

Large Scale Forest Taxation based on Single Tree Measurements using Airborne Laser Scanning Data and Spectral Information from Quickbird Satellite Imagery and Digital Orthophotos

*Dr. Markus Weidenbach
Dr. Roeland de Kok*

landConsult.de

*Geographical Information Management and Environmental Planning
Spannstattstrasse 40, D-77773 Schenkenzell, Germany*

<http://laser.landConsult.de>

ICAS Conference, Bucharest,
23.10.2008



Overview

landConsult's service and research

Automatic Detection of Individual Trees from Satellite and Airborne Scanners with the Definiens Developer

Measuring Forest Parameters with Laser Scanner Data

Integration into traditional forest planning

Costs, Data Quality and Future Developments



landConsult started in 2000 with the objective to transform scientific knowledge in the fields of Remote Sensing, GIS, Land Use and Forestry Planning into practical applications.

Today landConsult is a group of international experts working in the above mentioned fields with close cooperations to the Universities of Munich, Freiburg and Cracow.

landConsult's portfolio comprises for instance:

- Consulting and Capacity Building

- Remote Sensing Data Processing

- Training for the Definiens Developer Software

- Research and Development of RS applications (OBIA, LiDAR, RADAR)

You are welcome to visit our website on <http://landConsult.de>

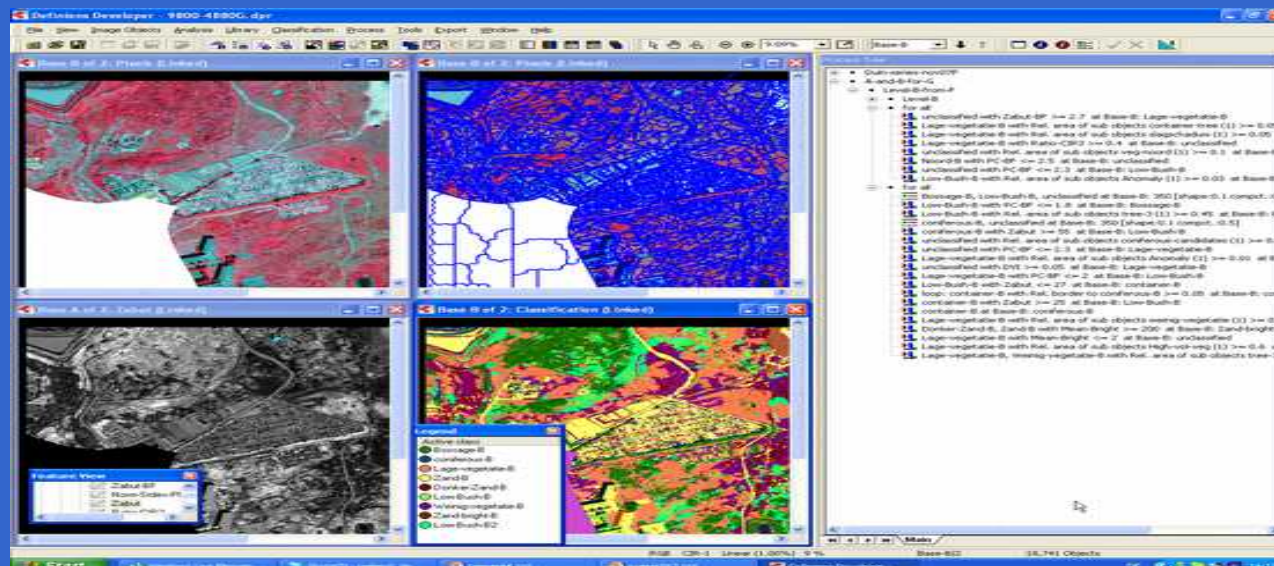




Time Schedule: Dobrich | Constanta
List of Participants and Lecturers

Time Schedule: Dobrich
List of Participants and Lecturers

Time Schedule: Constanta
List of Participants and Lecturers



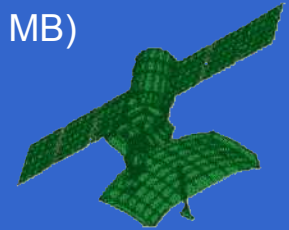
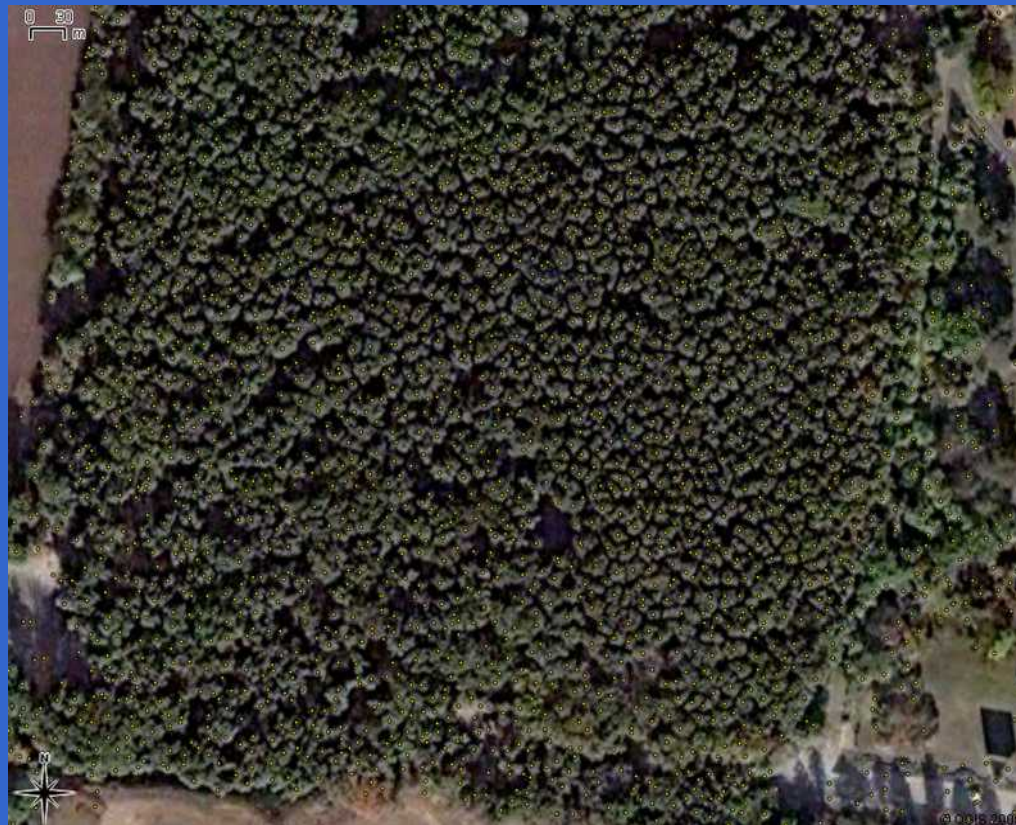
„Training on the Job“ for Definiens Developer (formerly e.cognition) users

