

**Comparison Study
Between eCognition and ERDAS Imagine
for the Classification of High and
Moderate Resolution Satellite Imagery**

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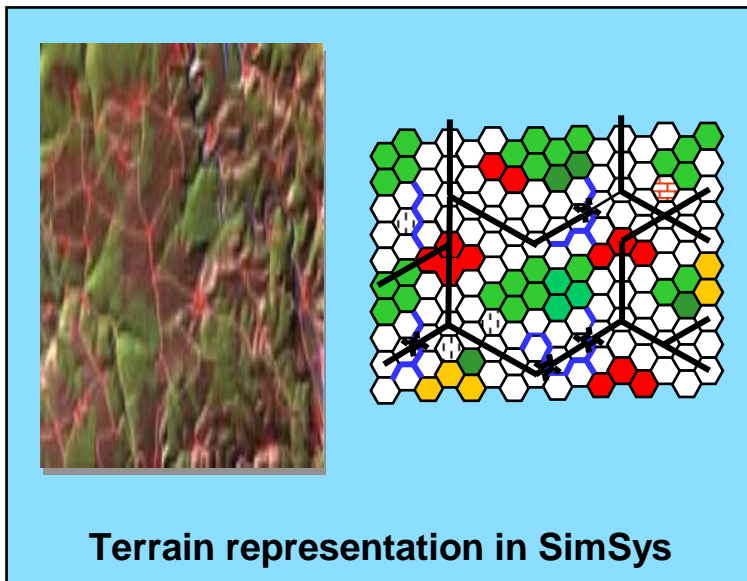
Madrid-Torrejón, November 28, 2006

- ▶ Project goal
- ▶ Image processing workflow
- ▶ Classification methods
- ▶ Classification results
- ▶ Conclusions and recommendations

Project goal




- ▶ Automated generation and/or update of 2D (3D) vector data for simulation and mission planning systems using commercial satellite imagery
- ▶ Build-up of an overall terrain database
- ▶ User: Bundeswehr Army Simulation Center



Prerequisites



- ▶ Hardware: PC's (Pentium4/2.6 GHz, 2GB RAM, 40GB hard disk)
- ▶ Operating system: Windows2000 SP4
- ▶ Software:
 - ERDAS Imagine, Vrs.8.7 SP2 Fix26280
 - eCognition Professional (LDH), Vrs. 4.0 (1st phase)
 - Definiens Professional / Developer (LDH), Vrs. 5.0.10 (2nd phase)

- ▶ Study areas:
 - NW Iraq (SPOT) 
 - Skopje, Macedonia (IKONOS)

