

Consortium for Permafrost Ecosystems in Transition (CPET)
Year 1 Update for BC Oil and Gas Research and Innovation Society

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Background:

Northeastern British Columbia and the adjacent southern Northwest Territories are among the most rapidly warming regions on Earth, and are experiencing unprecedented industrial expansion. Climate warming and human disturbance in the NEBC-NWT border region has led to widespread permafrost thaw and landcover change that has disrupted the hydrological cycle and the ecosystems and human activities that depend on it. The hydrological implications of this land-cover transformation remain poorly understood. As a result, there is an urgent need for an improved understanding of, and ability to predict, permafrost thaw and its hydrological consequences. In response to this need, the Consortium for Permafrost Ecosystems in Transition (CPET) has been formed. CPET consists of University researchers with partners from industry, local communities in NEBC and NWT, and government. CPET will investigate hydrological and ecological changes resulting from permafrost thaw in the border region, develop and mobilise knowledge of these changes, develop predictive modelling tools, and provide interactive training on these tools to our partners in industry, government and communities, including First Nations.

Objectives:

The CPET has five objectives:

- 1) Map the changing spatial distribution of permafrost, wetland and forest coverage over the past 60 years using aerial photography, satellite and light detection and ranging (LiDAR) images.
- 2) Conduct field studies for different ground thaw and moisture conditions to improve the understanding of the volume and timing of runoff from a) peat plateau–bog complexes and b) the adjacent channel fens, which convey the runoff that they receive from plateau–bog complexes to streams and rivers. For each setting, the water flux and storage processes that control runoff will be examined.
- 3) Simulate the major water flux and storage processes controlling runoff from the plateau–bog complexes using the cold regions hydrological model (CRHM) and the Raven hydrological modelling framework and, where needed, make improvements to both models based on the improved process understanding arising from objective 2.
- 4) Improve the ability to characterize permafrost impacts at larger scales through field investigation and subsequent adaptation of the northern ecosystem soil temperature (NEST) regional-scale permafrost model to handle the unique thaw response of bogs, fens and plateaus.
- 5) Use information generated from the improved hydrological models (objective 3) and the permafrost model (objective 4) to estimate future quantities of runoff and surface water storage within boreal and subarctic landscapes with discontinuous permafrost under possible scenarios of climate warming and human disturbance.

Overview of Year 1 progress:

Significant progress toward CPET objectives was made in Year 1 of the project. Particular highlights are:

- Two new experimental research basins were established in NEBC (Gote Creek and Suhm Creek). These new basins were selected to act as companion research basins to the previously established Scotty Creek site (1999-present), approximately 175 km north in NWT. Together, Suhm, Gote and Scotty basins provide end-members of a north to south transect traversing the southern zone of sporadic discontinuous permafrost. These basins enable significant insights into the development, parameterization and evaluation of hydrological models in the zone of sporadic discontinuous permafrost. It is noted that a wide range of work has been previously completed in Suhm, Gote and neighbouring NEBC basins by other academic researchers and professional consultants to the oil and gas industry. Some of these datasets were collected by CPET industry and academic partners and have been made available for research use.
- Many new talented post-doctoral fellows, graduate students and technicians were recruited to complete research toward CPET objectives. These personnel are supervised by CPET investigators, based at four different universities, and are receiving state of the art training and experience in areas such as field techniques, computer based modelling and geomatics.
- Several major field trips were completed by CPET researchers to the remote Gote, Suhm, and Scotty Creek basins in fall 2015, spring 2016 and summer 2016. An immense volume of data was, and is continuing to be, collected from manual sampling and automated instruments deployed at the sites measuring hydrological, ecological and climate variables. In addition, a considerable amount and variety of remote sensing data has been collected over CPET field sites enabling land-cover mapping, spatial analysis and development of datasets for ingesting into hydrological modelling.
- There has been an emphasis on outreach and networking with community members in the study region, presenting early science results at meetings with academic audiences, and hosting CPET science workshops. In addition, a growing number of CPET partnerships with industry, government and other research organizations have been developed.

A Year 1 timeline of key project activities are listed below:

Personnel recruitment –

September 2015: MSc Student Olivia Carpino at U of Guelph (supervisor: Aaron Berg) joins CPET as a student researcher.

October 2015: Dr. Justin Adams joins CPET as a Research Associate. He is responsible for leading research and assisting in project management and outreach.

January 2016: Elise Devoie joins CPET as a MASc student in Engineering at University of Waterloo (supervisor James Craig).

