

The logo for ULB (Université Libre de Bruxelles) is displayed in white text on a dark blue square background.

# Change detection for update of vector database through multi-level region-based classification of VHR data (ChaDe)

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# Outline

- **Introduction**
- **Objective**
- **Databases**
- **General method**
- **Applications and results**
- **Conclusion**

# The local geospatial databases need to be updated

- **Interpretation of areal photographs**
  - Expensive and time-consuming task
- **VHR satellite data (Pléiades HR and COSMO-Skymed data)**
  - Advantages of the satellite images
    - Digital format
    - Large spatial coverage
    - Multispectral mode
    - ...
  - Radar component
  - Very high resolution

# Objective

- **Study the potential of the Pléiades-HR data to detect change for update of vector databases through region-based classification**
- **Research network**



Royal Military Academy,  
Signal and Image Centre

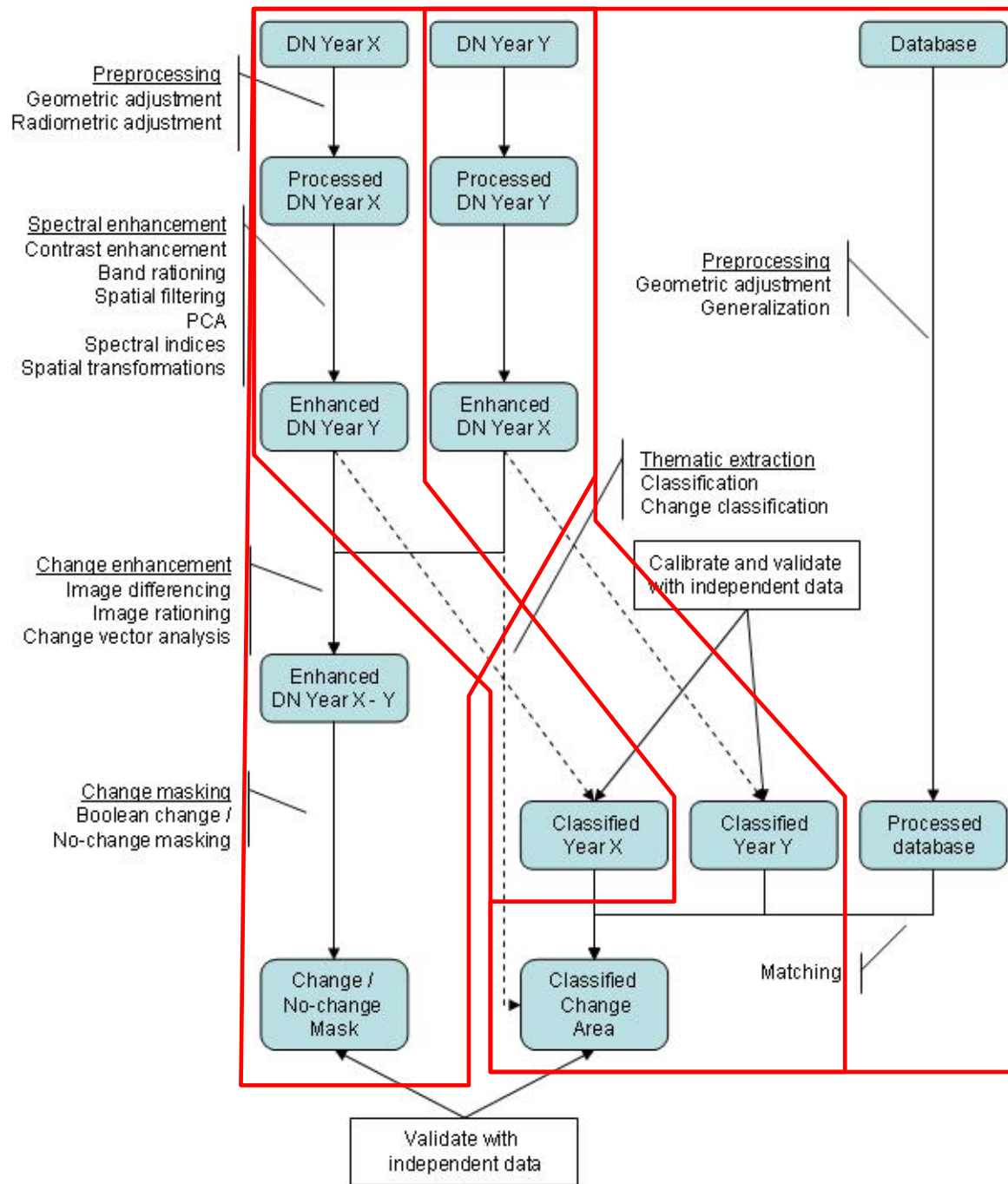


University of Liège,  
Space Centre of Liège

# Databases

- **National Geographical Institute**  
1/10 000 topographic map (TOP10v-GIS)  
Ambitious database updating policy
  - Road network each year
  - Buildings each three year
  - Complete database each six years
- **Agriculture Directorate-General (Walloon Region)**  
Land Parcel Identification System (LPIS)  
Error database detection
  - Inclusions
  - Wrong delineation
- **National Geographical Institute – France**
  - Topo-Pays: topographical map

# Change detection method



# Change detection method choice

- **Image-Database change detection method**
  - **Matching and integration of raster and vector data**
- **Through a region-based classification**
  - **Overcome the poor spectral resolution and the high variability**

# Study Area 1





# Area 1



DB Year Y with 92 classes



Image Year X



DB Year X manually updated

**Segmentation**  
constrained by  
the DB Year Y



**Segmentation**  
with image  
characteristics



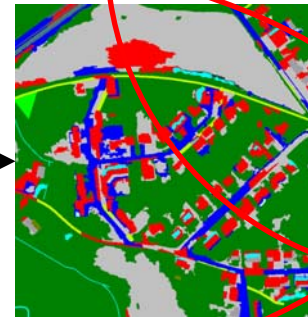
**Feature  
selection**

Classification  
with image  
features

Generalized DB Year Y  
with 5 classes



Classification  
constrained  
by DB Year Y



Reference change  
map (Year Y - Year X)

