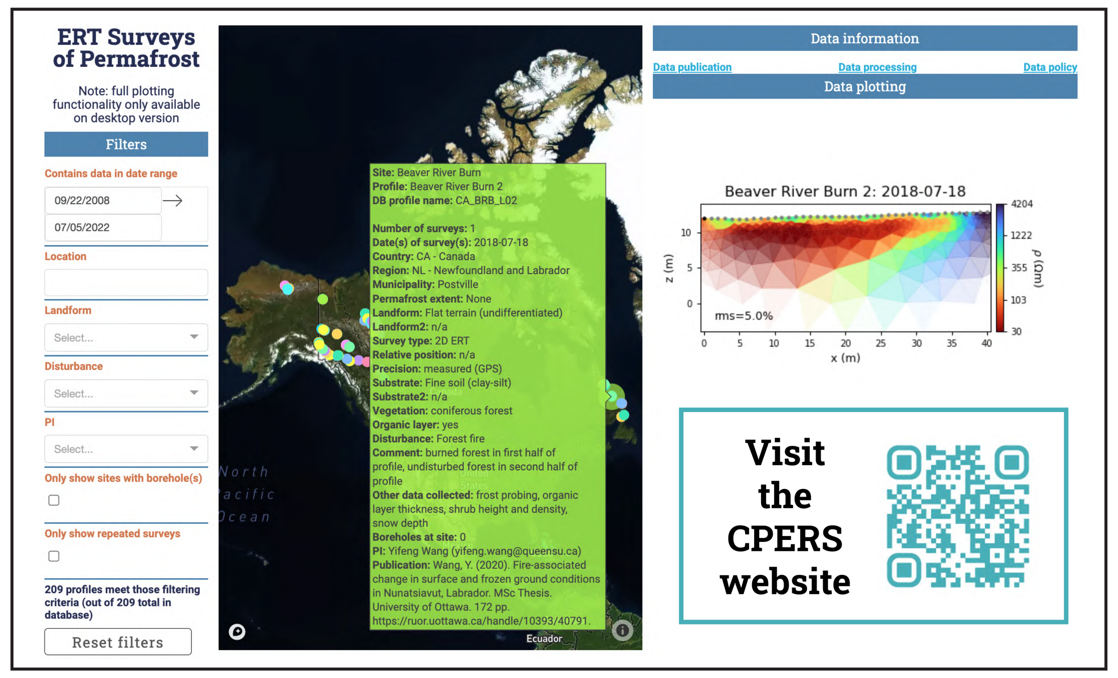
Motivation

Permafrost thaw affects landscapes, infrastructure, and communities across the North. Electrical resistivity tomography (ERT) is a geophysical method that is commonly used to map the distribution of frozen ground, but ERT datasets often go unpublished.

We created the Canadian Permafrost Electrical Resistivity Survey (CPERS) Database with the goal of **facilitating data sharing** between researchers, practitioners, and communities to **advance our collective understanding of permafrost conditions in Canada**.

Data availability

An **interactive webmap** can be found on the CPERS website. Data can be easily searched and visualized.



Visit the CPERS website

Archived data can be found in the Nordicana D data publication. This includes raw ERT data and descriptive, standardized metadata.

