PROSPECT OF AUTOMATED CLASSIFICATION OF TREE SPECIES COMPOSITION FROM IKONOS SATELLITE IMAGERY

3D Remote Sensing in Forestry
International Workshop 14-15 Feb. 2006

Mihi cura futuri

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Background:

Manual interpretation of aerial photos never quite operational

➡ call for development of knowledge-based classification methods

- **automated estimation of tree species composition from Ikonos VHR imagery using object-oriented approach**

thematic input to be integrated into detailed 3D stand modelling

Study area

Man-planted lowland forests

Diverse species composition and stand structure

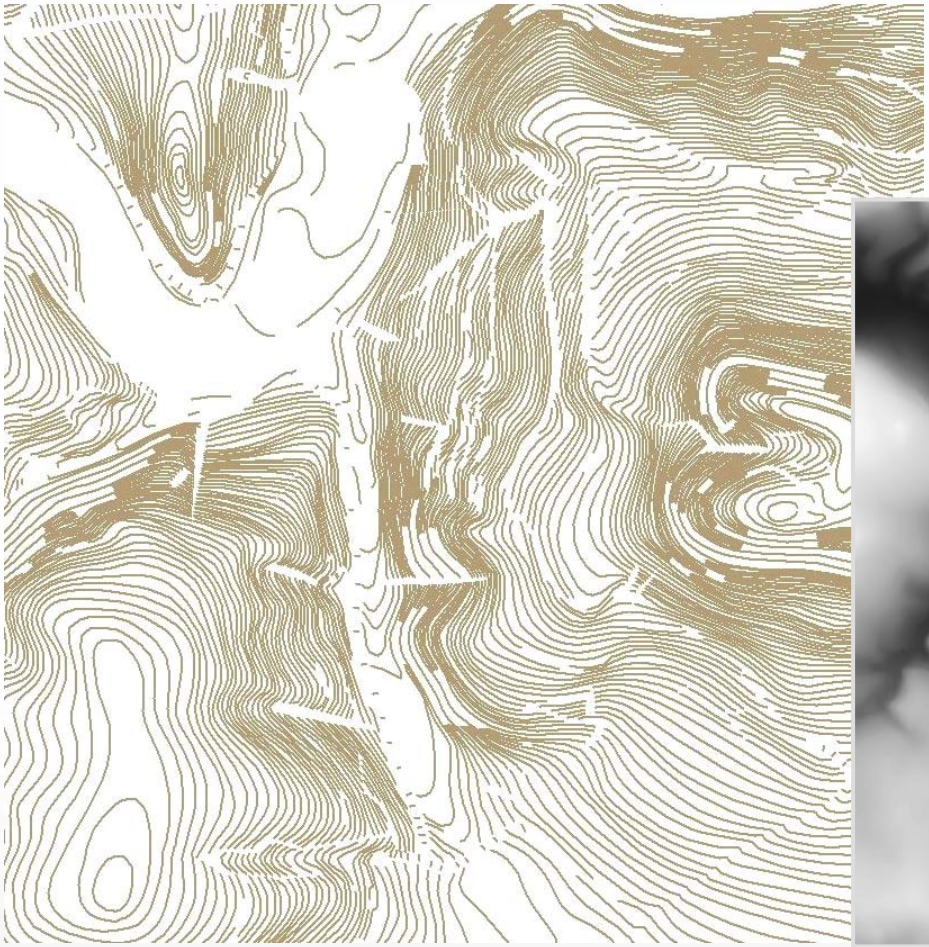
Mature stands:

- Picea
- Pinus
- Quercus
- Acer
- Larix
- Betula

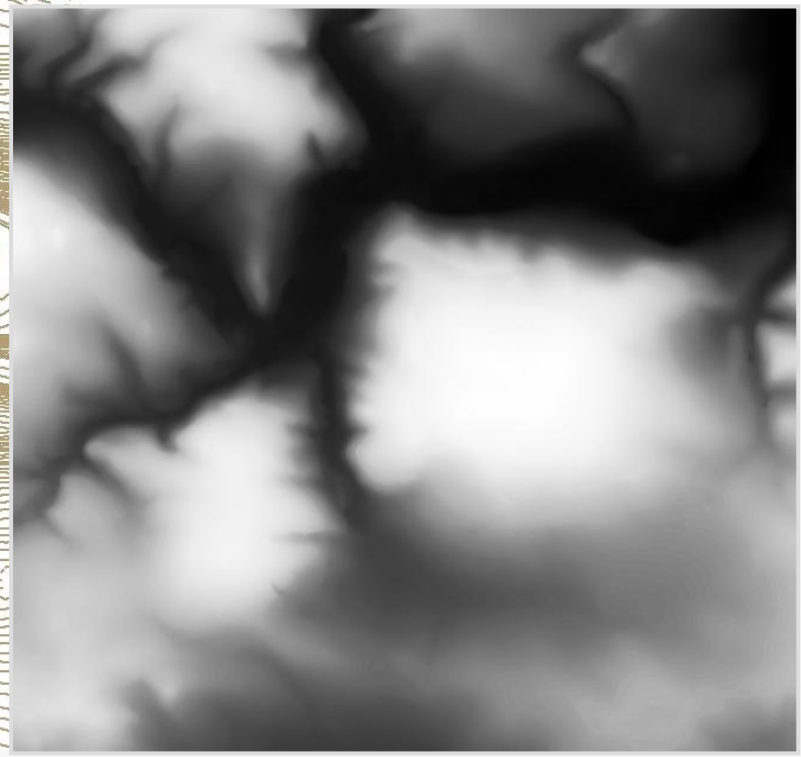
Young plantations of Pinus, Quercus

DEM

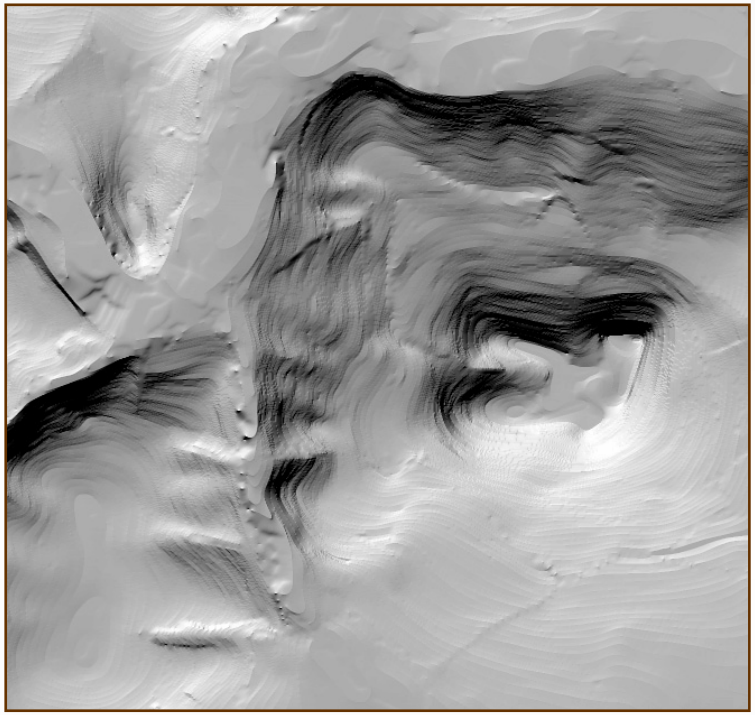
- digital contour maps from ZABAGED® GIS database at scale 1: 10 000

