

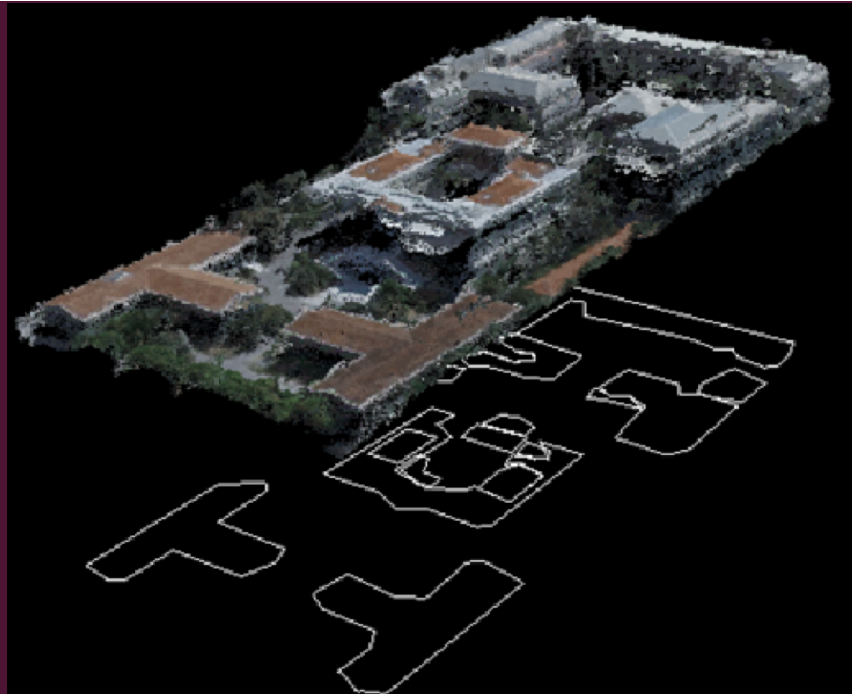


**NATIONAL TECHNICAL UNIVERSITY OF ATHENS**  
**SCHOOL OF RURAL AND SURVEYING ENGINEERING**  
**LABORATORY OF PHOTOGRAMMETRY**

# **AUTOMATED BUILDING DETECTION IN DENSE POINT CLOUD AND UPDATE OF OPEN SOURCE DATA BASES**

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Aroni E.

3D GEOINFO CONFERENCE  
DELFT

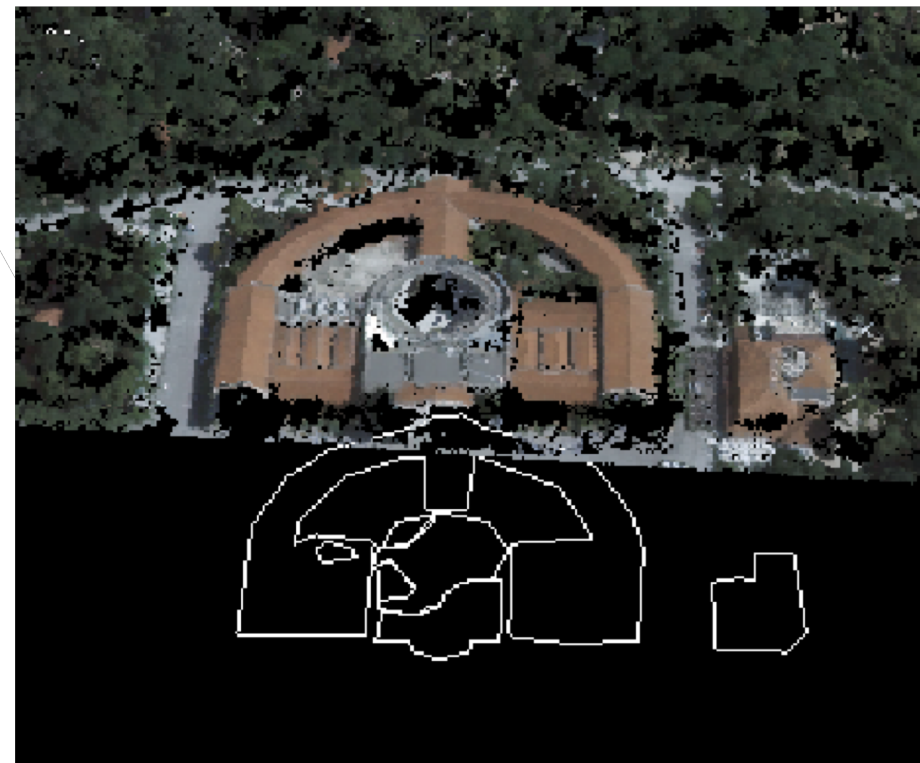
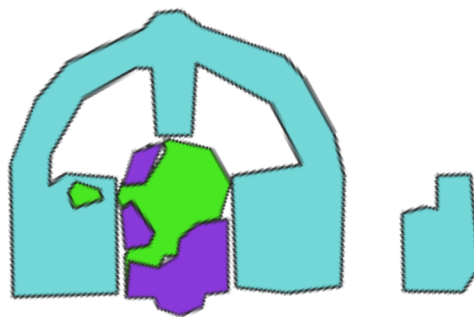


