LASER-WOOD: Estimation of the above ground biomass based on laser scanning and forest inventory data

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The Project „Laser-Wood - Estimation of the above ground biomass based on laser scanning and forest inventory data" aims at the development of methods for the generation of high resolution digital geodata regarding growing stock and above ground biomass potential for Austrian forests. The methods use airborne laser scanning (ALS) data in point and raster format as well as forest inventory data to derive input data for long term strategic energy conclusions. The high spatial resolution geodata is calculated via correlation analyses and semi-empirical algorithms implemented in an information system and provide further information like height of dominant trees, basal area or stem number. In sum this information are core requirements for future energy model regions. The investigations are done within a project consortium consisting of the Institute of Photogrammetry and Remote Sensing at the TU Vienna, the Department of Forest Inventory at the Federal Research and Training Center for Forests, Natural Hazards and Landscape (BFW), the alpS-Center for Natural Hazard Management, the LASERDATA GmbH - Management and Analysis of Laserscanning Data and the forest administration Stand Montafon Forstfonds. Project users are the *Landesforstdirektion Tirol* and the *ÖBf-AG*. The two and a half year project started in August 2009 and is funded by the *Klima- und Energiefonds* in the framework of the program *NEUE-ENERGIEN 2020*.

For the calculation of the growing stock tree species specific models will be developed, which allow a regionalisation of the existing forest inventory (i.e. national forest inventory) by the integration of large coverage ALS data with high precision. Based on the findings of the previous project ÖWI-Regio funded by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) the semi-empirical stem volume model [1],[2] will be adapted for tree species specific stem volume estimation. To apply the model for different tree species a classification of the forest at least into coniferous and deciduous trees is required. Additionally, the use of the available Austrian forest layer [3], which was derived from satellite data, for species specific stem volume estimation will be investigated. For the derivation of the biomass potential allometric functions are used, which are based on forest parameters such as tree crown diameter, heights and species extracted from ALS data. Beside the standard ALS data, which are increasingly covering the provinces of Austria, Laser-Wood uses full-wave ALS data. Additionally to the geometry of each 3D point physical parameters are available, which describe the reflexion properties of the captured objects [4],[5] and facilitate a tree species differentiation [6]. First investigations using full-waveform ALS data for tree species classification show promising results (Figure 1).

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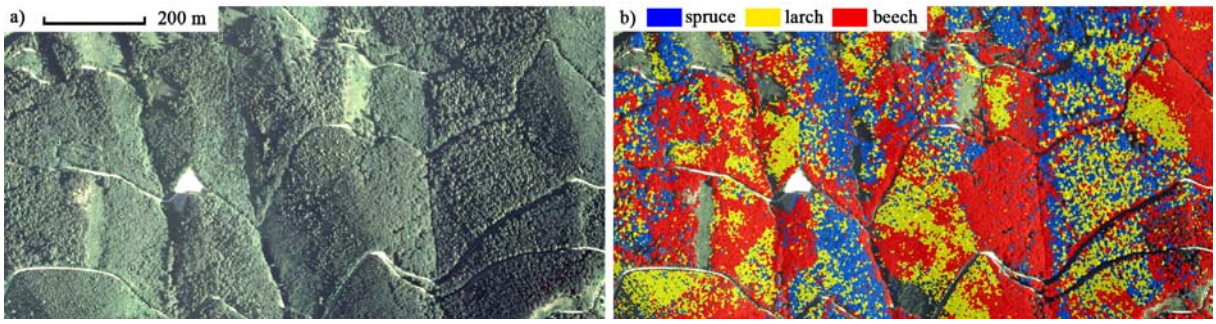

Figure 1: a) Orthophoto b) Result of tree species classification. [6]

A further objective of Laser-Wood is the development of an algorithm for forest area delineation based on ALS data. The algorithm should be able to delineate the forest area based on different forest definitions e.g. Austrian forest law or FAO. Furthermore, investigations for the subdivision of the classified forest area into homogeneous (i.e. vertical forest structure, age and density distribution, tree species) forest patches will be done. To be able to use the potential of point based forest parameter derivates for large areas appropriate software packages [7] and a specific information system [8] for ALS data has to be implemented, which allows the processing of large coverage and amounts of point data.

In cooperation with the project users *Landesforstdirektion Tirol* and *ÖBf-AG* different options for the usage of the derived forest parameters are investigated. In Tyrol the products derived from Laser-Wood (e.g. stem volume map, above ground biomass map) will be integrated into their web-based forest database. This database comprises all forest enterprises, forest tending plans, fostering measures and is a virtual market place for wood trade. Furthermore, the derived forest information can for example be used to extend available approaches for forecasting forest biomass resources [9] or can support the development of specific regional energy cascades with relevant material and energetic flows. The reduction of costs for the provision of carbon neutral energy resources, the mobilisation of wood in local forests and the optimisation of timber harvesting chains based on the project results are important outcomes of Laser-Wood. However, it should be noted that the derived information has to be analysed in combination with the ecological frame conditions with respect to property and environmental restrictions.

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