Introduction to the National Report of Finland for the International Cartographic Association (ICA)

When the previous ICA special issue of POSITIO magazine was published in 2019, few of us had any idea of the upheavals our societies would face in the coming years. The corona crisis swept two years from that period, and in February 2022 Russia launched its war of aggression in Ukraine violating harshly the international law and the UN Charter. Adapting to disruptions has become an integral part of our daily lives.

JUHA OKSANEN
Prof. Juha Oksanen
Chair of the Cartographic Society of Finland

The geographic information sector is also in a state of constant transition. Geospatial data and its cartographic representation are at the heart of information-based decision-making. Modern data collection methods and privacy-respecting big data, combined with powerful artificial intelligence solutions, will revolutionize the creation of high-value geospatial data sets. New types of geospatial data and efficient digital distribution channels will challenge the traditional ways of visually presenting information. As new solutions evolve, so will our ability to share historical aerial imagery and maps. The entire geographic information landscape, in all its diversity, has enormous potential for innovation, which can only be exploited through effectively functioning networks. Only time will tell how the world looks after the on-going digital revolution.

This magazine is a compilation of articles of general interest in the field of geoinformatics, mapping and cartography published in POSITIO magazine in 2019–2023, as well as a number of new reviews of current issues prepared for this special issue. This POSITIO Special Issue is the national report of the Cartographic Society of Finland for the 19th General Assembly of the International Cartographic Association.

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Location Innovation Hub – towards future solutions with location intelligence

The ultimate aim of the European Green Deal is that Europe achieves climate neutrality by 2050.To achieve this goal, the EU will invest massively in competitive and resilient industries technological innovation, and cutting-edge research. One of Europe's joint efforts has been to set up more than 150 digital innovation hubs.

ANNIINA LUNDVALL
Communication Manager
National Land Survey

The Location Innovation Hub is Europe's only centre of excellence focused on location information. LIH works with a largenetwork of partners. Operations started in early 2023.
"Our goal at LIH is to support businesses and government organisations in developing their competitiveness. We help to take leaps in digitalisation by using location data," says Project Manager **Antti Jakobsson**. "We are one of four European Digital Innovation Hubs in Finland. We operate on a one-stop-shop basis, directing customers to the services of other European hubs."

LIH helps businesses develop solutions for the future

According to the European Green Deal, businesses and governments should now look for concrete solutions to climate challenges, biodiversity loss, overconsumption of natural resources and the promotion of a circular economy. The aim of the Location Innovation Hub is to support actors in making use of solutions such as next-generation positioning technologies and precise positioning. By harnessing the potential of high performance computing and artificial intelligence, a company can makea significant leap in development .

"We provide our customers with networks, partners, training, guides, and test environments. Together with a network of partners, we tailor the package to the company," says **Faris Alsuhail**, technical infrastructure specialist at the Location Innovation Hub.

"We measure the digital maturity of customers at the beginning of the process and find out how the company is developing. The goal is to increase the competitiveness and digital competence of our customers so that they can thrive in the European market and expand into new business areas," says Alsuhail.

Networks unleash the potential of location data

The actual customer work in the Location Innovation Hub will start in the autumn 2023, when most of the services will be ready to be offered to customers. During the spring and summer, LIH has already been showcased at various events. For example, LIH brought to Finland the Geomob event concept, which is popular around the world. The first Geomob Helsinki event attracted dozens of researchers, students and companies interested in the future of earth observation. The event was a good example of LIH activities aimed at sharing knowledge, strengthening networks between people and promoting the potential of location data.

”From a sustainable development perspective, more efficient use of satellite data would make a lot of things possible! Innovations are waiting to be implemented when considering how to meet different environmental and climate requirements in sectors such as forestry and agriculture”, says Joonas Jokela, Customer and Network Manager at the Location Innovation Hub.

Aiming for a permanent ecosystem

From the outset, the Location Innovation Hub’s aim has been to create a permanent basis for action. LIH and other Digital Hubs are actively engaged with both the business community and government. Funding is essential as it helps small businesses to grow.
”We should have a dedicated funding programme with a permanent status to promote digitalisation through location-based information. This is what LIH is trying to contribute to,” says Antti Jakobsson.
”Our goal is to bring more innovations and businesses that make efficient and secure use of location data for a cleaner future in Europe.”

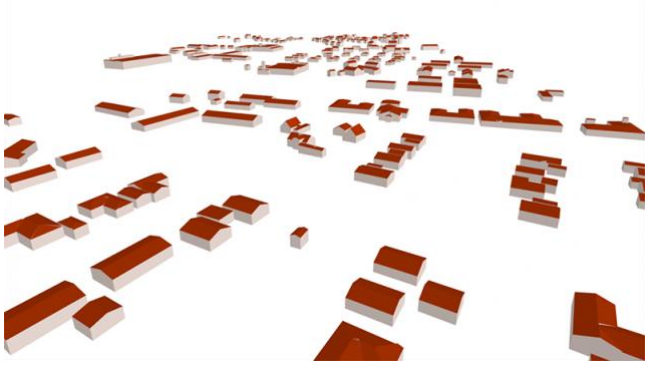
Location Innovation Hub

The Location Innovation Hub (LIH) is a centre of excellence in location information coordinated by the Finnish Geospatial Research Institute.
LIH serves small and medium-sized enterprises, start-ups and public administrations that have the need to test and refine innovation and develop their businesses with location data.
LIH consists of a wide network of companies, research organisations and universities, as well as the public sector.
The Location Innovation Hub, supported by the European Commission, is one of the four digital innovation hubs in Finland (EDIH) and is part of the European network of innovation hubs.

Read more: www.locationinnovationhub.eu

Building 3D models help in saving energy and mitigating climate risks

The 3D models of Finnish buildings produced by the National Land Survey of Finland are useful for municipalities, companies and citizens alike. A 3D model can be used to determine the solar energy potential of a property, identify flood risks and other key factors to support decision-making.



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These models can be viewed in the Land Survey of Finland's File service of open data. They provide building owners with useful information that supports their energy renovations and adaptation to climate change.

The 3D models can be used to estimate the solar energy potential of a building's roof and determine the best locations for installing the system.

The models display the exact height of buildings. When this data is combined with the elevation model of the terrain and the variation of the water level of nearby bodies of water, then the flood risk can be assessed on a building-by-building basis.
For a building that is in the stage of still being designed, seeing a 3D model of it embedded in the surrounding built environment will allow better understanding of its effects on shade, windiness and noise.

'The information needs of society are constantly changing, and three-dimensional building information covering the whole country allows finding completely new uses for the information. The National Land Survey of Finland develops the data content of the core geospatial data together with the authorities, companies and other parties using the data,' says **Jani Kylmäaho**, Director of Development and Digitalization at the National Land Survey of Finland.

Building and climate information from different sources linked to 3D buildings

'As a rule, building and apartment data and climate data must still be obtained from different sources today, and the data must be combined based on either unique identifiers or location. In the future, utilising the data would be easier if uniform quality criteria were applied to it and if the data was interoperable and available through a single channel,' Kylmäaho states.

Data has already been successfully combined in the European GeoE3 project, where Finland – together with Spain, Norway, Estonia and the Netherlands – created an

online platform in which 3D buildings and building information can be viewed on a map. The 3D building data material produced by the National Land Survey of Finland combines building information such as the time of construction, material and heating systems of public buildings. Climate data collected during average sunshine hours, like temperatures and wind speeds have also been added to the materials. View the material on the project pages.

Three-dimensional building models now available from one-sixth of Finland

The National Land Survey of Finland began to produce 3D models of buildings in 2021. Today, there is data available already from one-sixth of Finland. By the end of 2026, the whole of Finland will be laser scanned with the precision required for 3D modelling of buildings.

The National Land Survey of Finland produces the 3D building models from laser scanning data, which are collected as part of the national laser scanning programme. The material is updated in six-year cycles. The national laser scanning and aerial photography programme will keep core geospatial data up to date, including information such as altitude models, terrain data and basic positioning data. These are utilised in rescue services, national defence, agriculture and forestry, as well as by the construction and environmental sectors, among others.

Laser scanning, aerial photography and 3D building material are used, for example, by the Finnish Forest Centre, Finnish Environment Institute, Metsähallitus, Finnish Food Safety Authority, Ministry of Agriculture and Forestry, Defence Forces and Ministry of the Environment for their own purposes.

Dense materials require a license

Since 2020, laser scanning data has been more accurate than before. From the point of view of state security, the Finnish Defence Forces and the National Land Survey of Finland agreed that this new dense scanning data will not be distributed as open data. The materials are public, but their use requires accepting the terms of use. The licence is subject to a fee and is granted for an area of 3,000 square kilometres at a time, which corresponds to an average of one production area per year.

New material is constantly being created as open, freely available material when the 0.5-point density version is extracted from the dense material.

You can view a map to see the progress of 3D modelling of buildings in Finland:
https://tilannekartta.maanmittauslaitos.fi/3drakennukset
Download 3D materials of buildings in your area from the data service:
https://tiedostopalvelu.maanmittauslaitos.fi/tp/kartta
Explore the 3D models of buildings directly in your web browser (select Buildings3D from the top menu). https://geoe3platform.eu

Finland’s surface area varies

What is the surface area of Finland? The answer depends on who you ask and what you mean. Different sources give highly different estimates. A group of surveyors retired from the geospatial data sector decided to find the answer and redefine our country’s surface area and geographical centre. How did the project succeed?

ONNI KUKKONEN
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M Sc
Retiree

Finland’s geographical centre has been an area of interest before. While some have suspended an analogue cardboard model, some have tried to find the centre using mathematics. Because the calculation is so simple, mathematical methods have usually started by defining the centre of a polygon in a selected projection. As a result, calculation methods have been as simple as possible.

However, a 2D projection distorts the surface area, even fairly significantly, depending on the projection selected. At its largest, the difference can be up to hundreds of square kilometres when doing calculations for Finland. So far, no calculation of the geographical centre calculated using a 3D coordinate system has been identified in literature

As pensioners with all the time in the world on our hands, we decided to get on with it and redefine Finland’s surface area and geographical centre in 2D and 3D coordinate systems.

Where are Finland’s boundaries?

Different sources offer various conceptions of Finland’s surface area. Google search gives the lowest estimate of 338,440 km^2. According to statistics of the NLS, Finland is significantly larger at 390,908.62 km^2 (figure determined in 2020). The difference depends on whether the land area alone is calculated or whether sea areas are also included. The surface area should always be furnished with metadata, which contains the proper definition of surface area and method of calculation.

How is the surface area defined? The ground rule is that those who define it have an identical and accurate idea of the country borders. As we were unable to find a single source that would have provided sufficiently reliable and accurate border coordinates, we determined a boundary polygon from several sources we considered best. The polygon that outlines Finland consists of roughly **28,109** corner points.

The outer boundary of Finland’s territorial waters has been defined in an act and decree. The border between Finland and Sweden at the Torne River was last verified in 2006. The Norwegian border was verified in 2000, and the Russian border in 2018. The coordinates of the border points are available on the NLS website.

In defining points for the geographical centre, we used Finland's geoid model and the 128-metre elevation zone model in our calculations. They can also be found on the NLS website.

Table: Finland's surface area and geographical centre in different projections, in an Earth ellipsoid and geoid, and the elevation model's geographical centre.

Surface	Surface area, km²	Coordinates of the geographical centre		Elevation	Note
		E (TM35FIN)	N (TM35FIN)	N2000	
ETRS-TM35FIN	390 815.8	429 299.9	7 084 487.7		Projection plane
ETRS-GK27	391 128.7	429 299.9	7 084 487.7		Projection plane
LAEA	390 900.4	428 464.2	7 0841 96.4		Projection plane
LCC	387 893.6	431 255.5	7 094 830.1		Projection plane
Ellipsoid GRS80	390 900.1	429 335	7 084 607	-8 493	With 20-m zones
Geoid surface	390 903	429 335	7 084 613	-8 474	With 20-m grids
Elevation models		429 336	7 084 663	-8 343	With 200-m grids

The results rounded to the nearest metre are estimates based on the previous calculations from 2021.

Cannot wait to start calculating

We made our calculations using Excel, the Visual Basic for Applications programming language, QGIS software, and the Paikkatietoikkuna service (https://kartta.paikkatietoikkuna.fi/?lang=en). The algorithms we used can be found in the sources listed at the end of this article.

We found out right away that it was not as easy as we had thought to find elevations in the 10-metre elevation model. No services were available for interpolating elevations with large volumes of data. Therefore, we decided to obtain approximate elevation data from the 128-metre elevation model.

Calculating the surface area using the projection plane was relatively easy using Excel. We started with the coordinates of the polygon's corners. The geographical centre was fairly easy to calculate at the same time. The ellipsoid gave us a headache. Calculating the surface area using the ellipsoid was more challenging, but we succeeded using Excel's macro functions. We applied Charles F. F. Karney's algorithms, which are largely used in open data systems in the geospatial data sector. To calculate the geographical centre, we divided Finland into 20-metre latitude zones. We identified the intersections of the zones and the nation's border and calculated their coordinates.

