Introducing: Understanding fire behaviour in mountain pine beetle disturbed vs. managed fuel complexes using novel data sources

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The mortality of lodgepole pine from mountain pine beetle in Alberta's eastern slopes is a concern for communities due to the drying of trees and the development of fine fuels for wildland fire. In recent years, we have observed fires burn through communities. This is no doubt on the mind of citizens living in Jasper, Alberta and other montane communities in Alberta and British Columbia. Typically, fires spread most easily through fine fuels, including needles, narrow branches, and grasses, which dominate the vertical structure in the early years following mountain pine beetle attack. With time, and as branches and needles break down leaving larger tree boles, we expect that the risk for fire spread from dead trees will decrease, while post-disturbance regeneration of pine may increase fire risk after a few years.

Despite these observations, there have been relatively few studies on how fires spread in mountain pine beetle-affected forests and across attack phases, limiting understanding of the hazards of fires to communities within these rapidly changing environments. To improve understanding, fire behaviour models can be used to estimate fire movement, under certain weather conditions and with different tree structural attributes. Models can be empirical or physics-based; empirical models provide a generalised estimate of fire behaviour and physics-based models use 3D

Federal-Provincial MPB Research Partnership

Mountain Pine Beetle remains a severe threat to Alberta's pine forests despite the province making positive progress in controlling its spread within the province and reducing the risk to the rest of Canada.

Natural Resources Canada and Alberta Agriculture and Forestry have provided funding to a suite of projects with the goals of limiting the spread of Mountain Pine Beetle and mitigating damages where it has already invaded.

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fuel structures. While more computationally intensive, physics-based models are more appropriate in areas where fuels deviate from what would be considered structurally typical for that fuel type.

By using physics-based models with field and remotely sensed geospatial data, we have an opportunity to better understand how fire behaves within these environments, and how disturbed forests can be modified to alter fire behaviour. The integration of remote sensing with fire behaviour models may provide an important next step for fuel identification and management, especially near communities that are at risk for wildland fire.

Fallen trees and dry woody branches create fine fuels for wildland fire.

Objectives

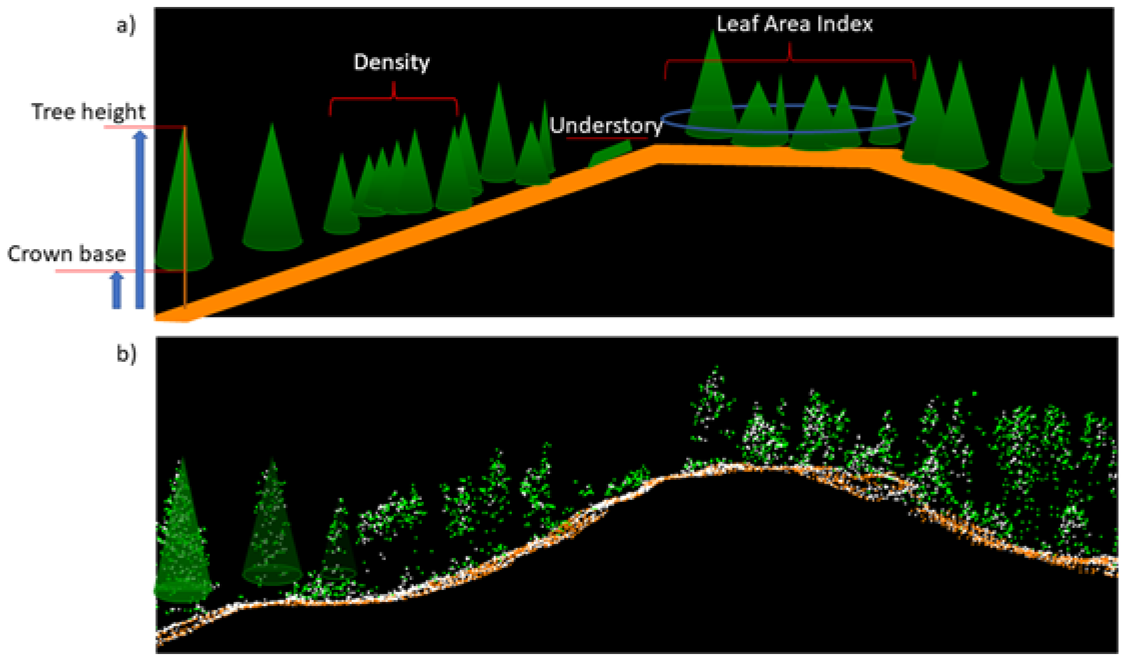
The overall objective of this research is to understand how fire might behave across different mountain pine beetle attack phases using a physics-based fire model applied to a variety of novel data sources, including field measurements and airborne lidar data. Field data can be used to create a 'virtual' fuel environment by placing measured trees within an area to be burned within the model. Here, we expand on this idea by using 3D tree structures measured by lidar with iterative modifications. Two questions include:

1. How do mountain pine beetle-disturbed forest fuel structures influence fire behaviour? Does fire behaviour vary when using field vs. lidar-based parameterization of a physics-based model?
2. If we virtually manage the forest, how do different strategies alter modelled fire behaviour following mountain pine beetle attack?

Measuring fuels in red-attack phase mountain pine beetle lodgepole forest.

Expected Outcomes

From this project, we will develop the use of geospatial data sources to better understand how fire behaviour varies across phases of mountain pine beetle disturbance. Use of lidar data inputs will be compared with field-based methods to determine whether lidar measurements could replace field measurements as an input to a physics-based fire behaviour model (all else being equal). This will provide a basis for understanding the implications of different attack phases for the Town of Jasper. The results will be disseminated in journals and conferences. We will also work with colleagues at Jasper National Park to improve fire management practices within the park, and especially within the context of a fire fuel map within an existing project with fRI Research.



Schematic comparison of a) 3D primitives developed along a 40 m x 4 m transect from field measurements and b) 3D point cloud of the same forest measured in a) from airborne, moderate point density lidar data. Some field-based fuel measurements, including tree height, density of ladder fuels, leaf area, etc. simplify vegetation structures observed using lidar measurements, however other attributes of fuels (e.g., fine downed woody debris) may not be easily identified in lidar data (b). How sensitive are behaviour models to measured inputs?

Implications for Land Management

Understanding the distribution of fire fuels is important for fire management. This project will enhance these activities by providing a range of scenarios indicating how fire will behave under specific conditions. From these examples, we will be able to identify areas where fire may burn with greater intensity and severity, and areas that require immediate fuel management to mitigate risk to the community. By developing these methods, we will contribute significantly to the integration of field and remote sensing methods for incorporating fire models as a critical next step in our understanding of fire behaviour.

Expected Social, Economic, and Ecological Value

This project will provide Jasper National Park and the Town of Jasper with a better understanding of the implications of mountain pine beetle on fire behaviour. In the short term, steps can be taken to improve fire management strategies and the regeneration of healthier forests. As a case study, this research will also build on new research that integrates field data with remote sensing and modelling to improve our understanding of fire risk for communities across Canada**.**

For more information on this project, contact Dr. Chasmer at laura.chasmer@uleth.ca