Building Monitoring Project in Hungary

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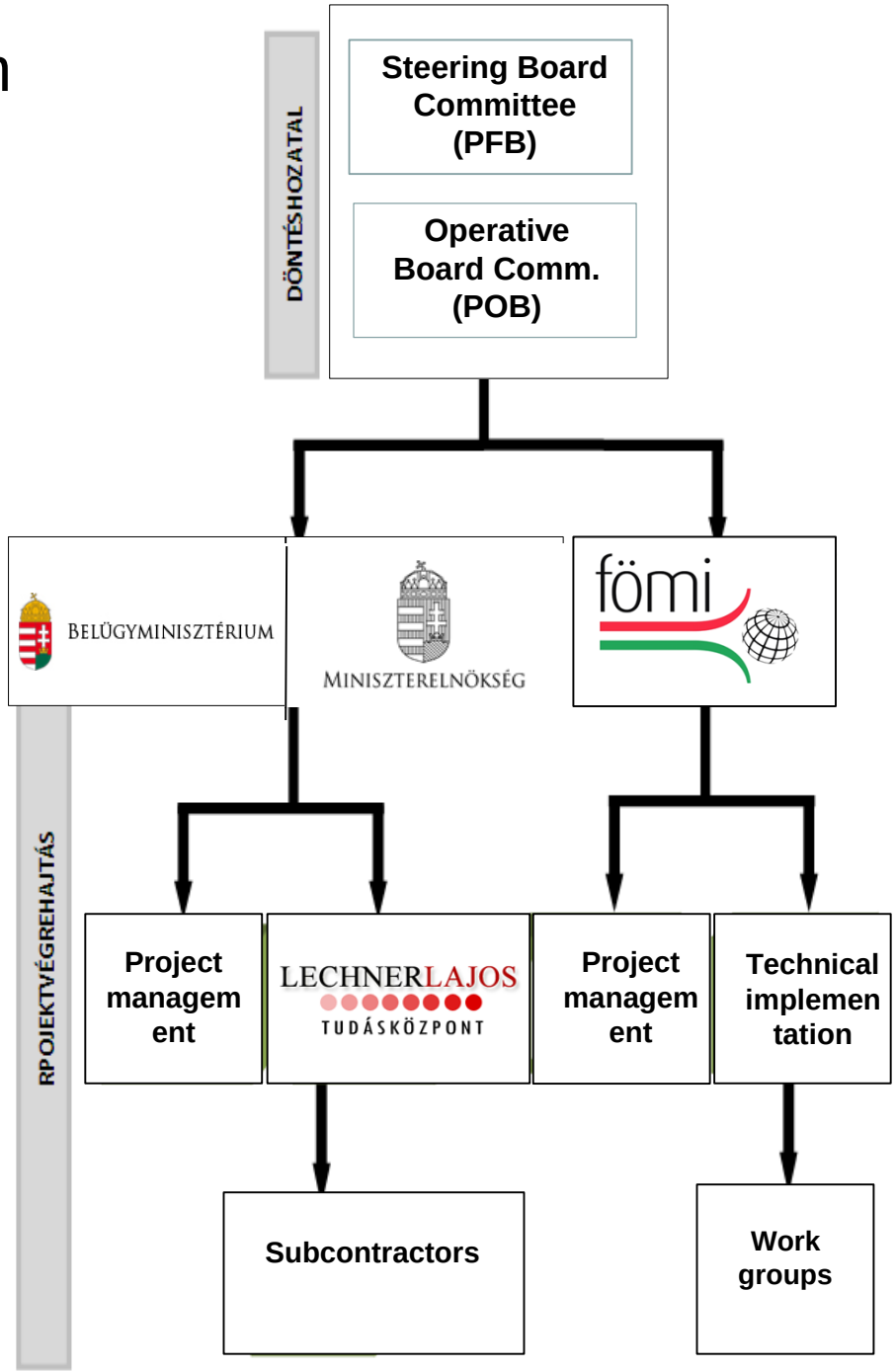
Institute of Geodesy, Cartography and Remote Sensing

Main characteristics of the project

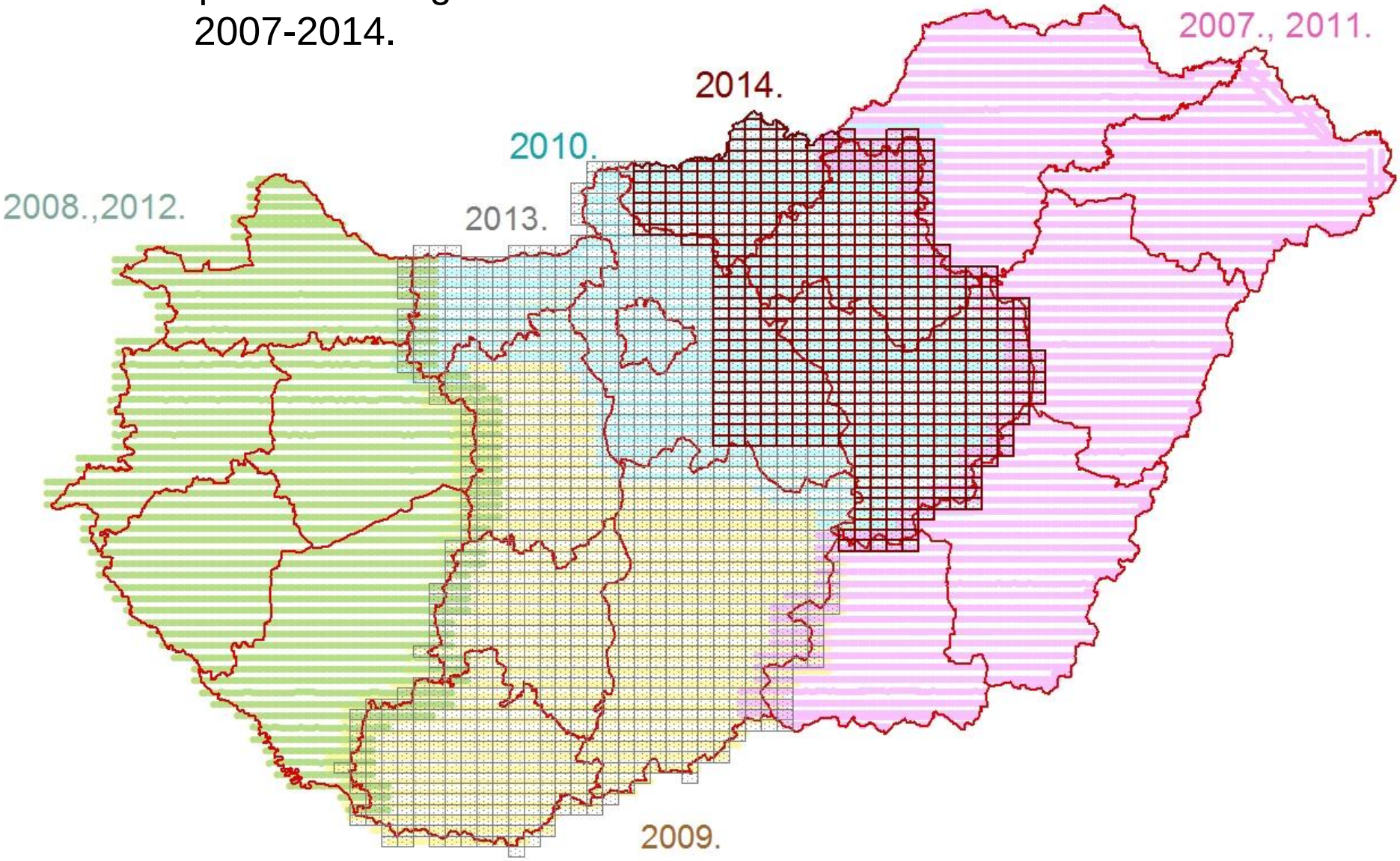
- **Frame of the Hungarian Electronic Administration Operational Programme**
- **Duration:**
  - **25 February 2013 – 30 September 2014**
- **Object of this project:**
  - **detecting of all remarkable building from ortophoto and DSM**
  - **supporting of the task Construction Authority**
  - **Complex monitoring used of all database of Hungarian Construction Authority**
  - **Provides an opportunity for the visualisation and analysis of the information based on the map**
  - **control of illegal construction (without a license or other authorization)**

