SUGRES

Politique scientifique fédérale
Federaal Wetenschapsbeleid

Services for Urban Green Monitoring using Remote Sensing

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gim

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Objectives

- To develop products for monitoring green in urban areas:
  - Inventory of urban green
  - Mapping life forms
  - Detection of vegetation changes
  - Monitoring tree health

Partners

- Science Policy pre-operational project
- Private partner
  - G.I.M. NV
- Scientific Partners
  - ULB (IGEAT, Eléonore Wolff)
  - VUB (CCG, Frank Canters)
  - UCL (MILA/ENGE, Pierre Defourny)
- Final users
  - IBGE/BIM
  - City of Ghent

Presentation

- According to a market driven approach, most interesting/promising products are :
  - Inventory of green areas
  - Detection of green changes

Inventory of green areas : Objective

- Establishment of an inventory of urban green areas, both public and private
- To find a method
  - Best discrimination between “green” and “non-green” areas
  - Most robust

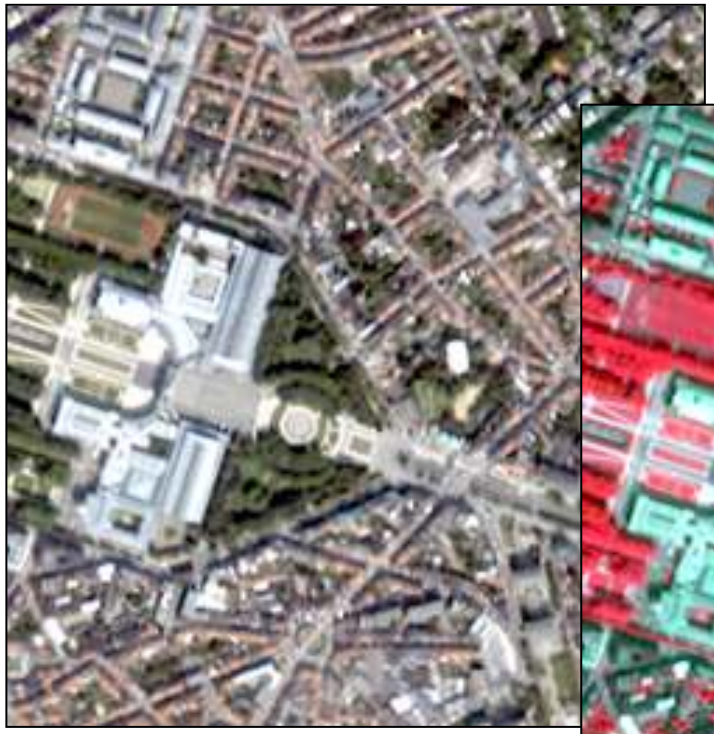
Definition of urban green

- Everything that is vegetation
  - Trees, shrubs, grass
  - Gardens, agricultural areas
  - …

Inventory of green areas : Method

- Choice of the most suitable vegetation index
  - 5 vegetation indices tested
    - NDVI, NIR/R, ARVI, SAVI and GEMI
  - 3 IKONOS images
    - Brussels, 05/08/2003
    - Brussels, 04/09/2003
    - Ghent, 14/06/2003

Inventory of green areas : Brussels, Ikonos (05/08/03)



Natural colour

Colour infrared

Threshold of NDVI

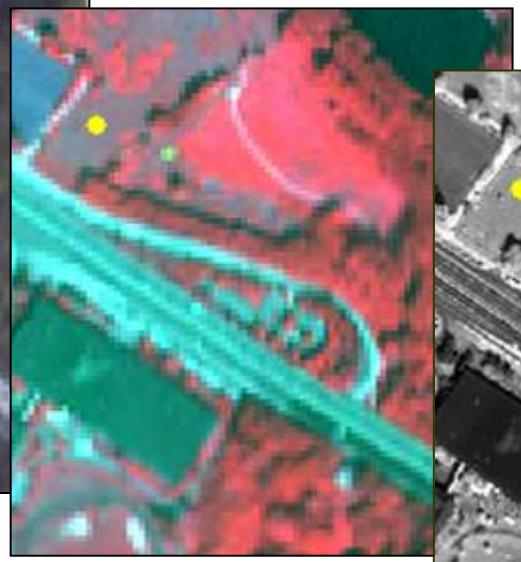
Inventory of green areas : Results

- Best vegetation index:
  - NDVI
- Errors
  - 0.4-1.7% of “green” in “non-green”
  - 9-14 % of “non-green” in “green”
    - bare soils and shadows

