



AUTOMOTIVE



INFOCOM



**MOBILITY, ENERGY
& ENVIRONMENT**



AERONAUTICS



SPACE



**DEFENCE &
SECURITY**

Modular Classification and Change Analysis of Vegetation Encroachment using Object-based Image Analysis

S. Günther, E. Krätzschar, J. Sehner, H. Klemm (IABG mbH Dresden/Munich, Germany)

A. Böhm (US ARMY, USAG Hohenfels, Germany)

J.R. Phillips (PARSONS, Richmond, USA)

ICC Dresden, 28.08.2013

IABG Geodata Factory – Geodata Services

Interpretation / Digitizing

- Vector data mapping
- Automated Image analysis
- Classification & attribution
- Analysis of aerial & space borne imagery
- Topographic maps / plots



Data acquisition

- Flight campaigns
- Aerial & space borne imagery
- Digital terrain & surface models
- Laser scanning data (LIDAR)
- Vector & attribute data, map research



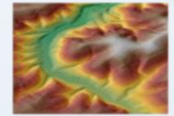
3D Stereo Analysis

- 3D city models
- Splitted waste water charge
- Analysis of solar potential
- Cadastral register for roads & open space



Photogrammetry

- Terrain models – DTM
- Surface models – DSM
- Aerial triangulation & orthophoto production
- Orthophoto mosaicing



Geoinformatics

- GIS development
- Add-Ins, user interfaces, web
- Modeling of (geo-) databases
- Database connection to GIS/CAD systems
- Interface programming



GIS-Consulting

- Project management
- Consulting for GIS-Systems
- GIS & Migration
- Quality assurance



Content

- Study Area and Motivation
- Data
- Classification Technology „on three pillars“
- Classification Results
- Quality Assurance
- Summary



Study Area

- Hohenfels, Germany
- Military training area under use (~ 160 km²)
- Karst/ limestone soils and semi-natural grasslands and pastures
- Biodiversity in the need of ecological protection
- Endangered by spread of invasive plants/ scrub encroachment - including Blackthorn (*Prunus spinosa*)



Foto: Niedersächsischer Landesbetrieb f. Wasserwirtschaft, Küsten- und Naturschutz; Mesophiles Gebüsch

Situation in the Study Area



Background – Why Remote Sensing?

- Area under focus (excluding forest) ~ 58 km²

- Reduction costs:

LOW STATUS (NEW)

grazing animals & mowing

ca. 200€/ha*



5%

3km²

60,000 €

MEDIUM STATUS

mowing, mulching, renaturation

400 – 5000 €/ha*



810,000 €

HIGH STATUS

mulching, manual intershop
renaturation

3000 – 8000€/ha*

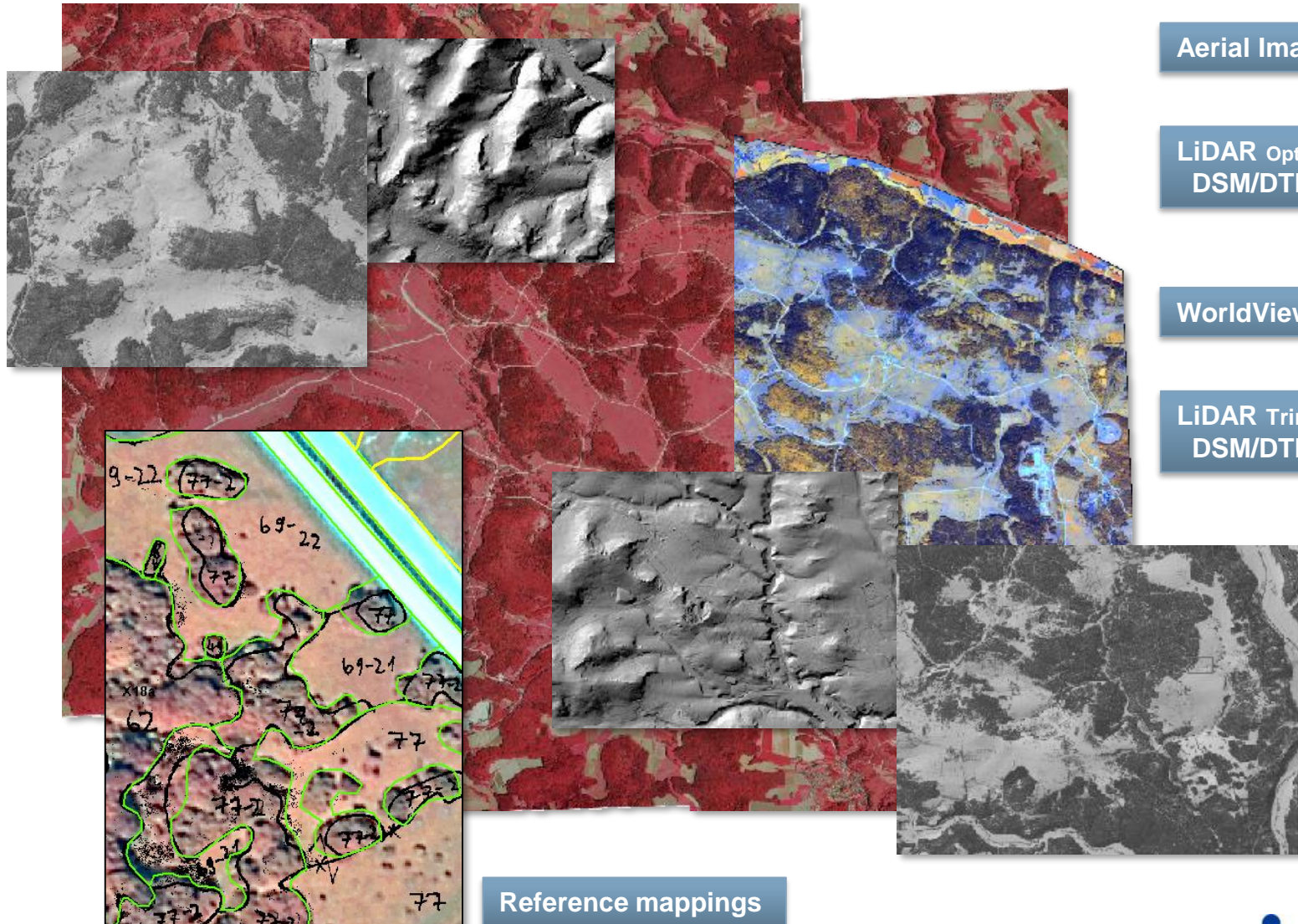


1,65Mio €

- Early action is much more cost effective
- Control measures are necessary for reduction of encroachment
- Efficient instrument to map the entire area

* Kosten der Erst- und Dauerpflege, changed acc. to FRIELINGHAUS 1998, TAMPE AND HAMPICKE 1995, KELLERMANN AND REINÖHL 1997, LUICK 1995 and DLZ 1994