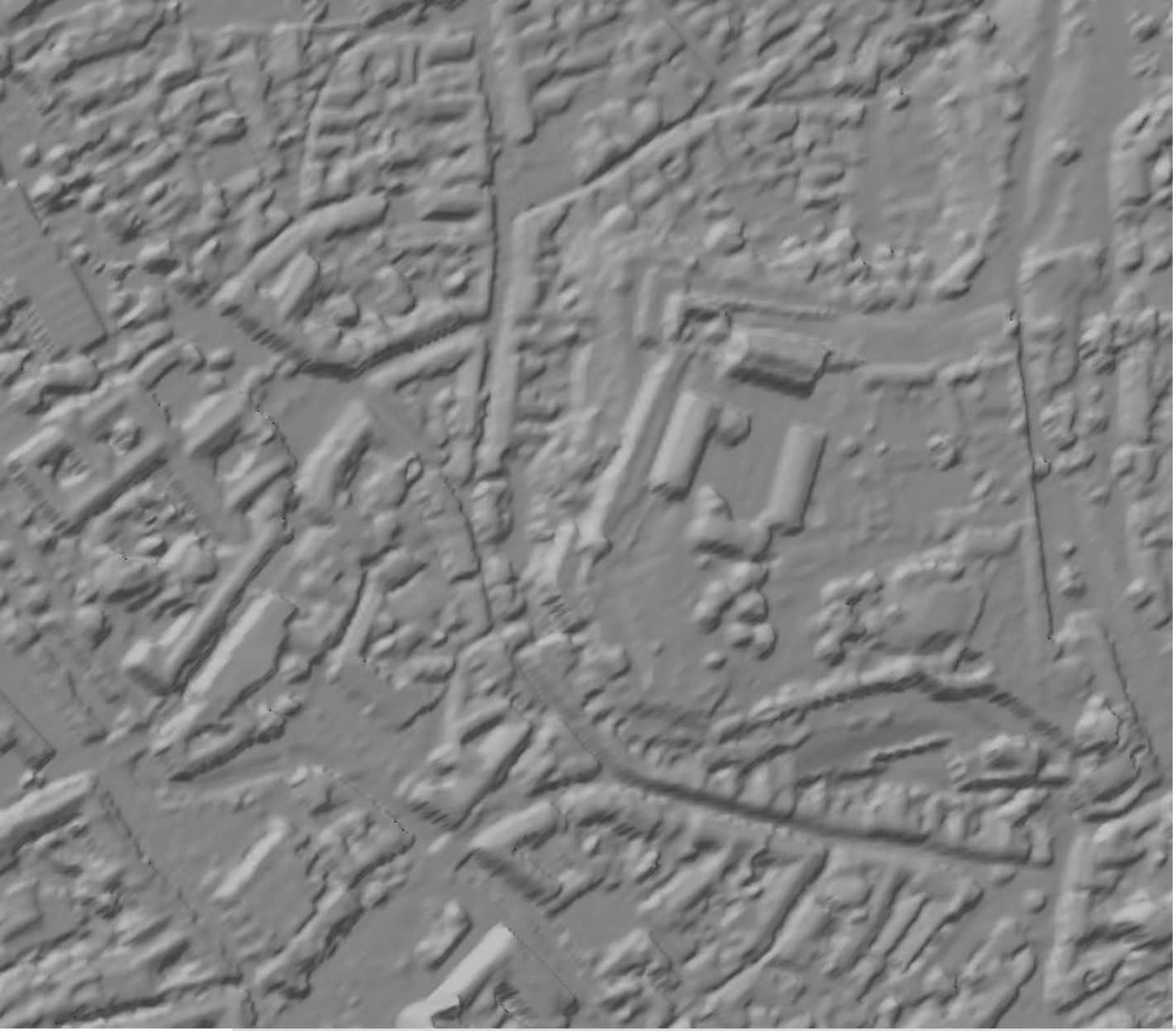
ÉMO consortium



Delopment of Photogrammetry

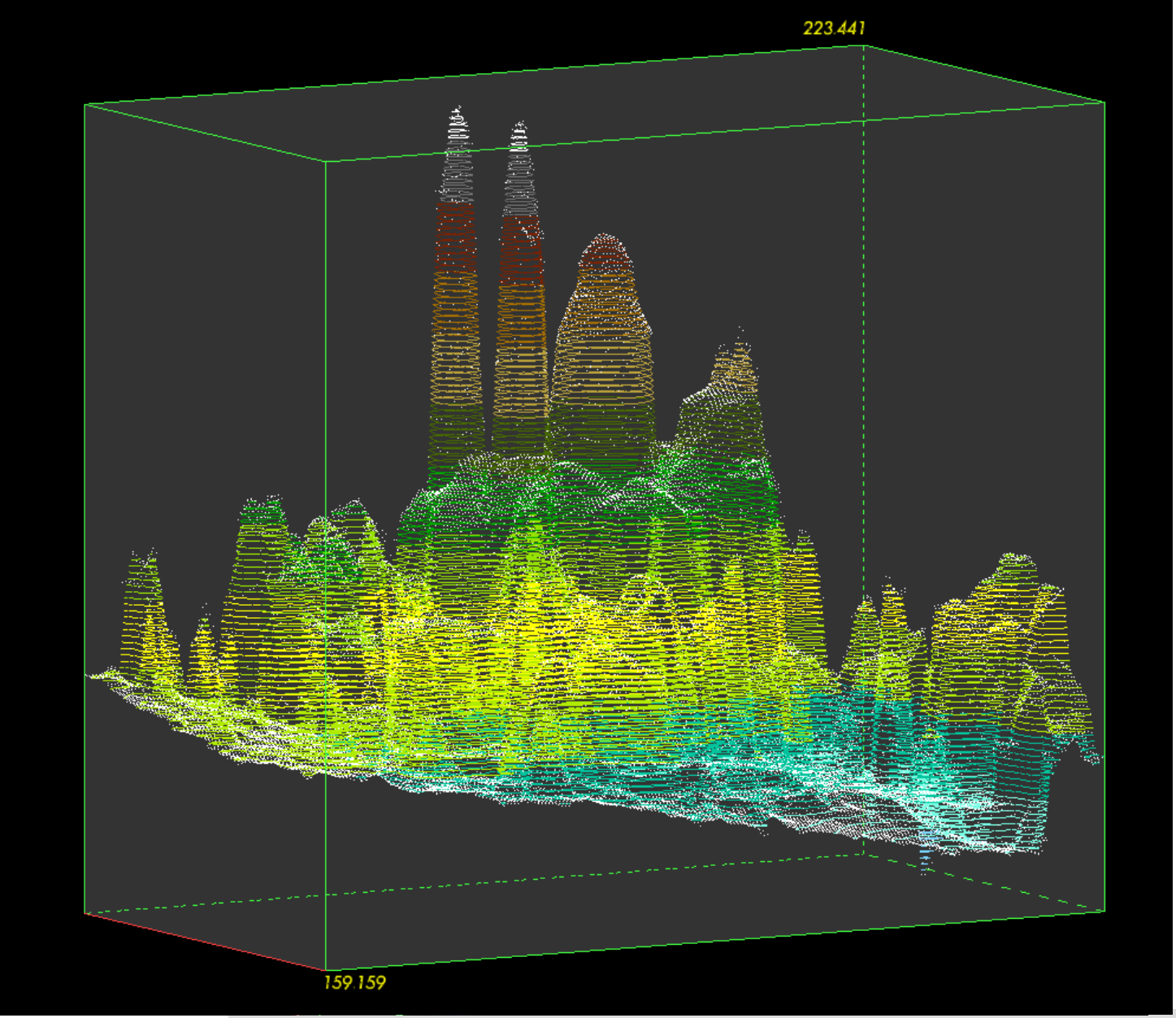
Aerial photo coverages 2007-2014.





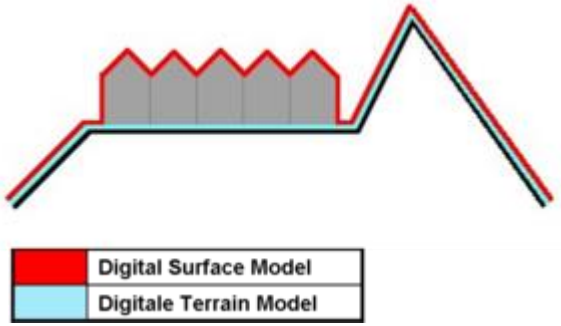
Generating DSM
for the whole
country
with
0.8 m -1.0 m
resolution by
stereo
photogrammetry

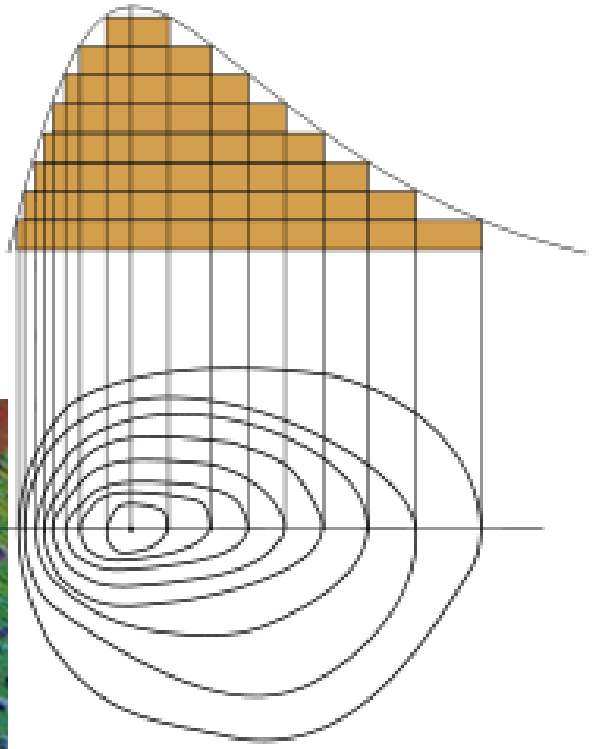
MATCH-T DSM
(**S**emi-**G**lobal **M**atching)
Trimble/Inpho

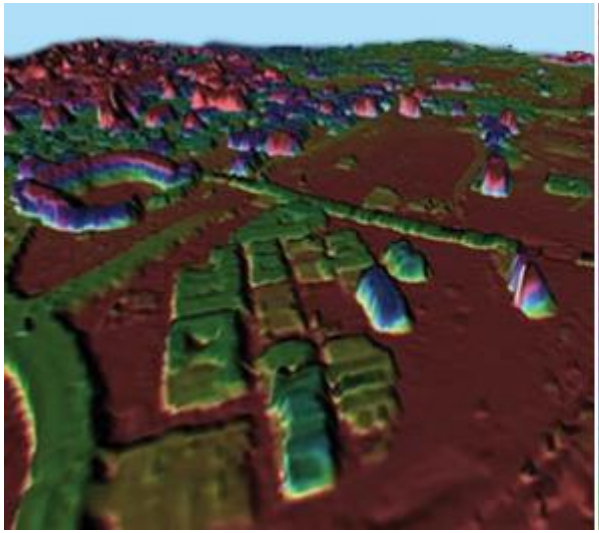


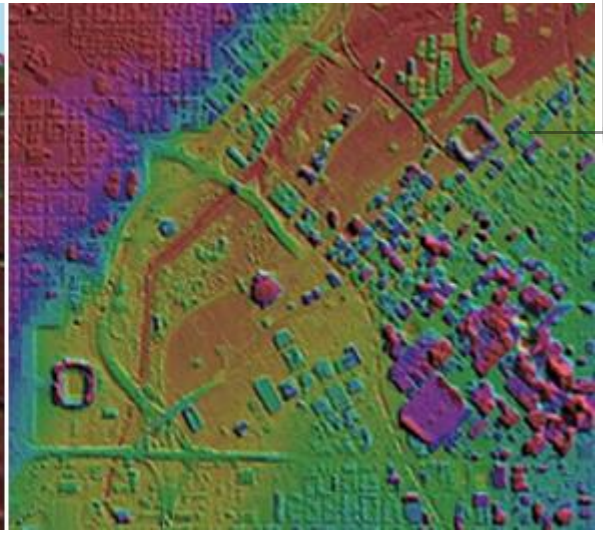
Editing DSM
in 2D, 3D
+
2.5 D
mode
using
DTMaster
profile view
Trimble/Inpho

