



XXVII FIG CONGRESS

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Volunteering
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Geospatial excellence
for a better living

Renewal of the Cadastral Map of the Netherlands, an Iterative Adjustment Approach

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Renewal of the Cadastral Map of The Netherlands: why?

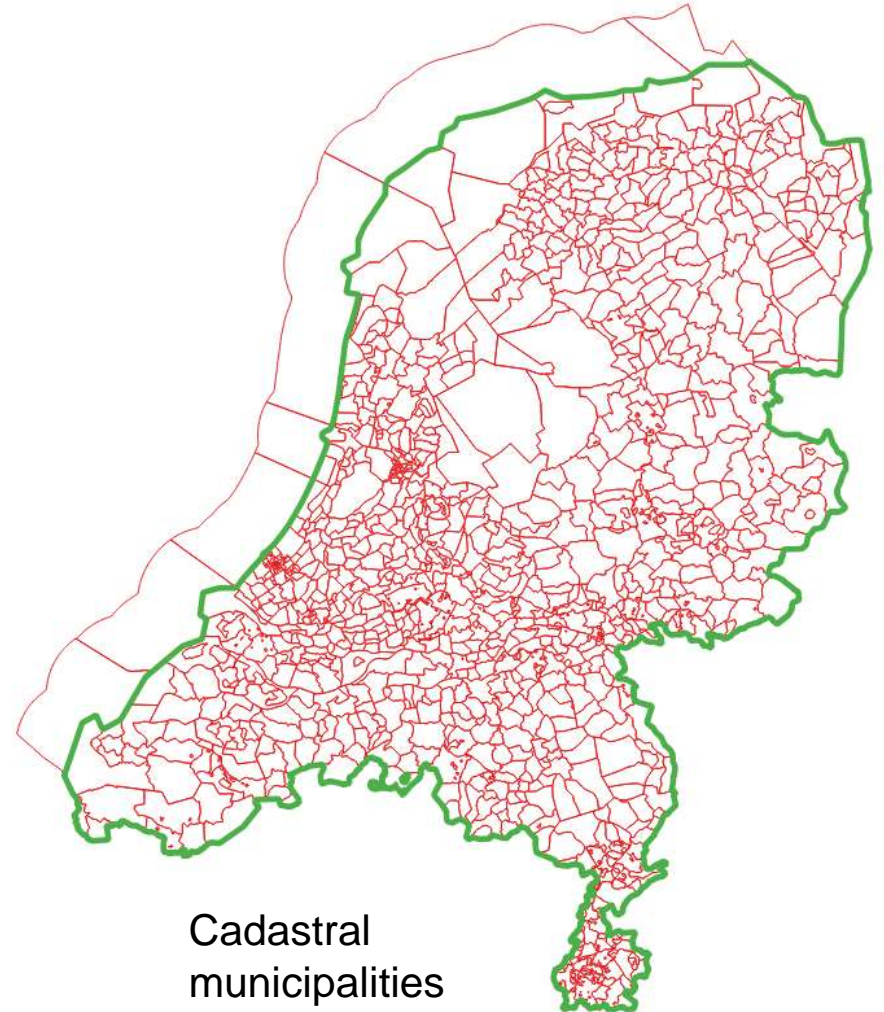
The Netherlands:

- 40.000 km², 17.7 million in habitants
- 1218 cadastral municipalities, 8 million parcels
- 5.5 million historical field sketches

Geometry of the current cadastral map does not meet the requirements of our digital society

Goal:

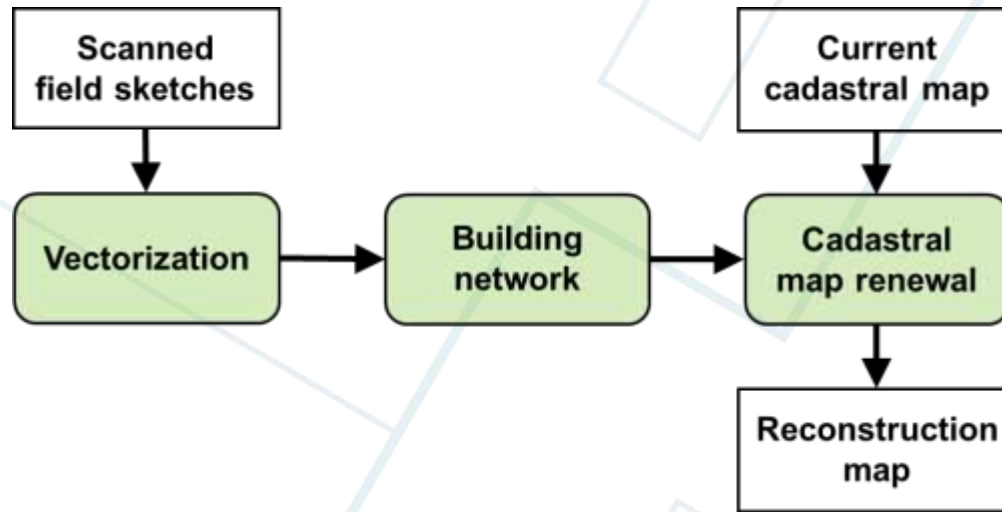
Future-prove accurate cadastral map of known quality



