AUTOMOTIVE | INFOCOM | MOBILITY, ENERGY & ENVIRONMENT | AERONAUTICS | SPACE | DEFENCE & SECURITY

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

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IABG Geodata Factory – Geodata Services

Interpretation / Digitizing

- Vector data mapping
- Automated Image analysis
- Classification & attributation
- Analysis of aerial & space borne imagery
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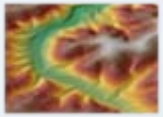

- Terrain models – DTM
- Surface models – DSM
- Aerial triangulation & orthophoto production
- Orthophoto mosaicing

Geoinformatics

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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)	MEDIUM STATUS	HIGH STATUS
grazing animals & mowing *ca. 200€/ha**	mowing, mulching, renaturation *400 – 5000 €/ha**	mulching, manual internshop renaturation *3000 – 8000€/ha**

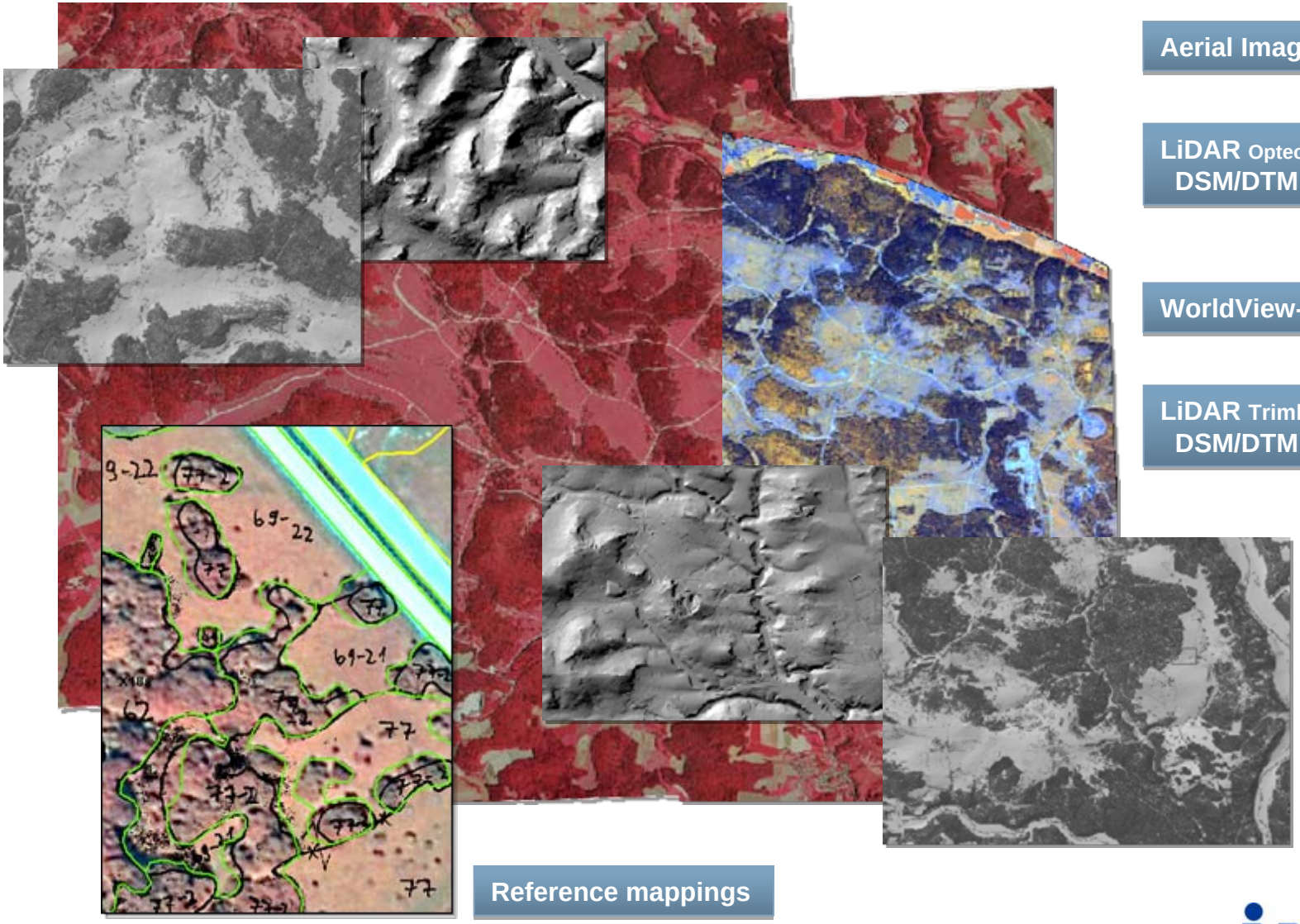
5% 3km²

60,000 € **810,000 €** **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

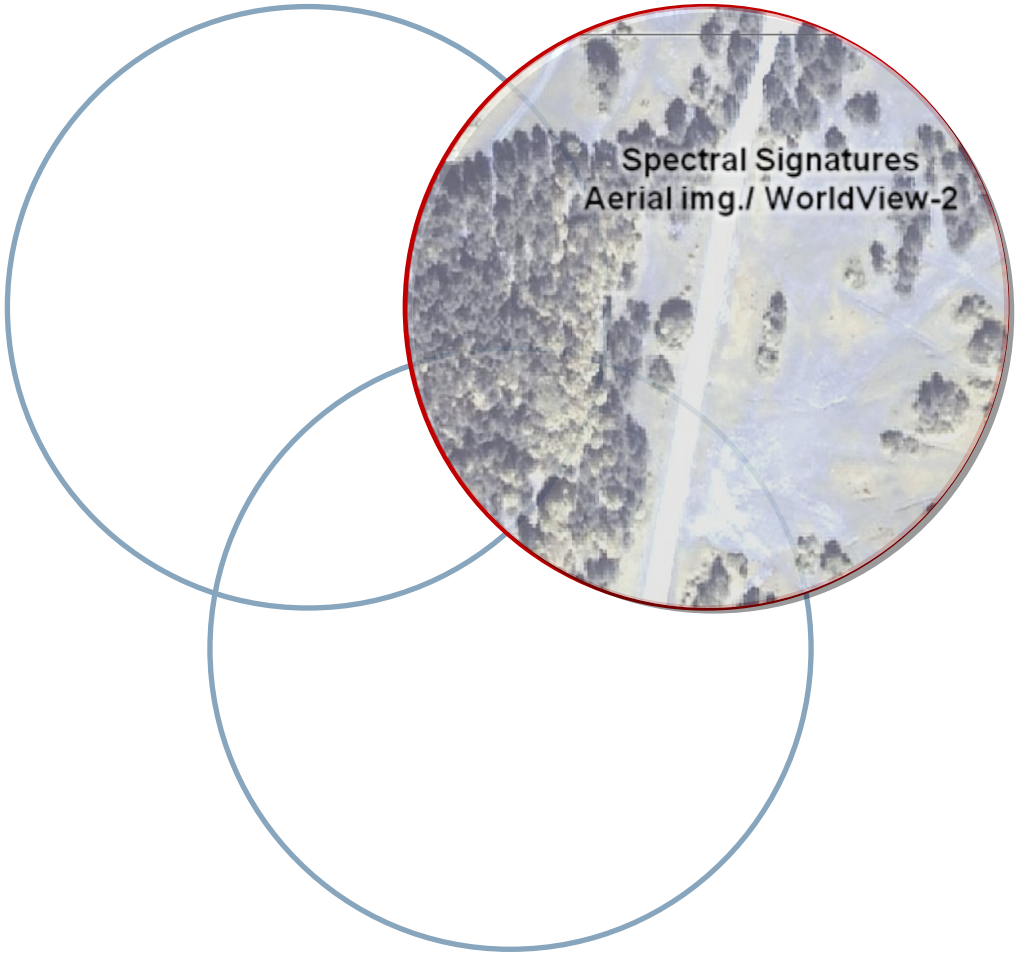
LiDAR Optech ALTM 3100
DSM/DTM 2007

WorldView-2 2012

LiDAR Trimble Harrier 56
DSM/DTM 2012

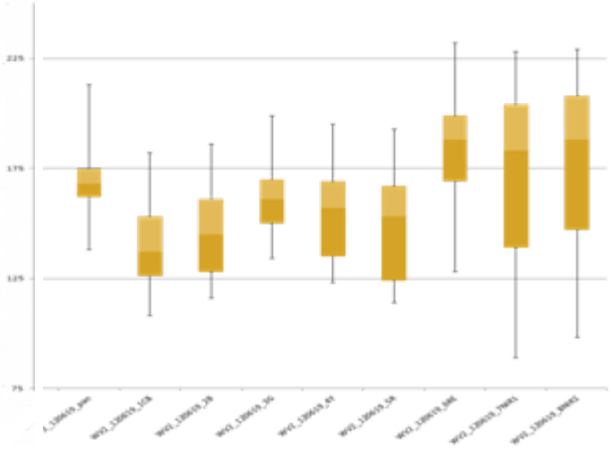
Reference mappings

Classification Technology – Spectral Pillar

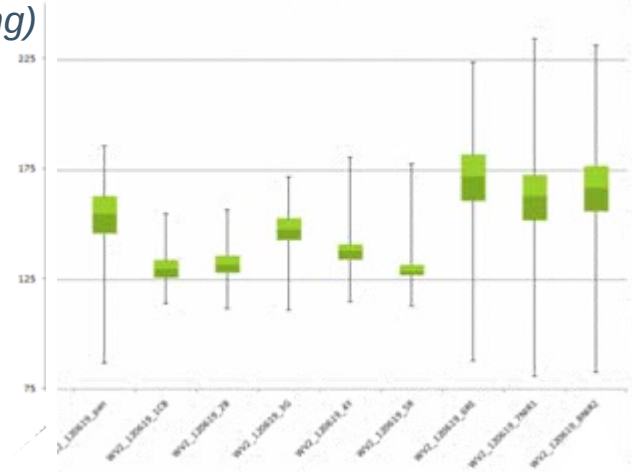


Classification Technology – Spectral Analysis

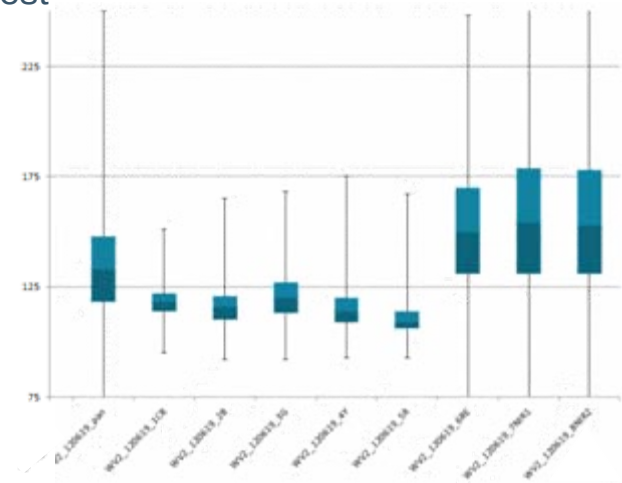
Grassland



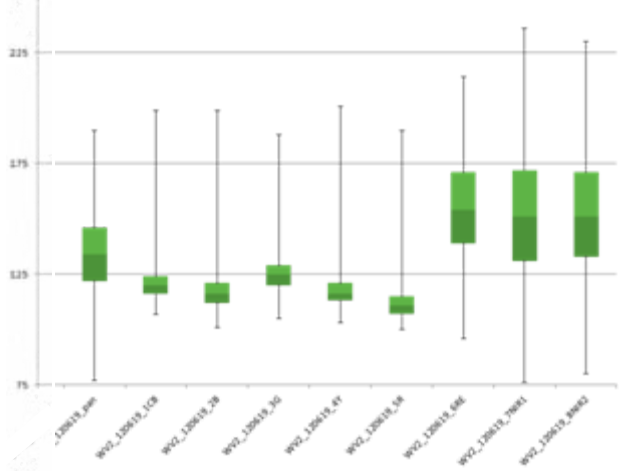
Blackthorn (young)