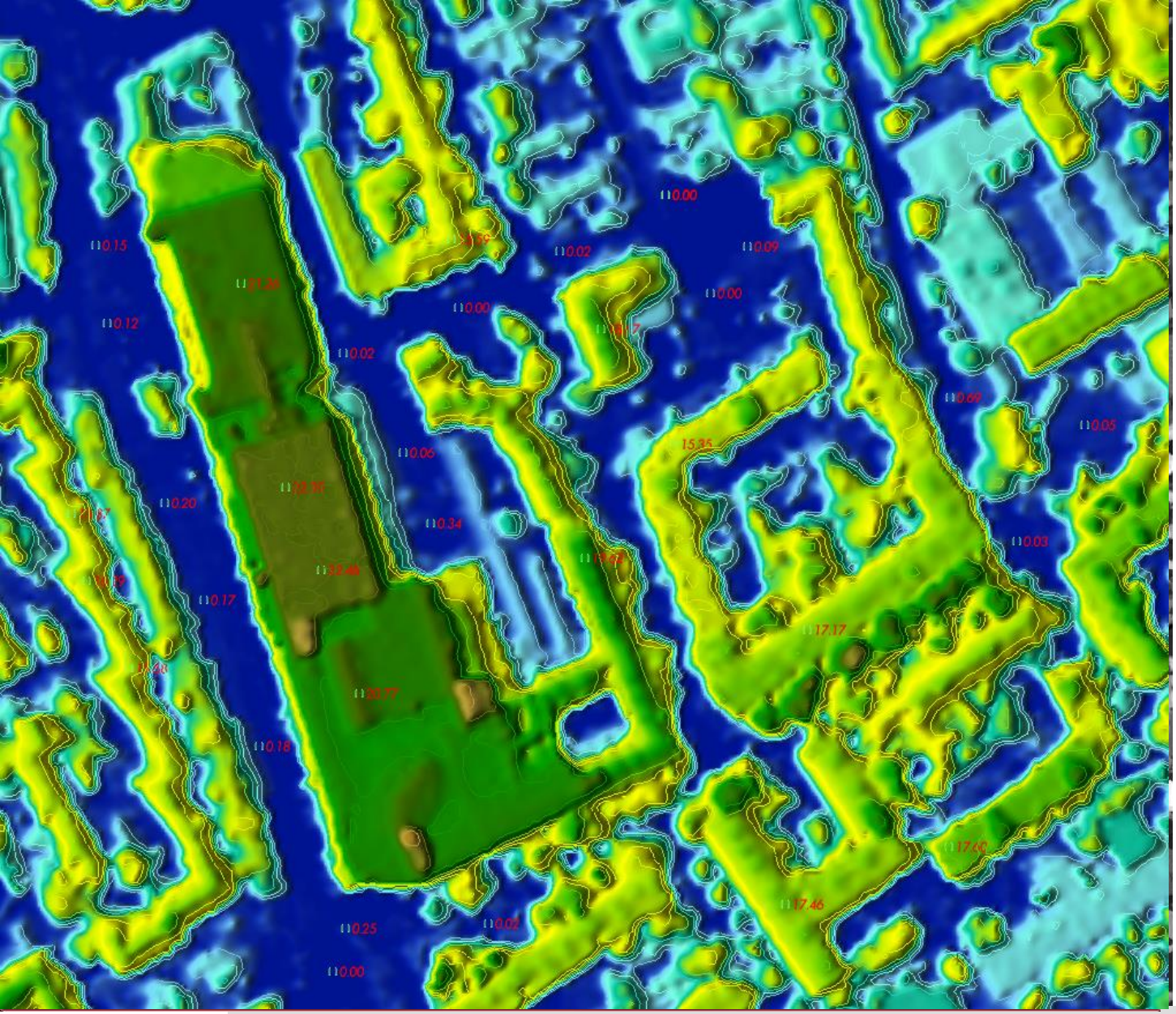
DSM and DTM











Computing the difference of DSM and DTM using SCOP ++

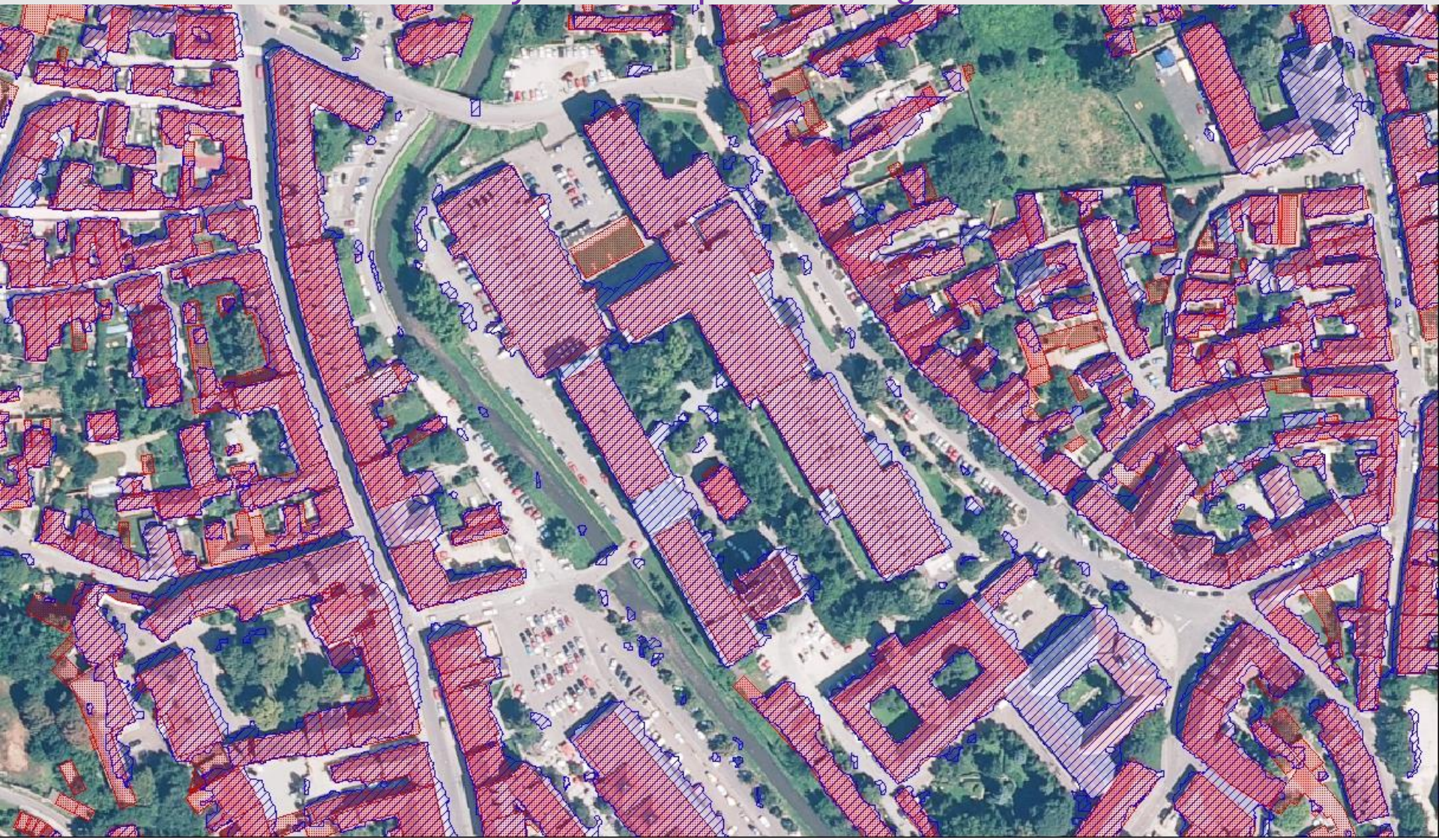
Generating DSMortho layer for the areas of high buildings (perspective distortion, roll of the building)

MATCH-AT
OrthoMaster
OrthoVista
SeamEditor
Trimble/Inpho

DSMortho + vegetation + buildings

DSMortho + cadastral layer

DSMortho + layer of automatically detected buildings+ cadastral data >> layer of computed changes



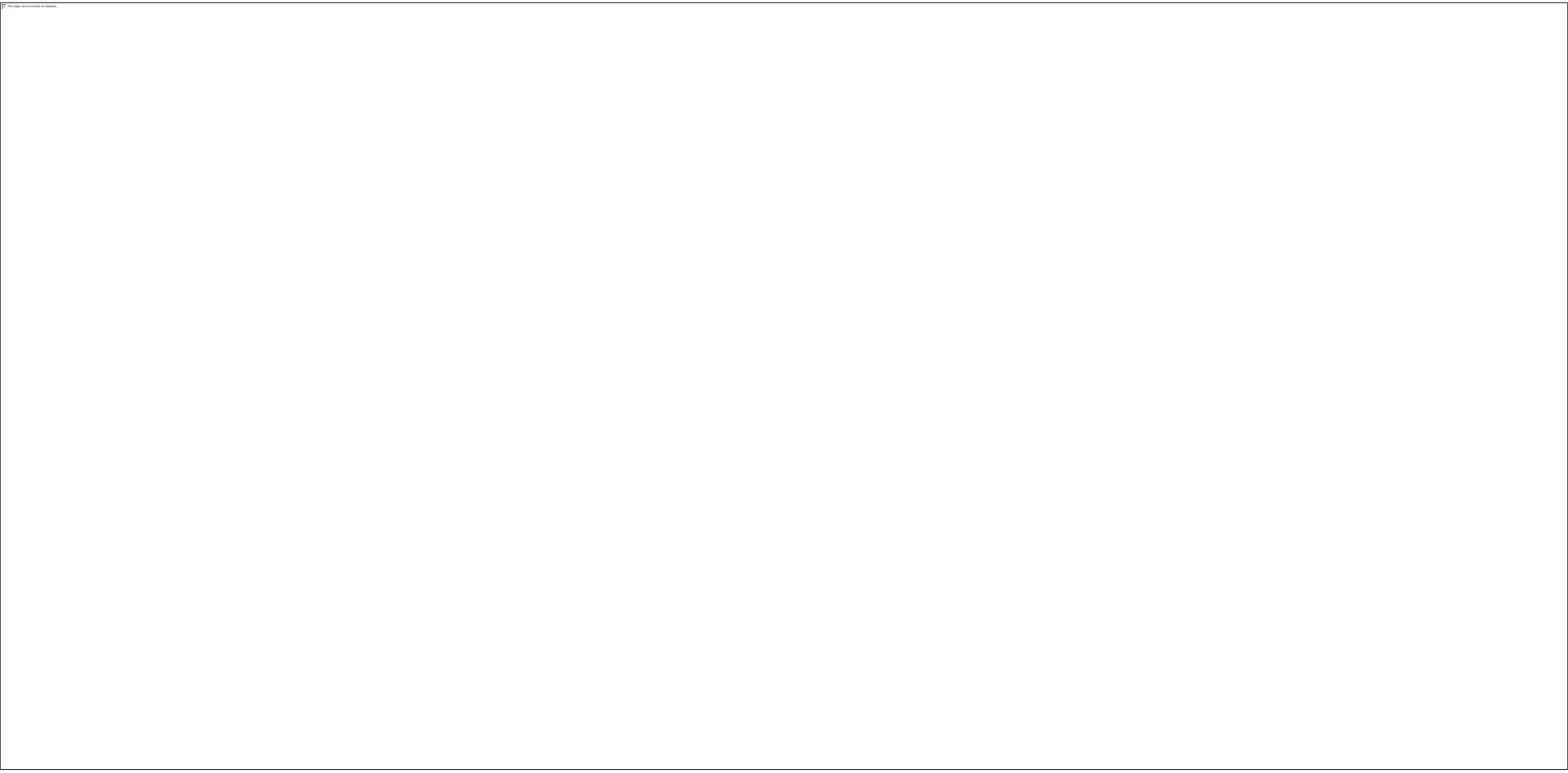

Deficit
Suficit

Stepi LPIS >>
Summit Evolution
DATEM

Stepi JRC >>
Stereo GeoEye test

++
Stereo workstations on different directorates for the „popular” photogrammetry

Next step is OBIA



OBIA = Object-based Image Analysis

Base concept (object vs. pixel):

- a group of neighbor pixels (homogeneous in some features) as a unit
- that unit (called object) has spectral, geometrical and textural features
  and it's a part of a hierarchy

OBIA's aim:

- to model human vision (good in recognizing textural and geometrical contexts) with preserving the fastness and accuration of computer „sense"

How to get objects?