Counting Trees from Space using Quickbird Satellite Images

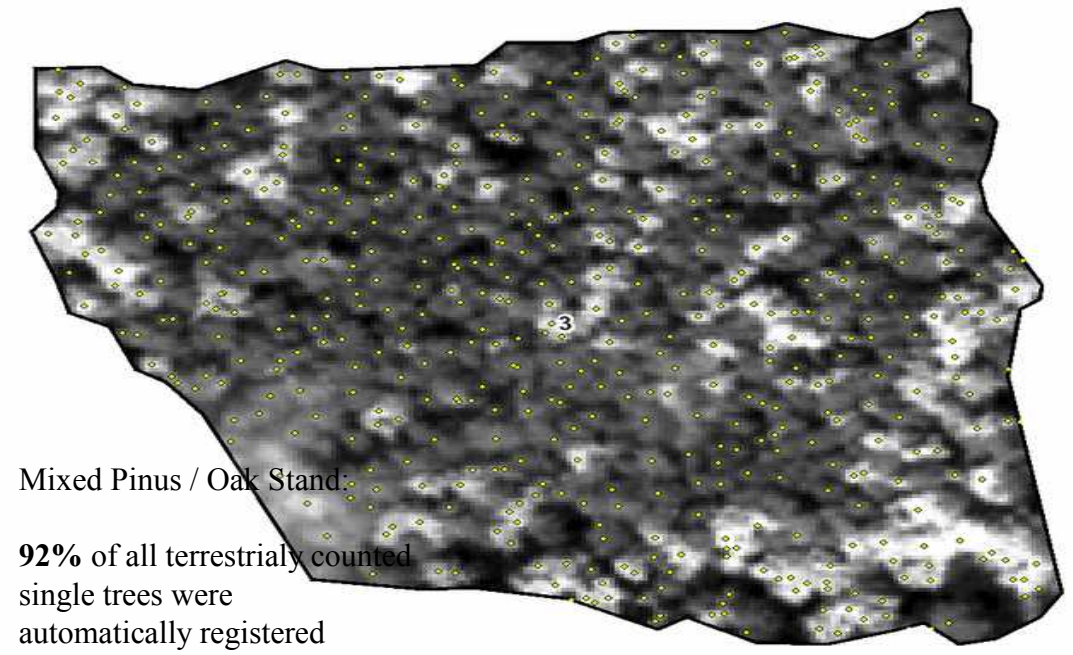
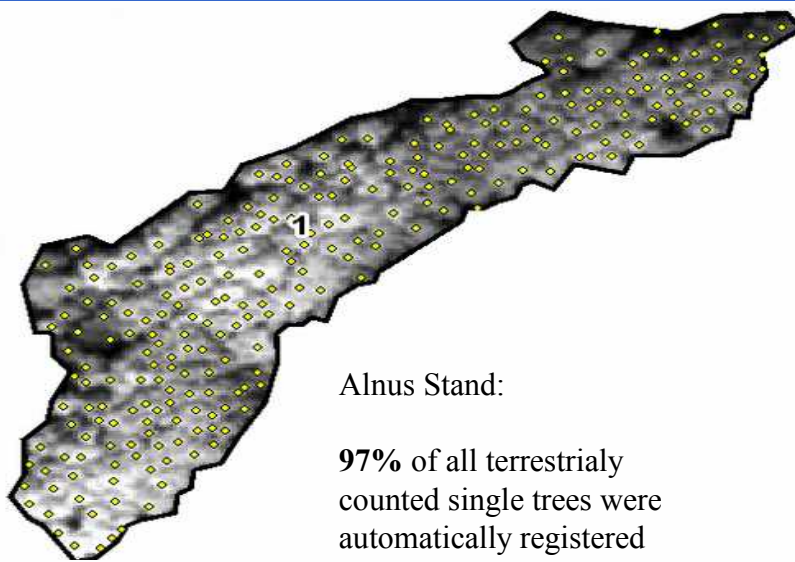
Methodology: Object Based Image Analysis (OBIA) with Definiens Developer

Example: Baneasa Park from **Google Earth**

<http://landconsult.de/google-data/baneasa-park.kmz> (file size 2 MB)

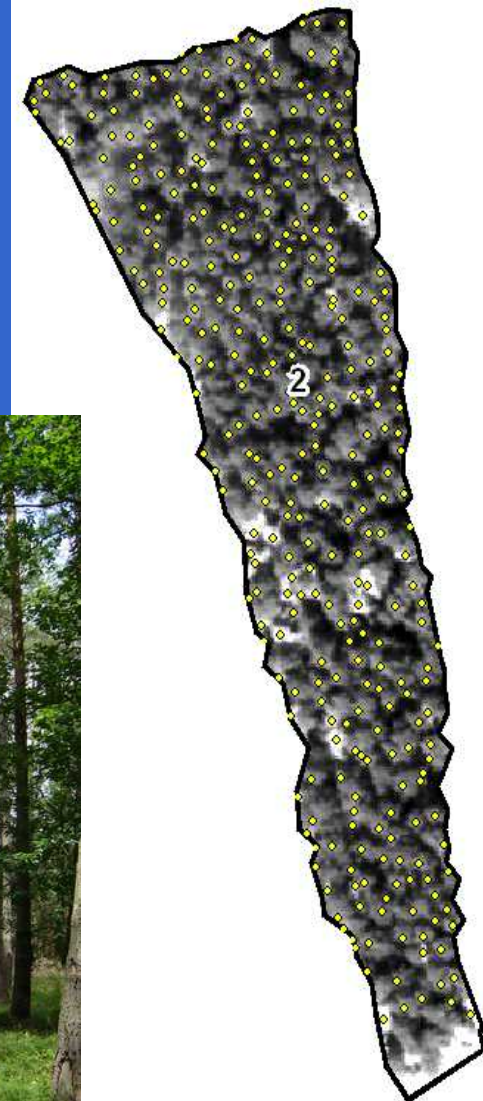


Example: Poland, mixed pinus stands



Pinus Stand:

95% of all terrestrially counted single trees were automatically registered



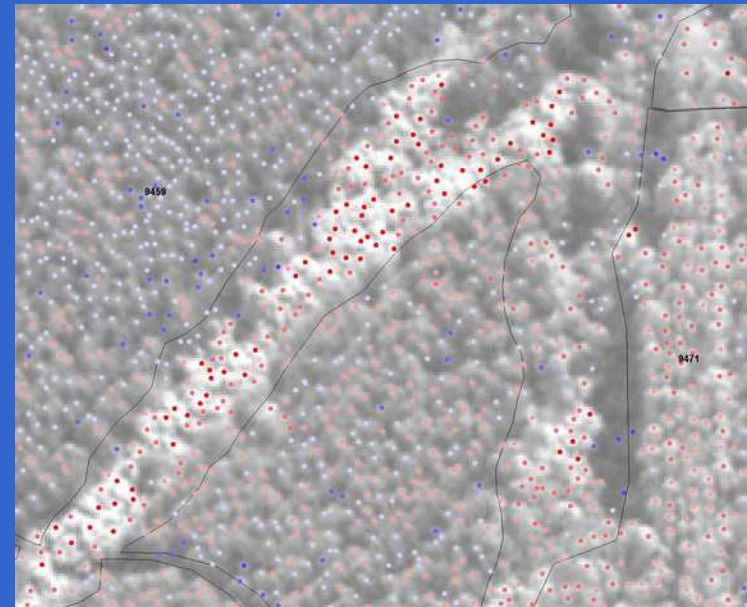
Example: South Africa, 6.300 ha of Pinus and Eucalyptus Plantations

Tree Density (trees per ha)