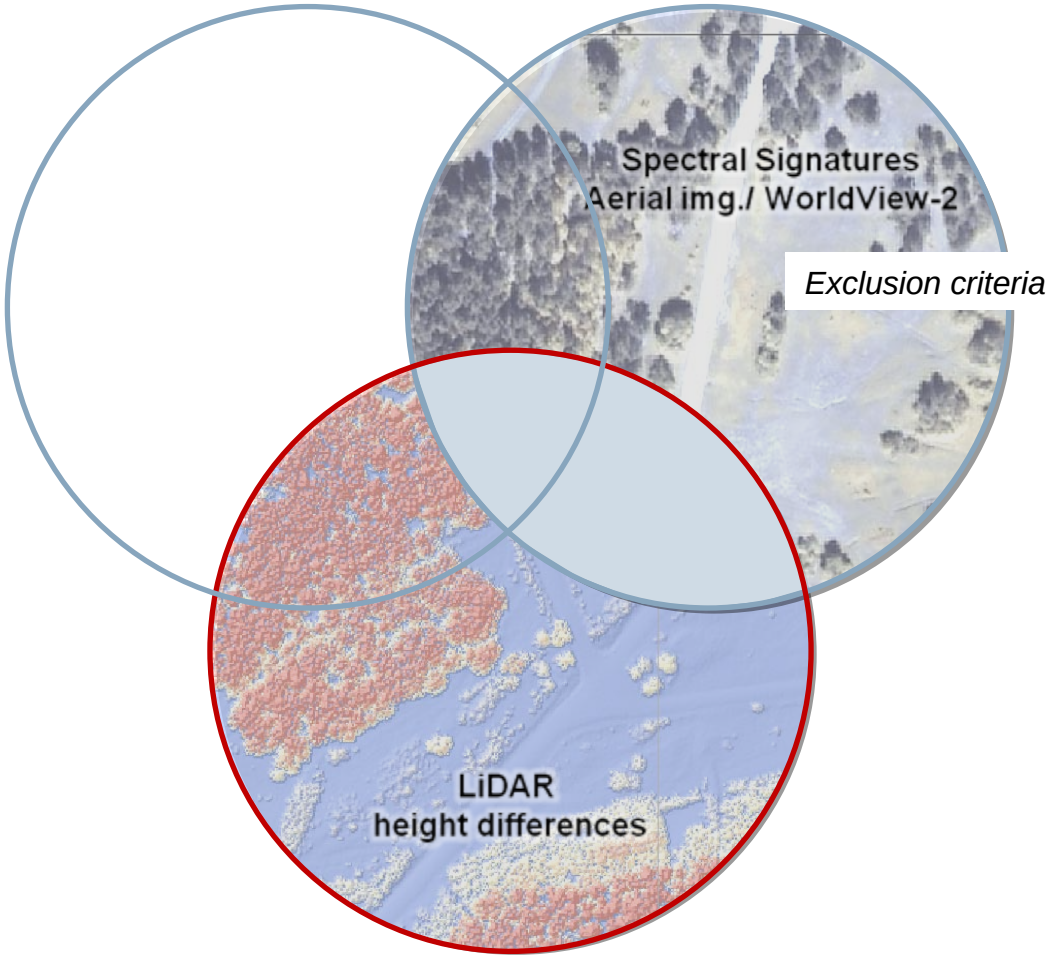
Forest



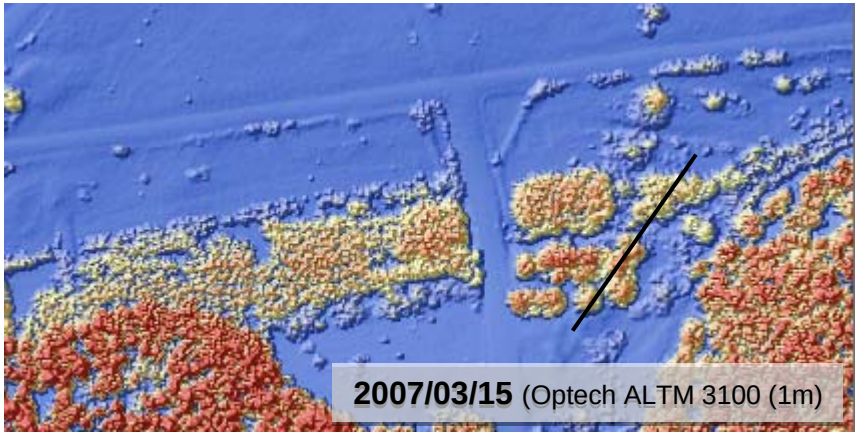
Blackthorn

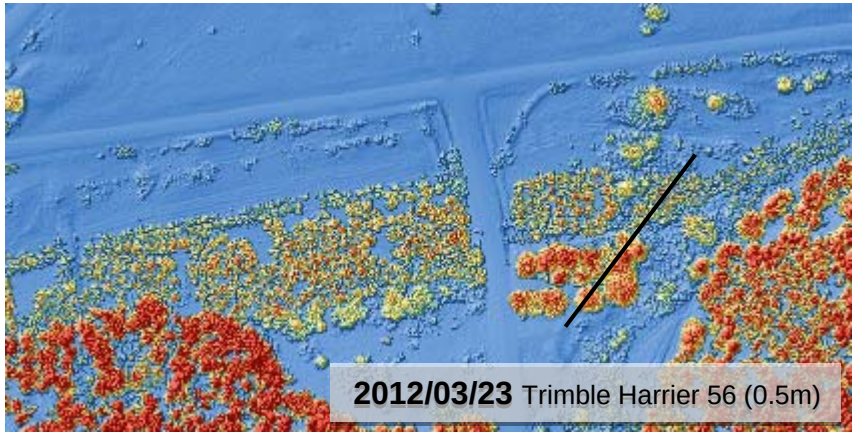


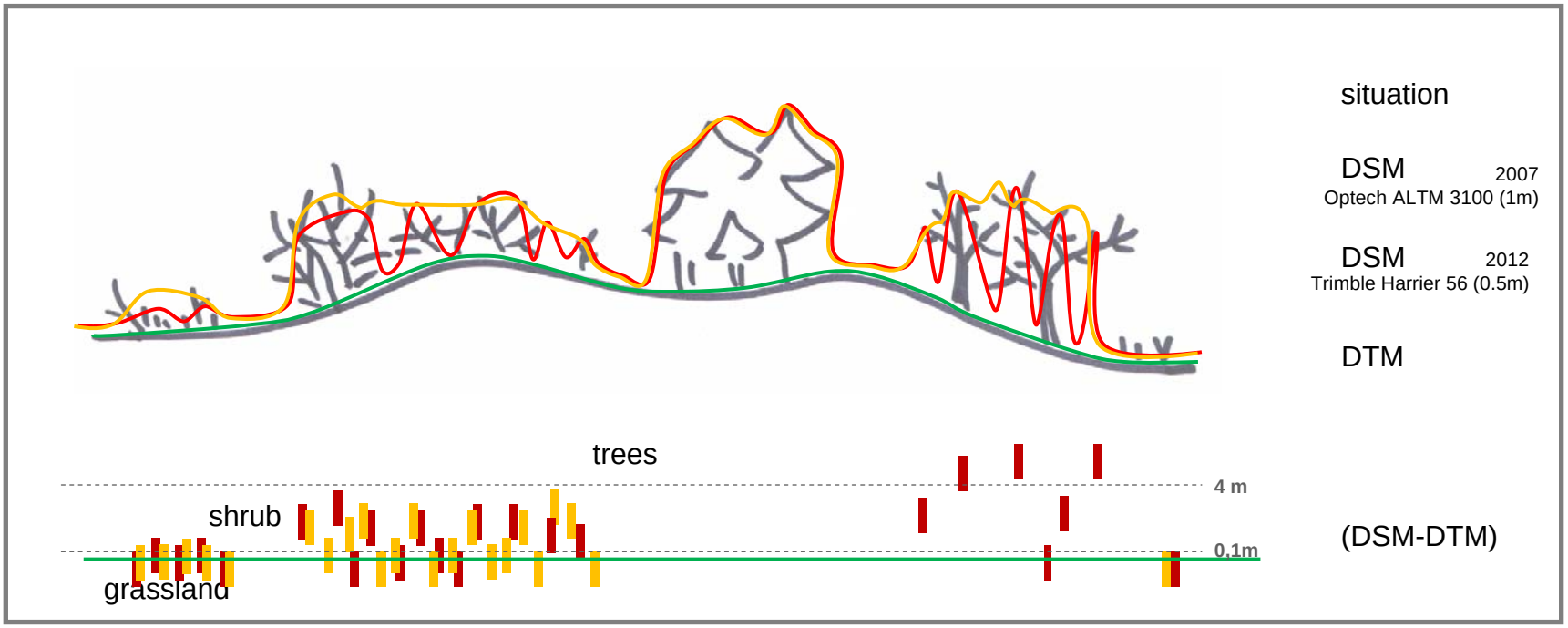
Classification Technology – Height Pillar