- segmentation for a good segment map we need to understand how the human vision works

Building monitoring as a remote sensing problem

- Spectral features are not enough to classify buildings,
- There is no adequate class-definition for a roof,
- In OBIA geometrical features can be used as well, - but even not enough
- So we use spectral and geometrical features and height information derived from DSM – DTM difference,
- Cadastral data can optimize the classification as well.

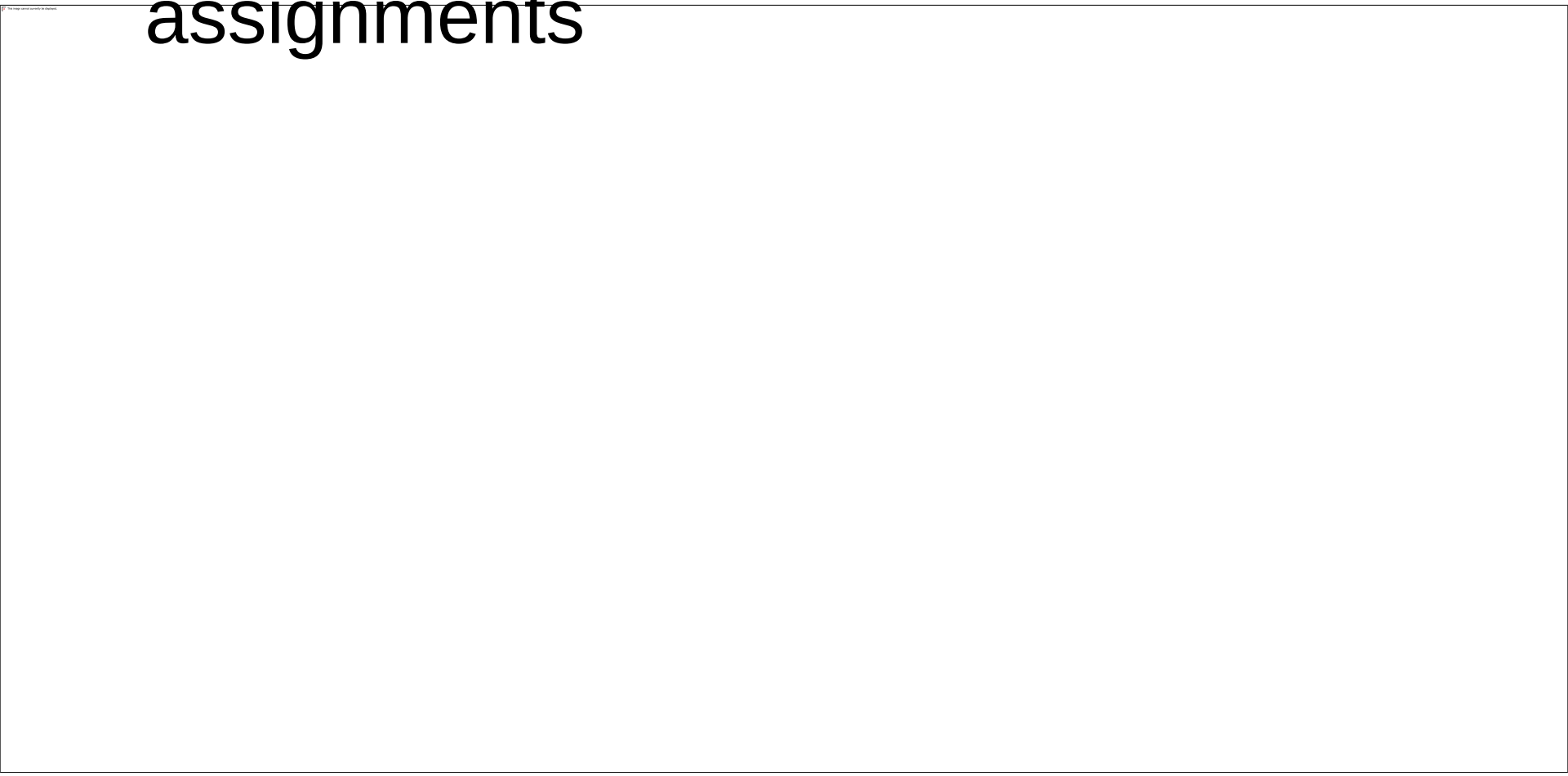
OBIA in Building Monitoring Project

- Input:
  - ortho or DSMortho (NIR, red, green layers)
  - DSM - DTM difference
  - cadastral layer

- Multi-step segmentation:
  - eCognition-specific algorithms
  - based on input layers, NDVI and brightness
  - cadastral border must be segment border as well

- Classification:
  - based on NDVI, DSM - DDM difference and cadastral layer
  - first step uses class-definitions (shadows, building, high building, pro-building (probably))
  - then fine-tuning by geometric features (area, neighbor objects, cadastral presence)

Next step is GIS working group assignments



GIS working group assignments

1. Preparation of the spatial datasets:
   - Cadastral database preparation
2. Post processing (filtering) of the OBIA result layer
   - Route database
   - Railway database
   - Water bodies database
   - Land Cover database
3. Detection of differences, changes (cadastral and orthophoto)
4. Implementation and operation of WMS service

Cadastral database preparation

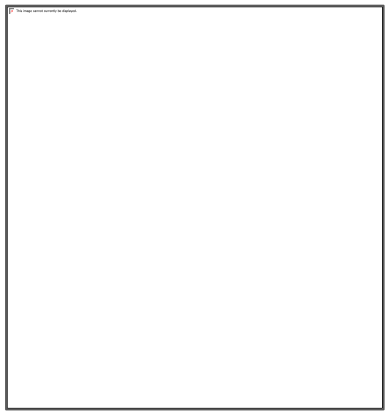
Creation and operation of the **Spatial Data Warehouse** is one of the most important tasks of the GIS department.

In the Spatial Data Warehouse the **Cadastral Database** is significant, where it is updated every 3 month and stored in an object-relational database management system (Postgres/PostGIS) in a DAT national standard schema for the whole country.

The necessary database for the building monitoring project is the **Cadastral Buildings** (together with their attachments) and the **Cadastral Parcels and their attributes**.

Cadastral database preparation

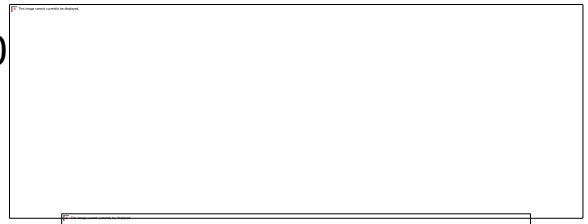
Along the photogrammetric processing we prepare the Cadastral Database for the GIS analysis.



DAT (estate registry) objects database national statistics:

Land parcels I. (public) and their attribute table: 622.214
Land parcels II. (private) and their attribute table: 7.300.093
Buildings and their attribute table: 6.510.408
Building attachments (polygon type) only the terrace and ramp objects and their attribute table: 284.080
Building attachments (line type) only the terrace, ramp and drip-line objects: 214.966

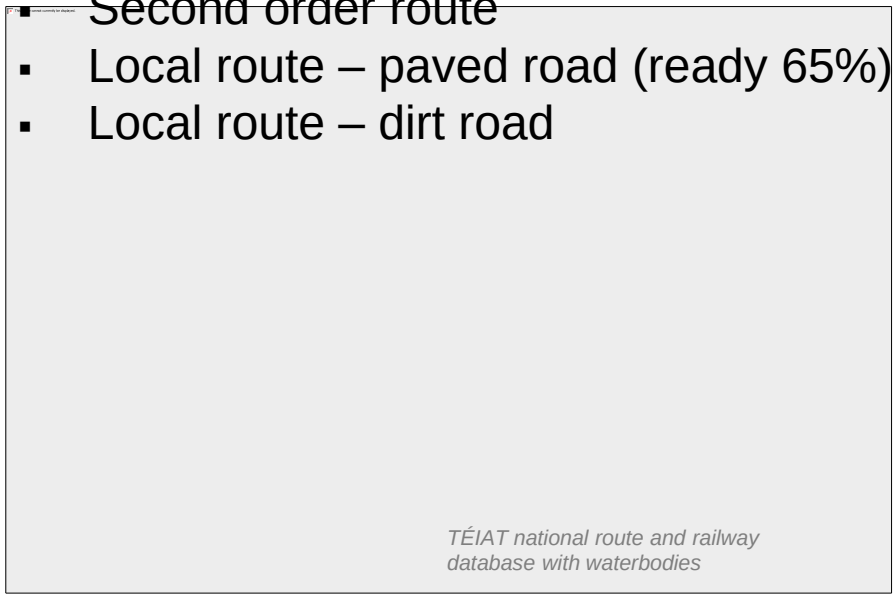
Summarized: 14.931.761



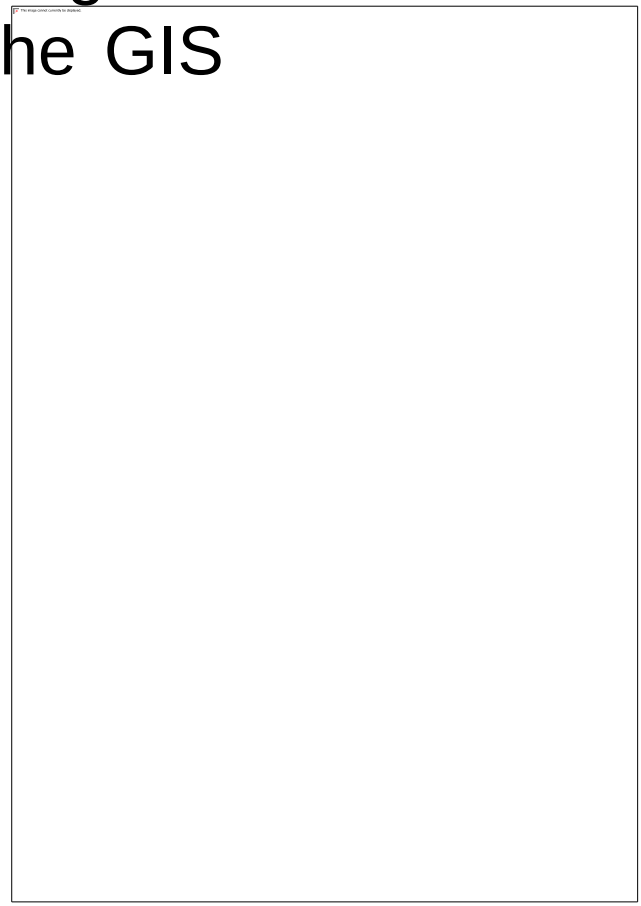
Route and Railway database preparation

Along the photogrammetric processing we prepare the Route database for the GIS analysis.

