Slovenian applied research project to utilise volunteered images for national topographic map updating in scales 1:5000 and 1:50000

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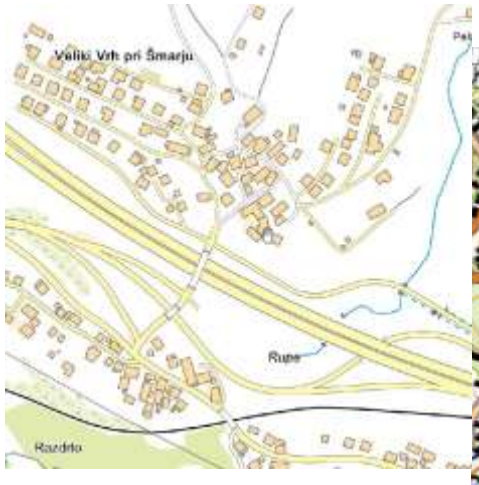

Crowdsourcing in National Mapping
Leuven, 16th January 2020

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Structure of the presentation

- Interactive orientation (monoplotting)
- Successful acquisition and processing of volunteered images of Slovenian floods 2012
- Volunteered images to monitor changes in topography for map updating

Applied research project:

Lidar-facilitated volunteered geographic information for topographic change detection (L2-1826)

Partners:

- Geodetic institute of Slovenia
- Faculty of Electrical Engineering and Computer Science, University of Maribor

Financed by:

- Slovenian Research Agency
- Surveying and Mapping Authority of the Republic of Slovenia (SMA)
- Ministry of Defence of the Republic of Slovenia (MD)

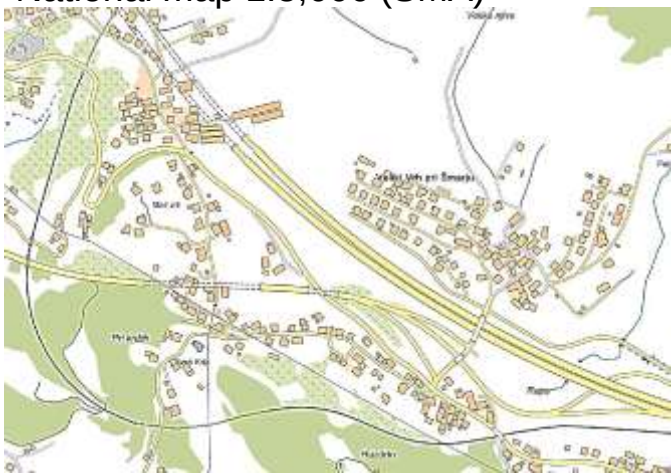
Duration:

- mid-2019 to mid-2022

Purpose of the applied research project

- What kind of additional cartographic data can be acquired from volunteered images for national maps of 1:5,000 and 1:50,000
- For image orientation and data acquisition the interactive orientation will be applied with dense digital elevation models (from lidar or photogrammetricaly derived point clouds)
- Conduct controlled pilot gathering of volunteered images
- Analyse the role of involved experts and non-experts in providing adequate images for topographic map updating

National map 1:5,000 (SMA)



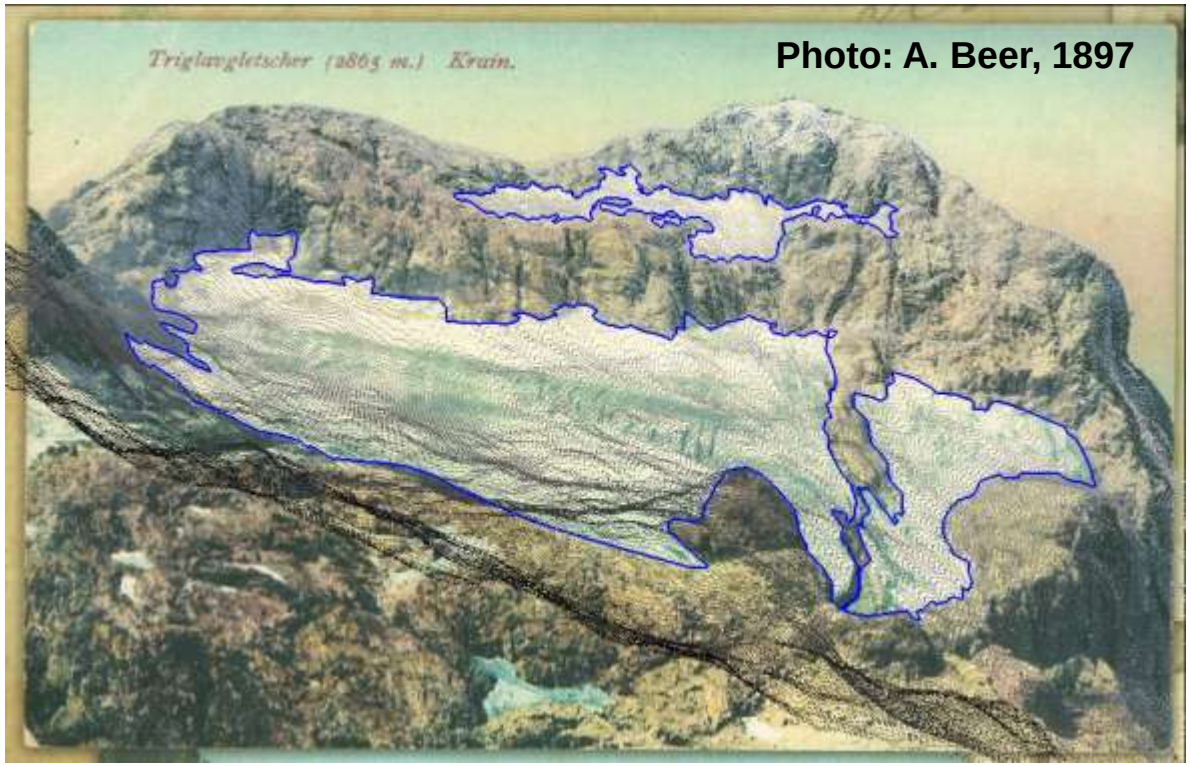
National map 1:50,000 (SMA)