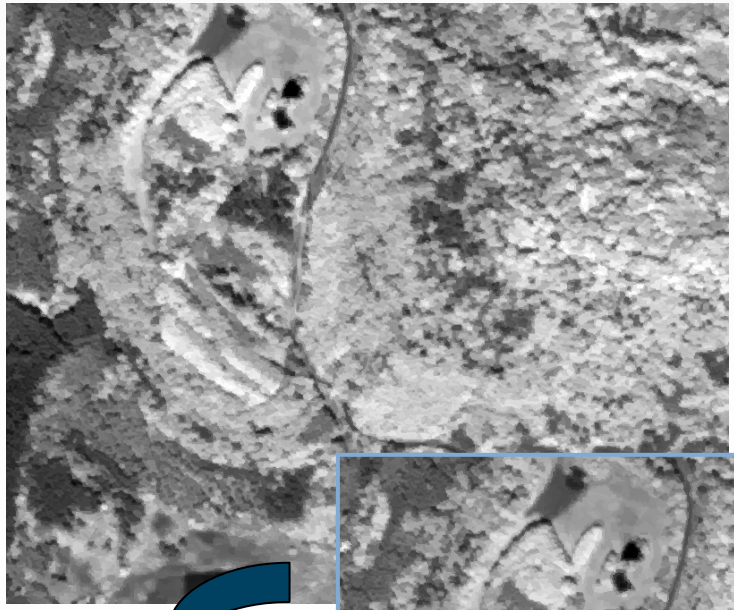


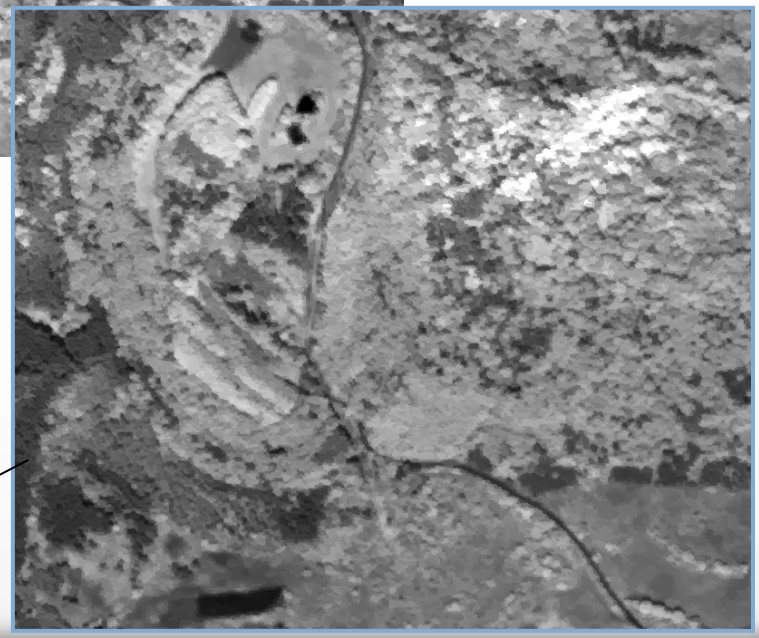
DEM with resolution 2m/pixel



Topographic normalisation







spectral values normalized by Shade layer

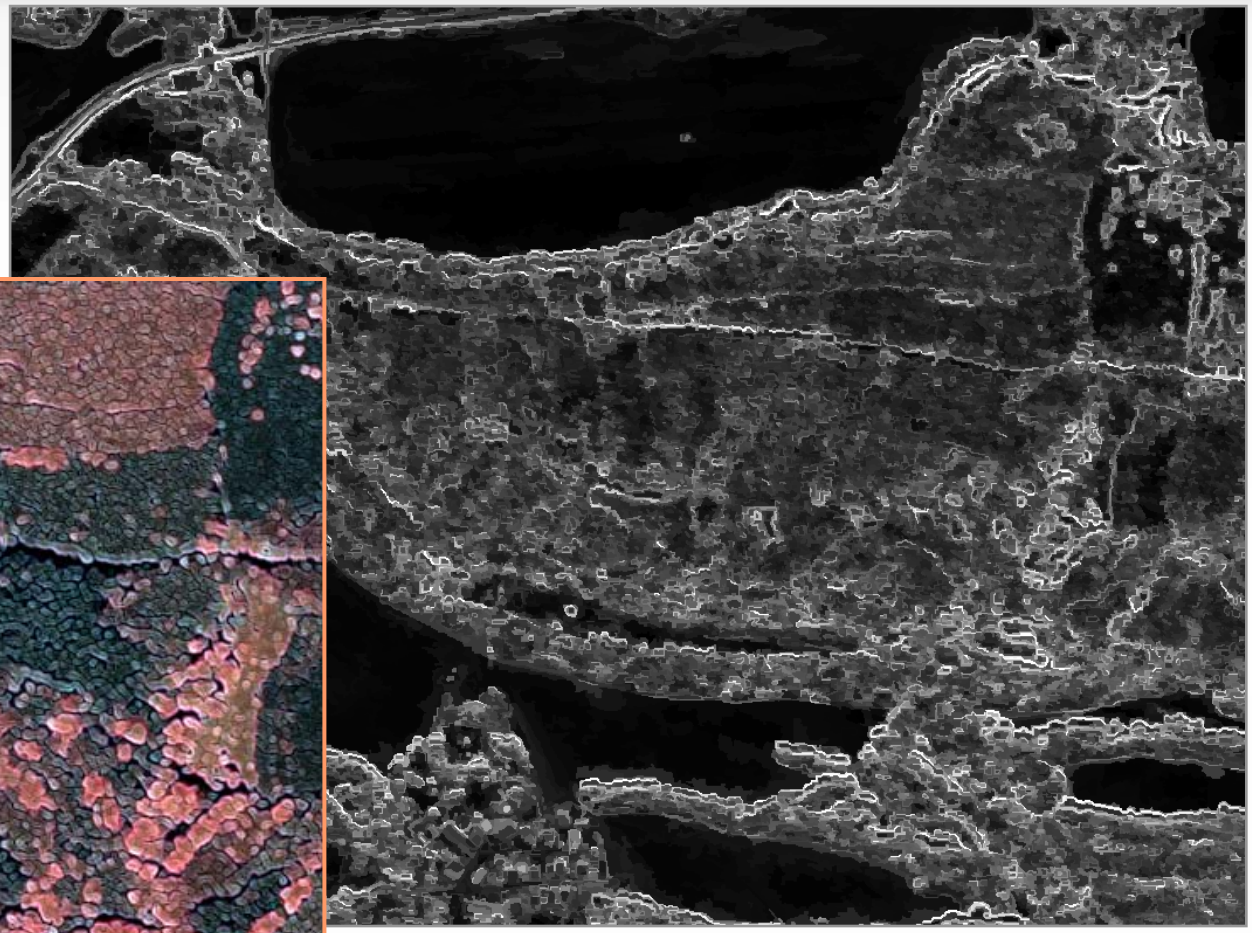
$$\frac{NIR}{(RED*shade)}$$

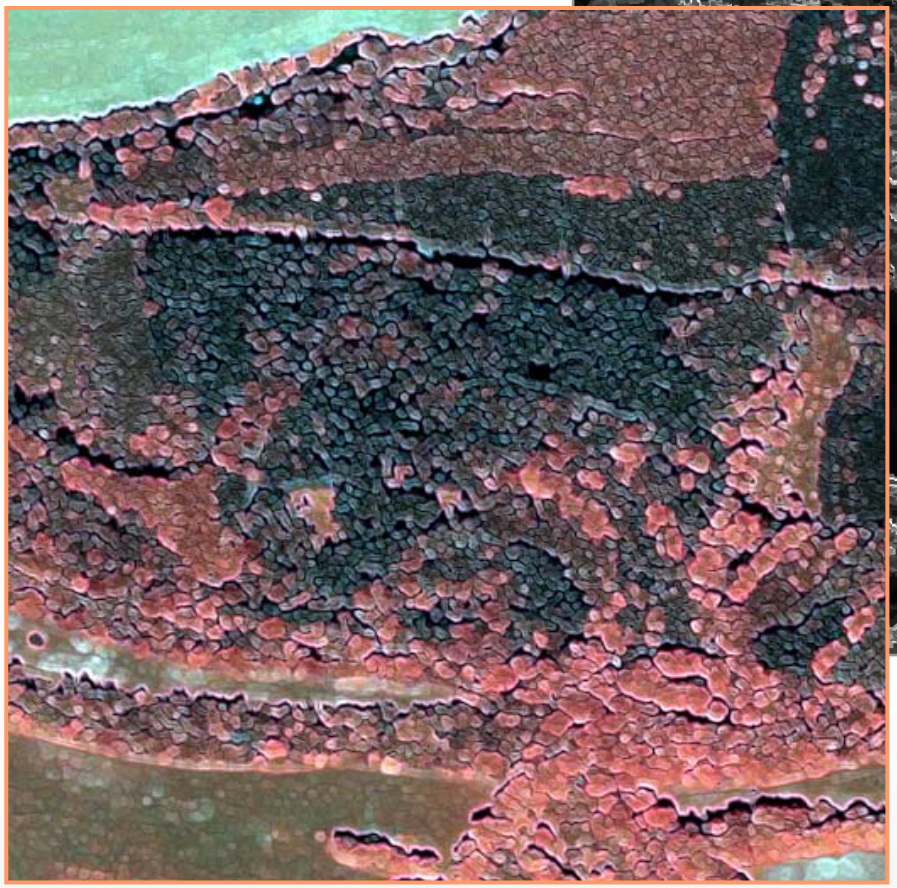
Signature space enlargement

- additional channels calculated in ERDAS Imagine 8.7:

  - Low-pass filters
  - Tasseled cap transforms
  - IHS transformation
  - Sobel edge detection
  - Haralick texture measures

- derived band rationing calculated as “Customised features” in eCognition 4.06 (NDVI, NIR/red, green*NIR….)