- Motorway
- First order route
- Second order route
- Local route – paved road (ready 65%)
- Local route – dirt road



TÉIAT national route and railway database with waterbodies



Water bodies and Land Cover database preparation

Data source is National LPIS database

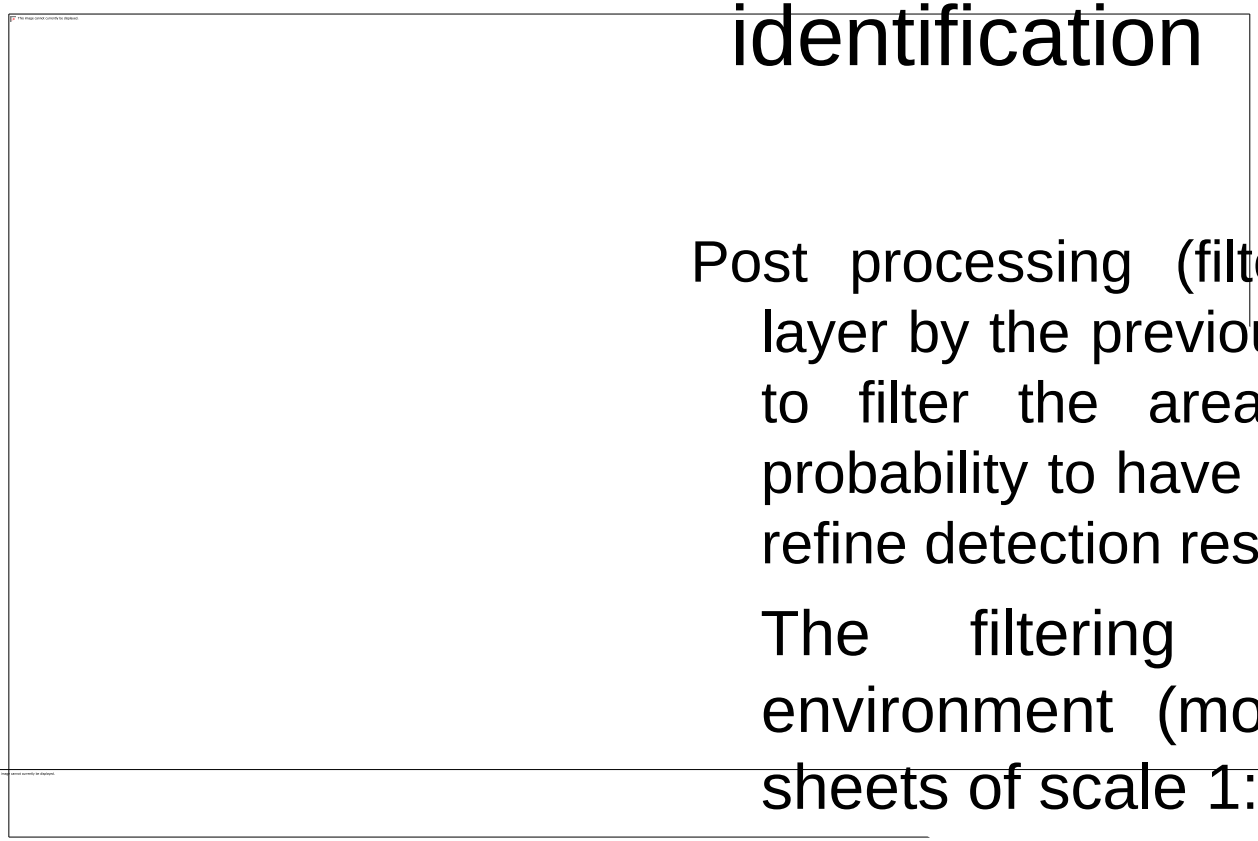
Water bodies:

- Great river boundaries
- Wide watercourse boundaries
- Lake boundaries

Land cover database:

Where the built-up infrastructure is unlikely to be present

Post processing (filtering) of the OBIA result layer before the change/difference identification

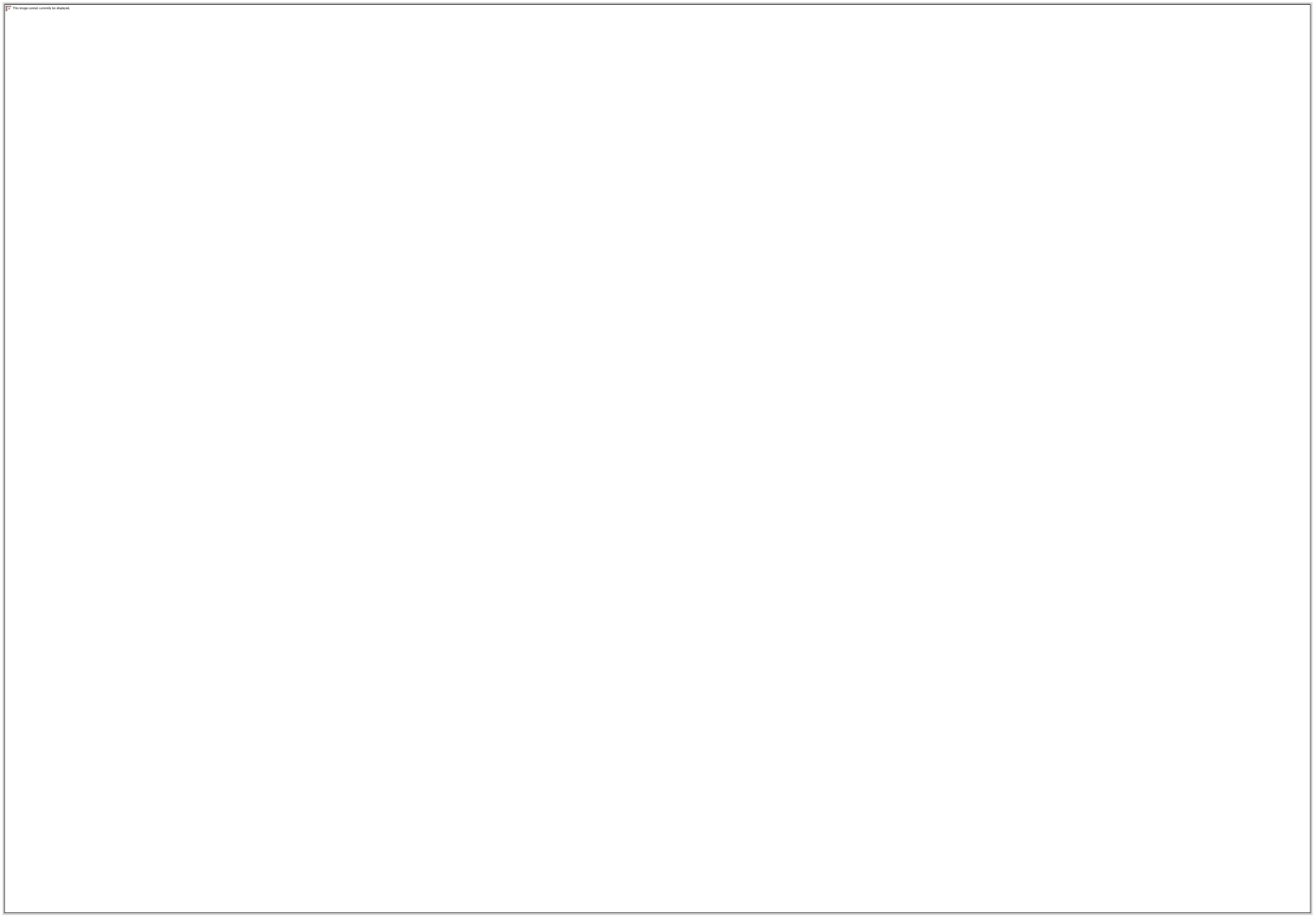


Post processing (filtering) the OBIA result layer by the previously introduced datasets to filter the areas where there is no probability to have building changes and to refine detection results.