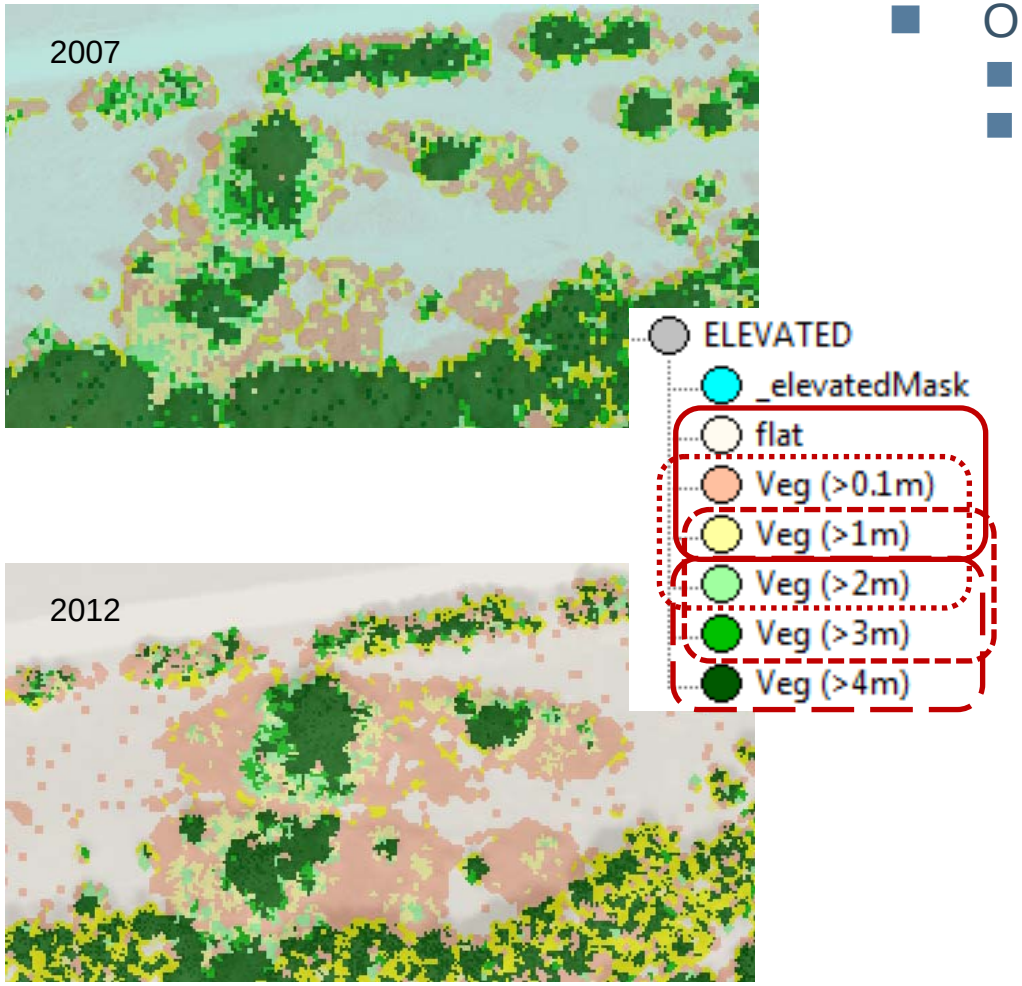
Classification Technology – LiDAR Data





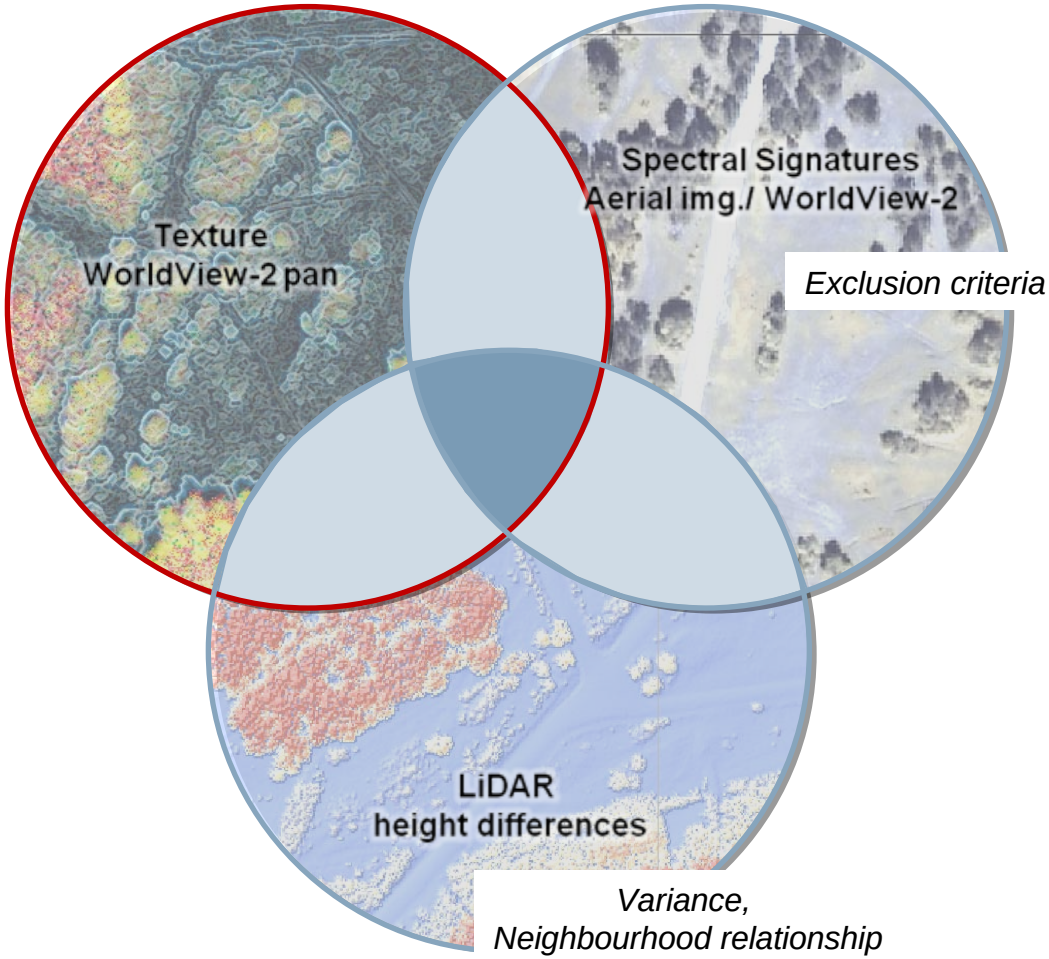


Classification Technology – LiDAR Data

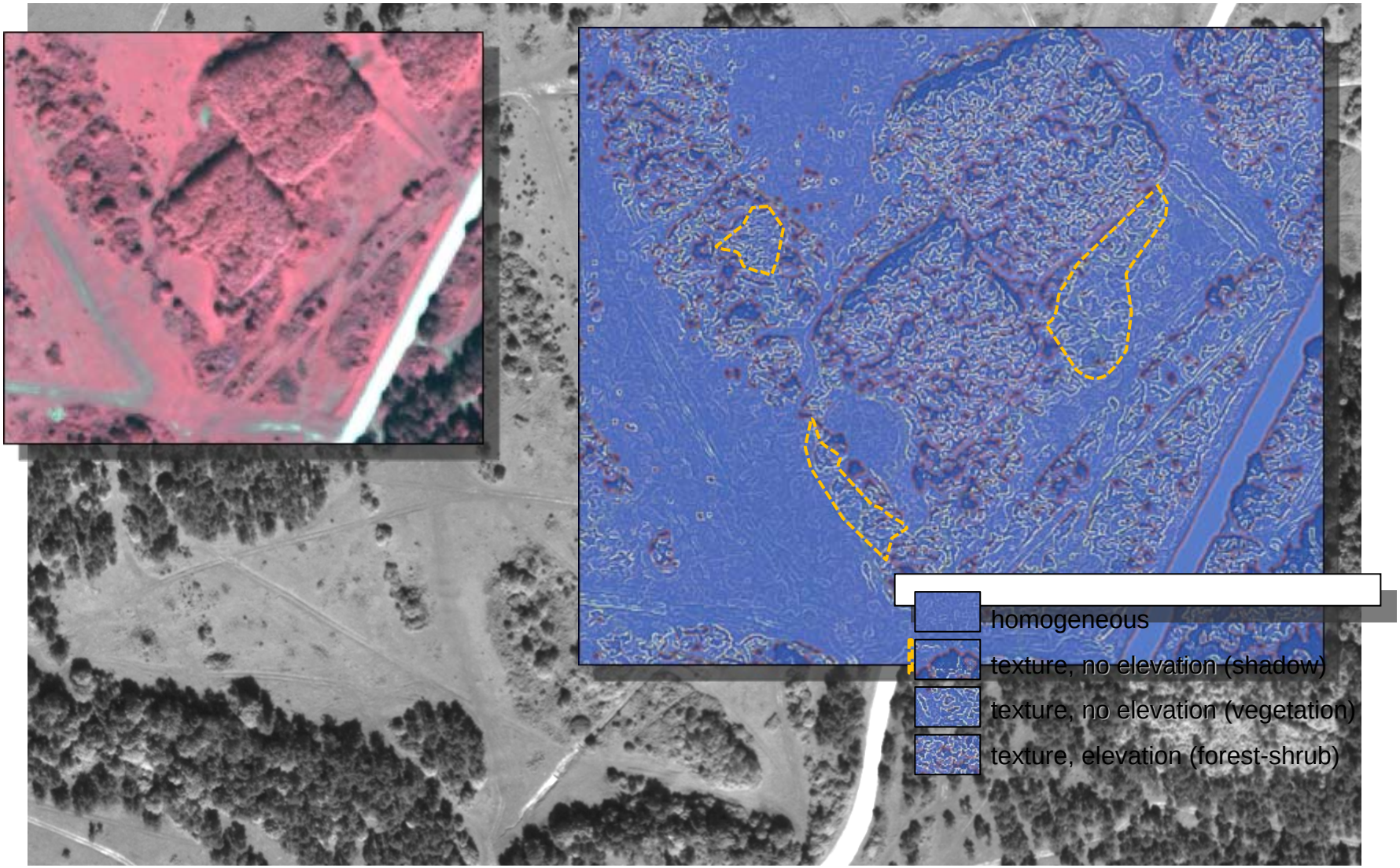