Cadastral
municipalities

Renewal of the Cadastral Map of the Netherlands: how?

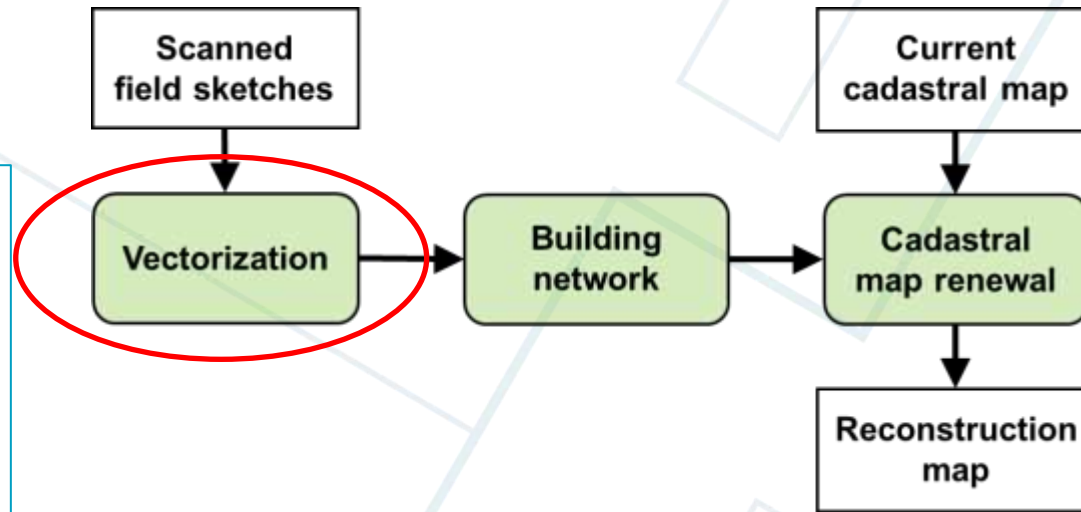
Overview of the renewal process:



Cadastral map improved geometry

Renewal of the Cadastral Map: step 1

Overview of the renewal process:



Cadastral map improved geometry

Vectorization of field sketches

Semi-automatic approach:

- Automation through **Machine Learning**
- Human-in-the-loop for maximum quality

Part of field sketch from 1944

Vectorization steps:

1. Identification & Reading:

- lines
- measurements
- parcel numbers
- ...

2. Quality control:

- Manual correction
- Adjustment



Vectorization of field sketches

Semi-automatic approach:

- Automation through **Machine Learning**
- Human-in-the-loop for maximum quality

Vectorization steps:

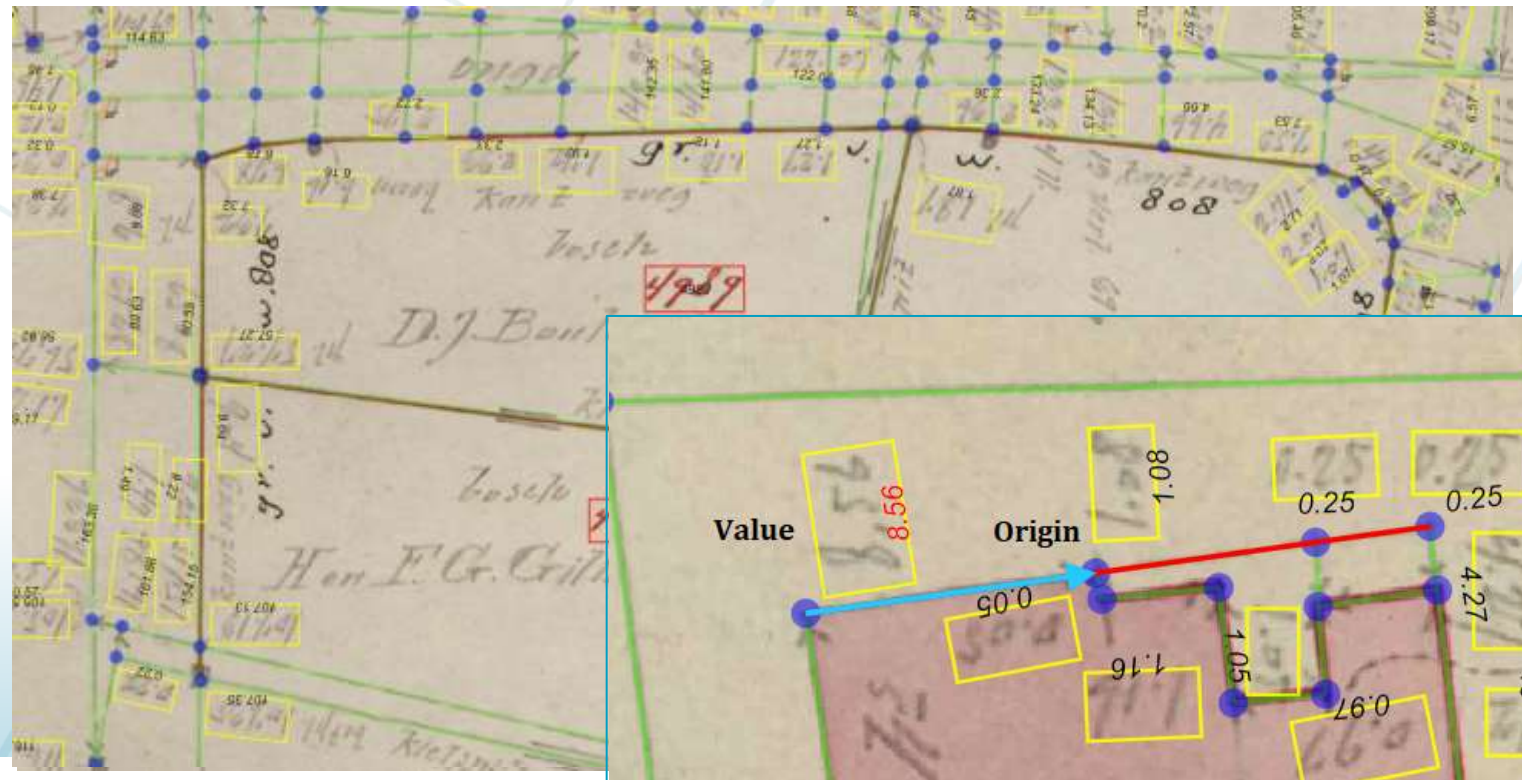
1. Identification & Reading:

- lines
- measurements
- parcel numbers
- ...

2. Quality control:

- Manual correction
- Adjustment

Part of field sketch from 1944



Renewal of the Cadastral Map: step 2

Overview of the renewal process:



Scanned field sketches

Vectorization

Building network

Current cadastral map

Cadastral map renewal

Reconstruction map



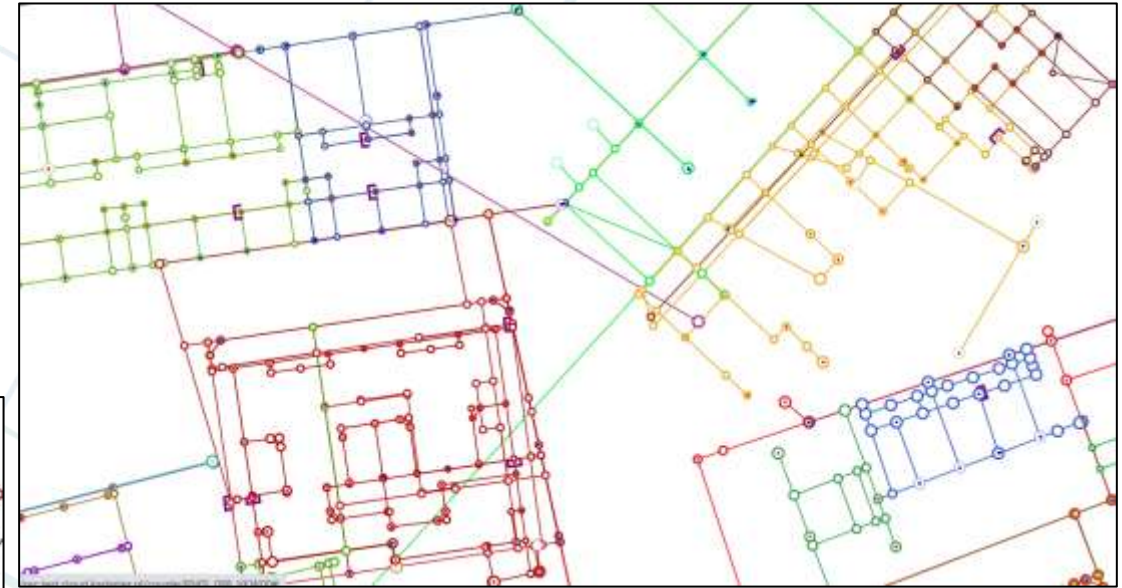
Cadastral map improved geometry





Building a survey network

- Linking field sketches by identifying common points
- Linking to GNSS-measured reference points

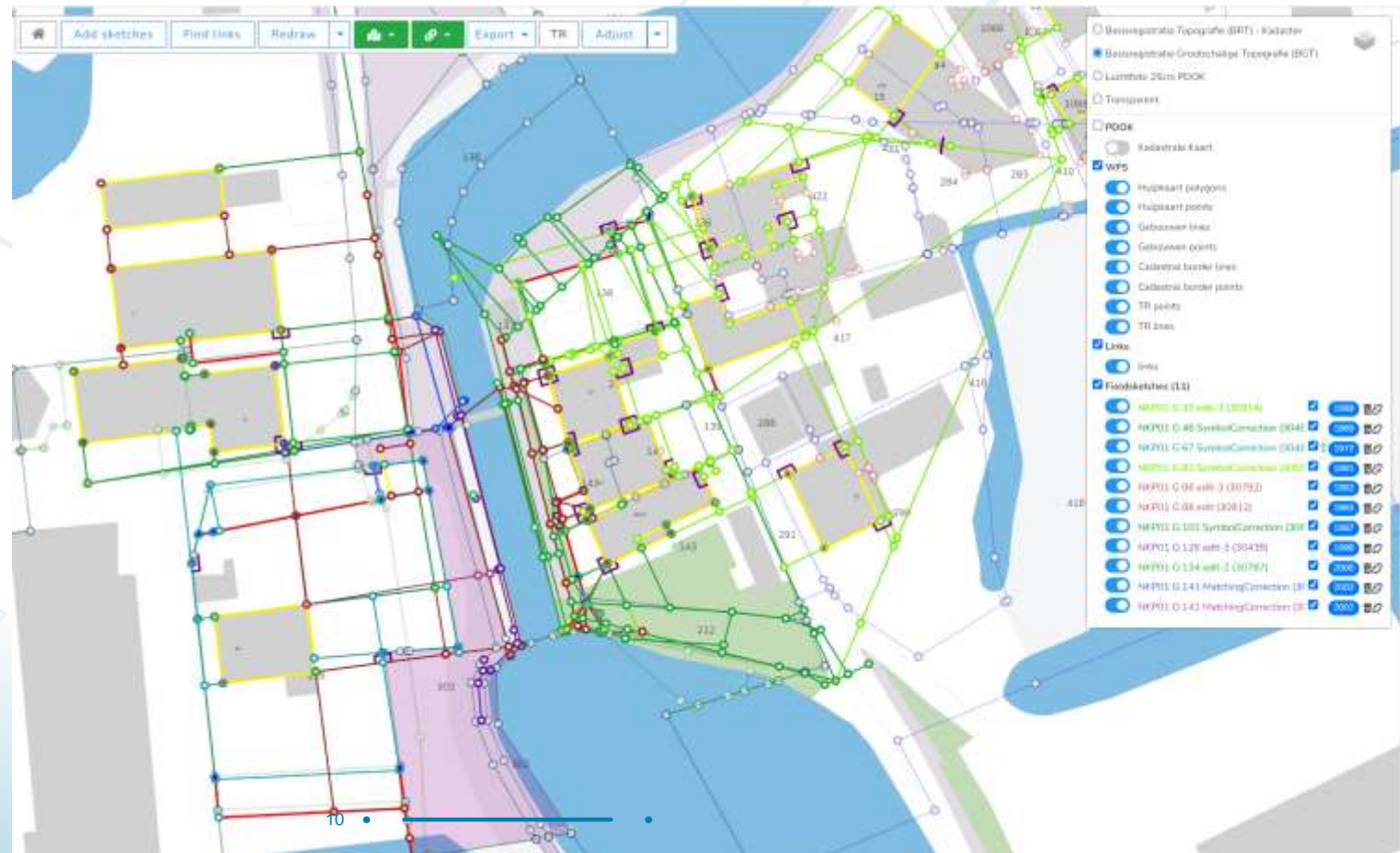




Building a survey network: quality control

Large-scale adjustment and testing of all data:

- Measurements
- Links:
 1. Between field sketches
 2. With cadastral map
 3. With GNSS reference



Large Scale Adjustment

Statistics:

#-files	0/11
Number of stations	291
Number of observations	2220
Degree of freedom	1247

ADVANCED

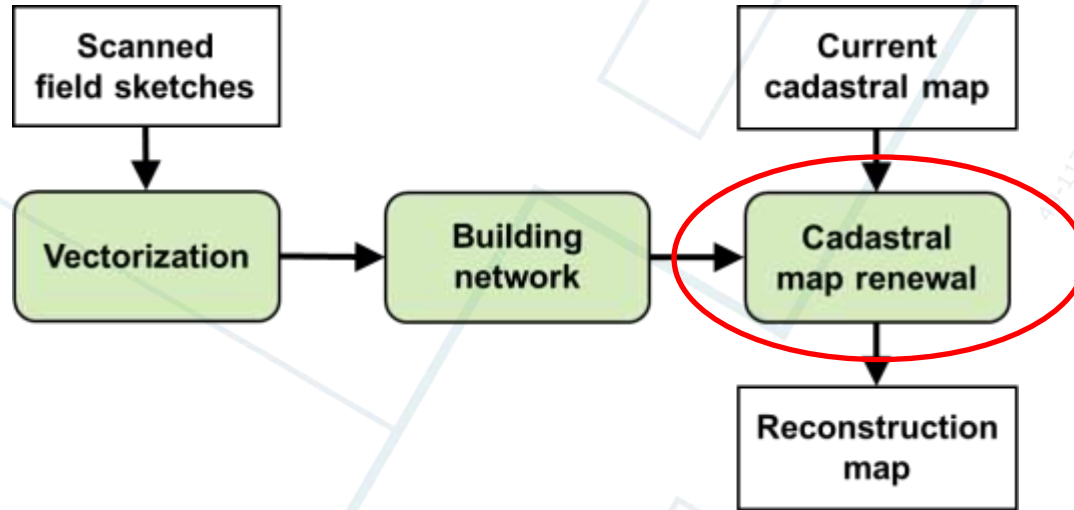
Observations

Type	Record	Status
CH	NKP01G00033_1131_791534	OK
PL	NKP01G00033_1131_791534	OK
TD	NKP01G00033_1132_791547	OK
CH	NKP01G00033_144_791555	OK
AN	NKP01G00033_s37_405483	OK
CH	NKP01G00033_148_791542	OK
CL	NKP01G00033_s42_405535	OK
CH	NKP01G00067_148_791910	OK
AN	NKP01G00067_s1_405570	OK
PL	NKP01G00067_s4_791919	OK
PL	NKP01G00033_167_791018	OK
SV	p_IDR_242288	OK
TD	NKP01G00033_1237_791694	OK
CH	NKP01G00067_111_791912	OK
SV	p_IDR_242288	OK
AN	NKP01G00033_s38_405484	OK
CH	NKP01G00033_1238_791995	OK
CL	NKP01G00033_s45_405533	OK
PL	NKP01G00033_1206_791090	OK
PL	NKP01G00033_120_791564	OK
AN	NKP01G00033_s39_405444	OK
CH	NKP01G00033_121_791332	OK
AN	NKP01G00033_s12_405457	OK
PL	NKP01G00067_145_791910	OK
TD	NKP01G00067_141_791913	OK



Renewal of the Cadastral Map: step 3

Overview of the renewal process:



Cadastral map improved geometry



Updating the cadastral map

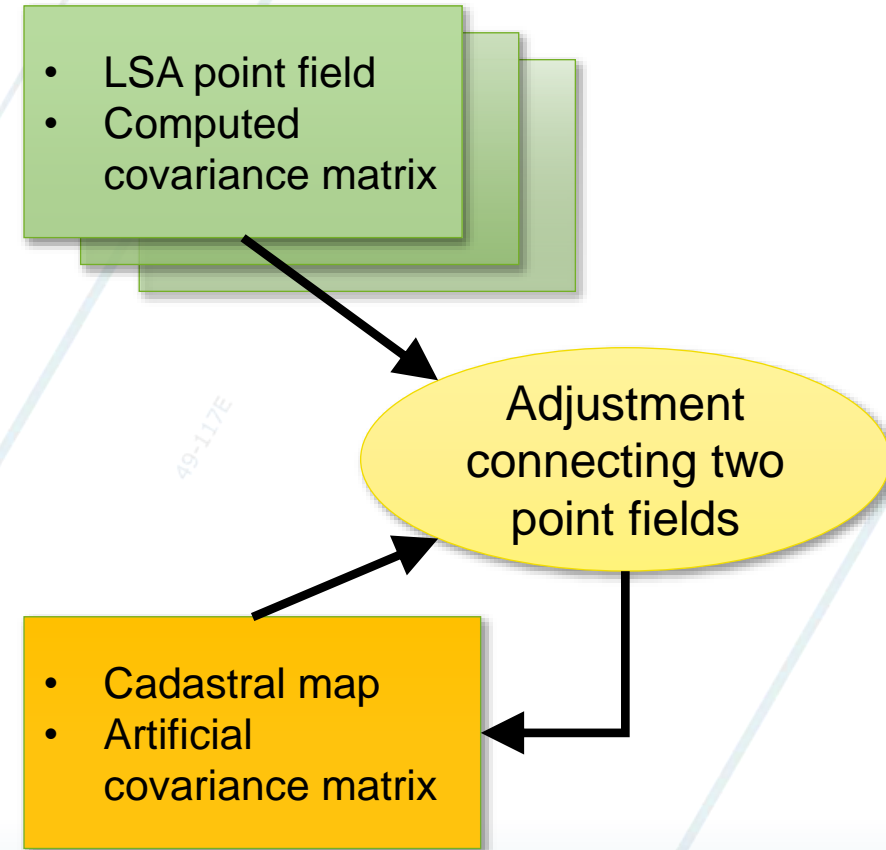
- Large-scale adjustment (LSA) for networks of field sketches
- Update the cadastral map for each network
- Quality control for each update

Use “full” covariance matrices for both point fields:

1. Computed by LSA for each geodetic network of field sketches
2. Artificial covariance matrix for current cadastral map

Benefits:

- Iterative and scalable approach
- Interpolation of points of the map that are not measured
- Quality description of updated cadastral map





Results of testing the cadastral map renewal process

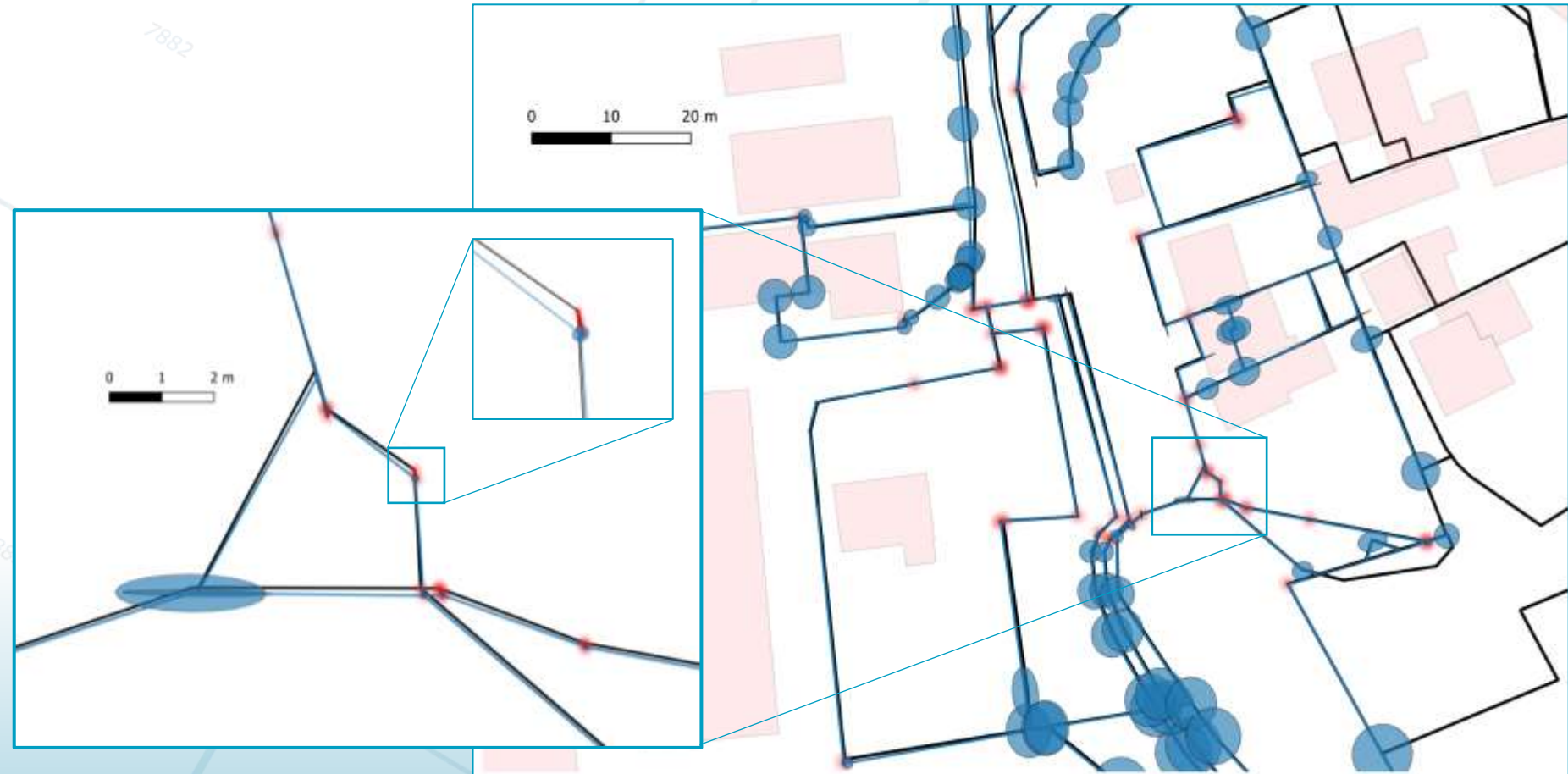
Performance and scaling investigated using simulated and real data





