EuroSDR

European Spatial Data Research

Annual Report 2023

www.eurosdr.net

About EuroSDR

EuroSDR - formerly known as OEEPE - is a not-for-profit organisation linking National Mapping and Cadastral Agencies with Research Institutes and Universities in Europe for the purpose of applied research in spatial data provision, management and delivery. The result is a network of delegates, effectively and practically addressing Europe's spatial data research requirements. EuroSDR also organises, in collaboration with related organisations, international workshops and courses which address key issues in a timely and focused manner.

Vision

EuroSDR is the recognised provider of research-based knowledge to a Europe where citizens can readily benefit from geographic information. Our mission is to develop and improve methods, systems and standards for the acquisition, processing, production, maintenance, management, visualization, and dissemination of geographic reference data in support of applications and service delivery.

Our Member States and their Prime Delegates (2023)

Austria	Wolfgang Gold	Bundesamt für Eich- und Vermessungswesen
Belgium	Eric Bayers	Institut Géographique National Belgique
Croatia	*To be confirmed*	Državna Geodetska Uprava (DGU)
Cyprus	Andreas Hadjiraftis	Ministry of the Interior, Department of Land and Surveys
Denmark	Katarina Ritz	Styrelsen for Dataforsyning og Effektivisering
Estonia	Tambet Tiits	Maa-amet
Finland	Juha Hyyppå	Maanmittauslaitos
France	Bénédicte Bucher	Institut National de l'Information Géographique et Forestière
Germany	Michael Hovenbitzer	Bundesamt für Kartographie und Geodäsie
Ireland	Paul Kane	Táilte Ireland - Surveying
Norway	Jon Arne Trollvik	Statens Kartverket
Poland	Anna Bober	Główny Urząd Geodezji i Kartografii
Portugal	Mário Caetano	Direção Geral do Território
Slovenia	Dalibor Radovan	Geodetski Inštitut Slovenije
Spain	Julián D. Hernández	Instituto Geográfico Nacional
Sweden	Tobias Lindholm	Lantmäteriet
Switzerland	André Streilein	Bundesamt für Landestopographie
The Netherlands	Martijn Rijsdijk	Kadaster, Data Governance Innovation & Projects
United Kingdom	*To be confirmed*	Ordnance Survey Great Britain

Our Associate Members and their Representatives (2023)

Esri/nFrames	Nick Land & Konrad Wenzel
Digitaal Vlaanderen	Jo Van Valckenborgh
Field Group	Leif Erik Blankenberg
Het Waterschapshuis	Jeroen Leusink
Hexagon	Wolfgang Hesse
ICGC	Julià Talaya
IGI	Philipp Grimm
RIEGL	Peter Rieger
Vexcel	Michael Gruber
1Spatial	Dan Warner

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Message from the President

Wolfgang Gold

Dear EuroSDR friends,

It is a great pleasure for me to introduce the Annual Report of EuroSDR for the first time. As in many other years we can look back over a very busy year – and a year with an unusual number of changes in the executive team of EuroSDR.

But let's start our review with the activiies of EuroSDR which are the most obvious from the outside. The EduServ course 2023 was – as it is almost every year – the highlight of EuroSDR-actions. We had four brilliant topics prepared by a motivated group of tutors. A sincere "Thank You" to everybody who contributed to this success. With regard to education and our younger colleagues, I was personally very pleased that the winner of the EuroSDR-PhD-award 2023 came from Austria and my institution. Congratulations again to Ana-Maria Loghin.

Besides a great number of workshops and other activities that EuroSDR was involved in, we had two BoD-meetings somewhat in the north of Europe – in Tallinn (Estonia) and Gävle (Sweden). I appreciated the special atmosphere of these regions being so different to Central Europe and the alps. To have a look on the penetration of digitization into daily life in these two countries was an interesting experience.

These meetings were affected by a number of changes in functions of the Executive Team of EuroSDR. At the Tallinn-meeting I had the honour of starting my period as President of EuroSDR (sorry for being so impolite to start with myself). Thanks to the delegates entrusting me with this function.

A big bang almost occurred at the Gävle meeting. The Belgian team handed the role of the Secretary-General to an Irish team. Best wishes to Conor Cahalane and Neasa Hogan for dealing with the difficult and often, unseen tasks which are the backbone of EuroSDR. Only a few minutes later EuroSDR-delegates had to vote for the selection of Vice-President as Fabio Remondino stepped down after two very active terms. For the first time in history of EuroSDR the delegates made the choice for a shared Vice-Presidency – all the best to Jantien Stoter and Joep Crompvoets for this challenging duty. And as if that was not enough: there was the need for a new person chairing EuroSDR-Commission 1 – Data Acquisition. A warm welcome to Eija Honkavaara in this leading role.

But every start into a role means that some people have finished an intensive period of promoting EuroSDR. Please let's say thank you to:

- Michael Hovenbitzer as past President
- Joep Crompvoets as past Secretary-General
- Tatjana van Huyck as past assistant to the Secretary-General
- Fabio Remondino as past Vice-President
- Jon Mills as past Commission 1 Chair

for their contributions to the success of EuroSDR!