Based on the intersections, we calculated geographical centres for each zone in the same way as for the arc of a circle, as well as averages for the geographical centres weighted by the length of the zones. This resulted in the 3D coordinates of the geographical centre of the ellipsoid surface.

We used the same zones in calculating the geographical centre of the geoid surface. We divided them into 20-metre grids, for which we obtained 3D coordinates from the geoid model. To have as accurate results as possible, we used almost a billion grids in our calculation.

Finally, we calculated the geographical centre of the surface model. We added elevation data to the grids formed in calculating the geoid model's geographical centre. Another option would have been to obtain elevation data from the 10-metre elevation model, and this would have given us more accurate results. However, it was not possible to interpolate the elevation model with such large volumes of data.

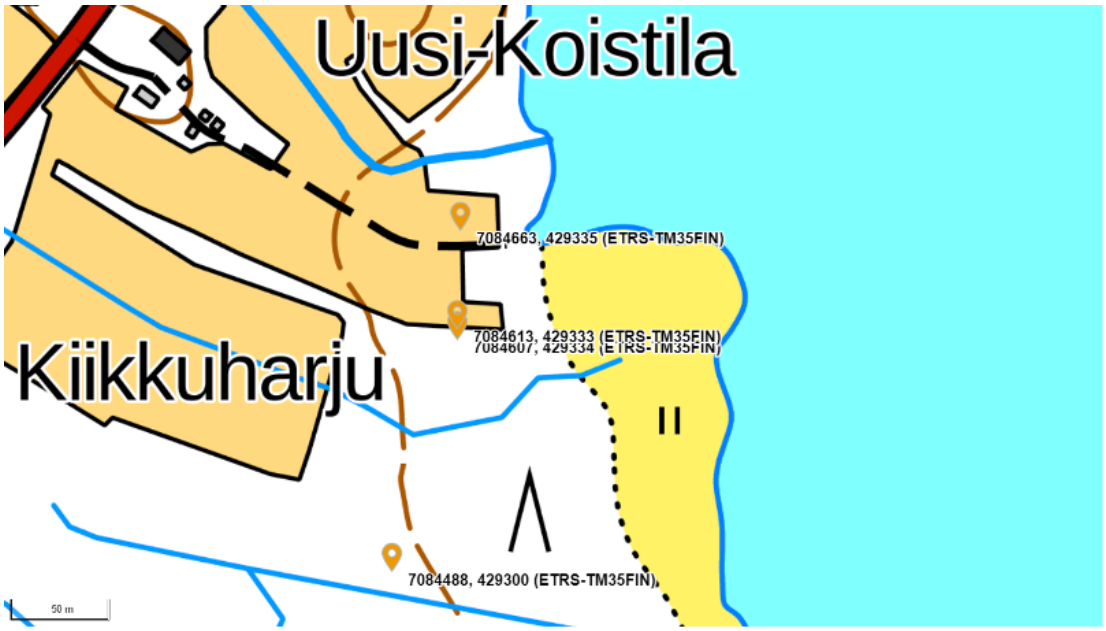

Image: The location of a few geographical centres in the NLS MapSite service.

The surface area is a question of definition

For us pensioners, the project was a fairly enjoyable and refreshing experience. It showed that the surface area is a question of definition. In calculations, we need to accurately define what we mean by the surface area and explain it using metadata. Because no metadata for the surface area is presented in national statistics, there can easily be misconceptions and differences in interpretation.

In addition, the method of interpolating the surface's outlines affects the final outcome. The surface area outlined in an Earth ellipsoid or geoid surface is something completely different from the surface area of a polygon projected on a plane. Coordinates for the nation's borders are available in various sources, and they are partly subject to interpretation – especially regarding the outer borders of territorial waters. Human errors in background information are also possible.

Defining the surface area accurately using an ellipsoid and geoid is slightly difficult, as not many geospatial data programs can do this. The accurate 3D calculation of the geographical centre requires a massive number of tiny surface area objects.
We hope that younger scientists will specify the location of the geographical centres with their more powerful computers.

The full description is available at https://napapiiri.webnode.fi/Suomen-keskipiste.

Terminology

Geoid: The shape of the potential of Earth's gravitational field that best connects with the mean sea level either globally or locally
Geoid model: A numerical estimate of the geoid
Earth ellipsoid: A spheroid that represents the shape of Earth's surface
Ellipsoidal height: The distance between a point and the Earth ellipsoid calculated along the Earth ellipsoid's normal

Sources

- Public Administration Recommendation JHS 197, Appendix 2
- Helsinki University of Technology's old handout no. 305/1972: R.A. Hirvonen, Mathematical geodesy
- Charles F. F. Karney: Algorithms for geodesics, J. Geodesy 87(1), Jan. 2013

Authors:

After his brief career in the Land Survey Administration, Onni Kukkonen worked as an IT specialist (City of Helsinki, Tietotehdas Oy) and entrepreneur (Vegasoft Oy) before returning to his roots dating back nearly 50 years in this project. Email: *firstname.lastname@vegasoft.com*

Reino Ruotsalainen started his career in the Land Survey Administration in the 1970s, worked as a development manager at Finnmap Oy throughout the 1980s, worked briefly as a special education teacher at the Espoo–Vantaa Institute of Technology in the mid-1990s, and returned to the NLS, retiring in 2013. Email: *firstname.lastname@kolumbus.fi*

Reforming the Topographic Map for the Digital Era

A perfect moment for reforming the topographic map of Finland came in the wake of the renewal of the topographic database. Not only the contents but also the visual styles of the map are redesigned. Map users have been actively involved in the planning by providing feedback.

PAULA AHONEN
Senior Specialist
National Land Survey

National mapping agencies have long prided themselves on their topographic maps, traditionally printed on paper for use in hiking, exploring, and navigating. However, in recent years, the usage of paper maps has significantly decreased. At the same time, topographic maps have been made more accessible on mobile and web-based applications.

In Finland, the current digital topographic map has undergone minor changes in recent years, but its appearance is still primarily based on styles that were originally optimized for paper maps. As a result, the map can often feel crowded and difficult to read on digital screens. Simply converting the map from its printing format to a digital format does not always produce the most user-friendly results.

From point symbols to clear forest borders

The National Land Survey of Finland (NLS-FI) is currently renewing its topographic database and production system. The ongoing reform of the topographic database presents an opportunity to simultaneously reform the maps, increasing their utility and usability. For example, as the new topographic database will include designated forest areas as features, it enables their presentation in the reformed topographic map.

Despite forest areas comprising a significant portion of landscape in Finland, historically, the extent of forest areas has not been included explicitly in the topographic map. The way the topographic map currently depicts forests is by using point symbols to represent tree types scattered throughout the forested areas. The white background of the map extends to forest areas, and therefore, if an area is not specifically designated as something else it is easily assumed to be covered by forest. The reformed topographic database allows for the addition of forest areas with clearly delineated borders, providing map users with a more accurate and visually intuitive representation of the extent and location of forested areas. Finland has a wealth of existing data on its forests, including information on the types of trees and growth stages in detailed areas. However, building automated process for producing generalized forest areas from existing data to meet the requirements of the users of the topographic database, will take some time and effort.

The use of green as the primary colour for representing forested areas is an international convention. However, adding a colour to represent forest areas on NLS's topographic map has a ripple effect on the colours of all the other features depicted in

the map. This necessitates rethinking of the entire colour scheme to ensure that all elements are clearly distinguishable and visually cohesive. As part of this work, the semantic relationships between features have been examined, and this will have an impact on how the colours depicting the areas are changed.

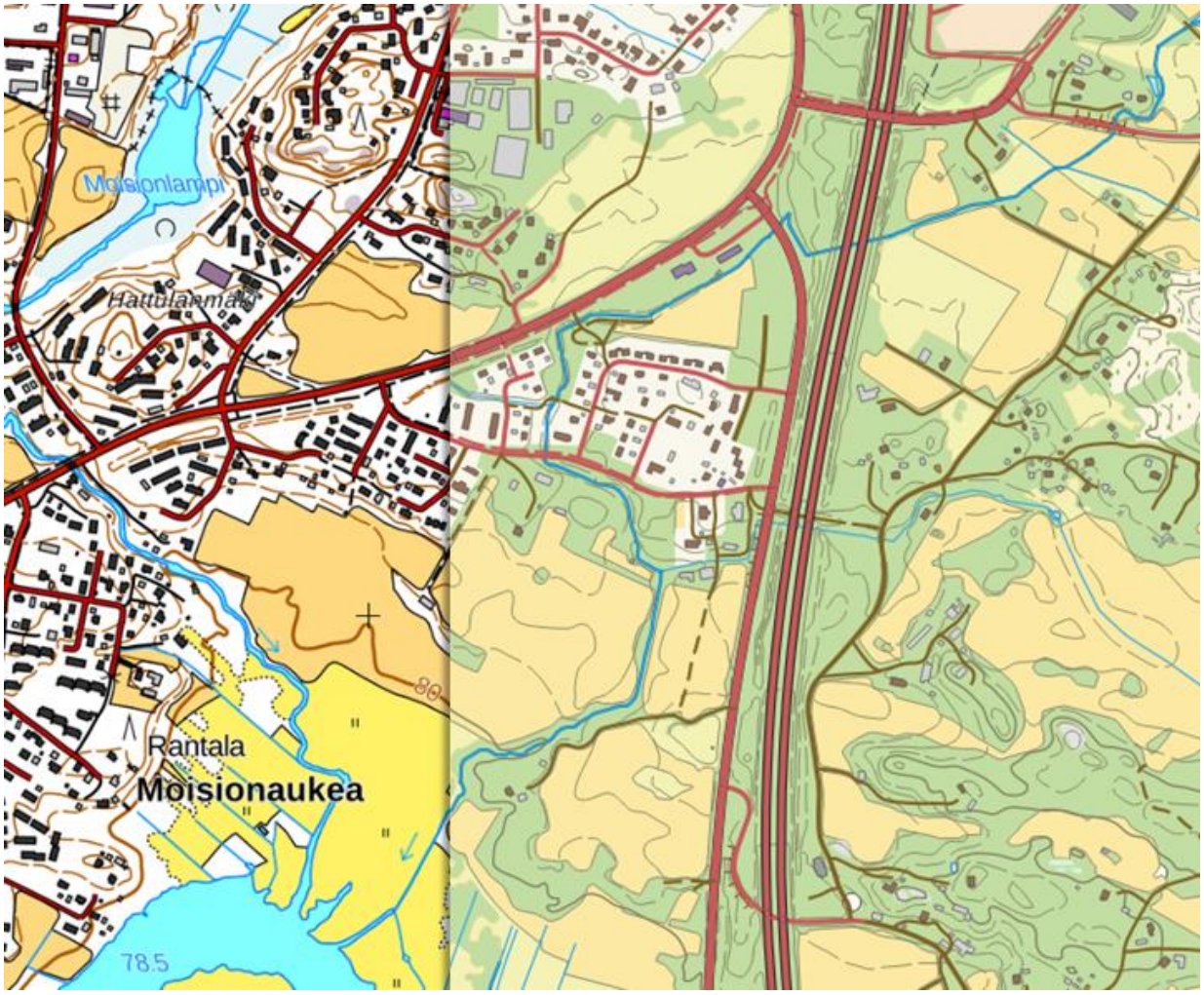

Figure 1. The appearance of the map drastically changes when forest areas are coloured. A preliminary draft is presented on the right; the current topographic map on the left.

Balancing print and screen in map design

Creating a map primarily for digital environment allows cartographers to prioritize the design and functionality for screen display. However, the need for printing cannot be completely ignored, as there are still key customers who rely on map in print. These users appreciate the current version for its usability. Therefore, this version of the map will be refined for printing purposes, in addition to the green forest map designed primarily for the digital environment. The goal is to make these two versions of the map visually as consistent as possible, although colours need to be adjusted to ensure sufficient contrast between features.

In addition to rethinking map styles, the reform of the topographic database and production system includes attention to map data through the scales. The aim is to

make the data more suitable for its intended scale by generalizing it more than currently, as it has been found to be overly detailed. The entire generalization process will be improved over the next years. The goal is to increase the level of automation in the process to improve the timeliness of the map data through the scales. Another goal is to define the desired contents and appearance of the map in small scales.

Labels are an essential information carrier in a topographic map. However, text and numbers are never an optimal means of visual communication. In bilingual or densely built-up areas, labels add visual load and become difficult to distinguish. In this work, the information carried by the labels have been critically examined. As a result, many of the current labels will be removed, as some of them are no longer relevant content in today's topographic map; they may originate from times when other information sources were scarce. Some of the labels will be replaced with map symbols, as in theory, maps should be primarily visual and rely only on minimal text.