- Object-based Image Analysis
  - Rule set technology
  - Using contextual information (neighbourhood), relations and changes

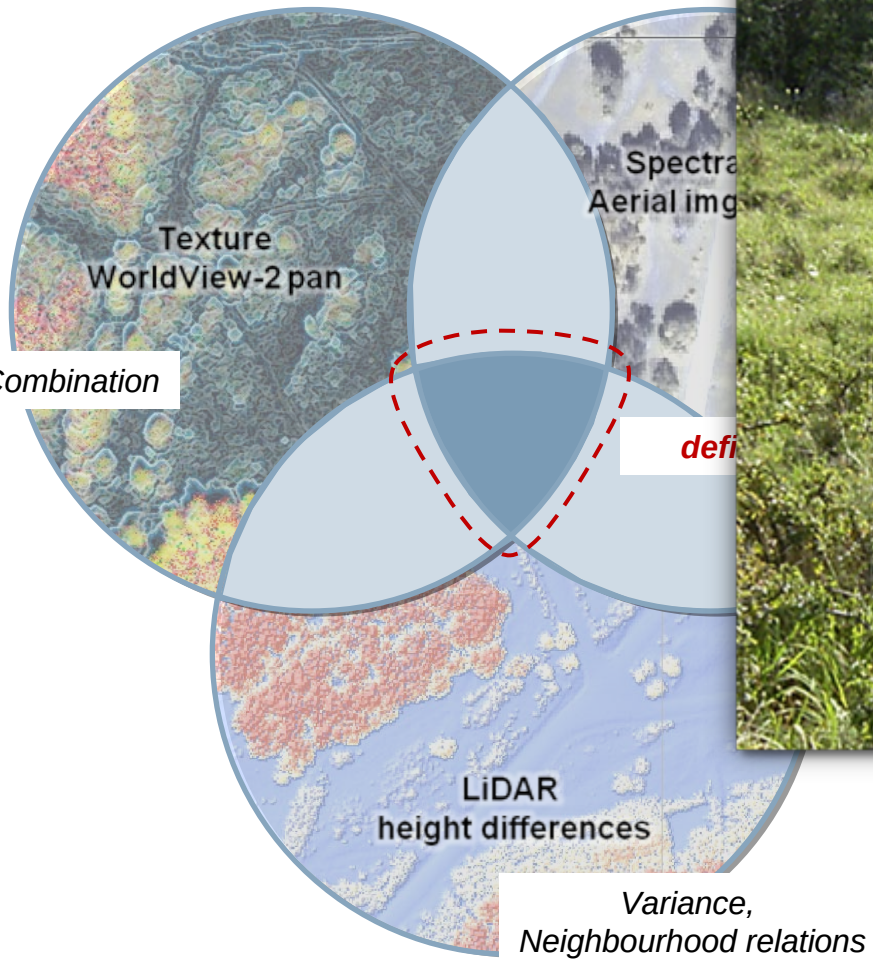
Classification Technology – Texture Pillar