Data



Aerial Imagery 2007

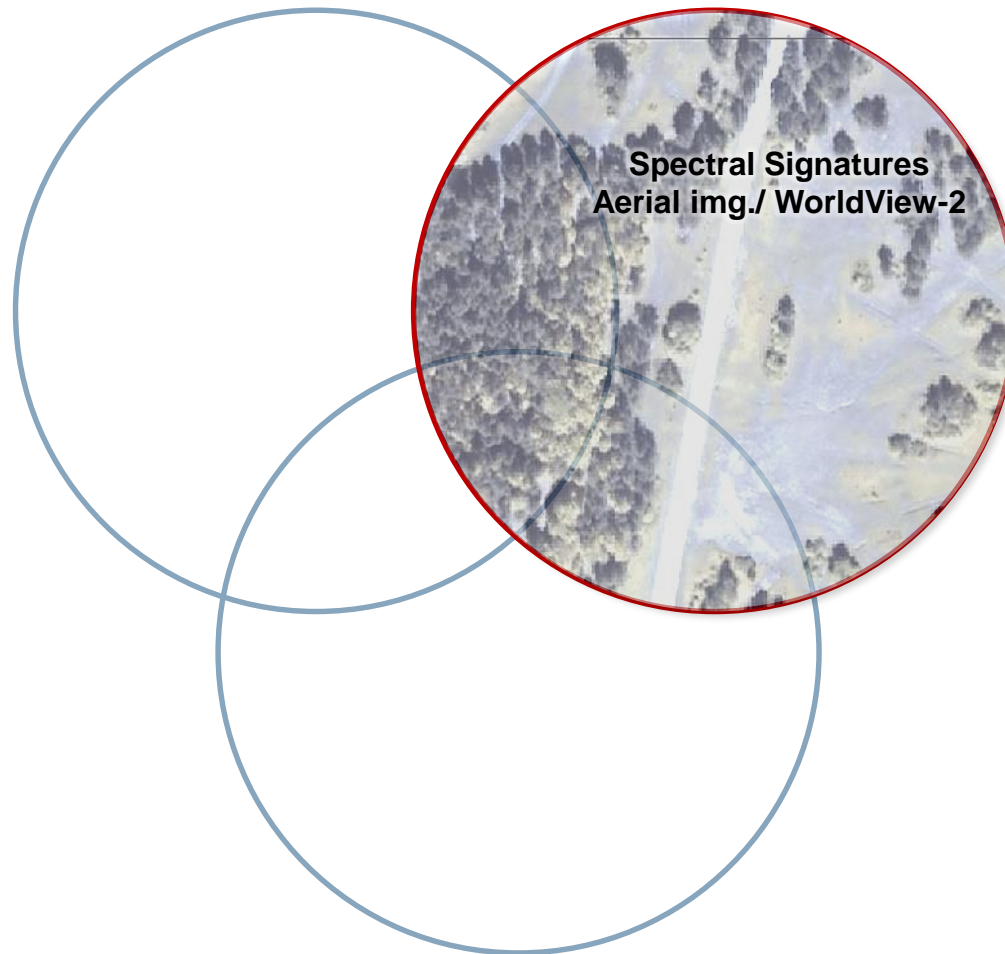
LiDAR Optech ALTM 3100
DSM/DTM 2007

WorldView-2 2012

LiDAR Trimble Harrier 56
DSM/DTM 2012

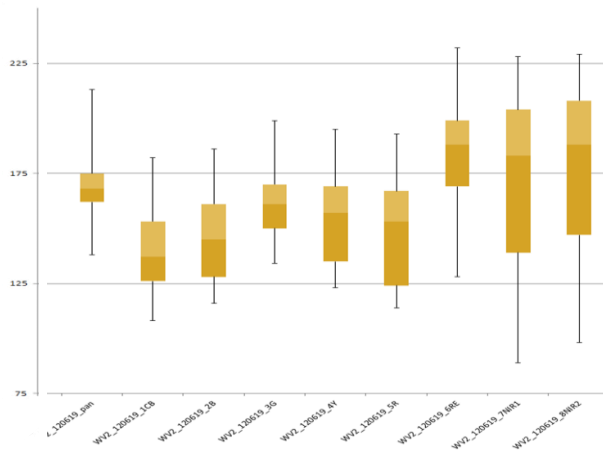
Reference mappings

Classification Technology – Spectral Pillar

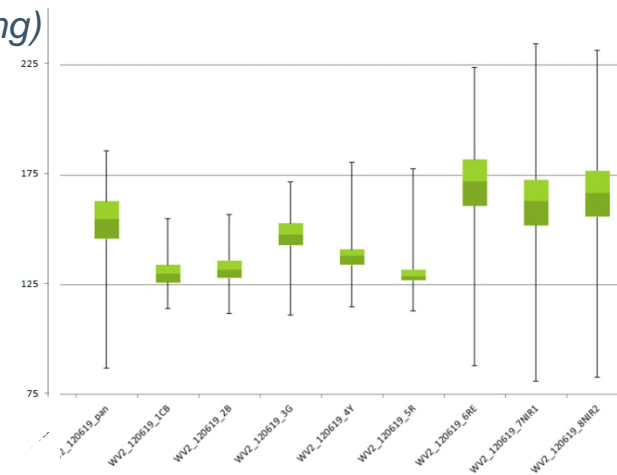


Classification Technology – Spectral Analysis

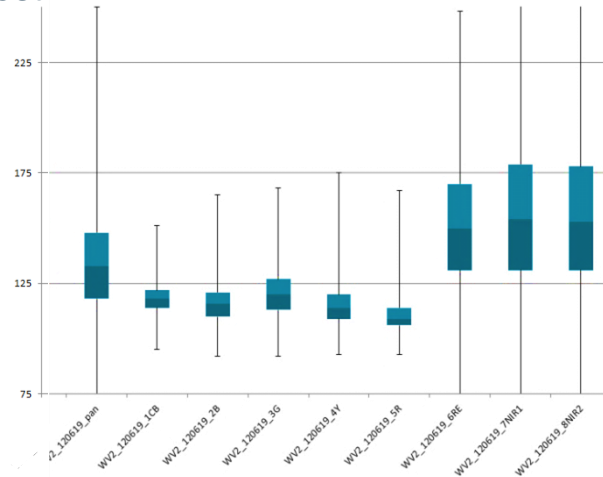
Grassland



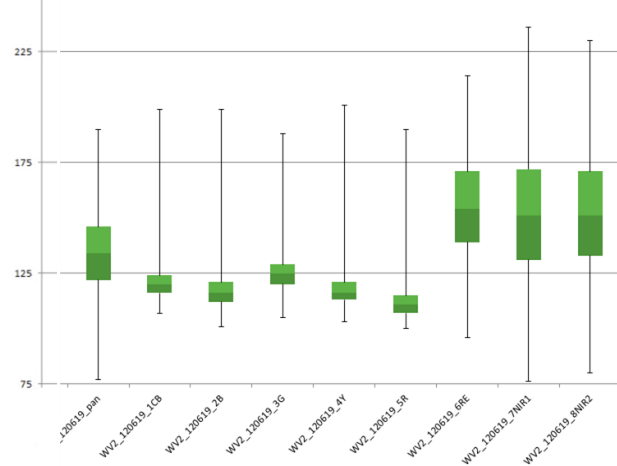
Blackthorn (young)