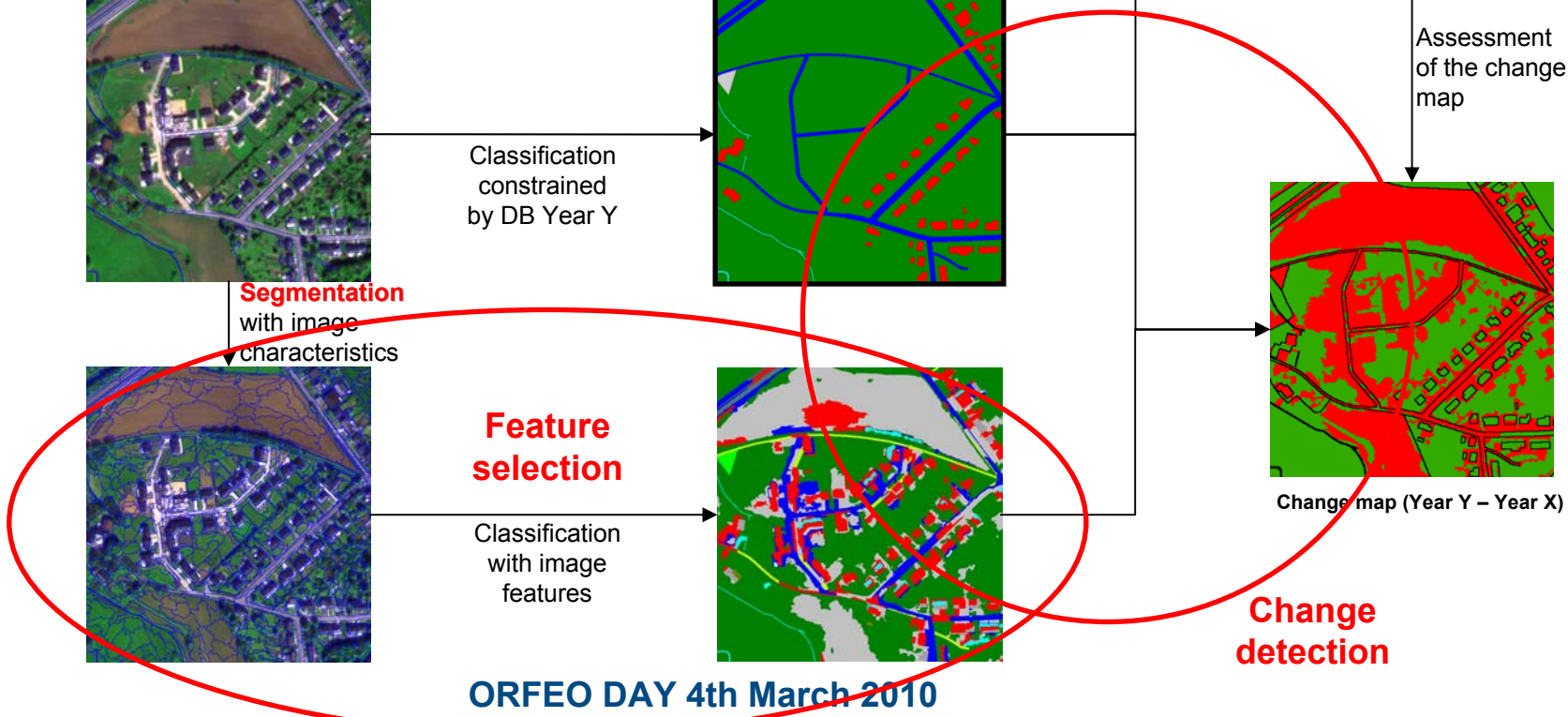


Assessment  
of the change  
map



Change map (Year Y - Year X)

**Change  
detection**



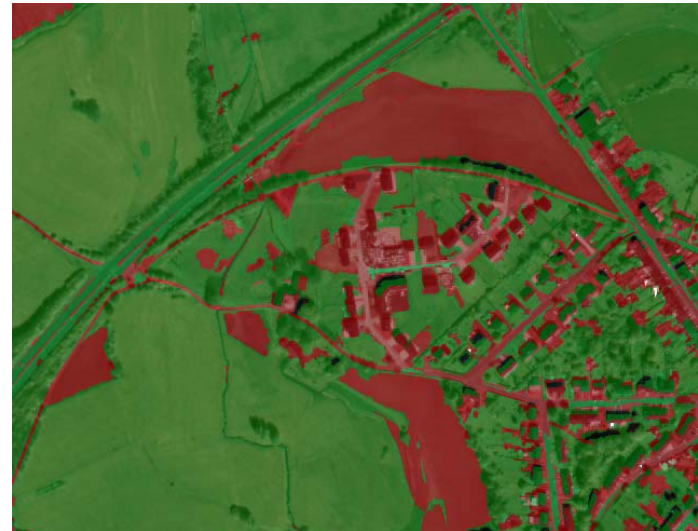
## Features selection

- **Bhattacharya distance based on training sites**
  - **Vegetation:**
    - NDVI threshold
  - **Shadows:**
    - Panchromatic threshold
  - **Baren surfaces, Roads, Building, Water :**
    - Panchromatic and Red bands
    - Contrast of Green and Red bands, Second Angular moment of Panchromatic band,
    - Length/Width

## Results

- **Classification with the selected features**
  - Change detection accuracy = 72%
  - Transition detection accuracy = 70%

**Classification detects 7.1 as much change than the reference and detects 90.5% of the true changes**



## Results

- **Classification with features + rules about the gardens, crops and pastures**
  - Change detection accuracy = 79%
  - Transition detection accuracy = 78%



**Classification detects 5.4 as much change than the reference and detects 90.7% of the true changes**

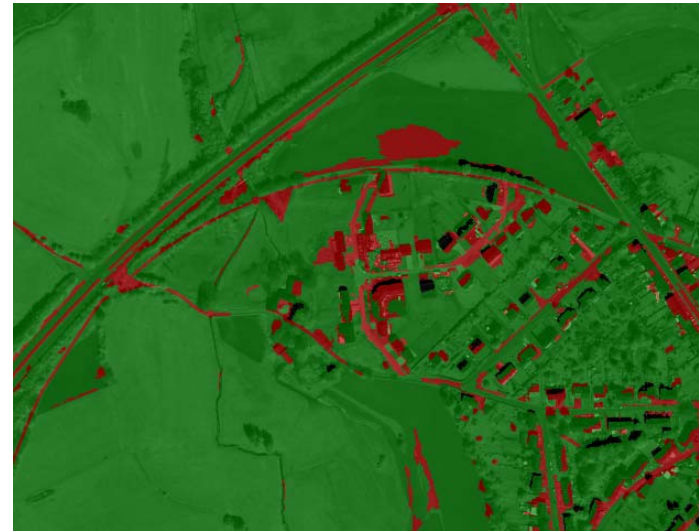




## Results

- **Classification with features + rules + class-related features for Building and Road**
  - Change detection accuracy = 86%
  - Transition detection accuracy = 84%