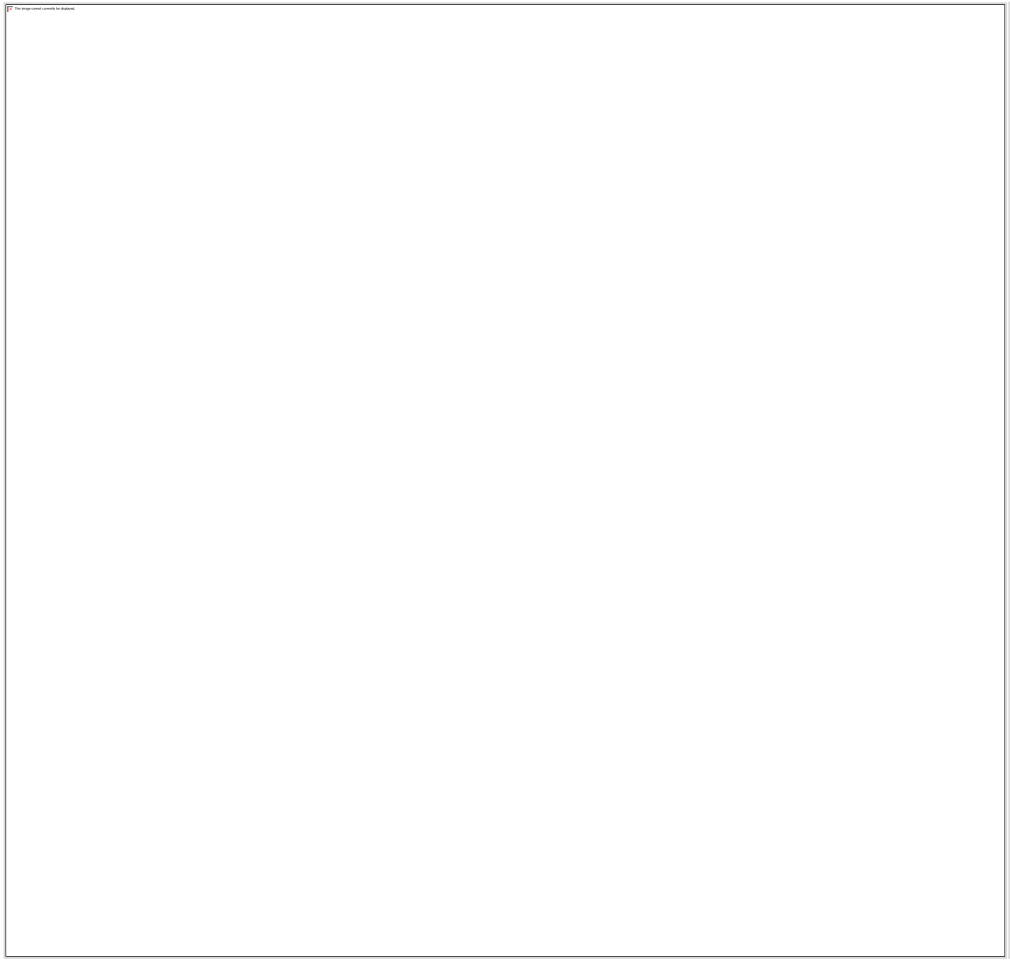
The filtering made in ArcGIS environment (model builder) for map sheets of scale 1:100.000.

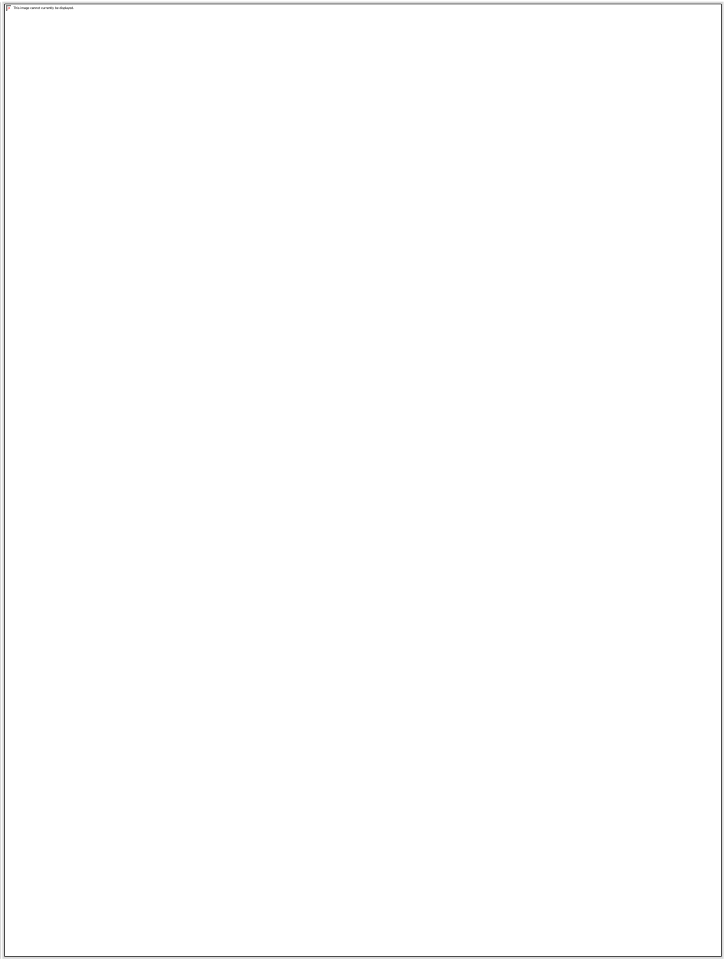
Post processing (filtering) of the OBIA result layer by route refined with cadastral parcels