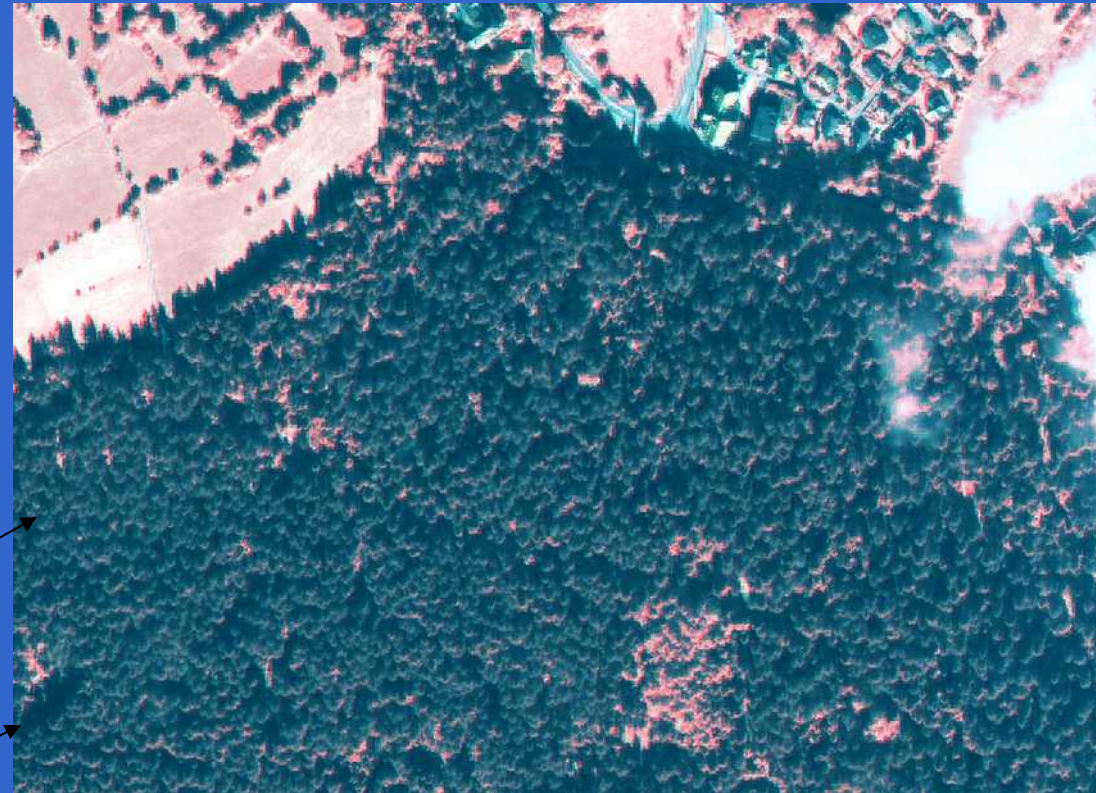


some **3.5 Mio. trees** and the NDVI of their crowns have been automatically detected and registered in a GIS database

	OBJECTID	TREE_ID	PINE_HT	MEANNDVI	RATIO_RED	X	Y	LAYER
	206	2910720	0	195.21053	0.09495	245131.81579	6765445.9105	Tile-13-p.shp
	289	2945552	0	210.6	0.08672	245131.82	6764506.1	Tile-13-p.shp
	324	2056659	20	174.84615	0.10591	245131.82308	6763663.2692	Tile-19-p.shp
	200	3846373	24	157.69231	0.10979	245131.82308	6769065.6692	Tile-1-p.shp
	197	3881892	0	186.9	0.09998	245131.83	6768387.27	Tile-1-p.shp
	170	3629480	0	199	0.09152	245131.83333	6766271.3	Tile-7-p.shp

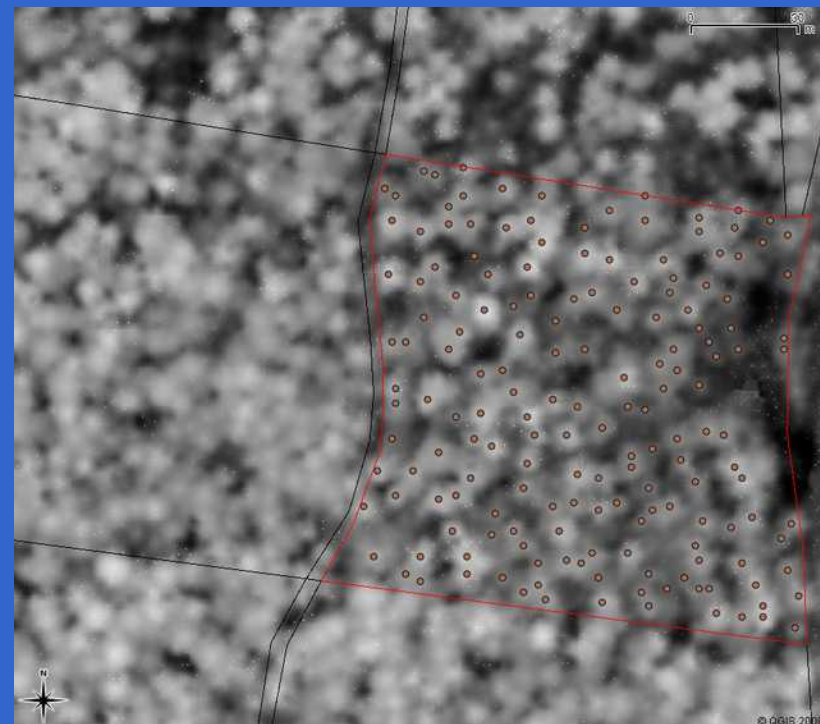
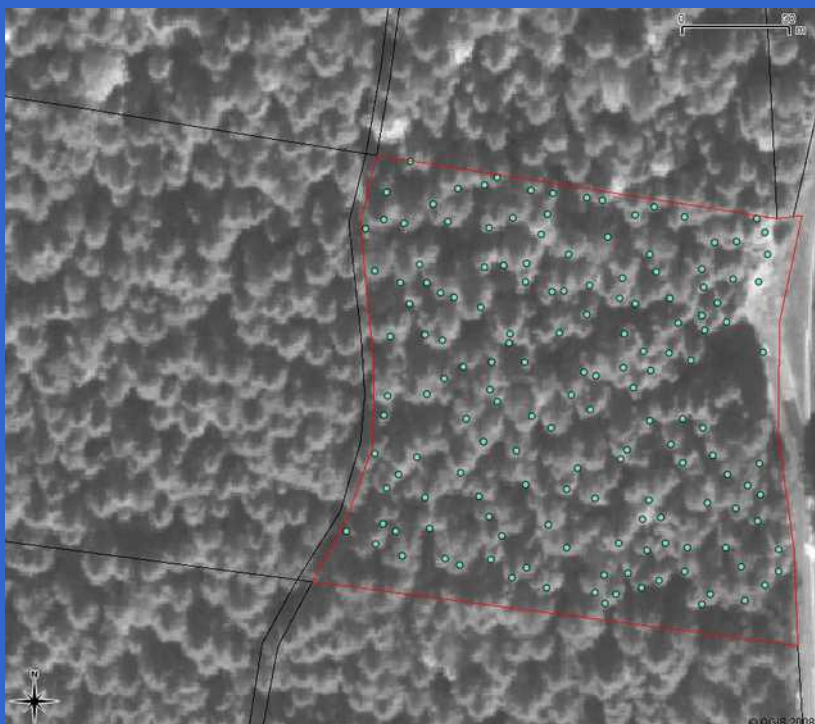
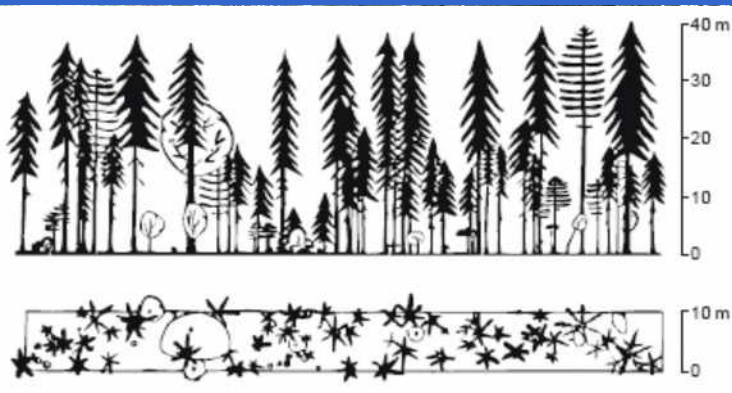