User input in the design process

Active involvement of map users and stakeholders in the planning process has been a crucial aspect of this work. To gather input from key users, a feedback group was formed, which was invited to participate in the project. Multiple questionnaires have been administered to this group to gather their insights and feedback. The answers have been taken into consideration throughout the planning process.

In addition, a large questionnaire was created. Its aim was to gather input not only from professional users but also from the public. The questionnaire was distributed through social media and the NLS-FI's website, and there were over 3,000 respondents providing feedback. The number exceeded expectations.

The proposed change of turning forest areas from white to green received significant feedback, with many expressing concerns about the lack of sufficient contrast in the map. The changes got negative feedback particularly from those who use the map frequently across various platforms. This is understandable, as they represent changes that would require users to re-learn how to read the map. The plans for retaining the parallel version with a white background were not presented to the respondents at this point.

On the other hand, the effort to modernize the topographic map was appreciated by many respondents. The updated map was perceived as fresher and more topical. Furthermore, the survey revealed user needs that were not previously considered. The feedback collected has been a useful contribution in the work. In addition to all of this, the questionnaire revealed that most users really rely on digital map and only use paper maps rarely if at all. However, there are still users, such as hiking enthusiasts, who require a paper map and cannot rely on digital products, for instance when in the wilderness.

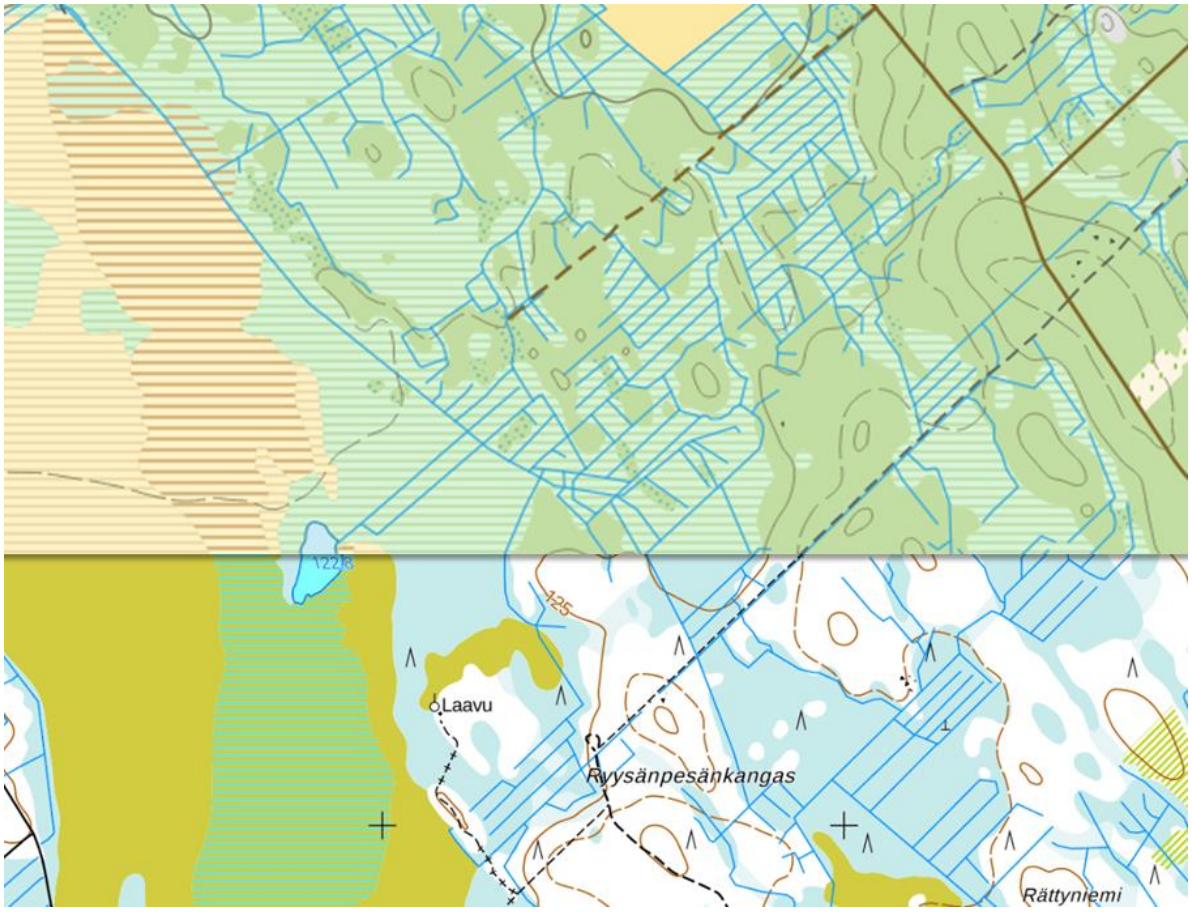

Figure2. Differentiation of various types of land, including swamps, is important for navigation in forested areas. A planning example is presented on top, the current topographic map below.

Towards a user-focused and flexible topographic map

It is widely acknowledged that vector tile maps represent the future of digital maps due to their scalability, flexibility, and fast loading times compared to traditional raster maps. In line with this, in the future the map styles and the map data will be distributed separately in addition to the map itself. This will provide developers and expert users the opportunity to create customized maps or modify existing ones to meet the specific requirements of their clients. Additionally, users will have access to map data through the scales, enabling them to generate map services across various scales and zoom levels. Throughout this work, one of the most valuable achievements has been the active involvement of key stakeholders in the planning process. By seeking ongoing interaction and input from these stakeholders, the updated topographic map can be developed to better fulfil their needs and those of the broader customer base. This collaborative approach will help to ensure that the map meets the expectations of its users, both now and in the future.

AI for topographic mapping

The Advanced Technology for National Topographic Map Updating (ATMU) project was one of the first artificial intelligence (AI) projects in topographic data production of the National Land Survey of Finland (NLS). The goal of the project was to reduce the amount of manual and routine work in topographic data production, increase the accuracy and up-to-dateness of the data, improve efficiency and save costs of the NLS, enhance the map updating technology automation level in NLS, and promote the use of AI technology for national mapping products.

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The ATMU project developed deep learning solutions for feature extraction and updating, focusing on buildings, roads, and watercourses. The project focused on two aspects: method development for the use of AI, and sharing knowledge and experience with society (Fig. 1). In the method development, special attention was paid to i) high-quality and large-quantity training data from diverse environments, ii) different neural networks and one with the best performance was selected to be used in the project. Social impact is an important measurement of a project's success.

During the project, public seminars were organized every half a year to share our knowledge and experience in collaboration with Geoforum Finland, Cartographic Society of Finland, and the ICA's Working Group on the Digital Transformation of National Mapping Agencies. Besides, at the end of the project, high-quality training data was released to the public. In addition, as byproducts of the ATMU project, more than 100,000km^2 true orthophotos were produced during the project. Through the two-year effort of the ATMU team, the project achieved great success and was fruitful.

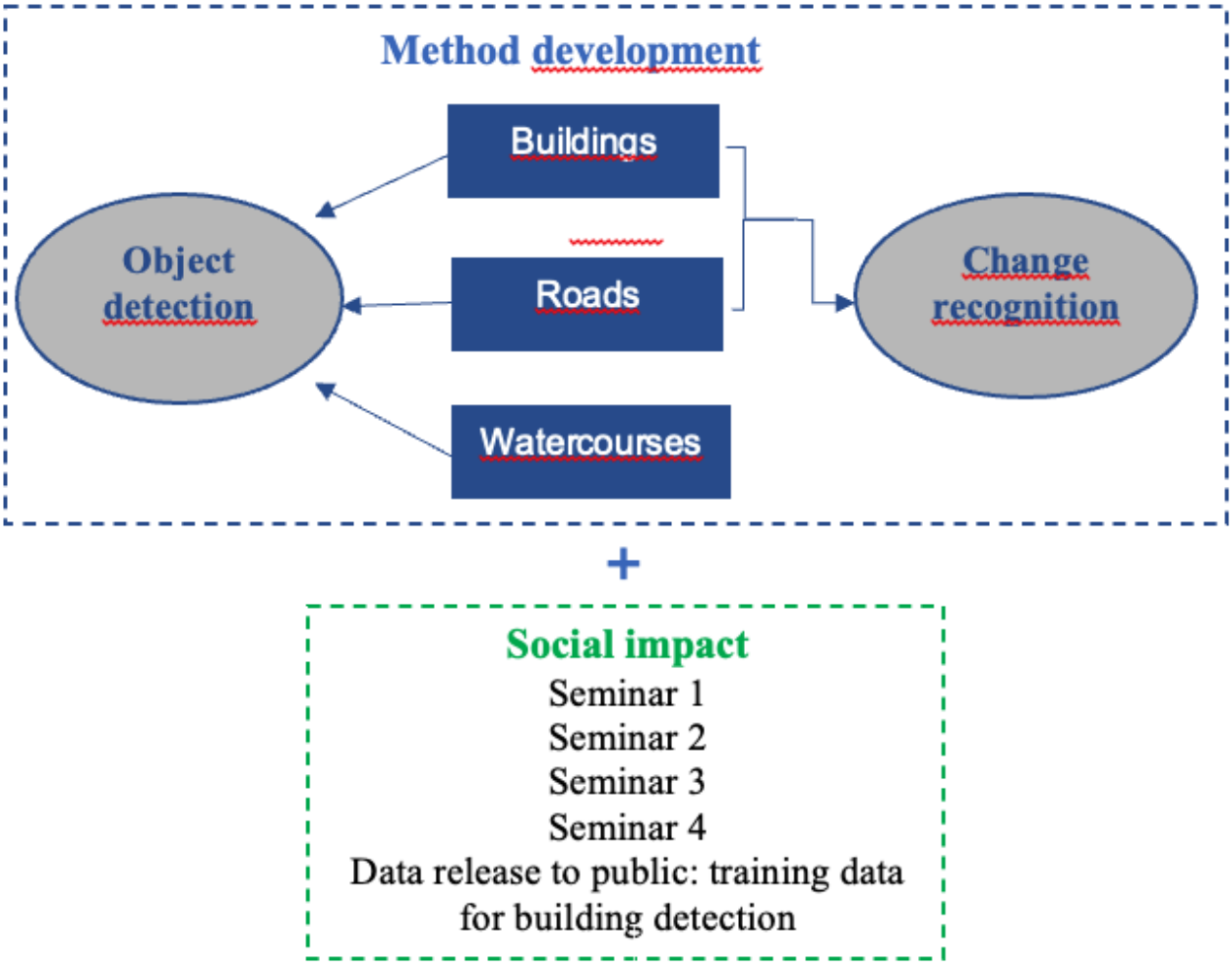

Figure 1. An overview of the tasks in the ATMU project

Method development

The ATMU project had development tasks on object detection and change recognition. Object detection is an important step in information acquisition automation from imagery. In the ATMU project, object detection focused on three types of objects: buildings, roads, and watercourses. For building detection, true orthophotos, building vectors, DEMs, and DSMs were utilized to train the UNet model. The outputs were the building outlines from the UNet. In road detection, either orthophotos or true orthophotos with road vectors were used to create training data. RoadVecNet (released in 2021) was employed to detect the roads. Along with multitask learning techniques, both road surfaces and edges can be obtained from the neural network. In watercourse detection, high-quality watercourse vectors were manually digitized from DEM-derived terrain visualizations and orthophotos. Clarity classes were also defined for digitized watercourses in order to enhance detection and vectors with 1.5m buffers were used to create the training data. Together with self-created 0.5m Lidar-DEM, the UNet model was trained. The segmented watercourses were output from the neural network. Table 1 summarises the deep learning solutions for different object detection in the project and Fig. 2 shows the results from neural networks.

Table 1. Object detection with deep learning technologies

	Building detection	Road detection	Watercourse detection
Input data (Training data)	True orthophotos, building vectors, DEMs, DSMs	Orthophotos or true orthophotos, road vectors	0.5m Lidar-DEM, watercourse vectors
Neural network	UNet	RoadVecNet	UNet
Output data	Building outlines	Road surfaces and edges	Segmented watercourses

Figure 2. Results from neural networks for buildings (UNet), roads (RoadVecNet utilizing multitask learning technique), and hydrographic features (UNet). Besides object detection, change recognition for buildings and roads was also studied. Different neural networks such as DSAMNet, MDESNet, Changer, NestNet, and NestNet2 were tested. As a result, NestNet2 performed the best in predicting the changes in buildings and roads from true orthophotos captured in different years.

Social impact

NLS is a national government agency in Finland providing information and services about the earth, sharing data and map products with the public, and researching and developing advanced technologies and methods. In 2012, the NLS was one of the European frontrunners by releasing the topographic database as open data. Under the open spirit in the NLS, the ATMU project shared the AI knowledge and experience

from the project by organizing open seminars once every half a year. During the past two years, the project has hosted four open seminars. More than 300 international participants have participated in the events. Among these, one event had 150 registered people. In each open seminar, the experiment on AI methods, experiences, and lessons was shared and openly discussed. Besides the open seminars, we released high-quality training data to the public. Thus, our work was beneficial for the geospatial community to boost AI development. The social impact is an important measurement of the success of a project. Besides open seminars and open training data releasing, the ATMU project was also introduced in many workshops, conferences, GIM- International magazine, and EuroGeographics' 2022 annual report. Three Master's theses were also completed in the project.

