Analysis of the scaling characteristics of snow depth in the Colorado Rocky Mountains

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Abstract. Previous studies on the spatial variability of snow have focused on determining the influence of wind, terrain, vegetation and other variables on the spatial distribution of the snow cover. Even though these studies have provided valuable information on the characteristics of the spatial distribution of snow, little is known about the statistical and scaling characteristics of the snow cover in different environments. This study focuses on the analysis of the statistical and scaling characteristics of snow depth, based upon the analysis of snow depths collected during the spring periods of 2002 and 2003, as part of NASA's Cold Land Processes Experiment (CLPX) in the state of Colorado (USA). Transect snow depth data and Light Detection And Ranging (LIDAR) snow depths distributed on nine 1-km^2 areas are studied to determine scaling behavior of snow depth. Logarithmic plots of $E[X_\lambda^n]$ versus scale (λ), and power spectra are analyzed to determine possible scaling behavior of snow depth. Log-log linearities between specified moments and length scale, and power spectra with segmented power law shape were obtained, indicating that snow depth fields possess scaling characteristics, supporting the hypothesis that snow related variables might present self similar behavior. Results from this study will support the application of scaling theories on the study of the spatial variability of snow cover properties, and on the development of upscaling and/or downscaling snow cover properties.