City of Freudenstadt im Schwarzwald, Germany
Individual Tree Detection in *Picea Abies* / *Abies Alba* (*Fagus Sylvatica*) Plenter Woods, Quickbird Satellite, Sept. 2007



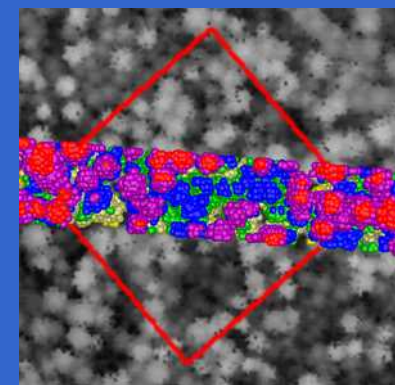
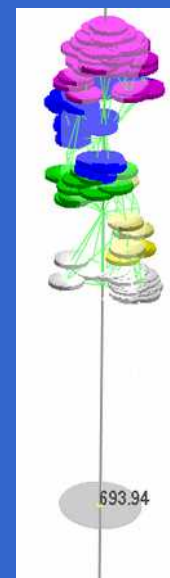
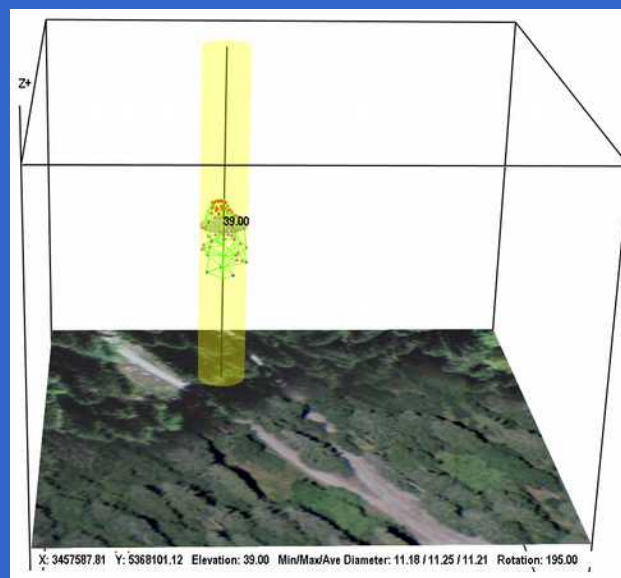
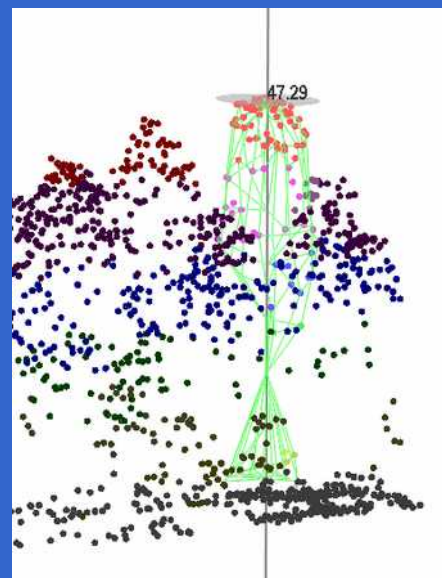
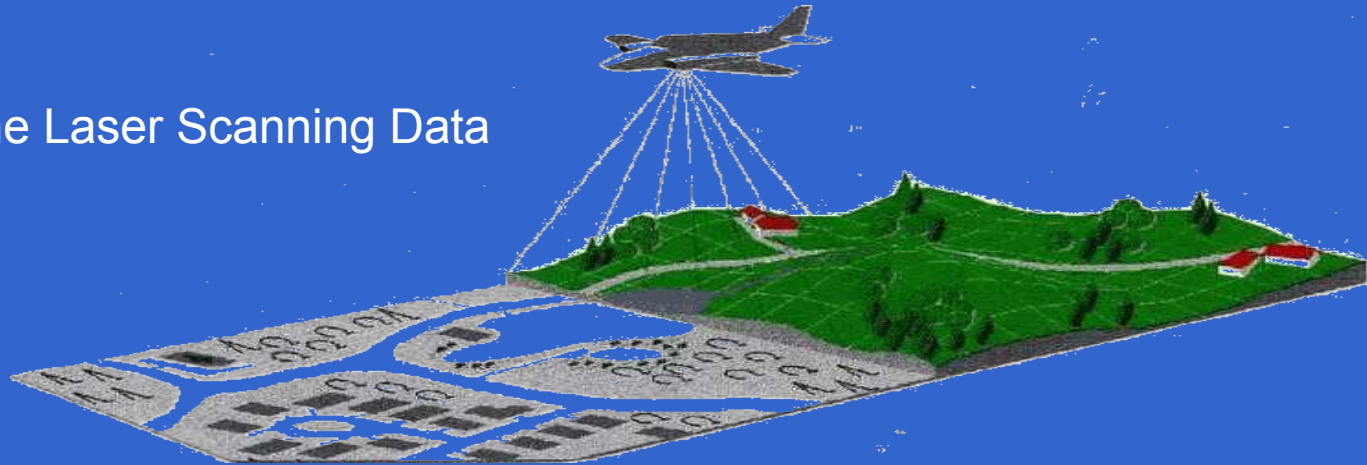
The reddish colours stem from the near infrared sensor which can be used to automatically discriminate different tree species and urban structures like roads and other sealed areas.

Example: Germany, Plenter Wood (single tree selection)



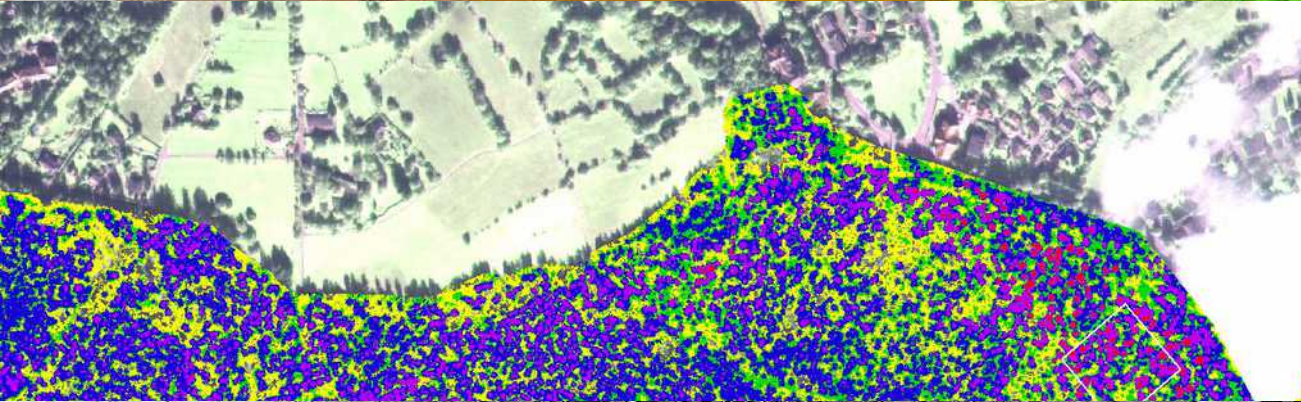
Measuring Tree Volume and other Forest Parameters with Laser Data