This extraordinary fluctuation within the spectre of functions superposes all the other things that happened. We had a short celebration of the 70th anniversary of EuroSDR, retirements and initiation of delegates and of course also our tasks for applied research. I hope that these will have more room in the report next year. The newly consolidated Executive Team will try to ensure optimal conditions for our work.

Last but not at least I want to thank all of you for your support to EuroSDR last year – and please “game on”.

Best regards

Wolfgang.

Message from the Vice-President

Fabio Remondino

Dear EuroSDR friends,

2023 was for sure another prosperous year for the EuroSDR community. The organization confirmed once again its leaderships and presence in the geospatial sector organizing many scientific events and running multiple research activities for the benefit of the community.

Two BoD meetings took place, in Tallin (Estonia) and Gavle (Sweden), with very interesting national days and reports of ongoing activities.

In terms of **organized and supported scientific events**, we can mention:

- Evaluation and BENCHmarking of Sensors, Systems and GEOspatial Data in Photogrammetry & Remote Sensing (in collaboration with ISPRS)
- Data Ecosystems and Spatial Data Infrastructure
- LoD2 Building Model Generation
- Spatial Data Quality
- Artificial Intelligence for NMCAs (in collaboration with EuroGeographics)
- Metadata Matters: What Role Does Linked (Meta)Data Play in the Geospatial World?
- How can GI science advance the value of city-level and nationwide Digital Twins? (in collaboration with AGILE)
- EU funding by EuroSDR members
- Point Cloud Processing

In terms of **projects and research activities**, delegates focused on various topics, such as:

- Benchmark evaluation of RPAS geometric survey quality in the absence of ground information
- Linking data in Europe, effective land administration (in collaboration with the UN Expert Group on Land Administration and Management)
- Distribution of historical and time stamped data from mapping agencies and other providers

In terms of **publications**, the survey reports on “Digital Twins” and “Automated Extraction of Topographic Map Data from Remotely Sensed Imagery by Classification and Cartographic Enhancement: An Introduction to New Mapping Tools” were published.

On the educational side, the 21st edition of the **EduServ** course was offered in Spring ’23 focusing on four topics:

- Integration of 3D City Models and BIM: GeoBIM
- 3D Point Cloud Classification for Mapping Purposes
- Remote Sensing and Change Detection with Sentinel Time Series Data
- Sustainable Business Models for Open Geospatial Data

The **PhD award** was assigned to Dr. Ana-Maria Loghin (TU Vienna, Austria) with her thesis titled “Potential of Very High Resolution Satellite Imagery for 3D Reconstruction and Classification”.

The two supported **PhD projects** (“Integration of multispectral LiDAR with imaging” and “Digital Twins”) are ongoing and in the next Spring 2024 BoD meeting a short report will present their status and achievements.

The Fall 2023 BOD meeting was also my last appearance in the EuroSDR community. After two terms as Vice-President and overall 12 years as “officer”, I step down and have to leave the community as Italy has no National Mapping Agency nor related organization joining EuroSDR. They were 12 fantastic years where I could enthusiastically organize many scientific workshops, prepare different datasets/benchmarks, run two EduServ courses and establish / launch various other activities (PhD award, EuroSDR Hype cycle, Associate members from industry, etc.).

I want to thank EuroSDR and all the people I met for their support and friendship and collaborations within these wonderful and productive years. I wish EuroSDR and you all a very successful continuation with many new research activities, events and educational courses under the EuroSDR umbrella!

Fabio.

Interesting examples of real-life practices at NMCAs based on results of existing applied research

1. Building Footprint Extraction for 3D city modelling from aerial LiDAR data and high-resolution aerial photo: Case Study of Limassol in Cyprus

Republic of Cyprus, Ministry of Interior, Department of Lands and Surveys (DLS) - (Prepared by: Alexandra Papadopoulou – email)

The Department of Lands and Surveys is probably the most important pillar of socio-economic development in Cyprus, as it provides the basis for the design of all development programs relating to immovable property, through innovative methods and the use of modern IT technology, offering services to many public sector entities. DLS is continuously investing on emerging technologies, constantly upgrading the quality and standard of digital geospatial data and e-services offered.

Manual extraction of features such as buildings, water bodies and roads from high resolution aerial imagery requires considerable time. A common trend in the scientific community is the use of automated feature extraction methods. For this work, we evaluated the methods of automated feature extraction of buildings, using orthophoto images which were acquired in 2019 from a major aerial photography project. These images have 0.1-meter spatial resolution and consist of four bands (RGB and NIR Bands) as shown in Figure 1 below. To achieve the best result in the classification process, LiDAR data (2019) was used as ancillary data. The vertical accuracy of point clouds, from Airborne Laser Scanning (ALS), is 20cm with density of 10 points/m^2. The process generates mass point cloud datasets (Figure 2) which the DLS Photogrammetry and Remote Sensing Section has explored, prepared, visualized and analyzed using ArcGIS Pro. The process extracts 2D building footprints and generates 3D multipatch buildings. The approach was tested on the built-up area of Limassol (Figure 1), which in the last few years is undergoing a major rapid urban development.