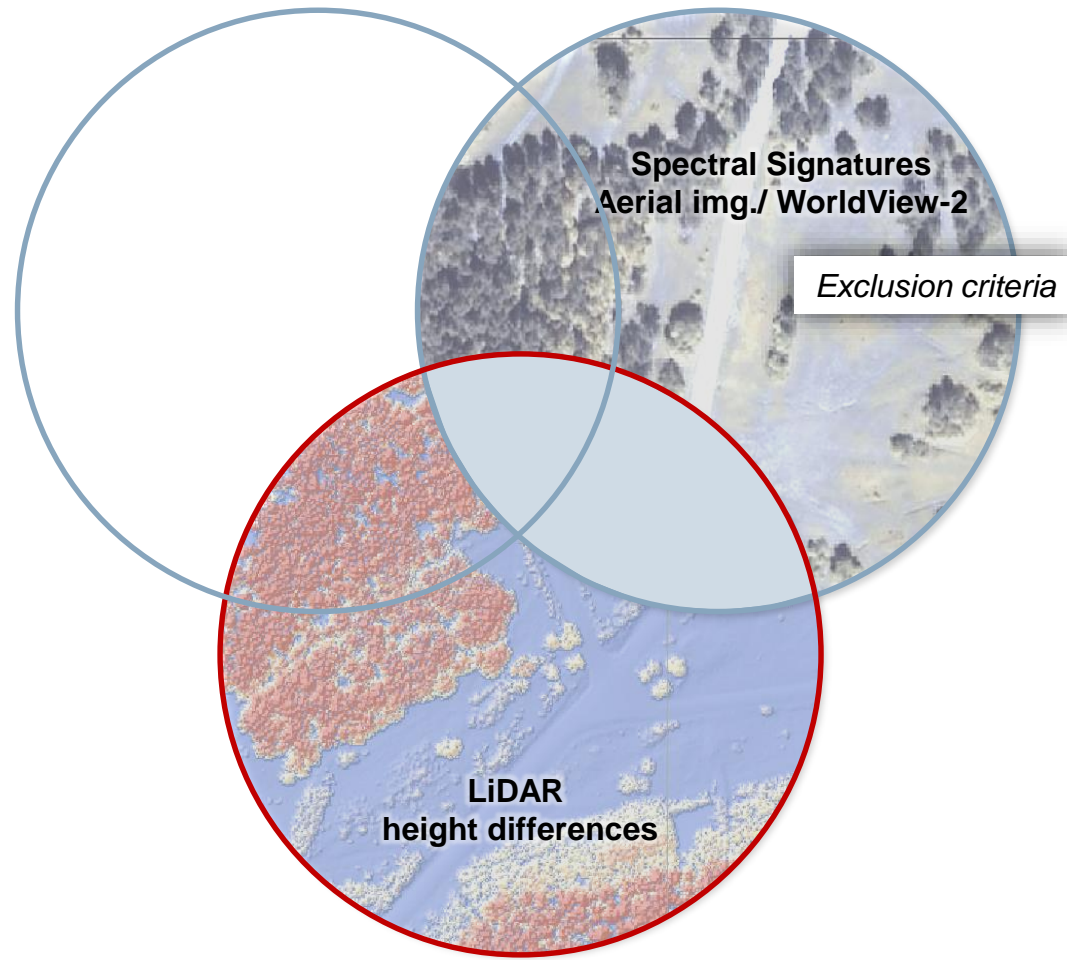
Forest



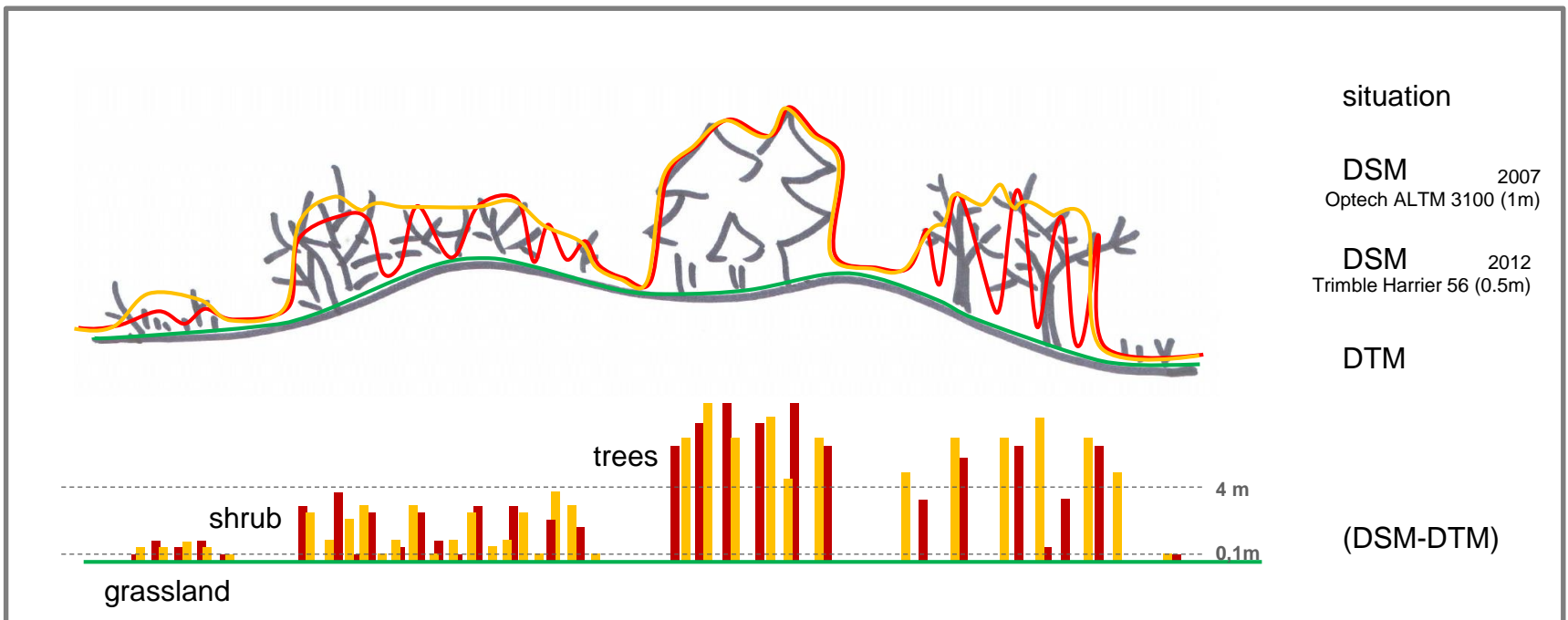
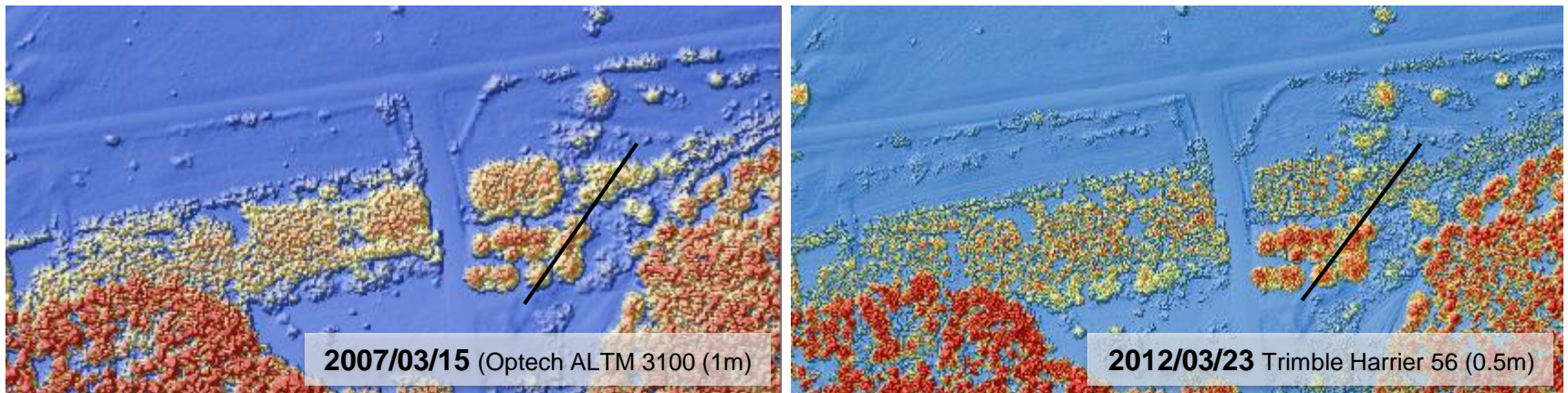
Blackthorn