Results of testing the cadastral map renewal process

Performance and scaling investigated using simulated and real data



Black: current map
Blue: updated map with
95%-confidence ellipses
Red: map points linked
to field sketches





Results of testing the cadastral map renewal process

Performance and scaling investigated using simulated and real data

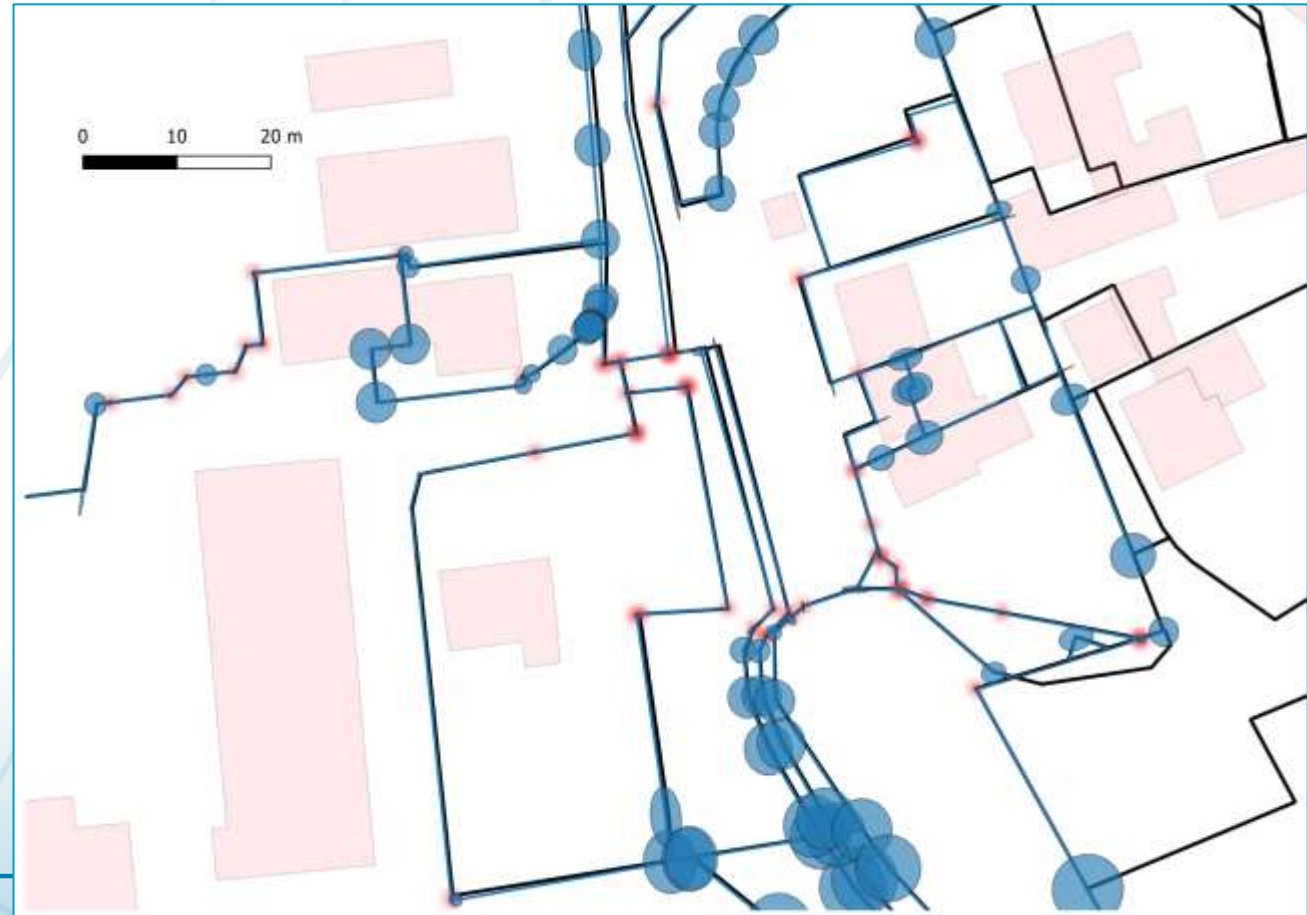
Conclusions:

- Iterative approach is feasible
- Precision of the improved map is at cm level as long as there is good connection with GNSS-measured reference points

Black: current map

Blue: updated map with
95%-confidence ellipses

Red: map points linked
to field sketches





Conclusions and outlook

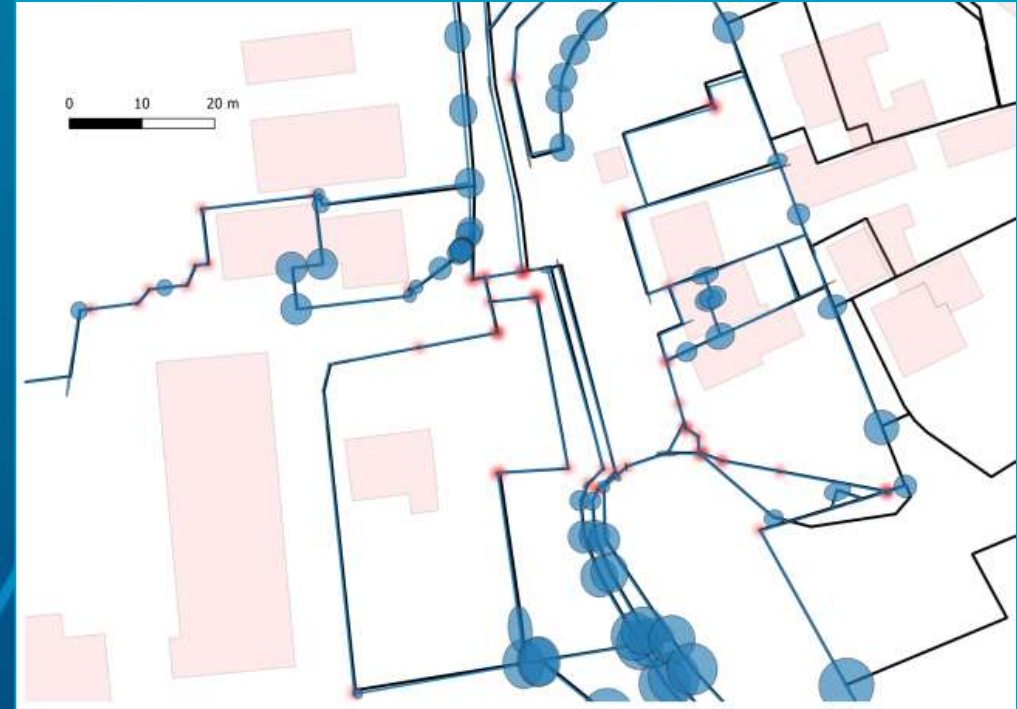
- The iterative adjustment approach is feasible and results in optimal and known quality of the reconstruction map

Next steps:

- Integration of the reconstruction map in the cadastral systems
- Starting the production of the reconstruction map next year.



kadaster



Frank van den Heuvel

Thank you