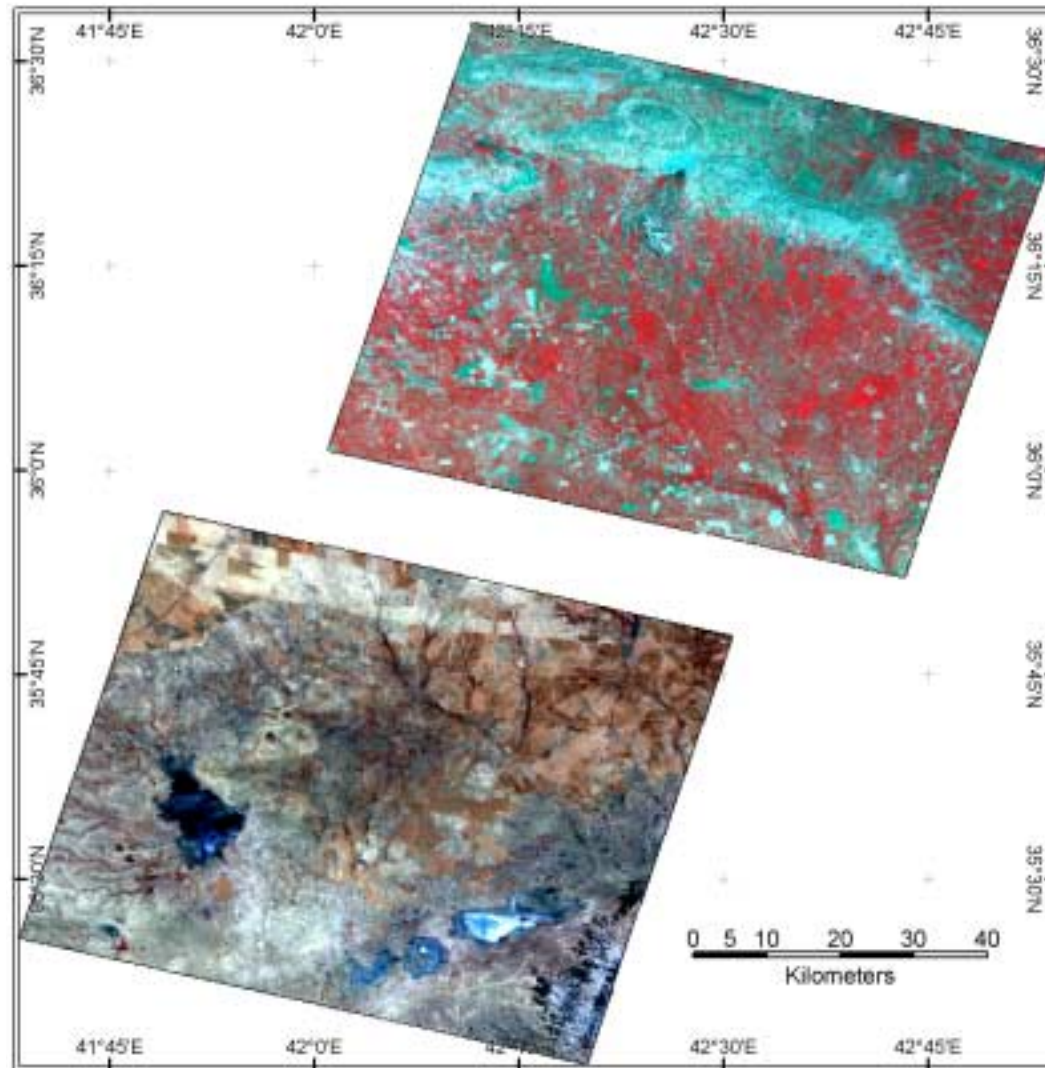


Imagery

SPOT



- ▶ SPOT 5
- ▶ 1 PAN channel
3 m resolution
8 bit
3388 × 5324 pixel²
17.9 MB
- ▶ 4 MS channels
12 m resolution
8 bit
1694 × 2661 pixel²
18.2 MB
- ▶ Format: GeoTIFF



Imagery

IKONOS



- ▶ IKONOS
- ▶ 4 MS channels
1 m resolution
1204 × 3137 pixel²
7.4 MB
- ▶ Format: GeoTIFF

Channel combination:
4 – 3 – 2



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General processing workflow

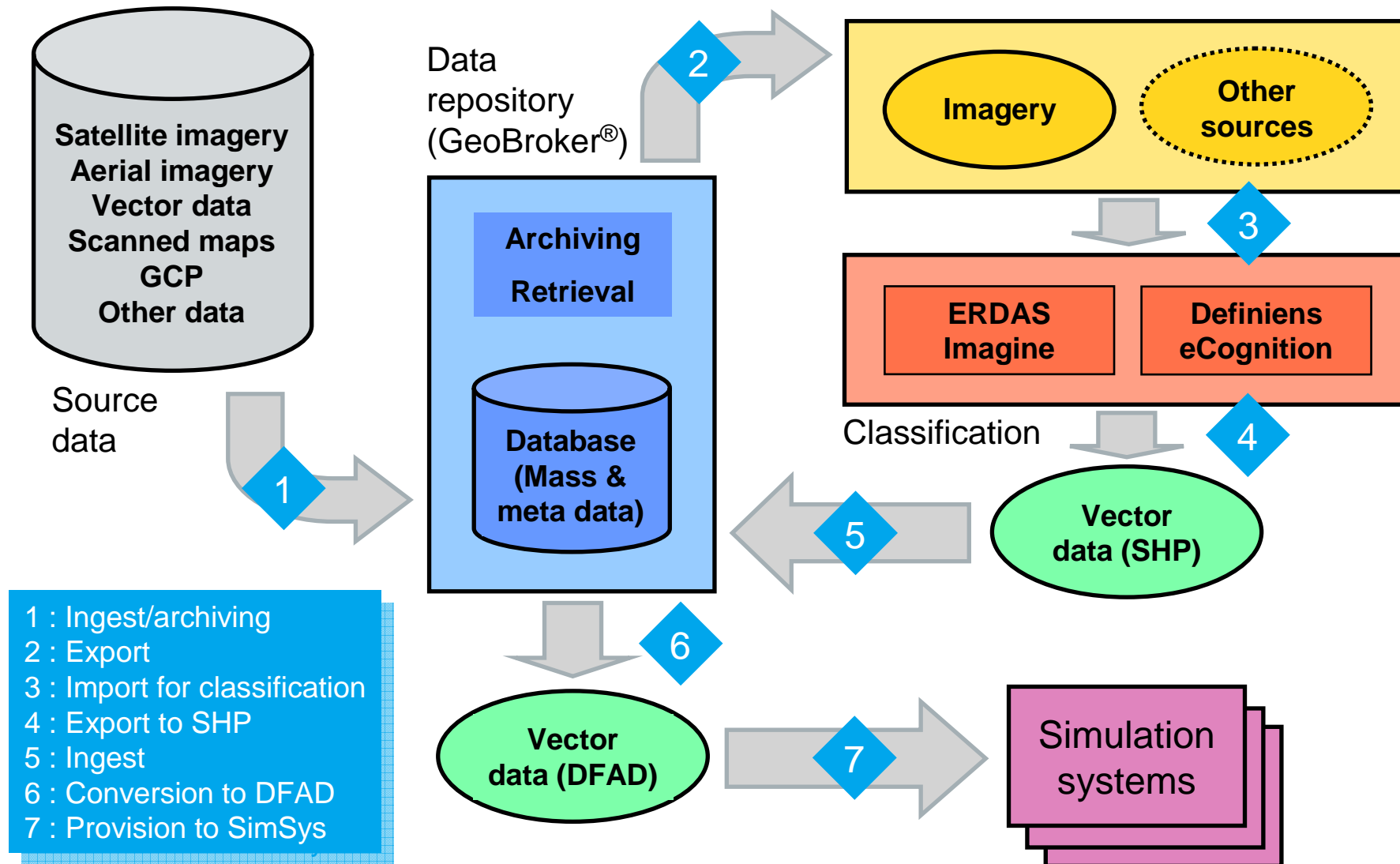
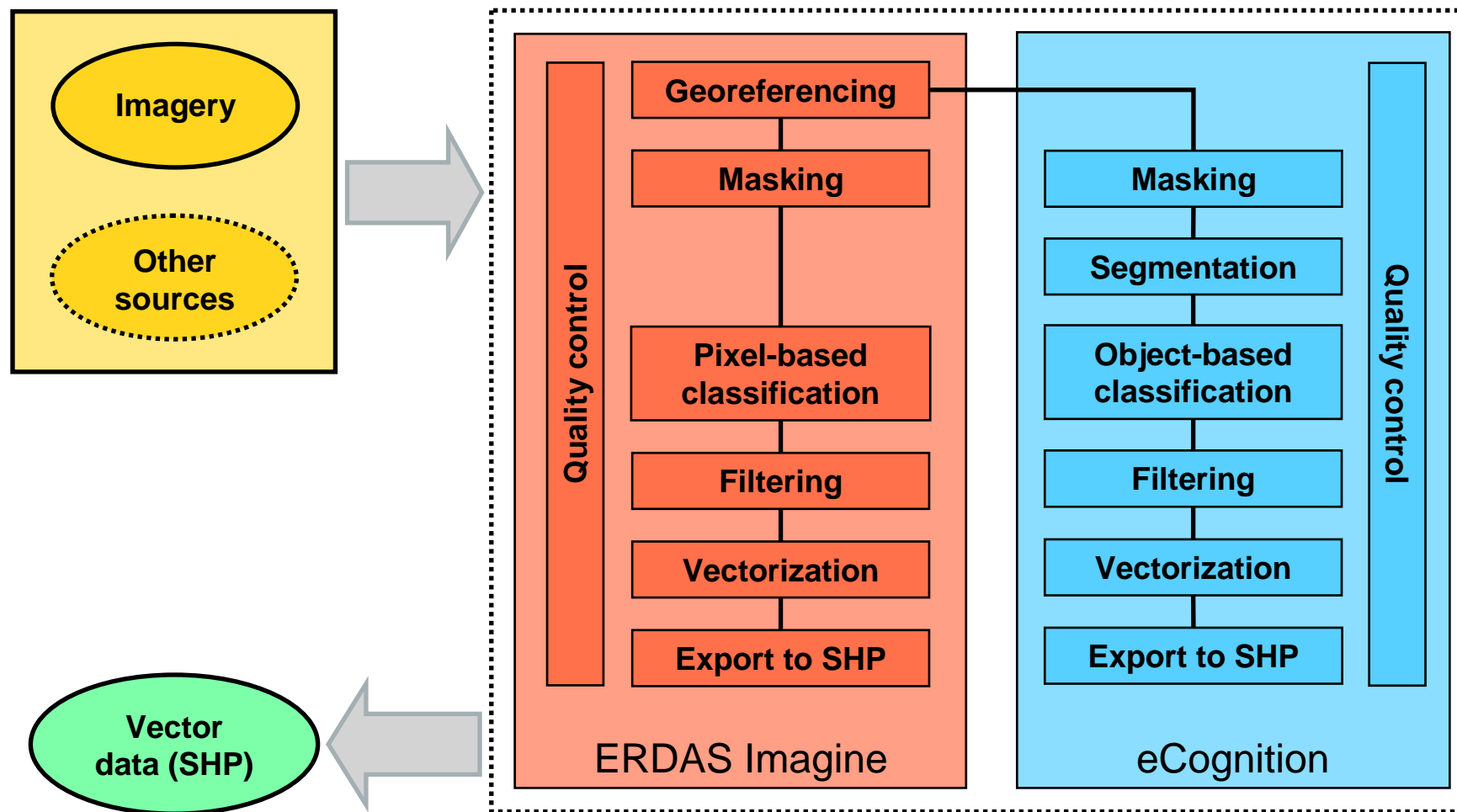


