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CHALLENGES FOR UPDATING 3D CADASTRAL OBJECTS USING LIDAR AND IMAGE-BASED POINT CLOUDS

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5TH INTERNATIONAL FIG 3D CADASTRE WORKSHOP

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ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

CONTENT

- 3D Cadastre – why?
- 3D Data
- LiDAR & VHR images
- Case study
- Change detection – challenges
- Conclusions

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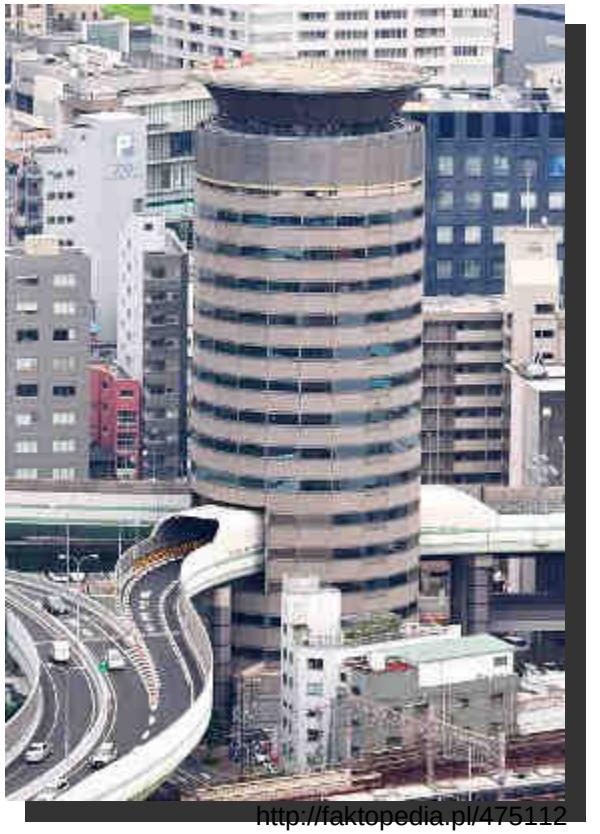
3D CADASTRE – WHY?

- Global urbanization
- Increasing complex and multifunctional building environment
  - Buildings within other buildings
  - Constructions above or bellow roads (tunnels, bridges)
  - Telecommunication and electric utilities on land ownership
  - Overlapping private properties

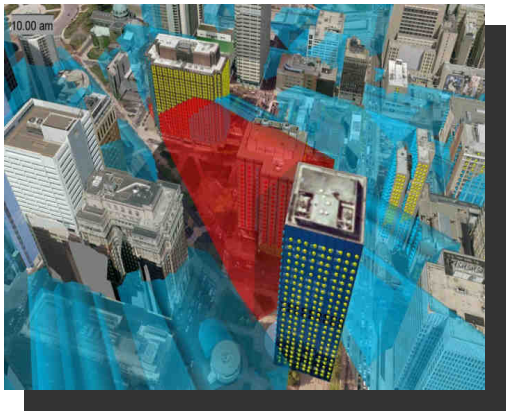
Necessity for accurate registration of 3D physical and legal information is reality

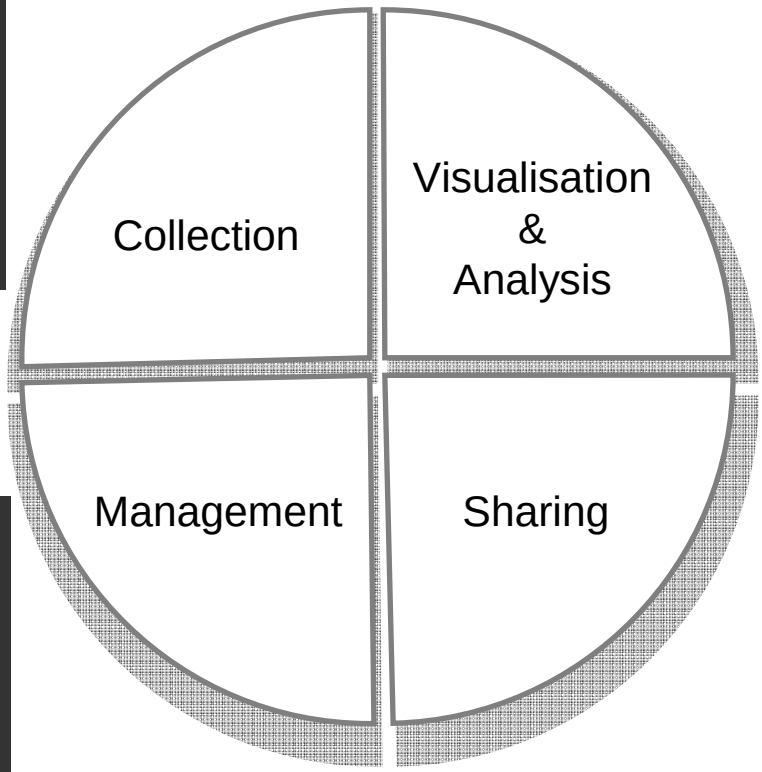
https://bbablog.spjain.org/2014/07/15/singapore-off-campus-idea-the-interface/

