Snow depth scaling properties examined at multiple spatial extents

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Abstract. Measurements and models of spatially variable snowpack properties are subject to scaling issues. The choice of a measurement or modeling spacing or resolution imparts an inherent scale bias, limiting the representation of actual variability in the observed property or process. In this context, knowledge of how snowpack properties change with scale is critical to sampling and model design. Scaling effects have been characterized as having three components (the 'scale triplet'): 1) support – the area or volume integrated by a measurement; 2) spacing – the distance interval between measurements; and 3) extent – the overall size of the area under consideration. The choice of these three parameters, and any changes in them as a part of subsequent modeling or data manipulation, potentially induces scaling errors.

Recent work has demonstrated spatial snow depth distributions scale as multifractals, with coherent power-law behavior over multiple scale ranges separated by relatively sharp boundaries where process dynamics change. These studies have examined scaling properties dependent on changes in spacing of measurements. However, they have focused primarily on extents of 1 km^2. It is critical to understand if these scaling relationships hold for areas of different extent. In the work presented here, a scaling analysis examining spacing changes is repeated for a range of extents from 100 to 1100 m. The overall scaling pattern is found to be preserved over the range of extents examined, though variability between individual subsets increases as the extent is decreased.