Summary

In December 2020, the Advanced Technology for National topographic Map Updating (ATMU) project was selected as one of the funded projects (so-called "Robo funding") by the Ministry of Finance. It was a two-year project for the period of 1.1.2021-31.12.2022, with a funding of 399,200 €. The ATMU project has developed methods for detecting buildings and roads from aerial imagery (including true orthophotos and orthophotos) and detecting watercourses from Lidar-DEM. By the end of the project, more than 100,000km^2 true orthophotos were produced, and the UNet model for building detection had been trained with datasets selected from data from different areas of Finland covering more than 60,000 km^2. According to the NLS expert evaluation, it has reached an accuracy level of up to 97.9% when compared to different reference data. It is now available for practical use in map production. The option of integrating the ATMU building model with the new topographic database system is currently under discussion. The AI model (RoadVecNet) for road detection likewise achieved a great result and further application is under consideration. Meanwhile, the preliminary results for the complex watercourse detection using UNet provide a good basis for further research. In addition, expert evaluation of building and road change recognition had been implemented. The results showed that approximately 96% of changes from roads and buildings have been found from true orthophotos using the NestNet2 model. The change detection results can be used as pointers for the operators so that they do not need to check the changed areas across the entire image. This will significantly reduce the amount of manual work. Further application of the change detection method might need to be discussed in the coming years. The ATMU project also produced high social impact by organizing open seminars to share knowledge and experiences, releasing high-quality training data to the public to boost AI development in the geospatial field, and also introducing the project in many workshops and conferences nationally and internationally.

The AI method development and application in the production of the NLS continue after the ATMU project. The new project AI4TDB utilizes the AI models developed in the ATMU project to improve the accuracy of vectors in the topographic database for buildings and watercourses.

The high-quality training data for building detection from the ATMU project has been released to the public on 1st November 2022. The training data included true orthophotos and their corresponding labels. It covered an area of about 50km^2. The scenes include urban, suburban, and rural areas. You can download them from the this link.

Fluent cycling in the city? – Measuring urban cycling quality with tracking data

How fluent is cycling in your city? Are you able to cycle without interruptions, or do you have to stop frequently? The ProGIS-awarded master's thesis introduces a method for estimating the smoothness of cyclists' traffic flow in urban areas.

ANNA BRAUER
M.Sc
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Image: Visit Finland

As one of the most environmentally friendly modes of travel, cycling plays an important role in designing sustainable urban mobility. In an ideal, cycling-friendly city, the infrastructure should allow cyclists to travel fluently: continuously at a comfortable speed, undisturbed by other road users, and without having to stop and wait.

More and more cyclists use activity tracking applications to record, monitor and share their rides. As a result, the data collected by the application providers is unprecedented in its spatio-temporal extent and the number of active contributors. This data makes extensive data-driven analyses of urban cycling possible. The results can help cities to develop a better understanding of the status quo and identify effective measures to make city cycling more convenient and attractive.

Calculating a fluency measure for street segments

My graduate thesis introduces a method for estimating urban cycling fluency using mobile tracking data. The study is based on more than 50 000 real-life tracks from the 'Sports Tracker' application. The tracks were recorded by close to 3 700 cyclists in the Helsinki area between the years 2010 and 2012. All tracks were publicly available on the application.

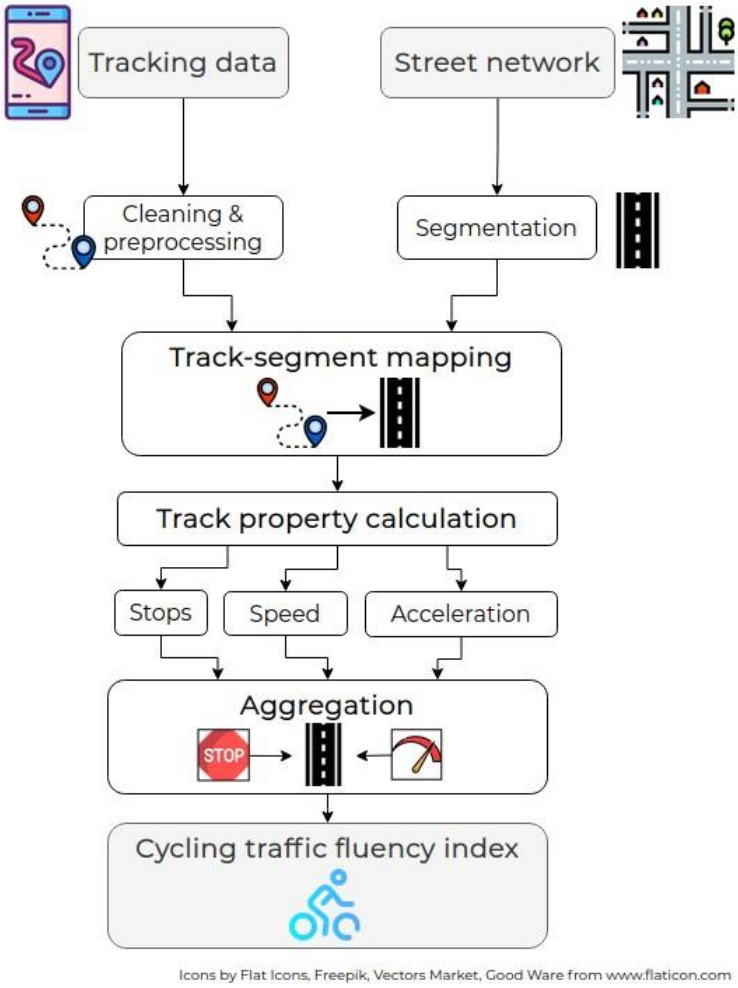
In a pre-processing step, the tracks are smoothed and cleared from outliers. Subsequently, the tracks are mapped to the street network. Each street is divided into segments of about 25 meters. For each segment a track passes, properties related to the cyclist's dynamics and stopping behavior on the segment are calculated.

If a segment is passed by at least ten different cyclists, these cyclists' properties are aggregated into segment characteristics. These characteristics describe the following aspects:

1. How many of the cyclists stopped on the segment?
2. What was the average duration of the stops?
3. How high was the cyclists' acceleration on average?
4. How did the cyclists' speed on this segment compare to their average speed?

These characteristics are the building blocks of the final cycling fluency index. Each segment receives an index value between 0 and 1. High index values indicate fluent cycling conditions: relatively high speed, little acceleration, no stops with long waiting times. Low index values imply obstructions on the segment.

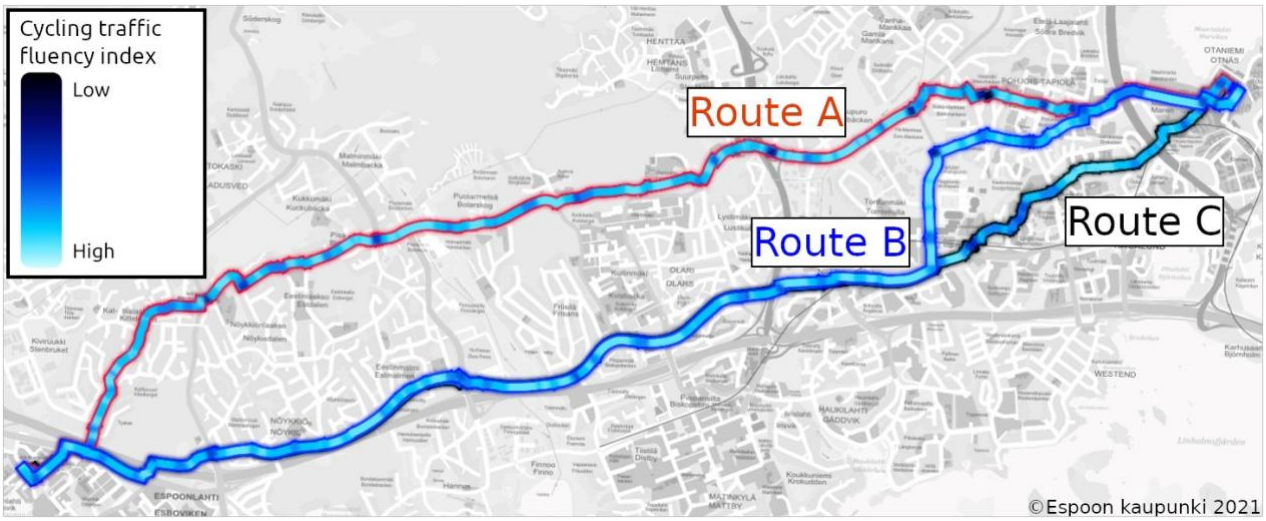
Overview of the method: tracking data is processed along with street network data to obtain an estimate of cycling fluency.



A promising estimation from imperfect data

Through experiments with different secondary data, it became clear that the results describe the on-street circumstances in and around Helsinki sufficiently well. The cyclists' stops correlated clearly with the locations of traffic lights and intersections. Moreover, the characteristics describing the cyclists' movement correlated with the properties of single tracks that were not included in the original dataset. This suggests that the aggregated values can predict, to some extent, how fluently an individual cyclist will be able to cycle.
However, the data can only show what has been, not what is. Additionally, deliberate choices of cyclists, such as stopping to take a picture, are difficult to detect and can distort the results.
Furthermore, the data is biased due to participation inequality, as 10% of the cyclists in the dataset account for 65% of the tracks. Confident, enthusiastic cyclists are most likely significantly overrepresented in the data.

Challenges like these are unavoidable when working with data recorded in an uncontrolled setting. Irregularities of individual tracks, however, are mitigated when a few tens of tracks or more are aggregated to calculate the cycling fluency index.



Fluency of three different cycling routes between Otaniemi and Kivenlahti in Espoo. Route C is the shortest and Route A the fastest according to the dataset, but Route B offers the most fluent cycling experience.

A cyclist-centered perspective of the city

The method described here is one possibility to condense mobile tracking data into an indicator of urban cycling quality. It could support the design and monitoring of urban cycling infrastructure, as it offers a cyclist-centered perspective on the accessibility of cycling in the city.

Experiments with the cycling fluency index as a routing criterion showed that fluency-based routing tends to produce routes resembling the fastest route. At the same time, fluency-based routing tends to include detours on popular cycling infrastructure, even though the index does not possess a notion of popularity. Thus, there is a potential for the measure to be utilized for developing advanced, data-driven routing algorithms for cyclists.

Anna Brauer works as a scientist in the Finnish Geospatial Research Institute (FGI), National Land Survey of Finland (NLS), and prepares her doctoral thesis in the University of Helsinki. Brauer got a M.Sc.(Tech.) degree from the Dresden University of Technology in 2020 and received the ProGIS master's thesis award from her diploma thesis "Characterizing cycling traffic fluency using big mobile activity tracking data". The work was supervised by Prof. Lars Bernard, Dresden University of Technology, Prof. Juha Oksanen (FGI, NLS) and research group leader Dr. Ville Mäkinen, (FGI, NLS). email: anna.brauer(at)helsinki.fi

The Struve Geodetic Arc is a shining pearl among UNESCO World Heritage Sites

The Struve Geodetic Arc stretches from the European side of the Black Sea all the way to the Arctic Ocean. Finland's northernmost World Heritage Site is located at the top of Stuorrahanoaivi in Enontekiö. Photo: National Land Survey of Finland.

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The Struve Geodetic Arc stretches from the European side of the Black Sea all the way to the Arctic Ocean. Finland's northernmost World Heritage Site is located at the top of Stuorrahanoaivi in Enontekiö. Photo: National Land Survey of Finland.

Congratulations, you have received heritage! Not just any heritage, but World Heritage. You do not need to pay any inheritance tax or worry about registering the transfer of ownership.

Since 1972, sites that carry a significant value as unique culture and natural heritage sites have been added to the UNESCO World Heritage List, which includes sites in nearly 200 countries. Keeping heritage sites in as original and authentic condition as possible is the common cause of all humankind. They convey knowledge, skills, conceptions and traditions to us. Currently, there are seven UNESCO World Heritage Sites in Finland.

Being added to the list is the result of a long-term process, during which the authenticity and significance for science and culture, for example, are identified under

close scrutiny. Furthermore, it is not self-evident that a site remains listed. During last summer, the removal of the Liverpool waterfront from the World Heritage List due to the construction of the Everton football stadium was discussed onvarious media platforms. At the same time, Old Rauma, a World Heritage Site in Finland, is having similar problems: a modern shopping centre is defying the idyllic wooden centre.
In addition to Old Rauma, Finland's World Heritage Sites include the Fortress of Suomenlinna in Helsinki, the Petäjävesi Old Church, the Verla Groundwood and Board Mill in Kouvola, the archaeological site of Sammallahdenmäki in Rauma, the Struve Geodetic Arc, and the Kvarken Archipelago. Building architecture by Finnish architect Alvar Aalto and the Ringed Seal Archipelago of Lake Saimaa are seeking a place onthe list.

