NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

Smartphone Positioning Accuracy and Characteristics of Volunteered Geographic Information from Pyykkijahti

EuroSDR/AGILE 2024 workshop:
Current trends of volunteered geographic information in national mapping and cadastral agencies

4.6.2024 Glasgow, Scotland

Pyry Kettunen, Anssi Jussila, Milja Korhonen, Mikko Rönneberg

Research Group of *Geospatial Representation and Interaction* GEORI

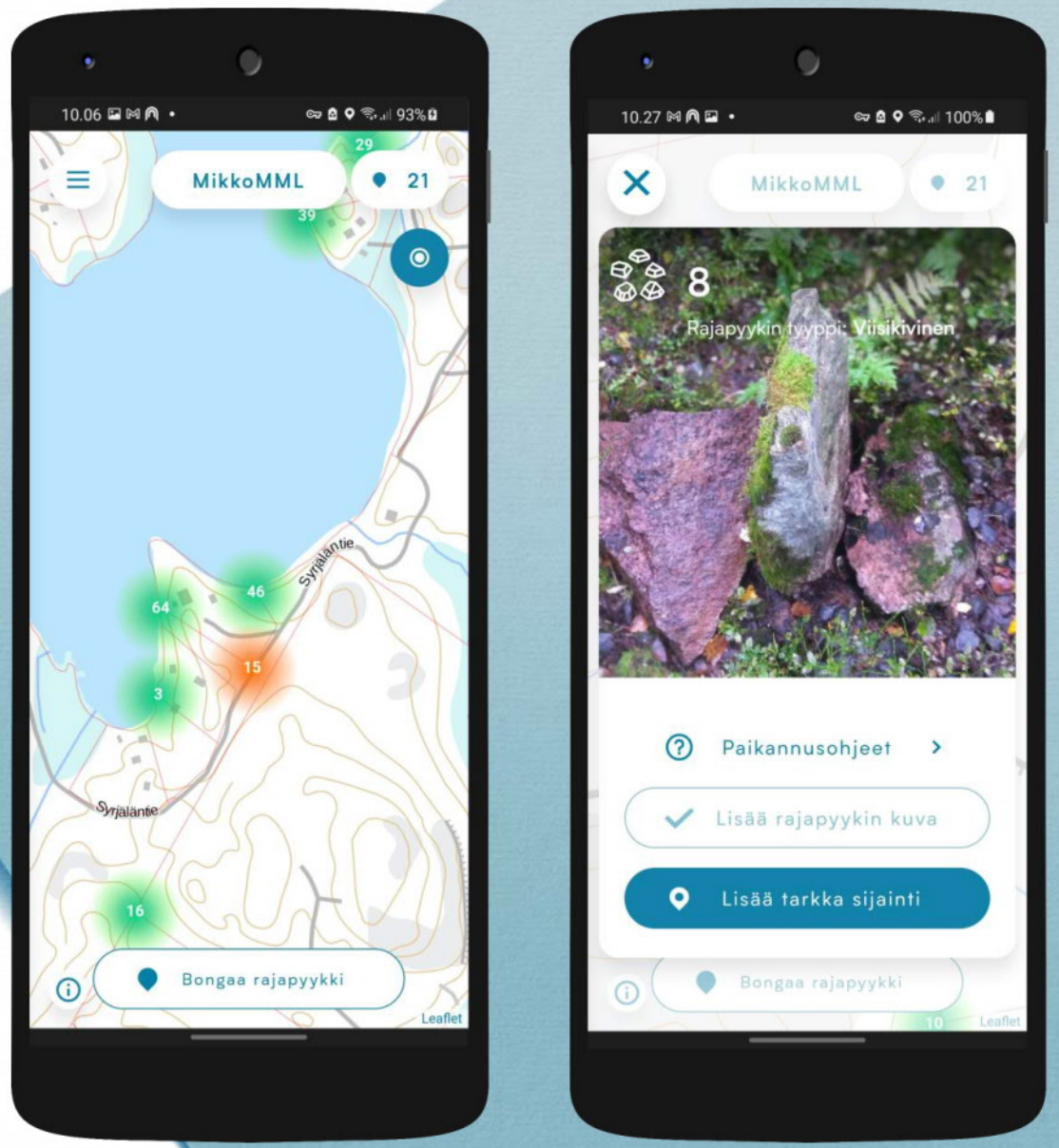
Department of *Geoinformatics and Cartography* FGI-GEOINFO