Classification Technology – Height Pillar

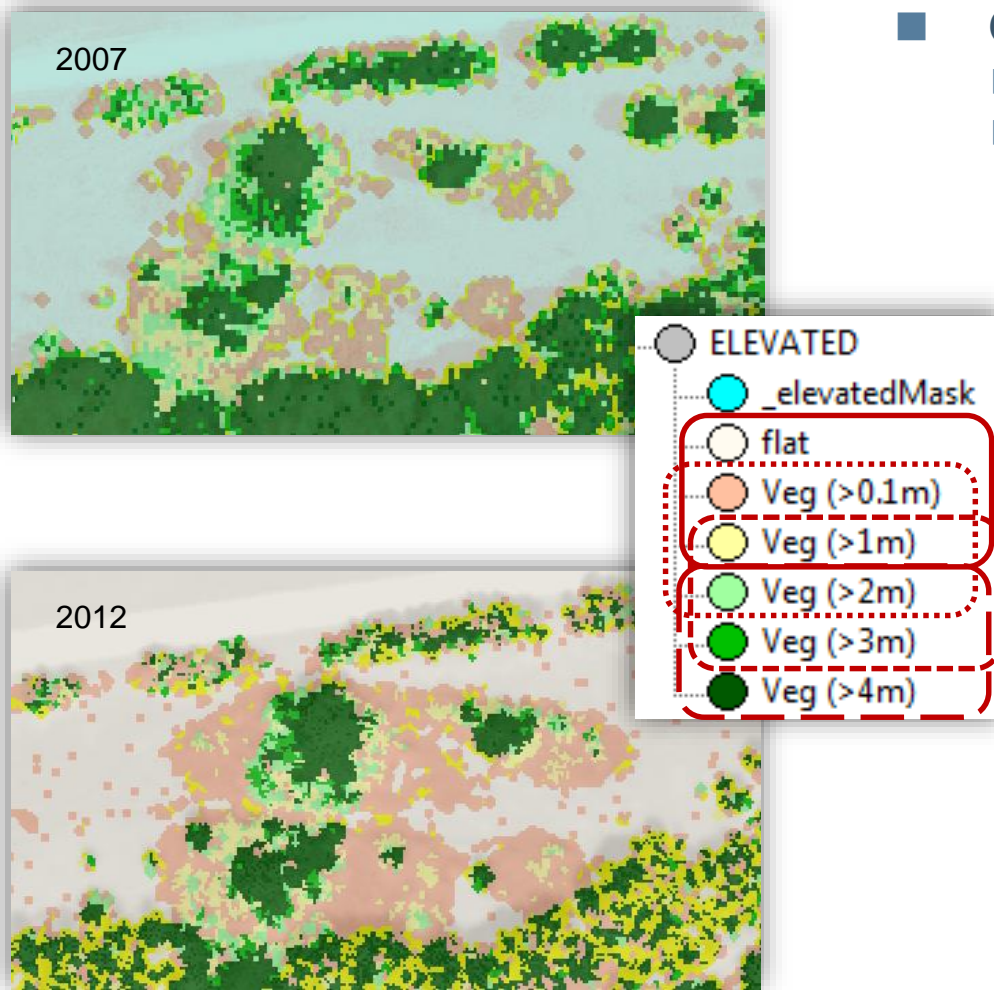


Classification Technology – LiDAR Data

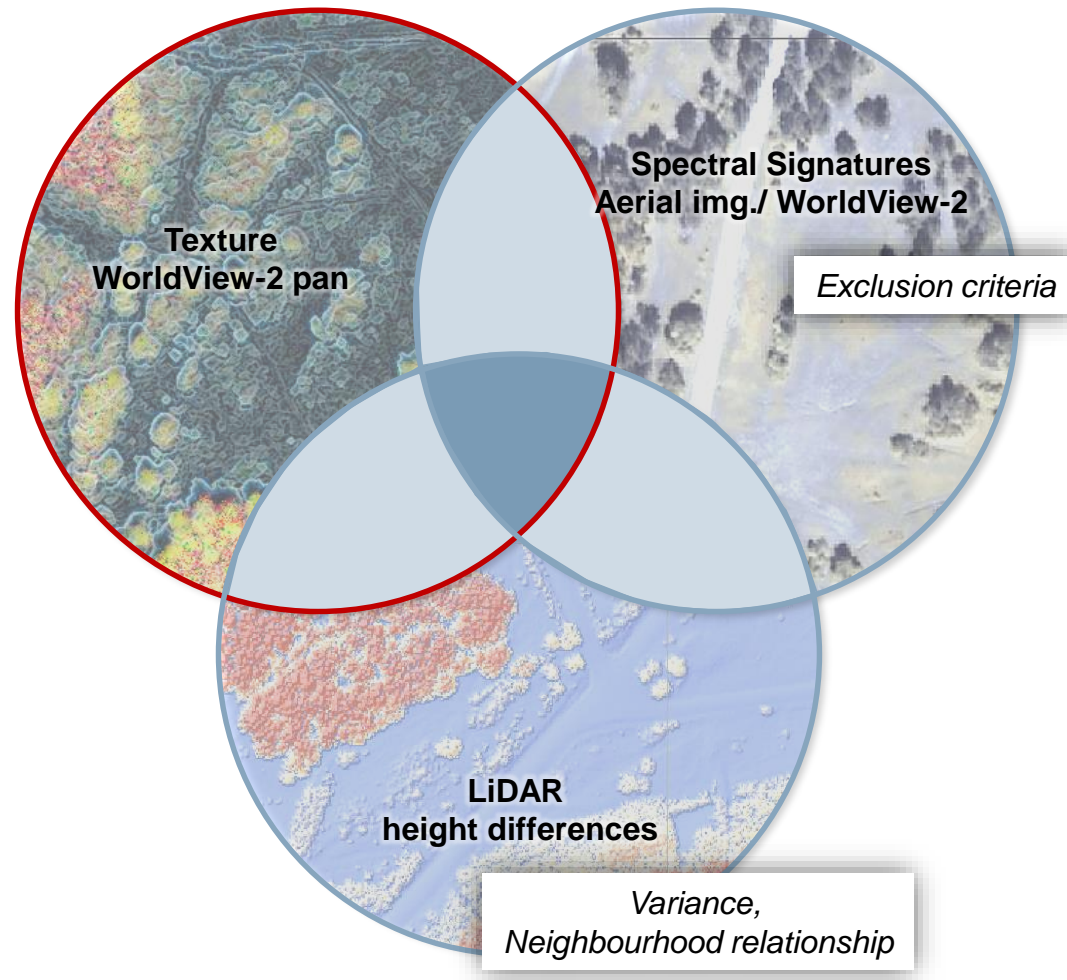


Classification Technology – LiDAR Data

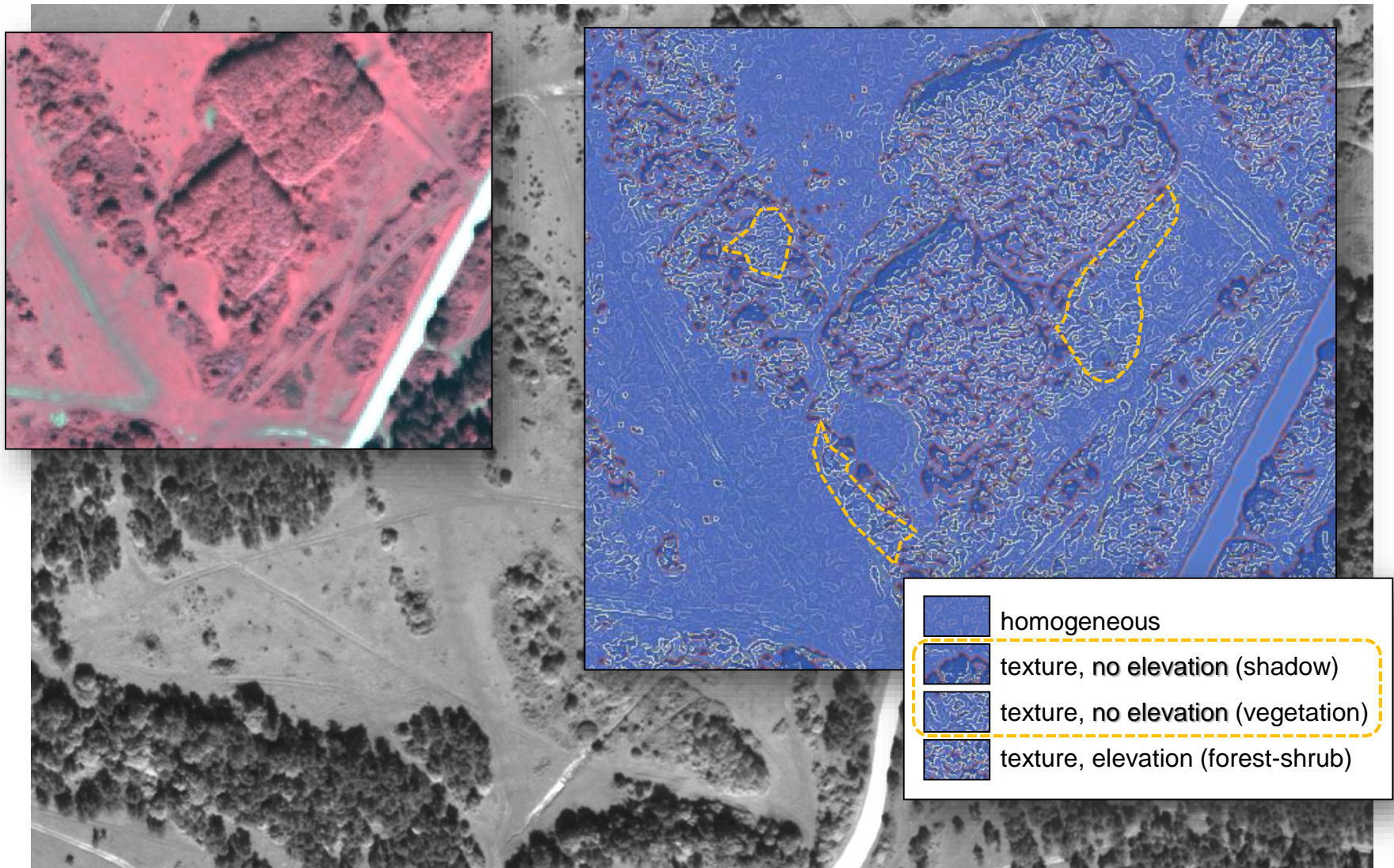
