Geophysical Research Abstracts
Vol. 20, EGU2018-4648, 2018
EGU General Assembly 2018

Modeling lacunarity functions for forest applications

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It has been known that the gap-structure (space-filling characteristic) of the forest determines the current horizontal (area-based: e.g. distribution of trees) and vertical (single tree-based: e.g. emergents, canopy, understory) structural variations. It was also shown that it has significant effect on the evolution of the vegetation and the behaviour of the wildlife owing to its relationship with biodiversity. One of the quantities of the fractal analysis called lacunarity measures this property related to a mosaic-like pattern which can be represented by an altitudinal level of the forest.
As a consequent of the evolution of the remote sensing technologies, for today the aerial sensor platforms can provide forest point cloud data with sufficient spatial resolution for lacunarity calculations. Modeling these lacunarity functions provides quantitatively more coherent aspects of the examination as the model parameters and the residuals can be mapped together.
In this study we model lacunarity functions applied to planted and natural Hungarian forests. The related point clouds are originated from fullwave-form LIDAR data, got through voxelization, and the lacunarity functions are calculated from binary images.
The nonlinear least-square function regression method is applied which considers nonlinearity and is seemed to be robust enough as many outliers are not suspected. A 3-parameter hyperbola model function is found to be the supremely fitted function versus the less satisfying results of exponential initial models. Both the resulted residuals and parameters one by one are found to be competent for relating them to ecology-specific variations.

BSz contributed to this study as an Alexander von Humboldt Research Fellow.