Airborne Laser Scanning Data

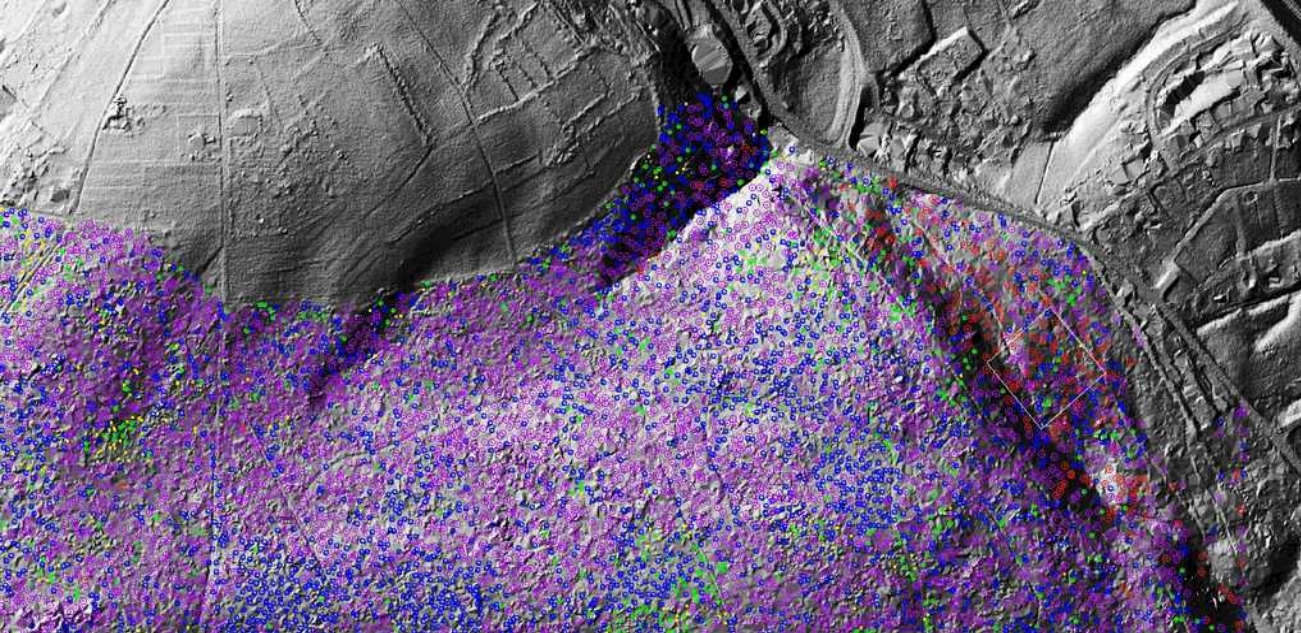




Digital elevation model generated from aerial laser scanning data that reveals „hidden“ structures under the forest canopy, such as roads, ditches or deadwood on the ground.

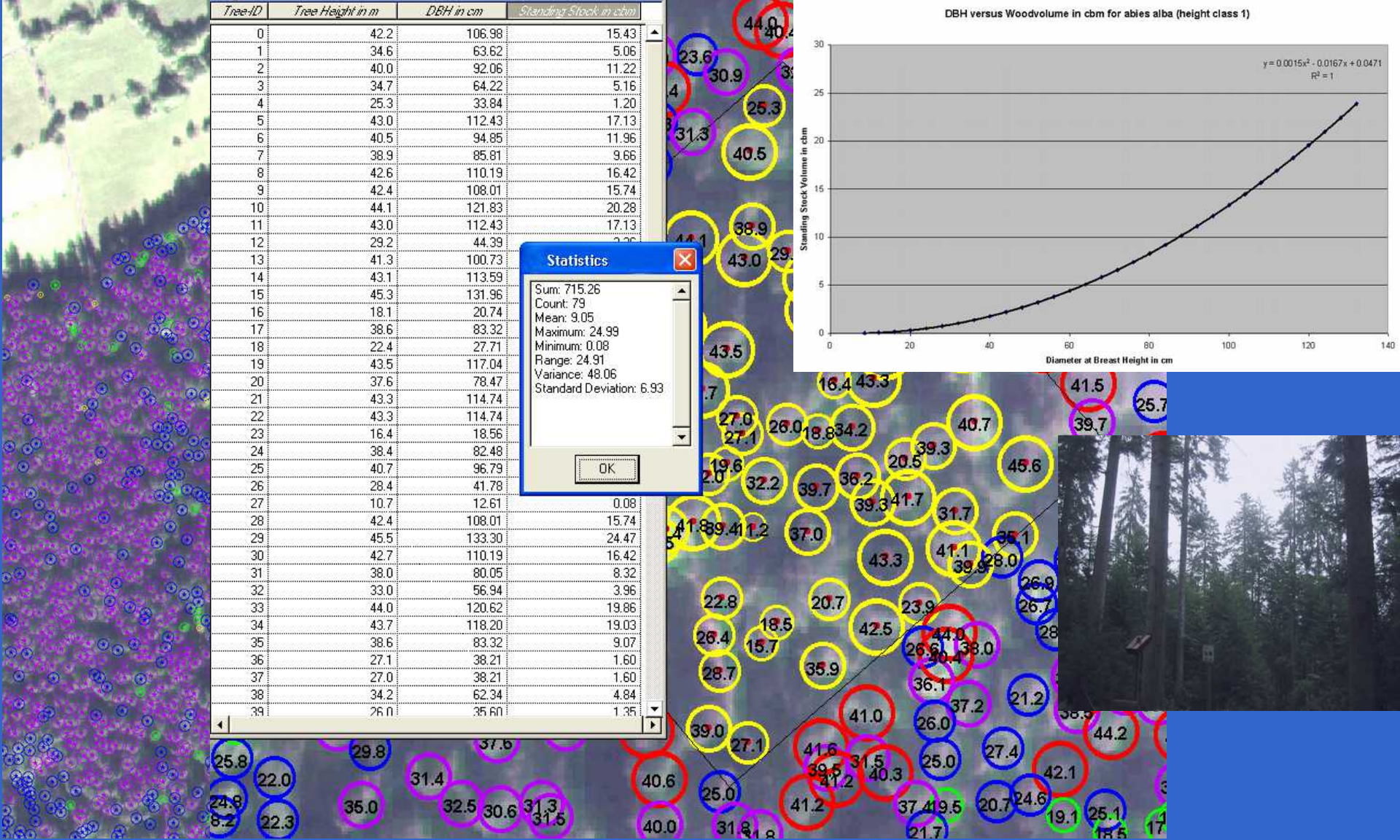


Digital model of the canopy generated from aerial laser data. This model is used to detect and measure individual trees.