Image processing workflow



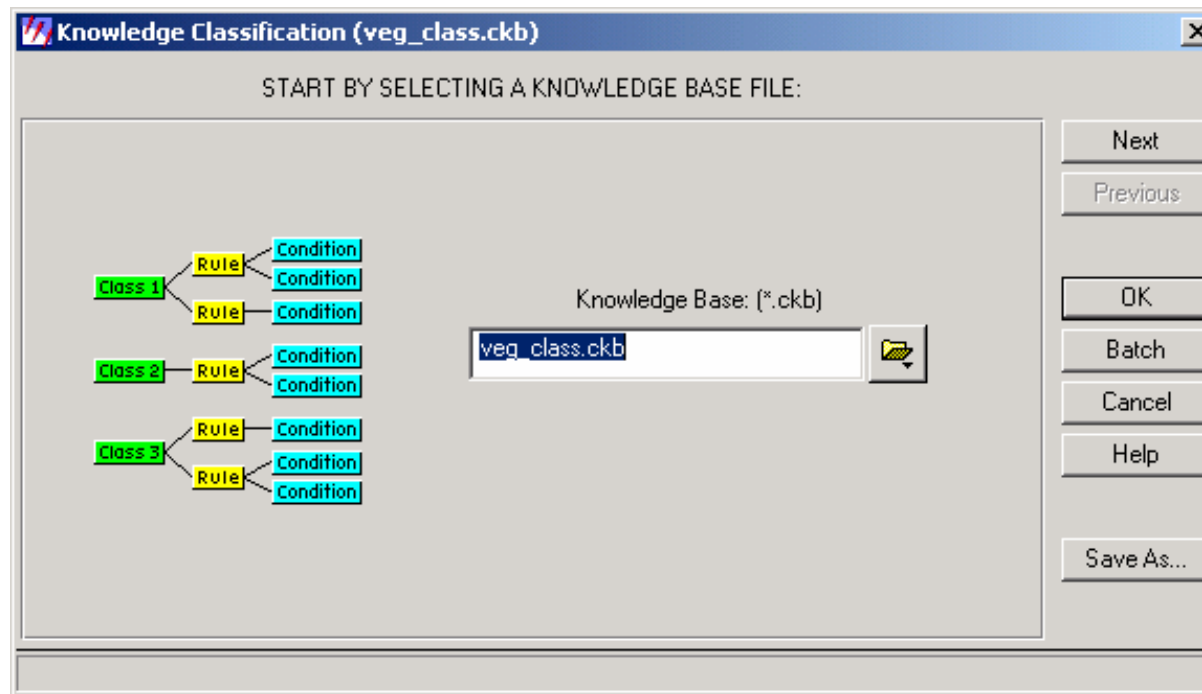
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Classification methods

