PhD project – Analysis of Water and Energy Budgets in a Subarctic Experimental Watershed at Laval University, Quebec City

Where You Will Study

Université Laval (UL) is the oldest French-language university in North America. UL is a comprehensive university boasting some 48,000 students—a quarter of them graduates—as well as 17 faculties, 60 departments and schools, and nearly 400 undergraduate and graduate programs in every field of knowledge. **Université Laval offers strong graduate programs in northern research.** Although graduate studies at Université Laval can be carried out in English, the candidate will be strongly encouraged to learn French.

What You Will Do

We propose an exciting opportunity for the candidate to develop a set of skills at the interface of snow sciences, hydrology and micrometeorology, by working on one of the most heavily instrumented high-latitude basins in the world. Hydrometeorological models adapted to northern weather forecasting, climate change projection, and water resources modelling have yet to be developed. In the subarctic region, snow can cover the ground from as early as October until as late as June, making it a key – yet challenging to study – component of the water cycle. This project aims to measure and to better understand fluxes of energy and water along the full soil-snow-vegetation-atmosphere continuum. To do so, the candidate will have access to a unique set of observations, including continuous measurements of the soil and snow thermal conductivities, as well as eddy covariance data of the turbulent fluxes of heat above the snowpack. Of particular interest is the detection of water vapor fluxes in the snowpack and their effect on the snow density profile. The student will also analyze the energy budget in the snow-free summer period, along with a study of the water budget at the catchment scale. The project builds on an existing network of hydrometeorological observations, including monitoring of streamflow discharge and groundwater flow, deployed in a 2.1 km^2 watershed near Umiujaq, Canada (56.5°N, 76.5°W), along the coast of Hudson Bay. The acquisition of this dataset will support the development of advanced operational models through a complementary PhD project. This work is part of the highly funded Sentinel North program, designed to develop innovative tools in optics-photonics and improve our understanding of the northern environment and its impact on human beings and their health.

Experimental site near Umijiaq, Canada in the summer season (left) and in the winter (right).

What You Need

Academic background:

- MSc degree in Engineering, Physics, Environmental Sciences or Geography
- Experience in data analysis and field work
- Strong skills in written and oral communication of research results in English

Technical/computational skills:

- Competence with analysis and scripting in MATLAB or similar analysis language

Application

Please send an email to Prof. Florent Domine (florent.domine@takuvik.ulaval.ca) and Prof. Daniel Nadeau (daniel.nadeau@gci.ulaval.ca) with your CV, a short motivation letter, examples of previous research (M.Sc. thesis or published papers), as well as the names of two referees.