Geophysical Research Abstracts
Vol. 18, EGU2016-10323, 2016
EGU General Assembly 2016

Investigating the limitations of tree species classification using the Combined Cluster and Discriminant Analysis method for low density ALS data from a dense forest region in Aggtelek (Hungary)

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Airborne Laser Scanning (ALS) is a widely used technology for forestry classification applications. However, single tree detection and species classification from low density ALS point cloud is limited in a dense forest region. In this study we investigate the division of a forest into homogenous groups at stand level.
The study area is located in the Aggtelek karst region (Northeast Hungary) with a complex relief topography. The ALS dataset contained only 4 discrete echoes (at 2-4 pt/m2 density) from the study area during leaf-on season. Ground-truth measurements about canopy closure and proportion of tree species cover are available for every 70 meter in 500 square meter circular plots.
In the first step, ALS data were processed and geometrical and intensity based features were calculated into a 5×5 meter raster based grid. The derived features contained: basic statistics of relative height, canopy RMS, echo ratio, openness, pulse penetration ratio, basic statistics of radiometric feature. In the second step the data were investigated using Combined Cluster and Discriminant Analysis (CCDA, Kovács et al., 2014). The CCDA method first determines a basic grouping for the multiple circle shaped sampling locations using hierarchical clustering and then for the arising grouping possibilities a core cycle is executed comparing the goodness of the investigated groupings with random ones. Out of these comparisons difference values arise, yielding information about the optimal grouping out of the investigated ones. If sub-groups are then further investigated, one might even find homogeneous groups.
We found that low density ALS data classification into homogeneous groups are highly dependent on canopy closure, and the proportion of the dominant tree species. The presented results show high potential using CCDA for determination of homogenous separable groups in LiDAR based tree species classification.
Aggtelek Karst/Slovakian Karst Caves" (HUSK/1101/221/0180, Aggtelek NP), data evaluation: 'Multipurpose assessment serving forest biodiversity conservation in the Carpathian region of Hungary', Swiss-Hungarian Cooperation Programme (SH/4/13 Project). BS contributed as an Alexander von Humboldt Research Fellow.

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