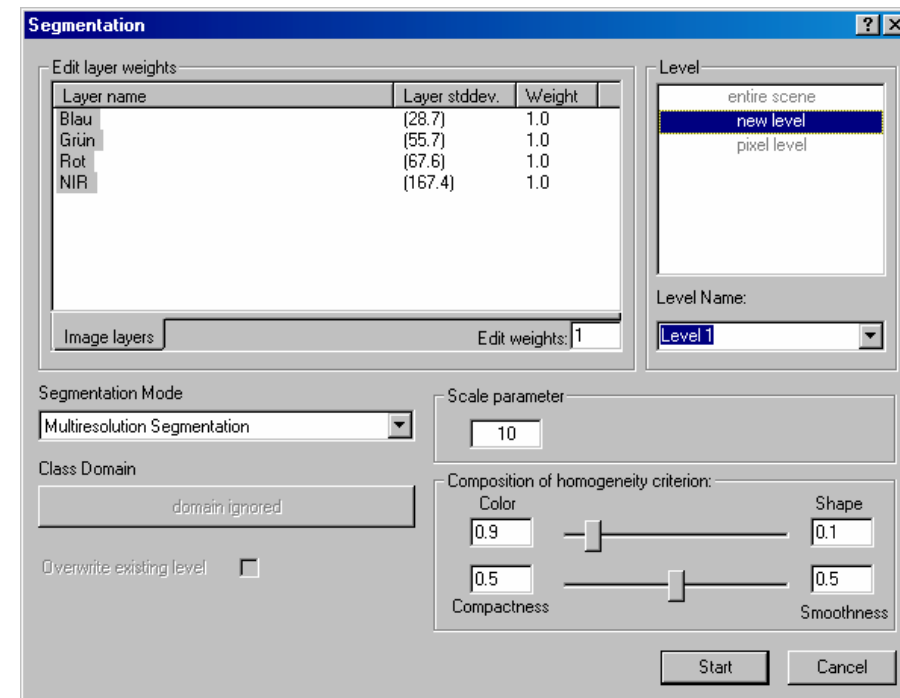
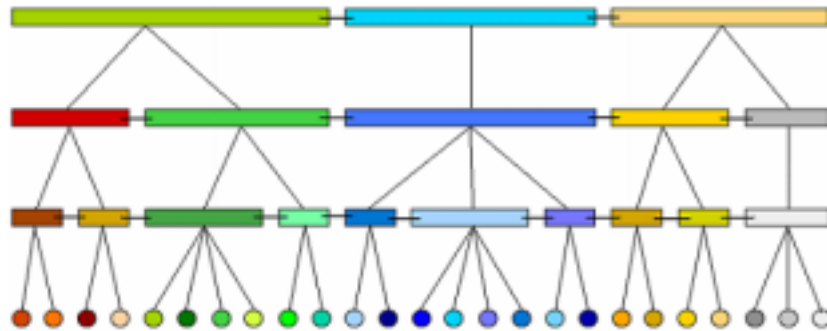


ERDAS Imagine	eCognition / Definiens
Unsupervised classification (ISODATA cluster analysis)	—
Supervised classification (e.g. Maximum-Likelihood)	—
Knowledge-based classification (<i>Expert Classifier</i>)	—
—	Segmentation
—	Object-oriented classification

- ▶ Knowledge Engineer: Definition of hypotheses, rules and variables
- ▶ Knowledge Classifier: Rule-based classification
- ▶ Iterative approach