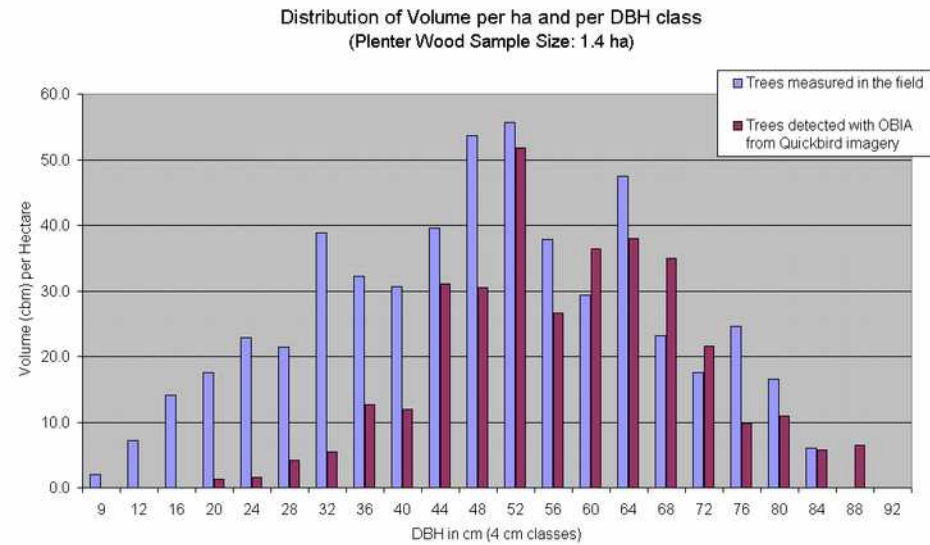
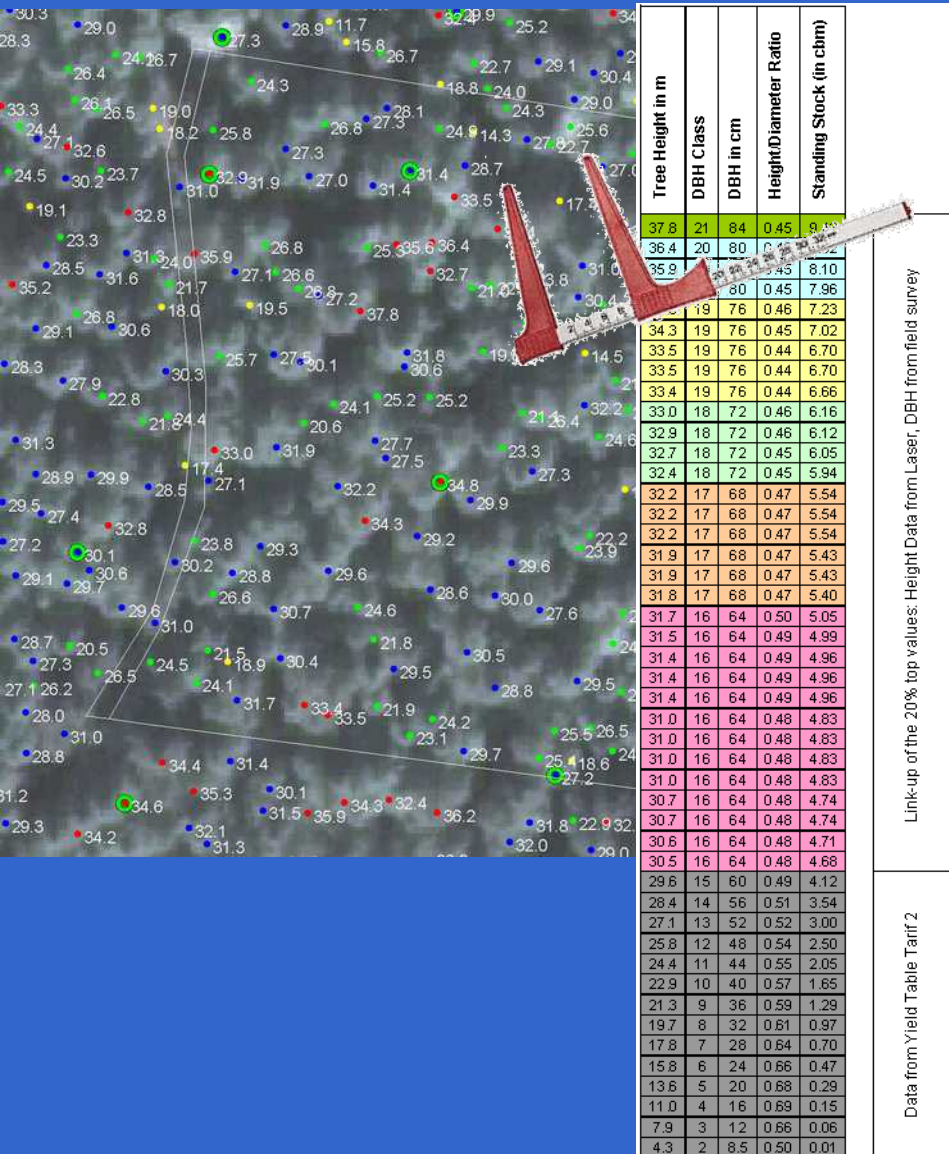
Individual trees with terrain model in the background.



