Tree species classification in Romania using RapidEye and LiDAR data

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ABSTRACT

Light Detection and Ranging has proved that it is the most suitable technology for the derivation of high resolution ground DEMs and it is a required attribute in forest inventory and biomass estimation. Tree species composition is an indicator of forest type and LiDAR and RapidEye missions play a key role in improving classification performance because mapping tree species is essential for forest management purposes. In this paper the performances of LiDAR, RapidEye data, and their combination on tree species classification were investigated in a coniferous forest in Romania. The variables that contributed most to classification accuracy were canopy height model (CHM), NDVI and NDRE. By analyzing data collected in the field and orthophoto available from the study site, training areas for final vegetation classification were selected.

INTRODUCTION

Tree species composition is an indicator of forest type. It is also a required attribute in forest inventory, biomass and stand volume estimation. Accurate mapping tree species is essential for forest management purposes. In the last few years, hyperspectral data alone and in combination with LiDAR data have been broadly tested for tree-species classification in different forest ecosystems.

METHODS

Study site

The study area is located in northeast Romania (Frumosu, Suceava). The size of the study area is about 23 ha and mainly covered by coniferous plantation forests. The forest predominantly consists of Norway spruce (Picea abies) and European silver fir (Abies alba) plus a few European beech (Fagus Sylvatica). Vegetation Inventory data available over this area was used in this work in addition to the ground reference data collected during a field campaign carried out in the spring of 2018.

Figure 1 - The forest predominantly consists of Picea abies

LiDAR Data

The LiDAR data used for this study were collected in the autumn of 2012, using a Riegl LMS-Q560 laser scanner instrument and processed using LP360 and ESRI ArcGis 10.4 software to extract canopy height models. LiDAR data covered the whole area of interest with the point density of 4 points per square meter (pts/m2).

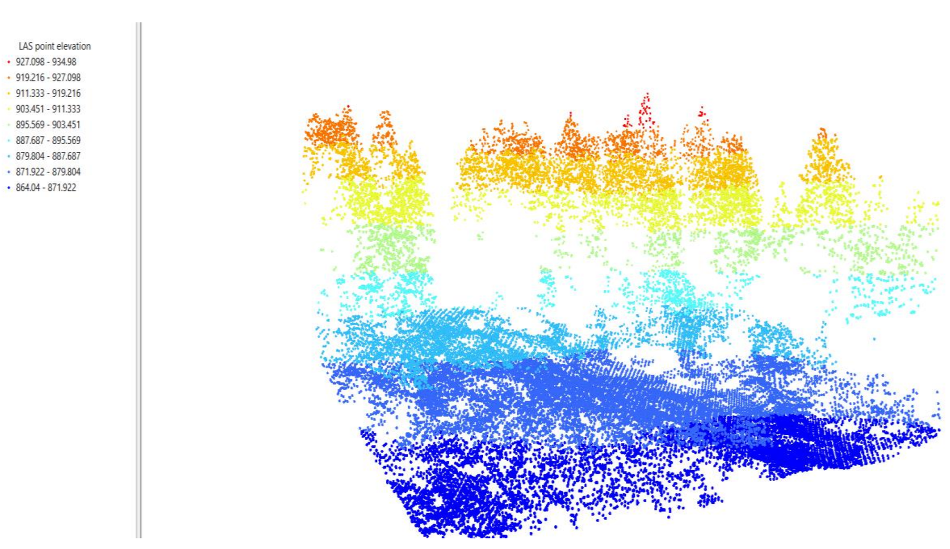

Figure 2 - LAS point elevation

RapidEye data

RapidEye data were acquired in May, 2018 over the study site. The image was projected and rectified to the world geodetic survey 1984 (WGS 1984) datum and featured in a Universal Transverse Mercator (UTM) which is UTM-35N. Five multispectral bands were stacked.

RESULTS AND DISCUSSIONS

To calculate the effective height of the trees in the scene, ground and vegetation returns were separated using modules of LAStools in ArcGIS 10.4. Khosravipour et al., (2014) introduced a novel pit-free algorithm that can construct pit-free CHMs directly from lidar data using modules of LAStools and can be adapted to work with different lidar point densities, and demonstrates a statistically significant improvement in the accuracy of tree detection.