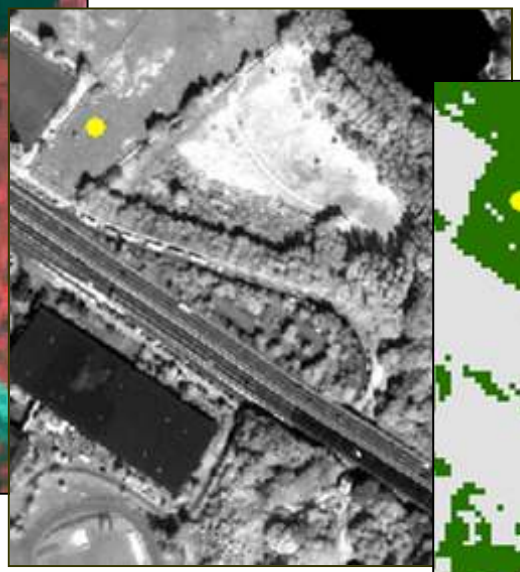
Inventory of green areas : Results

Examples of « bare soils » in « green »

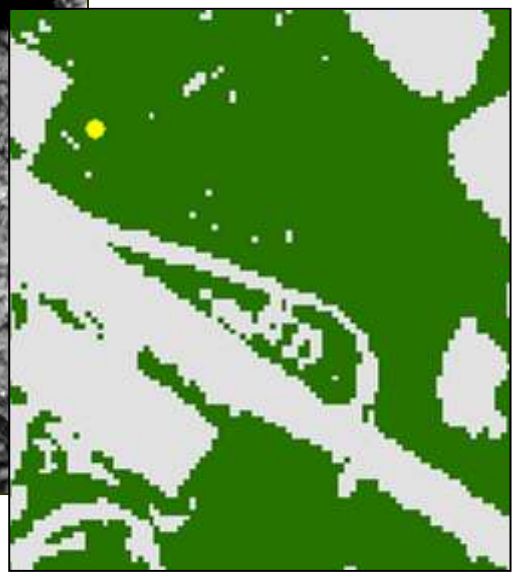
Natural colour



Colour infrared



Panchromatic

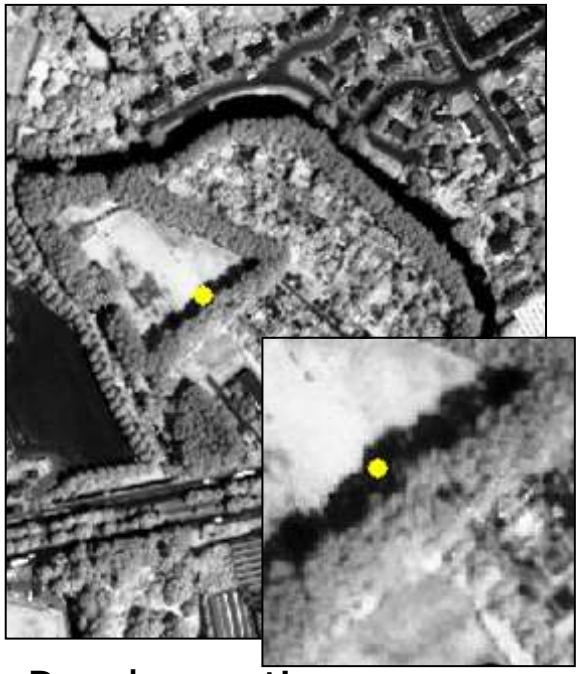


Threshold of NDVI

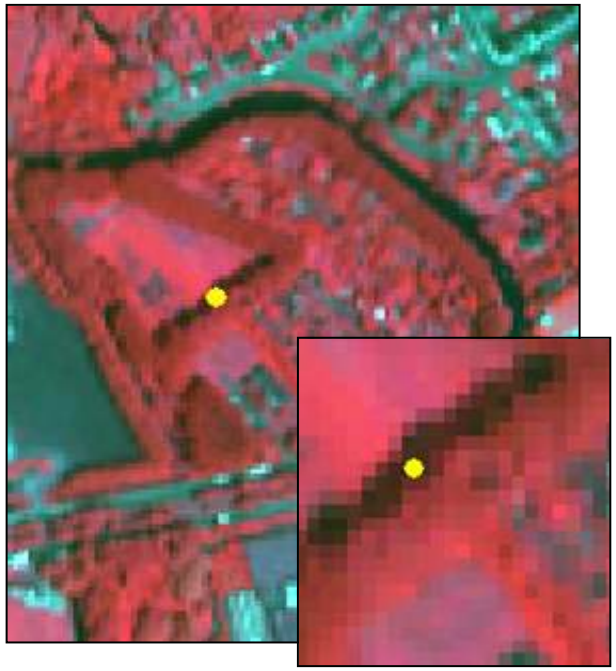
Brussels, IKONOS (04/09/03)