May 2016: Three ecology researchers join CPET working with supervisor Dr. Jennifer Baltzer, at Wilfrid Laurier University - Post-doctoral fellow Dr. Christoforos Pappas, PhD student Katherine Standen and MSc student Meagan Warkentin.

July 2016: Funding for MITACS accelerate internship positions (2016-2018) with CPET industrial partner Nexen were confirmed to fund new CPET post-docs and PhD students at Wilfrid Laurier University.

August 2016: a dedicated CPET research technician has been recruited to oversee logistical operations with field-work and manage the data and maintenance for the growing network of automated instruments across the three CPET field sites.

Field work –

June 2015: Bill Quinton, Aaron Berg, Oliver Sonnentag and Jennifer Baltzer completed a field-trip to NEBC to identify prospective field sites in the region. Two experimental basins (Gote Creek and Suhm Creek) were selected to act as southern end-members of the CPET north-south transect traversing the southern margin of the zone of discontinuous permafrost.

October 2015: Bill Quinton and Justin Adams conducted a 10-day field trip to NEBC to launch four new climate monitoring stations at CPET sites in Northeastern BC at Gote Creek and Suhm Creek. Bill and Justin worked with Eva Needlay, a technician from Fort Nelson First Nation. Eva's local knowledge was very valuable.

March 2016: A field-work trip to the CPET field sites at Scotty Creek, NWT, Suhm Creek, BC and Gote Creek, BC was led by Bill Quinton. Climate stations were maintained and snow surveys were done at all three sites. Eva Needlay from Fort Nelson First Nation assisted with the work in NEBC. Several students remain posted at Scotty Creek camp for the next couple of months completing their research.

May – August 2016: CPET ecologists Jenn Baltzer, Katherine Standen, Meagan Warkentin and Christoforos Pappas commenced field-work at CPET sites in BC and NWT (Suhm Creek and Scotty Creek) installing Sap Flow sensors and sampling parameters of trees. Eva Needlay from Fort Nelson First Nation assisted the team in NEBC.

August 2016: Bill Quinton leads a two-week 10-person trip to Scotty Creek, NWT to conduct field research in support of CPET research objectives.

Community outreach, science reporting, project meetings and new networking –

June 2015: James Craig and William Quinton lead a Raven hydrological modelling workshop in Yellowknife for the scientists at the Government of Northwest Territories.

November 2015: Shawn Williams at Nexen presented a poster describing CPET research and partnerships to the annual KNOWvember symposium at Nexen Centre in downtown Calgary. Shawn is a lead contact at CPET industrial partner Nexen.

November 2015: Bill Quinton, James Craig and Justin Adams travelled to Nexen head office in downtown Calgary to conduct a knowledge transfer session with Nexen staff about future hydrological modelling work in the NEBC region.

November 2015: CPET affiliated students Ryan Connon, Bhaleka Persaud and Olivia Carpino presented an update of their research at the annual Scotty Day meeting at Wilfrid Laurier University.

January 2016: A Geoscience BC article was published by Drs. Quinton, Adams, Baltzer, Berg, Craig and Johnson describing CPET in the 2015 Summary of Activities section. This can be found here <http://www.geosciencebc.com/s/SummaryofActivities.asp>

February 2016: a Ducks Unlimited Canada data sharing agreement was signed as well as discussions on opportunities for informal collaboration going forward

March 2016: A very productive CPET science meeting was held at Wilfrid Laurier University. Research objectives and logistical plans for the upcoming field season were refined.

March 2016: Bill Quinton and Justin Adams held meetings with community leaders from Jean-Marie First Nation, Liildlii Kue First Nation, Sambiaa K'e First Nation and the town of Fort Simpson.

April 2016: CPET research associate Justin Adams travelled to Ottawa and met with Government Scientists at Natural Resources Canada to discuss a strategy for NRCAN-CPET collaboration, knowledge and data transfer going forward. A software sharing agreement was completing to further completion of some CPET science objectives.

May 2016: CPET student researchers Ryan Connon, Bhaleka Persaud, and Olivia Carpino presented some of their thesis research at the Canadian Geophysical Union annual meeting in Fredericton, NB.

June 2016: CPET researchers William Quinton, Justin Adams and Ryan Connon presented research findings at the 11th International Conference on Permafrost in Potsdam, Germany.

August 2016: Dr. James Craig hosted a CPET hydrological modelling workshop at Wilfrid Laurier University. Many CPET affiliated researchers participated including several new CPET affiliated researchers from University of Western Ontario.

August 2016: work for a CPET website is nearing completion and it is set to released this month at coldregions.ca