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Identification of invasive and expansive plant species based on airborne hyperspectral and ALS data

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The aim of Natura 2000 network is to ensure the long term survival of most valuable and threatened species and habitats in Europe. The encroachment of invasive alien and expansive native plant species is among the most essential threat that can cause significant damage to protected habitats and their biodiversity. The phenomenon requires comprehensive and efficient repeatable solutions that can be applied to various areas in order to assess the impact on habitats.
The aim of this study is to investigate of the issue of invasive and expansive plant species as they affect protected areas at a larger scale of Natura 2000 network in Poland. In order to determine the scale of the problem we have been developing methods of identification of invasive and expansive species and then detecting their occurrence and mapping their distribution in selected protected areas within Natura 2000 network using airborne hyperspectral and airborne laser scanning data. The aerial platform used consists of hyperspectral HySpex scanner (451 bands in VNIR and SWIR), Airborne Laser Scanner (FWF) Riegl Lite Mapper and RGB camera. It allowed to obtain simultaneous 1 meter resolution hyperspectral image, 0.1 m resolution orthophotomaps and point cloud data acquired with 7 points/m2. Airborne images were acquired three times per year during growing season to account for plant seasonal change (in May/June, July/August and September/October 2016). The hyperspectral images were radiometrically, geometrically and atmospherically corrected. Atmospheric correction was performed and validated using ASD FieldSpec 4 measurements. ALS point cloud data were used to generate several different topographic, vegetation and intensity products with 1 m spatial resolution. Acquired data (both hyperspectral and ALS) were used to test different classification methods including Mixture Tuned Matched Filtering (MTMF), Spectral Angle Mapper (SAM), Random Forest (RF), Support Vector Machines (SVM), among others. Simultaneously to airborne data acquisitions also botanical surveys were performed covering in total 5680 reference plots for 18 alien invasive and native expansive plant species (1886 in first flight campaign, 1907 in second and 1887 in third). The collected data were used to identify species characteristics such as spectral properties among others (percentage cover, growth stage, discoloration, coexisting species, land use, plant litter).
The research includes 10 invasive alien species and 8 native expansive plant species. Amongst plant species selected for the purposes of this study were: Robinia pseudoacacia, Padus serotina, Rumex confertus, Erigeron annuus, Spiraea tomentosa, Solidago spp., Lupinus polyphyllus, Reynoutria spp., Echinocystis lobata and Heracleum spp. as alien invasive species, and Urtica dioica, Filipendula ulmaria, Phragmites australis, Rubus spp, Calamagrostis epigejos, Cirsium arvense, Molinia caerulea, Deschampsia caespitosa as native expansive species.
In this study we present the methodology used for identification of invasive alien and expansive native plant species using hyperspectral and airborne laser data with resulting accuracies using different classification methods and exemplary distribution maps. The research within this study will be continued during growing season of the year 2017.
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