Newsletter

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The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 262786 EUFODOS

A message from the coordinator

By Mathias Schardt, Joanneum Research

The final results of the EUFODOS project prove that it was possible to derive powerful Downstream Services (DSS) from different Earth Observing data sources. The services incorporated and optimized existing information from Geoland Core Services. Various DSS have been developed in several countries throughout Europe. The backbone for the success of the outcome was the intensive incorporation with the regional forest users. The dissemination of the results has been published to a wider audience of forest users and will still be publicly available on the EUFODOS webpage (www.eufodos.info). Finally, as the coordinator I would like to thank all the partners, users and REA for a successful cooperation within the three years project life-time.

Derivation of forest parameters in protective forests using LiDAR and satellite data

By M. Schardt, K. Granica, M. Hirschmugl and A. Wimmer, Joanneum Research

Forest plays a key role in the economy and environment. This role incorporates ecological functions which can be affected by the damage due to insect infestations, forest fire, heavy snowfall or storm events. Forestry Management authorities need detailed, province-level information about the structure and state of protective forest, because their responsibility lies in its observation and preservation. In order to fulfil their role for forestry management strategies and for a sustainable management of forests they have to observe the degree and impact of forest degradation. Most inventory techniques employed by forestry management departments for the mapping of forests to date have relied on aerial photography and ground-based surveys, but could not be realized for larger regions due to high costs and limited personal resources. Further these surveys do not allow the derivation of the spatial (wall to wall) distribution of forest function parameters. One main purpose of COPERNICUS is to deliver information that meets the user's need, meaning that the Forest Services being developed within EUFODOS are strongly focused on the user interest. As a consequence of this fact an operational service was developed for forest authorities to derive major functional forest parameters. In order to fulfil this task it can be stated that the synergetic use of LIDAR data - providing 3D structural parameters on height, crown closure or vertical structure - with satellite data either from RapidEye data and/or Core Service products

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derived from GEOLAND 2 (LMSC: land monitoring core service) - which provide information on tree species distribution - proved to be a very effective approach.

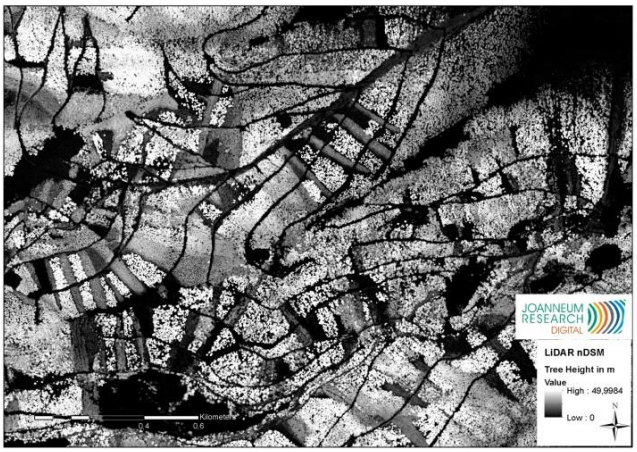

Figure 1: LiDAR nDSM with 50cm spatial resolution (source LFD Styria.

Testregion and Data

One of the six EUFODOS test cases is located in the Austrian province of Styria characterized by a high-mountainous terrain which is prone to natural hazards. The region is mainly stocked with coniferous trees, spruce and larch, which are in the subalpine tree line mixed with dwarf mountain pine and green alder. Aside from the LiDAR data, also CIR ortho-images were available for visual interpretation and comparisons. Field measurement campaigns were performed applying "Bitterlich Sampling" to obtain ground truth data. The derived LiDAR products are of high relevance for the user, because this type of information is unique in terms of high spatial resolution and details. The basic LiDAR data is obtained by airborne surveys. The data was obtained by a Riegl LMS-Q560 sensor with 200 kHz and the original point cloud has a density of 4 points/m² below 2000 m a.s.l. and 2 points/m² above this elevation limit.

Forest Parameters and Software Environment

From this LiDAR data, the following important forest parameters were derived: a detailed forest mask – including the upper forest border line; tree height, growth classes, forest density, vertical structure and

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timber volume. The workflow of the EUFODOS processing line encompass all necessary steps for the derivation of the forest parameters from the raw LiDAR point cloud to the resulting forest parameter map in an automated procedure. The workflow has been implemented in the JOANNEUM RESEARCH in-house software package IMPACT and is called "IMPACT LiDAR Toolbox" (see Fig. 2).