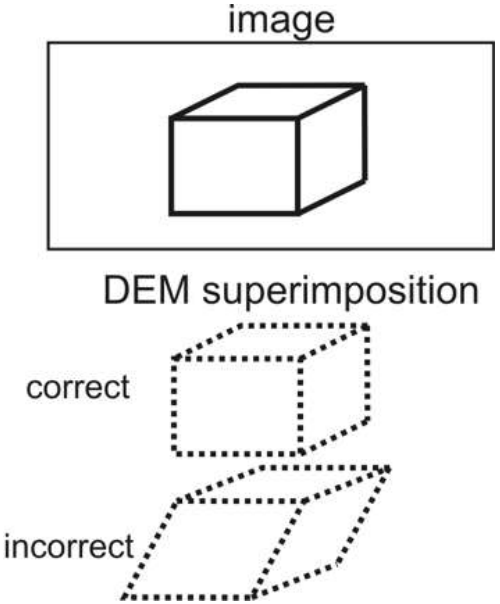
Interactive orientation (monoplotting) of a single image

Interactive orientation:

Step 1: manual or semiautomatic interactive orientation

Step 2: mapping from the image using digital elevation model (DEM)





Triglav Čekada, M., Bric, V., Zorn, M. (2014). How to decide which oblique image has the highest mapping potential for monoplotting method : a case studies on river erosion and floods. *ISPRS Technical Commission V Symposium 23-25 June 2014, Riva del Garda, Italy*, (ISPRS Annals). http://www.isprs-ann-photogramm-remote-sens-spatial-inf-sci.net/II-5/379/2014/isprsannals-II-5-379-2014.pdf

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Manual interactive orientation of an oblique image

What we need for manual interactive orientation:

- image in adequate resolution
- detailed DEM
- easily recognizable tie points/ patches on image and DEM
- in lowlands some additional vector break-lines (e.g. roads, rivers)

Can also be applied for manual search of distortions:

Step 1: search for a general best fit of DEM superimposed points in the central part of the image

Step 2: apply distortion parameters to achieve a better best fit of DEM superimposed points,

i.e. the image is not resampled, the distortion parameters act on DEM superimposed points

Idea:

To use location embedded in the image file made by smart-phone for the first approximation of orientational parameters.

November 2012 floods in Slovenia

How to choose the best images for interactive orientation?

Photo: Dominik and Damijan Cehner, Aviofun

Photo: Silvo Sok

Photo: Ana Grum

http://www.gis.si/poplave-2012

Triglav Čekada, M., Radovan, D. (2013). Using volunteered geographical information to map the November 2012 floods in Slovenia. *Natural hazards and earth system sciences*, http://www.nat-hazards-earth-syst-sci.net/13/2753/2013/nhess-13-2753-2013.html

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November 2012 floods in Slovenia

Purpose:

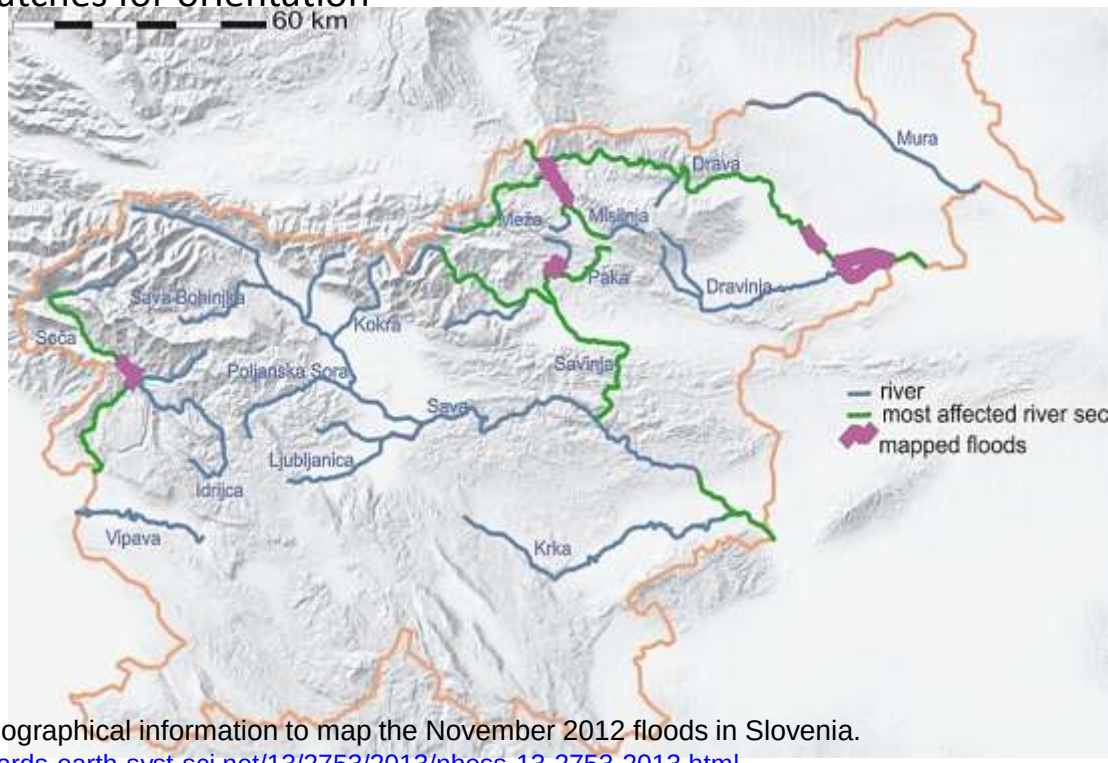
- try to map as many flooded areas of the November 2012 floods as possible from volunteered images
- 400 km sections of main rivers were flooded

Result:

- 3D-boundary of the flooded area

Data:

- **102 volunteered non-metric oblique terrestrial or aerial images** from different volunteers made with different cameras
- National photogrammetrical **DTM 5 m × 5 m** available for the whole Slovenia, enabled **mapping with geometrical accuracy of 10 m**
- vector break-lines of roads and riverbanks were used as tie patches for orientation