Inventory of green areas : Results

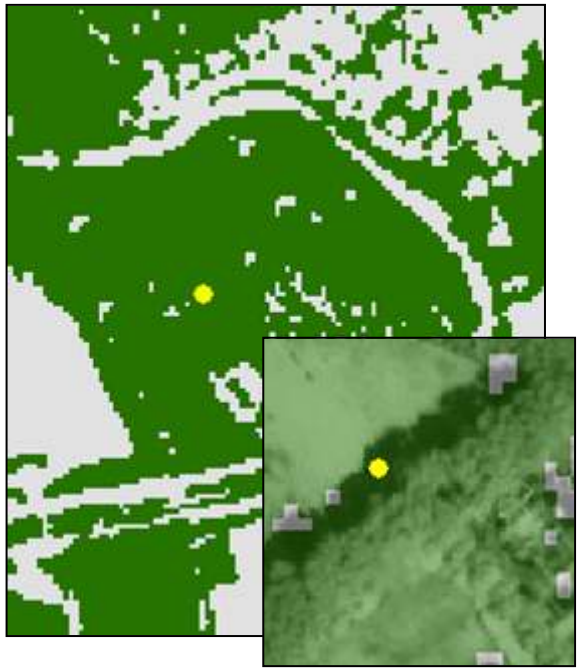
Example of « shadows » in « green »



Panchromatic



Colour infrared



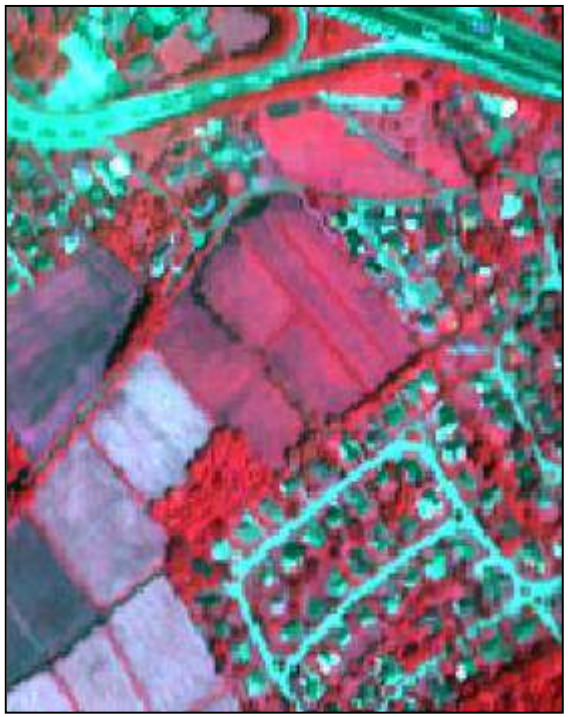
Threshold of NDVI

Ghent, IKONOS (14/06/03)

Inventory of green areas : Results

- Problem: agricultural fields without crops

Natural colour



Infrared false colors

Threshold of NDVI

Ghent, IKONOS (14/06/03)

Inventory of green areas : Results

- Classification using object oriented image analysis:
  - Segmentation on P band
    - with a scale parameter of 100
  - Classification
  - Post classification filtering

Inventory of green areas : Results

- Segmentation
- Classification
  - on P, B, G, R, NIR + ratio on all the bands + compactness + homogeneity in all directions on P
  - into 4 classes
    - Non vegetation
    - Vegetation
    - Field with crops
    - Field without crops
  - Membership function for Field without crops
    - Area Center point > 2000
- Post classification filtering