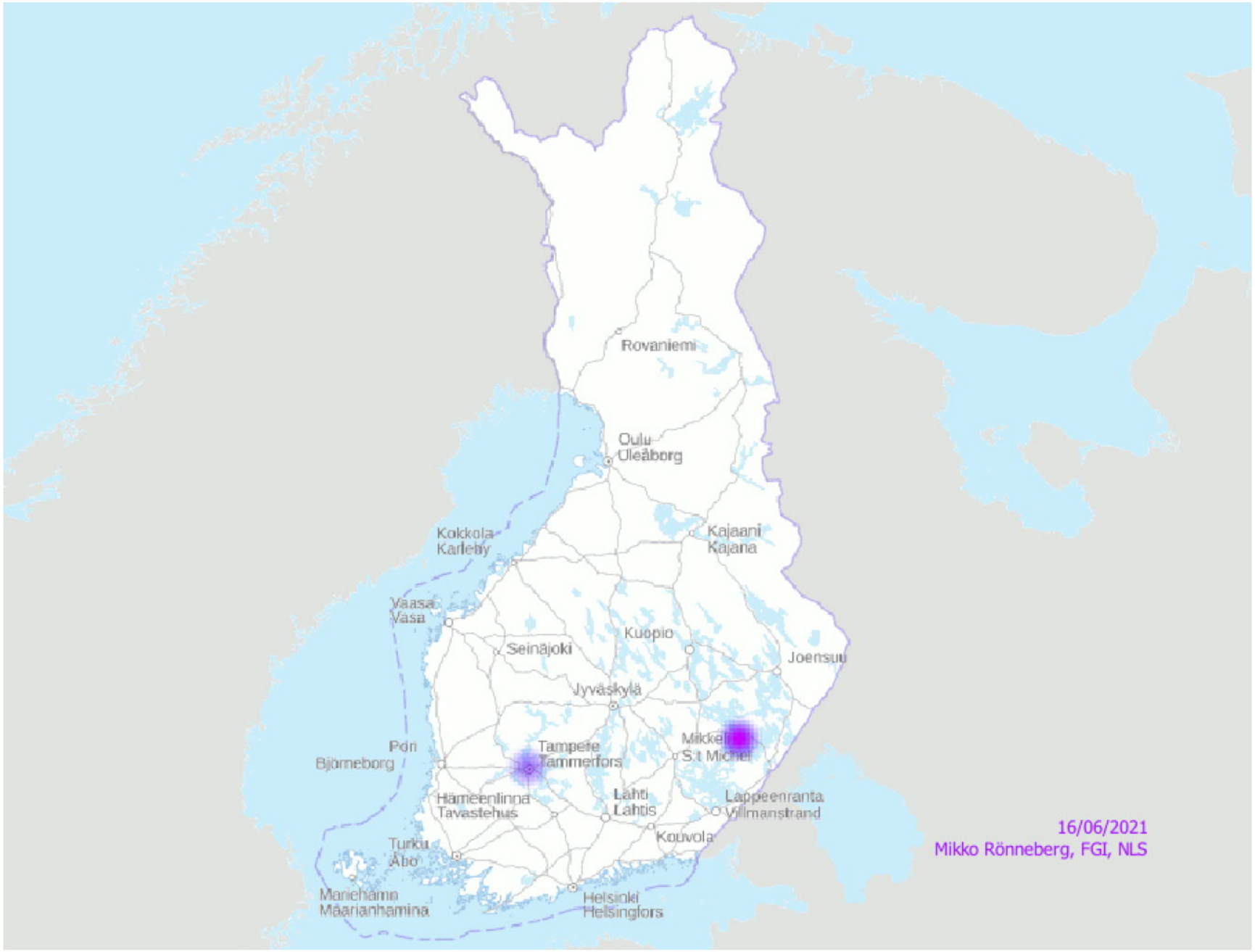
Finnish Geospatial Research Institute (FGI, NLS)

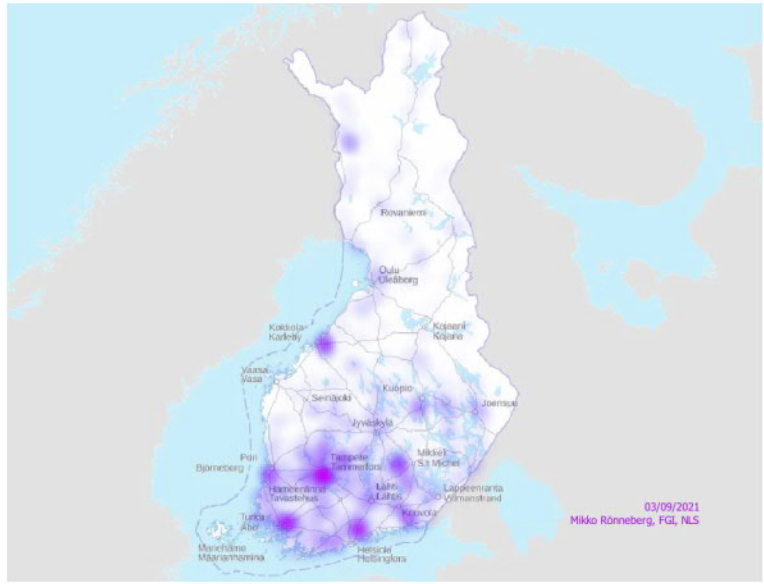

28
15

Marker Quest (Pyykkijahti)

- Game for enhancing location accuracy of border markes in the Finnish cadastral index map (CIM) by crowsourcing.
- Players measure inaccurate markers in the terrain *or* mark them missing.
- June 2021 – September 2022
  - +4 500 users.
  - +30 000 contributions.
  - 82% considered Pyykkijahti pleasant or very pleasant experience (n=402).