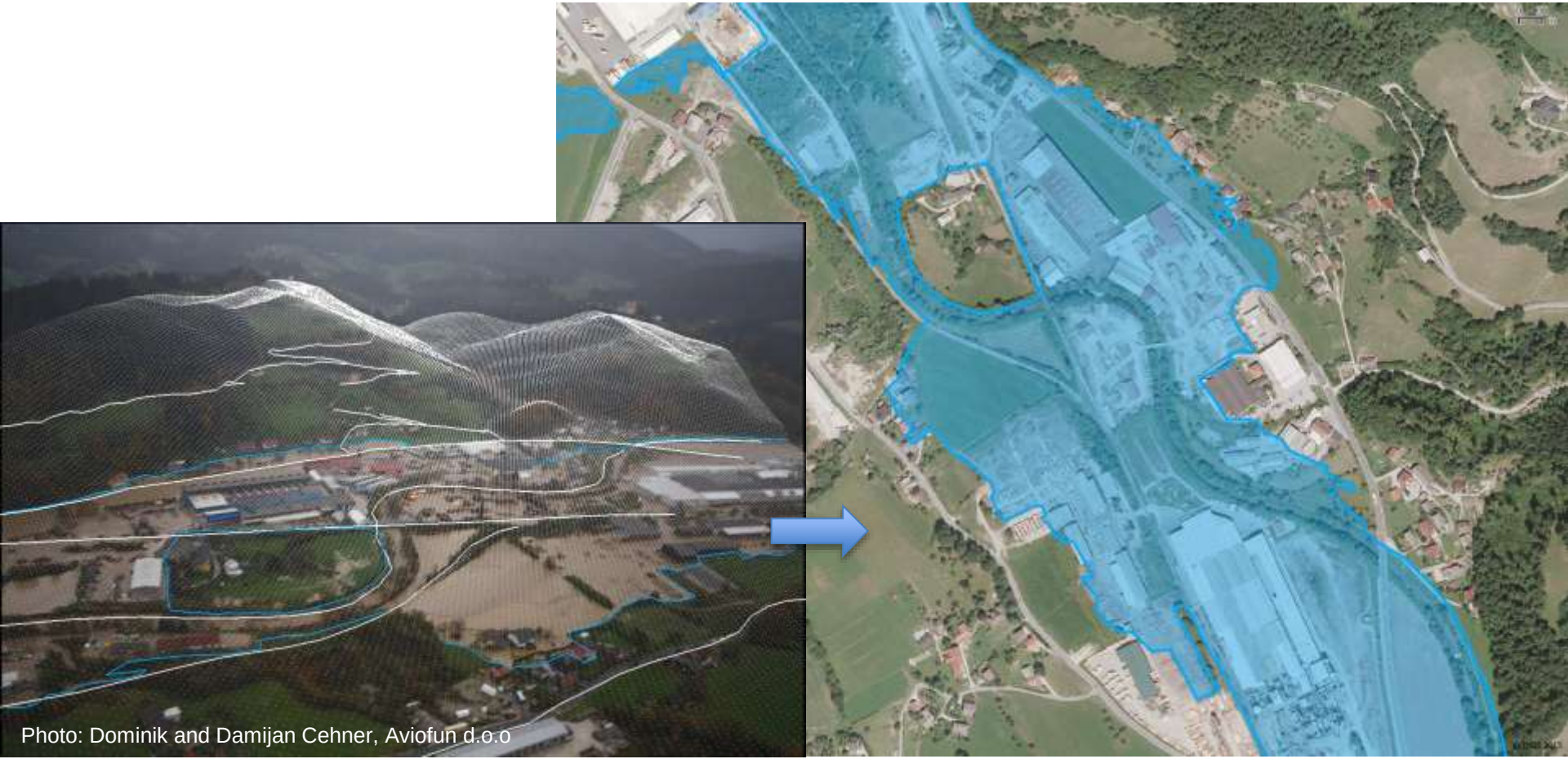


Triglav Čekada, M., Radovan, D. (2013). Using volunteered geographical information to map the November 2012 floods in Slovenia. *Natural hazards and earth system sciences*, http://www.nat-hazards-earth-syst-sci.net/13/2753/2013/nhess-13-2753-2013.html

November 2012 floods in Slovenia

How many images were used for interactive orientation?

- **from 102 images collected**
  - 45 % were classified as potentially useful
  - only 21 % were used for mapping
- **=> mapped:** river length 48 km of the most affected river sections (400 km) or 1440 ha of flooded areas



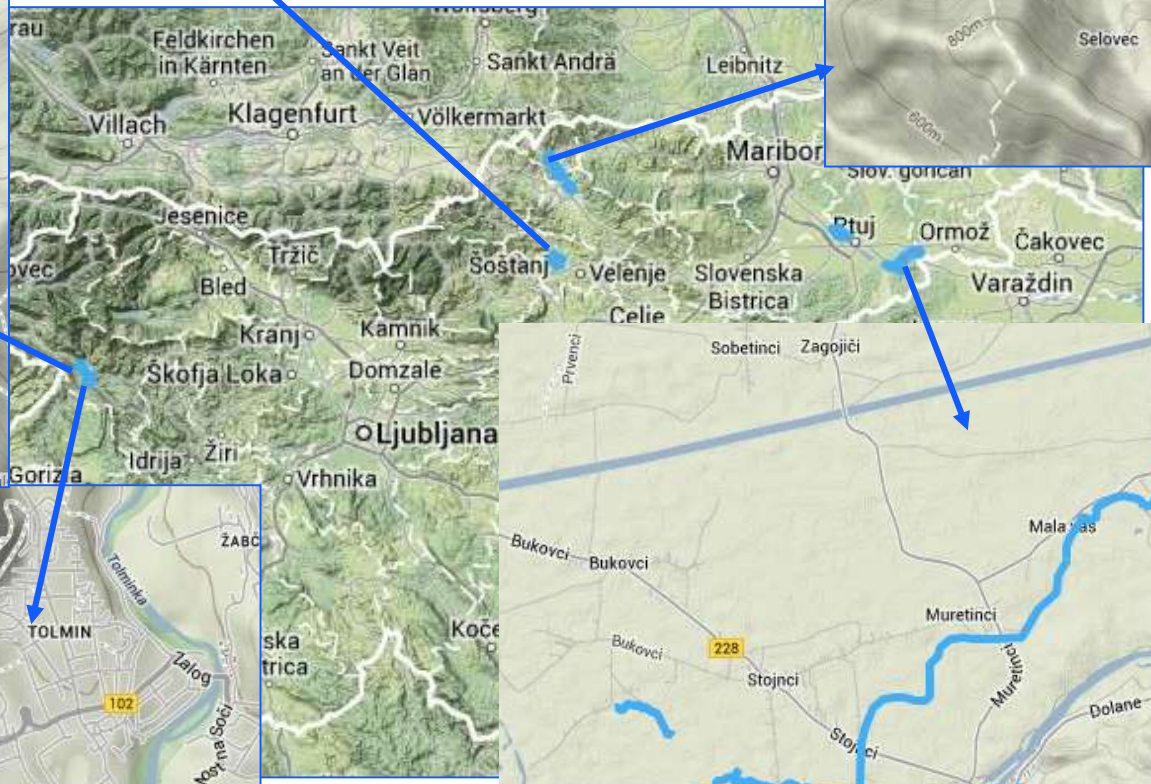
Maps of November 2012 floods in Slovenia