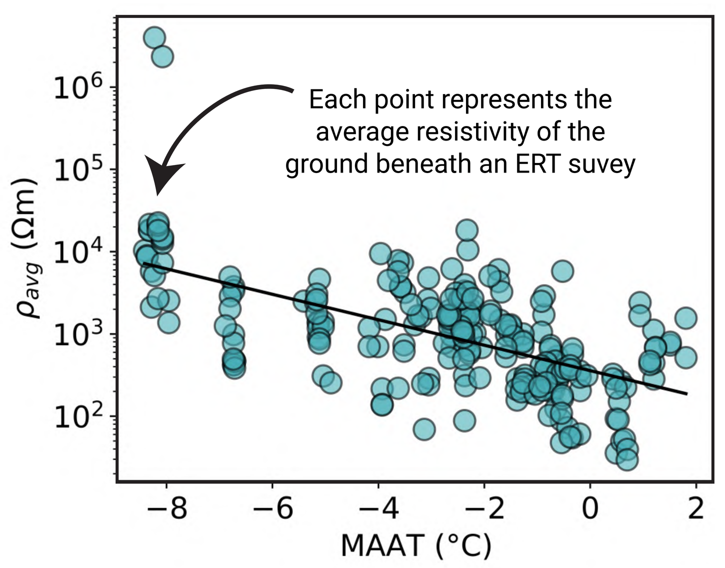
Nordicana D

Access the data

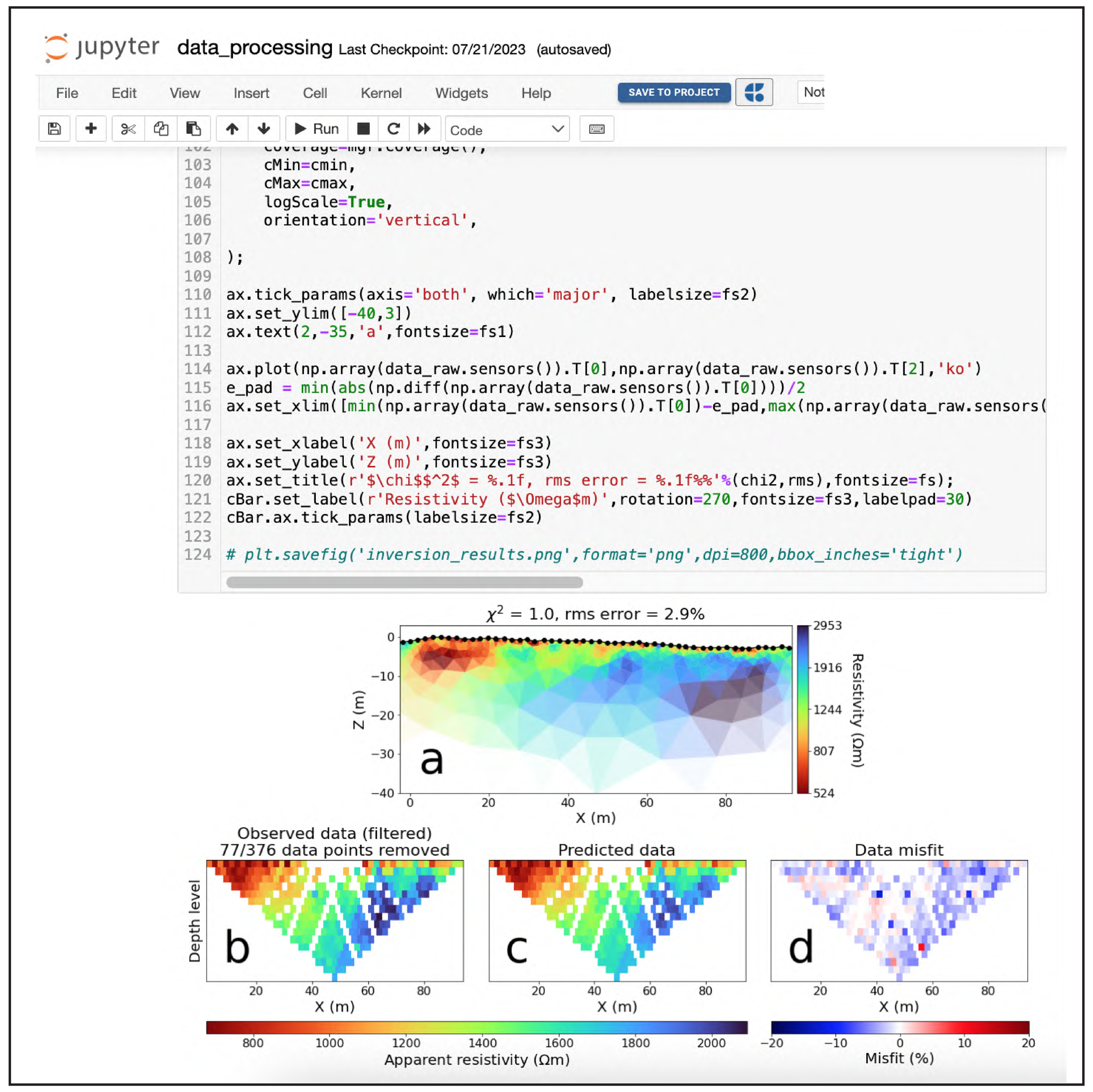
Outcomes

Improved data sharing

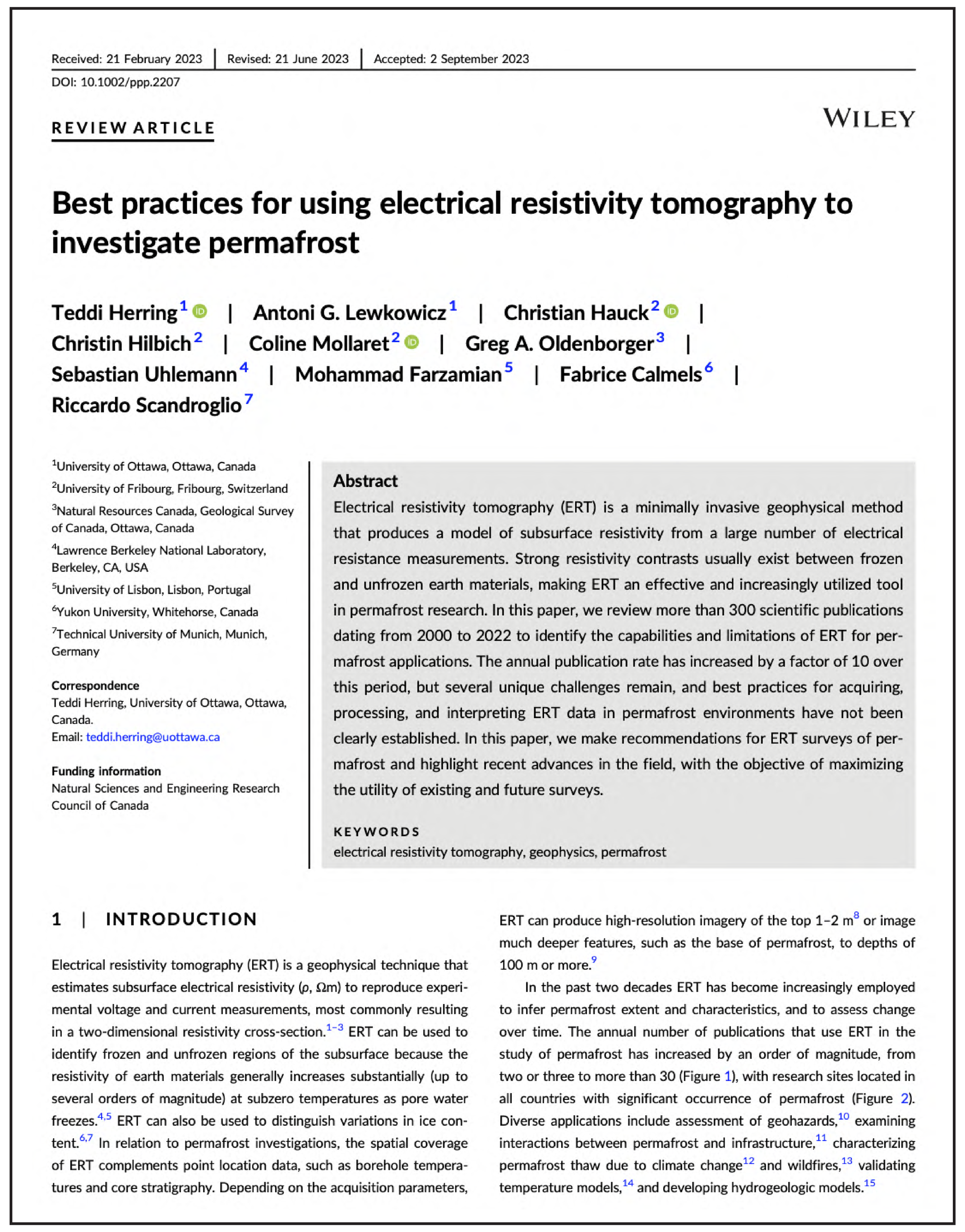
Large-scale permafrost assessments



Open-source data processing workflow



Best practices document



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REVIEW ARTICLE

WILEY

Best practices for using electrical resistivity tomography to investigate permafrost