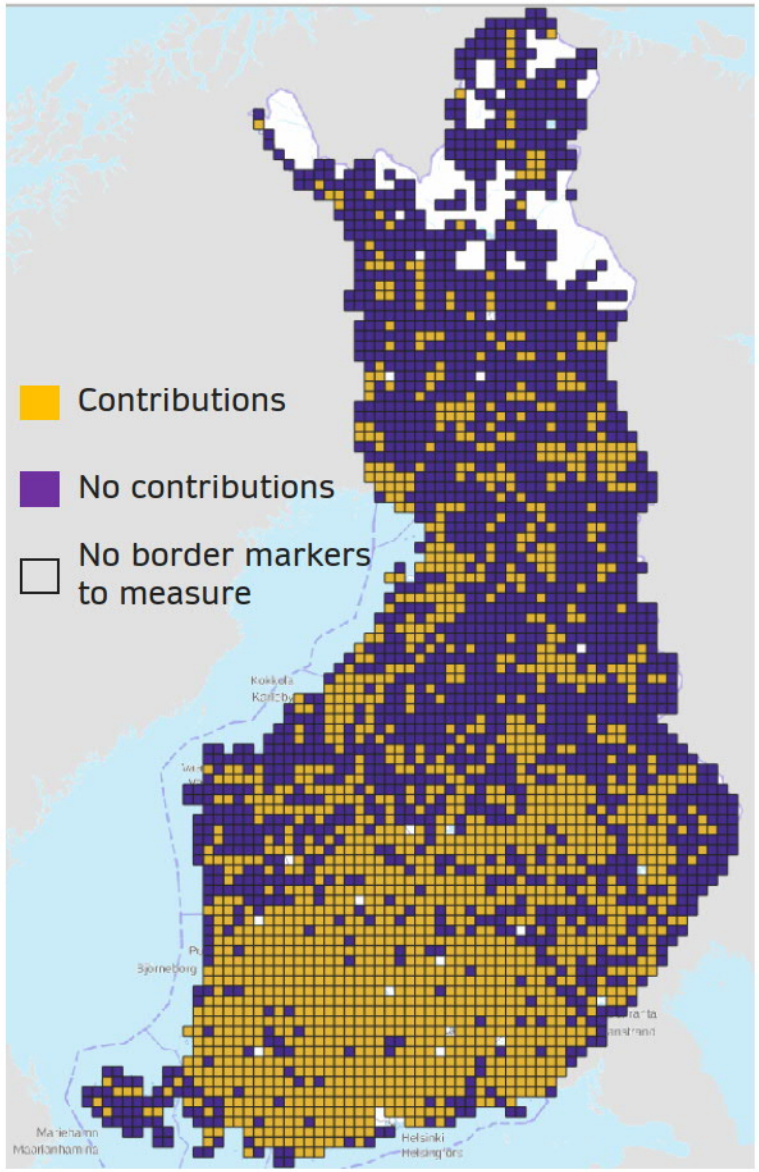


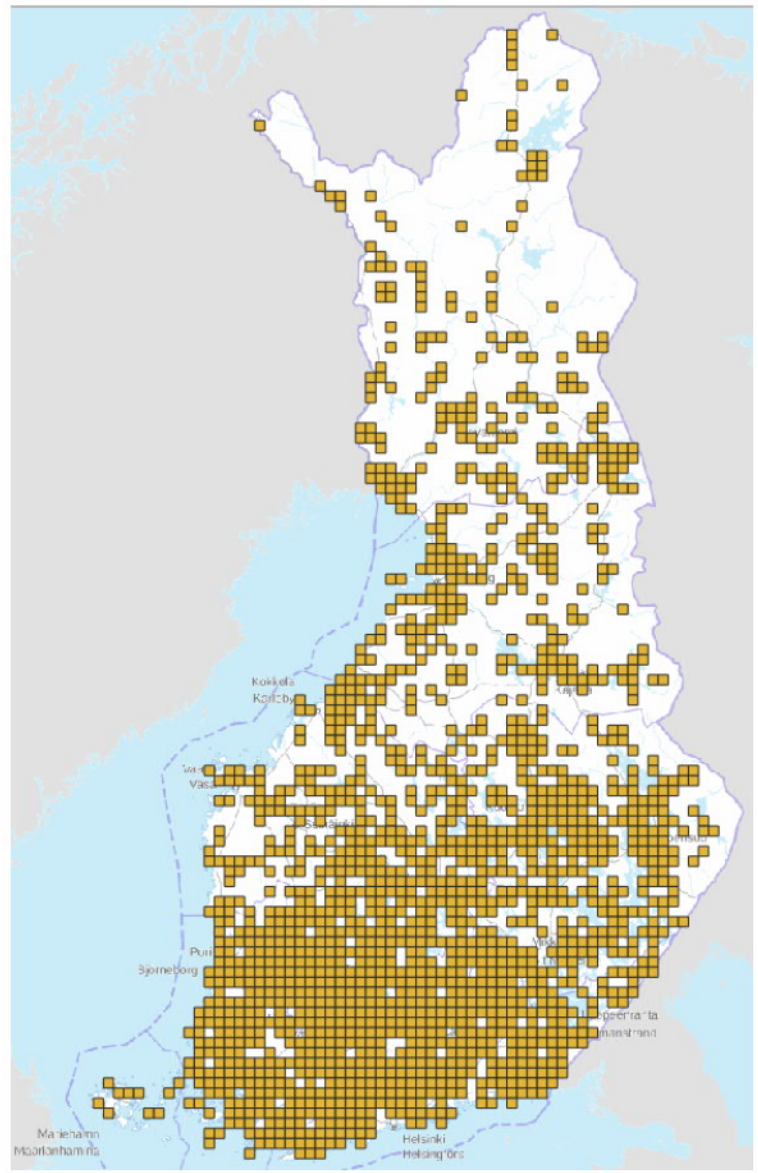


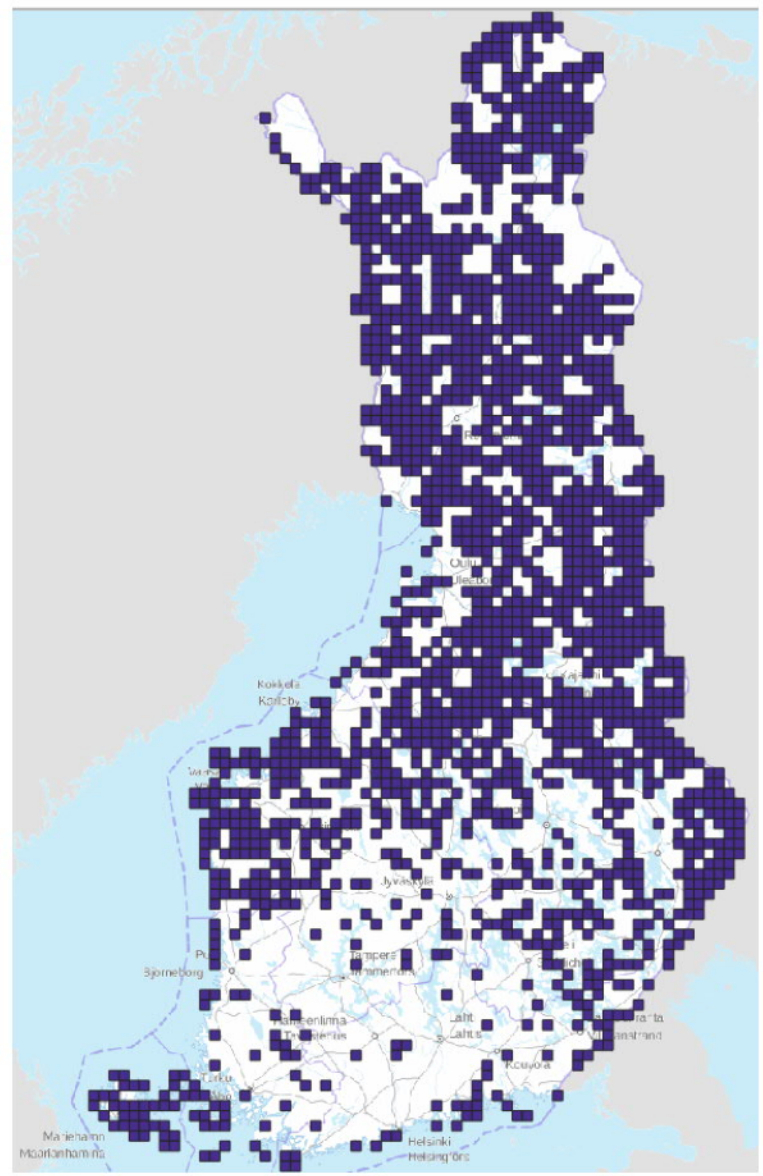


Accumulation of measurements during the pilot

- 17.6.-1.9.2021
- media campaign in Pirkanmaa