# INTRODUCTION

## BUILDING DETECTION IN DENSE POPULATED CITY AREAS

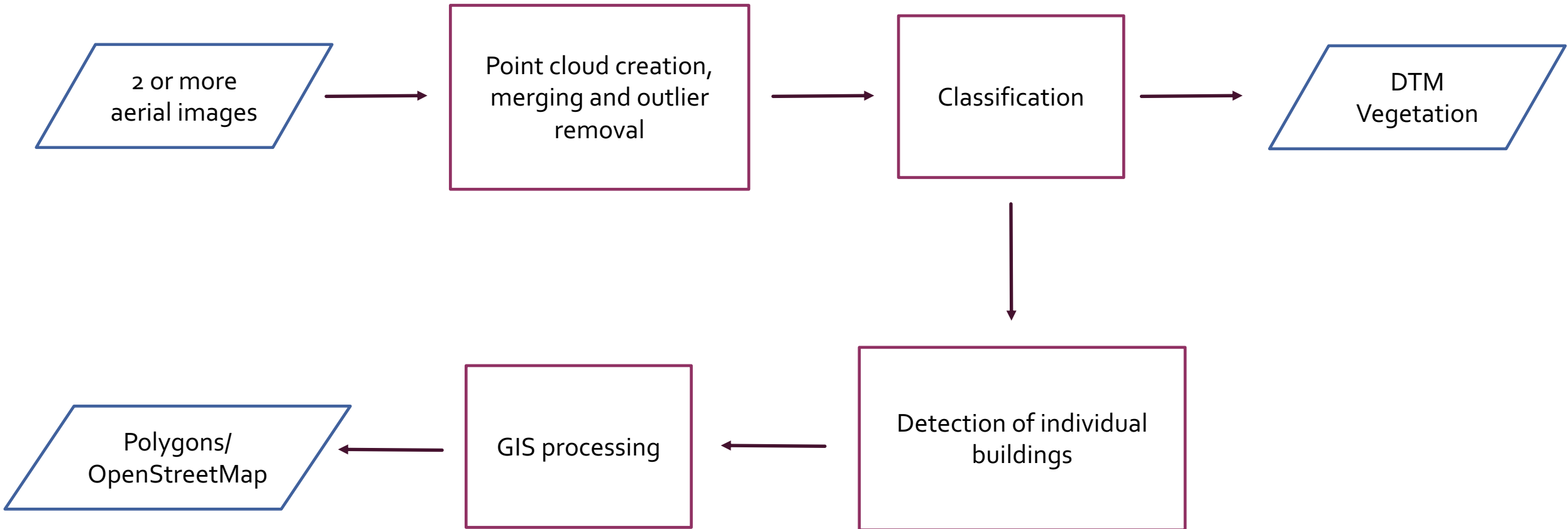
- Outline
- Height

Mass update of  
opensource  
databases





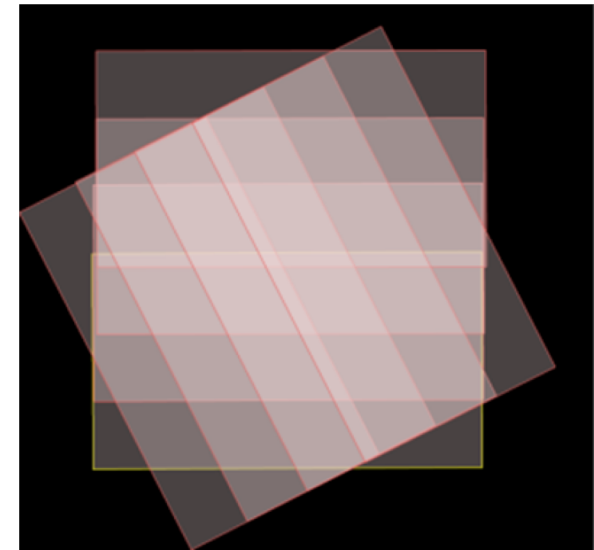
# PROPOSED METHODOLOGY



# DATA

## 8 AERIAL IMAGES

- ✓ Georeferenced
- ✓ Interior Orientation
- ✓ Ground pixel size 0.25 m
- ✓ Overlap 54%
- ✓ RGB, near infrared



# STUDY AREA



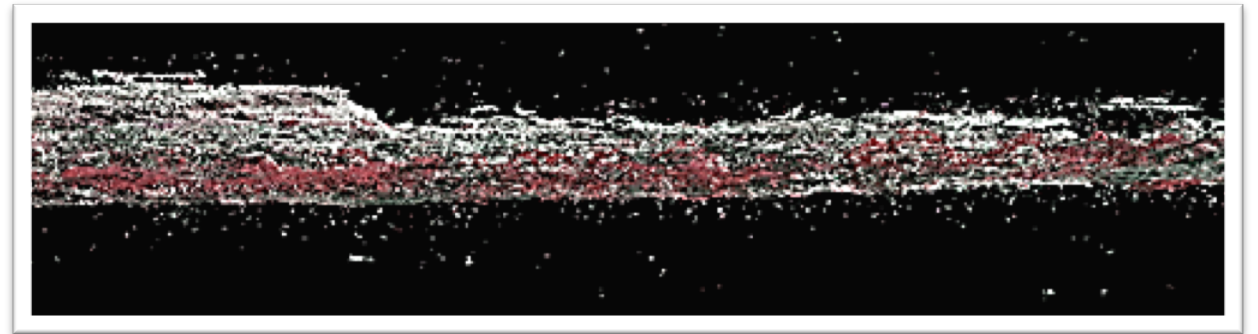
## Athen's city center:

- Different types of architectural structure
  - Intense terrain
  - Monuments
  - Vegetation
- Various road networks