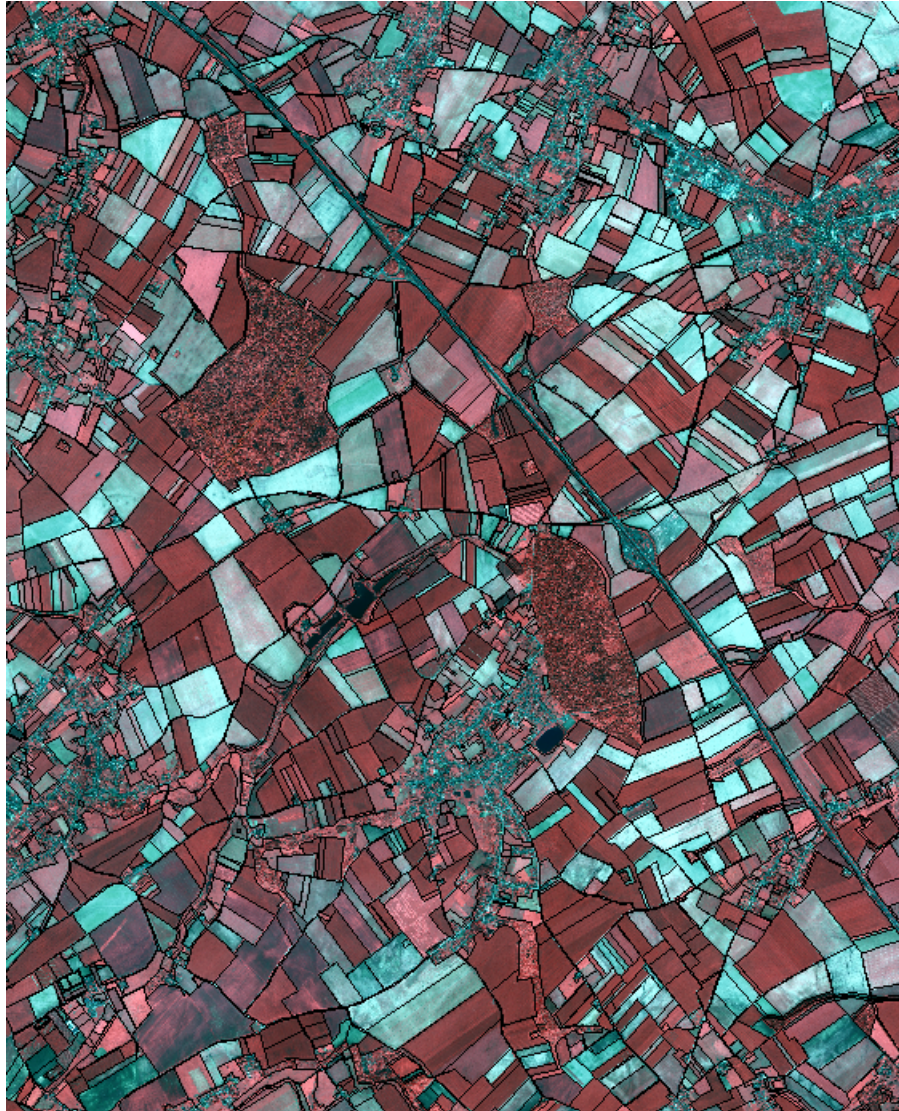
**Classification detects 3.9 as much change than the reference and detects 88.4% of the true changes**



# Conclusions

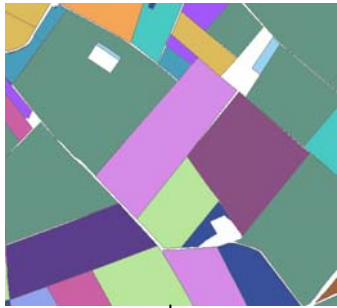
- **Very good results with all the transition classes**
- **Other rules in the classification**
- **Features selection optimization**