http://www.gis.si/poplave-2012

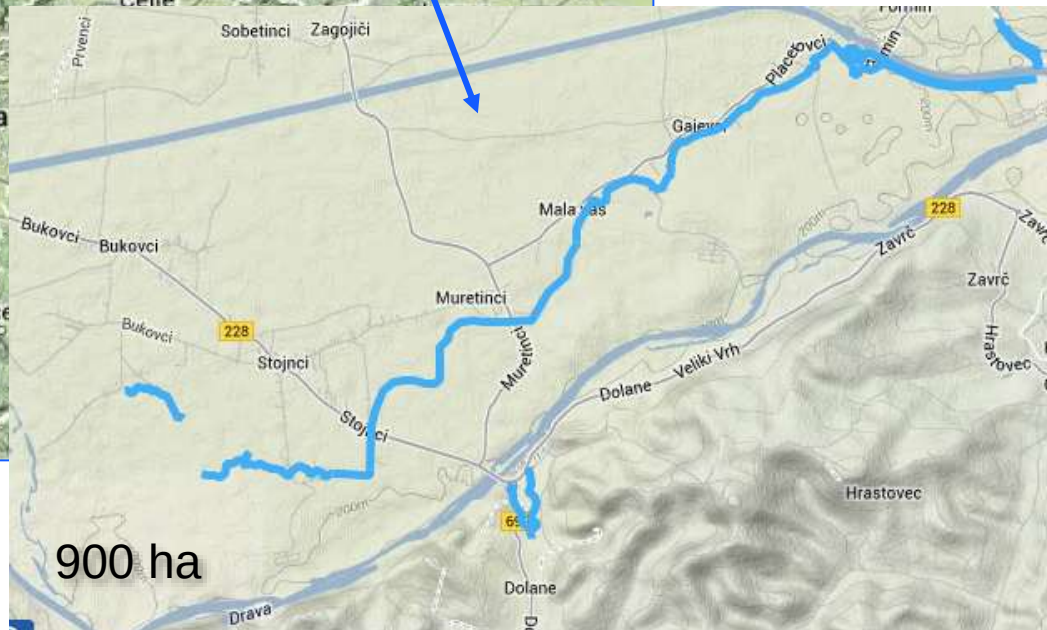
56 ha of flooded area

39 ha

81 ha



127 ha



900 ha

November 2012 floods in Slovenia

Comparison of VGI results with satellite data

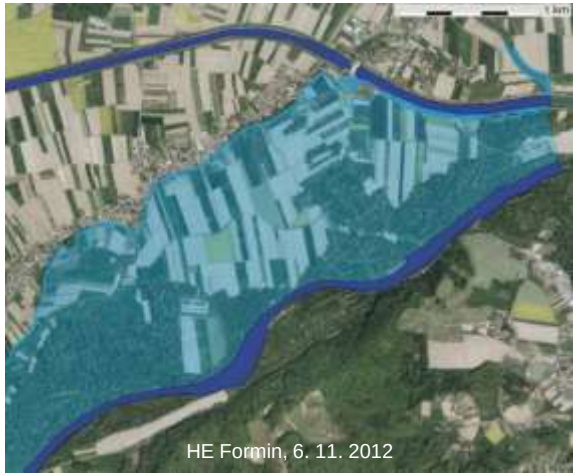
Coverage of the most affected areas in 2012 floods:

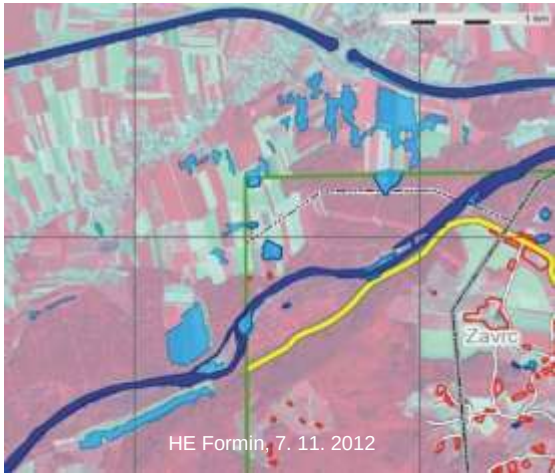
- the **volunteered imagery** covered 12%
- Satellite flood maps covered 18% of most affected areas

SOURCE

Volunteered images

Satellite flood maps:
GIO EMS Mapping products





1 day difference in imaging => reduction of flooded areas to 10%

Triglav-Čekada, M. (2014): Sodelovanje javnosti pri pridobivanju posnetkov za določitev obsega poplav v novembru 2012, Knjižna zbirka Naravne nesreče, ISSN 1855-8879, 3, Ljubljana: Založba ZRC. str. 53-62.