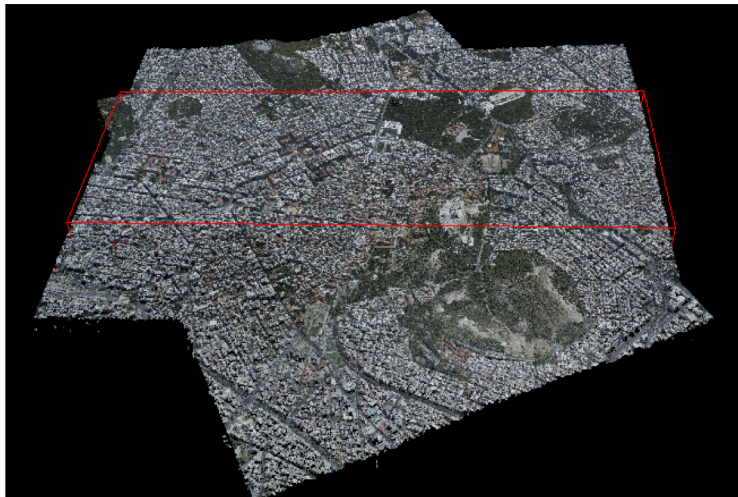


# 3D POINT CLOUD

## DENSE MATCHING: SEMI- GLOBAL ALGORITHM



Position  
Color



## OUTLIERS

Already detected:  
2%

Estimated remaining:  
3%

# DIGITAL TERRAIN MODEL(I)

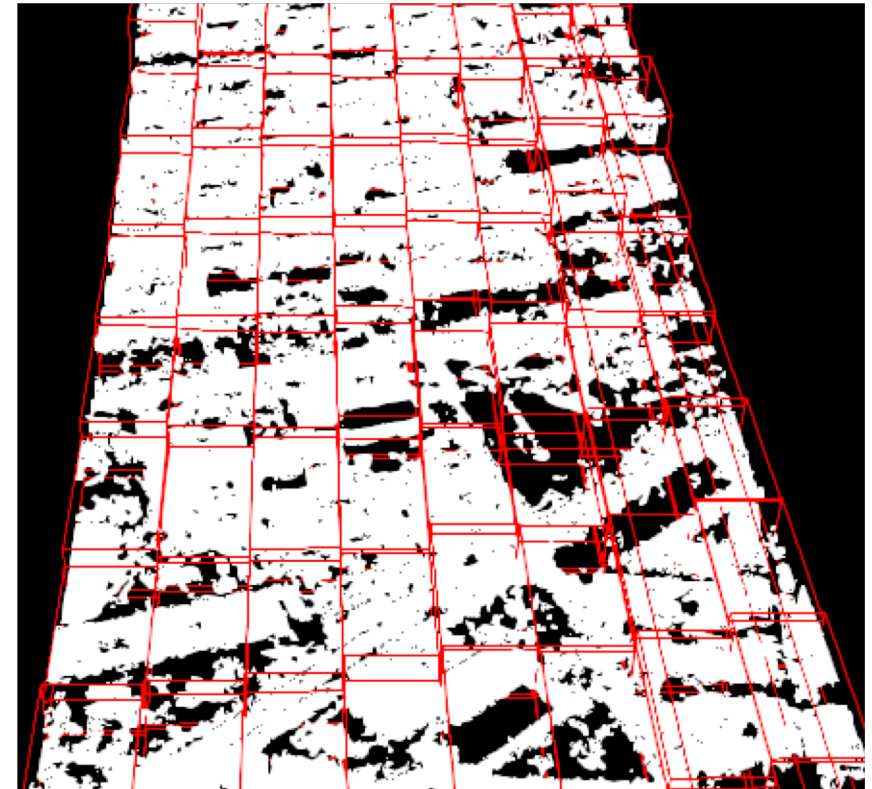
## CLASS I: TERRAIN

- Search in subparts of the cloud for the local elevation of the ground



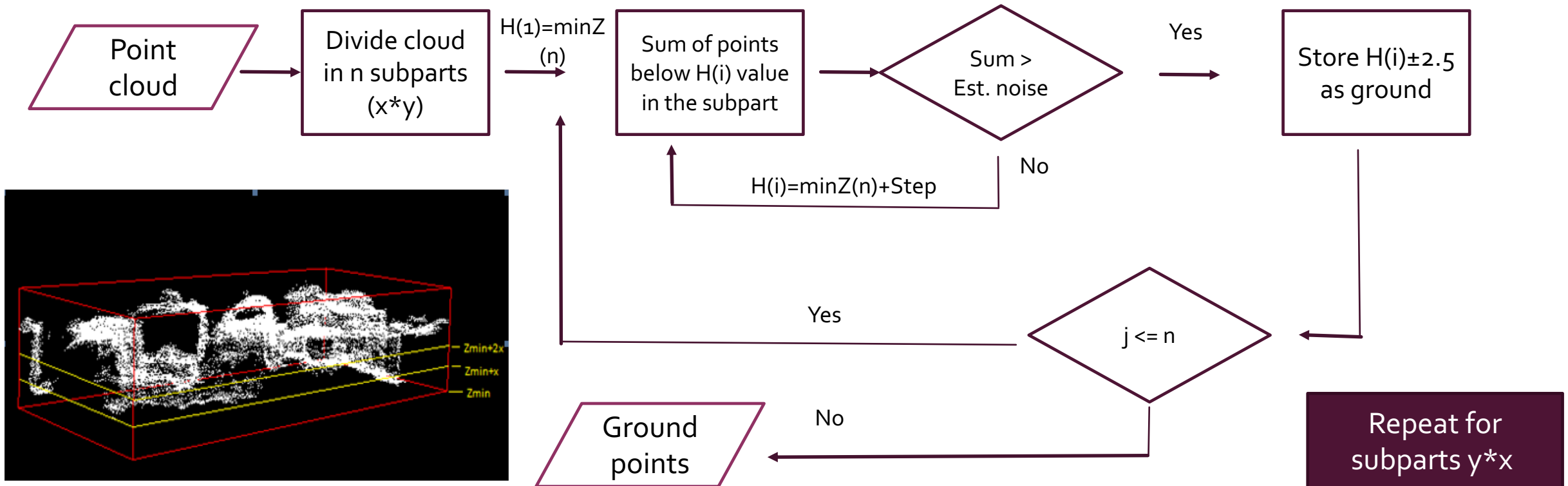
Which is the suitable size of each subpart?

1. At least part of the ground has to be visible in each chosen part of the cloud
2. The density of the sampling should not be sparse-rectangular shape



# DIGITAL TERRAIN MODEL(II)

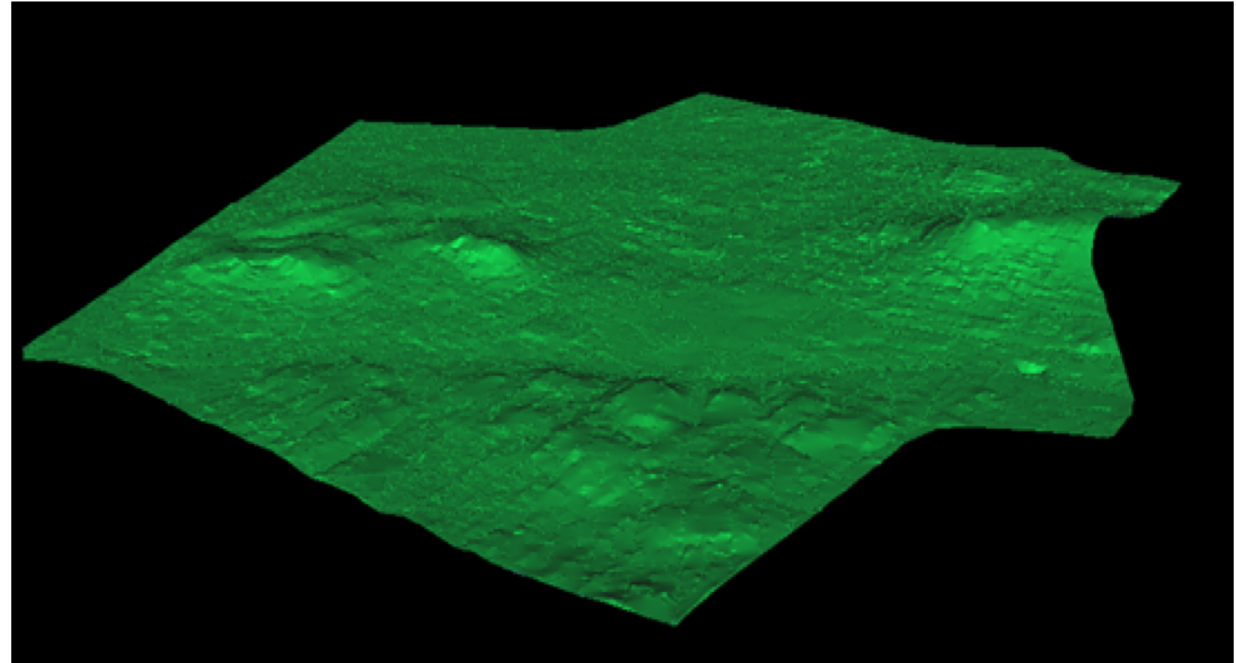
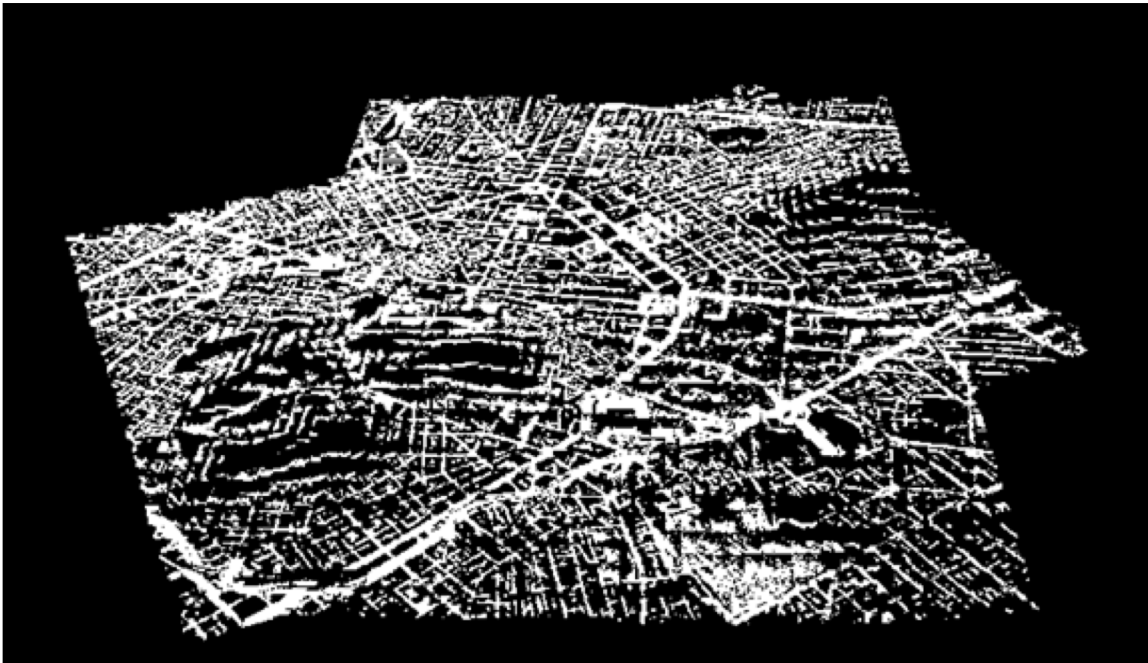
## DETECTION OF THE GROUND