What is the Struve Geodetic Arc?

The Struve Geodetic Arc is a chain like structure that resembles a gigantic tape measure, which was used to verify the shape and size of Earth in the 19th century. It was used to determine the length of the meridian arc from the Black Sea to the Arctic Ocean, totalling at 2,820 kilometres.

The chain was determined based on triangulation. In triangulation, the unknown lengths of two sides of a triangle can be calculated based on the angles of the triangle if the length of one side is known. Triangulation networks consist of points that form several triangles.

The scale of the chain was determined using baselines, which are lines of a few kilometres, the length of which is known at the accuracy of millimetres. The shape and size of the chain was calculated based on the lengths of the sides of the triangles and observations of their angles. The actual location of the chain and its position relative to Earth's surface were determined usingstronomical positioning.

Administrative cooperation and networks

The Struve Geodetic Arc passes through ten countries. In Finland, it is under the management of the NLS.

The Struve Geodetic Arc was inscribed on the UNESCO World Heritage List in 2005. The administrative authorities of the ten countries work together every year to ensure the preservation and authenticity of the site, also internationally. The UNESCO World Heritage Committee monitors the listed sites actively, and all maintenance and administrative measures must be reported to UNESCO.

The factors that threaten authenticity have changed along the years, and they vary from one country to the next. Currently, wind farms are a hot topic around the Struve Geodetic Arc, especially in the Nordic countries. How can the generation of renewable energy be smoothly combined with the preservation of world heritage?

In addition to the NLS, the Finnish Heritage Agency and the Association of World Heritage Sites in Finland are driving forces behind the Struve Geodetic Arc. They play an important role in the World Heritage Centre project in Central Finland, in which a new round-the-year visitors' centre will be built next to the Petäjävesi Old Church. The aim of the centre is to provide information not only about the Petäjävesi Old Church,

but also about the Struve Geodetic Arc and UNESCO World Heritage principles in general.

One of the triangulation points of the Struve Geodetic Arc is located in Oravivuori, Korpilahti, Jyväskylä, which will benear the World Heritage Centre yet to be built. The accessibility of the Oravivuori point was tested last summer by preparing a paper and digital route guide for the area.

Struve North strengthens cooperation in the northern parts of the chain

Struve North is a three-year cooperation project between Finland, Sweden and Norway. Its goal is to increase knowledge of the Struve Geodetic Arc and improve its accessibility. At the same time, it strengthens Nordic cooperation and the vitality of the area. The NLS participates in the project as a guiding specialist and partial funding provider.
In Lapland, the triangulation pointsare sparsely spread over an area of difficult terrain , and various digital solutions based on geospatial data are used to increase their visibility.

Welcome to the virtual world, says Mr Struve

The Struve North project has also carried the Struve Geodetic Arc into virtual reality. Drone videos and 360° photos of the triangulation points have been entered in a game environment, where they can be explored using a VR headset. For example, museum visitors can access the triangulation points in a virtual 3D world. In virtual reality, visitors can also try their hand at triangulation by using a measuring instrument in the surroundings of the Alatornio Church.
The aim is also to use ultrahaptics technology, which enables the touchless control of screens. A student of visual arts from Lapland University of Applied Sciences has re-animated Mr Struve who now acts as a guide in the touring exhibition using an ultrahaptics device.
Steps of Struve mobile game, in which players can travel north from Tornio while solving puzzles, is available on app stores.
In addition to digital solutions, the Struve North project underlines the significance of world heritage as an asset for productisation and learning. In the winter, comprehensive schools in the northern region were able to learn more about the ‘Haluatko tutimusmatkailijaksi?’ (Would you like to be an explorer?) concept piloted by Humak University of Applied Sciences, and several schools are now organising field trips to the triangulation points with an adventure-based approach. In addition, various webinars and workshops have been held for companies.

Welcome to the wondrous world of the Struve Geodetic Arc!

- More information about the Struve Geodetic Arc and instructions on how to find its triangulation points are available at https://www.maanmittauslaitos.fi/en/struvegeodeticarc.
- Tips on how to reach the Oravivuori triangulation point are also available in the Citynomadi.com service.
- You can follow the Struve Geodetic Arc on Facebook (@StruveFI), Twitter (@Struvenketju) and Instagram (@Struvenketju).

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Climate change mitigation calls for interoperable and up-to-date information about land use

While the land use sector is a significant carbon sink, it is also an emission source. Reliable information about land use and its changes is required for decision making, research and international reporting. Organisations that provide land use information joined forces to improve the knowledge base required for climate action.

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LULUCF stands for land use, land-use change, and forestry. Photo: Julia Hautojärvi

In Finland, several organisations have collected and maintained land use and land cover information for decades now. They have collected information from various sources using different methods, and this information has then been saved in different systems. The goals of monitoring and the factors to be monitored have also changed from time to time. Regardless of close and smooth cooperation, merging the information into a comprehensive land use dataset has been a challenge. Developing a knowledge base for land use requires that current data needs are understood. These needs have to be specified and prioritised with data providers and stakeholders. Here close and open cooperation between data providers and shared practices is required.

'Forests, for example, play a significant role in climate change mitigation and the targeting of actions. As forestry land accounts for more than 80% of Finland's land area, building new infrastructure inevitably causes forest loss making it more difficult

to achieve our climate goals,' says Kari T. Korhonen, principal scientist at the Natural Resources Institute Finland (Luke).

The goal of developing a common knowledge base for monitoring land use and its changes (Mammutti) is to develop monitoring. The project is coordinated by the Finnish Environment Institute (SYKE). Other project parties include the NLS, Luke, the Finnish Food Authority and the Finnish Forest Centre. The project brings the organisations' individual and shared goals together.

'Together, we need to ensure that we have a sufficient understanding of each other's goals and those of our stakeholders to produce relevant data products. In the project, we plan shared sustainable practices to provide even better information about changes in the land use sector,' says Elise Järvenpää, senior coordinator at SYKE.

The Topographic Database is to be updated more frequently to make reporting easier

A significant goal for the NLS is to make those features that represent land use and land cover in the Topographic Database more up to date by using tips and any new register and remote sensing datasets.

'The current updating rate of the Topographic Database is insufficient from the perspectives of monitoring land use changes and international reporting,' says Ulla Pyysalo, senior specialist at the NLS.

'We hope that in 2025, the NLS will chart feature classes that represent land use and land cover so that their definition matches even the most recent needs of stakeholders.'

Lifecycle data will be saved in features pertaining to the new feature classes in order to monitor changes better than before. A permanent ID will also be provided for features, which can also be used to link other data providers' data. Mapping will be based on aerial photos and other datasets.

Steps towards better reporting and a carbon-neutral Finland

Luke is responsible for inventorying the greenhouse gas emissions of national forests and the land use sector. This is why developing the monitoring of land use is an important goal.

'We hope that in 2025 we will have detailed guidelines to update and specify geospatial data related to land use so that the data can be used in reporting the greenhouse gas emissions of the LULUCF sector and in improving the accuracy of forest resource estimates,' says Korhonen.

SYKE monitors the state of the environment and any long term changes in it extensively. To this end, it requires information about waterbodies, biodiversity and the built environment.

'Our goal is that a detailed and harmonised knowledge base for land use will lay a solid foundation for the monitoring of climate action in the future. At the same time, it

will provide valuable background data for other environmental state monitoring reports and datasets,' says Elise Järvenpää.

Addressing the environment better in agriculture

The Finnish Food Authority enforces the EU's Common Agricultural Policy (CAP) in Finland. It is responsible for the payment of national and EU subsidies. One of the goals of the upcoming CAP period (2023–2027) is to better address targeted environmental activities in agriculture.

This requires that planning, decision making and monitoring are based on comprehensive and high-quality datasets.

Towards a more carbon-neutral Finland

The Mammutti project is part of the Catch the Carbon programme, the goal of which is to reduce greenhouse gas emissions and strengthen carbon sinks and stocks.
'We hope that by 2025 all organisations participating in the project will have an even better understanding of the data needs related to land use and its monitoring, and that cooperation to meet these needs is effective as a result of mutually agreed processes,' says Järvenpää in summary.

If these goals can be achieved, Finland will again have slightly better grounds in order to take steps towards carbon neutrality.

What is the Mammutti project?

- The project for developing a shared knowledge base for monitoring land use and any changes in it (Mammutti) is a joint project of five organisations that provide land use information. The project parties include SYKE, the NLS, Luke, the Finnish Food Authority and the Finnish Forest Centre.
- The land use sector covers forests, agricultural land, grasslands, peatlands and wetlands, for example.
- The project is funded by the Ministry of Agriculture and Forestry and is part of the Catch the Carbon programme.
- Its aim is to improve the knowledge base that represents land use and any changes in it as a platform for reporting, planning, monitoring and decision making, and produce data products for this purpose.
- In addition, the project will build shared practices for organisations that provide land use information to enable the regular monitoring of land use and any changes in it.
- The project started in January 2021 and ends in the summer of 2023.

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Lidar remote sensing as a tool of archeology

Laser scanning data offers help in studying the Stone Age and WWII military camps.

OULA SEITSONEN
Researcher
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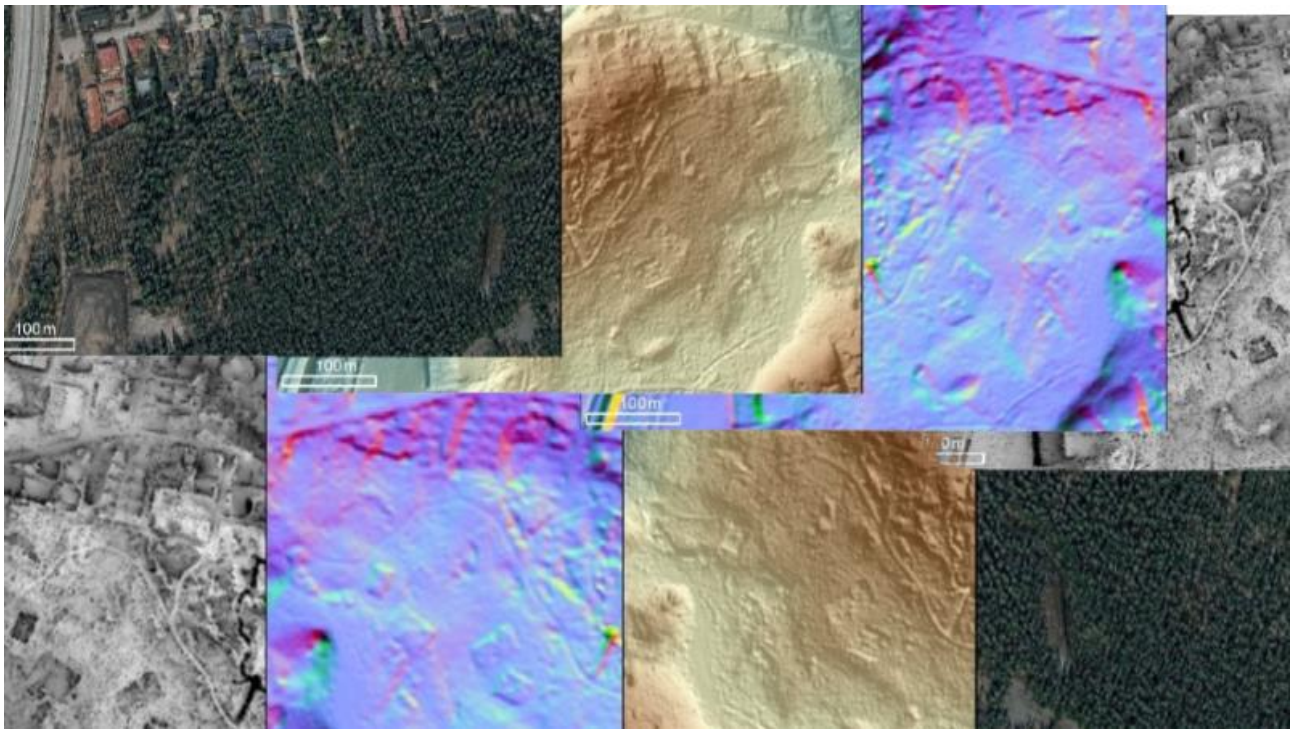
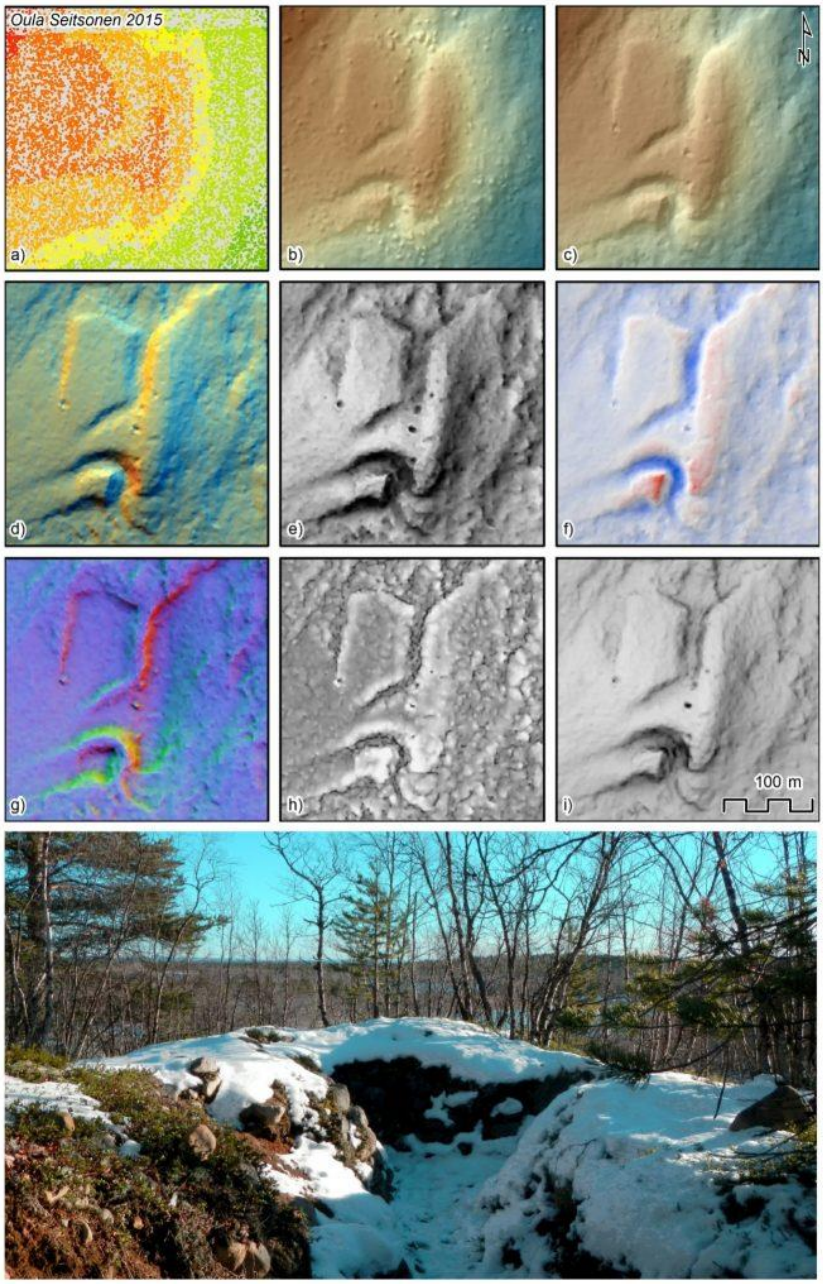