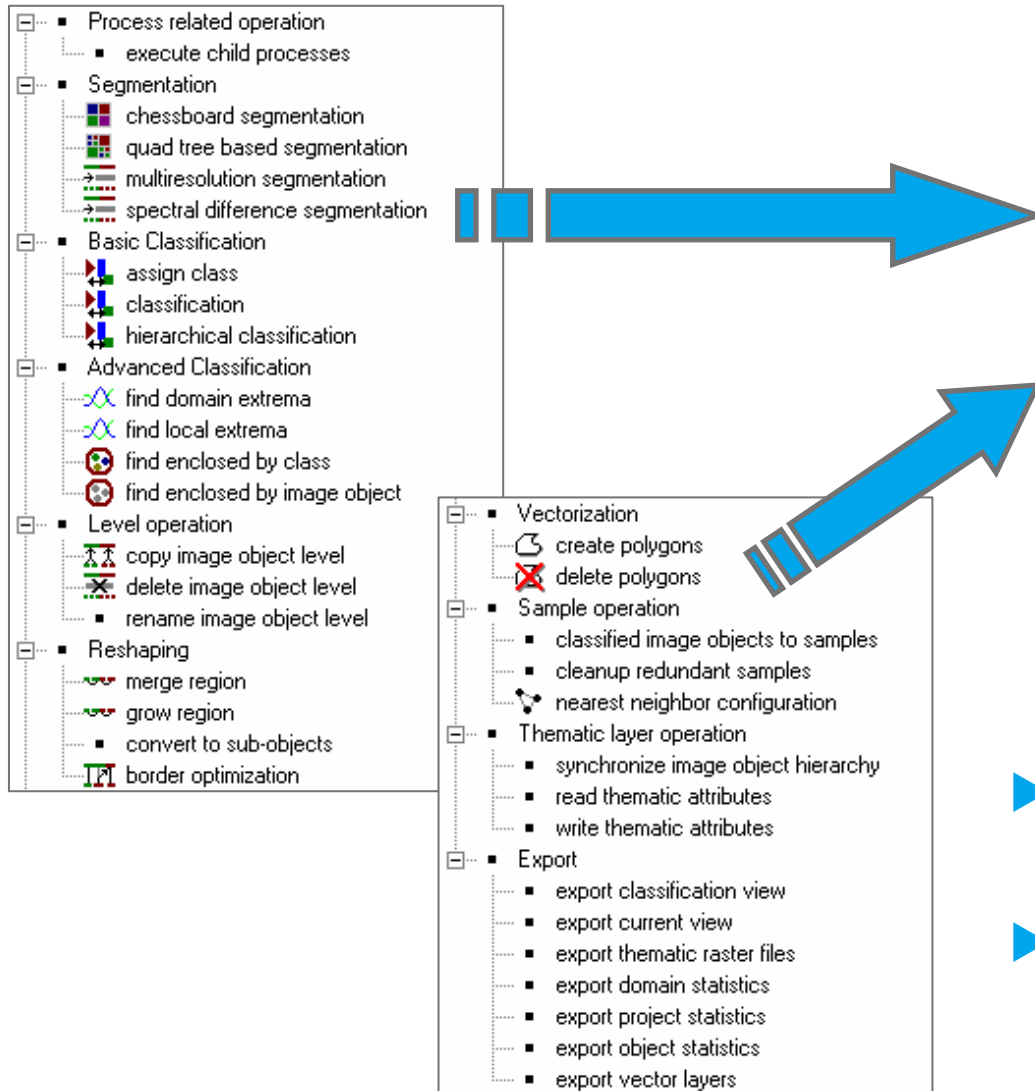


- ▶ Hierarchical network of segments in different scale levels
- ▶ Choice of proper thresholds for homogeneity and heterogeneity criteria
- ▶ Trial & error



eCognition / Definiens

Process tree



- ▶ Selection of adequate process steps
- ▶ Automation of classification workflow

Accuracy assessment

Confusion matrix



- ▶ Accuracy assessment of classification results
- ▶ Samples with reference segments (eCognition) / reference points (ERDAS)
- ▶ Samples are assumed as error-free
- ▶ Statistical analysis = confusion matrix

	Vegetation	Ground surface	Fresh water	Sealed area	Sum	User accuracy
Vegetation	70	0	2	0	72	0.97
Ground surface	3	58	7	9	77	0.75
Fresh water	0	0	7	0	7	1.00
Sealed area	0	5	1	22	28	0.79
Sum	73	63	17	31		
Producer accuracy	0.96	0.92	0.41	0.71		
Overall accuracy						85 %
Kappa index						0.78

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Classification results (IKONOS)

ERDAS Imagine

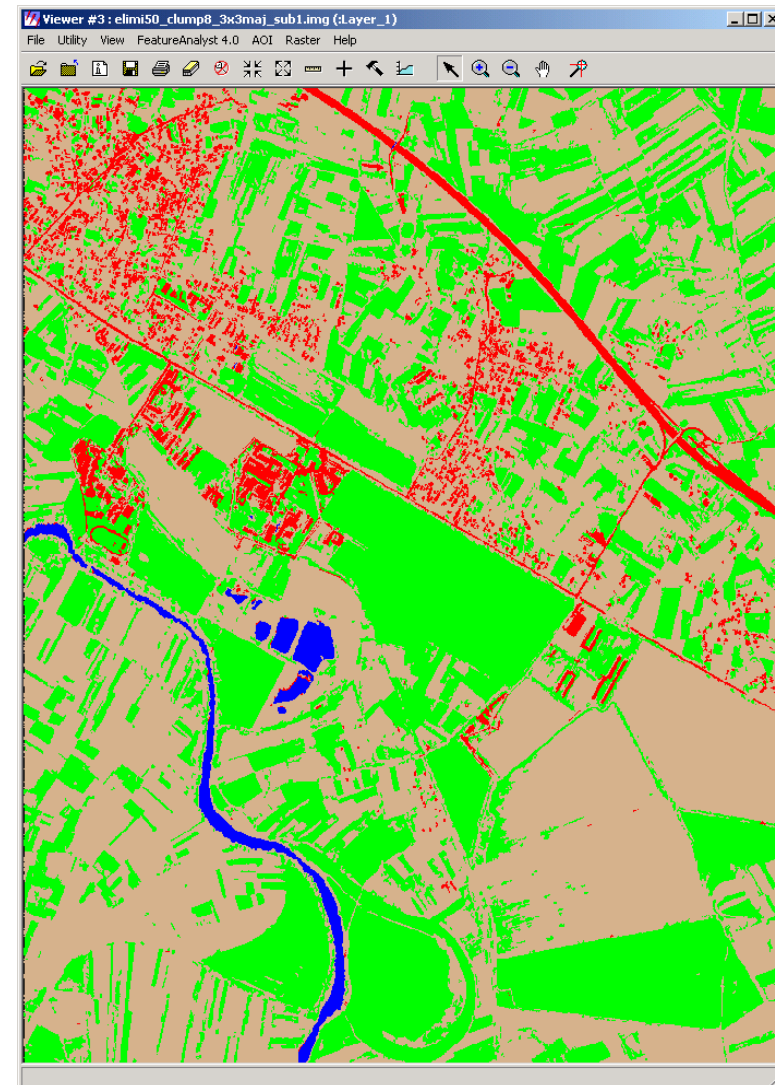


Classification result after post-processing
(filtering, elimination of single pixels)