Classification Technology – Texture Analysis



Classification Technology – Feature Space

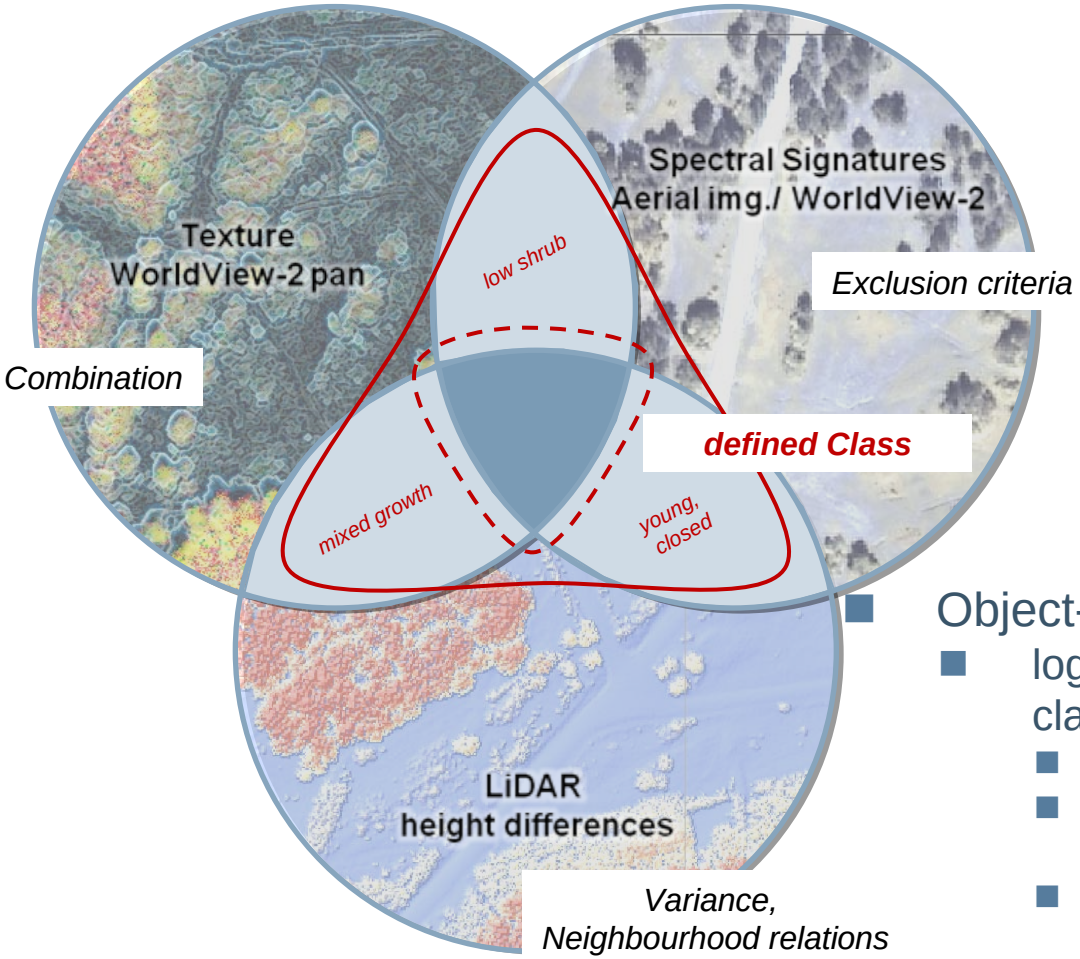


Combination

defi

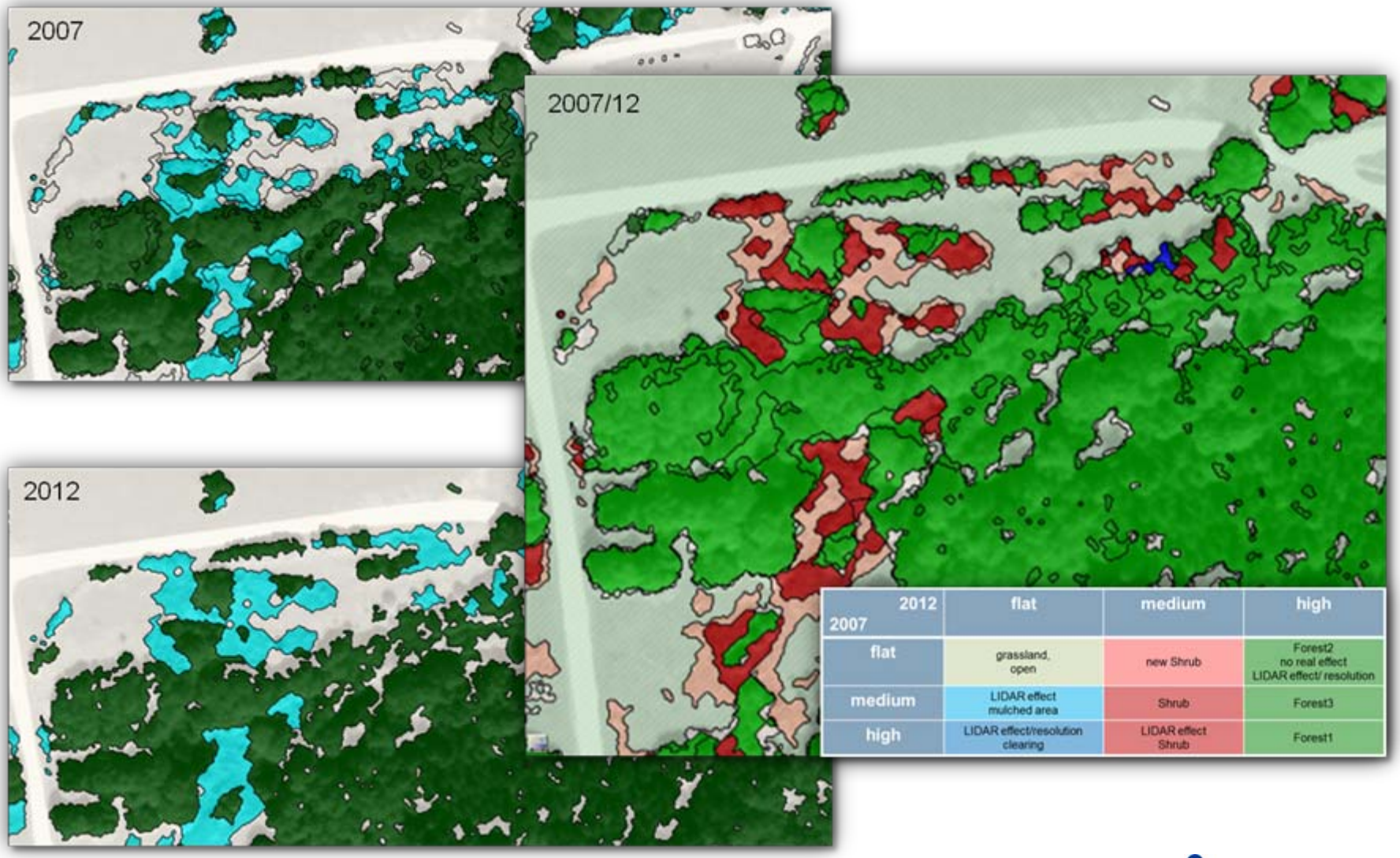
Variance,
Neighbourhood relations

Classification Technology – Feature Space



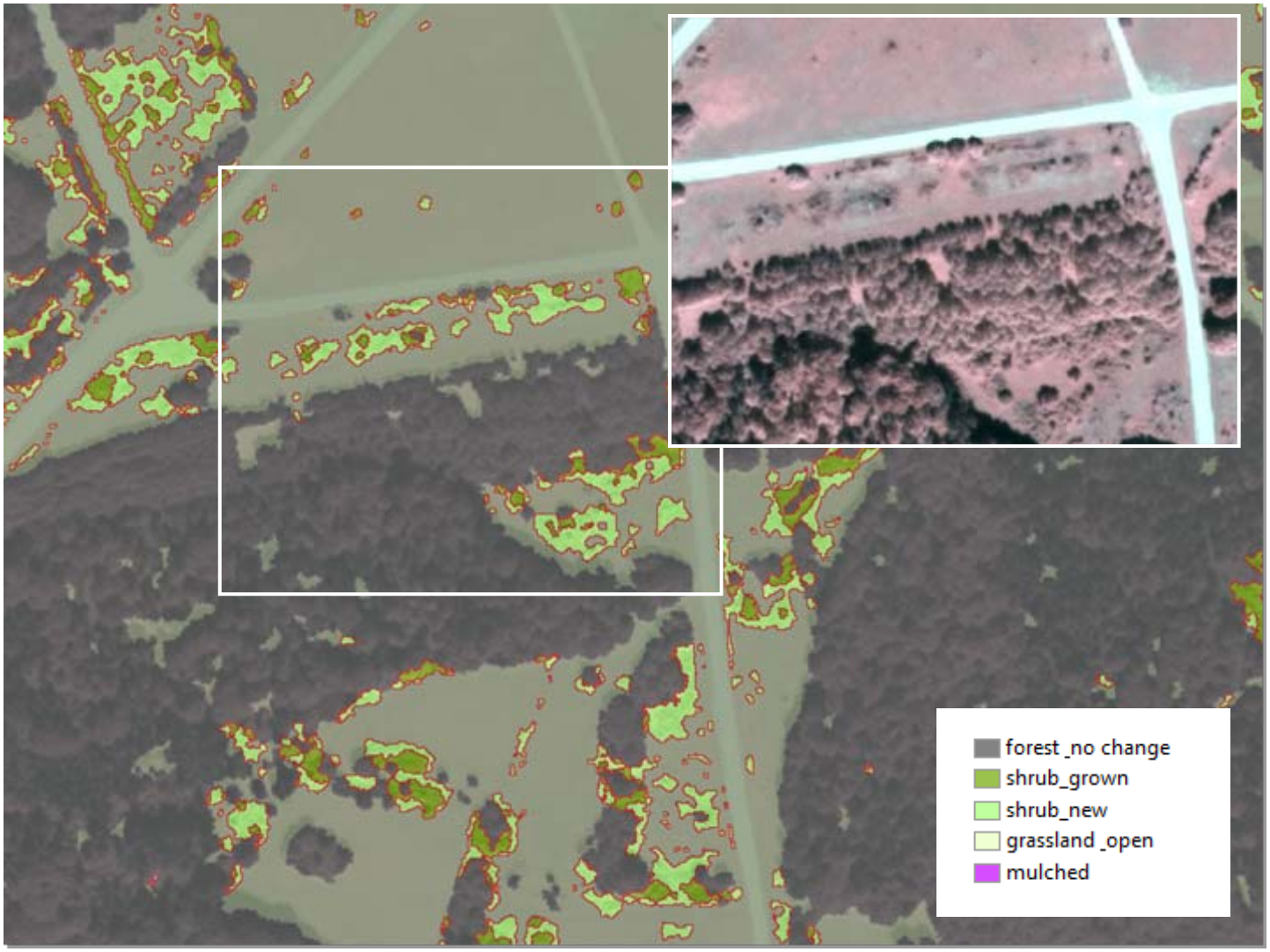
- Object-based Image Analysis
  - logic expansion of classification via
    - Reference knowledge
    - Neighbourhood relationships
    - Plausibilities & Valuing of changes 2007/2012