Inventory of green areas : Results

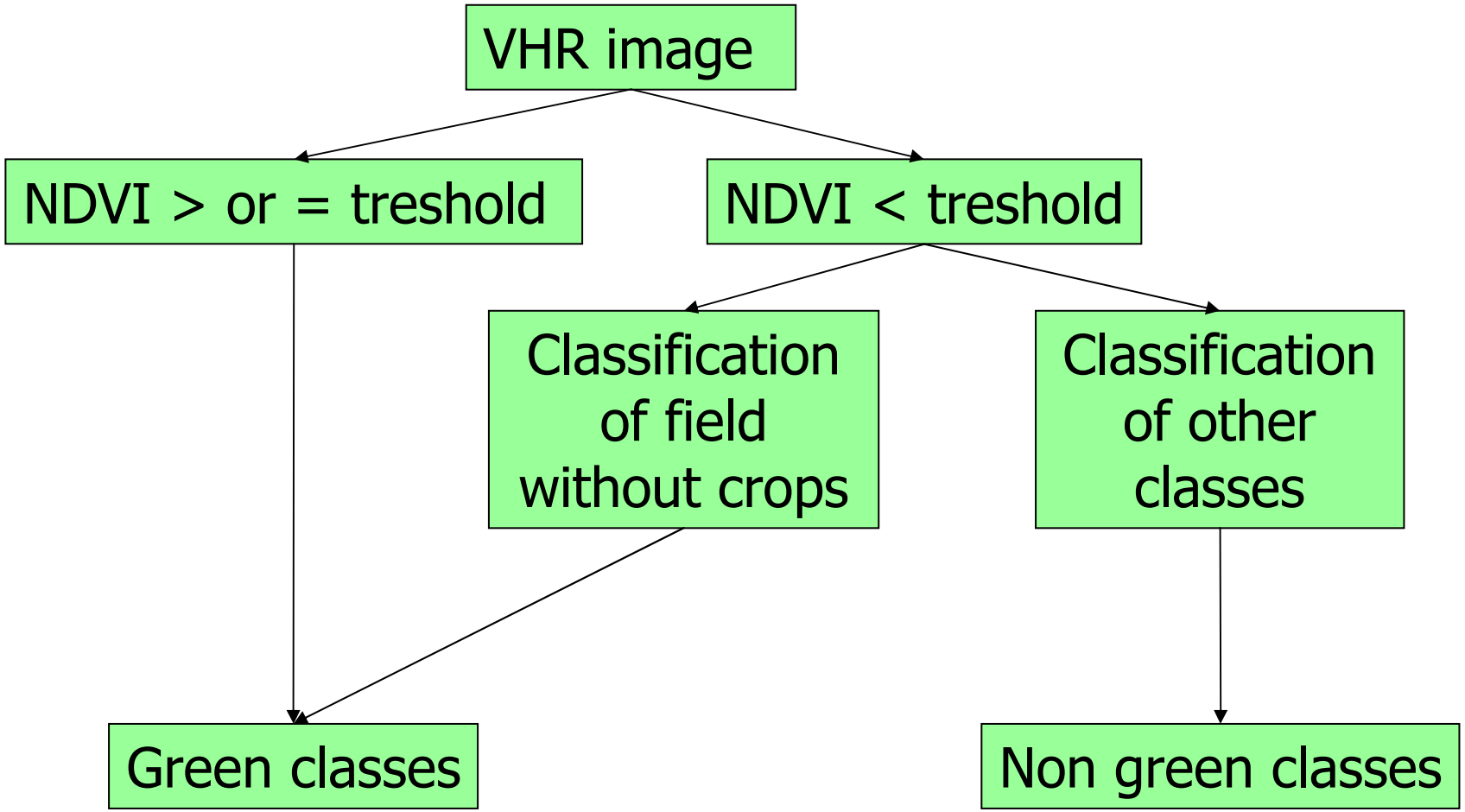
- Segmentation
- Classification
- Post classification filtering
  - merging polygones with area > 4000 m^2

Inventory of green areas : Results

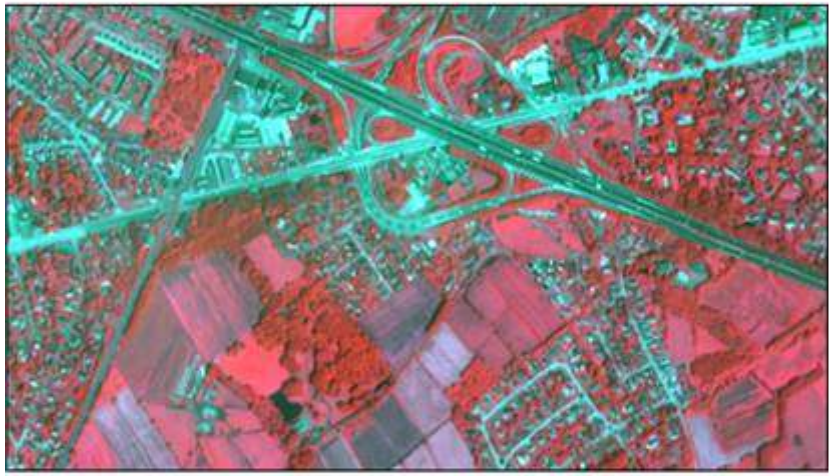
- Accuracy of the identification of fields without crops

