Application of synthetic generation techniques for illustrating the differences between the spatial organization of snow depth fields in sub-alpine forest and alpine tundra

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Abstract. In this study, differences in the spatial organization and scale invariance properties of snow depth between a forested environment and an alpine environment are studied. The analysis is based on estimates of the probability distribution function, two-dimensional correlation functions and power spectral densities of high- resolution LIDAR measurements (~ 1 m) obtained for two adjacent study areas of 500 m x 500 m located in the Colorado Rocky Mountains. Both of the areas are located in the Alpine ISA of NASA's Cold Land Processes Experiment (CLPX) and present similar topographic characteristics (e.g., slope and aspect), limiting the differences to vegetation characteristics and the influence of snow redistribution by wind. Furthermore, Fourier filtering techniques and the Turning Bands Method are used for generating synthetic one-dimensional profiles, and isotropic and anisotropic two-dimensional random fields that reproduce the scale invariance properties (i.e., spectral exponents and scale breaks) observed in the snow depth fields. These methodologies are also used to infer explanations for the breaks in the scaling behavior of the spatial distribution of snow depth, as well as the meaning and implication of the spectral exponent values with respect to the variability of the fields. Implications of these results for the design of measurement strategies, interpolation, and modeling are discussed.