Size/frequency power-law relationships for several groups of snow avalanche paths

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Abstract. Our poster summarizes the results of Birkeland and Landry (2002), where we direct the interested reader for more details on this research. Our results show scale-invariant relationships between avalanche frequency and size in several groups of avalanche paths. Specifically, data from Gothic, Colorado, Bridger Bowl, Montana, Jackson Hole, Wyoming, and Snowbird, Utah demonstrate loglinear relationships, or power-laws, for both natural and artificially released avalanches. We also analyzed a group of snow avalanche paths at Yule Creek, Colorado for their response to 104 storms, showing that a power-law exists between the magnitude and frequency of the resultant avalanche cycles. Recently, other researchers have also documented a number of power-laws associated with snow avalanches, including acoustic emissions, crown crack heights, and crown crack lengths (Louchet *et al*., in press; Dendievel *et al*., 2002; Faillettaz *et al*., 2002a; Faillettaz *et al*., 2002b), as well as presenting evidence that slab avalanching is a chaotic process (Rosenthal and Elder, 2002). Several other natural hazards, such as earthquakes and forest fires, exhibit similar power-law relationships (Drossel and Schwabl, 1992; Olami *et al*., 1992; Malamud *et al*., 1998). Our results, as well as our avalanche forecasting experience, suggest that snow avalanches may exhibit self-organized criticality (Bak *et al*., 1987; 1988; Bak and Chen, 1991), an observation recently backed up by the research of others (i.e., Louchet *et al*., in press; Dendievel *et al*., 2002). Frequency-size relationships for small and medium sized avalanches, and avalanche cycles, may be useful for quantifying the risk of rarer large snow avalanches, and avalanche cycles, within a given group of avalanche paths.

Keywords: avalanches, power laws, size/frequency distributions, scale invariance, self-organized criticality

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