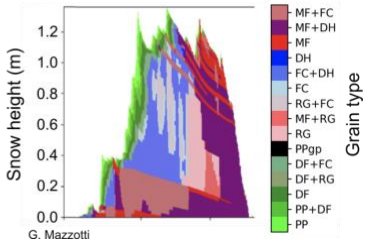
PhD position

Towards a better representation of snow in the boreal forest within the SVS2-Crocus model


D. Nadeau


J. Labelle



G. Mazzotti

Project

If the forest were an isotropic environment, as many models assume, forecasting spring floods would be much easier. However, the forest is a mosaic of closed-canopy zones and gaps of various sizes. This complex structure has multiple hydrological repercussions during the winter months. For instance, it modulates snow accumulation on the ground, which is greater in the gaps than under the canopy due to interception. It also controls the drivers of snowmelt, which vary considerably across the landscape, as well as the ground's thermal regime and infiltration capacity. In SVS2-Crocus, the model being developed for the next version of Environment and Climate Change Canada's hydrometeorological forecasting platform, the canopy is described as a homogeneous medium. This prevents the model from capturing the heterogeneous nature of the snow on the ground.

The aim of this PhD project is to improve the representation of interactions between snow and boreal forests within the SVS2-Crocus model by including the effects of canopy heterogeneity (i.e. the presence of gaps and areas of closed canopy) on the snowpack. The first phase of this project will be based on field work. This will involve detailed monitoring of snow stratigraphy in the boreal forest, building upon our team's existing experimental set-ups at two sites in the Canadian boreal forest. The candidate will then gain familiarity with the high-resolution forest snow model, FSMCRO, by comparing model outputs with observations. Based on FSMCRO, SVS2-Crocus will be simplified to account for heterogeneous canopies. These new implementations will then be tested against our observations and on a larger scale in different boreal forest biomes.

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 dates: as soon as possible in 2026. The student will be supervised by Professor Daniel Nadeau (Cold Regions Hydrology Laboratory – HydroNord, Université Laval) and co-supervised by researcher Giulia Mazzotti (Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement – Grenoble).

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
- Strong motivation, ability to work in a team and good communication skills
- Programming experience (Python, R, Matlab or equivalent)

Application

Please email Prof. Daniel Nadeau (daniel.nadeau@gci.ulaval.ca) and Dr. Giulia Mazzotti (giulia.mazzotti@inrae.fr) with your CV, a short cover letter, examples of previous research (M.Sc. thesis or published articles), and the names of two references. Only selected applicants will be contacted.