- Object-based Image Analysis
 - Rule set technology
 - Using contextual information (neighbourhood), relations and changes



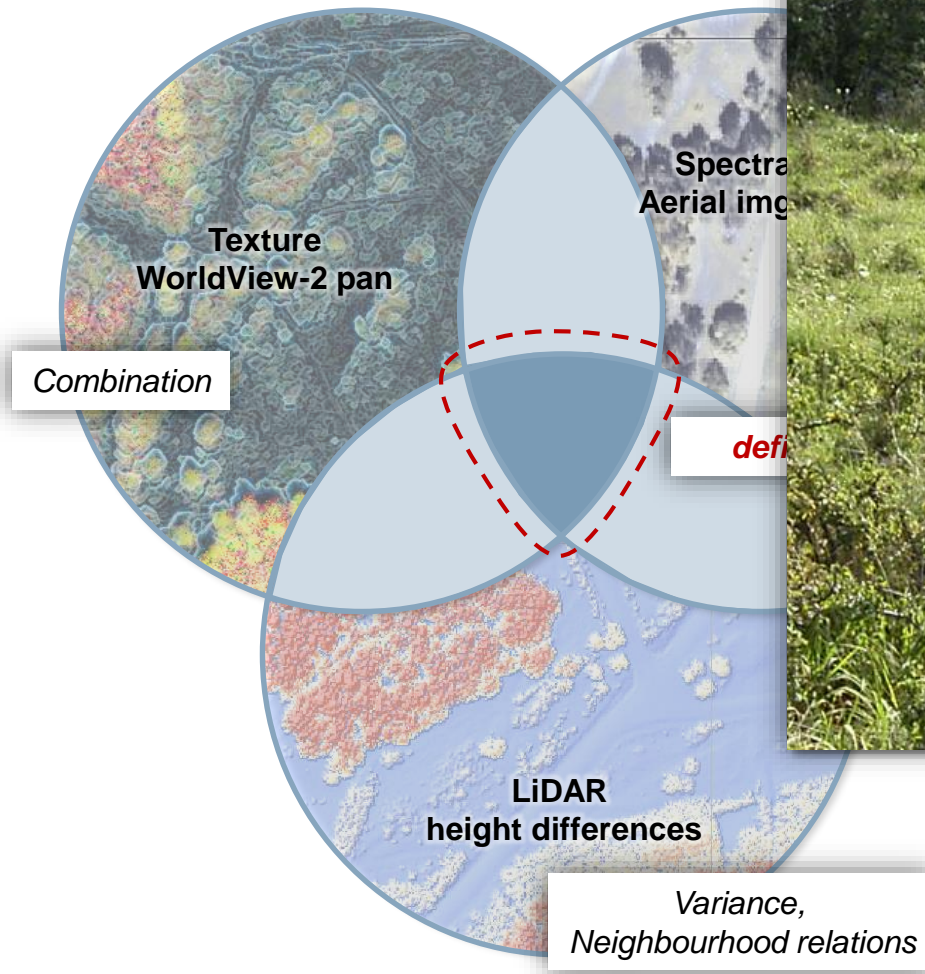
Classification Technology – Texture Pillar