	NDVI treshold	Classification	NDVI treshold + classification
Brussels	5.6 %	88.9%	94.4%
Ghent	45%	65%	80%

Inventory of green areas : Results



Inventory of green areas : Results



	Classes	Confusion errors	Omission errors	Overall accuracy
Brussels	Non-Green	0.4	6.2	95.5
	Green	12	0.8	
Ghent	Non-Green	3.5	11.3	92.3
	Green	11.7	3.7	

Inventory of green areas : Conclusions

- "Inventory of urban green areas" in the market survey
  - Few interested cities: cities at the beginning of a GIS implementation
    - ⇒ Useful tool for deriving inventory maps
  - Brussels: update the data of 1997 on the greenery rate
- 5 cities interested to buy this product; one inventory already sold.

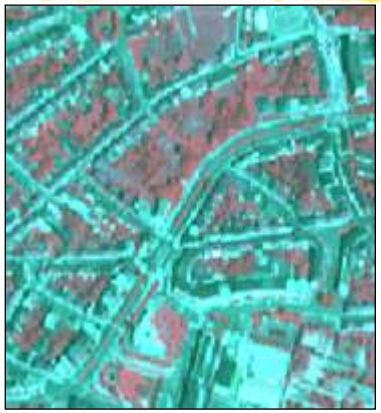
Detecting vegetation changes

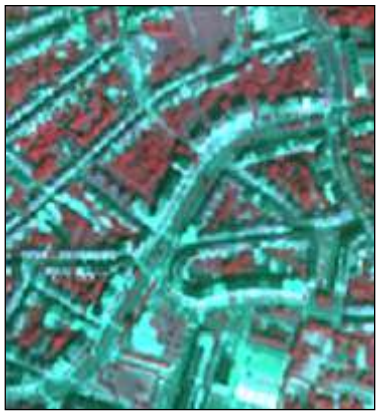
- Objective
  - Development of method that detect green areas that changed into non-green areas and vice-versa
- Data
  - Two IKONOS images of Brussels
    - 8 June 2000
    - 4 September 2003

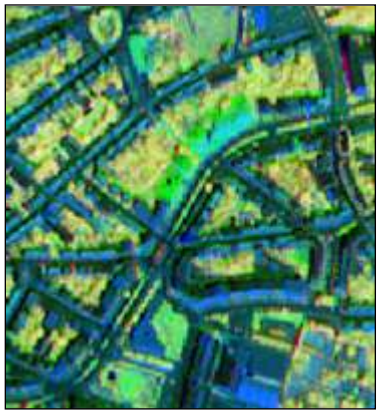
Detecting vegetation changes

- Pre-processing
  - Transformation of the bits depth
    - Linear rescaling into 16 bits
  - Co-registration
    - RMS 0.86 in X and 0.57 in Y
  - Creation of subsets
- Method of change detection
  - Multitemporal color composition (visualisation)
  - Object oriented image analysis (interpretation)