    - Minimum values / Similarities

Classification Result – Status and Change Analysis



2012 / 2007	flat	medium	high
flat	grassland, open	new Shrub	Forest2 no real effect LIDAR effect/ resolution
medium	LIDAR effect mulched area	Shrub	Forest3
high	LIDAR effect/resolution clearing	LIDAR effect Shrub	Forest1

Classification Result



LIDAR
height differences

Spectral signature
aerial Img./WorldView-2

Texture

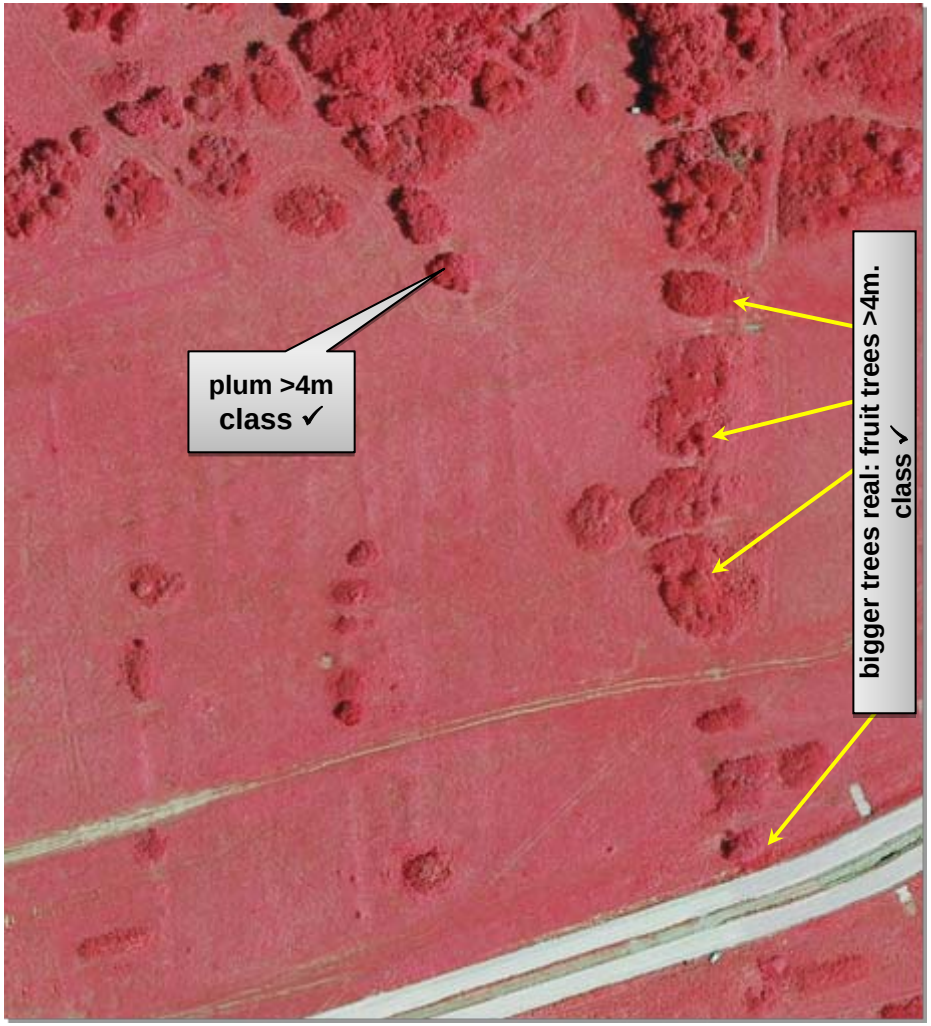
+ eCognition
(rule set)