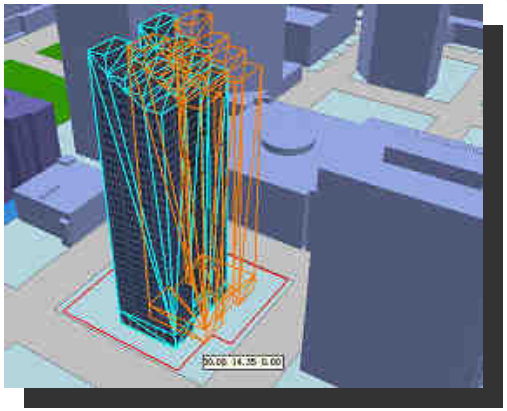


http://faktopedia.pl/475112

3D DATA







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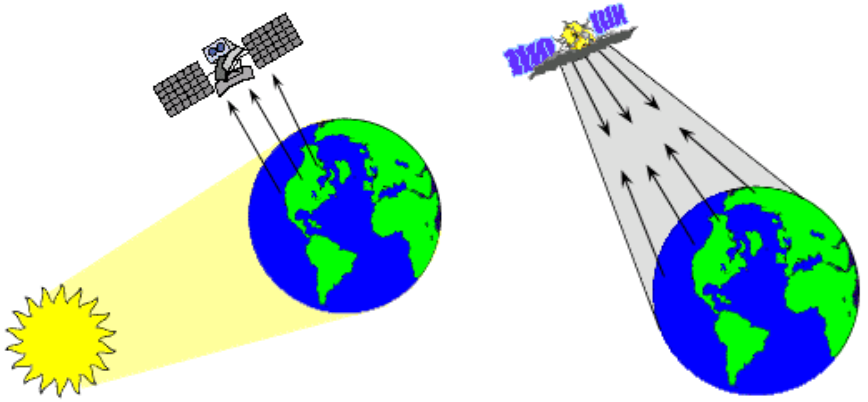
www. esri.com

3D DATA

Data collection - challenges



- Formats
- Quality
- Availability
- Metadata
- Automatization

“BIG DATA”

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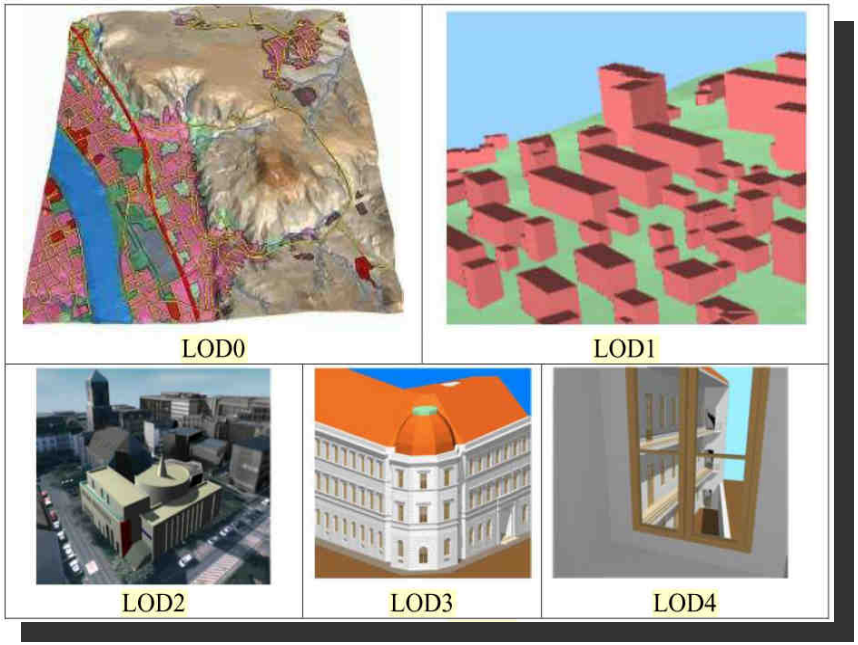
3D DATA

- Visualisation – users, purposes
- Analysis – geoprocessing opportunities
- Management – editing, storing, pricing

(3D spacial databases and 3D SDI

- Sharing – use, publishing,

dessimination (eg.Google Earth)



(Mao, 2010)

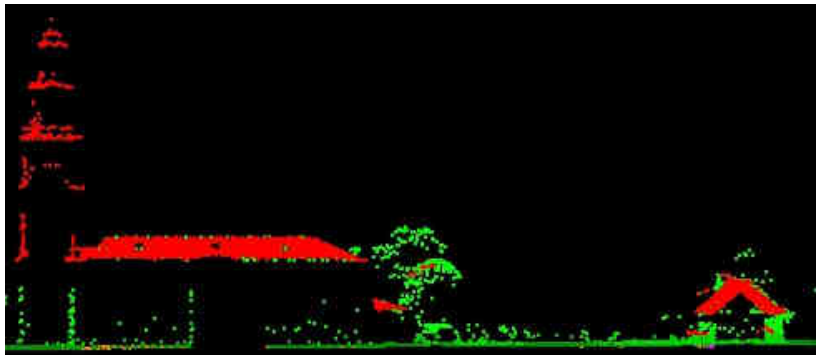
LIDAR & VHR IMAGES

Reliable source for obtaining precise 3D data

Challenges:

- Processing
- Storing
- Transferring
- Visualizing

“BIG DATA”



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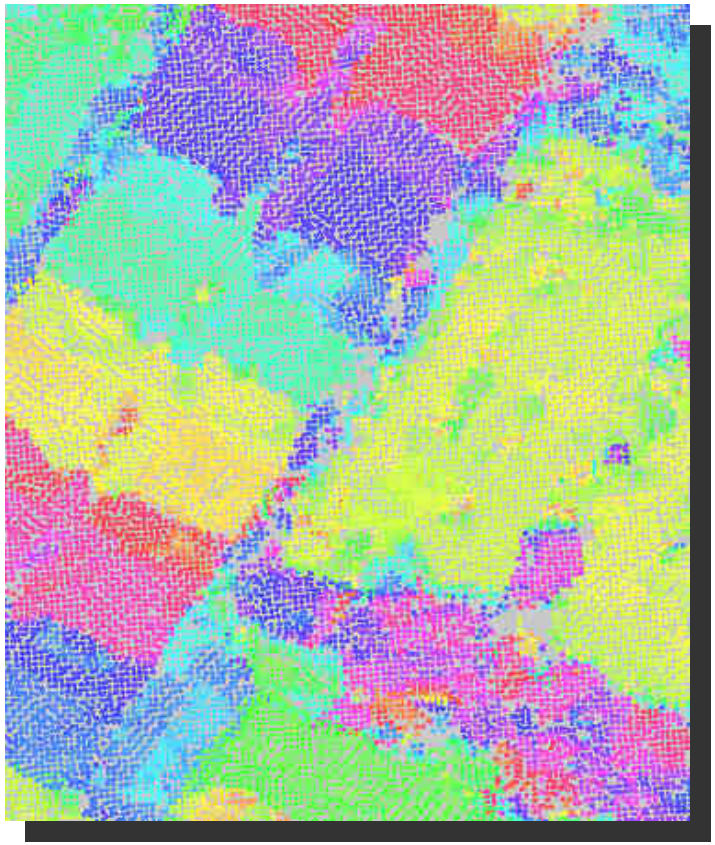
UPDATING

