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, we present 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.

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 x 3 m cell was obtained and the output raster was calculated using the formula:

\[ \text{LM}=\text{Con}(\text{CHM}==\text{FS}, \text{CHM}) \]

where

Con=conditional function
CHM=Input CHM
FS=maximum values in a 3 x 3 m cell
LM=local maxima

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:

\[ \text{NDVI} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}} \]
\[ \text{NDRE} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}} \]

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.

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:
3. Xiaohui Yang,_mapping tree species in a boreal forest area using rapideye and lidar data
4. M.A. Rusdianto, Classification of mangroves vegetation species using texture analysis on rapideye satellite imagery