Fine-scale water balance in boreal forest impacts onfire susceptibility and severity

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Background: The Western Boreal Plain of Canada is characterized by a mosaic of forest and peatland ecosystems. Wildfire is a key component of the ecohydrological functioning of these environments with an average fire return period in the order of 120 years. The Canadian Forest Fire Danger Rating System (CFFDRS) is used operationally to warn decision makers of the level of risk from forest fire. CFFDRS is comprised of two subsystems, the Canadian Forest Fire Weather Index (FWI) System and the Canadian Forest Fire Behaviour Prediction (FBP) System. The system is used throughout the world, including within the UK by the Met Office. However, the CFFDRS system is limited due to its empirical nature and the focus of the FWI on a single forest stand type. As a result, projections of wildfire risk have to be interpreted by the user for the specific forest of interest. Projections are also applied only to infer large scale ecosystem susceptibility to fire despite the small scale variations in forest ecohydrology.

You will investigate the water balance in a Canadian boreal forest with a view to understanding fire risk and how the moisture content of the litter, moss, soil and undergrowth affect the fire susceptibility and severity. You will work with the Canadian Forest Service towards developing an appropriate landscape warning system for key areas within Alberta, Canada. This region is home to the Albertan oils sands which accounts for 175 billion barrels of oil. You will combine fine-scale ecohydrological process understanding with improved canopy information to infer small sale variations in landscape vulnerability to combustion. Specifically, this will focus on areas which have undergone recent ecological shifts and have been identified as regions of high vulnerability to fire. Spending a minimum of 2 months (up to 6 months) at the Canadian Forest Service, you will develop and apply this detailed process based knowledge to produce high resolution landscape vulnerability maps across the mosaic of different landscape types. This will inform fire managers, future fire mitigation strategies and Oil Sand restoration strategies who urgently require such knowledge of the vulnerability of Boreal ecosystem to fire.

Methods: The Boreal Ecohydrological Tree Algorithm (BETA) will be developed to simulate the progression of wildfire through Boreal forests. This will be integrated with an enhanced version of the peatland smouldering and ignition model (PSI; developed by project partner within the Canadian Forestry Service; CFS). The PSI model will be developed through detailed laboratory based smouldering experiments conducted at the CFS fire laboratory and within the UK. The latter will utilize detailed X-ray Computed tomography (CT) scans of burned peat samples to enhance model parameterisations. Model simulations will be evaluated against detailed field data of the stand hydrology and fuel moisture content of the different fuel components within central Alberta, Canada.

Partners: The student will be registered at the Birmingham University and co-supervised by the University of Leicester. The Canadian Forest Service is a project partner and will provide logistical support for fieldwork as well as data and expertise.

Applicants should apply via http://www.birmingham.ac.uk/postgraduate/courses/research/gees/geog-environ-sciences.aspx where they should click on ‘Apply now’ and choose the option ‘PhD in Department of Geography and Environmental Science (Physical Geography)’ and give the PhD title in the ‘Funding details’ section of the online application.