4 thematic layers:

- ▶ Sealed area (red)
- ▶ Fresh water (blue)
- ▶ Vegetation (green)
- ▶ Ground surface (brown)

according to DFAD specification



Classification results (IKONOS)

ERDAS Imagine



- ▶ Left: Ikonos imagery in true color representation
- ▶ Right: Overlay of imagery with extracted class „sealed area“



Classification results (IKONOS)

eCognition / Definiens

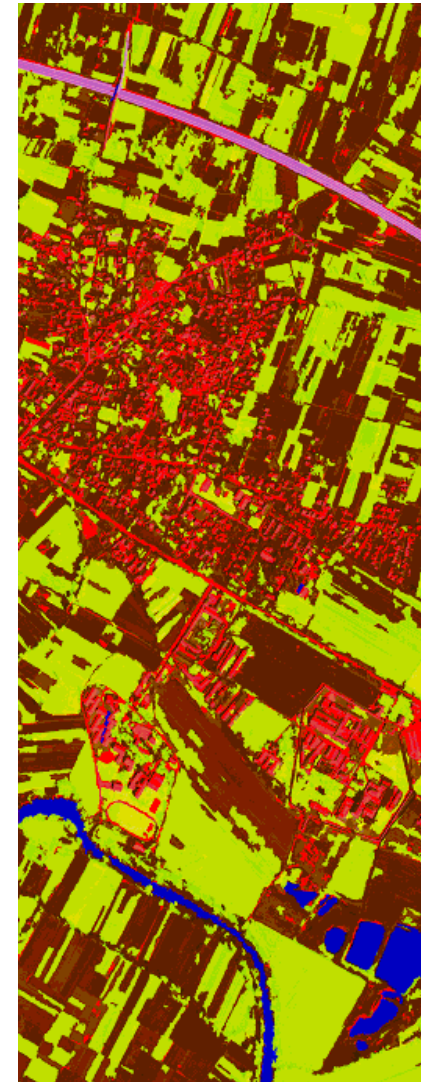


Classification result after post-processing
(filtering, elimination of single pixels)

5 thematic layers:

- ▶ Sealed area (red)
- ▶ Dual highway (purple)
- ▶ Fresh water (blue)
- ▶ Vegetation (green)
- ▶ Ground surface (brown)

according to DFAD specification

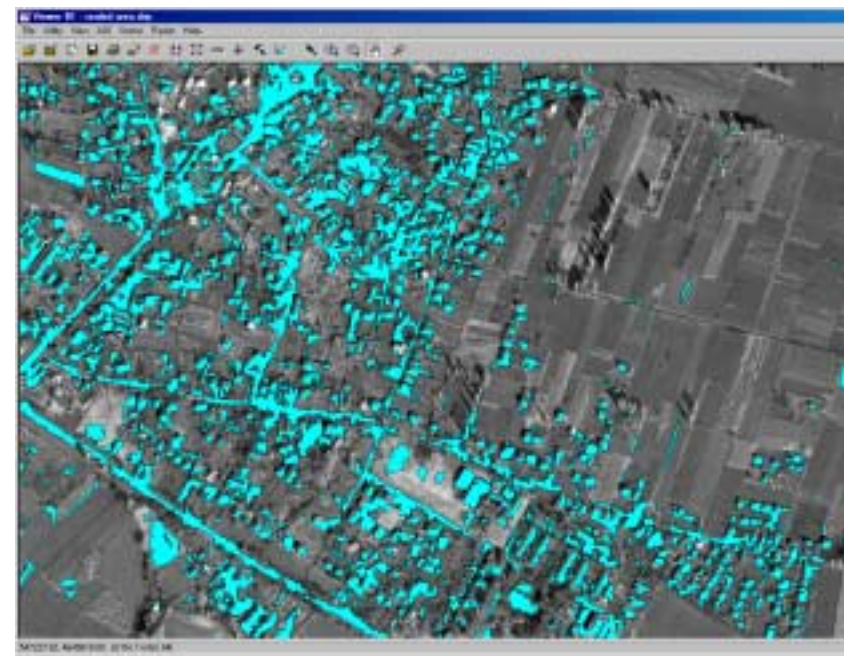


Classification results (IKONOS)

eCognition / Definiens



- ▶ Left: Ikonos imagery in true color representation
- ▶ Right: Overlay of imagery with extracted class „sealed area“