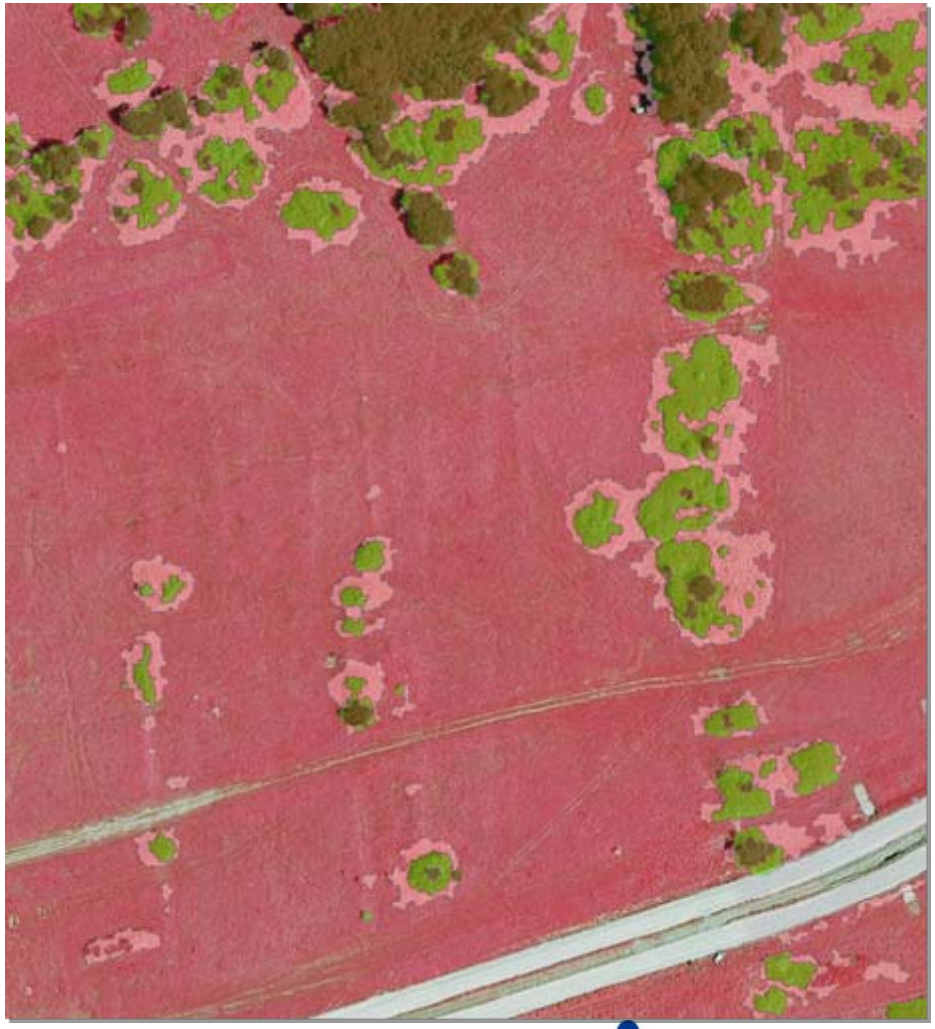
aggregated classification
secure classes: class.matrix
Generalisation1: Similarity, Neighborhood, Size/ location
Generalisation2: Class!, rel. difference, location/ plausibility

Mask
(Change elements)

Quality Assurance – Field Check

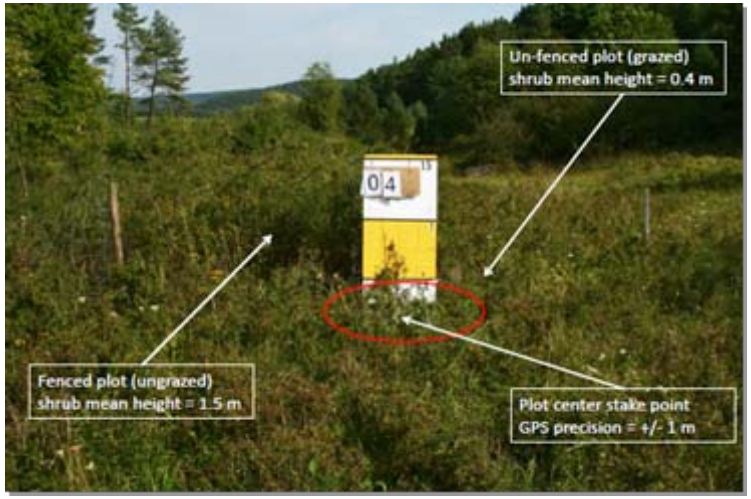
- Visual control with result and experts: complete matching

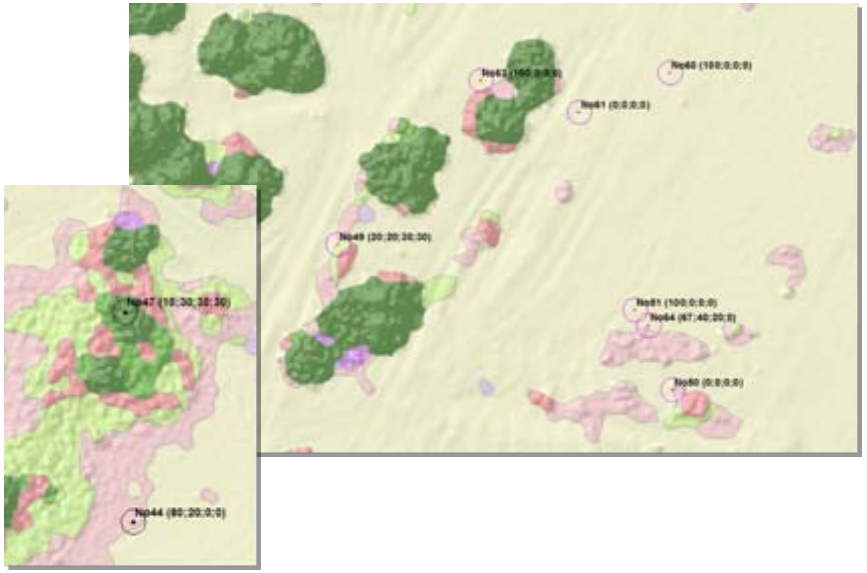




Quality Assurance – Reference Mapping

- 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!

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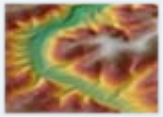

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