Post processing (filtering) of the OBIA result layer by railway

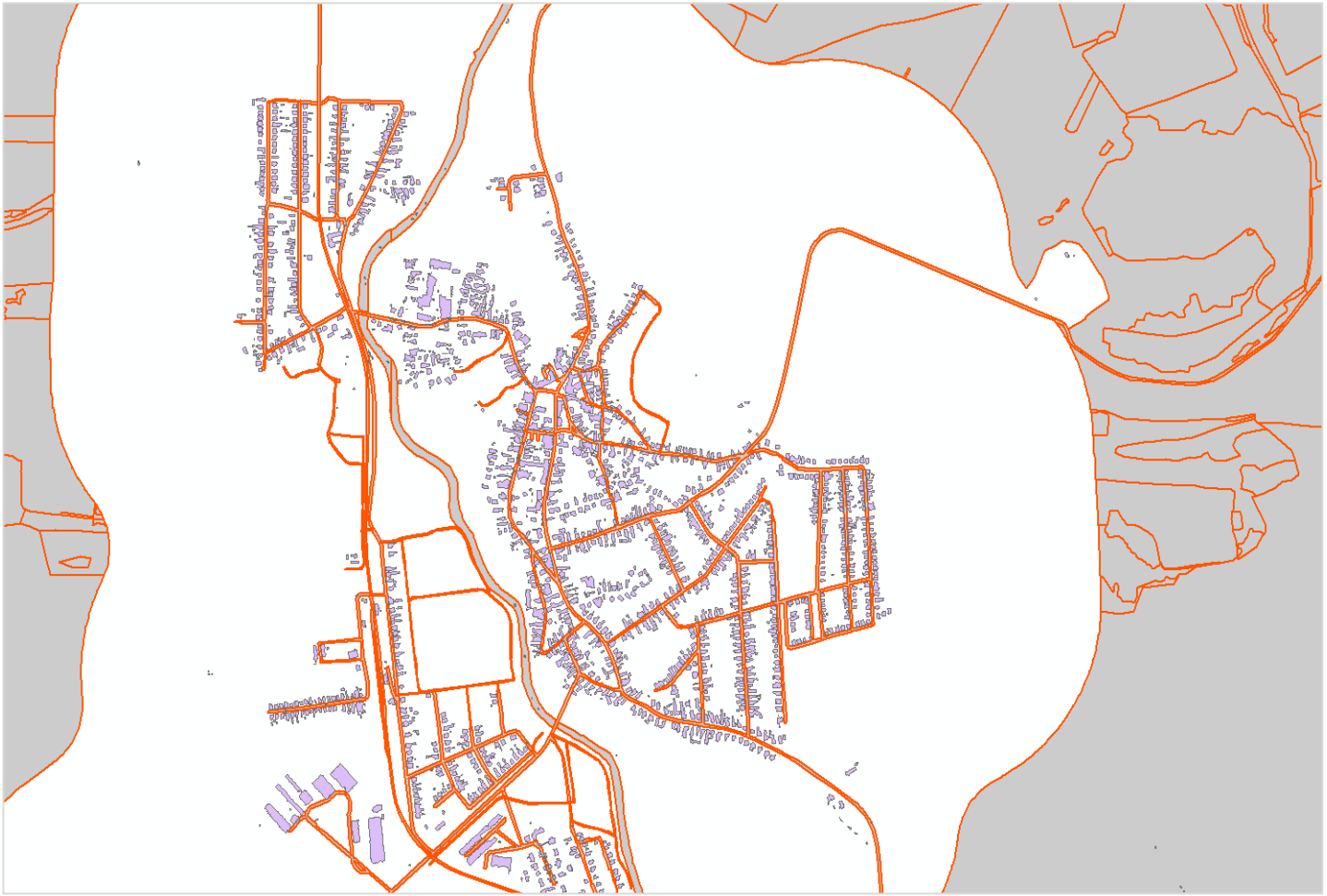


Post processing (filtering) of the OBIA result layer by water

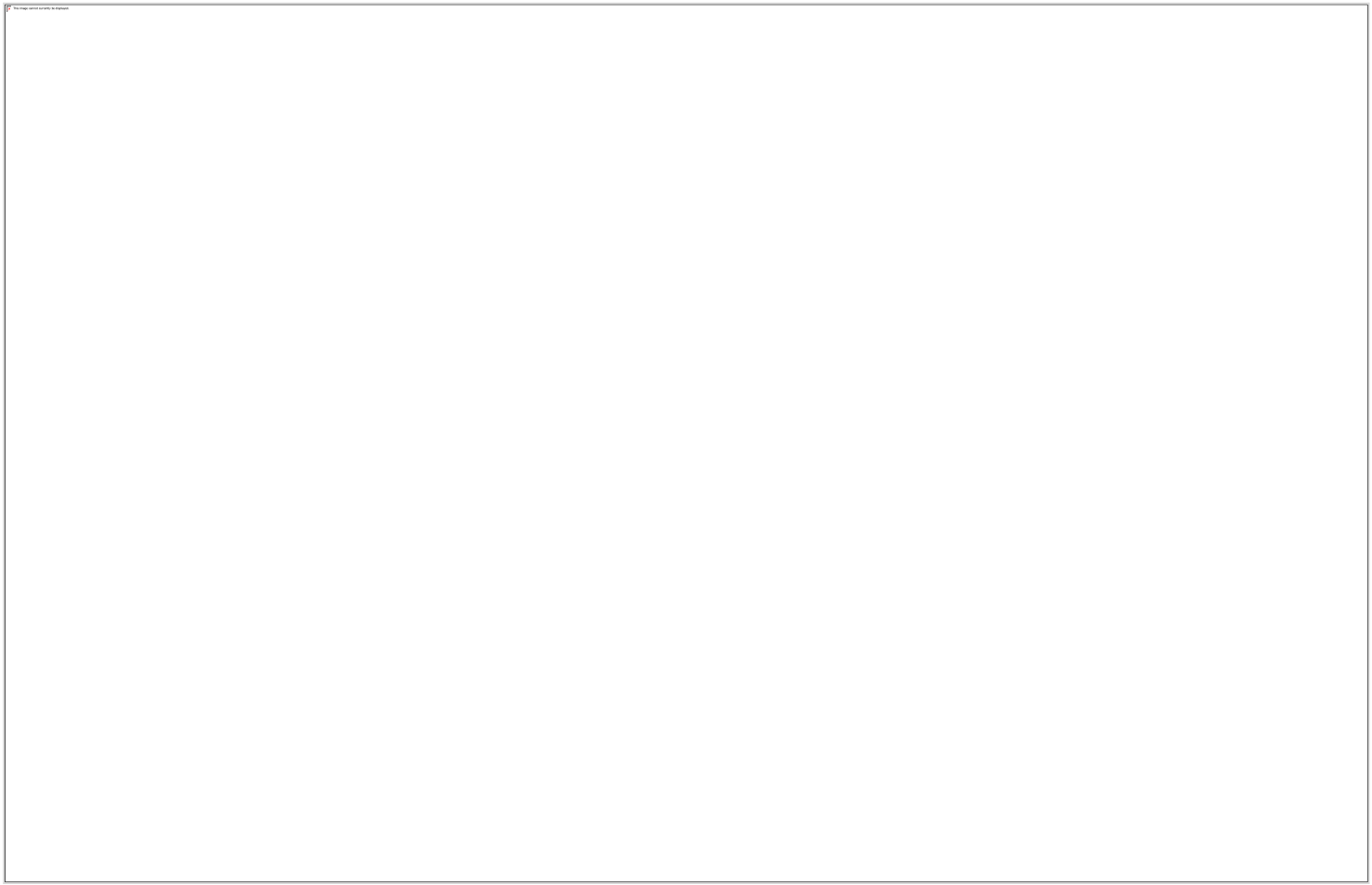




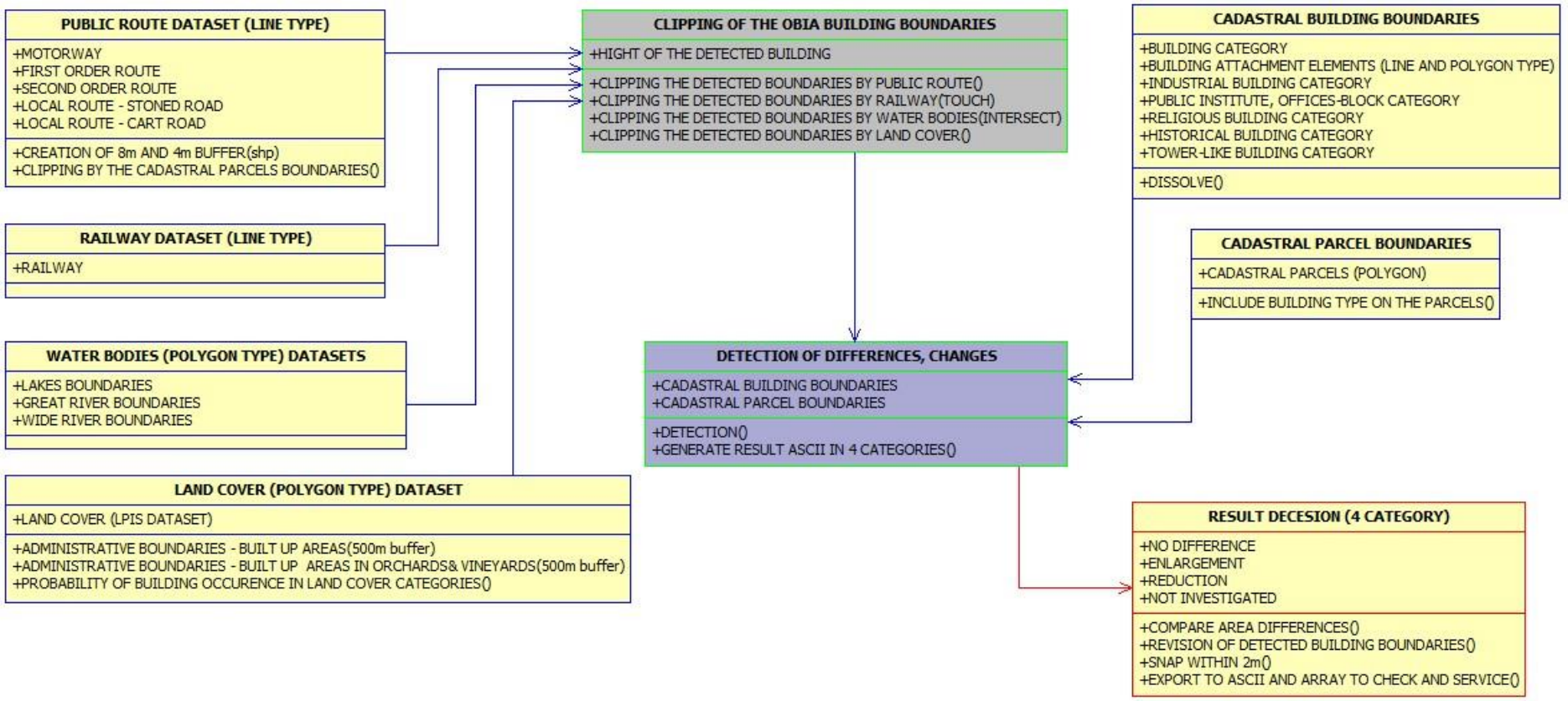
Post processing (filtering) of the OBIA results by combination of all layers



Post processing (filtering) of the OBIA results by combination of all layers



Identification of differences, changes

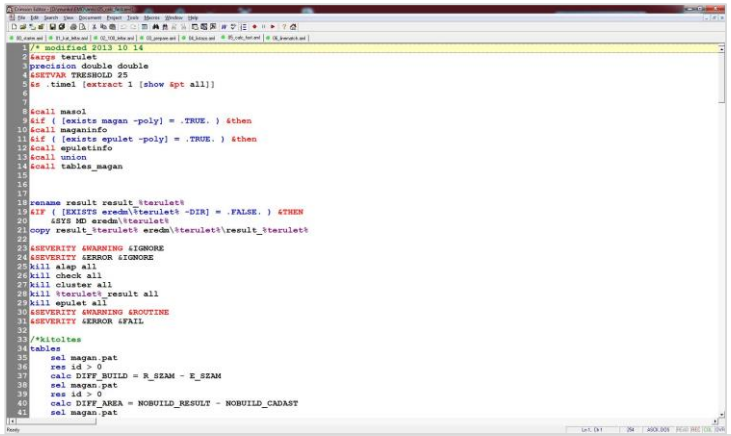


Identification of differences, changes

- Automatic creation of the detected and post processed (filtered) buildings from the map sheets (1:100.000) to the administrative boundaries for each settlement.
- Comparison of the detected and cadastral data, identification of changes/differences:
  - enlargement,
  - no change/difference,
  - reduction in building dimensions.
- There is no change identification in the area of high buildings, industrial buildings, shopping-malls, public institutions, offices-blocks, religious buildings, historical and tower-like buildings.

Identification of differences, changes

- Export the datasets for quality check.
- Export a point layer where the identification results coded per categories for WMS service creation and provision.
- Processing environment is ArcInfo Workstation, and the modeling language is ArcMacroLanguage (aml).

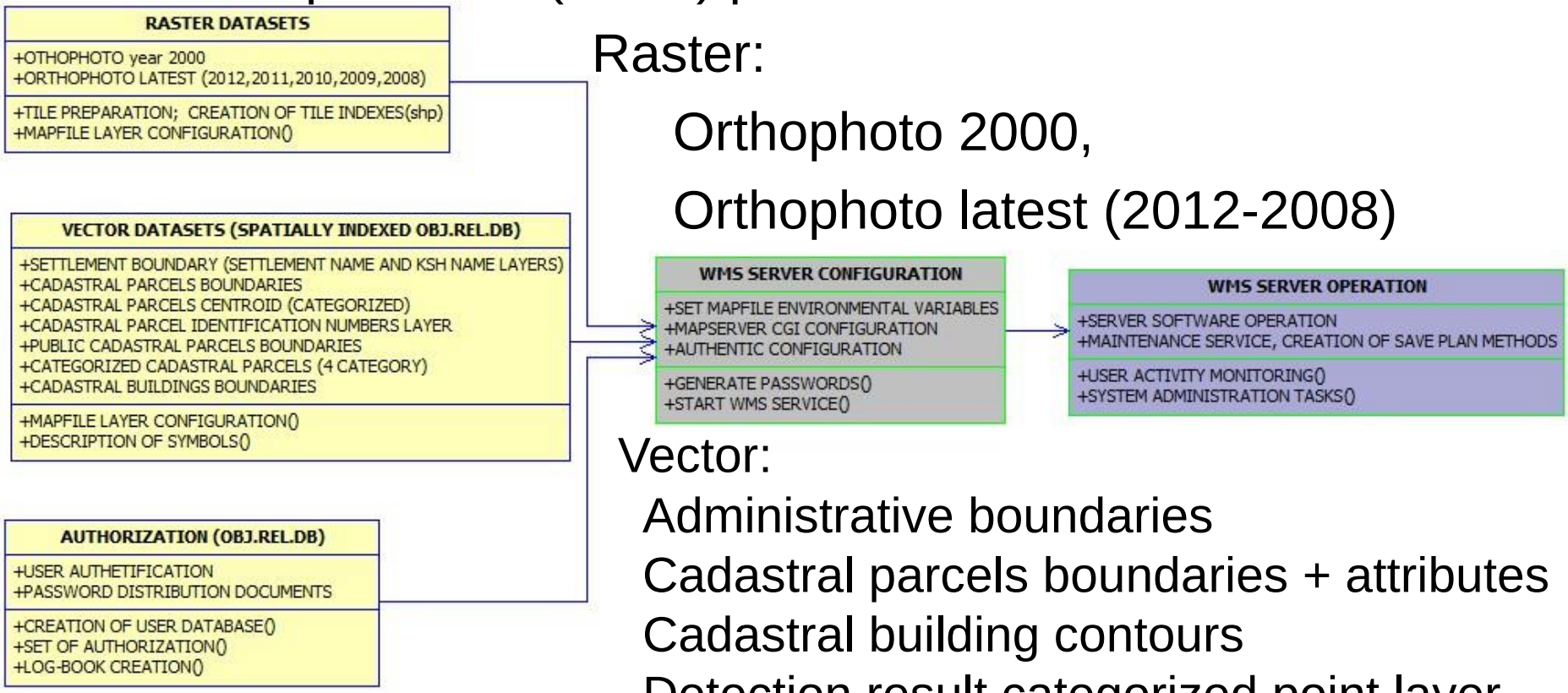


```
/* modified 2013 10 14
&args terulet
precision double double
&SETVAR TRESHOLD 25
&s .time1 [extract 1 [show &pt all]]


&call masol
&if ( [exists magan -poly] = .TRUE. ) &then
&call maganinfo
&if ( [exists epulet -poly] = .TRUE. ) &then
&call epuletinfo
&call union
&call tables_magan


rename result result_%terulet%
&IF ( [EXISTS eredm\%terulet% -DIR] = .FALSE. ) &THEN
    &SYS MD eredm\%terulet%
copy result_%terulet% eredm\%terulet%\result_%terulet%

&SEVERITY &WARNING &IGNORE
&SEVERITY &ERROR &IGNORE
kill alap all
kill check all
kill cluster all
kill %terulet%_result all
kill epulet all
&SEVERITY &WARNING &ROUTINE
&SEVERITY &ERROR &FAIL

/*kitoltes
tables
    sel magan.pat
    res id > 0
    calc DIFF_BUILD = R_SZAM - E_SZAM
    sel magan.pat
    res id > 0
    calc DIFF_AREA = NOBUILD_RESULT - NOBUILD_CADAST
    sel magan.pat
```