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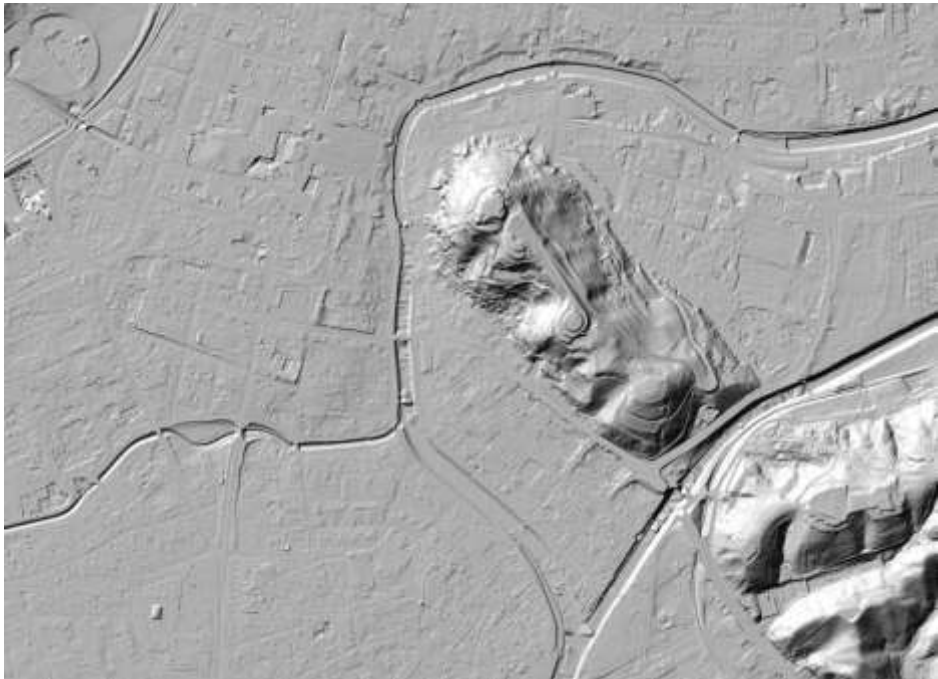
Changes in topography for maps 1:5,000 and 1:50,000

- New buildings, new roads …
- Local volunteers usually notice the change before it is seen on standard national spatial ground data:
  - National **orthophoto** from Cyclical Aerial Survaying (CAS) updated regularly on every 3 years: ordered by the Surveying and Mapping of Slovenia (SMA)
  - National **lidar** was preformed only once for whole country 2011-2015: ordered by Slovenian Ministry for Environment and Spatial Planning

Orthophoto CAS

Lidar 2011-2015, analytical shading of DTM



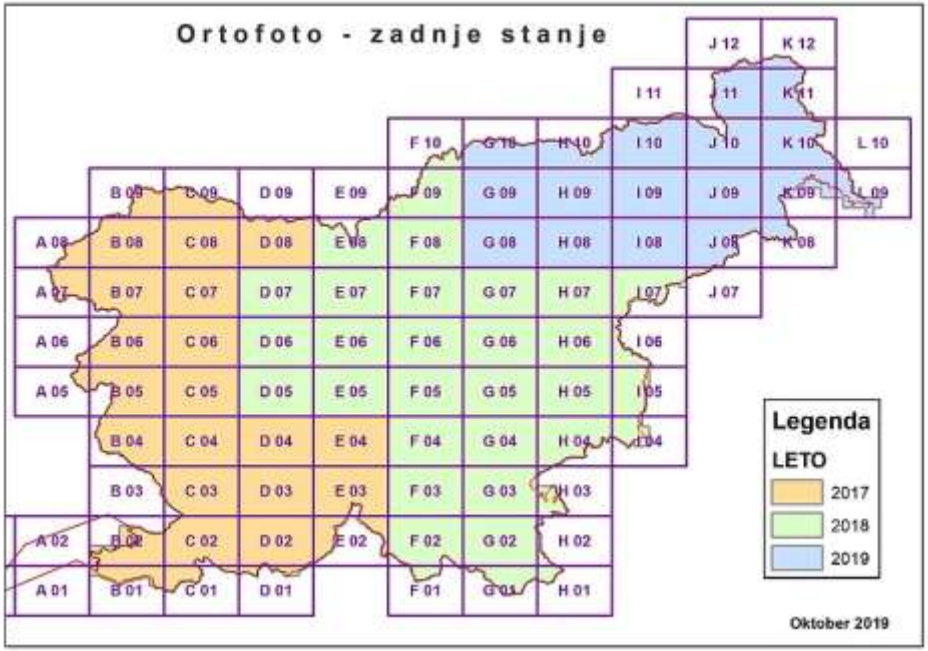
National spatial ground data

Cyclical Aerial Surveying (CAS)