## Study area 2





## Area 2



DB Year X

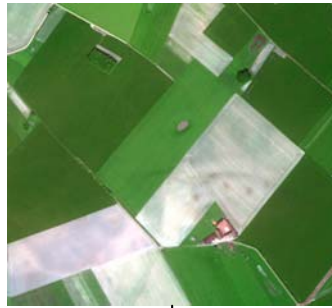
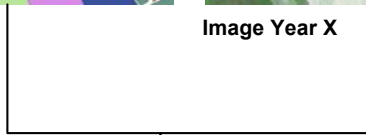
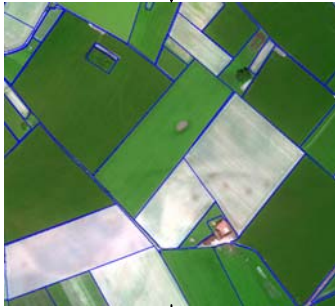


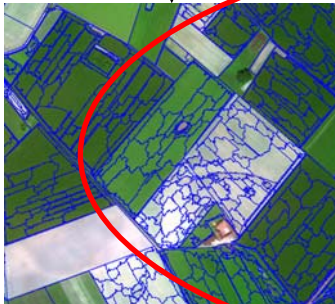
Image Year X



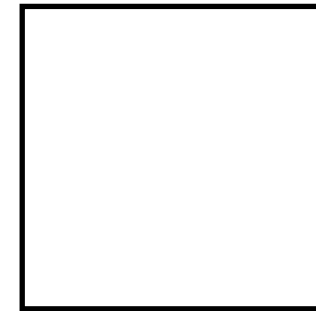
**Segmentation**  
constrained by  
the DB Year X