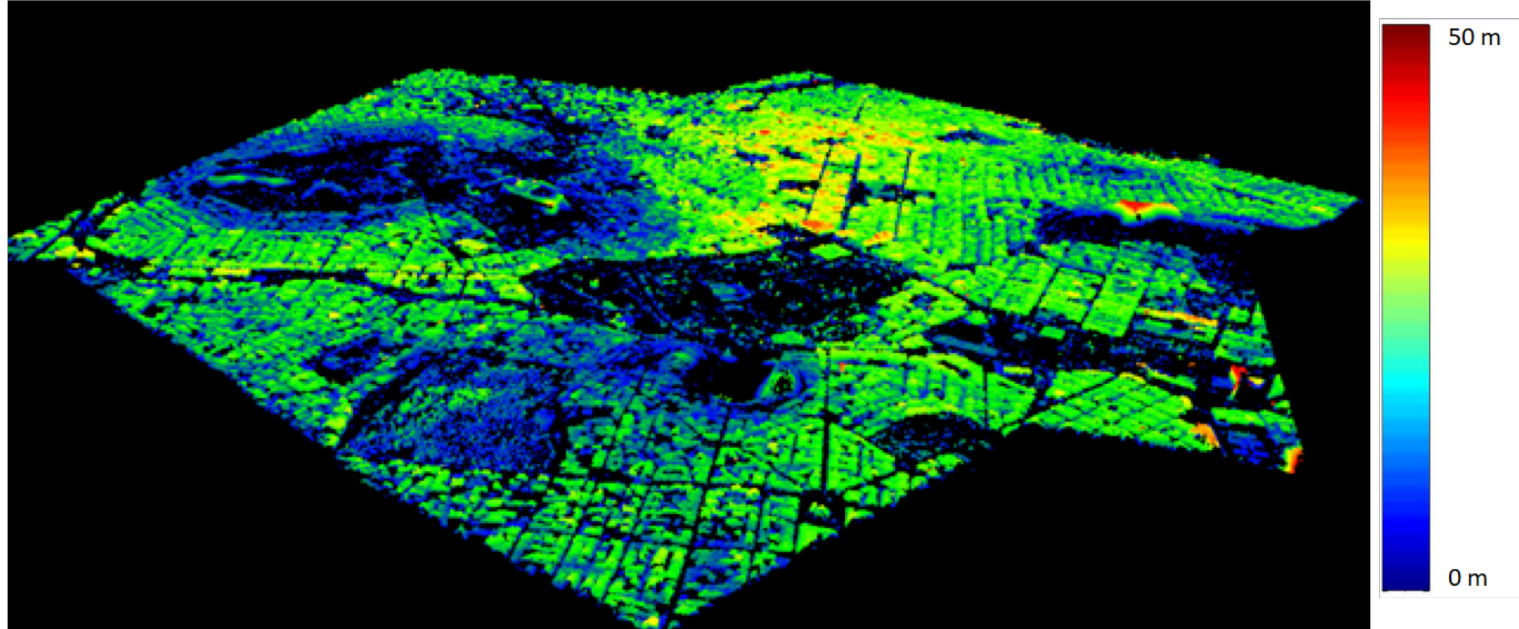
# DIGITAL TERRAIN MODEL(III)

DETECTION OF THE LOWEST LEVEL IN EACH SUBPART



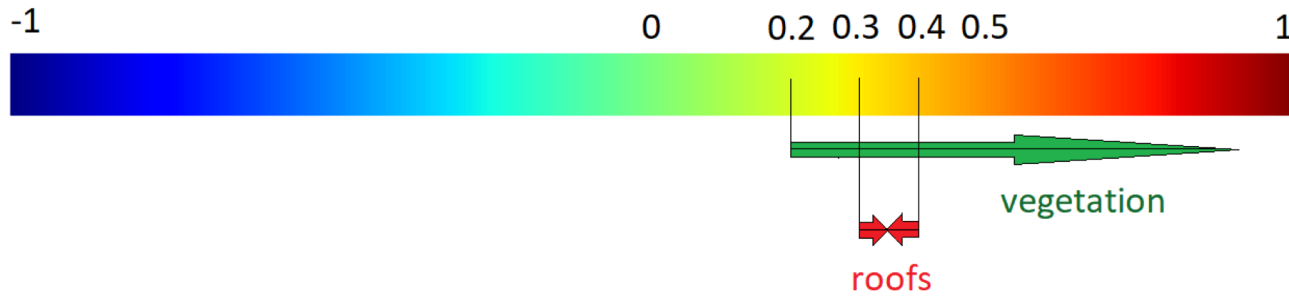
# DIGITAL ELEVATION MODEL

- Elevation up to 2m: Vegetation, Constructions
- Elevation up to 7m: Kiosks, Sculptures, Constructions and 1-level buildings

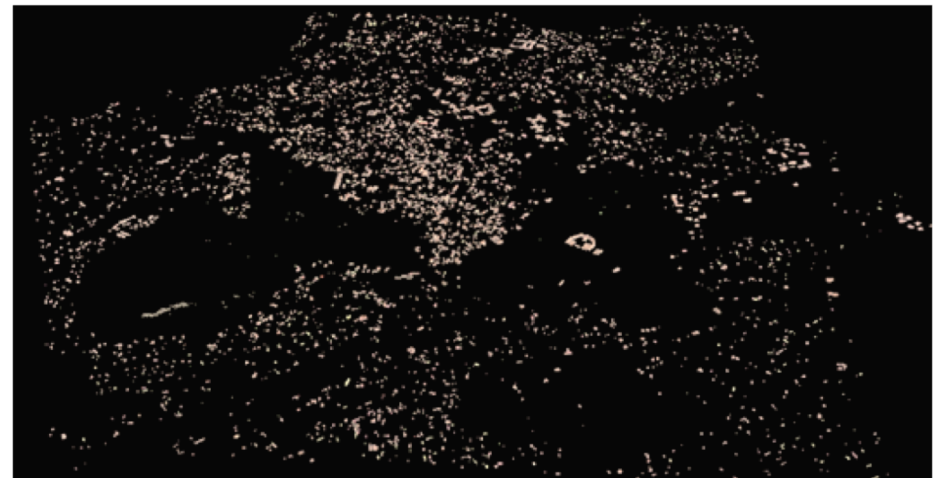


# CLASSIFICATION

## NDVI- threshold



- Roofs - high values in the red band - low in the blue:  
 $3/1 > 1.3$
- Vegetation - highest values in the green band:
  - $2/3 < 1$