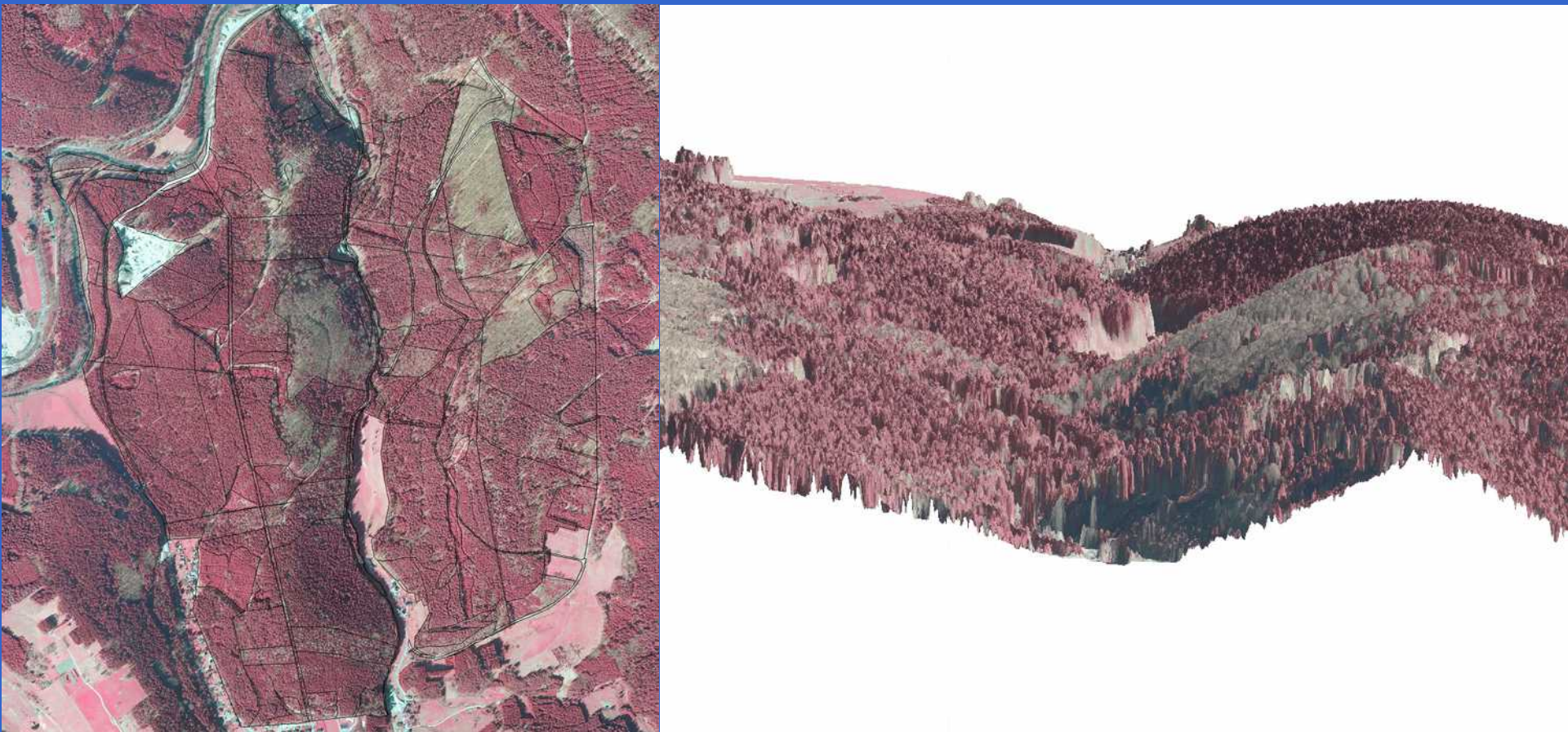


View to the Plenter Wood sample plot (1 ha).

Example: Germany, Plenter Wood (single tree selection)

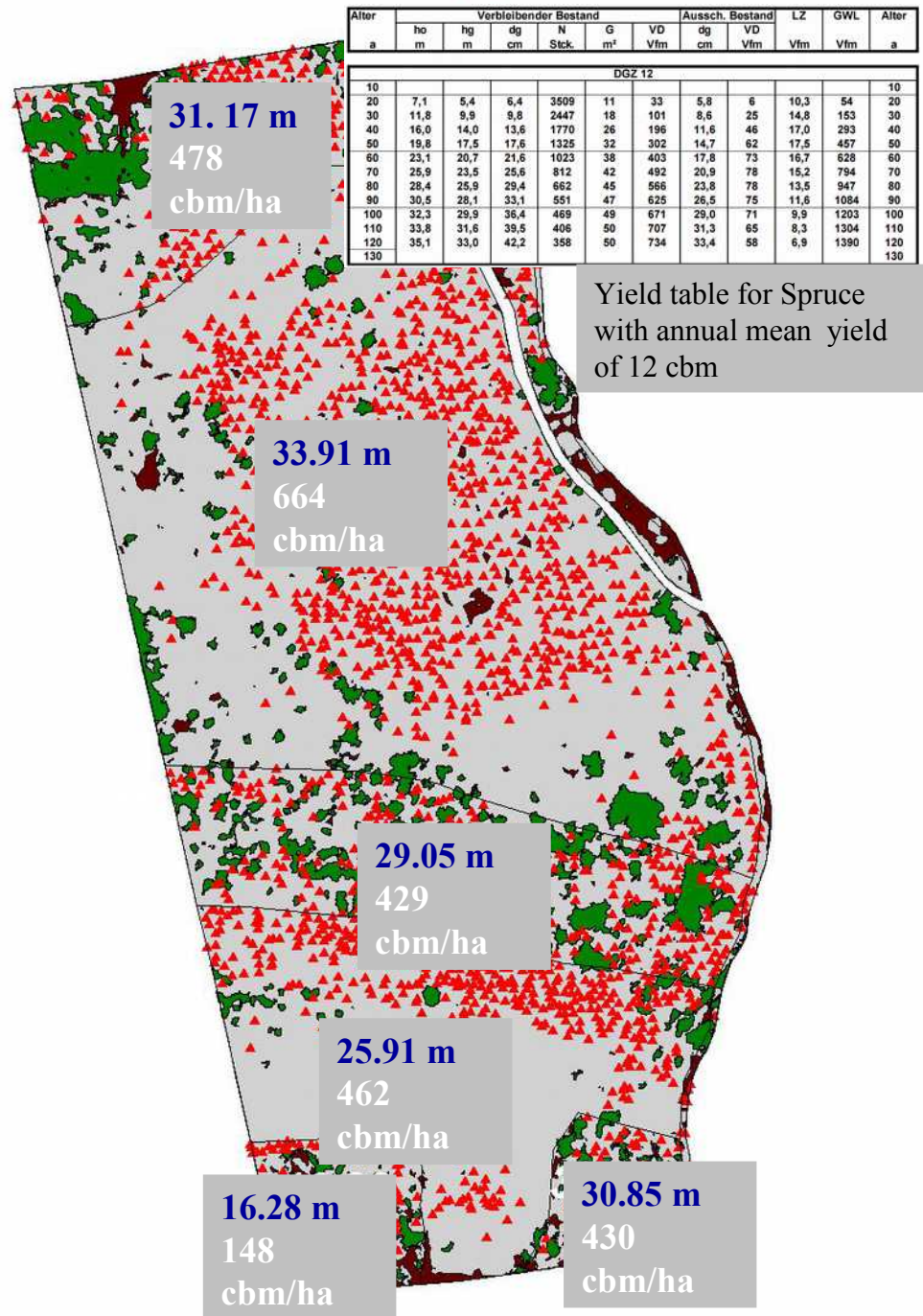
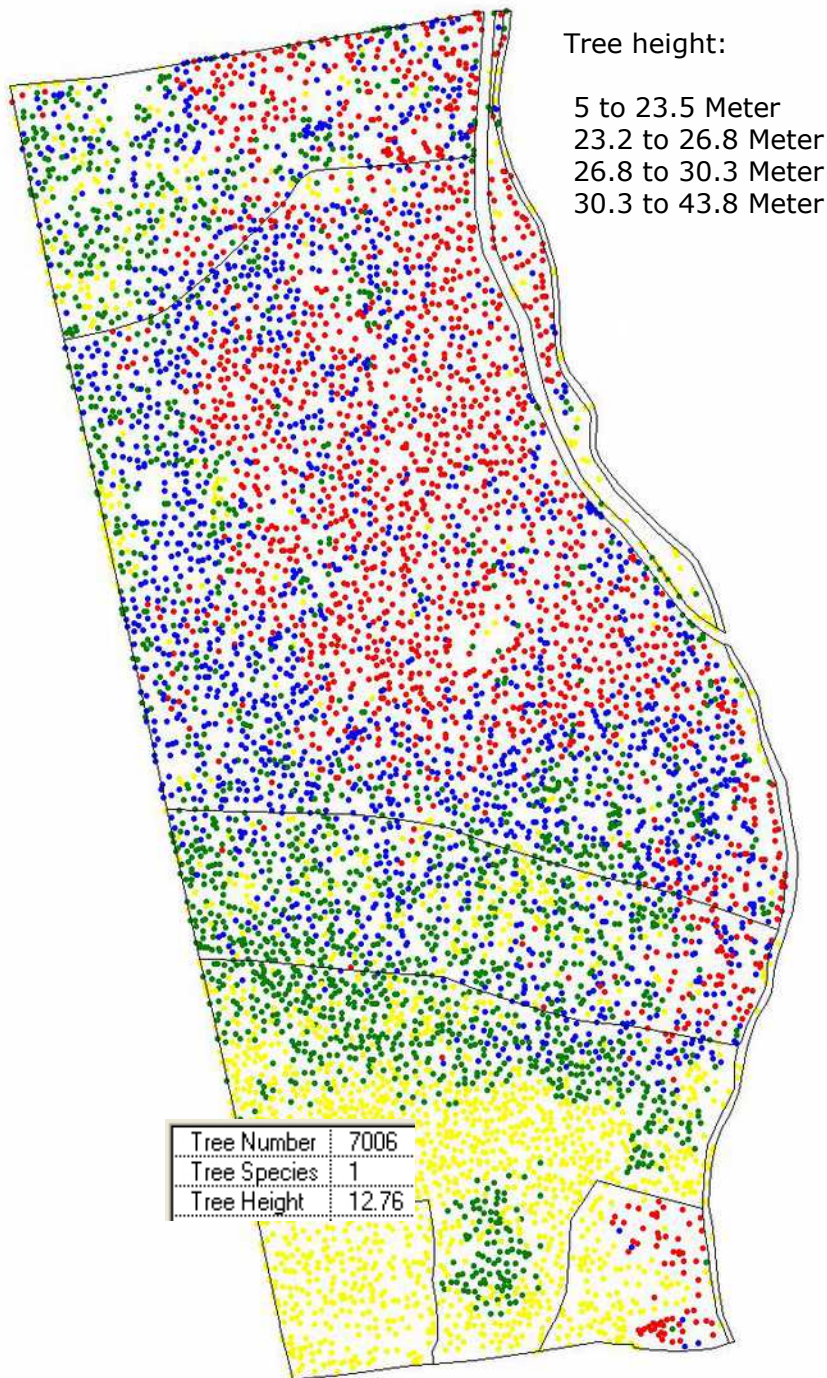