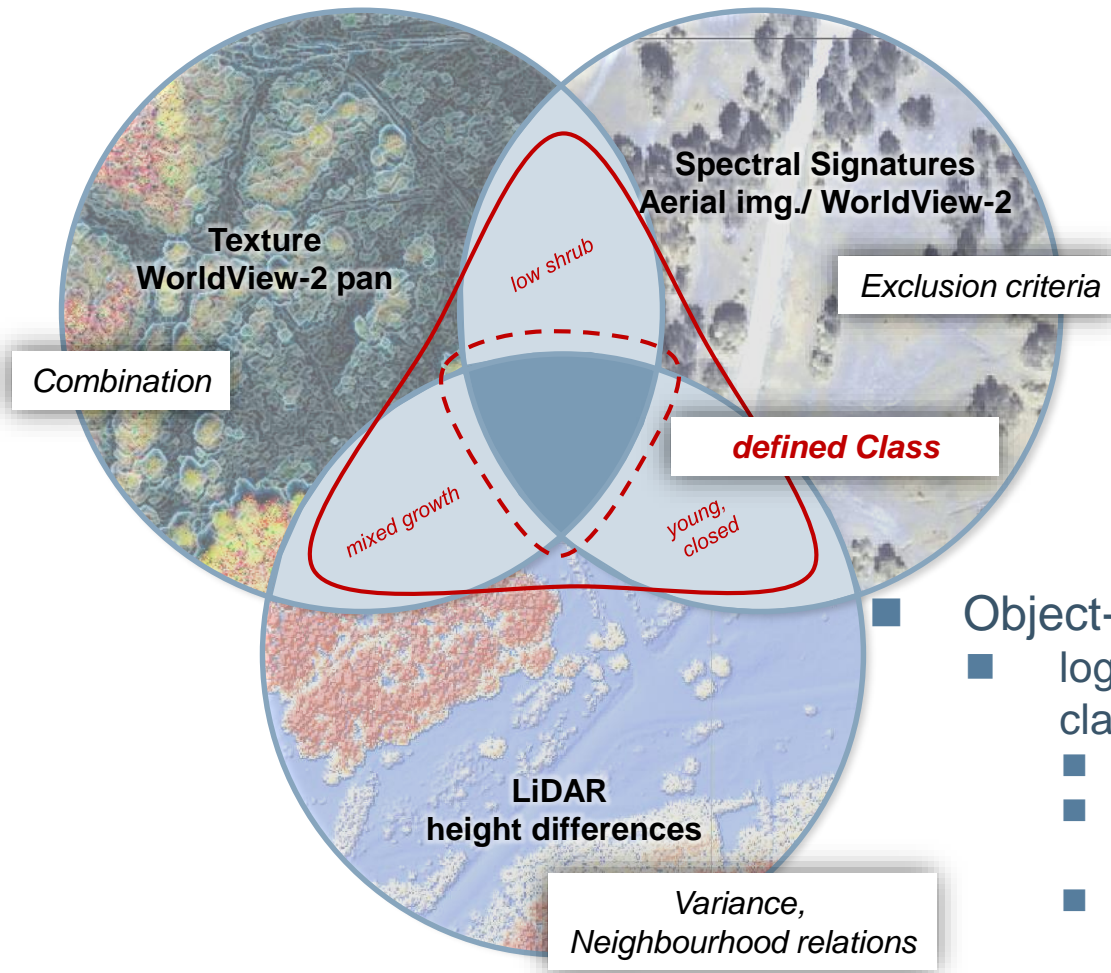
Classification Technology – Texture Analysis



Classification Technology – Feature Space



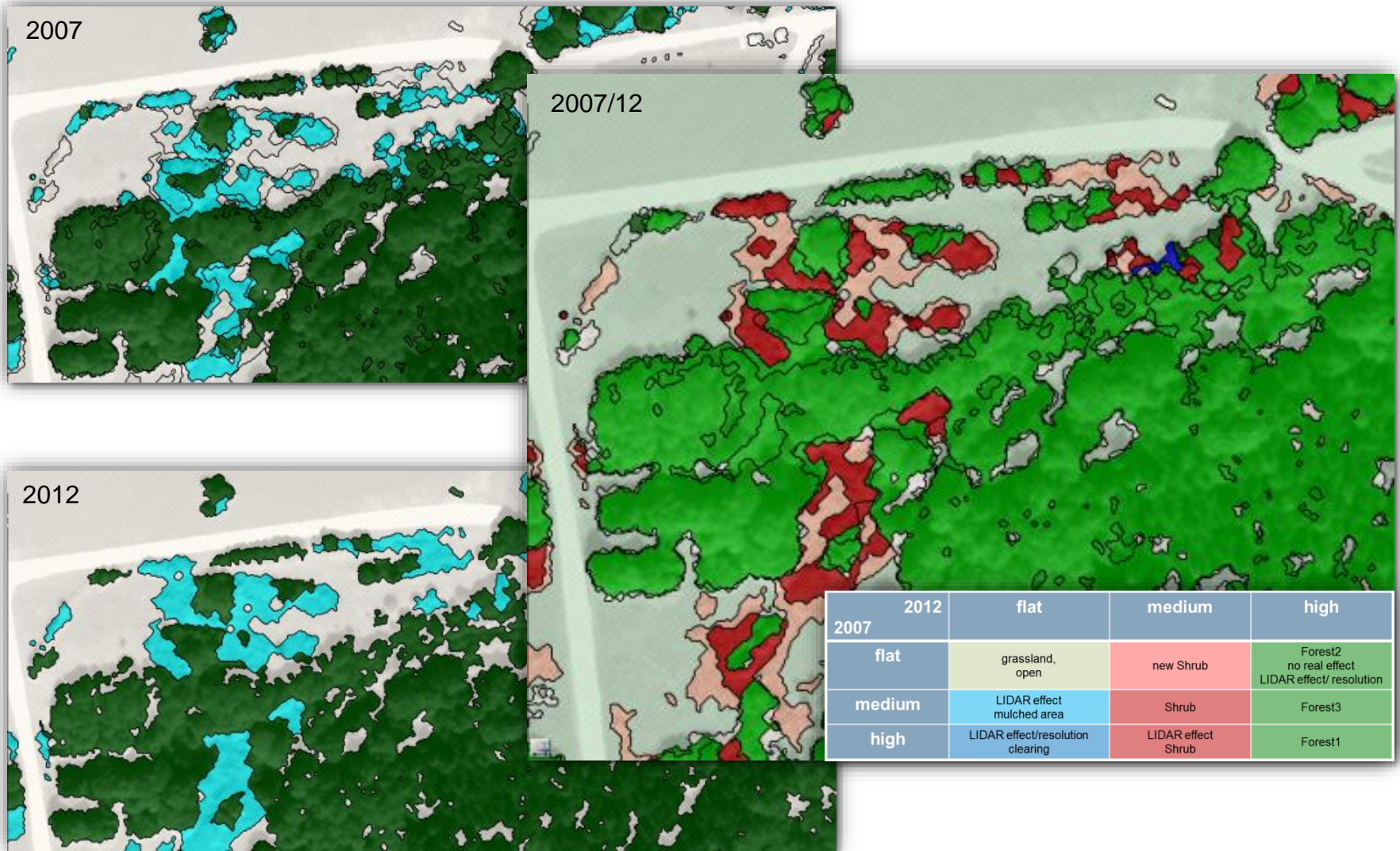
Classification Technology – Feature Space



