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Biochar Erosion in a Temperate Forest Assessed with Terrestrial Laser Scanning

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Biochar amendment in soils is seen as a potential greenhouse gas mitigation strategy. There are a number of examples of successful amendment strategies in agricultural ecosystems, where biochar is mixed with the mineral topsoil by ploughing or similar manipulation techniques. The application in forest ecosystems, however, comes with the limitation that biochar can only be applied directly on the surface. Light-weight biochar particles may be prone to erosion by environmental forces, such as precipitation and wind. We therefore assessed biochar erosion patterns by using Terrestrial Laser Scanning (TLS) in combination with a time-lapse camera on a micro topography scale in a temperate spruce-dominated forest with herbaceous ground vegetation.

TLS is a photogrammetric technique that utilizes the laser light detection and ranging (LiDAR) principle to provide high resolution, 3D geometrical information of the object at millimeter scale. A biochar-amended (10 t/ha) plot with the size of ca. 3m x 3m was surveyed with 4 TLS scans taken from each of 4 plot's sides. The acquired scans were co-registered using the professional targets that were installed on the plot's corners. The resulting point cloud was then used as a base for calculating digital terrain model (DTM), to spatially map vegetation heights, vegetation density and roughness. These TLS products were derived by analyzing the geometrical properties of the acquired point cloud.

A time-lapse camera was installed during summer 2013, continuously observing the entire plot at 3min intervals. A single, representative, precipitation event in August was selected for a detailed image analysis of biochar particle movement. The analysis showed that areas of notable particle movement correspond to places of flow accumulation simulated from the DTM. This suggests that the very high resolution terrain information can be usefully for planning the biochar amendment on temperate forest ecosystems.