Use of the statistical forest inventory for the LiDAR-based modelling of the forest variables – preliminary results

Patočka Zdeněk[1], Kománek Martin[2], Balková Marie[3]

1 Department of Forest Management and Applied Geoinformatics, Faculty of Forestry and Wood Technology, Mendel University in Brno, zdenek.patocka@mendelu.cz
2 Department of Silviculture, Faculty of Forestry and Wood Technology, Mendel University in Brno, martin.komanek@mendelu.cz
3 Department of Geology and Pedology, Faculty of Forestry and Wood Technology, Mendel University in Brno,

In this year, statistical forest inventory on 114 sample plots in University Forest Enterprise was used for forest variables modelling. Forest stand volume were calculated using local volume tariffs. Dominant height, basal area and number of trees were calculated as well.

LiDAR data acquired in 2018 was processed in Fusion software [1] based on an area-based approach (ABA). ABA method, designed for point cloud low-density, is used for forest inventory in Scandinavia since 2002. In this statistical method, features and predictors are assessed from the laser derived surface models and point clouds, which are directly used for forest parameters estimation, typically using linear regression or k-nearest neighbor imputation method [2].

Based on satellite images from Sentinel - 2, different vegetation indices were created in the leaf-on and leaf-off period. Using training sets and the Random Forest algorithm, a tree map was created.

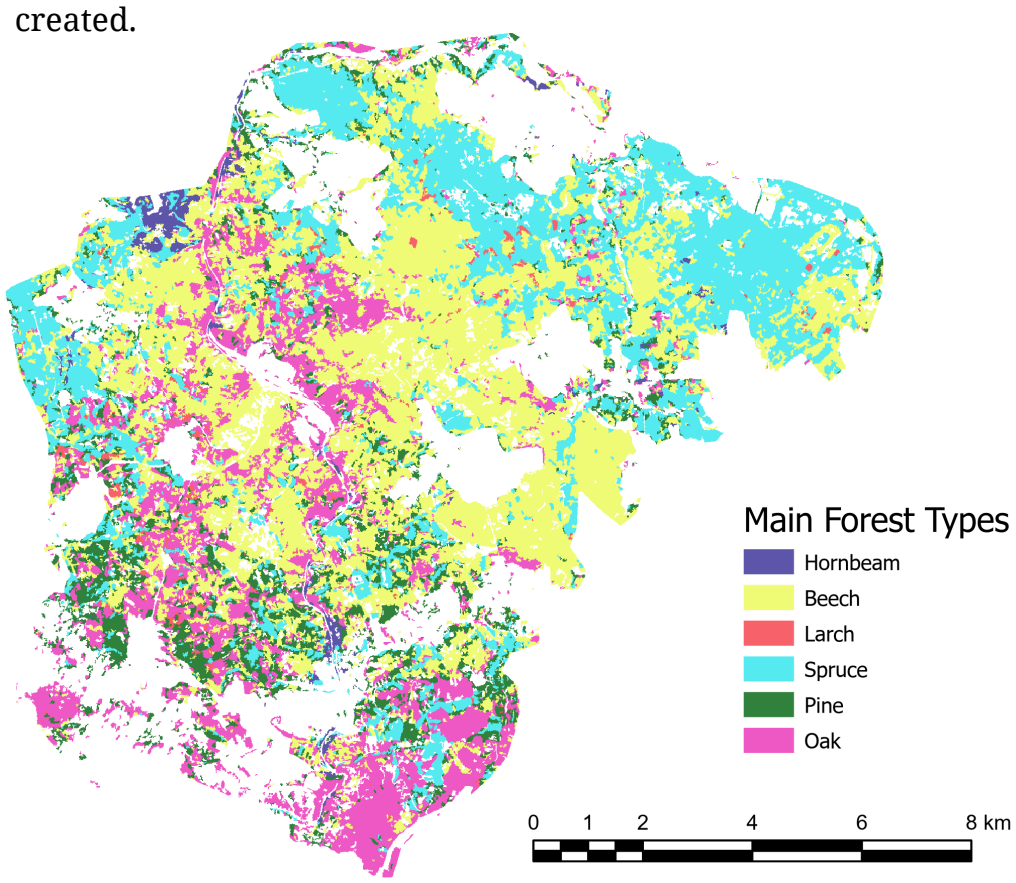

Fig.1. Tree species map

Tab.1. Statistical parameters of derived regression models

Forest variable	R^2	NRMSE (%)	cvR^2	cvNRMSE (%)
V (m^3/ha)	0.72	14	0.70	15
BA (m^2/ha)	0.74	12	0.70	14
H_{dom} (m)	0.97	3	0.97	3
N_{trees}	0.65	20	0.61	25

This year, the following forest variable maps were created for beech: number of trees, dominant height, basal area, forest stand volume and in addition site index using bitemporal LiDAR data and Generalized Algebraic Difference Approach (GADA) models.