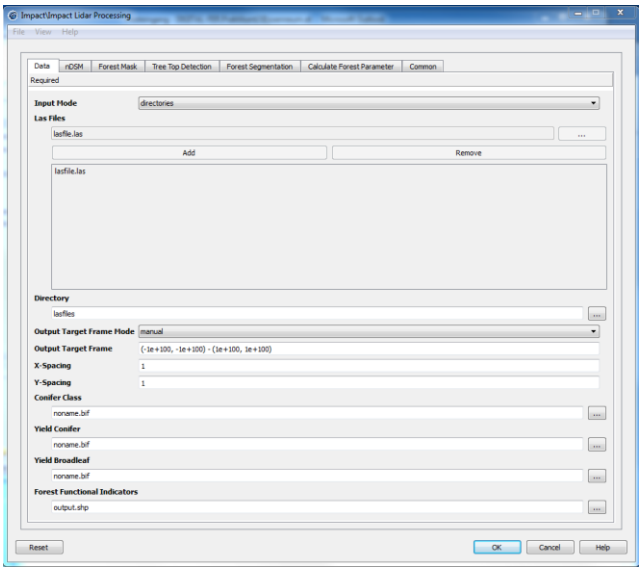

Figure 2: GUI of the "IMPACT LiDAR Toolbox" workflow.

In a first step, the digital terrain model (DTM) and the digital surface model (DSM), were imported into a raster file from the original *.las point cloud data. Then, a normalized digital surface model (nDSM) with a spatial resolution of 50 cm was computed from DTM and DSM. Figure 2 exemplarily shows several modules for the data processing.

Resulting Forest Parameters

From the nDSM, a forest mask was derived according to the definitions from the forest experts. It has to be emphasized that a special focus was put on the automated derivation of the upper forest border line and the related "succession zone", which plays an essential role for the management of mountainous forest areas.

For all forest parameters, polygons of homogeneous forest patches are needed. If such polygons are not available from existing sources as in the Styrian testcase, they have to be generated. An automated procedure was developed and applied to derive these polygons.

The next processing step detected all tree tops within the forest area and the result was later used as input for the calculation of several forest parameters, e.g. dominant height. In Figure 3 the dominant height per polygon (forest stand) is displayed.

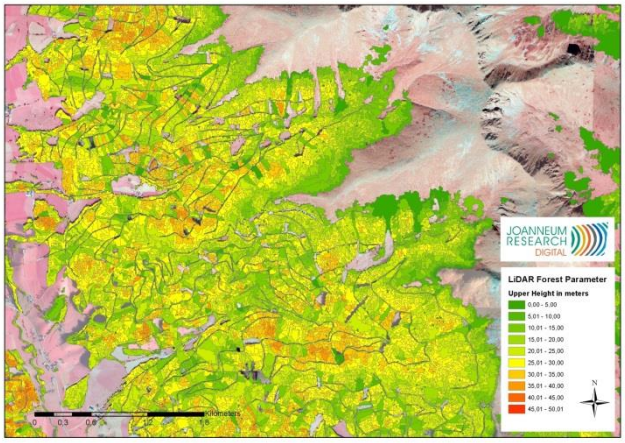

Figure 3: Height of dominant trees in meters per stand.

These processing results served, in combination with the distribution of tree species type derived from RapidEye satellite data, as essential inputs for the computation of further parameters such as height of dominant layer, mean height of stand, mean slope, mean exposition, mean height above sea level, number of detected trees per ha, vertical stand structure, stage of stand development or canopy space integral. The last parameter in combination with the field measurements was used for the calculation of timber volume (see Fig. 4).

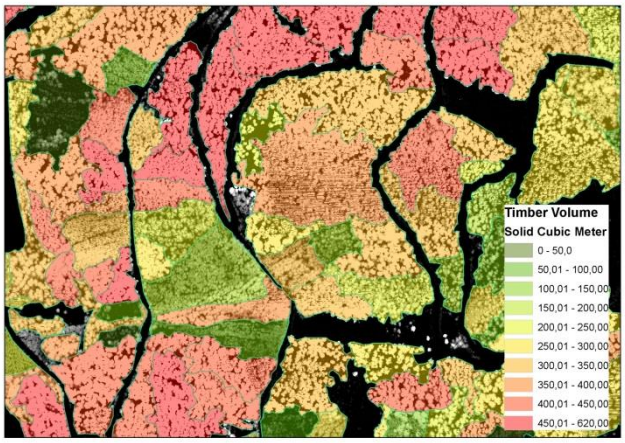

Figure 4: Timber volume in solid cubic meters.

Conclusions

For the first time, the Styrian Forestry Board has now an area-wide coverage of forest parameters with high details to be used for its protective forest management plans. The "Impact LiDAR Toolbox" was implemented within EUFODOS as an operational software package saving processing time and costs.