Photo: XXI:6, a WWI base in Patola in Oulunkylä, presented in various ways.

Lidar remote sensing datasets have become commonplace tools for many archaeologists. In Finland, NLS datasets offer an excellent starting point in planning and conducting archaeological surveys. Elevation model data is vital in studying the Stone Age, for example, as features located in prehistoric coastal areas can be tens of metres higher than the current coastline as a result of land uplift. In addition, Lidar datasets help find previously unidentified ancient monuments before any fieldwork.

A German WWII base in Enontekiö visualised in a point cloud for more detailed analyses. Ruins of the base in September below.



See the forest from the trees

The most useful datasets in archaeology include digital surface and topographic models, i.e. bare earth models, from which any aboveground vegetation is filtered out.

There are many approaches to visualising Lidar datasets. The most commonly used analytical hill shading has its limitations. In them, the light source is usually placed northwest to produce a realistic illusion of 3D topography. If the light source was placed southeast, we would interpret the results the other way around – holes would be mounds, and vice versa. In addition, any line features parallel to the light source often disappear. To solve these problems, methods have been developed especially for the interpretation of Lidar datasets, including the local relief model and

the sky view. The relief model highlights tall or low features that stand out from their background, while the sky view examines the surface area of the sky that can potentially be seen from each point – simply put, a smaller part of the sky can be seen from the bottom of a hole than from the top of a mound.

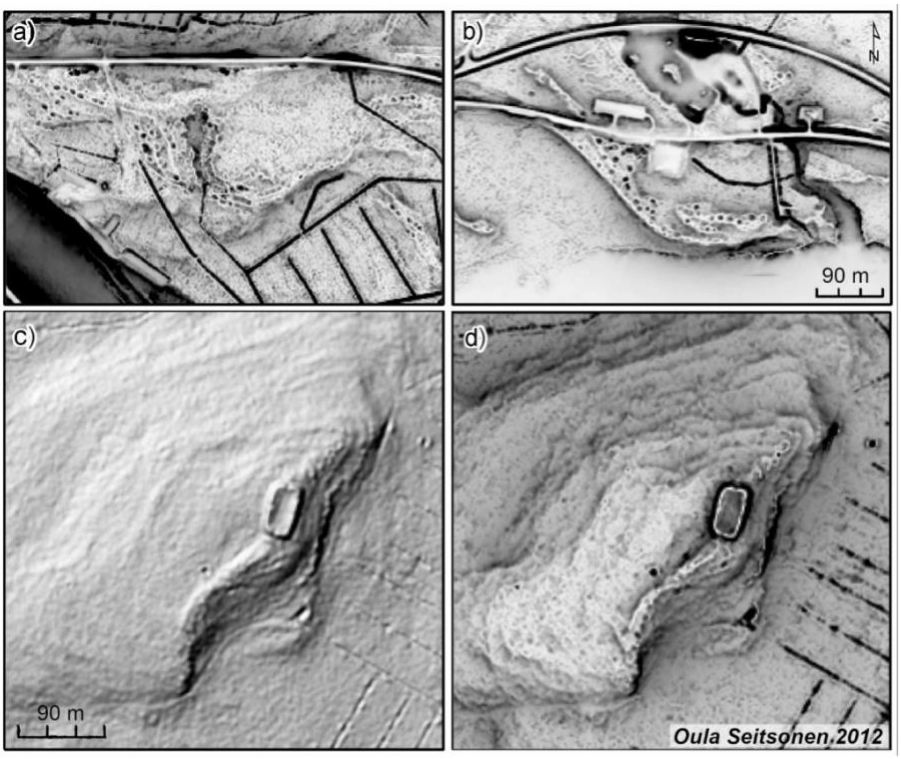
Stone Age coastal areas: pit-houses and stone walls

In the Stone Age, people lived in pit-houses, i.e. houses built in depressions in the ground, in many parts of Finland. They can still be identified in forests as shallow depressions. These depressions range from a few metres all the way to features of roughly twenty metres and features that resemble terraced houses.

Pit-houses can easily be identified in Lidar datasets, as they often stand out when visualised using simple hill shading. People interested in prehistory have identified hundreds of pit-houses using elevation models of the NLS which have enabled them to be engaged in the targeting of fieldwork.

A giant's church is another Stone Age feature, which has been examined using Lidar datasets. Giant's churches are stone enclosures built at the tops of hills in the coast of Ostrobothnia. Their size varies from a few to several tens of metres. They date back some 4,000–5,000 years, but their purpose remains unclear. A potential giant's church has also been identified in Pielinen, outside the previously identified area, using Lidar datasets.

Above, rows of Stone Age depressions stand out as pearl necklaces in prehistoric coastal areas, and below, the Kastelli giant's church in Pattijoki visualised in different methods.



20th century archaeology: military trenches and Nazis

Lidar datasets are also useful in studying more recent features. In Finland, 20th century conflict archaeology has been studied especially in Helsinki, Hango and

Lapland. One of the difficult themes of Finland's recent history has been investigated in Hanko and Lapland: the presence of the Wehrmacht in Finland, which was also the topic of my doctoral dissertation at the University of Helsinki. My studies focus on the internal organisation of military camps. Other projects have identified the defensive positions of the Germans in Enontekiö, among other locations.

In Helsinki, we have also tested the semiautomatic identification of features with encouraging results. Recently, Lidar mapping using drones has also increased: for example, an accurate elevation model has been prepared for the ancient Rapola hill fort. Photogrammetry models of German features in Lapland have been produced based on drone photos.

WWI structures in Pirkkola visualised by hill shading from several directions.

Juoksuhauta	Trench
Tykkiasema	Gun emplacement

Commonplace in the future

Lidar datasets offer an excellent tool for targeting archaeological surveys and protecting cultural heritage. The use of Lidar datasets in Finland could be advanced through open access analysis services customised for the datasets of the NLS. They could be automated online services.
In the midst of all the technology, we should keep in mind that the analysis of Lidar datasets is only one preparatory phase. Fieldwork carried out by professional archaeologists will continue to be invaluable considering research, ancient monument management and land use planning.
Author:

Oula Seitsonen is an archaeologist and geographer who works in the Domestication in Action project at the University of Oulu and heads the Archaeology of the Mannerheim Line project at the University of Helsinki. His doctoral dissertation "Digging Hitler's Arctic War. Archaeologies and Heritage of the Second World War German military presence in Finnish Lapland" is available in the digital archives of the University of Helsinki. His current project is called "Vaakunakylä: Contemporary archaeological perspective on the inequalities of the welfare society".

Interoperable citizen observation services

Citizens' observations collected by means of crowdsourcing are important in many activities related to environmental monitoring. SYKE has deployed a service to promote the shared use of citizens' observations.

TIMO PYHÄLAHTI
Senior Expert
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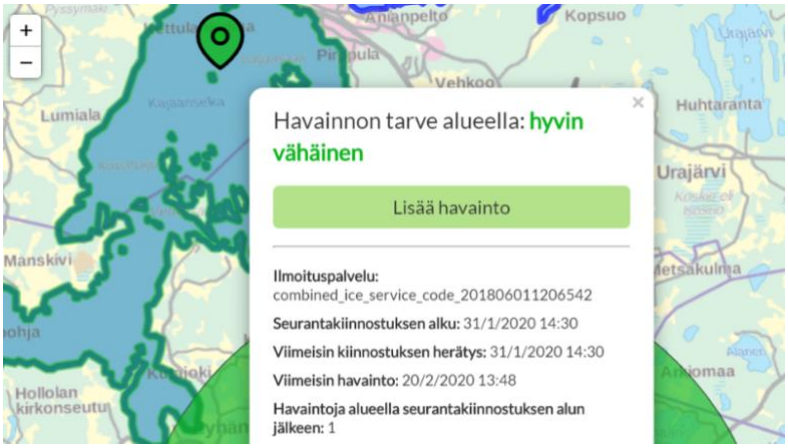

In the spring of 2020, the demo service of SYKE and Avoin illustrated on a map which places it would be interesting to obtain observations of thawing after a winter of thin snow and ice sheets.

Citizens' observations mean that information is collected by volunteers. Typically, such observations are related to people's local environment, including the weather, the thawing of a nearby lake, or flooding rivers in spring.

Information about beach litter or invasive alien species is not productive on its own – often, the aim is also to encourage people to clean beaches or combat invasive alien species. Some themes are popular each year. After all, who has not made observations of changing seasons? Regrettably, often the monitoring of new promising themes dies down when the project that enabled the experiment ends.

In citizen science, regular people participate in science in various ways, for example, by making observations. Volunteers play an important role in making observations of animals and plants. Birdwatching is a true success story in this area: most bird observations are made by volunteers. Volunteers also publish their research results and observation stories in papers of their associations. Thus crowdsourcing can also be effective in ensuring the quality of species observations.

Opportunities of crowdsourcing

In crowdsourcing, a certain task is carried out jointly by a large group of participants. The self-organised and self-advanced collection of information, which produces reliable results, presents an interesting opportunity in various fields. Would it be possible to obtain information about the clearing of yards and roads from snow or the need for cleaning and repairs after snow has melted by any means other than retroactive feedback?

However, the road from knowledge to action is usually long. The participants may not have enough motivation to consider how the quality of the information collected could be improved or how the collection of information could be organised better. If the participants are not sufficiently committed, the collection of information through crowdsourcing is reduced to nothing but feedback on quality.

Motivation decreases if the participants are not personally attached to the cause, but feel that they are helping organisations that drive their own interests. A new participant does not easily join a campaign if there are only a few other participants or observations.

Why don't we download yet another mobile app?

When the collection of information is technically easy, we may end up in a situation that is familiar from digital business. The number of services is high, while that of service administrators and funding providers is low after the initial excitement has died down. Not many are willing to pay more than a small download fee for participation in citizens' observations.