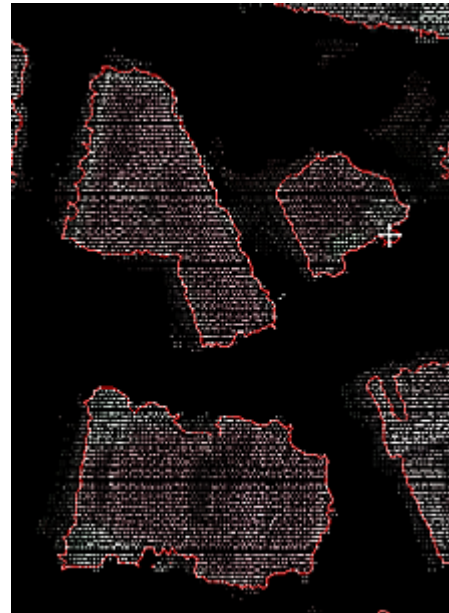


# OUTLINES (I)

Lasboundaries.exe (Lastools)

Outline based on the clustering  
of the points

- Single buildings
- Buildings' complexes

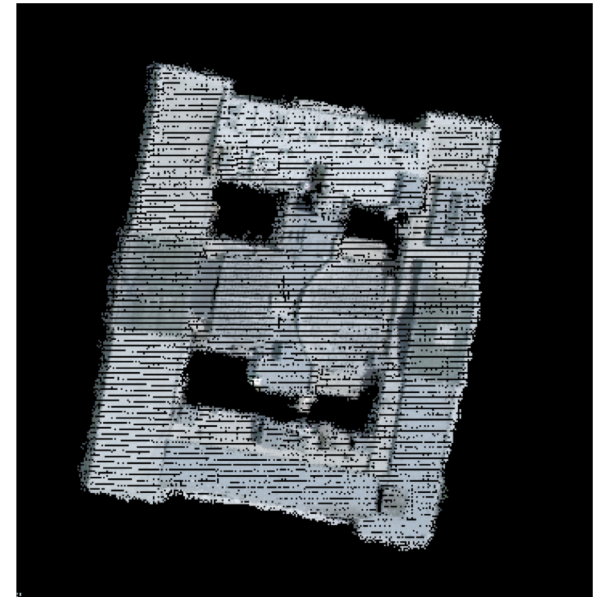
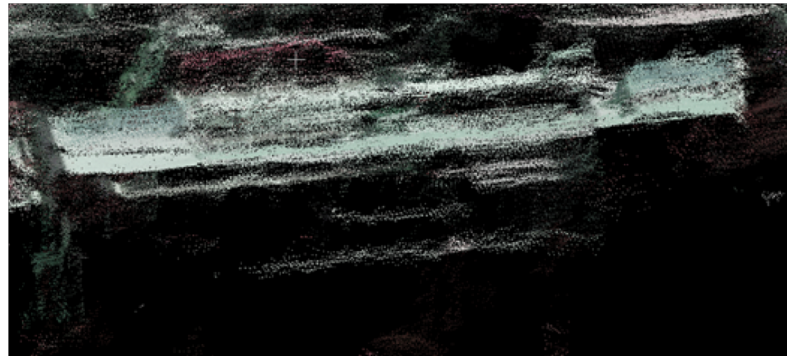


# OUTLINES (II)

## DETECT SEPERATE BUILDINGS WITHIN THE COMPLEXES- HEIGHT

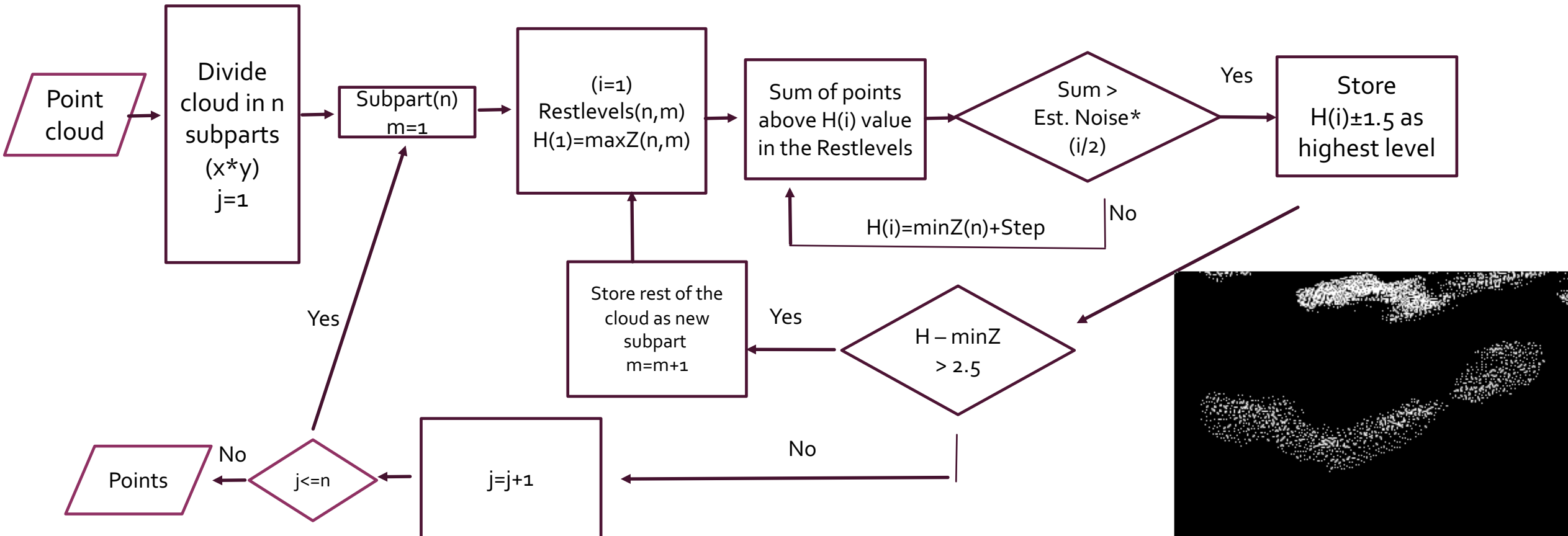
Possible issues:

- Small constructions on terracies
- Quality of the cloud
- Buildings with many parts and terracies in different levels (balconies, attics etc)
- Parts of the building's front view detected in all lower levels