How to keep the 3D data “Big data” up-to-date ?

How to detect changes?

Automatic change detection



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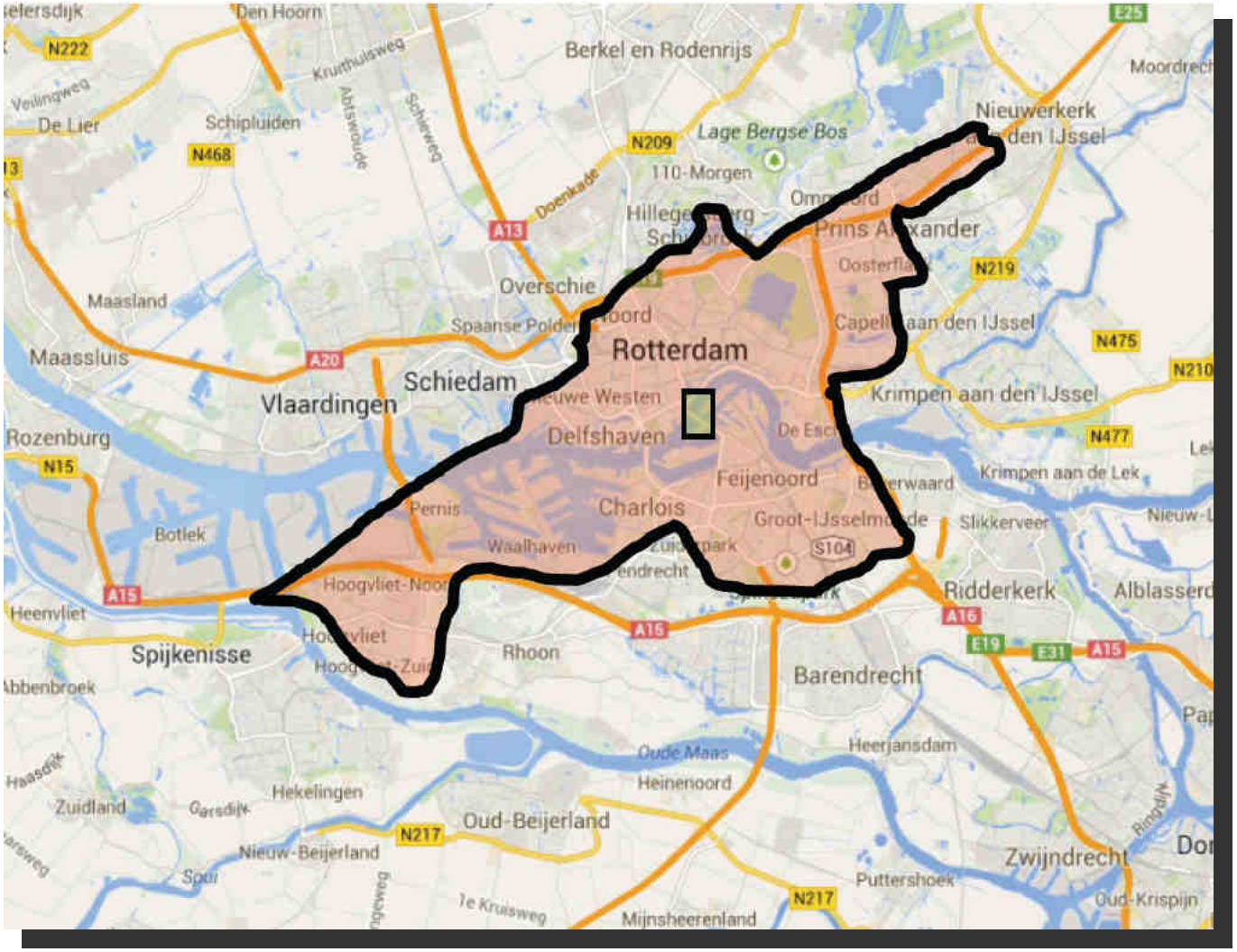
STUDY AREA



Rotterdam. Source: (Xu, 2015)

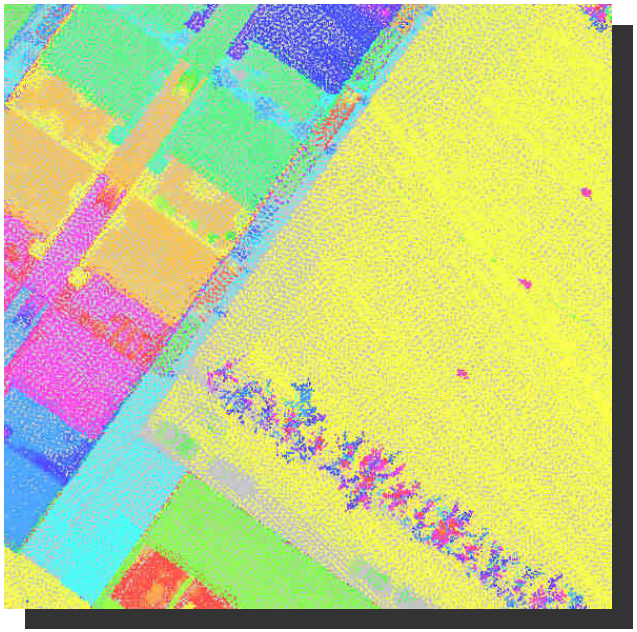
CURRENT STUDY

Data provided from the Municipality of Rotterdam

- LiDAR data
  - 1 epoch – 2008 – average point density 20-30 points/m^2
  - 2 epoch – 2010 – average point density 30-40 points/m^2