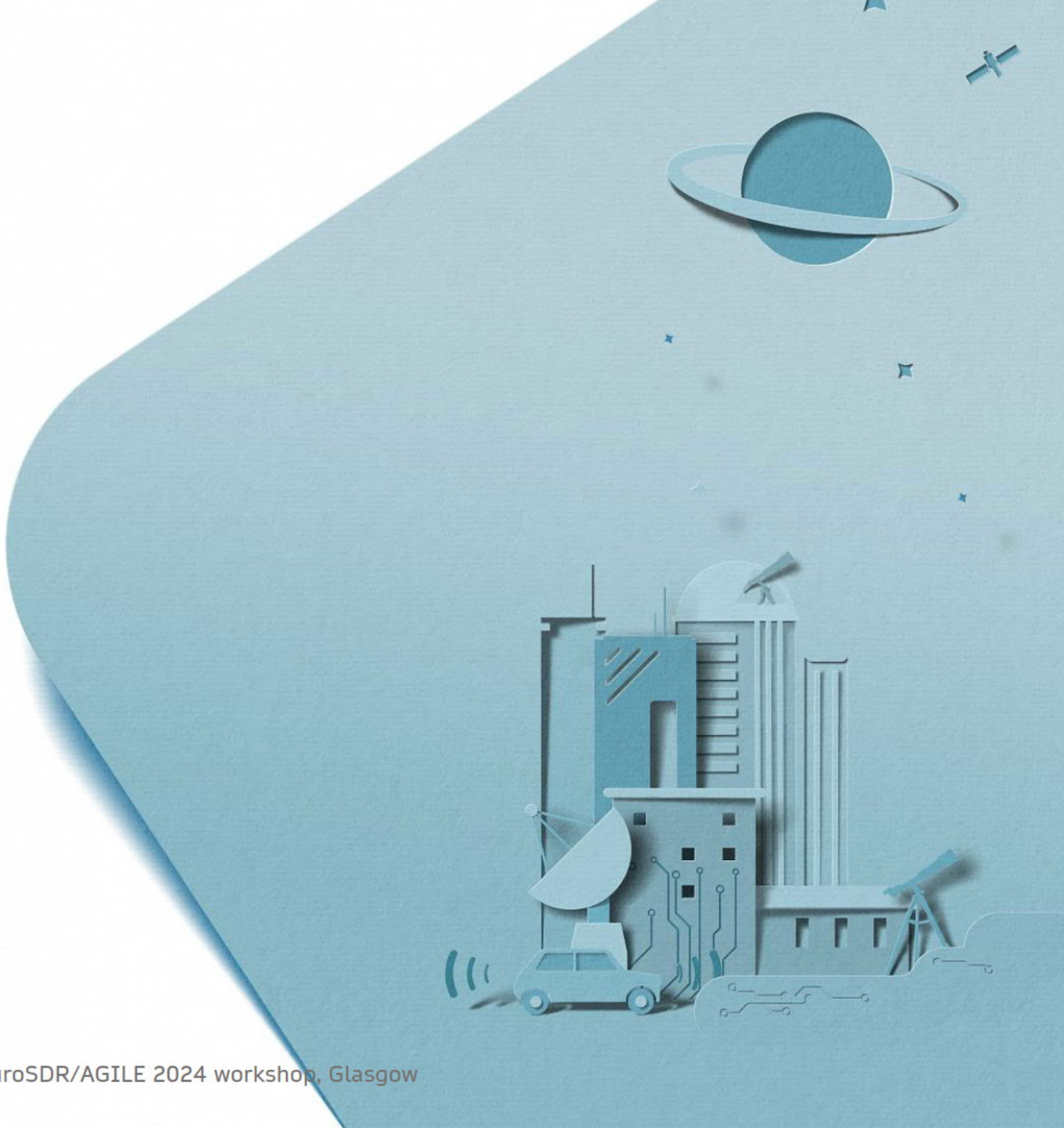

Contributions
No contributions
No border markers to measure
Kokkola
Karleby
Pori
Björneborg
Mariehamn
Maarianhamina
Helsinki
Helsingfors


Kokkola
Karleby
Pori
Björneborg
Mariehamn
Maarianhamina
Helsinki
Helsingfors