Sobel Edge layer with false colour composite

Feature selection

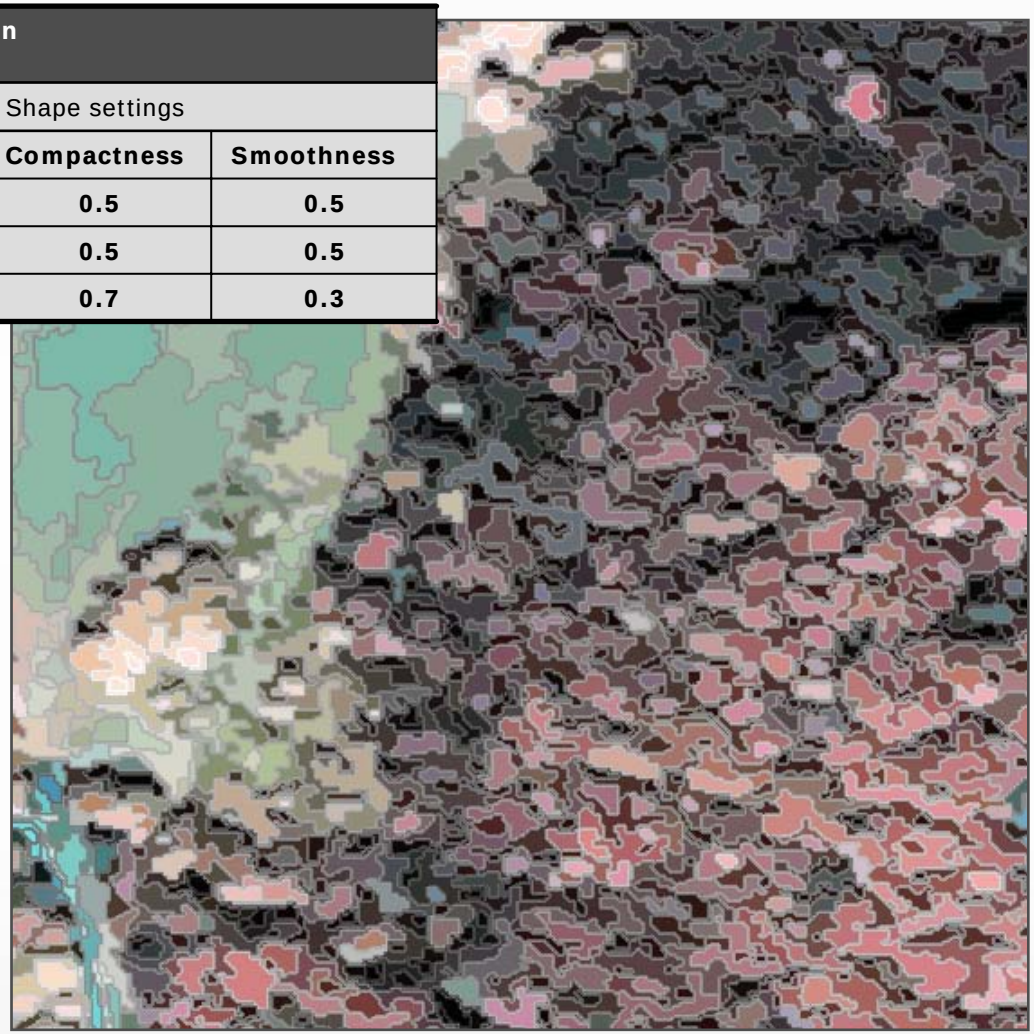
1. **30 sample objects manually classified**
2. **contribution of 15 selected features assessed by Disriminant analysis in S-plus**

feature distribution of two competing classes visually verified (histogram comparison)

Segmentation parameters

Segmentation level	Scale 4m/pan	Homogeneity criterion			
		Color	Shape	Shape settings	
				Compactness	Smoothness
Level I – Landuse	25 / 60	0.8	0.2	0.5	0.5
Level II – Forest	18 / 45	0.7	0.3	0.5	0.5
Level III - Stand	5 / 12	0.7	0.3	0.7	0.3

