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Vegetation mapping from medium-density discrete echo Airborne Laser Scanning data: a case study of the Lake Balaton wetlands

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Airborne Laser Scanning (ALS) is mainly used for collecting information on geomorphology, but the high spatial resolution and accuracy and especially the sensitivity to vertical structure are also proven to be valuable in vegetation mapping. Point cloud datasets acquired for regional or country-wide ALS surveys have strong potential as an easily accessible basis for consistent automatic vegetation mapping across large areas. However, automatized classification on the basis of multivariate analysis algorithms is not widely applied to moderate resolution discrete echo point clouds that these surveys typically produce. The number of relevant independent variables that can be derived from these datasets is often considered insufficient for multivariate classification-based detection of species or vegetation health, but in some cases it can be enhanced to a level sufficient for vegetation mapping. Although in conventional (single-wavelength) ALS the radiometric information produced is restricted to a single band, the differences of the radiometric parameters of the surveyed vegetation can considerably aid discrimination. In most cases, the horizontal distribution of the scanned points holds no information as this is governed by the sensor scan pattern. However, the horizontal distribution of points with specific radiometric intensity can add to the number of independent variables.

In our case study of a lake shore and wetland area (ca. 100 km2 of wetlands distributed in a surveyed area of 1000 km2) a raster-based approach was used to average vertical structural parameters across cells occupied by several points. The information present in the position of the points relative to each other was thus exploited. Radiometric calibration of the echo amplitude also provided valuable information on vegetation type. Given a sufficient amount of pre-surveyed ground truth areas, a straightforward decision tree classification of LIDAR data mapped not only land cover categories, but also the main vegetation genera and the health of the dominant species. The decision tree algorithm was set up on the basis of a signature analysis comparing the histograms of each ALS-derived variable within the ground truth areas, and separating the classes based on histogram differences. This has proven robust enough to work across the full study area, and artefacts were relatively easy to recognize and understand. Classification accuracies produced by this study are between 60% and 92%, with an overall accuracy of 83% for all categories. While this is clearly below the maximum accuracy achievable by hyperspectral surveys of small areas, it is comparable to many passive multispectral or fused passive multispectral and ALS vegetation surveys and also the accuracies of ALS-based forest monitoring.

Since the method itself is not specific for wetlands, it is believed that such an approach could provide valid vegetation classification results in other areas. As shown by this case study, medium-density discrete echo ALS datasets similar to those collected during European region-wide surveys can successfully be used to map vegetation classes relevant for ecology and conservation.