Covarage 120 km^2

Pre-processing: organization and filtering (separation between terrain points and non-terrain ones)

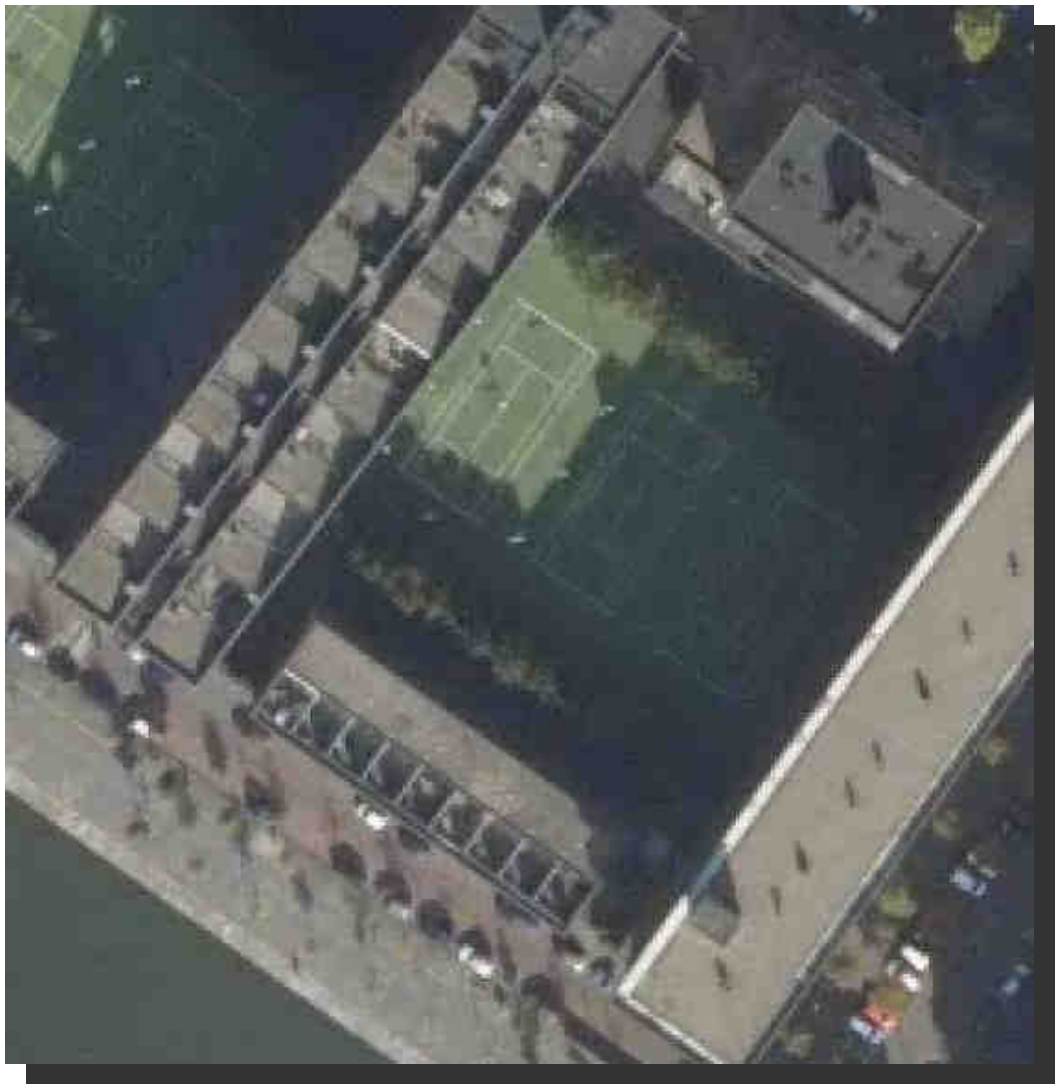


CURRENT STUDY

- VHR images

Aerial image taken with digital Ultracam camera with 10 cm. resolution

- Maps



CHANGE DETECTION

Changes in urban areas can be due to different reasons (natural disasters or human activities)

For 3D Cadaster – structural geometric changes (buildings)

Methods with ALS data: detecting differences overlaying point clouds

For our study we used the algorithm for automatic change detection described in Xu et al (2015).

