PhD position

Towards a better representation of wind slabs in Arctic snowpacks within the SVS2-Crocus model

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Project

At high latitudes, snow covers the ground for most of the year. Due to its high albedo and low thermal conductivity, snow regulates air temperature near the surface, in addition to influencing the soil thermal regime. In the Arctic, snow cover is typically structured in two layers with contrasting physical properties. The lower layer consists of depth hoar, which is not very dense and is a poor heat conductor. The layer just above it is a wind slab – it is much denser and conducts heat more effectively. This layer is the focus of the proposed PhD project. While the processes responsible for the densification of this wind slab are known (fragmentation of snow grains under the effect of wind, sheltering effect of low vegetation, water vapor flux from the underlying layer), their relative importance in the Arctic is poorly documented. This results in an imperfect representation in the SVS2-Crocus snow model, which is currently being developed for the next version of Environment and Climate Change Canada's hydrometeorological forecasting platform.

This PhD project aims to enhance the SVS2-Crocus model's representation of the processes responsible for the densification of wind slab layers in the Arctic snowpack. First, various existing parameterisations will be tested using available Arctic snow datasets. Next, a measurement campaign will be conducted in Ikaluktutiak (Cambridge Bay, Canada), in close collaboration with the local community and another research team that is very active at the site. These in situ measurements will enable us to develop parameterisations of the effects of wind and vegetation on wind slabs, while also capturing their spatial variability. The candidate will also collaborate with another PhD student in our team who is working specifically on water vapour fluxes in snow, as well as with the Snow research centre in France.

Funding of 30,000 CAD/year available for 4 years, plus a supplement of 3,000 CAD/year from Université Laval's Faculty of Science and Engineering and teaching assistant contracts. Possible start date: September 2025 or January 2026. The student will be supervised by Professor Daniel Nadeau (Université Laval) and co-supervised by researcher Vincent Vionnet (Environment and Climate Change Canada).

Institution

Université Laval (UL) is the oldest French-speaking university in North America. It is home to some 47,000 students in 17 faculties, 60 departments and schools, and nearly 400 undergraduate and graduate programs in all fields of knowledge. Université Laval offers strong graduate programs in northern research. Although it is a French-speaking university, it is very common to complete graduate studies in English.

Required Qualifications and Skills

- MSc degree in engineering, physics, environmental sciences or geography
- Desirable: experience in data analysis, modeling and/or field work
- Motivation, teamwork and communication skills
- Programming experience (Python, R, Matlab or equivalent)

Application

Please email Prof. Daniel Nadeau (daniel.nadeau@gci.ulaval.ca) and Dr. Vincent Vionnet (Vincent.Vionnet@ec.gc.ca) with your CV, a short cover letter, examples of previous research (M.Sc. thesis or published articles), and the names of two references.