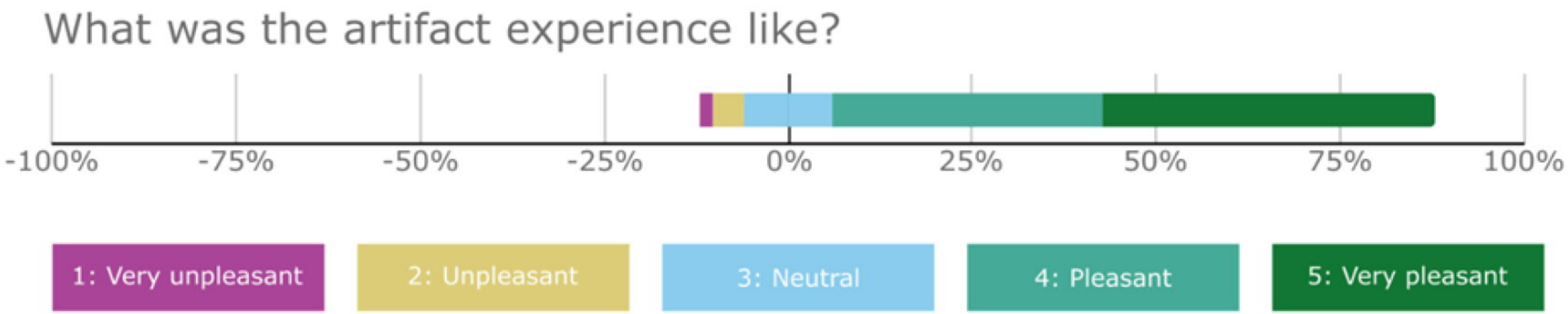

Kokkola
Karleby
Pori
Björneborg
Mariehamn
Maarianhamina
Helsinki
Helsingfors

Crowdsourcing

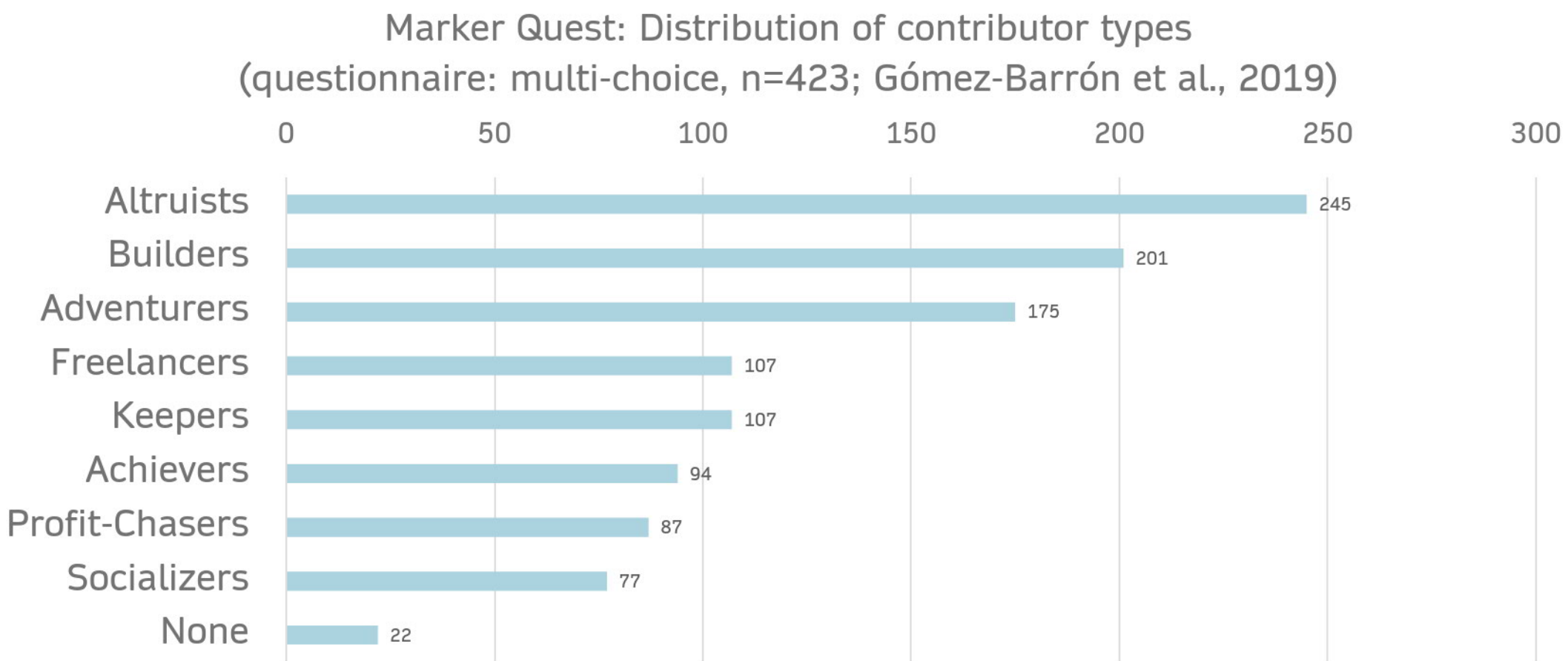
Why over 4600 citizens went searching for border markers?



