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Investigating the Lack of Pit/Mound Microtopography in Subalpine Forests of the Canadian Rockies

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This investigation is a followup to our earlier study analyzing tree throw and associated sediment transport in Hawk Creek Watershed, Canadian Rockies (Gallaway et al., 2009). The motivation for the present study is that landscapes in subalpine forests in the Canadian Rockies do not show the pronounced pit/mound microtopography found in some other forests, such as some deciduous forests of eastern North America or coniferous forests in western British Columbia, Canada. Given the impact that pit/mound topography can have on both soils and hydrology, it was decided to investigate why some forests demonstrate notable pit/mound microtopography while other forests do not. First, we analyze field data from our study drainage basin in the Canadian Rockies to define the sizes of pit/mound features in these forests and how slope gradient influences pit/mound dimensions. Next, we test a series of possible formulae to simulate degradation for different sizes of pit/mound features in profile form for slopes ranging from 10 to 30 degrees. For slopes of zero or near-zero gradient, our field results show that the majority of sediment from the root plate is returned to the pit and does not form a distinct pit/mound feature; this finding is in agreement with other studies in the published literature. Our model results show that the magnitude of a pit/mound feature and the choice of formula to simulate pit/mound degradation play key roles in determining pit/mound longevity. Finally, we connect our earlier numerical model of tree population dynamics in the Canadian Rockies to a numerical model of pit/mound degradation to explore how these elements combine to influence landscape microtopography over time. At any time, the density and size of pit-mound features on the landscape is a function of pit/mound formation rates (not necessarily constant) and the rate of pit/mound degradation (Schaetzl and Follmer, 1990). Our tree population dynamics model is driven by wildfire disturbance which initiates development of the forest, with the model cycling through generations of forest based on tree recruitment and mortality rules. Algorithms define the size of root plates for trees that topple, and this information is used to assign the dimensions of each pit/mound feature. Over time, degradation processes act to diminish the individual pit/mound features that form as trees topple. Changes in microtopographic expression of the landscape surface over time in response to different sets of controlling variables are examined.