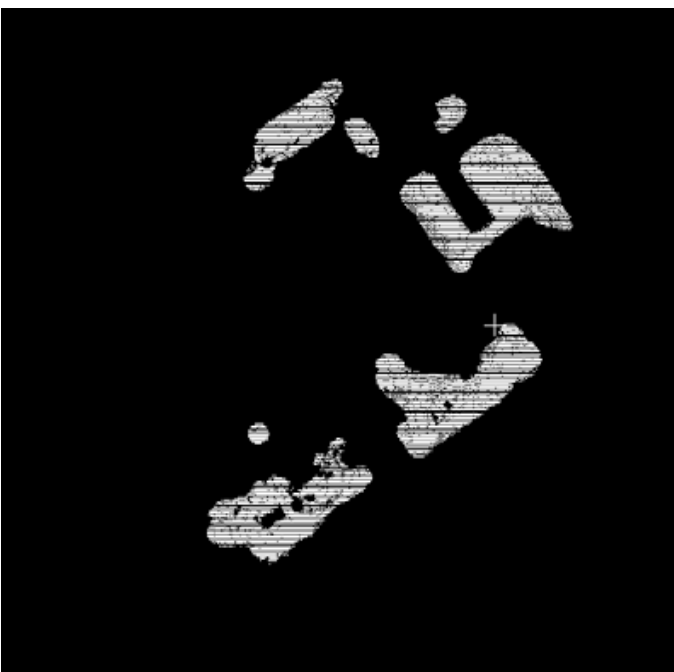
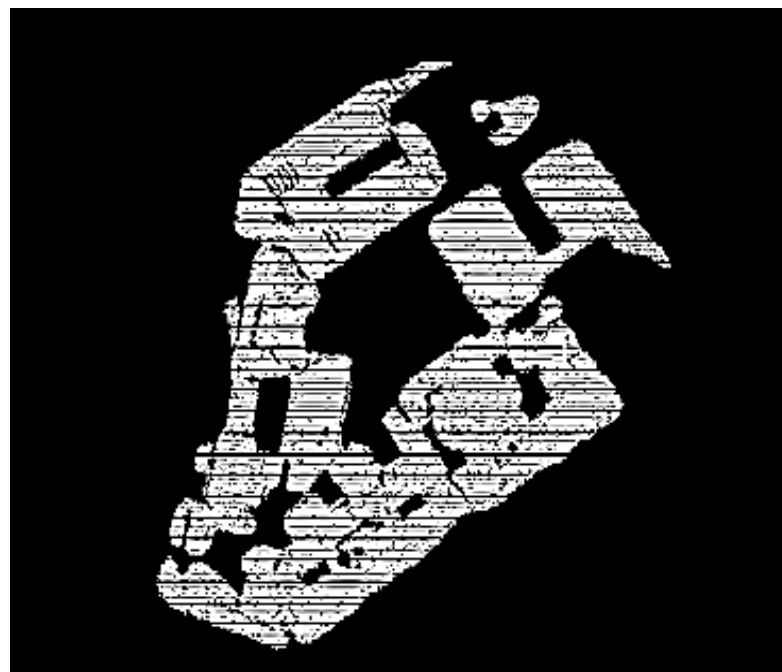
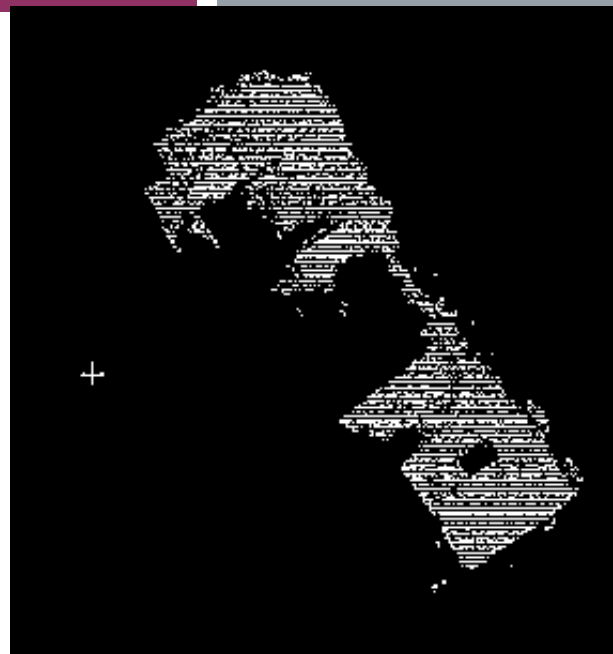
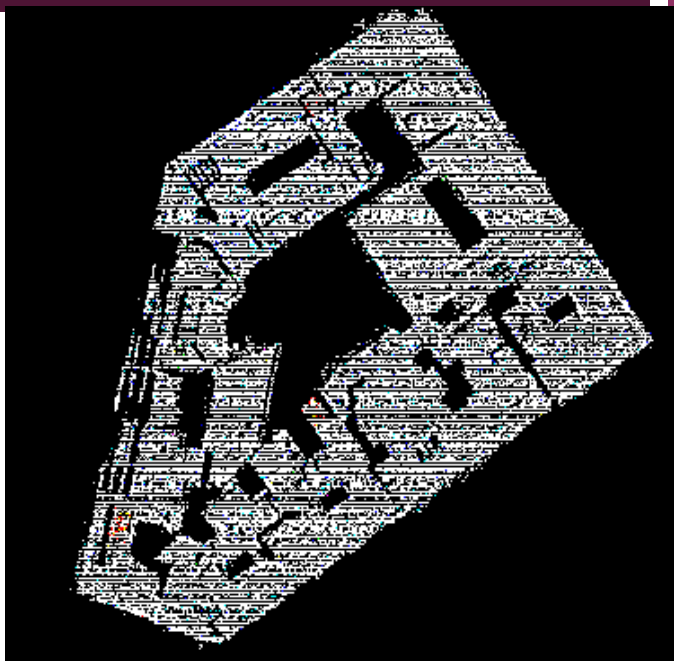


