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Single Tree Classification Using Multi-Temporal ALS Data and CIR Imagery in Mixed Old-Growth Forest in Poland

编号	030032204
推送时间	20211220
研究领域	森林经理
年份	2021
类型	期刊
语种	英语
标题	Single Tree Classification Using Multi-Temporal ALS Data and CIR Imagery in Mixed Old-Growth Forest in Poland
来源期刊	REMOTE SENSING
期	第322期
发表时间	20211215
关键词	tree species classification; airborne laser scanning (ALS); colour-infrared (CIR) aerial images; multi-temporal data; individual tree; random forest (RF);

摘要 Tree species classification is important for a variety of environmental applications, including biodiversity monitoring, wildfire risk assessment, ecosystem services assessment, and sustainable forest management. In this study we used a fusion of three remote sensing (RM) datasets including ALS (leaf-on and leaf-off) and colour-infrared (CIR) imagery (leaf-on), to classify different coniferous and deciduous tree species, including dead class, in a mixed temperate forest in Poland. We used intensity and structural variables from the ALS data and spectral information derived from aerial imagery for the classification procedure. Additionally, we tested the differences in classification accuracy of all the variants included in the data integration. The random forest classifier was used in the study. The highest accuracies were obtained for classification based on both point clouds and including image spectral information. The mean values for overall accuracy and kappa were 84.3% and 0.82, respectively. Analysis of the leaf-on and leaf-off alone is not sufficient to identify individual tree species due to their different discriminatory power. Leaf-on and leaf-off ALS point cloud features alone gave the lowest accuracies of 72% ≤ OA ≤ 74% and 0.67 ≤ κ ≤ 0.70. Classification based on both point clouds was found to give satisfactory and comparable results to classification based on combined information from all three sources (83% ≤ OA ≤ 84% and 0.81 ≤ κ ≤ 0.82). The classification accuracy varied between species. The classification results for coniferous trees were always better than for deciduous trees independent of the datasets. In the classification based on both point clouds (leaf-on and leaf-off), the intensity features seemed to be more important than the other groups of variables, especially the coefficient of variation, skewness, and percentiles. The NDVI was the most important CIR-based feature.

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