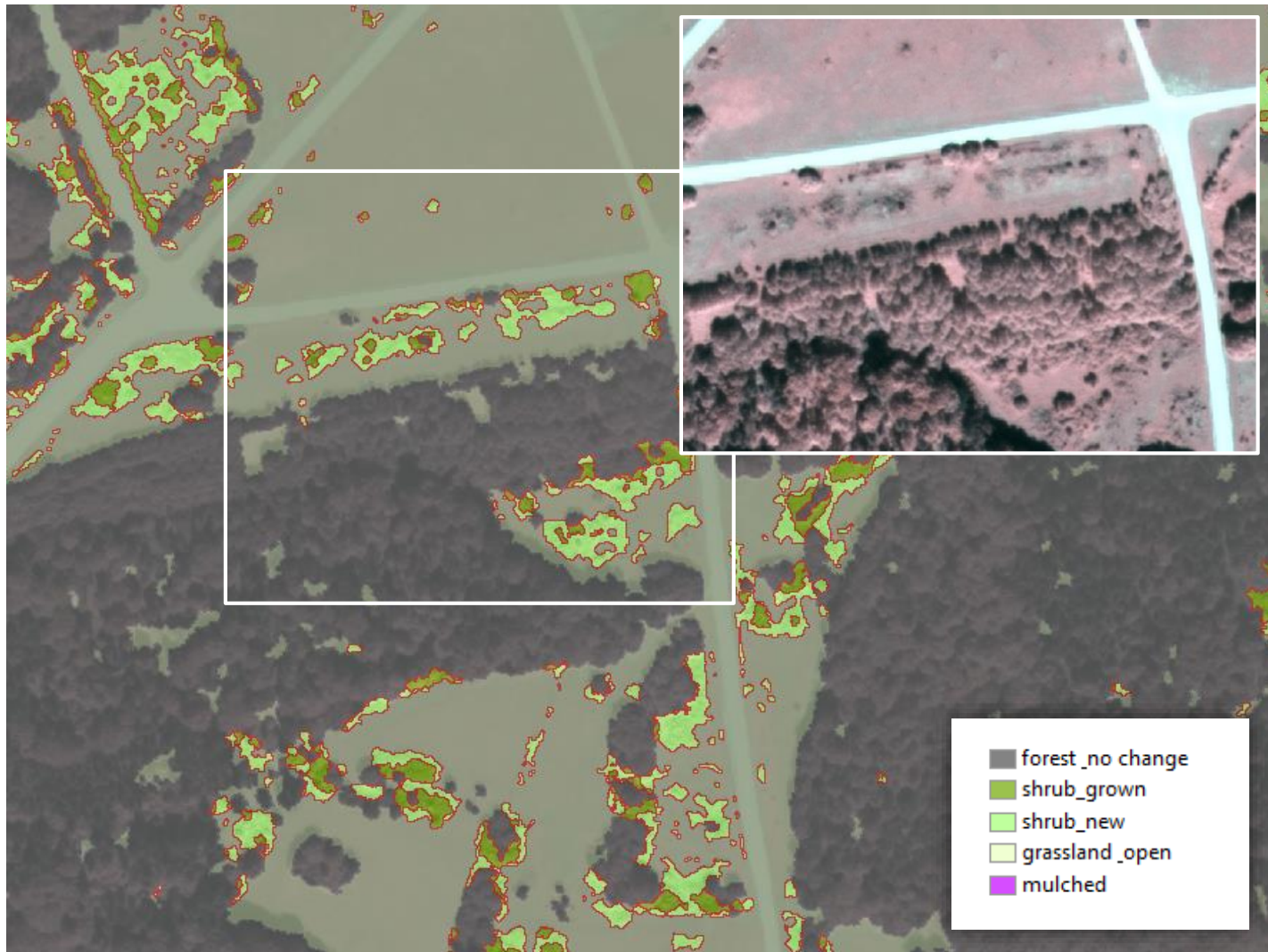
Object-based Image Analysis

- logic expansion of classification via
 - Reference knowledge
 - Neighbourhood relationships
 - Plausibilities & Valuing of changes 2007/2012
 - Minimum values / Similarities

Classification Result – Status and Change Analysis



Classification Result



LIDAR
height differences

Spectral signature
aerial Img./WorldView-2

Texture
+ *eCognition*
(rule set)

aggregated
classification

secure classes:
class.matrix

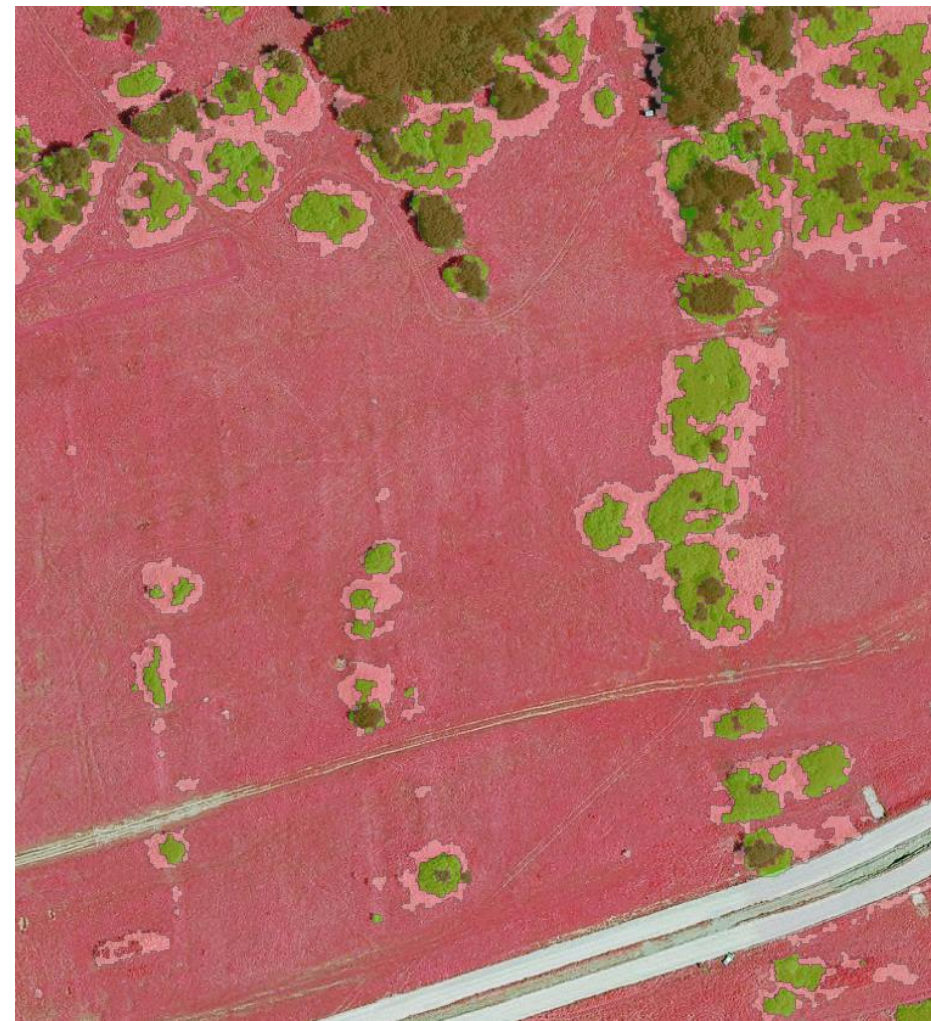
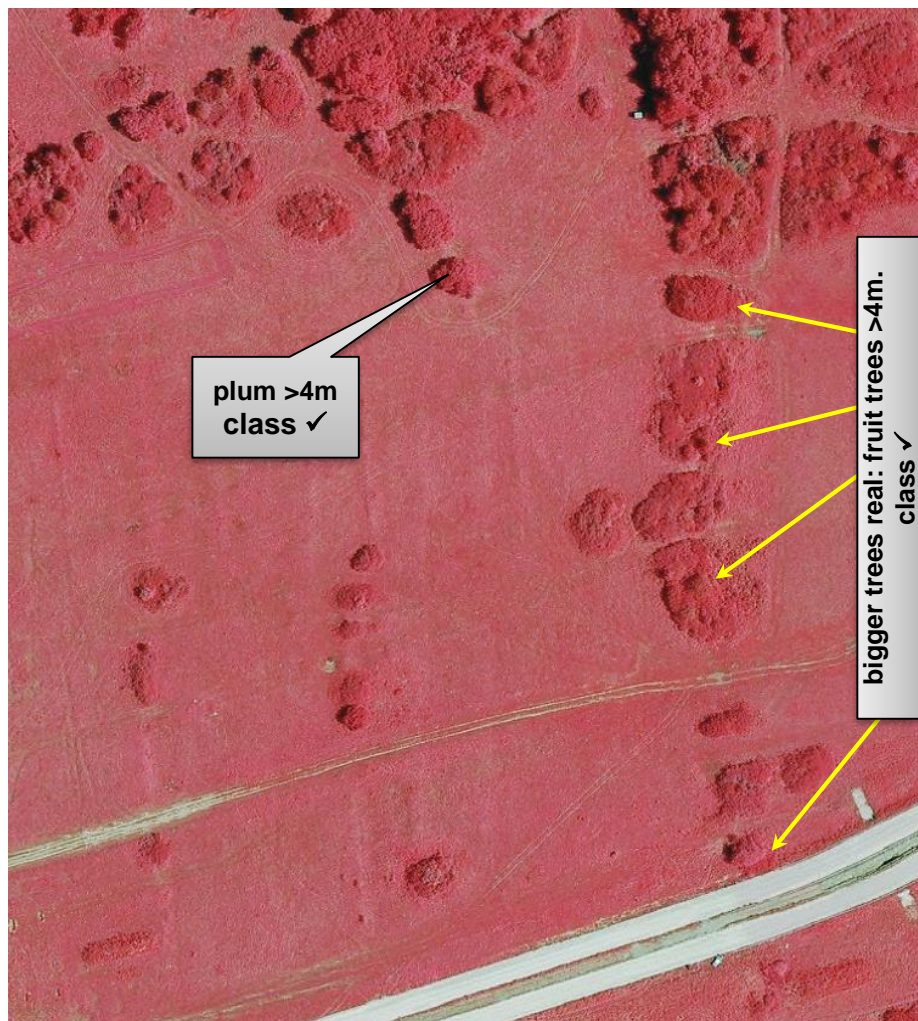
Generalisation1:
Similarity,
Neighborhood,
Size/ location