Teddi Herring[1] | Antoni G. Lewkowicz[1] | Christian Hauck[2] | Christin Hilbich[2] | Coline Mollaret[2] | Greg A. Oldenborger[3] | Sebastian Uhlemann[4] | Mohammad Farzamian[5] | Fabrice Calmels[6] | Riccardo Scandroglio[7]

[1]University of Ottawa, Ottawa, Canada
[2]University of Fribourg, Fribourg, Switzerland
[3]Natural Resources Canada, Geological Survey of Canada, Ottawa, Canada
[4]Lawrence Berkeley National Laboratory, Berkeley, CA, USA
[5]University of Lisbon, Lisbon, Portugal
[6]Yukon University, Whitehorse, Canada
[7]Technical University of Munich, Munich, Germany

Correspondence
Teddi Herring, University of Ottawa, Ottawa, Canada.
Email: teddi.herring@uottawa.ca

Funding information
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Abstract
Electrical resistivity tomography (ERT) is a minimally invasive geophysical method that produces a model of subsurface resistivity from a large number of electrical resistance measurements. Strong resistivity contrasts usually exist between frozen and unfrozen earth materials, making ERT an effective and increasingly utilized tool in permafrost research. In this paper, we review more than 300 scientific publications dating from 2000 to 2022 to identify the capabilities and limitations of ERT for permafrost applications. The annual publication rate has increased by a factor of 10 over this period, but several unique challenges remain, and best practices for acquiring, processing, and interpreting ERT data in permafrost environments have not been clearly established. In this paper, we make recommendations for ERT surveys of permafrost and highlight recent advances in the field, with the objective of maximizing the utility of existing and future surveys.

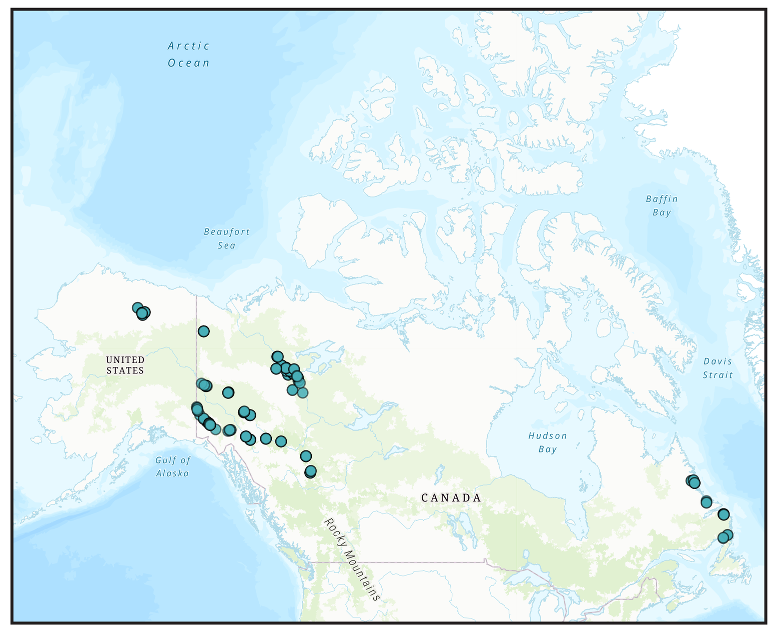
KEYWORDS
electrical resistivity tomography, geophysics, permafrost