Class-based segmentation at two lower levels



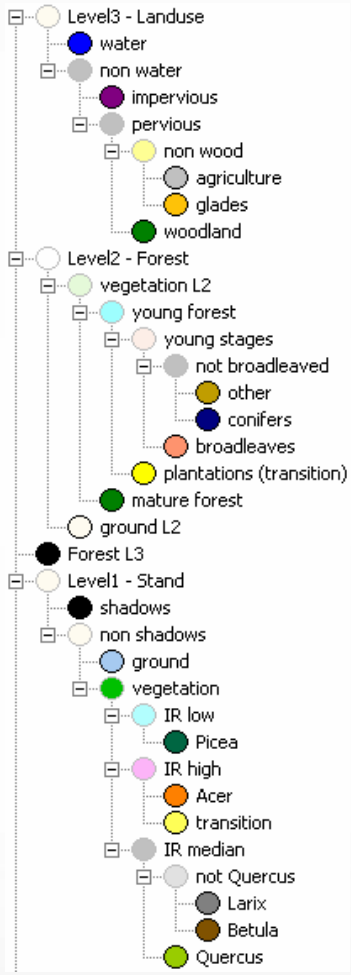
Class definition

Image object classification at three levels:

Level 3 – LANDUSE
- Urban
- Agriculture
- Forest

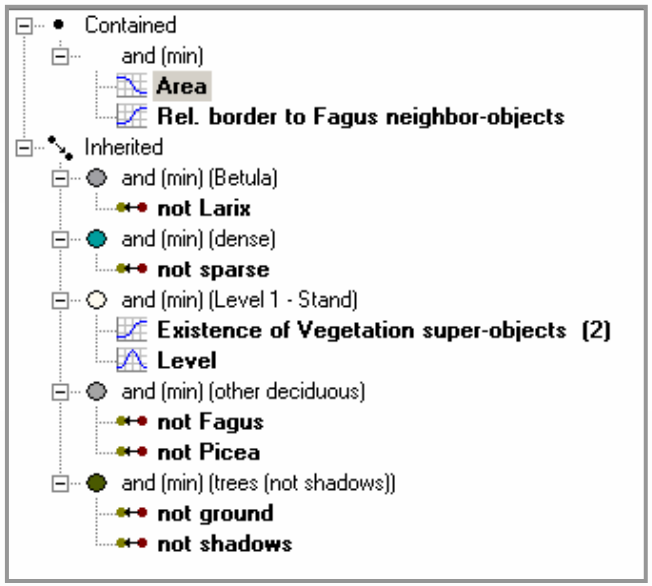
Level 2 – FOREST
- Clear cuts
- Plantation (transition)
- Young stages
- Mature stages

Level 1 – STAND
- Picea
- Acer
- Quercus
- Larix
- Betula



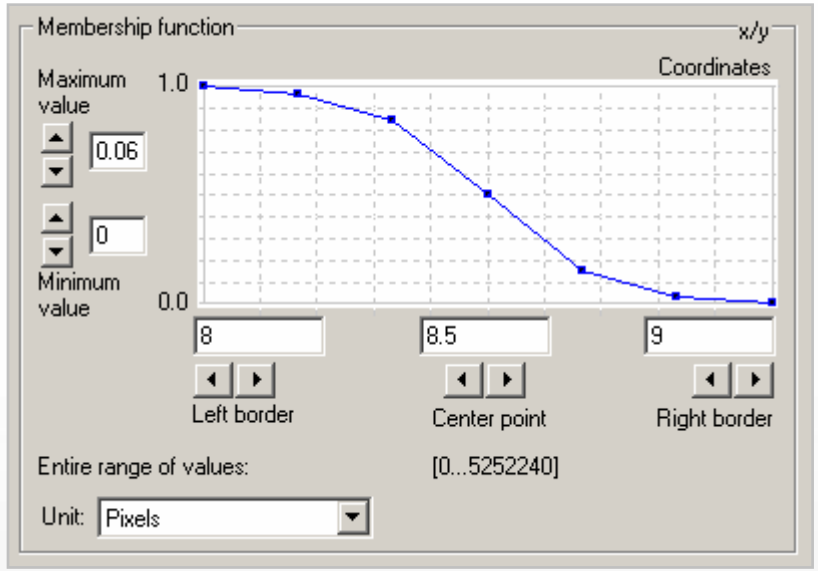
Fuzzy classification

classes characterised by a sets of features:



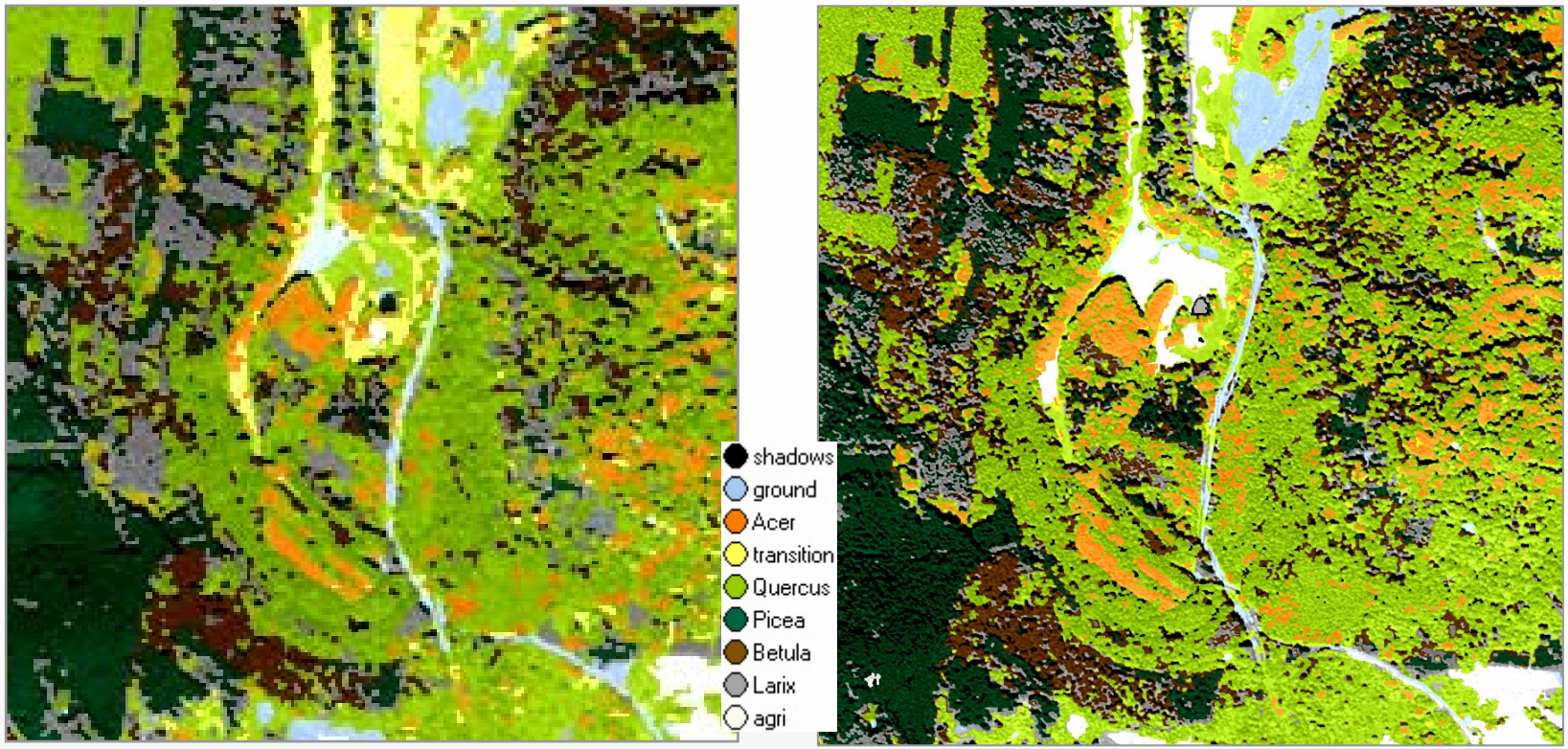
- Spectral
- Textural
- Geometric
- Contextual