Evaluation results



Contributor types

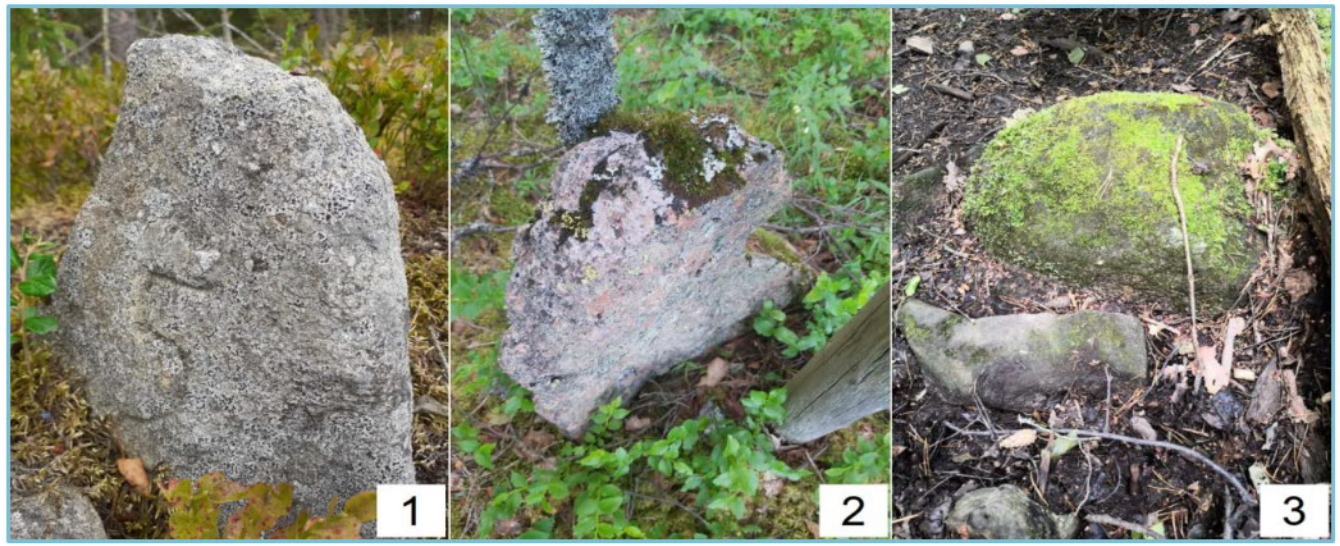


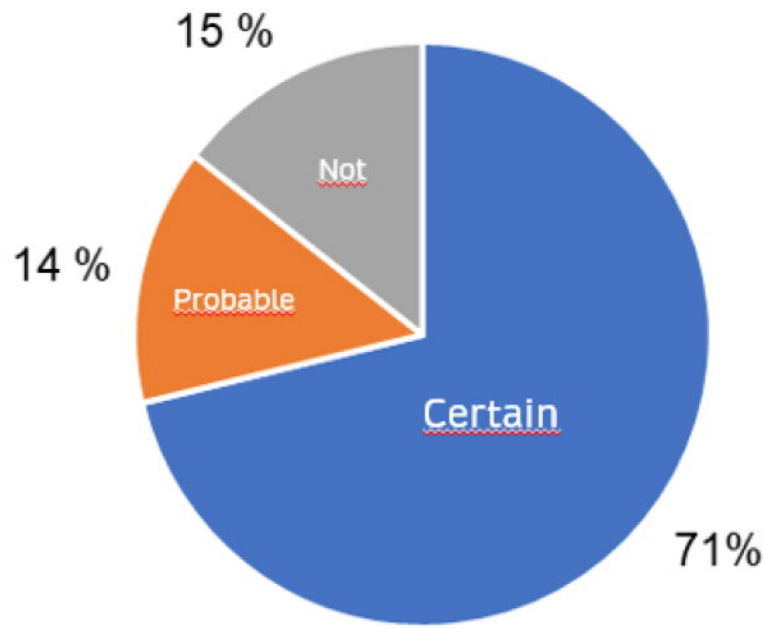
Reliability of Marker Quest measurements