Generalisation2:
Class!,
rel. difference,
location/ plausibility

Mask
(Change elements)

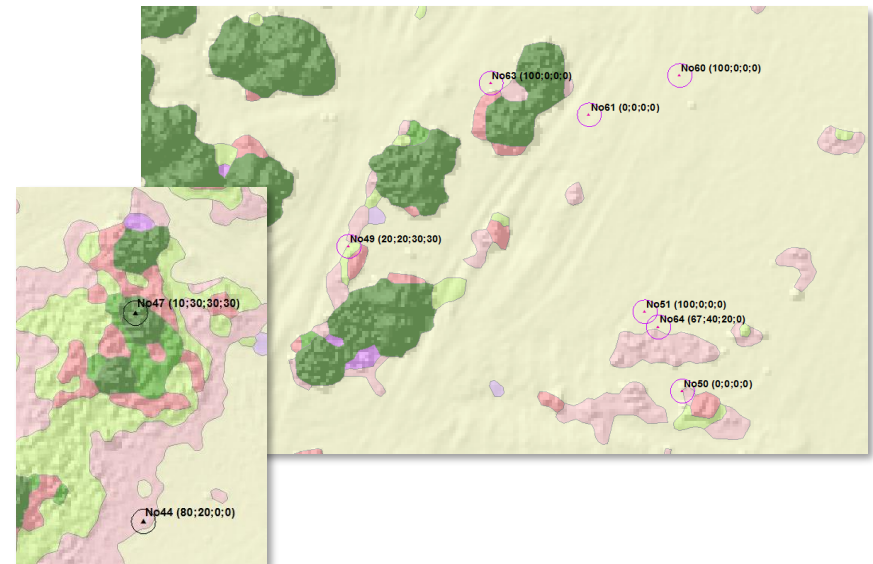
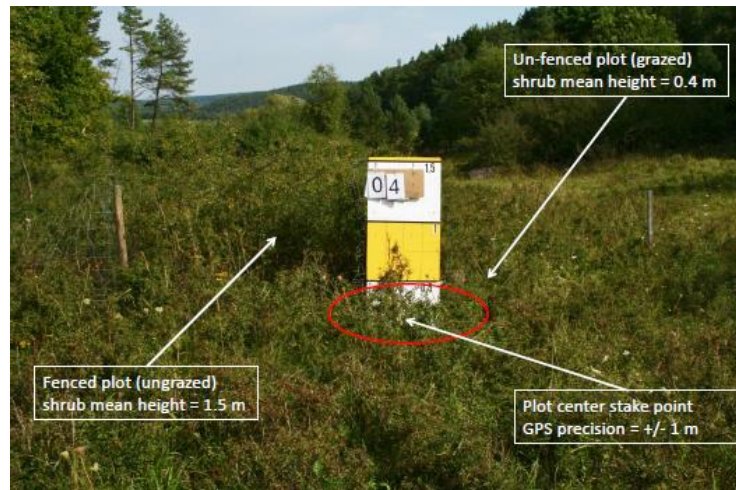
Quality Assurance – Field Check

- Visual control with result and experts: complete matching



Quality Assurance – Reference Mapping

- Numeric control with reference data - “Monitoring of Vegetation Control Areas” (NRI) using 84 2x2m plots: correlation of 94%



Correlation	Total	%
Class difference = 0	79	94.0%
Class difference = 1	4	4.8%
Class difference > 1	1	1.2%
Sum	84	100.0%

Summary

- Control measures for scrub encroachment are essential for military training areas in order to
 - Protect heterogeneous habitats (heterogeneous grassland, etc.) and
 - Enable training activities
- Object-based image analysis and modular classification technology allow high quality status mapping and change analysis
- LiDAR (surface and terrain) in combination with spectral information (WorldView-2 or other) enables a high degree of accuracy

Thank you for your attention!

IABG Geodata Factory – Geodata Services

Interpretation / Digitizing

- Vector data mapping
- Automated Image analysis
- Classification & attribution
- Analysis of aerial & space borne imagery
- Topographic maps / plots



Data acquisition

- Flight campaigns
- Aerial & space borne imagery
- Digital terrain & surface models
- Laser scanning data (LIDAR)
- Vector & attribute data, map research



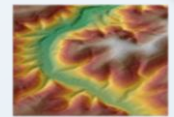
3D Stereo Analysis

- 3D city models
- Splitted waste water charge
- Analysis of solar potential
- Cadastral register for roads & open space



Photogrammetry

- Terrain models – DTM
- Surface models – DSM
- Aerial triangulation & orthophoto production
- Orthophoto mosaicing



Geoinformatics

- GIS development
- Add-Ins, user interfaces, web
- Modeling of (geo-) databases
- Database connection to GIS/CAD systems
- Interface programming



CONTACT

IABG mbH Geodata Factory

Sylvia Günther

Herrmann-Reichelt-Str. 3

01109 Dresden

+49 351 8923-144

guenthers@iabg.de

www.iabg.de