**Segmentation**  
with image  
characteristics



Error detection  
with outliers  
identification



DB Year X manually corrected

Assessment  
of the error  
map

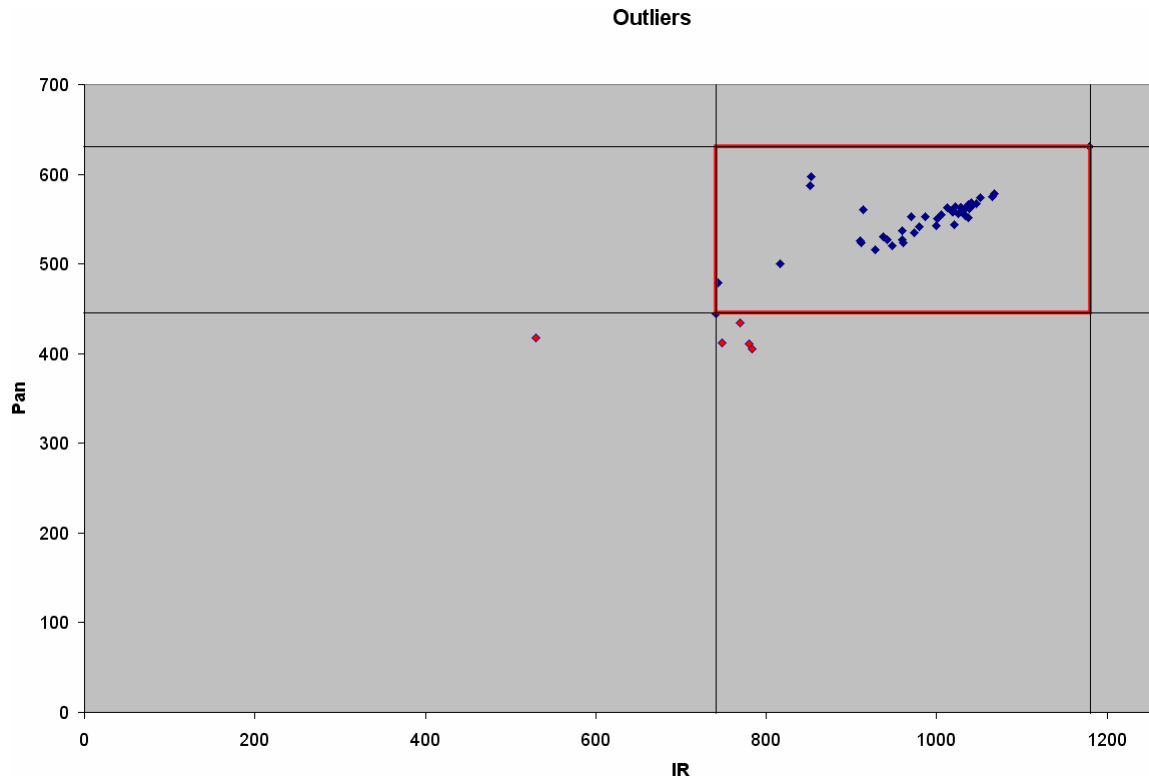




# Outliers identification



Identification System