When it comes to free services, users are mainly interested in those that others are also using and that run on familiar service platforms. However, the use of a certain service may become viral if it meets the needs of active users at the right time. The excitement of even the most engaged participants will eventually die down if the activities are not appropriately arranged, there is no motivation to continue making observations or the participants are not thanked and rewarded. Many participants believe that "someone else" will take care of the continuation the project in the future. When a project ends, this easily leads to a situation where the provision of advice for new participants and the maintenance of the service end up with randomly selected parties overwhelmed by high workloads.

A single project may feature several different mobile apps and websites. Overlapping services are often available for a good reason, and they have their own groups of users. Financially attractive themes naturally evolve into services that compete with each other. Even if services are competing, users should have access to observations added to other services. Openly accessible information is more valuable and makes the collection of information more meaningful. From the citizens' point of view, observations connected to the present are the most important.

SYKE's solutions for shared use

SYKE has deployed the CitobsDB citizen observation service. This provides SYKE's users and other organisations that use the service with the same questions and data content through the Open311 API service.

A model for the information to be collected can be defined in the service, which can be used to create a user interface for the entry of information, even on the fly. Observations are given a permanent and unchangeable identifier, and the service code of the data model helps translate the questions into different languages. Observation forms and maps can be embedded on any website using the CitobsDB Open311 widget. While the model and observations can be shared as open data (Creative Commons 0 licence), the closed processing of information is also possible. In this case, information is only available to the API key holder that made the observation and the platform itself in the Open311 API service.

Open observation information is available through the Web Map Service (WMS) and ESRI REST API services and, in principle, the entire system can be deployed published

with the European Union Public Licence (EUPL). In practice, it is, however, easier to use SYKE's citizen observation service.

Close cooperation is recommended in service design to plan long-term maintenance activities together.

For example, SYKE provides an advisory email address (havaitsemaan@ymparisto.fi) for everyone who makes observations. This ensures that everyone receives the same instructions. Annotations, i.e. additional markings, can also be added to new observations in the CitobsDB service. They may be links to previous observations or references furnished with coordinate data to satellite images or certain locations under long-term monitoring.

In the spring of 2020, SYKE, together with Avoin (www.avoin.org), provided a demo service, in which map symbols are used to indicate how interesting it would be to obtain observations from a certain location. People can also indicate to other themes and locations that interest them (Image 2).

More information

SYKE citizen observations: www.kansalaishavainnot.fi
Open311 API service: www.open311.org
Interesting observation locations: seuranta.avoin.org
Want to use the citizen observation service?
Contact: kansalaishavainnot@ymparisto.fi.

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Maritime Spatial Plan 2030 – a window to the future

Finland's first Maritime Spatial Plan defines a framework for the development of Finland's sea areas. What does the future look like?

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Image: Vaasan kaupunki / Kimmo Makkonen

The Maritime Spatial Plan is a strategic development document for a sustainable blue economy, and its key goal is to support the status of the marine environment. The plan is illustrated on a map. Map symbols depict significant locations with maritime values and functions, as well as areas with a future potential and their location in Finland's sea areas.

Sustainable well-being from the sea

Maritime stakeholders, together with maritime spatial planners, have built a shared vision for sea areas: *Sustainable well-being from the sea*. A healthy Baltic Sea and healthy people walk side-by-side in a mutualistic relationship and support a sustainable blue economy. Using regional development targets and roadmaps, anyone can see what steps are required to fulfil the vision.

The guiding principle is that well-being in the marine environment and the use of sea areas cannot be in conflict with one another, as sustainable blue growth only produces maximum benefits when the operation of the marine ecosystem is secured and the marine environment is in a healthy state. A healthy sea is a productive sea.

Synergies and multiple uses of the sea area

The Maritime Spatial Plan helps identify locations and processes, as well as future processes, which are significant for the current state of maritime sectors and the marine environment. The different needs and future prospects of various parties have challenged planners to consider reasons for plans and ways to present them on a map.

For example, outlining fishing areas on a map is challenging, as fishers use the sea area very extensively. The scale (1:750,000) also sets its limitations on how to present point-like features. However, identifying value chains in the fishing industry – and presenting it on a plan map – is important to illustrate the significance of the sector. Fishing and aquaculture are part of Finnish food production, and their carbon footprint is fairly small compared with meat production, for example.

The draft plan indicates the most significant gillnet and trawler fishing areas of professional fishers. In addition, trap net locations and fishing ports are available as background map material. Fish spawning areas are indicated using the "Significant ecological underwater nature values" marking.

The "Energy production" marking shows wind power locations that have the highest potential for the future. The plan adopts a proactive approach to the transition to large offshore production facilities. It also addresses strategic goals for growth and the space they require. Optimised location control prepared in the SmartSea project is used in the definition of areas, considering economic, ecological and societal factors. However, the Maritime Spatial Plan does not reserve any areas for future uses, nor is it a promise of the future. Wind turbines will continue to require planning and permit processes and environmental impact assessment procedures as before.

Open planning

The Plan is by its nature enabling, not exclusive. Areas cannot be reserved solely for any specific sector, and operations are not prohibited in sea areas outside the markings. The goal is to illustrate the different and often overlapping needs of various parties and also raise discussion of them.

Several overlapping operations are allocated in sea areas in the plan. This indicates that different parties have interests and future potentials in the same areas. Different parties can find opportunities for cooperation and on the other hand, possible conflicts can be avoided by discussing beforehand.

The themes covered by the plan cannot be examined as separate map layers. This is appropriate, as operations cannot be planned sustainably if the needs of other parties and the locations of operations are unknown. The sea area is indefinite, where everything affects everything, and not all cumulative impacts can yet be identified.

Efficiency through collaborative decision making

Maritime spatial planning has been carried out in close cooperation with different stakeholders over the course of several years. As a result, volumes of information about the needs of different parties has beenobtained. The impact of the plan comes from the process, in which stakeholders understand one another, are committed to the plan and feel it as their own cause.

The Maritime Spatial Plan is an important national and regional strategy document, which guides the sustainable use of sea areas. It also provides indirect steering As a tool of spatial planning, it supports regional planning and development by providing information about the opportunities and conditions of maritime sectors and the maritime environment.

Fact box:

Maritime spatial planning is based on the EU directive (2014/89/EU) on maritime spatial planning, which is implemented nationally in the Land Use and Building Act. Eight coastal regions prepared three Maritime Spatial Plans, covering territorial waters and the exclusive economic zone. The plans are reviewed at least every six years to ensure that they are up to date.
Maritime spatial planning focuses especially on activities related to the preservation, conservation and improvement of the environment and nature eg. the energy sector, maritime transport, fishing and aquaculture, tourism and recreation.Other key themes for planning include cultural heritage, the maritime industry, the extractive sector and blue biotechnology. Maritime spatial planning pays attention to the needs of national defence, the special characteristics of sea areas, and land-sea interactions.
Finland's Maritime Spatial Plan 2030 was approved in December 2020. Read the digital plan at www.merialuesuunnitelma.fi or see the original map image in PDF format here.

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Old maps for geospatial data and use

Finland's maps are national treasures, and preserving them for future generations and ensuring their availability are important tasks. Various archives contain volumes of maps, and finding a specific map is a challenge.

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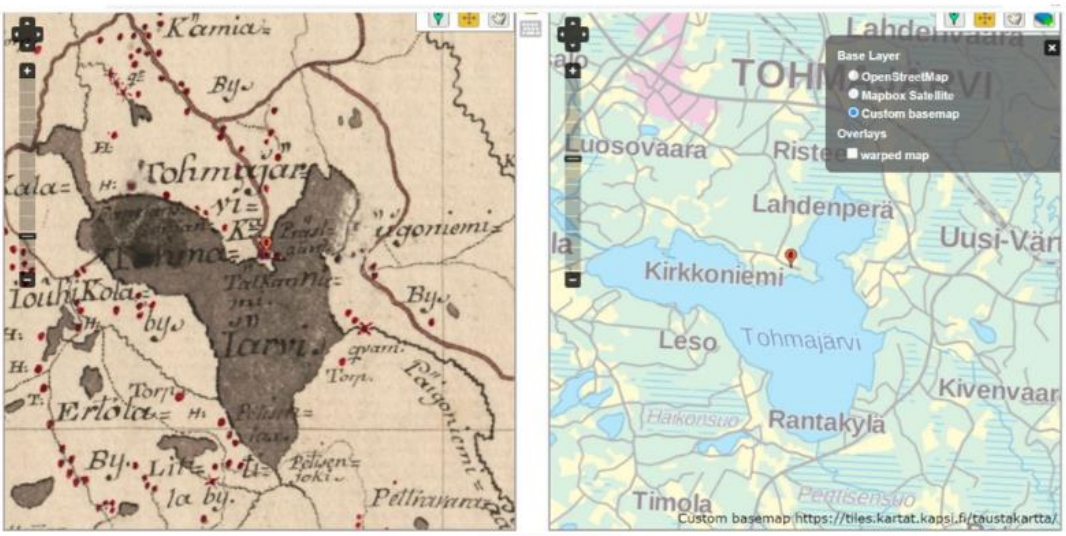

The majority of Finland's old maps are available in the archives of the National Archives of Finland, the National Library of Finland and the NLS. Maps are also available in the National Archives of Sweden, the National Library of Sweden, the archives of the National Land Survey of Sweden, and many other libraries in Europe. In the spring of 2020, the NLS investigated the current location of old maps, resulting in lists of maps, listing some 79,000 maps with the oldest dating back to the 17th century. Using the lists, you can search for maps by map name, mapmaker and mapmaking date.

Challenges during the investigation

The lists of maps include links to digitised maps. However, it was already identified when preparing the lists that the links are not often permanent. The National Archives of Finland had discontinued the use of one of its search systems, and links to the system stopped working. Now the links work again, and permanent links were added to some maps. However, not all maps include links.

Incomplete metadata presents another challenge. Old maps of the National Library of Finland include a title, but it can often be incomplete or even incorrect. Similarly, old maps of the NLS often include incomplete metadata.

It would be particularly interesting to identify the year in which an old map was made. Metadata may include the information, but it may be incorrect. A map may or may not have been made this year. Timing is not always easy, especially regarding maps

dating back to the 16th and 17th centuries, because maps may have been printed for hundreds of years using a single printing plate, possibly with very minor changes.

Compare old maps with current maps

Old maps can be georeferenced, i.e. converted into the coordinate systems of current maps. This is relatively easy if a map follows the map sheet division and its projection is known. A single map can also be converted into another coordinate system by identifying a sufficient number of unambiguous points on the map and their corresponding points on a modern map. There are various good examples of the georeferencing of old maps globally and also in Finland.

In the spring, Mikko Kutilainen from Shingle Oy opened the vanhatkartat.fi website, which contains all of Finland's basic maps until 1993. The maps can be compared with modern background maps of the NLS. Kutilainen downloaded the maps from the NLS download service for old maps. As the maps had not been georeferenced, Kutilainen georeferenced some 10,000 maps.

Old maps in map image services

Currently, there are only a few image services for old maps in Finland. Municipal map image services include individual maps and aerial photos, but no comprehensive services exist besides the vanhatkartat.fi website.

The root cause for this may be that old maps have not yet been systematically georeferenced. In addition to the maps available on the vanhatkartat.fi website, the NLS has some 10,000 maps that follow the map sheet division and can be georeferenced. They could then be offered to users through an API service. As a result, maps of the areas of municipalities and the central government could be presented in time series to illustrate any changes.

National map services across the world

The map service of the National Library of Scotland (maps.nls.uk) is possibly the best example of a national map service that presents old maps. In the service, interesting maps can be searched for based on place names or map series or directly by the name of the map required. The service also features index maps and georeferenced maps.

The portal for old maps in Switzerland (kartenportal.ch) is another good example. Maps of Swiss libraries are available in the service, also including Finnish maps. The map portal of the Cartography Division of the Swiss Federal Office of Topography (maps.geo.admin.ch) features old topographic maps that can be compared and viewed on a timeline.

The best results achieved through cooperation

Converting old maps into georeferenced geospatial data requires some effort, but it is possible, as shown by the examples of Scotland and Switzerland. The best results can be achieved in cooperation between map archives, National Land Surveys and private

service providers. Georeferenced old maps are not sufficient on their own, as a portal in which the maps can be presented, a search system (e.g. Finna), map metadata, and map service APIs are also required.

As a result, each of us can easily use old maps. Would it not be great if you could check changes in a specific location on a timeline, ranging all the way from the 17th century to this very day?