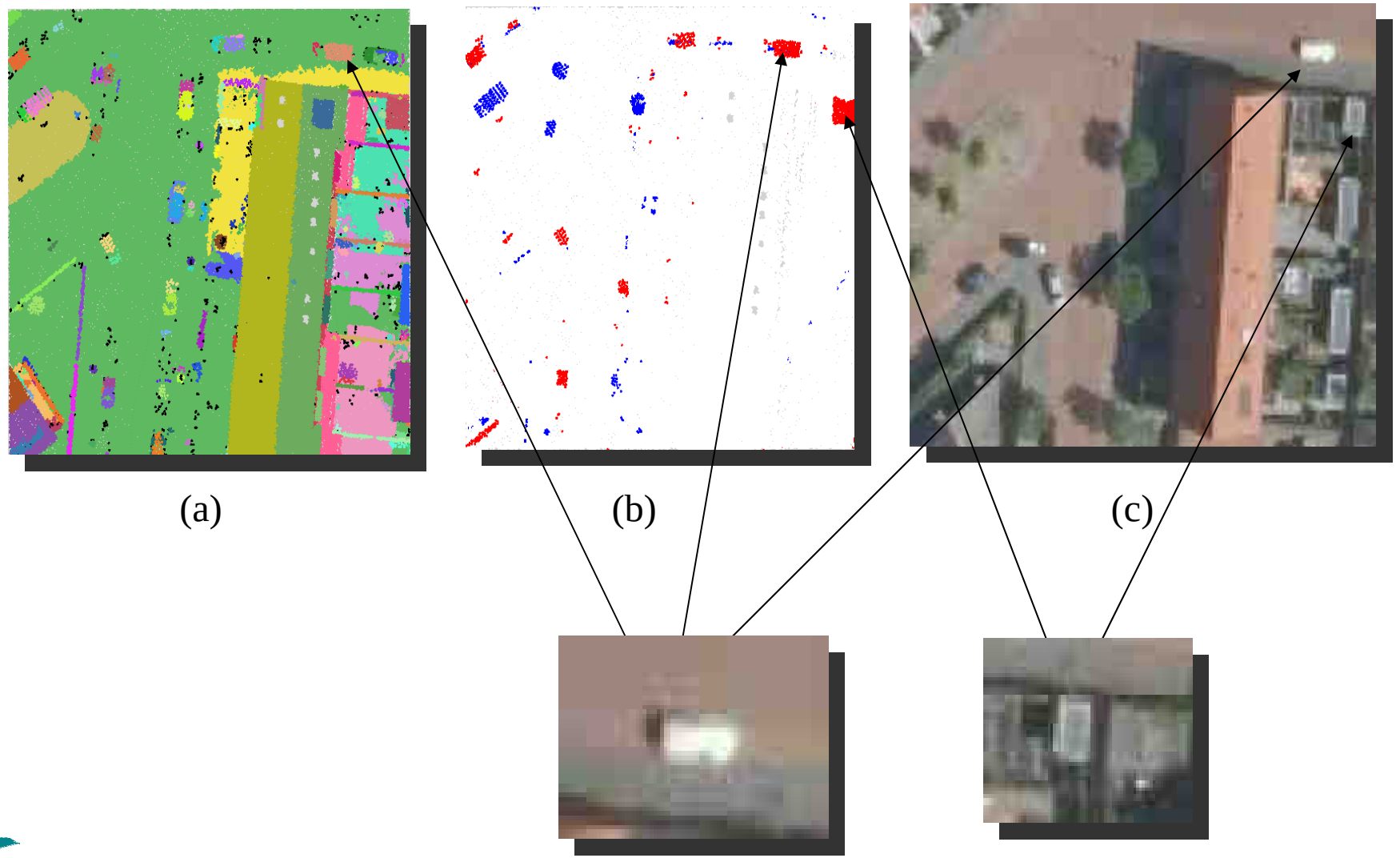
Output is a difference map which contains the geometric indication of an existing change.

CHANGE DETECTION

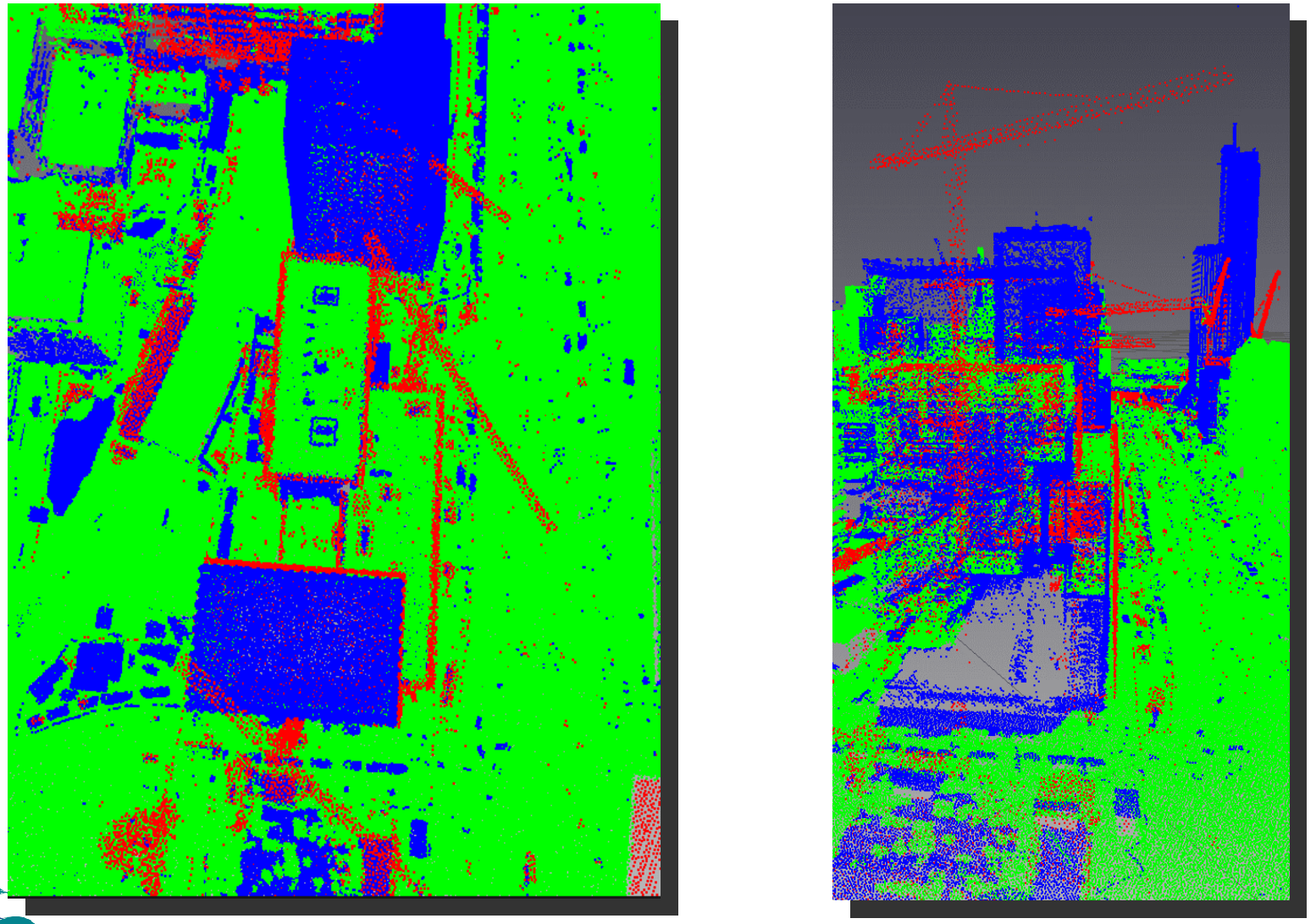
??? Are these real changes or due to other reasons