Identification of differences, changes examples

Implementation and operation of WMS service

Web Map Service (WMS) provided datasets:



Raster:

Orthophoto 2000,

Orthophoto latest (2012-2008)

Vector:

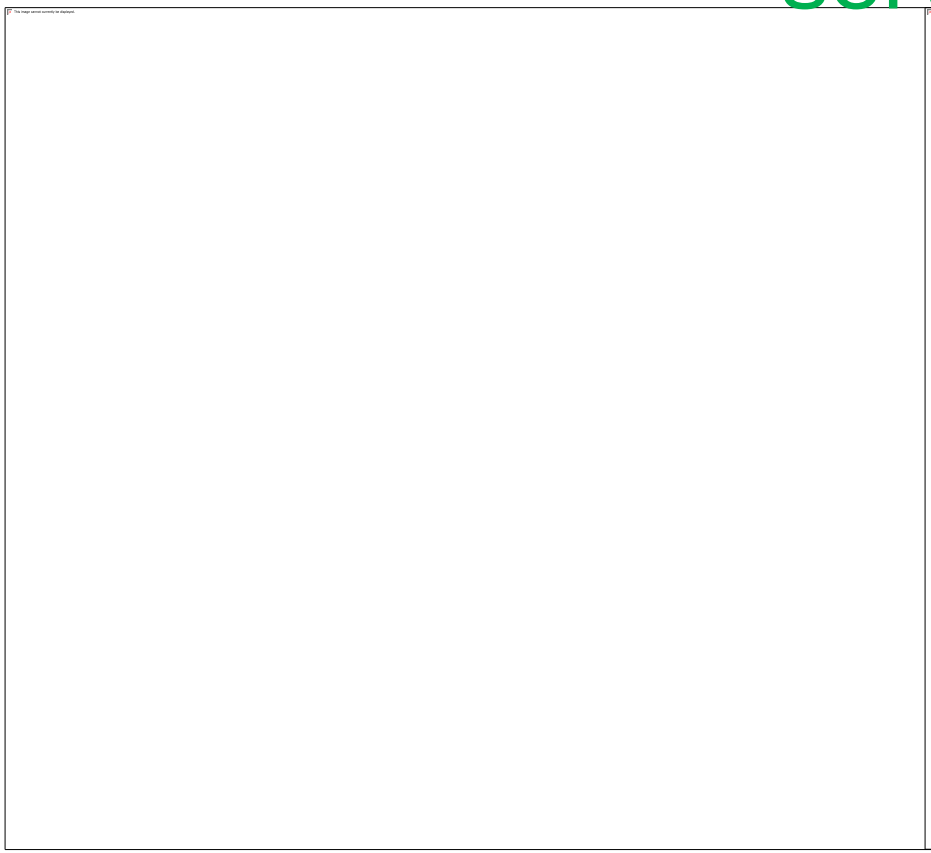
Administrative boundaries

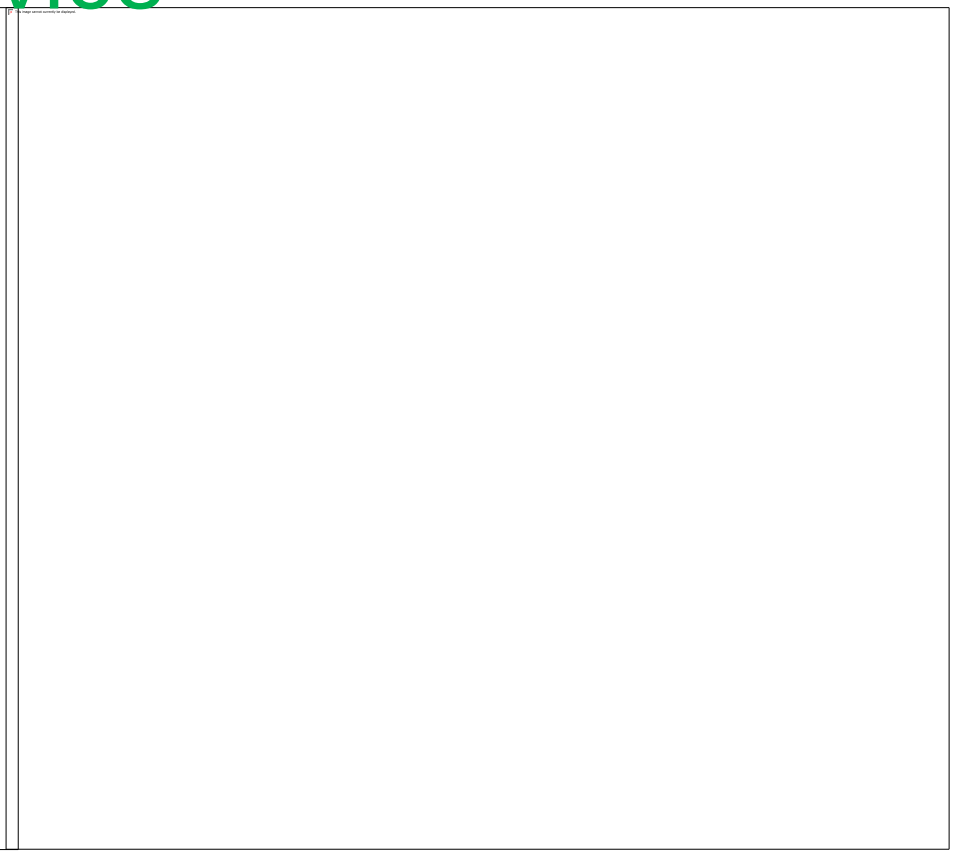
Cadastral parcels boundaries + attributes

Cadastral building contours

Detection result categorized point layer

Implementation and operation of WMS service



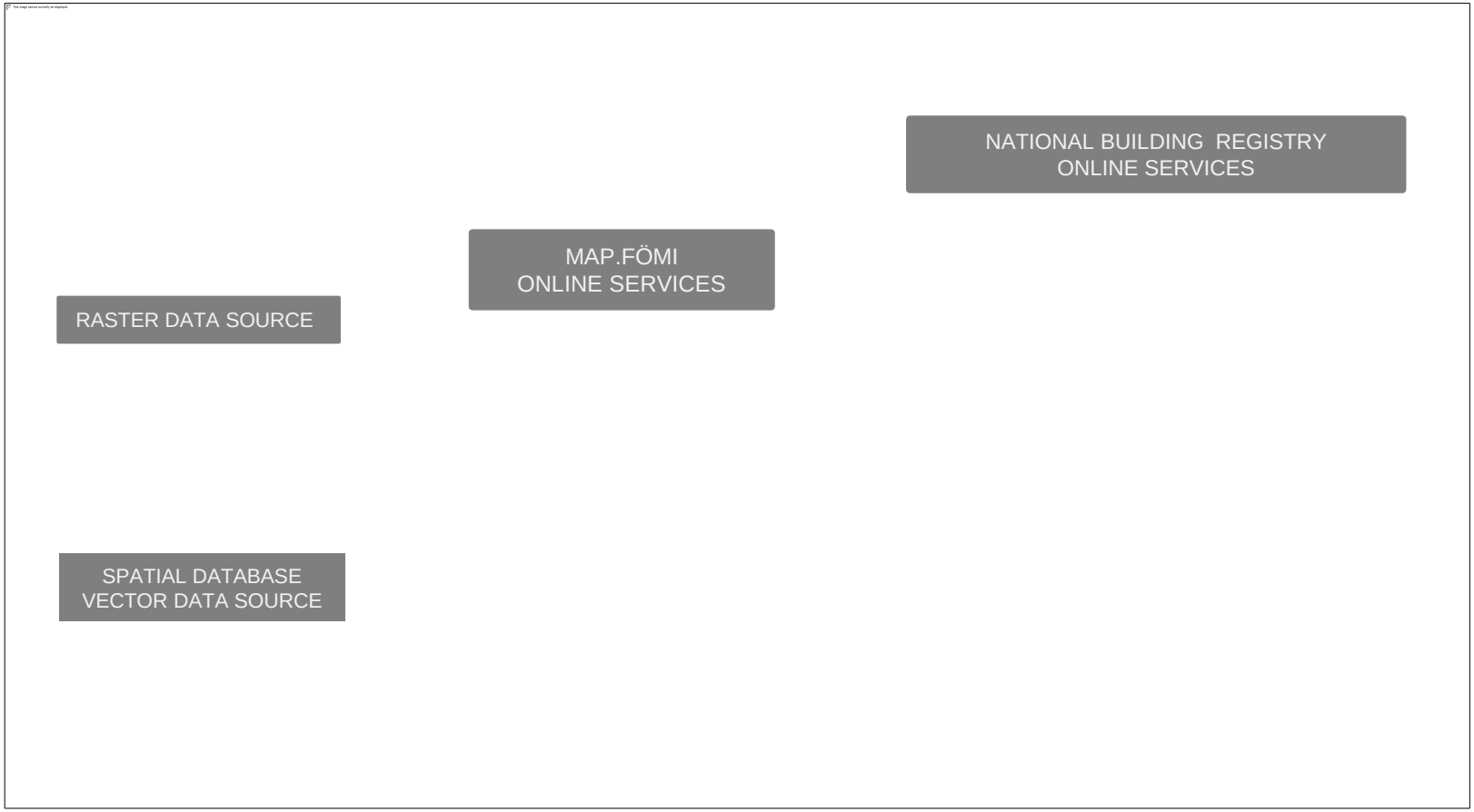


2010 ORTHOPHOTO RESULTS: ORIGINAL

DETECTION (GREEN) WITH DSM (RED)

Implementation and operation of WMS service

WMS service structure:



THANK YOU FOR YOU ATTENTION!