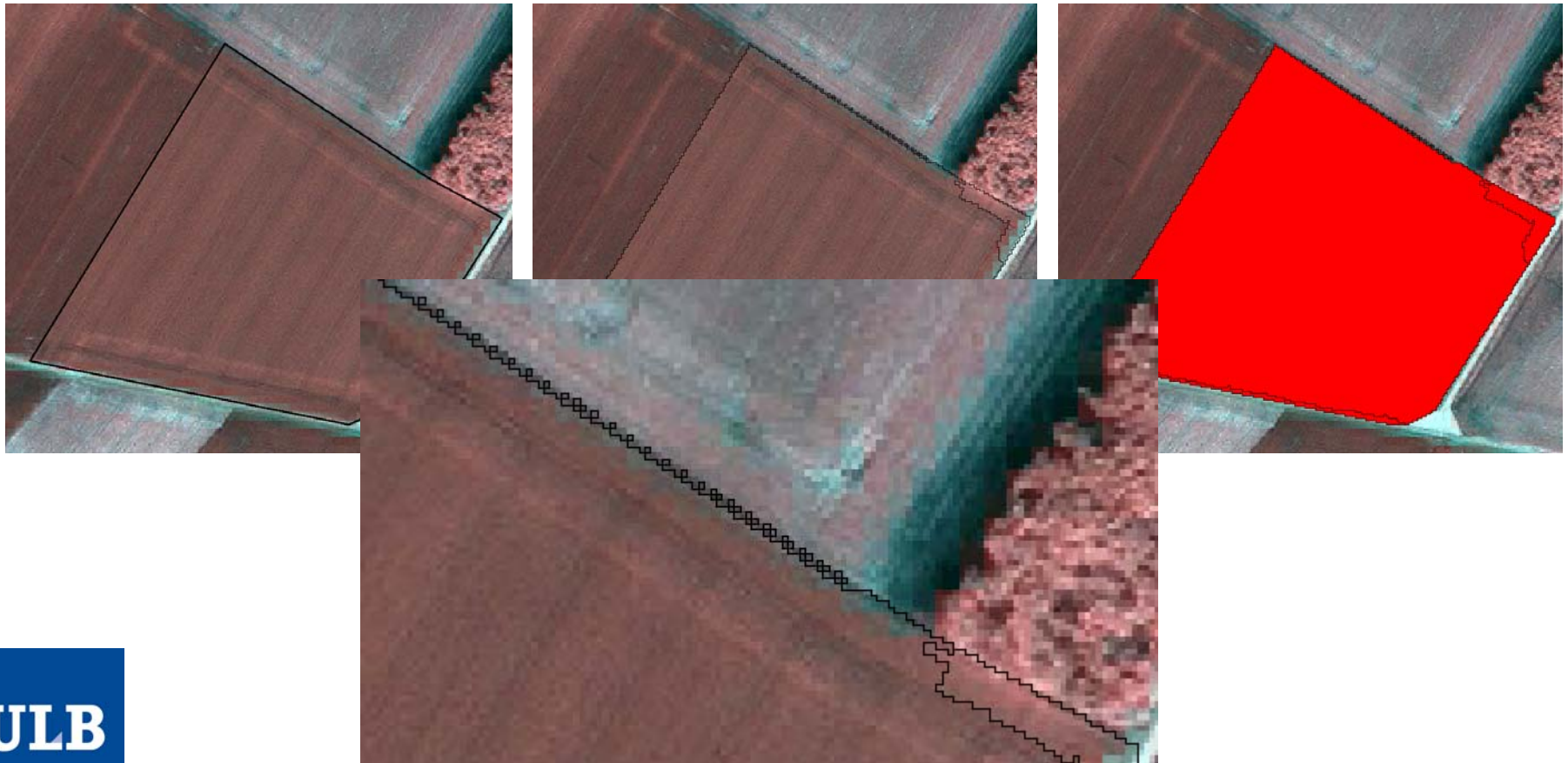


Outliers  $< \text{mean} - 2 \times \sigma$   
Outliers  $> \text{mean} + 2 \times \sigma$

} for IR and Pan band

## Problems

- Little segments become more important to identify outliers ( mean and  $\sigma$  )