It was found that the position of the plots of the statistical forest inventory from 2019 is not accurate, so in 2020 a complete remeasurement was performed using a GNSS receiver Trimble GeoExplorer 6000 GeoXH with RTK corrections from the CZEPOS network. All models will then be recalculated.

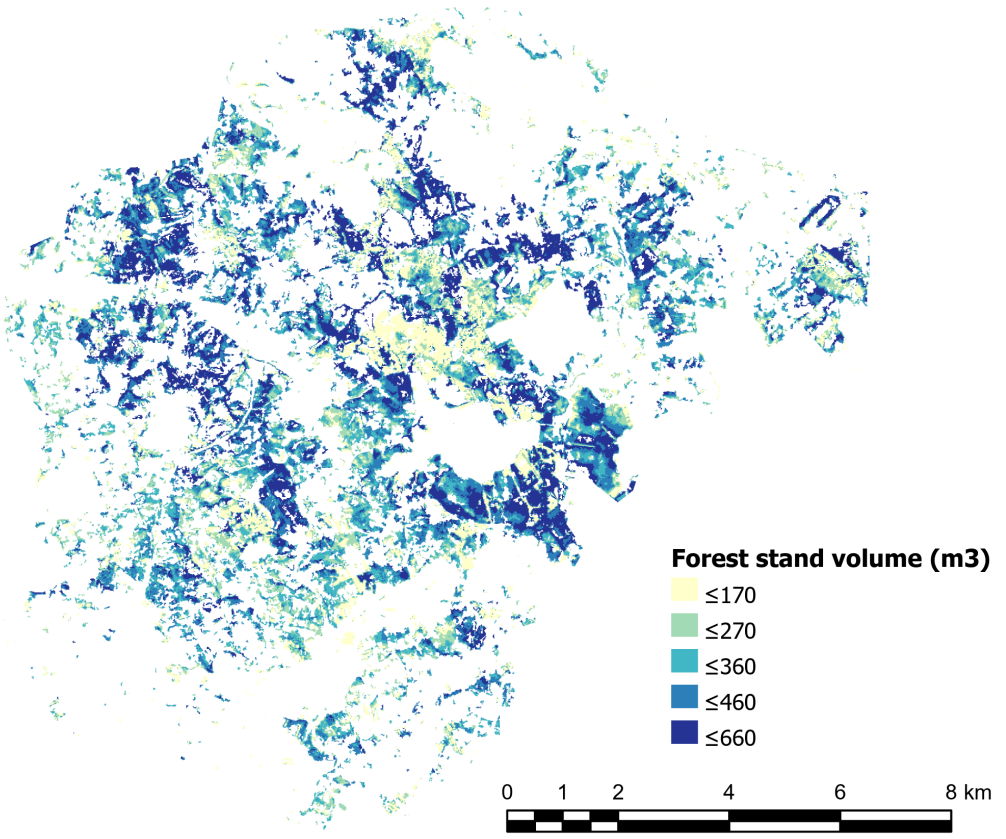

Fig 2. Map of forest stand volume for beech tree species

Another part of the project concerning multispectral imaging and health assessment was published this year in the following publication:
BALKOVÁ, M., BAJER, A., PATOČKA, Z., MIKITA, T. 2020. Visual Exposure of Rock Outcrops in the Context of a Forest Disease Outbreak Simulation Based on a Canopy Height Model and Spectral Information Acquired by an Unmanned Aerial Vehicle. ISPRS International Journal of Geo-Information. 9:5. ISSN 2220-9964.

REFERENCES
[1] MCGAUGHEY, R. 2019: FUSION/LDV: Software for lidar data analysis and visualization. Version 3.8. Seattle, WA: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station [online].
[2] NÆSSET, E. 2002: Predicting forest stand characteristics with airborne scanning laser using a practical two-stage procedure and field data. Remote Sensing of Environment, 80. 88–99p.
[3] SHARMA, R.P., ŠTEFANČÍK, I., VACEK, Z., VACEK, S. 2019. Generalized Nonlinear Mixed-Effects Individual Tree Diameter Increment Models for Beech Forests in Slovakia. Forests 10, 5: 451.

ACKNOWLEDGEMENT
This research was financed by the IGA project n. TP_2019012 (Remote sensing to support the sustainability of forest production under the condition of ongoing climate change).

MENDELU
Faculty of Forestry and Wood Technology