Visual inspection of marker photos by professional surveyors

- 400-marker random sample

1. Certain border marker
2. Probable border marker
   - 60 % possibility
3. Not a border marker





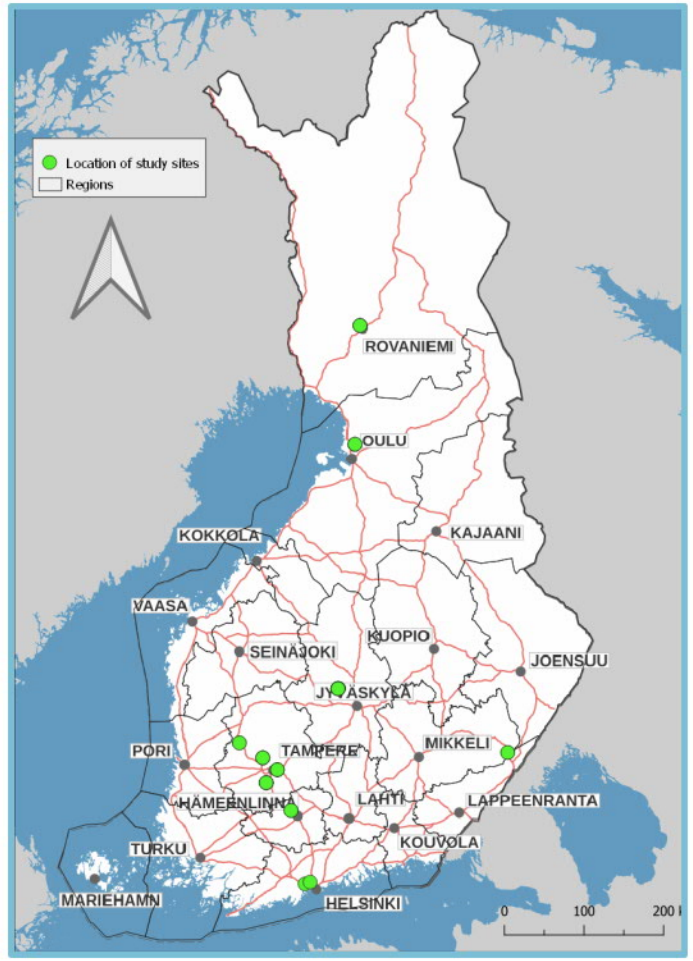
Accuracy of smartphone positioning

Accurate at all?

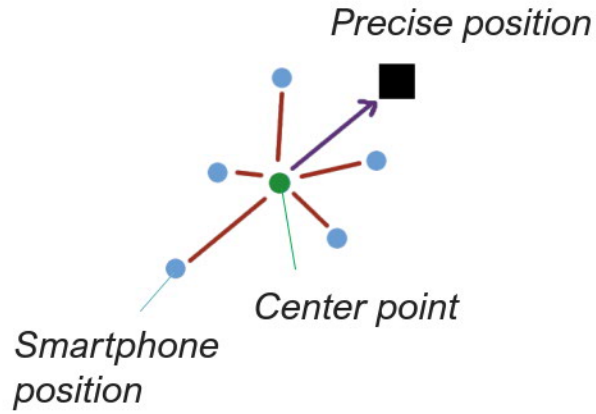
Study areas and measurements

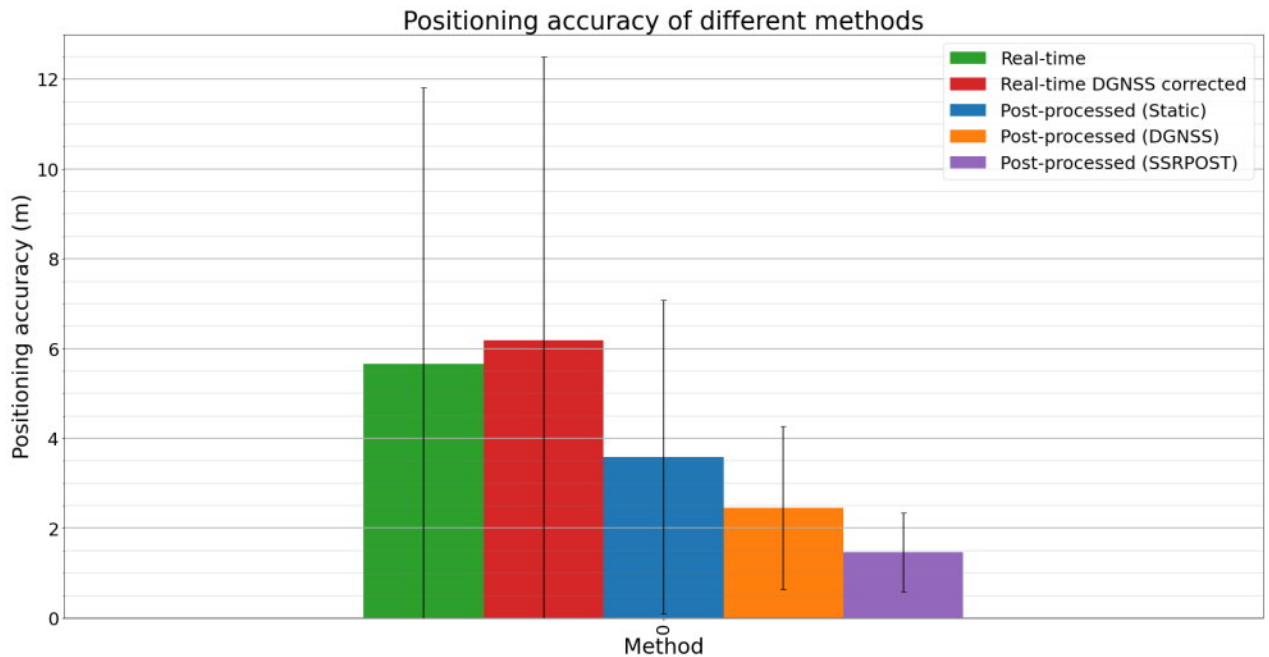
- Test measurements were done by surveyors of NLS
  - Measuring was done in a simulated crowdsourcing environemnt
  - Smartphone measurements were taken from each border marker
  - Reference measurements of border markers were taken by accurate GNSS RTK positioning