Detecting vegetation changes : Multitemporal color composition







Multitemporal color composition

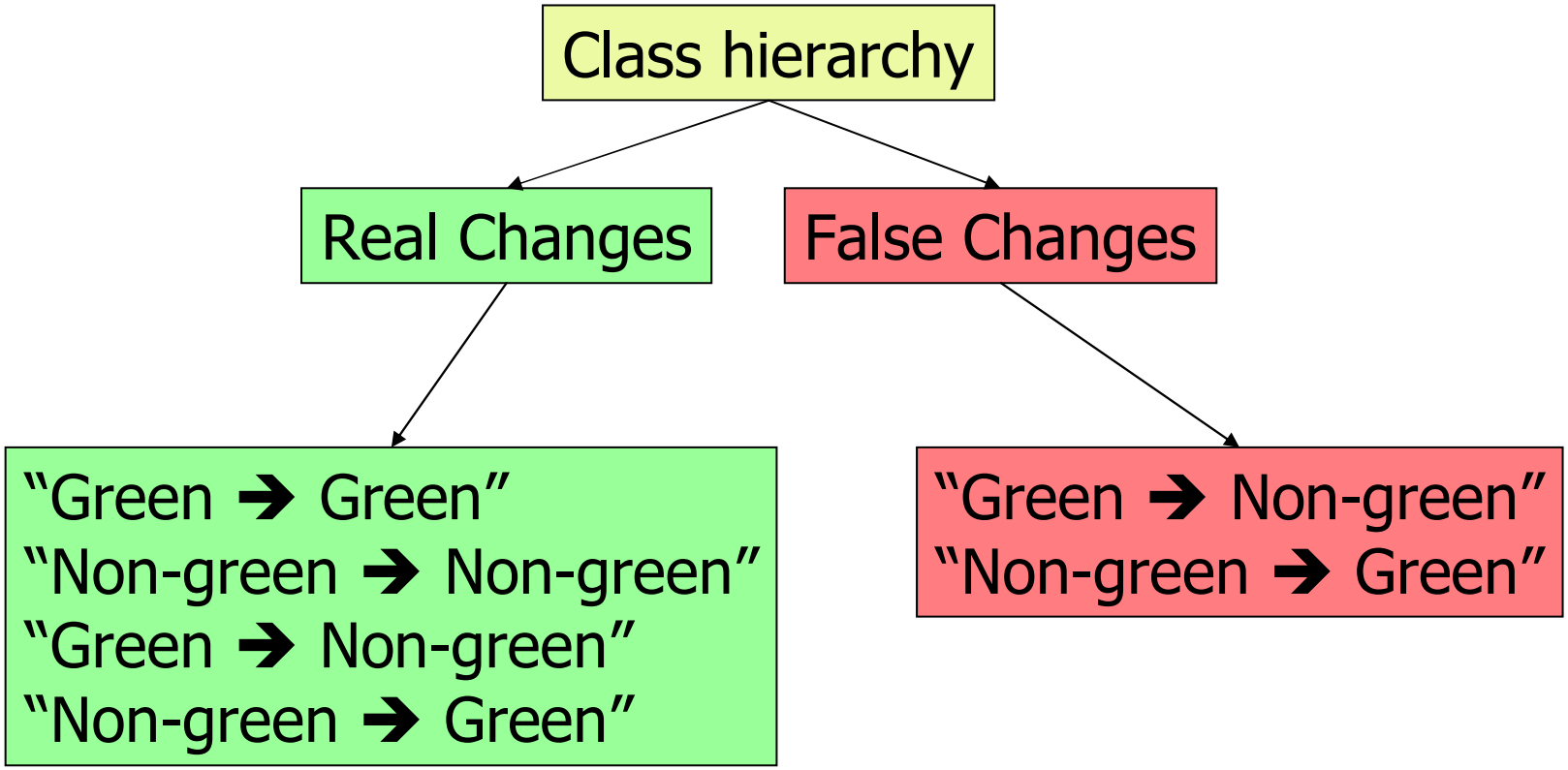
Panchromatic

Colour infrared

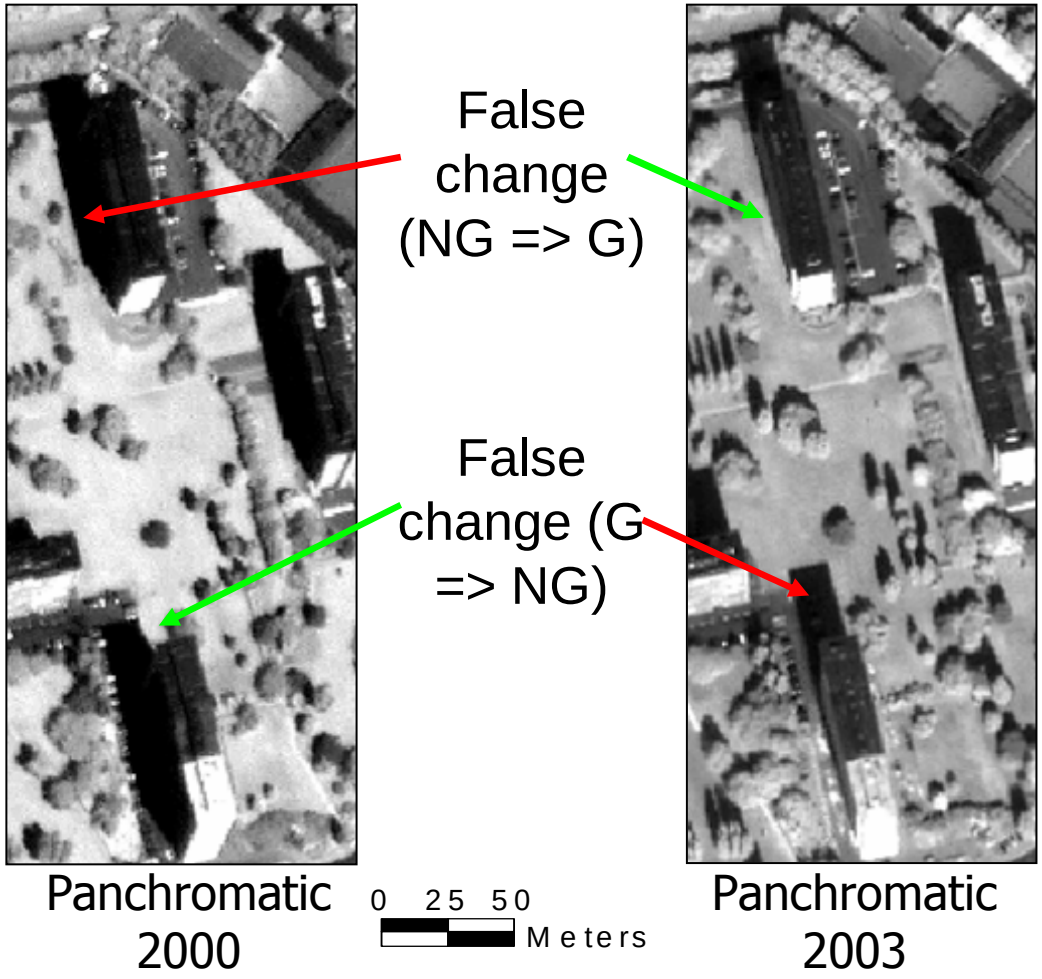
0 100 200
Meters

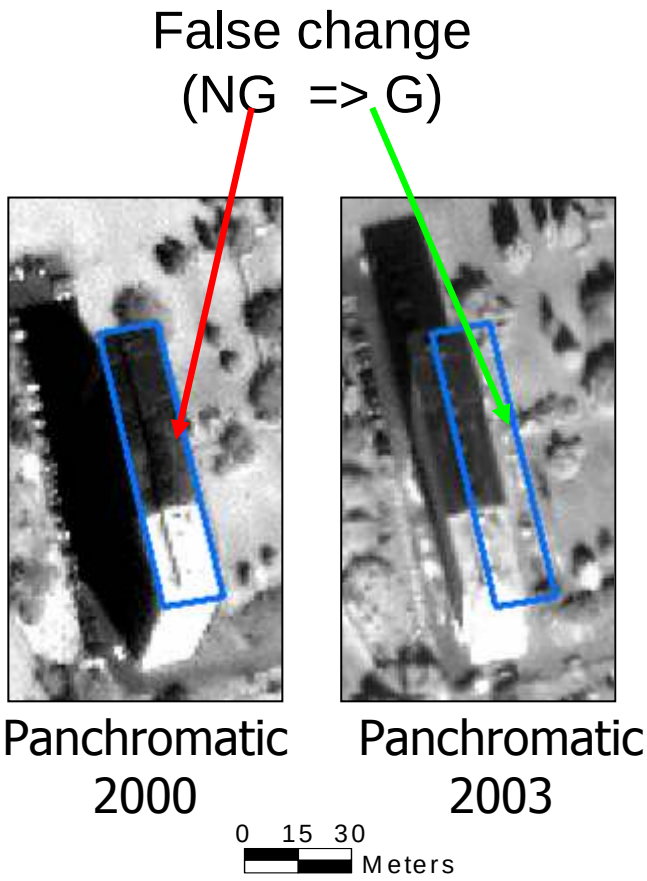
- Layer used:
  - R = NDVI 2003
  - G = PAN 2003
  - B = NDVI 2000
- Color composition
  - Non-changes in yellow and blue
  - Changes in red and turquoise

Detecting vegetation changes : Class hierarchy



Detecting vegetation changes : Examples of false change





Detecting vegetation changes

- Segmentation
  - 2 PAN bands + 2 NDVI neo-channels
  - Scale parameter: best results with 350
  - Default homogeneity criteria
- Classification
  - On screen training samples
  - 2 NDVI (calculated in eCognition)
  - ➔ Overall accuracy: 79 %

    confusion between "False change NG ➔ G" with "Non-green ➔ Green" and vice-versa

Detecting vegetation changes : Post-classification

- All fields with crops or bare fields should be included in the "Green" class
  - ➔ No interest to distinghuish fields that changed or not
- Post-classification rules to reclass fields to the "Green ➔ Green" class
  - Merging adjacent regions with the same class
  - Rules based on area, compactness and rectangular fit
  - 75 % of the fields correctly reassigned
  - Overall accuracy: 78 %