The observed challenges are described to emphasize the need for further research on detecting changes on cadastral objects if using such methods.

DYNAMIC OBJECTS AND REAL CHANGES

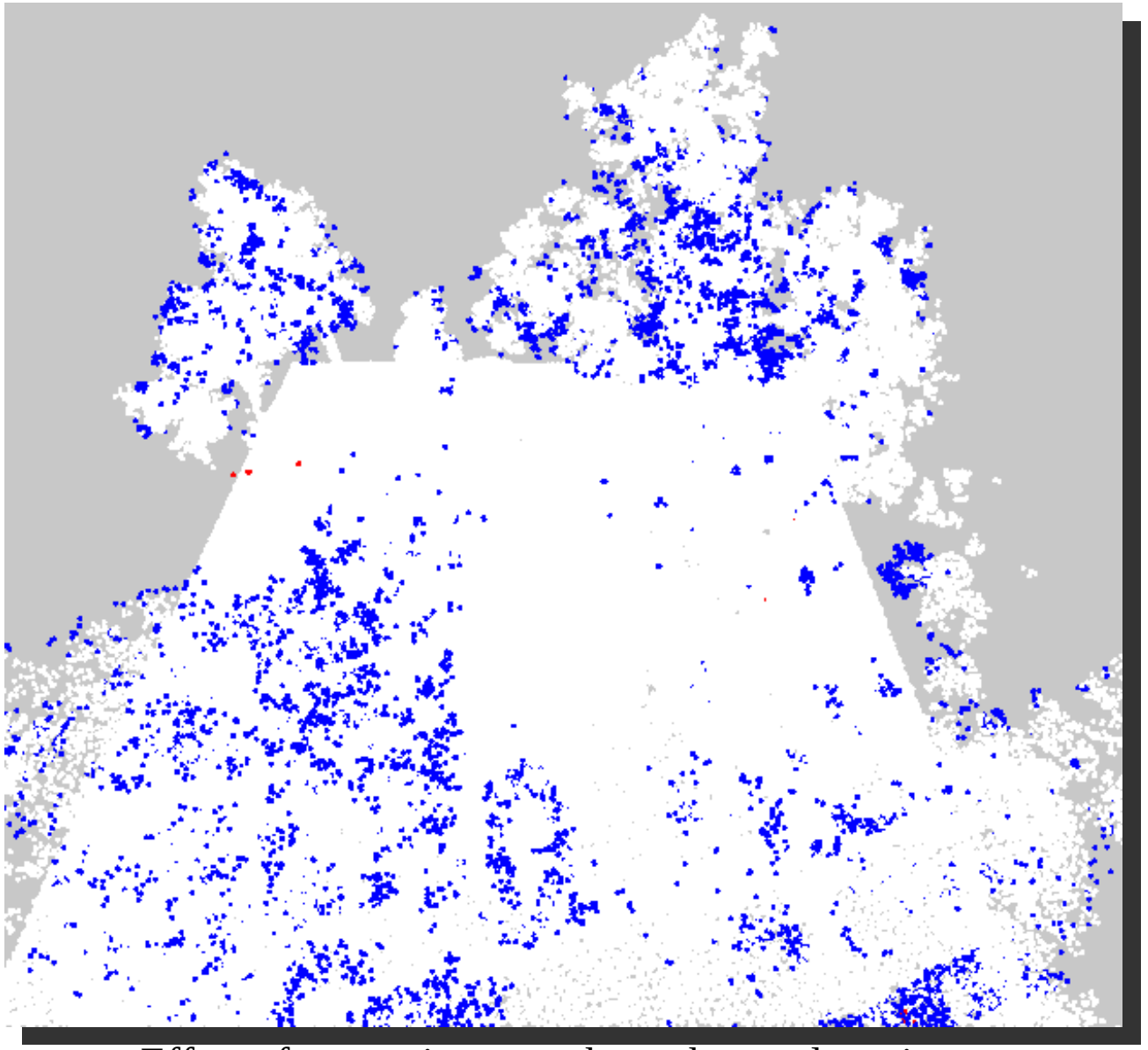


TRANSITION PERIOD BETWEEN OLD AND NEW SITUATION



(a) Detected temporal constructions (b)

