THE EFFECT OF SLOPE-SCALE SPATIAL VARIABILITY OF SLAB CHARACTERISTICS ON PROPAGATION SAW TESTS

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EXTENDED ABSTRACT

Understanding propagation in complex, non-uniform terrain is critically important for avalanche forecasting and mitigation. Currently our understanding of how propagation varies at the slope-scale is limited, particularly on complex wind loaded slopes with a wide variation in slab properties. Guy and Birkeland (2013) investigated the spatial variability of snow structure in complex terrain, but did not definitively tie that variation back to stability. This study investigates the variability of slab properties (depth, SWE, hardness), and how that variability affects Propagation Saw Test (PST) cut lengths.

We collected data from eight transects on seven slopes in southwest Montana during the 2015-16 winter. The primary buried weak layer consisted of depth hoar and faceted grains ranging from 2 – 5 mm. We sampled transects either downslope or cross slope, depending on which direction offered the greatest variability from wind loading (Figure 1). Each transect consisted of five pits, and we determined spacing between individual pits by changes in snow depth and/or slope angle. We used two metrics to determine the variable spacing *d* between pits: 1) an increase or decrease in height of snow (HS) ≥ 10 cm or 2) an increase or decrease in slope angle ≥ 3 degrees. In each pit we performed three PSTs and one Compression Test (CT), as well as one Extended Column Tests (ECT) in the first, last, and middle pit of the transect (Figure 1).

Strong positive linear correlations exist (Pearson's *r* p-values < 0.02) between PST cut lengths and slab depth, slab snow water equivalence (SWE), slab bridging index, and total snow depth for two transects, while strong negative linear correlations exist (Pearson's *r* p-values < 0.03) between PST cut lengths and these same slab characteristics for one transect. The other five transects did not have any statistically significant linear correlations (Pearson's *r* p – values > 0.05).

The variable results in our simplified approach may be partially explained by some insights into critical cut lengths provided by Schweizer et al. (2016) and Gaume et al. (2016). Both show that critical cut lengths increase with increasing slab stiffness and weak layer specific fracture energy, and decrease with increasing load. Our data collection did not directly measure these mechanical parameters, though slab characteristics such as depth and bridging index are likely positively correlated with slab stiffness and SWE provides a measure of load.

Next season we will utilize thin – blade penetrometer measurements (Borstad and McClung, 2011) to index some properties of the weak layer and to hopefully help to explain some of the variability we are observing. In addition, we also plan to utilize LiDAR and Structure from Motion (SfM) data to build surface models of field sites with and without snow. Being able to quantify the temporal changes and spatial variability of snow depth may provide valuable information to better understand variations in snow distribution. Combined with additional statistical analyses, we hope this work will help us better understand the variability of crack propagation in complex, non-uniform terrain.

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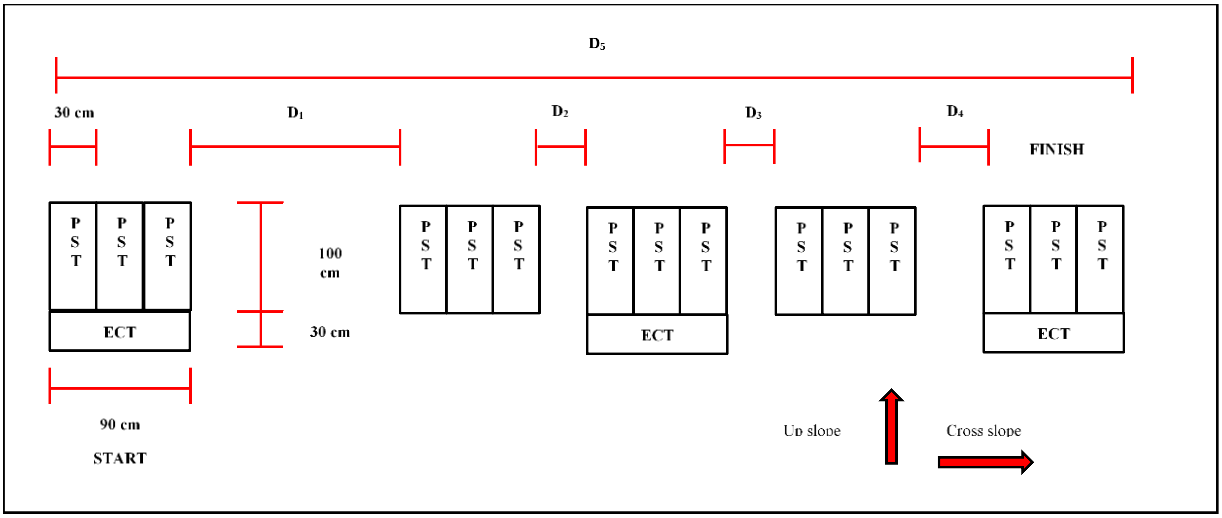

Fig. 1: Cross slope transect plot layout. Dimensions (meters) of ***d*** are determined after sampling height of snow with a standard avalanche probe. We utilized the same layout in a downslope direction for our downslope transects.

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