# DETECTING INDIVIDUAL BUILDINGS WITHIN COMPLEXES

## SEPERATION CRITERION: HEIGHT



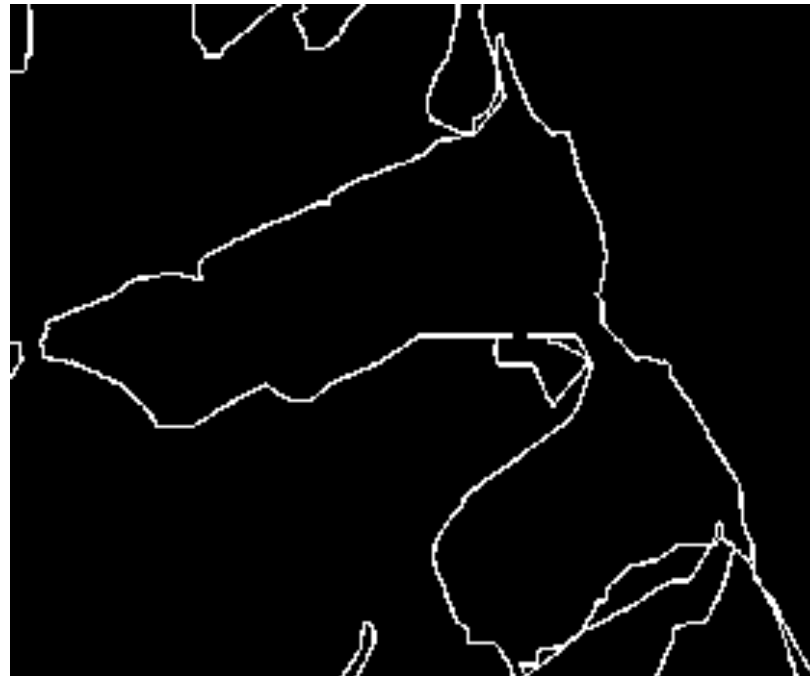




# POLYGON PROCESSING (I)

## Geographic Information System

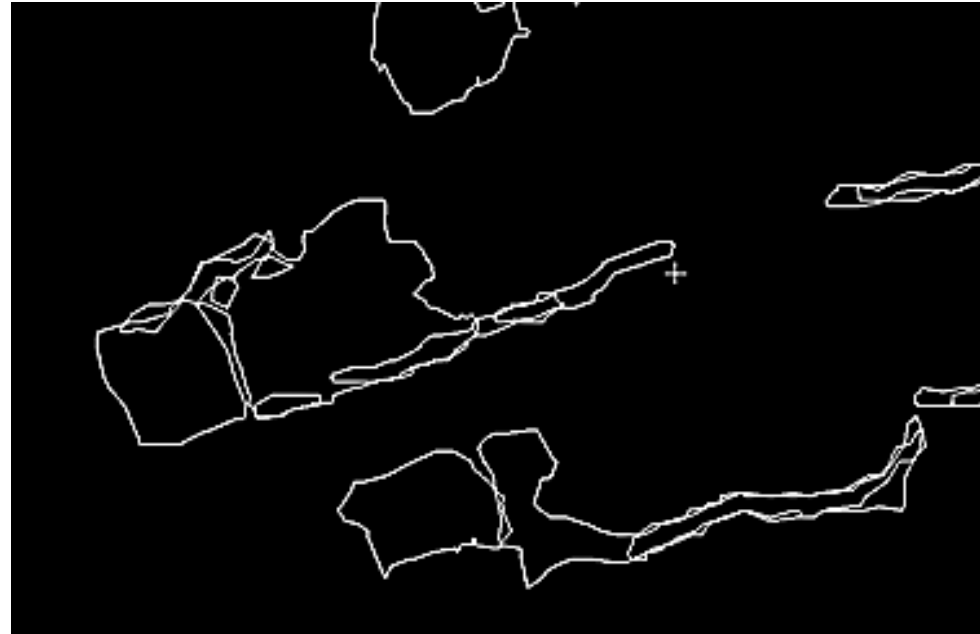
*Merge parts of buildings detected in adjacent subparts*



# POLYGON PROCESSING (II)

## Geographic Information System

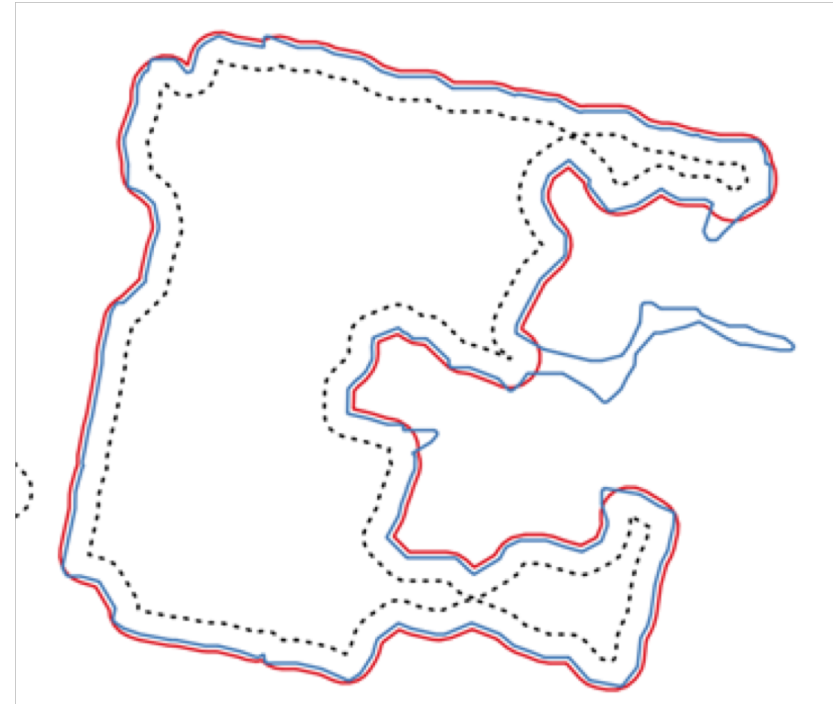
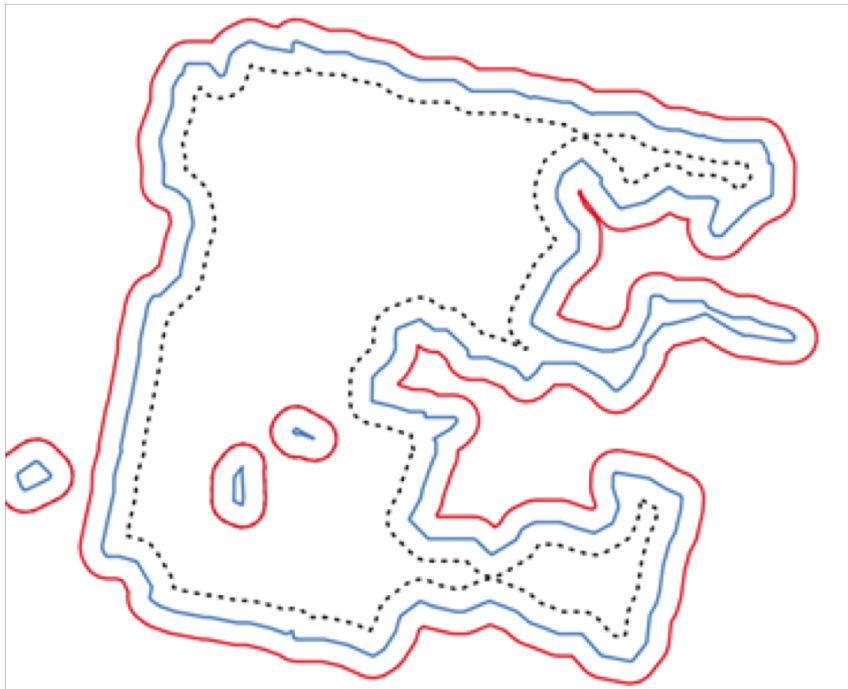
*Delete elongated parts (noise, balconies, front views etc)*



# POLYGON PROCESSING (III)

Geographic Information System

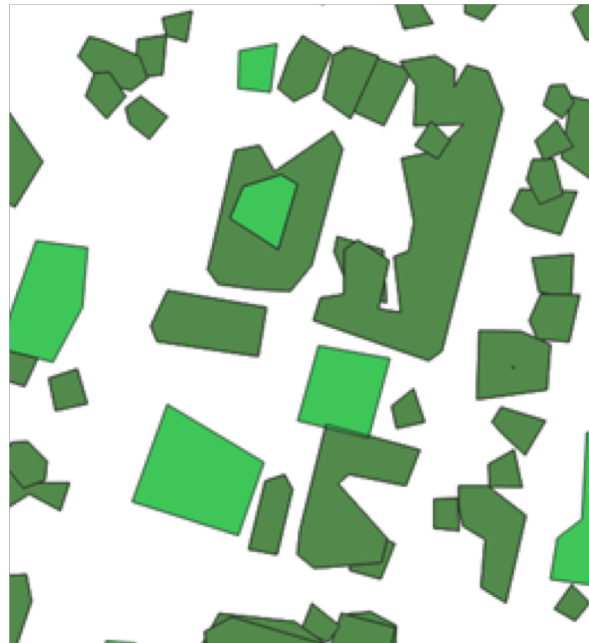
*Delete elongated parts (noise, balconies, front views etc)*