each feature defined a FUZZY membership function

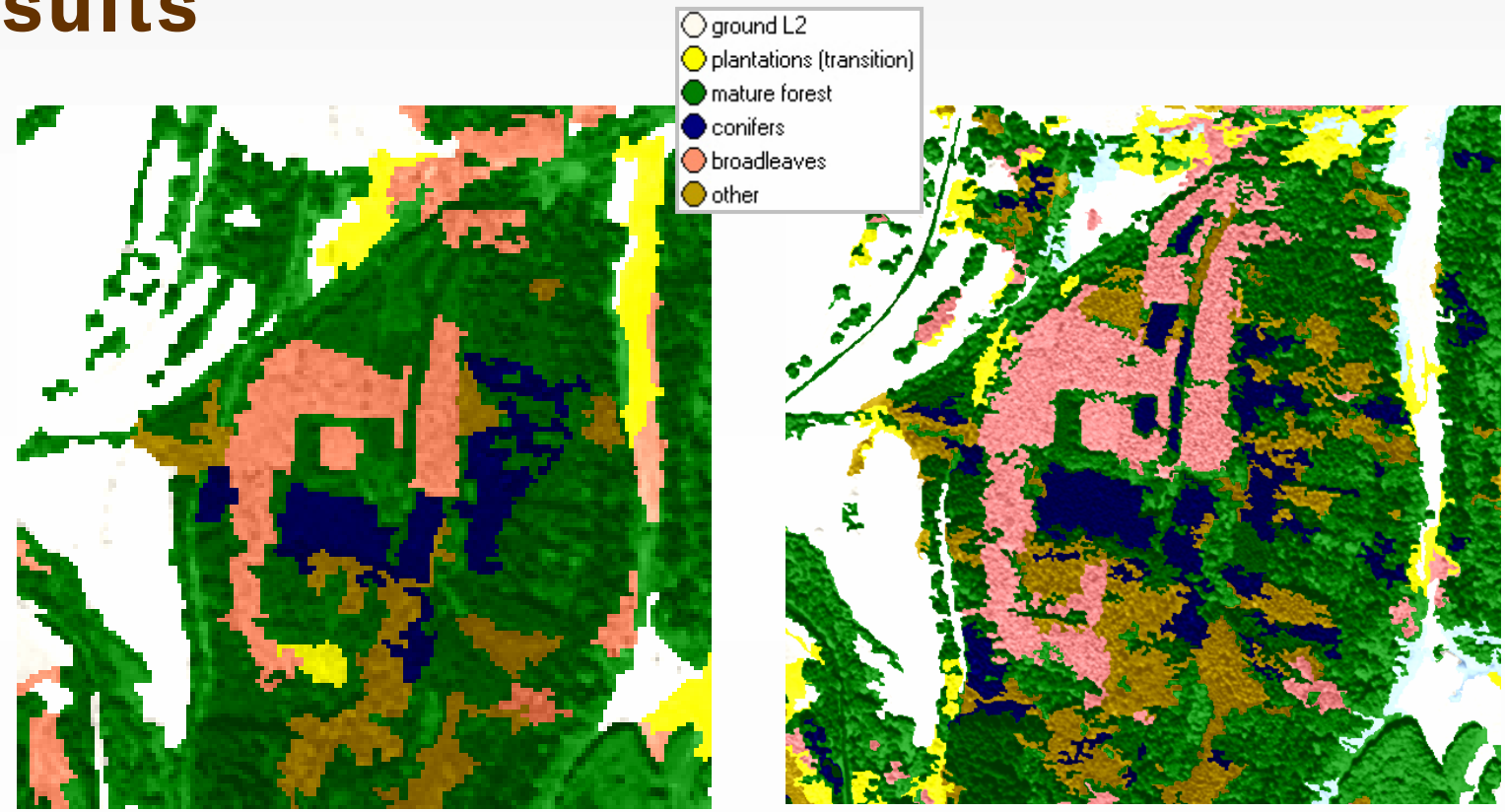


Results

Cover type / Statistics	shadows	ground	transition	Acer	Quercus	Picea	Betula	Larix
KIA per class (4m)	0.68	0.85	0.63	0.92	0.92	0.92	0.70	0.77
KIA per class (pan)	0.94	0.78	0.58	1.00	0.77	0.94	0.82	0.61
Overall accur (4m/pan)	**0.83 / 0.83**							
KIA (4m/pan)	**0.80 / 0.81**							



Results



Cover type / Statistics	ground	plantat	mature	Y conifer	Y broadl	Y other
KIA per class (4m)	0.63	0.64	0.74	0.36	0.30	0.76
KIA per class (pan)	0.48	0.36	0.87	0.61	0.88	0.82
Overall accuracy (4m/pan)	**0.63 / 0.71**					
KIA (4m/pan)	**0.57 / 0.66**					

Conclusions

1. Estimation of forest species composition can be achieved at sufficient scale by object analysis of 4m and pan-sharpened Ikonos data

   conditions:

   - derived image transforms (ratios of green and NIR bands, Sobel edge and GLCM Variance)
   - spectral signatures normalised with the high resolution DEM

2. Delineation of succession stages is dependent on amount of texture information

both 4m / 1m resolution imagery have specific benefits

↳ utilization in different forest management tasks