VEGETATION INFLUENCES

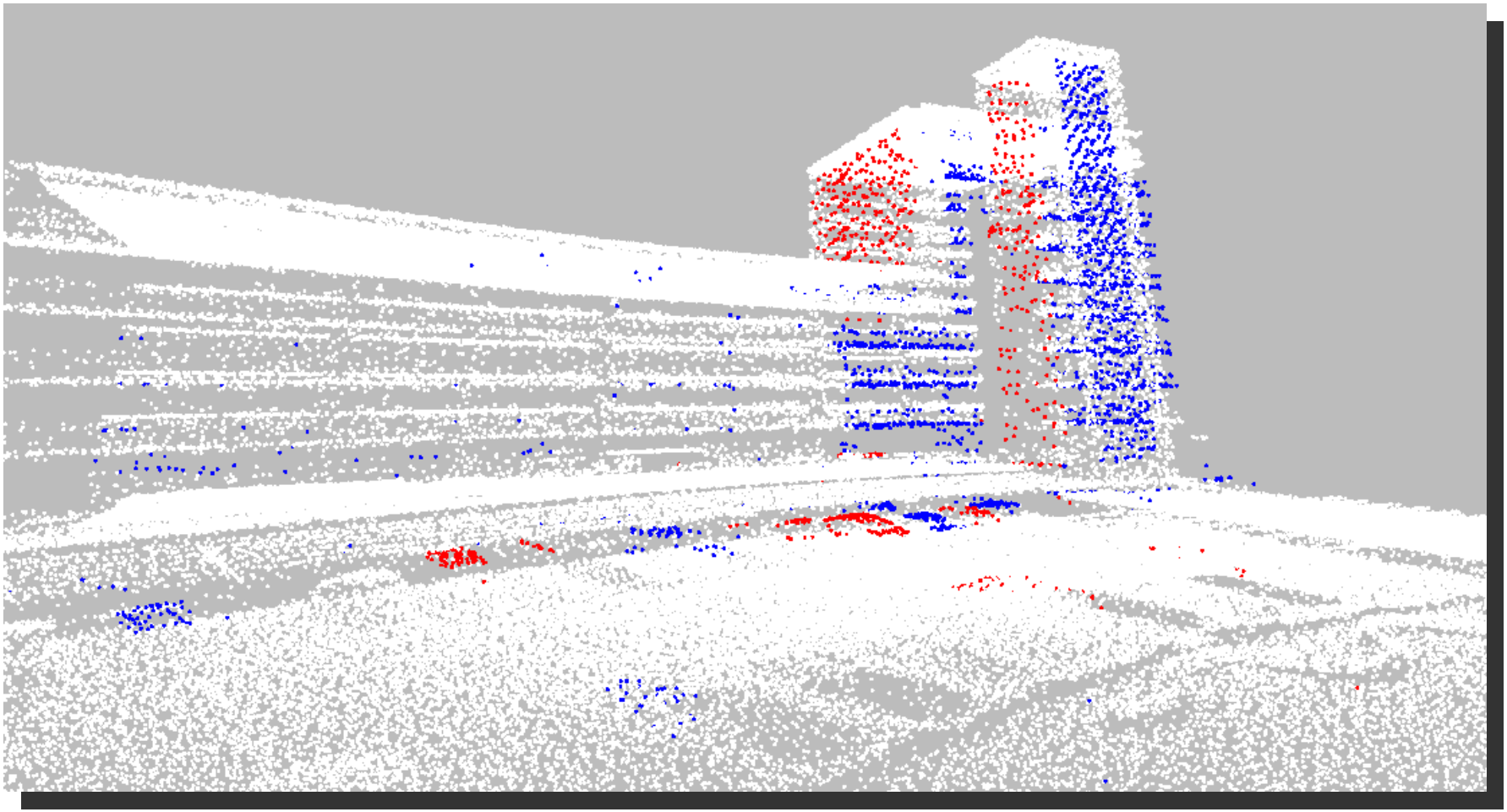


Effect of vegetation growth on change detection

VEGETATION INFLUENCES

Green hedges

DIFFERENT VIEWING ANGLE



Detected changes due to differences in the viewing angle

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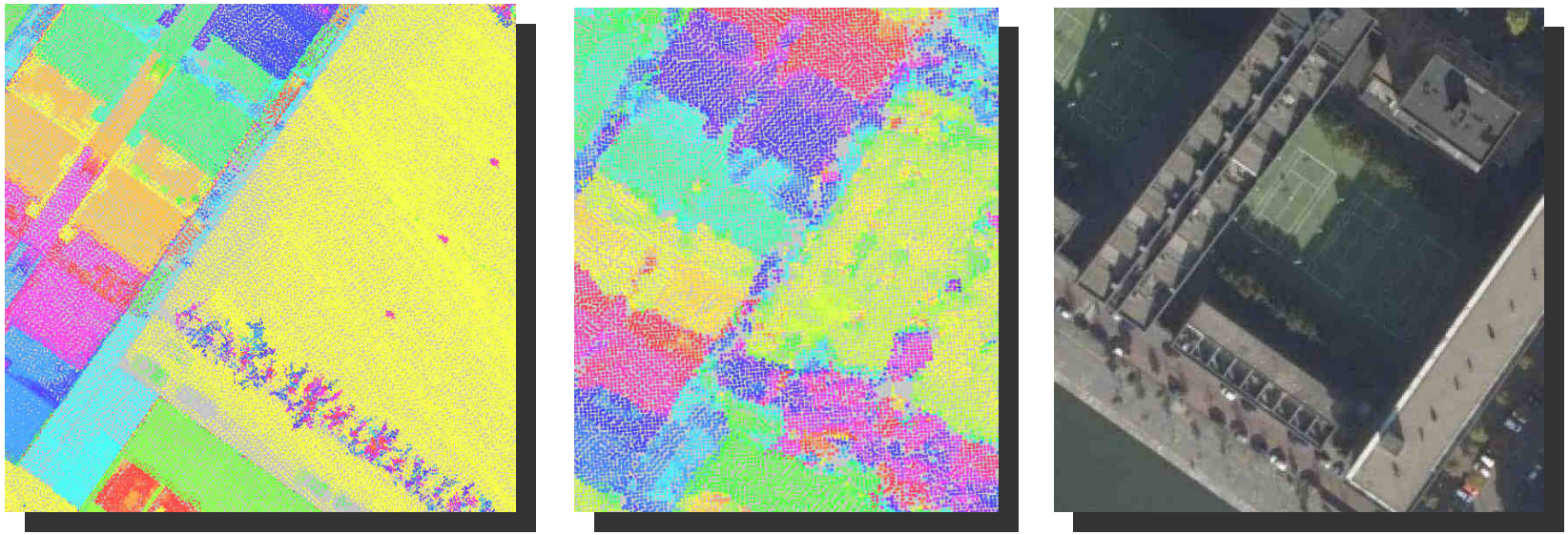
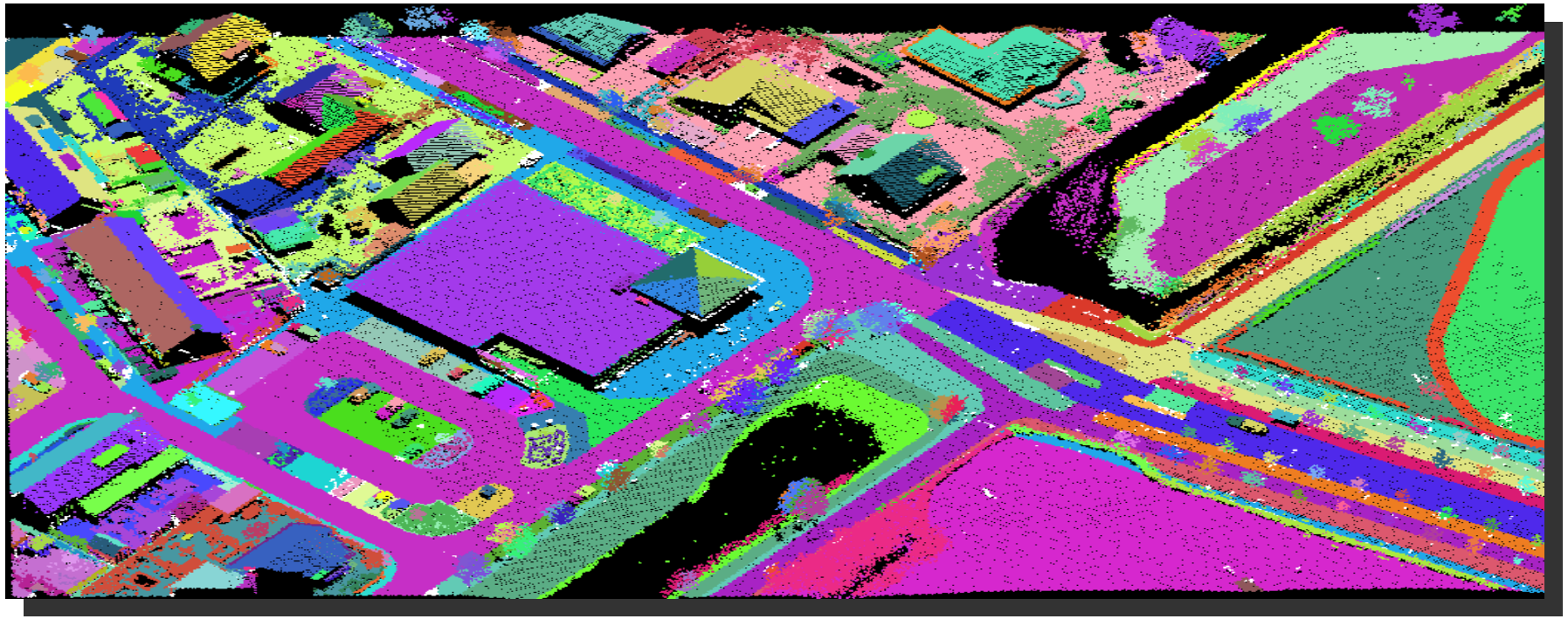
DIFFERENT ACQUISITION TECHNIQUES



Point clouds from different acquisition technique and a digital aerial image

MAP BASED SEGMENTATION OF ALS DATA