1 | INTRODUCTION

Electrical resistivity tomography (ERT) is a geophysical technique that estimates subsurface electrical resistivity (ρ, Ωm) to reproduce experimental voltage and current measurements, most commonly resulting in a two-dimensional resistivity cross-section.[1–3] ERT can be used to identify frozen and unfrozen regions of the subsurface because the resistivity of earth materials generally increases substantially (up to several orders of magnitude) at subzero temperatures as pore water freezes.[4,5] ERT can also be used to distinguish variations in ice content.[6,7] In relation to permafrost investigations, the spatial coverage of ERT complements point location data, such as borehole temperatures and core stratigraphy. Depending on the acquisition parameters, ERT can produce high-resolution imagery of the top 1–2 m[8] or image much deeper features, such as the base of permafrost, to depths of 100 m or more.[9]

In the past two decades ERT has become increasingly employed to infer permafrost extent and characteristics, and to assess change over time. The annual number of publications that use ERT in the study of permafrost has increased by an order of magnitude, from two or three to more than 30 (Figure 1), with research sites located in all countries with significant occurrence of permafrost (Figure 2). Diverse applications include assessment of geohazards,[10] examining interactions between permafrost and infrastructure,[11] characterizing permafrost thaw due to climate change[12] and wildfires,[13] validating temperature models,[14] and developing hydrogeologic models.[15]

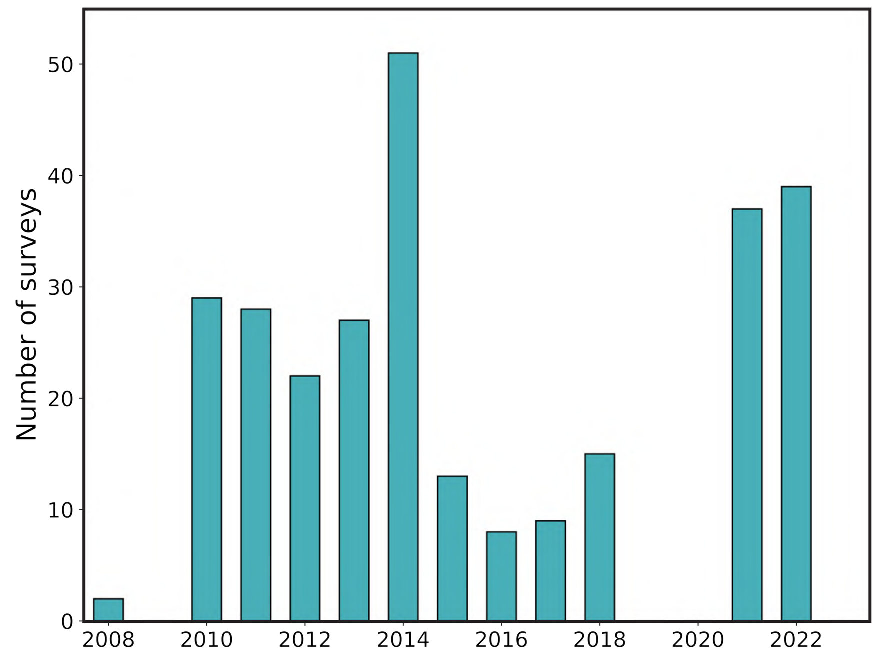
Database contents



209 profiles

280 surveys

British Columbia, Labrador, Northwest Territories, Quebec, Yukon, and Alaska



Data collected between

2008 - 2022

15 profiles with time-lapse data

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

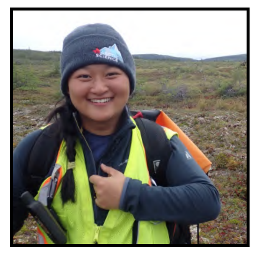
16 landform types

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

Data contributors


Dr. Antoni Lewkowicz

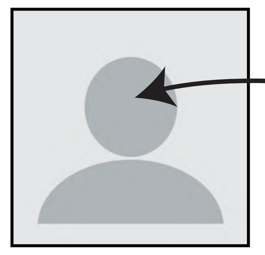

Alexandre Chiasson


Yifeng Wang


Dr. Robert Way


Joseph Young


Dr. Duane Froese


You?

Learn how to contribute your data

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.

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