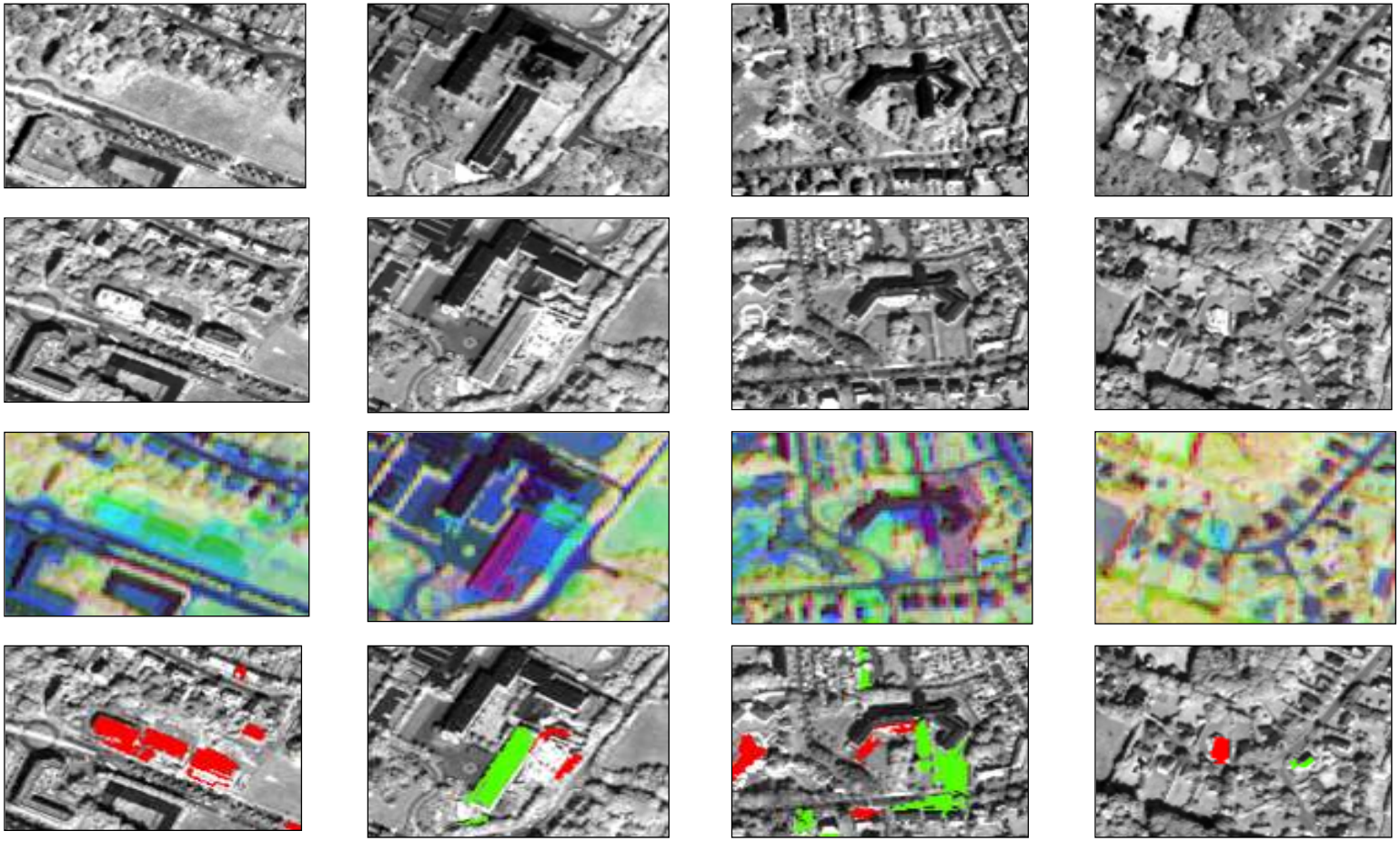
Changes after post-classification

Panchromatic image 2000

Panchromatic image 2003

Multitemporal color composite

Change detection



« Green => Non-green »

« Non-green => Green »

0 50 100
Meters

Habay-la-Neuve

Conclusions (1/2)

- More or less satisfying results
  - Difficulties to discriminate small false changes from the real changes
- Post-classification rules
  - Some large and compact regions of the "Green => Non-green" class are re-labelled with the fields
  - No rules for the bare fields
  - A lot of false changes still remains

Conclusions (2/2)

- Possible improvements
  - Additional features for the classification
  - Multiresolution classification
  - Other post-classification rules that do not only use area and shape features

Contacts

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