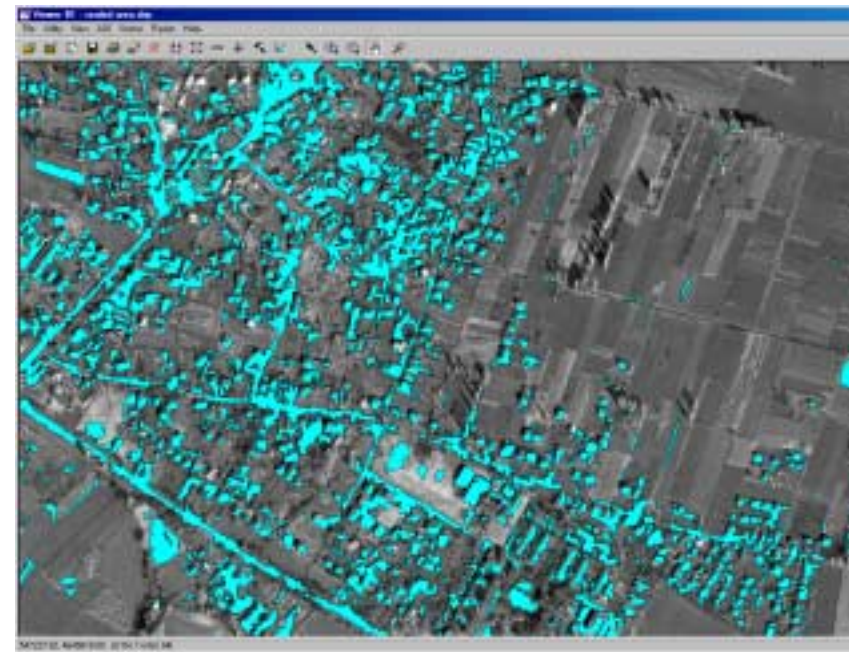


Classification results (IKONOS)

Comparison ERDAS Imagine – eCognition / Definiens



- ▶ Left: Extracted class „sealed area“ using ERDAS Imagine
- ▶ Right: Extracted class „sealed area“ using eCognition / Definiens



Classification results (IKONOS)

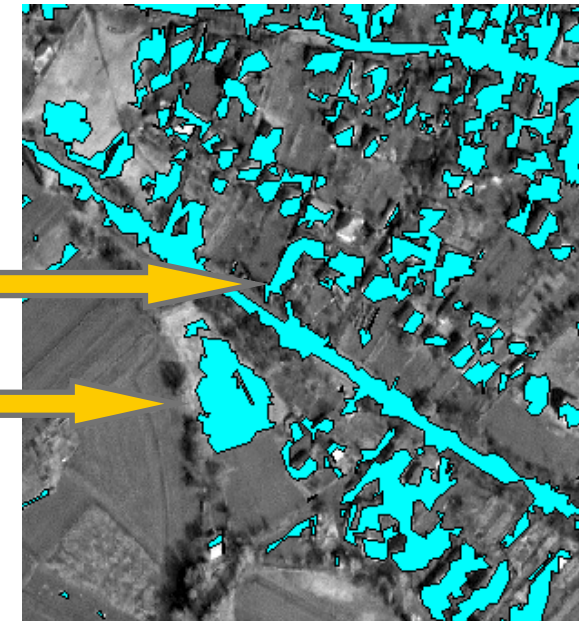
Comparison ERDAS Imagine – eCognition / Definiens



Original IKONOS
image



Classification result
ERDAS Imagine



Classification result
eCognition

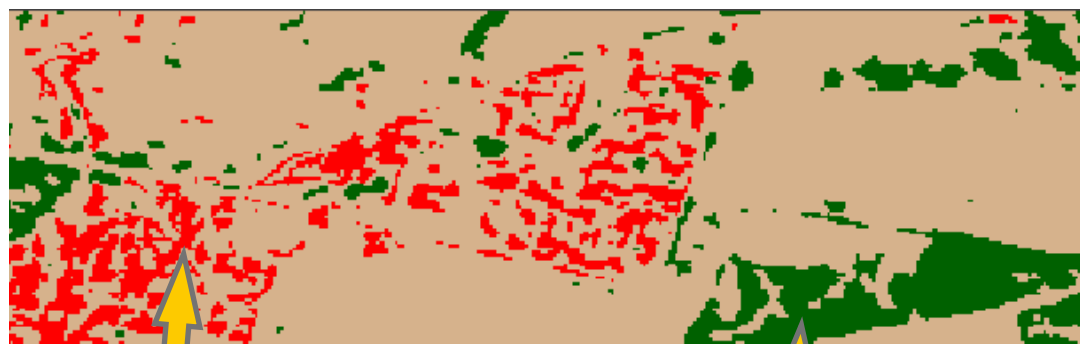
- ▶ Same extracted features in most areas
- ▶ eCognition provides features even in areas with irregular texture
- ▶ eCognition provides more homogeneous features than ERDAS (see SPOT)

Classification results (SPOT 5)

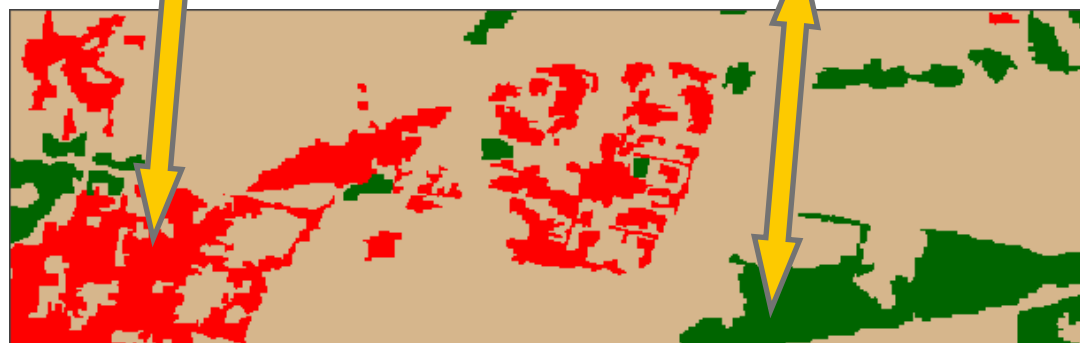
Comparison ERDAS Imagine – eCognition / Definiens