# POLYGON PROCESSING (IV)

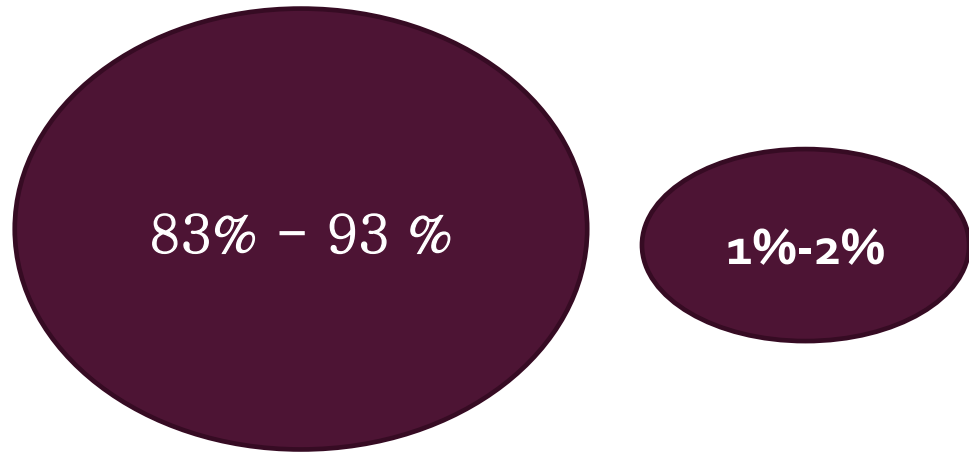
## Geographic Information System

*Detect overlapping areas- Multiple Z information for the same XY value*

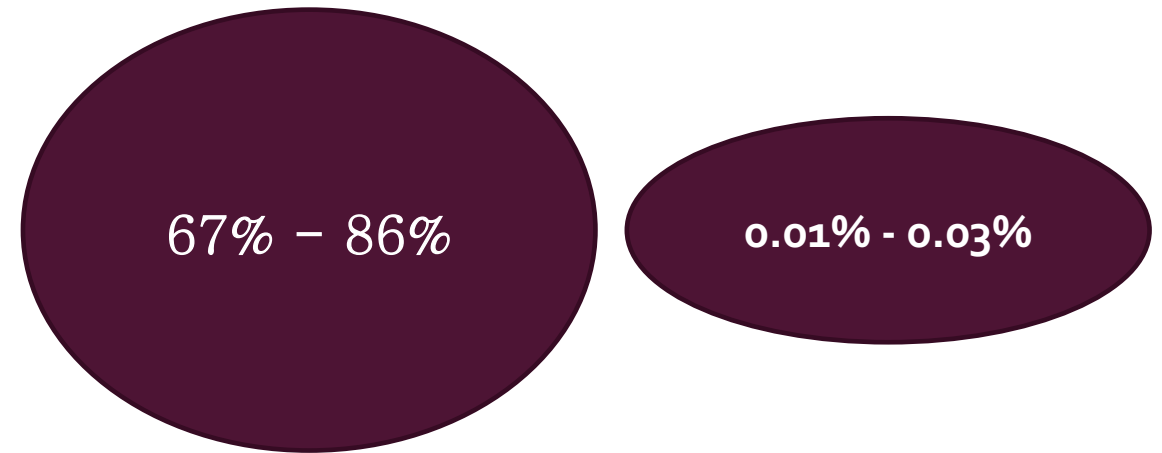


# RESULTS

## NUMBER OF POLYGONS



## AREA OF POLYGONS



## ESTIMATED LEVEL

	No difference	Up to 1 level difference	Up to 2 levels difference
Total	75%	21%	4%



# OPENSTREETMAP

## COMBINING THE DATASETS

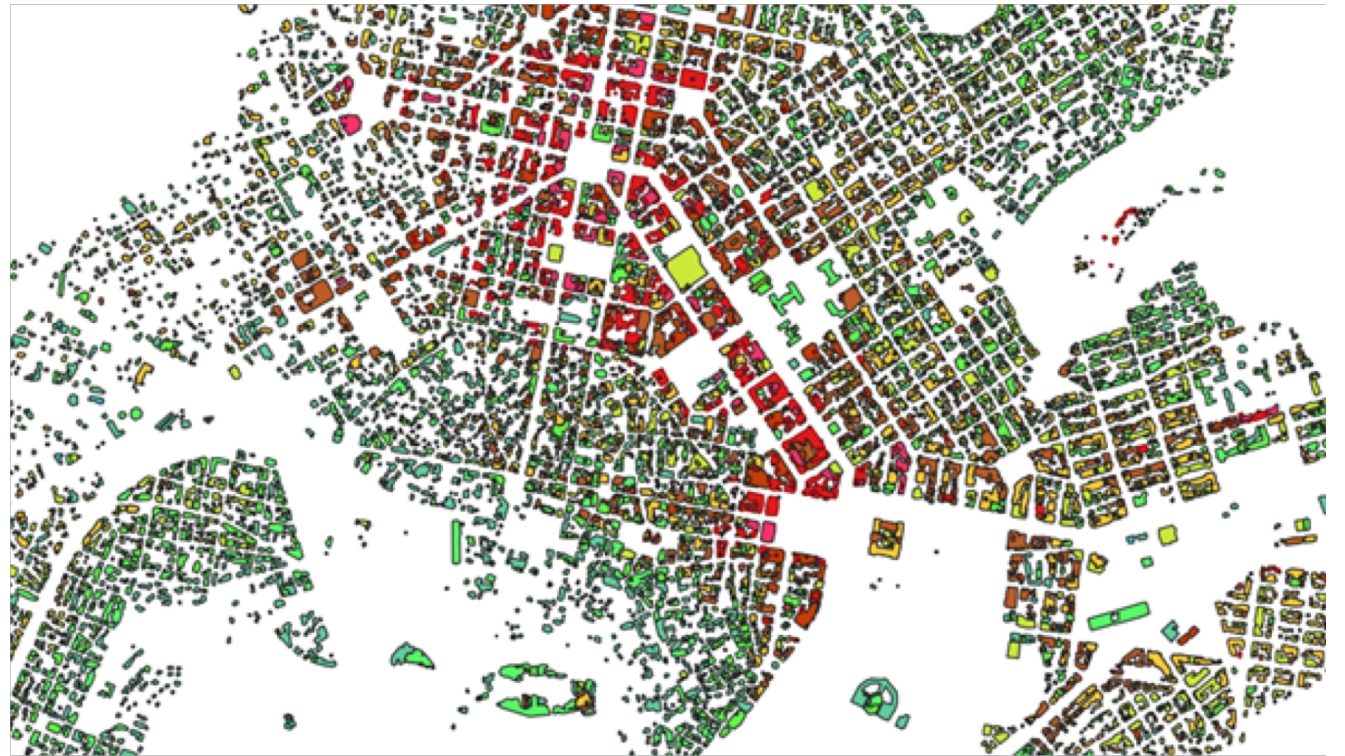


1. Different footprints
2. One building with multiple levels
3. Different buildings of the same level- one polygon



# CONCLUSION

- Time and money saving
- Minimum data requirement
- Minimum false detections
- Different images- larger scale
- Extra data (LIDAR, DTM)
- Focal length
- SFM



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*Thank you !*