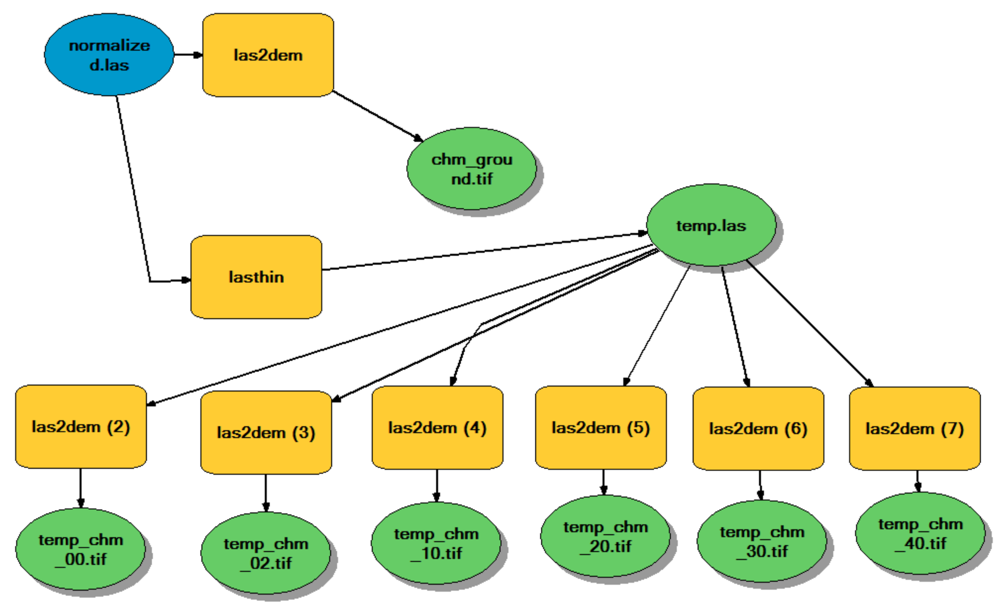

Figure 3 – Model builder of the pit-free algorithm's work-flow

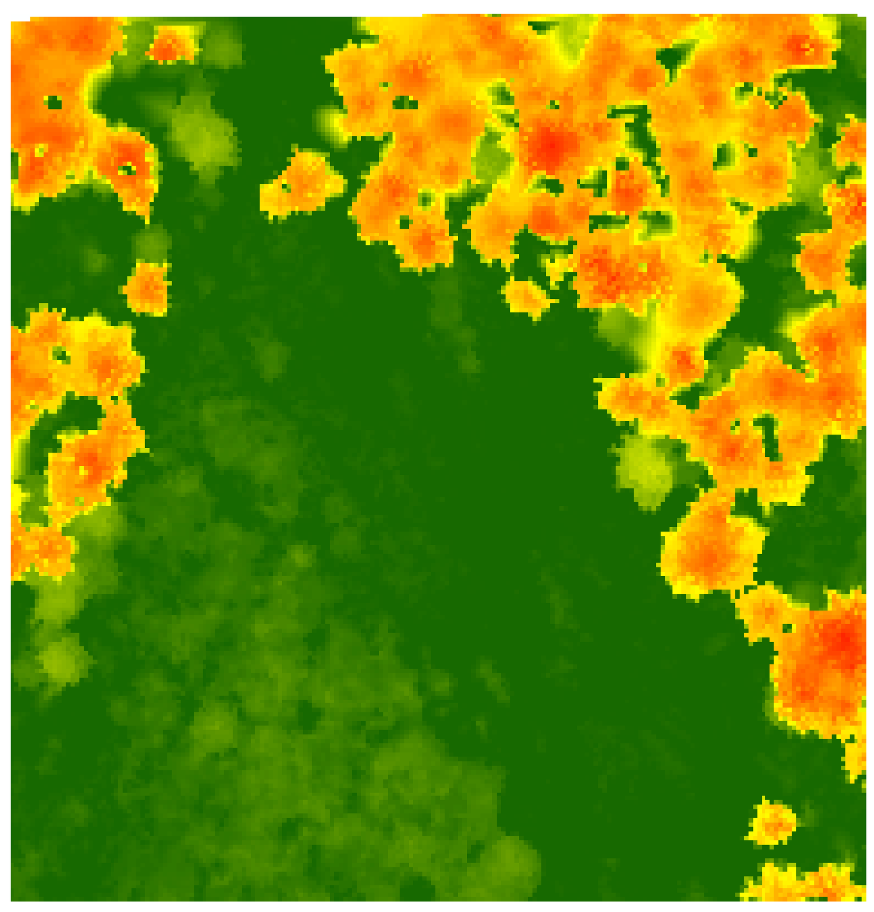

Figure 4 - The performance of the pit-free algorithm

Taking the CHM as an input, pixels with elevation values greater than or equal to 5 m were extracted. The maximum value in a 3 m x 3 m cell was obtained and the output raster was calculated using the formula:

LM=Con (CHM==FS, CHM)

where

Con=conditional function

CHM=Input CHM

FS=maximum values in a 3 m x 3 m cell

LM=local maxima

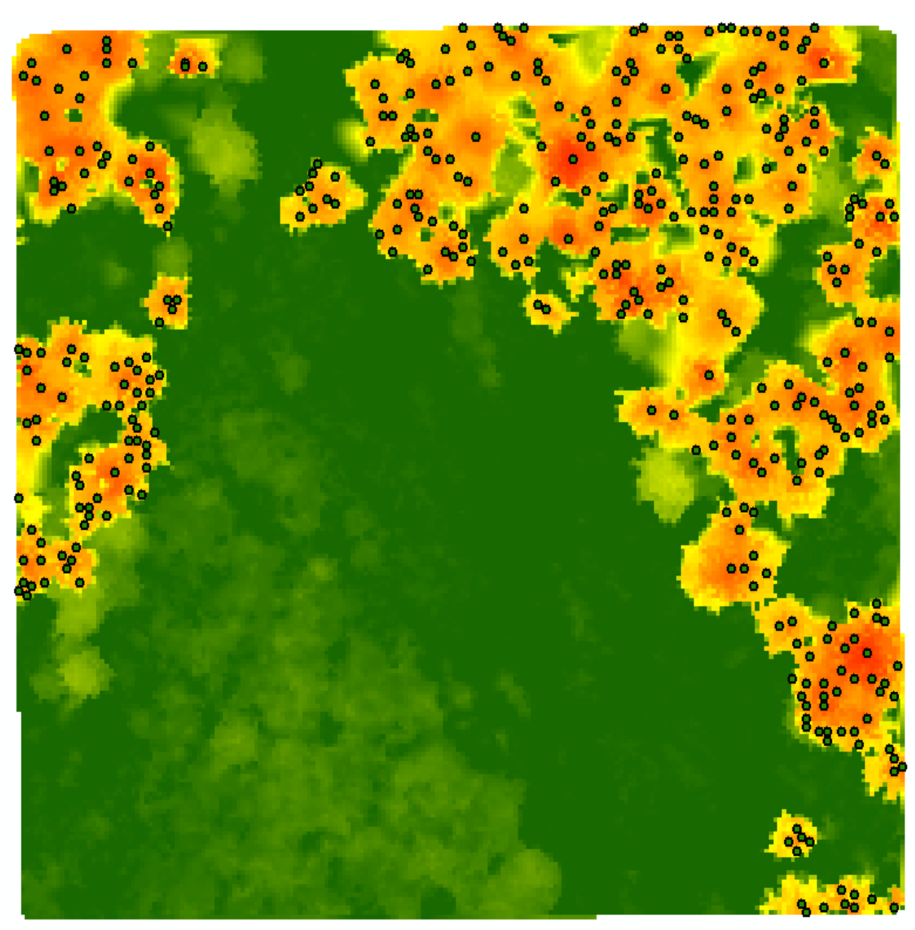

Figure 5 – The local maxima to points overlaid in the CHM

Remote sensing data classification

The Normalized Difference Vegetation Index (NDVI) and Normalized Difference Red Edge Index (NDRE) was then calculated using the RapidEye red-edge band as follows:

NDVI = NIR – RED / NIR + RED

NDRE = NIR – RE / NIR + RE

Supervised classification is a technique that allows the user to define certain signatures from which the image is classified. In this technique, the RapidEye image was classified using the maximum likelihood classifier (MLC) in the ArcGis 10.4 software.