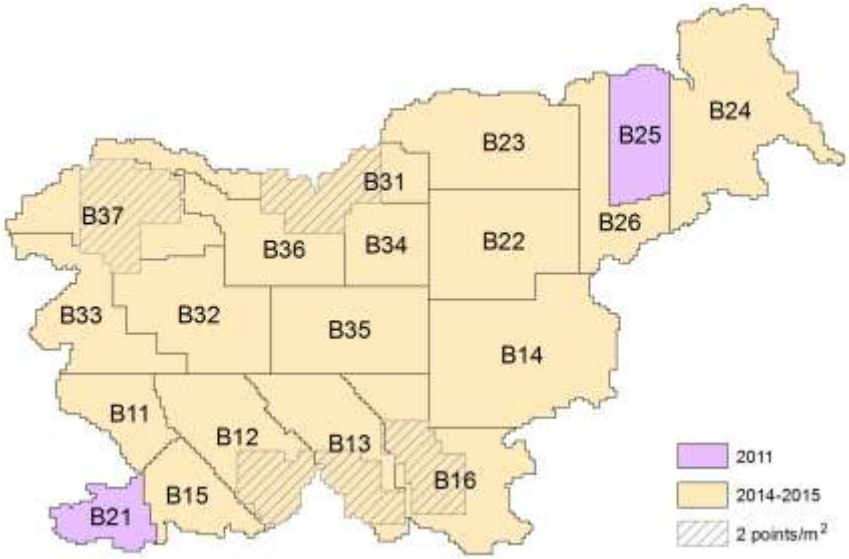
- Ortophoto CAS: resolution 0,5 m× 0,5 m and 0,25 m × 0,25 m
- Aerotriangulation
- Stereo imagery for 3D-stereorestitution

Lidar 2011-2015

- Georeferenced and classified point cloud
- Digital terrain model (DTM): resolution 1 m × 1 m
- analytical shading of DTM: raster in resolution 1 m× 1 m



https://www.e-prostor.gov.si/zbirke-prostorskih-podatkov/topografski-in-kartografski-podatki/ortofoto/



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National maps 1:5,000 and 1:50,000

National map 1:5000 (ordered by SMA)

- 2.5 D topographic database
- Every object has at least one elevation
- Some have a multiple elevations: buildings, tall objects

National map 1:50,000 (SMA and MD)

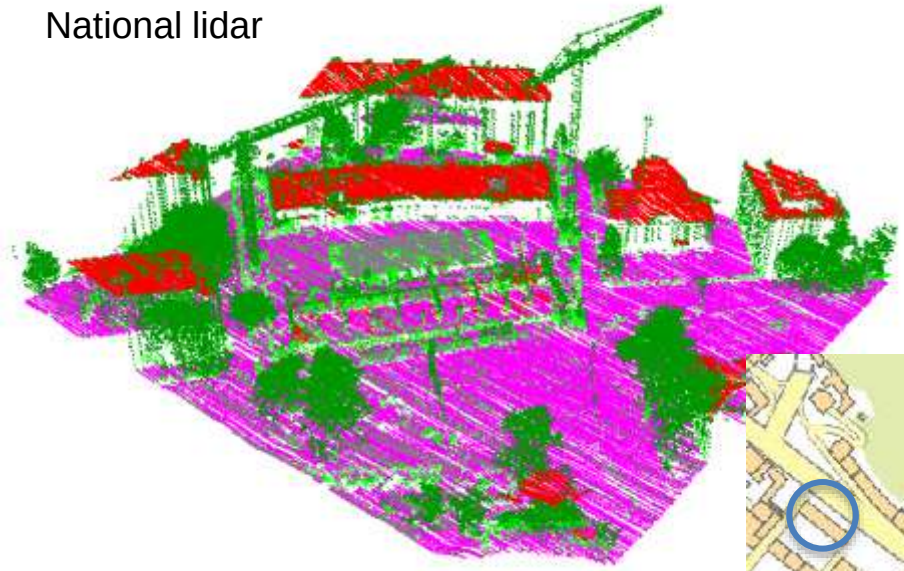
- 2 D topographic database
- Some layers have also additional attribute giving elevation: contour lines, characteristic points