Original SPOT 5 PAN image (~1:10k)



Classification result ERDAS Imagine



Classification result eCognition

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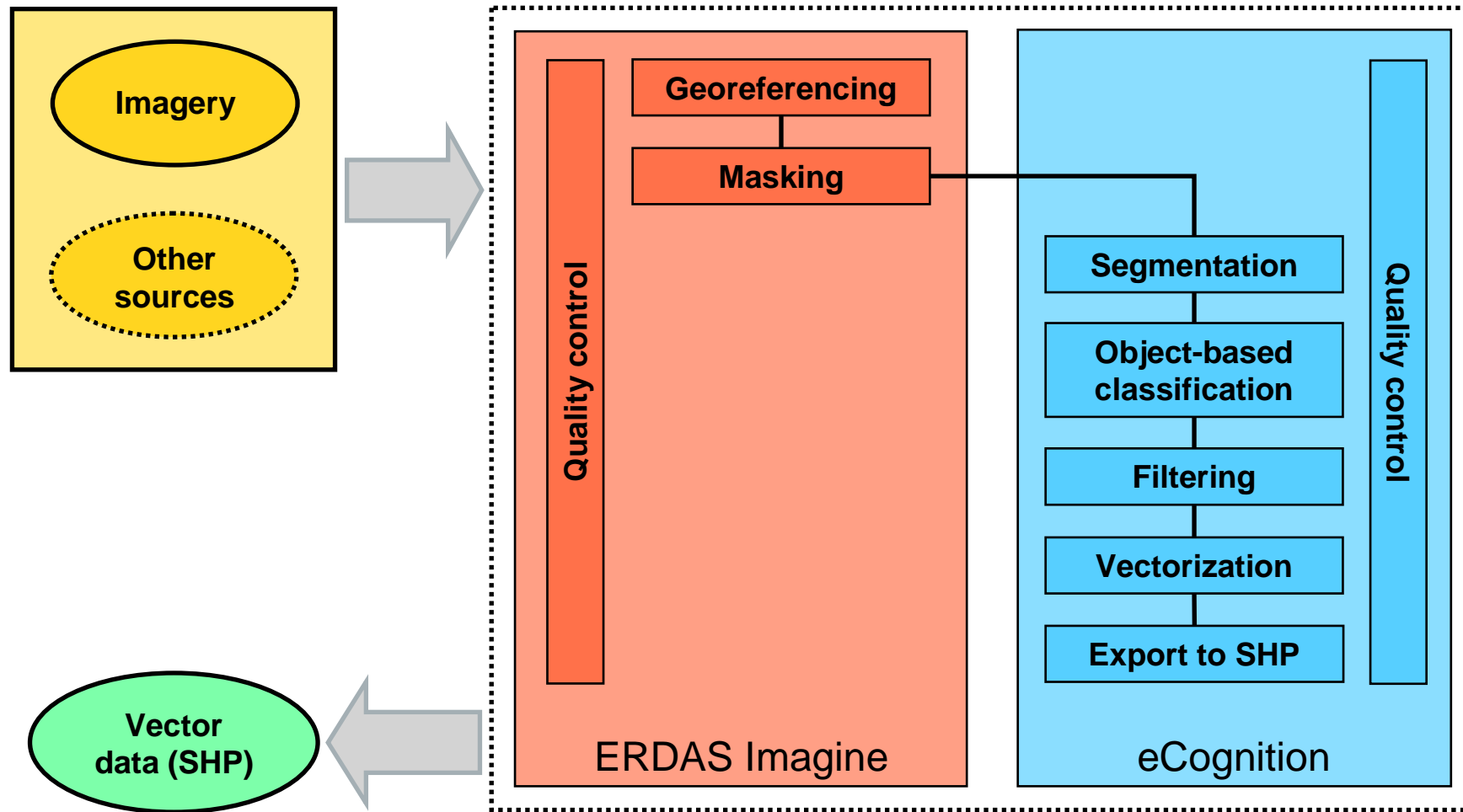
- ▶ Both software tools have advantages and disadvantages (functionality, computing time, handling, cost, results) → combination
- ▶ The process tree in eCognition is very useful, can be easily adapted and automates the workflow
- ▶ Documentation of the complete workflow in a handbook and a „cookbook“ for beginners

- ▶ Both in the veld of NW Iraq and in Mechedonia 4-5 thematic classes w.r.t. the DFAD catalogue can be classified
- ▶ The accuracy of the classification is sufficient for simulation purposes both with ERDAS and eCognition (overall accuracy 90%, kappa index 0.85)
- ▶ Computing times for 1 SPOT scene: ERDAS 4 h, eCognition 32 h (without process tree), ~15 h (with process tree)

- ▶ Manual editing of extracted vector data is necessary by GIS software (e.g. ArcView, GeoMedia)
- ▶ Additional information (geography, geology, geomorphology) for the region of interest is useful
- ▶ Portability of the rule set (Expert Classifier, eCognition) is difficult for images from different regions, from different seasons, or having different resolutions
- ▶ Operators with longtime experience in visual image interpretation may improve the results
- ▶ Outlook: Comparison with software *Feature Analyst* (Visual Learning Systems)

Recommended image processing workflow

Combination of ERDAS Imagine and eCognition / Definiens





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