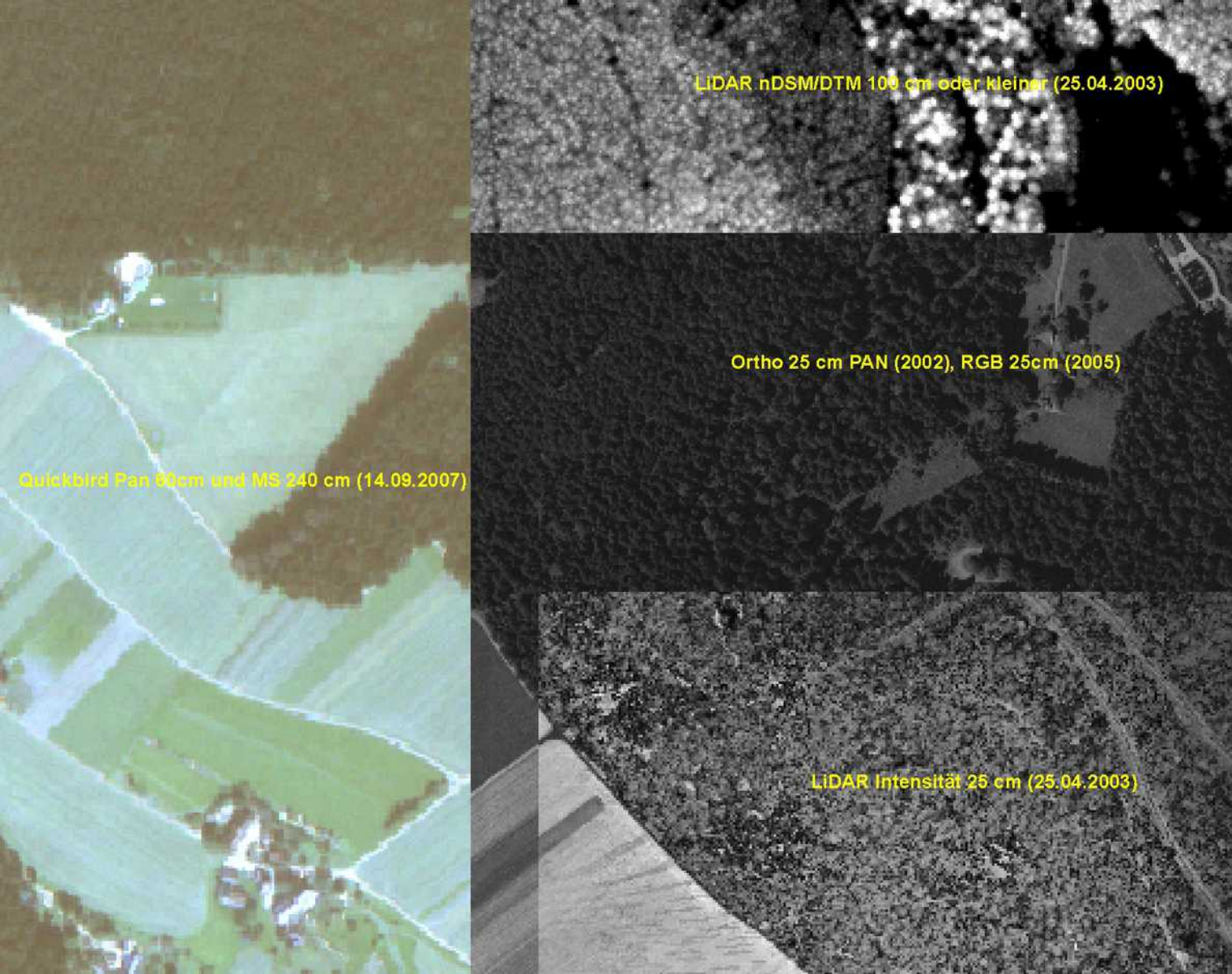
Measuring Tree Volume and other Forest Parameters with Laser Data on large scale even aged forests in Saxonia



On 270 ha, some 95.000 trees have been automatically measured







Other LiDAR Applications: Terrestrial Laser



Conclusions: Airborne Laser Scanning

LiDAR is suitable to measure many forestry parameters in comprehensive and measurable way. It is a valuable addition to traditional methods and a perfect basis for long-term forestry monitoring.

Following Forest Parameters can already be assessed with the first LiDAR data generation:

- Terrain Aspect
- Terrain Slope
- Terrain Morphology
- Terrain Suitability for logging machines
- Canopy Layers
- Canopy Closure
- Capacity of Stand Productivity
- Infrastructure, Roads and Logging Lines
- Species Groups (partly)
- Location of mixed species (partly)
- Form of stand composition (partly)
- Percentage of Tree Species (partly)
- Maximum Tree Height
- Tree Numbers and Density



Perspectives

Satellite Scanners versus Aerial Imagery

http://www.itc.nl/research/products/sensordb/Launch_Schedule.aspx

<http://www.geoeye.com> (launched Sept 2008, 0.41-meter panchromatic and 1.65-meter multispectral imagery)

<http://www.rapideye.net/> (launched August 2008, 5 Satellites to observe the different vegetation periods → useful to discriminate tree species)

<http://www.digitalglobe.com/> (WorldView1 with 50 cm resolution im Pan)

<http://www.eurimage.com> (European reseller of Quickbird, 60 cm Pan and 2,4 m NIR, price starting from ca. 0.13 € per ha)

http://en.wikipedia.org/wiki/Indian_Remote_Sensing_satellite (CartoSat, ca. 0.30 €/ha for a 2.5 m StereoPan including Surfacemodel)

ALOS (Radar and 2.5 Meter Stereo Panchromatic – PRISM, even more economical than CartoSat)

<http://www.infoterra.de/> (TerraSAR X-Band Radar Sensor with up to 1 m ground resolution, in 2008/09 another Radar Satellite to process surface models is foreseen, L-Band und P-Band evtl. suitable to model the terrain under forest cover)

<http://en.wikipedia.org/wiki/ICESat> (ICESat/Glas, LiDAR Data from Space)

HyperSpectral Sensors (suitable to discriminate tree species)



Thank you for your attention

This presentation will be available for your download at <http://laser.landconsult.de>