Result of map based segmentation for multi-land-cover landscape.
Source: (Wang, 2016)

CONCLUSIONS

- Detecting changes in cadastral objects is essential
- Automatization is beneficial – however full automatization is still challenging
- Needs further investigation – more challenges
- Combinations with other data:
  - Point cloud data- eg. Terrestrial
  - BIM
  - CAD and GIS data

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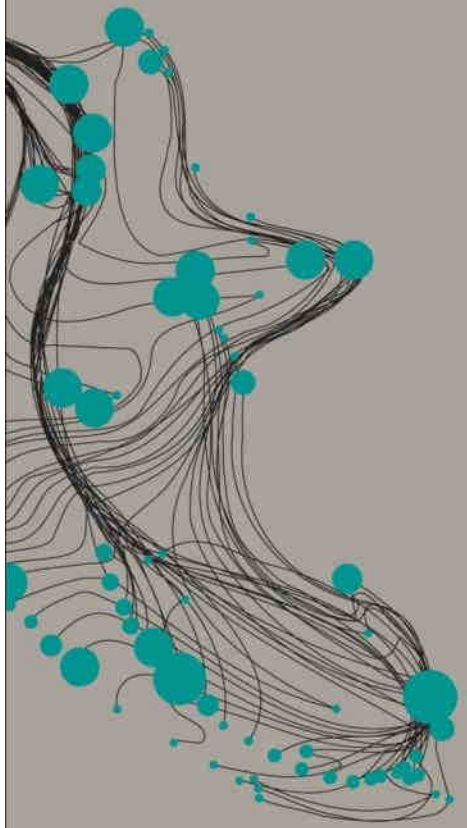

THANK YOU FOR YOUR ATTENTION !

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