- Statistics
  - 41 border markers
  - 1889 measurements
  - 12 smartphone types



Positioning accuracy of center points





Positioning accuracy of positioning techniques

	mean (m)	st dev (m)	median (m)
Real-time	5,66	6,15	3,18
Real-time DGNSS corrected	6,19	6,31	3,76
Static	3,58	3,49	2,31
DGNSS	2,45	1,81	2,09
SSRPOST	1,46	0,88	1,34

Positioning accuracy change when number of measurements increases

- Order of measurements was selected randomly for each iteration.

Summary & Conclusions

- Big data crowdsourcing is realistic for NMCA needs
  - gamification and ease of use inspires to start and keep measuring.
- Over 90% of border markers with lower than 5 m accuracy can be enhanced significantly.
- Positioning accuracy improves importantly with post-processing
  - individual measurements: 3,92 m
  - average center points: 1,42 m.
- Repeated measurements
  - most improvement with 2–3 measurements
  - minimal improvement after 10 measurements.
- Further studies
  - geodetic and calculational optimisations of the post-processing workflow
  - study differences of common smartphone models
  - longer field measurement times.

Publications & Acknowledmegments

Rönneberg, M. and P. Kettunen, 2023. A gamified map application utilising crowdsourcing engaged citizens to refine the quality and accuracy of cadastral index map border markers. *International Journal of Digital Earth*, 16(2), 4726-4748. https://doi.org/10.1080/17538947.2023.2279673

Jussila A, 2023. Positioning accuracy of smartphones in crowdsourcing context. Master's thesis, Department of Geoinformatics, Aalto university. http://urn.fi/URN:NBN:fi:aalto-202305213319

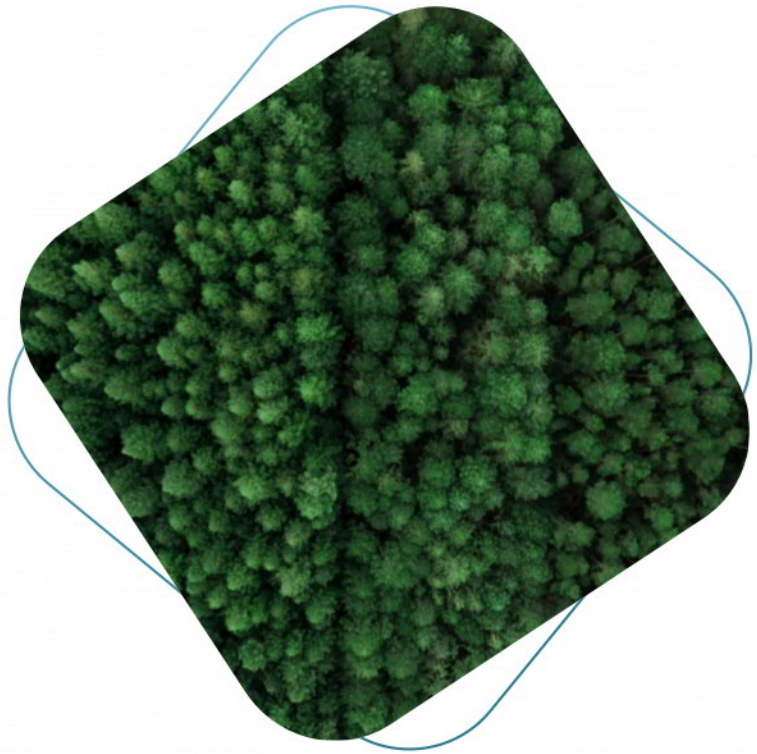
Kontiokoski A, 2021. Rajamerkkien sijaintitarkkuuden parantaminen joukkoistetuilla älypuhelinmittauksilla. Opinnäytetyö, Lapin AMK. https://urn.fi/URN:NBN:fi:amk-202202252860

Kettunen, P. and M. Rönneberg, 2022. Accuracy Enhancement of Cadastral Boundary Marker Coordinates with Smartphone Crowdsourcing. In Krisp, J.M., Meng, L., Kumke, H. and H. Huang (eds.), Proceedings of the 17th International Conference on Location-Based Services, pp. 154–155. https://hdl.handle.net/10138/350768

Luore and *Matko* projects of the *National Land Survey of Finland*, 2021-22.

CITIZEN CONTRIBUTORS

Thank you for your attention!



Knowing the Earth – Securing the future

NLS
FINNISH GEOSPATIAL RESEARCH INSTITUTE
FGI