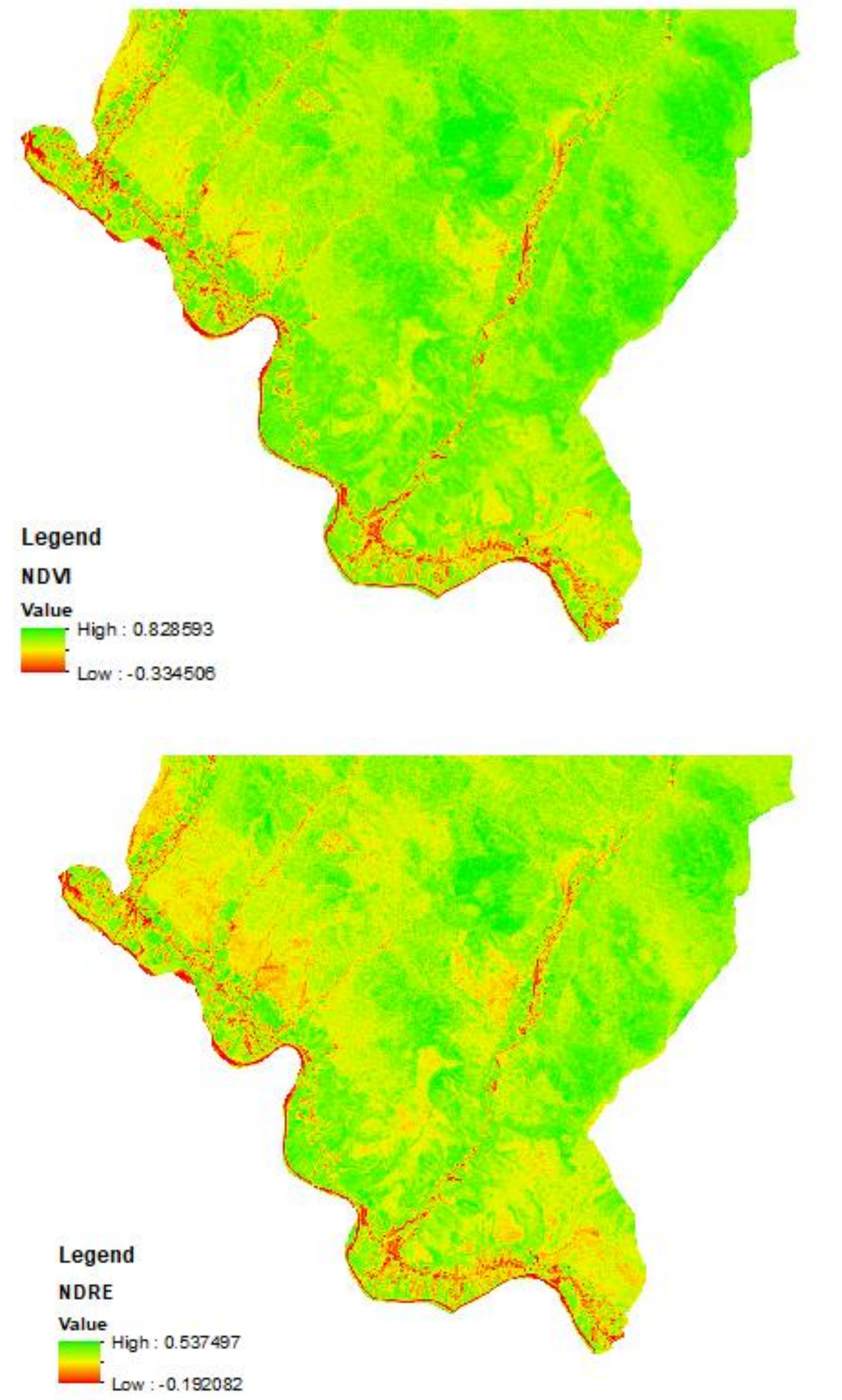

Figure 6 – NDVI and NDRE

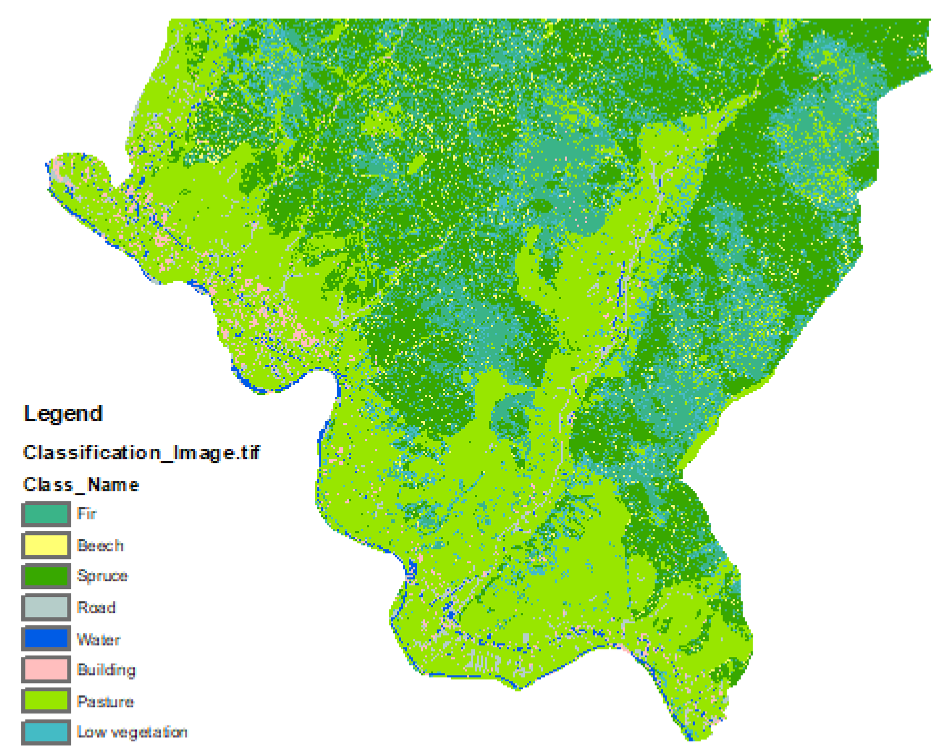

Figure 7 – Supervised classification

CONCLUSIONS

The airborne light detection and ranging (LiDAR) has already been widely used in forest inventory investigation with the advantage of obtaining multiple forest information. The canopy height model (CHM) derived from LiDAR data is a key model, which is used frequently to retrieve forest parameters, such as the tree height, crown width, diameter at breast height, crown density, volume and biomass and so on. Combined RapidEye and LiDAR data improved the classification accuracy, compared to using each type of data separately.

References:

1. Khosravipour, A., Skidmore, A.K., Isenburg, M., Wang, T.J., Hussin, Y.A., 2014. GENERATING PIT-FREE CANOPY HEIGHT MODELS FROM AIRBORNE LIDAR. rapidlasso GmbH
2. R. J. L. Argamosa , E.C. Paringit , K.R. Quinton , F. A. M. Tandoc, R. A. G Faelga, C. A. G. Ibañez, M. A. V. Posilero, G. P. Zaragosa, FULLY AUTOMATED GIS-BASED INDIVIDUAL TREE CROWN DELINEATION BASED ON CURVATURE VALUES FROM A LIDAR DERIVED CANOPY HEIGHT MODEL IN A CONIFEROUS PLANTATION
3. Xiaohui Yang, MAPPING TREE SPECIES IN A BOREAL FOREST AREA USING RAPIDEYE AND LIDAR DATA
4. M.A. Roslani, CLASSIFICATION OF MANGROVES VEGETATION SPECIES USING TEXTURE ANALYSIS ON RAPIDEYE SATELLITE IMAGERY