# PhD opportunity: Simulation of permafrost change and quantification of confidence in resulting data products

Updated June 3, 2020.

This fully funded PhD studentship will be based at Carleton University in Ottawa, Canada. As part of NSERC PermafrostNet (permafrostnet.ca), the new Permafrost Partnership Network for Canada, it will have an outstanding training environment. A start in the Fall (September) term 2020 is anticipated; with flexibility in responding to e.g. COVID-19 related travel restrictions.

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**PROJECT:** This project will develop methods and tools for evaluating permafrost models with observational data. This is important because the lack of meaningful and quantitative evaluation of permafrost simulation results impedes the improvement of simulation tools and the use of their outputs for informing adaptation design or policy. This project will use the database compiled in NSERC PermafrostNet (PINGO) as a source of observational evidence to provide confidence in simulation-based permafrost climate services. This project will investigate how well ground temperature change and ground-ice loss can be predicted. For this, ensemble permafrost predictions will be analyzed in terms of error and uncertainty. Ensembles will use multiple re-analyses, downscaled heuristically, as driving climate, multiple models as well as multiple parameter and input data sets (e.g., estimated ground ice distribution, vegetation) for perturbed physics simulations in each model. Error and uncertainty will be statistically decomposed with respect to their likely origins to better inform model development and the use of model results. This quantitative evaluation will be complemented by investigating face validity, a concept developed to capture the trust that diverse experts, such as model developers, permafrost field scientists and northerners, place in simulation results based on subjective assessment.

The supervisor of this thesis will be Stephan Gruber (Carleton University) and the advisory group will include Joe Melton (University of Victoria / Environment and Climate Change Canada), Trevor Lantz (University of Victoria) and Steve Kokelj (Northwest Territories Geological Survey).

**PROFILE:** The successful candidate will have (1) a master's degree in a relevant discipline (e.g., geography, Earth science, geophysics, soil physics, atmospheric science, environmental engineering or geotechnical engineering); (2) demonstrated skill in programming and data analysis; (3) previous experience (or a demonstrated interest) in cold regions; as well as (4) excellent written communication in English.

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**FUNDING:** This PhD studentship is fully funded for twelve months per year, for up to four years. International students are now eligible to receive a bursary that will reduce their tuition to the amount paid by domestic PhD students.

**APPLICATION:** Send a cover letter, c.v., copies of transcripts, a writing sample, and contact details for three references to Stephan Gruber (stephan.gruber@carleton.ca). Applications will be received until the position is filled.

NSERC PermafrostNet and Carleton University are strongly committed to fostering diversity within their community as a source of excellence, cultural enrichment, and social strength. We

welcome those who would contribute to further diversification including, but not limited to women; visible minorities; First Nations, Inuit and Métis peoples; persons with disabilities; and persons of any sexual orientation or gender identity and expressions.

**ENVIRONMENT:** NSERC PermafrostNet is a pan-Canadian research network of 12 universities and more than 40 partner organisations, incorporating territorial, provincial and federal governments, Indigenous communities, industry, and international partners. It is funded for five years. Central activities such as network management and a data scientist will be housed in Carleton's new Advanced Research and Innovation in Smart Environments (ARISE) Building. The training environment in PermafrostNet maximises the research impact, job readiness and longer-term employability of its 60 graduate students, postdoctoral fellows and northern research assistants. Students and trainees will forge a broad network of connections and benefit from diverse experiences in universities, in Arctic fieldwork and during internships. The focus on data sharing, simulation and knowledge products for stakeholders will further support employability and academic excellence. Our training environment will be respectful, diverse, equitable and inclusive.

**Permafrost research at Carleton University** is prominent and based on multiple initiatives involving several faculties and researchers. The research of Chris Burn is focused on the relations between climate and permafrost, supported by long-term field investigations. He held a Northern Research Chair, recently received the Polar Medal from the Governor General of Canada and co-leads Theme 5 of PermafrostNet. Stephan Gruber joined Carleton in 2013 as a Canada Research Chair, investigates permafrost thaw and is the principal investigator of PermafrostNet. He has been co-editor-in-chief of The Cryosphere and a lead author in the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Shawn Kenny focuses on engineering practice related to pipelines and other infrastructure in cold environments. In PermafrostNet, he leads projects on infrastructure design and risk management. Peter Pulsifer is the new director of the Geomatics and Cartographic Research Centre, focusing on polar data, interoperability and sharing across knowledge domains. In PermafrostNet, he provides an interface with the Canadian Consortium for Arctic Data Interoperability. Steve Kokelj (Northwest Territories Geological Survey), Stephen Wolfe (Geological Survey of Canada) and Peter Morse (Geological Survey of Canada) are Adjunct Professors and key collaborators in PermafrostNet. Many other faculty members at Carleton work in permafrost environments with fields of expertise that include glaciology, human geography, cybercartography, public policy, engineering and Earth science. The permafrost research group at Carleton has close ties, and joint seminars with, researchers from other institutions in Ottawa such as the Geological Survey of Canada, the Canada Centre for Mapping and Earth Observation, the National Research Council and the University of Ottawa. Boosted by the eight PhD students and three master's students added by PermafrostNet, there will be a cohort of 15–20 graduate students working on permafrost research concurrently during the coming five years. This critical mass is further increased with the interdisciplinary master's program in Northern studies and the collaborative master's in data science that are offered at Carleton. As the leading institution in PermafrostNet, Carleton will host the research manager and the data scientist.

As Canada's capital, **Ottawa** provides unique opportunities for research and engagement with diverse groups and institutions nationally and internationally. It has a population of almost one million and reflects the country's bilingual and multicultural character. The proximity of the Gatineau Park makes Ottawa attractive to outdoor and sports enthusiasts.