How to georeference maps

- Georeferencing the old maps of the NLS, Jukka Rahkonen, 2013
- Georeferencing the map sheets of the Senate Atlas, Jukka Rahkonen, 2014
- Rasters in place – georeferencing made easy using the QGIS application, Jarmo Kinnunen, 2020
- Setting old maps straight – serial processing of raster images using GDAL, Jarmo Kinnunen, 2018
- Utilising georeferencing in the use of old maps, Kristiina Salonen, thesis, Metropolia University of Applied Sciences, 2018
- Historical geospatial data: producing digital geospatial data using historical maps, Teemu Mökkönen, Suomen ympäristö 34/2006

Bonus: Register in the MapWarper service. You can upload your own map to the service and georeference it without any separate geospatial data software. The service includes satellite images of OpenStreetMap and MapBox, but you can also use other maps, including background maps, orthophotos and basic maps of the NLS in the KAPSI service. You can download a georeferenced map in GeoTIFF, PNG or KML/WMS/Tiles format.

Historical map series added easily to map image services

1. Digital basic maps from 2018 onwards, 1:25,000, and annual raster maps from the last seven years
2. Printed basic maps from 1946–2018, 1:20,000 and 1:25,000
3. Downscaled basic maps, and topographic maps, 1:50,000, from 1964–2018, and digital versions after 2018
4. Topographic maps, 1:100,000, from 1955–1989, 1928–1951
5. Sweden–Finland map of Lapland from 1944, 1:100,000
6. Older topographic maps, 1:20,000 (1918–1947) and 1:50,000 (1919–1937)
7. Maps in the Senate Atlas and printed Russian topographic maps, 1:21,000 and 1:42,000 (partly 1:84,000) from 1870–1917
8. Kalmberg Atlas, 1:100,000, 1855
9. General map, 1:400,000 (1873–1963, 1955–1966, 1984–1987) and 1:500,000 (1996–2000)
10. Economic map of Finland, 1:100,000 (1912–1955)
11. Swedish parish maps, 1:20,000 (1927–1950)
12. Road maps, 1:200,000 and 1:400,000 (1932–1992)

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Aerial photos reveal the hidden past of Porkkala

Old aerial photos illustrate an area's history. What can they tell us about Porkkala, an area occupied by the Soviet Union for more than ten years after the Continuation War?

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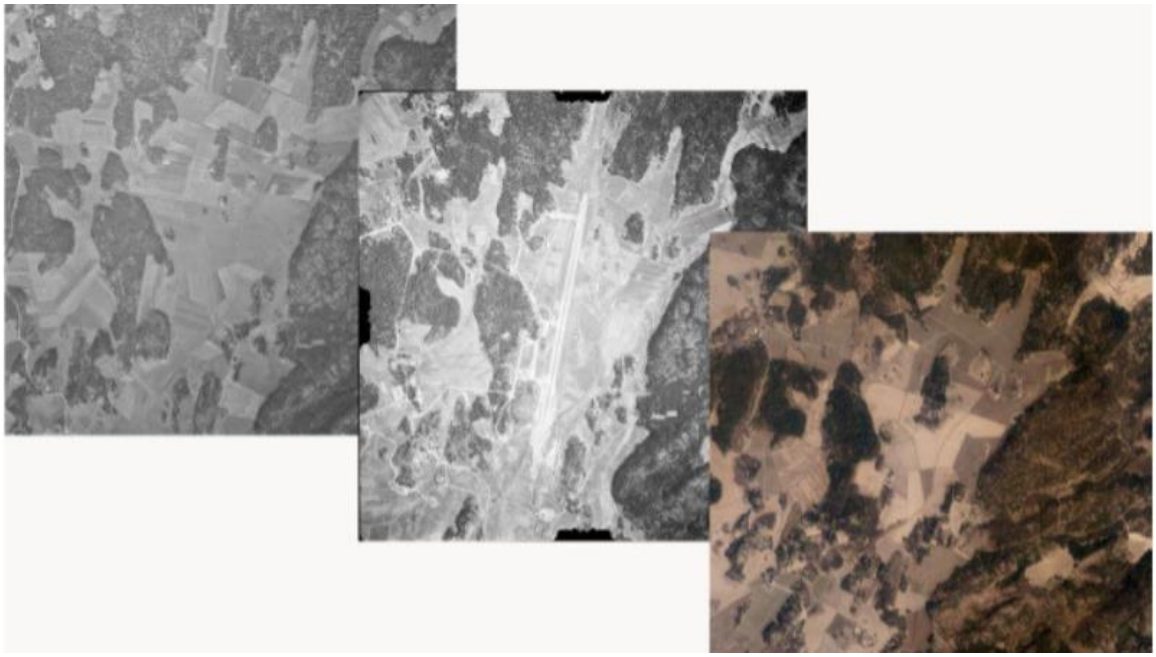

In the 1944 aerial photo (on the left), Friggesby was a quiet rural village with large open fields. The aerial photo taken after the Soviet occupation in 1956 (in the middle) reveals an airfield with its runways and concrete shelters. Since then, the airfield has been covered by vegetation, and it can no longer be identified in the aerial photo taken in 2019 (on the right). Photos: National Land Survey of Finland

The Moscow Armistice was signed in September 1944. It marked the end of the Continuation War and forced Finnish troops to move to the western side of the border defined in the Moscow Peace Treaty signed in 1940. Petsamo remained in the Soviet Union, causing Finland to lose its connection to the Arctic Ocean.

However, the heaviest demand was the obligation set for Finland to lease out Porkkala to the Soviet Union for 50 years as a naval base. If hardly anyone had heard anything of Porkkala before, now the situation had changed completely.

The total area of the leased area was some 1,000 square kilometres, with land covering roughly 388 square kilometres. Kirkkonummi and Siuntio suffered the biggest losses. Degerby was lost in its entirety. In addition, small parts of Inkoo and Espoo were lost.

Thousands were evacuated in ten days

A few days after signing the Moscow Armistice, a survey was conducted in the border between Finland and the Soviet Union to define accurate boundaries in the area. Originally, the borderline was drawn using a ruler. The border passed from the sea following Espoonlahti through Luoma, Hvitträsk and Humaljärvi to the Sjundby Manor, from where it returned back south to the sea through Päivölä and Ingarskila.
After the detailed boundaries had been defined, all 7,272 people living in the area were evacuated in ten days. The area had to be evacuated before midnight on 29 September 1944. All possible modes of transport were used: horse-drawn carriages, lorries, trains, boats and ships. Work was carried out practically non-stop.

First, all the residents' personal belongings, including furniture, were moved to the other side of the borderline. At the same time, cereals and potatoes were harvested and firewood was gathered. Cattle was moved during the night to keep the roads free for transport vehicles during the day. Altogether, 20,000 people participated in the operation.

White area on Finnish maps

The new national border was located in the middle of Espoonlahti. The border was crossed through the Kivenlahti bridge. Even today, it remains a pedestrian bridge on the southern side of the new bridges built for a local road and a highway.
According to the Moscow Armistice, Soviet troops had free access from the eastern border to Porkkala by road and rail.

The leased area of Porkkala disappeared from Finnish maps. Finnish people did not know what was being done in the area. In particular, the eastern part of the leased area remained out of sight from the Finnish side. In the area around Siuntio station, Finnish people were able to watch across large open fields what was happening in the Soviet-occupied area.

In Espoo in 1954, flight activities were identified in Porkkalanniemi. An airfield had apparently been built in the area, in which Soviet troops operated MiG-15 jets, among others. In autumn 1955, the Soviet Union announced that the Porkkala base had become unnecessary. Missile technology had advanced significantly, and large coastal gun batteries were no longer required to shut down the Gulf of Finland.
The area was given back to Finland on 26 January 1956. It had been leased to the Soviet Union for eleven years and four months instead of the originally planned 50 years.

Aerial photos reveal all the secrets

Aerial photos of Porkkala were previously taken in 1944. A new project for aerial photography was immediately started in 1956.

Many old buildings had disappeared. Some had been burned, while some had been relocated to the Soviet Union. There is an area to the east of Tallinn, in which many of these buildings are now located. Many new buildings had also been built at the base, including the Upinniemi military harbour and Kantvik military hospital.

The fighter jets identified a few years previously had taken off from an airfield built in the village of Friggesby. Many who have visited Porkkalanniemi cannot have missed the sign standing on Porkkalantie that says Lentotie (Airfield road), which leads to the southern end of the airfield area. Currently, it is a private road.

When looking at the aerial photo taken in 1944, it is easy to imagine where the airfield would be built ten years later. There is a level field of roughly two square kilometres.

The aerial photo taken in 1956 shows a 1,500-metre-long runway and a number of concrete shelters for aircraft. The soil could not support heavy aircraft. Soil surveys revealed metal sheets that covered a 20-metre-wide area throughout the length of the runway.

A round, slightly tilted control tower can be seen in the middle of the field. In addition, there are 33 airfield structures that are in ruins.

In current aerial photos (taken in 2019), many parts of the airfield are covered by vegetation.

Sources

- Old aerial photos in the Paikkatietoikkuna service: www.paikkatietoikkuna.fi/historiallisetilmakuvat
- Book: Porkkala – tapahtumien keskellä (Porkkala – in the middle of it all), National Defence University, Department of Warfare, 2007
- Porkkala series in the Lähierä blog: lahiera.wordpress.com > Porkkala series
- Video: Old Porkkala airfield
- Lynx, a Kirkkonummi-based orienteering club, has done massive work and mapped various structures in the leased Porkkala area. Read more: porkkala.net/parenteesi-suunnistuskartalle

The NLS opened its aerial photo archives

In June 2021, the NLS opened its archives of old aerial photos by making the photos available in the Paikkatietoikkuna service. The oldest photos date back to the 1930s. The NLS aerial photo archives consist of some 1.5 million aerial photos, roughly half of which have been scanned in digital format. Scanning was started from the oldest films. Later, the aim has been to scan the largest possible areas from different decades. Currently, photos from the early 1970s are being scanned. The photos must be further processed after scanning to add them to the service for old aerial photos. This is a laborious, but invaluable project.

'Many researchers of history, in particular, have been interested, and we have received valuable positive feedback on the service. We are also constantly told about new applications. By comparing aerial photos taken in different decades, changes in beaver populations have, for example, been investigated by identifying their dams,' says **Heli Laaksonen**, Head of Cartography at the NLS.

Aerial photos have recorded Finland's history over roughly a hundred years. The impact of the war years can also be dramatically identified. For example, photos taken

in the late 1940s show various traces of bombings, especially in the areas of Rovaniemi and Kemi–Tornio airports.

'I have heard that old aerial photos of Porkkala show that structures were built on the border using sand to check every morning that no-one had tried to cross the border,' says Laaksonen.

There is plenty to study for everyone interested in history, as the material added to Paikkatietoikkuna currently covers some 400,000 square kilometres. More photos will be added as the scanning project progresses.

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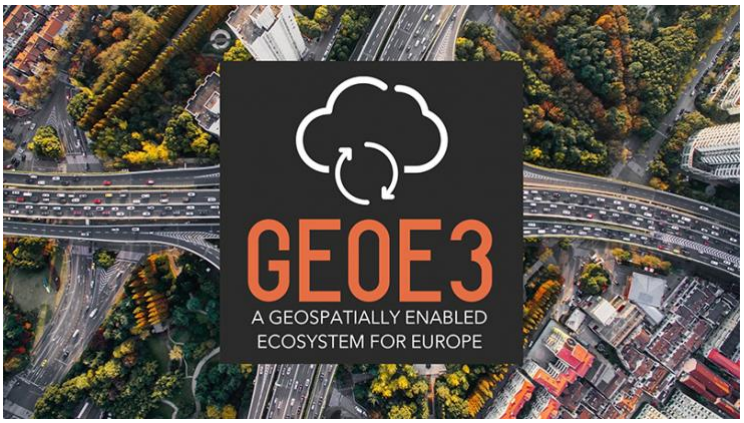
GeoE3 – A geospatially enabled ecosystem for Europe



Our society is facing great challenges. Achieving climate goals and reacting to global threats, such as biodiversity loss, require reliable databases from the public and private sectors. Geospatial information systems facilitate the analysis of the effects that climate change, habitat loss, population growth, and pollution have on the environment.

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For geospatial data to be useful for the monitoring, analysis, and calculation of such effects, they must be comprehensive and meet quality standards. This requires collaboration between information-producing actors as well as product developers. From 2020 to 2023, The National Land Survey of Finland is coordinating the GeoE3 project. This project serves as an example of a data integration platform for high-value datasets and services (e.g. meteorological or statistical data), and geospatial features from existing national geospatial data platforms (e.g. building data or road network data). It creates dashboards and visualisations for a comprehensive understanding of data from a variety of sources.

To produce tangible results, the GeoE3 tools address three use cases:

1. The energy efficiency and solar energy potential of buildings
2. Assessment of electric cars (especially heavy vehicles) using terrain elevation data
3. Helsinki-Tallinn smart city concepts

The data integration platform has 3D building data from Finland, the Netherlands, Norway, Spain, and Estonia. The Finnish 3D building data is covering some areas of Finland. In other areas 3D data is estimated in the same way as in Norway. The rest of the countries' 3D data is already analysed nationwide.The project is co-financed by the Connecting Europe Facility of the European Union.

List of partners can be found here. You can also find the latest newsletter here. The article was first published on EUROGI website.