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Invasive tree species detection based on the fusion of hyperspectral images and LiDAR data

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Remote sensing of invasive species is a critical component of nature conservation and forest management, but reliable methods for the detection of invaders have not been widely established. The accuracy of species level classification based on spectral characteristics can be increased by the application of geometry information generated from aerial laser scanning which gives the possibility to classify each individual as well. If a species is dominant in the canopy and its characteristics can be distinguished from other species, then it is possible to detect based on spectral reflectance. However, many relevant invasive species can be found in the lower vegetation, covered by the canopy dominant species. These circumstances make the detection of these species almost impossible using remote sensing techniques. In this case study, the aim was to establish a specific framework for mapping and monitoring the spread of non-native invasive key species (e.g. Ailanthus altissima) with greater detail and accuracy.
During our research we tested various supervised classification algorithms on the original and transformed hyperspectral bands to classify tree species especially considering invasive species. In these cases, defining precise training area is nearly impossible because of the spectrally mixed pixels of the hyperspectral images. Mapping the potential spread of Ailanthus, rule images of the classification was reused. Combination of predefined thresholds, rank among the classes and relative thresholds of classified pixels were used to reclass all the pixel, weighting the potential occurrence of Ailanthus. LiDAR was used to model forest canopy height (CHM) which allowed the automated masking of forest gaps and low vegetation. To delineate the individual tree crown, inverse watershed method was performed on the gaussian filtered CHM. R software was used to cross tabulate the crowns by the classes and assign the class of the most frequent pixels as a class of the crown. As a result, a tree species map has been processed where the invasive species were weighted to help the field work of the experts.