## Conclusions

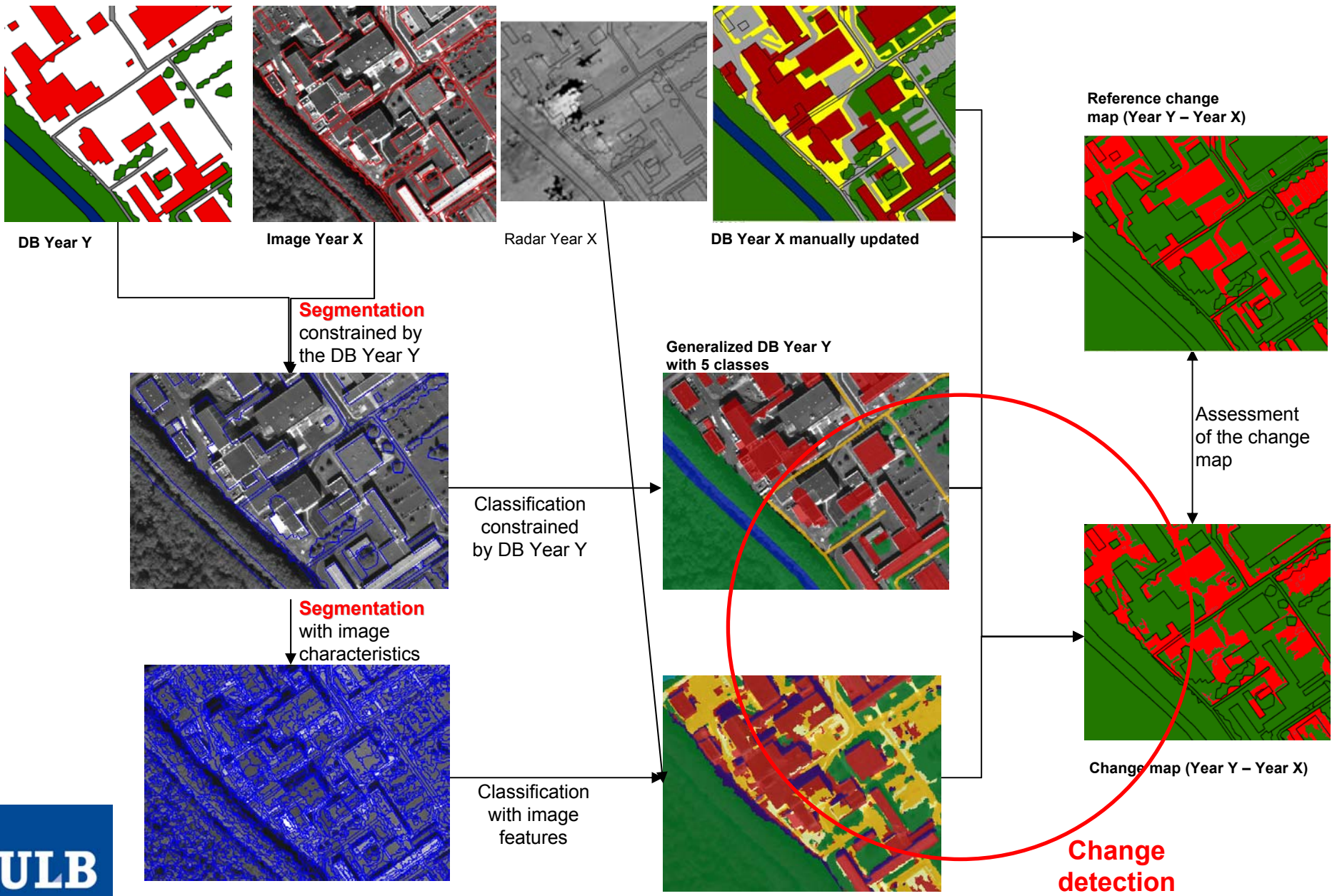
- **Simple, good and unsupervised method**
- **Use of Minimum Mapping Unit (Regulation tolerance)**
- **Other outliers identification methods**
- **Other features to identify outliers**
- **Other study sites**
- **Identify wrong crops with the same method**

# Study Area 3





# Area 3



# Results

- **Kappa = 0.52**

**Classification detects 1.2 as much change than the reference and detects 65.7% of the true changes**



## Conclusions

- **The method needs to be adapted with each database**
- **Utility of radar data**

**But**

**Need of a better resolution**

# General conclusions

- **Each method need optimization**
- **Use of other segmentation method**



- **Thank you for you attention**