National map 1:5,000

National map 1:50,000

A new building which replaced an old building of different shape and size

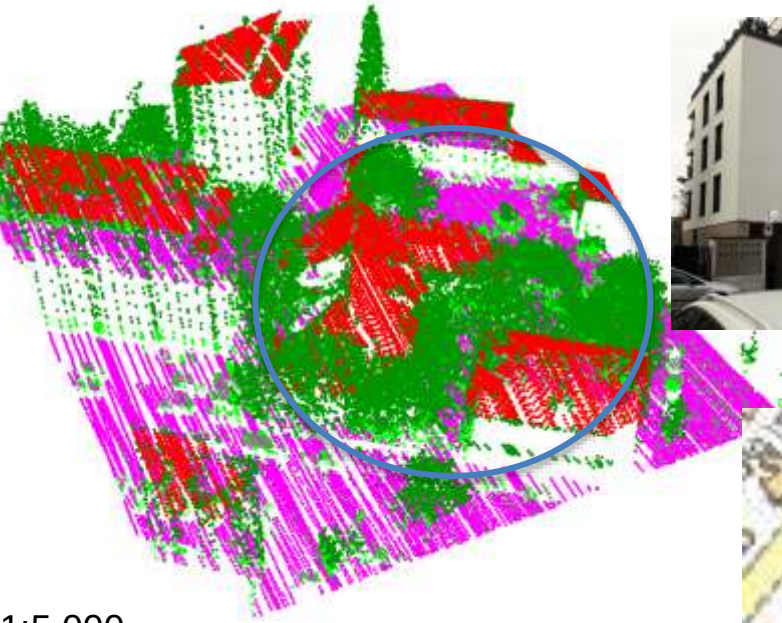
National lidar

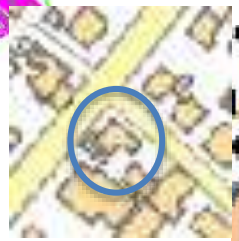


1:5,000

1:50,000

A new building which replaced an old building of different shape and size



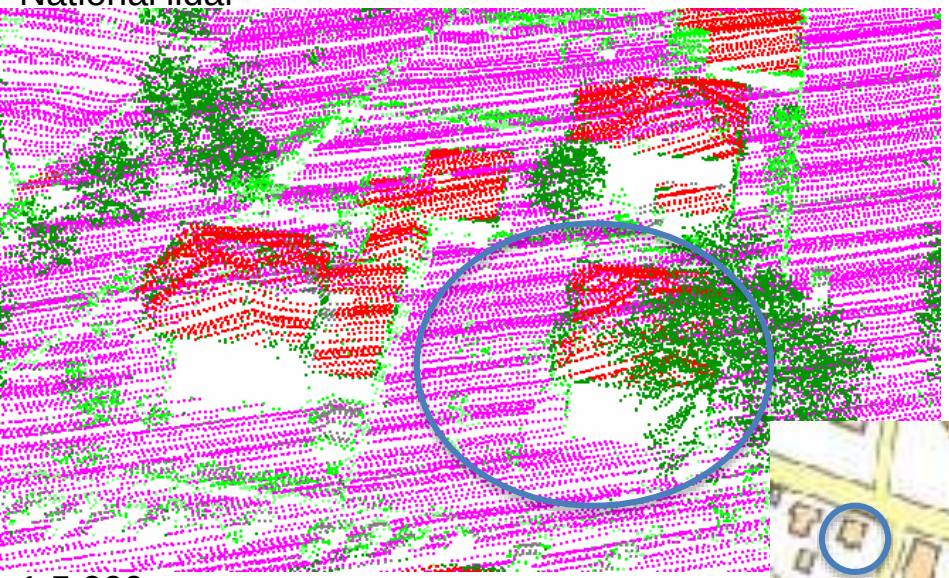


1:5,000

1:50,000

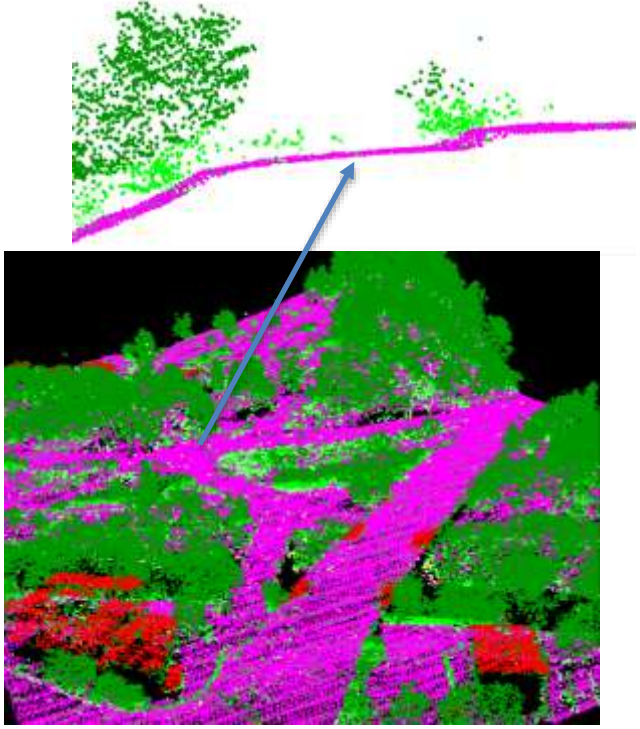
An empty parcel waiting for a new building to be re-erected

National lidar

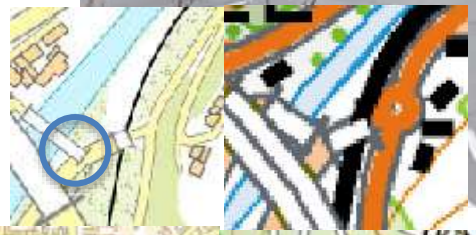


1:5,000

1:50,000



1:5,000



1:50,000

How we can use such images?

- Only as an **information** about the spatial change
- As **location indicator** when using images from smart-phones with embedded location
- More images taken from different angles enable:
  - the **reconstruction of general shape** of a new building, acquisition of detailed changes in roads…
  - acquisition of **3D-data** about new building

Project plan

- **Optimize manual interactive orientation** for topographic change detection acquisition
- **Develop pilot platform** for Volunteered Geographic Information (VGI) data gathering intended for topographic maps change detection
- Plan and perform **controlled VGI gathering of images**
- Process gathered images and **asses its data usability** for national topographic map updating of scales 1:5,000 and 1:50,000