Fig. 1: High-resolution Orthophoto 2019, 10cm

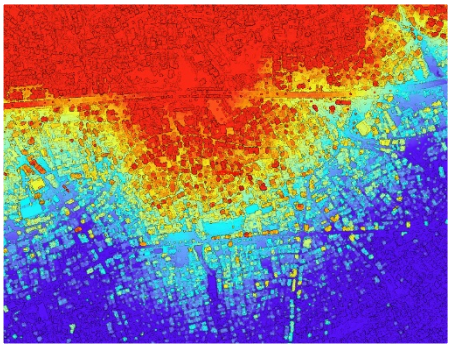


Fig. 2: 2019 airborne LiDAR dataset

At first, the point cloud was classified into ground and non-ground xyz points. The ground points were used to generate Digital Terrain Model (DTM), which represents the bare earth surface without any other features such as buildings or vegetation, while Digital Surface Model (DSM) in Figure 3, was produced from the entire point cloud and captures both the natural and artificial features of the environment. Subtracting DTM from the DSM, a model (CHM) was developed to estimate the canopy top height of features above the terrain surface (Figure 4).

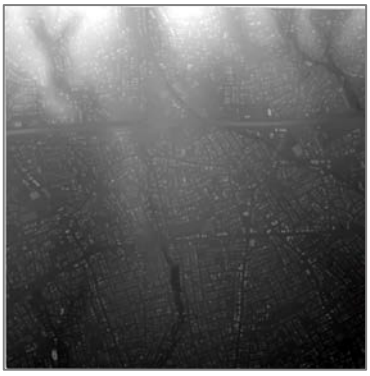


Fig. 3: DSM from Aerial Photography 2019

Fig. 4: Intensity 1 Band image from CHM

Thereafter, trees and vegetation cover were filtered using the Normalized Difference Vegetation Index (NDVI) in which different threshold values were tested to achieve the best identification of the building rooftops. The NDVI values range from -1 to + 1 as a function of the natural response of ground features the red and near infrared spectral bands, where the positive value represents the denser of green vegetation (Figure 5). Then the extracted building footprints, from the building class, were further processed to generate 3D model (Figure 6).

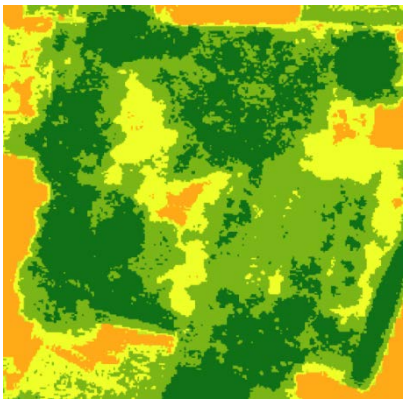


Fig. 5: NDVI map showing the greenness

Fig. 6: Regularized Building footprints without holes

For 3D representation of the building polygons, the height values of these buildings were extracted from the CHM. A colored representation of building footprints according to their height values, appears in Figure 7 below. The cleaned up extracted regularized building footprints were subsequently used for the 3D building model development without architectural details, using the average height of the Limassol area, occupied by the respective footprints (Figure 8).

Fig. 7: Building footprints according to height values

Fig. 8: 3D Multipatch building footprints

LiDAR scanning is an emerging technology which provides precise three-dimensional representation of the existing imaged surface. The model provides 3D visual perception of the spatial pattern of the buildings, which can be useful to provide support for urban planning activities, building mass appraisal, risk management, 3D city modeling and natural disaster damage. Visually comparing the extracted building results with the orthoimage, we find that mostly the buildings have been extracted successfully, and no terrain and vegetation points have been extracted as buildings. Extraction accuracy is very high, estimated at 95%. In conclusion, the methodology requires further improvement and a better approach for building geometry, especially on curved edges of buildings where the contour line is not completely accurate. DLS will continue investigation on this subject.

2. The AI4TDB Project - The National Land Survey of Finland

Prepared by Lingli Zhu, National Land Survey Finland lingli.zhu@nls.fi

This growth of the urban population has accelerated building and other infrastructure construction as well as the number of built-up areas. Although the information in the National Land Survey (NLS)' topographic database (TDB) updates yearly, owing to historical factors, some building vectors may remain inaccuracies. For instance, decades ago, analog photogrammetric instruments were used to measure buildings from film-derived stereo images. The evolution to digital photogrammetry workstations and subsequent advancements in digital cameras drastically improved aerial image resolution, accompanied by robust software and hardware facilitating precise calculations. Yet, revisiting earlier measurements across different periods proved impractical. The errors of TDB building vectors (also called building footprints) have been evidenced in other projects when the building vectors were overlapped with LiDAR point clouds. These errors included deviations in building locations, instances of missed buildings, and cases of demolished structures. Under such a context, the AI4TDB project was launched. 'AI4TDB' was the abbreviation of 'Artificial Intelligence for Topographic Database Accuracy Enhancement'. The focus of the AI4DB project was on two types of objects: buildings and watercourses. The development included: improving the positional accuracy and data completeness of TDB building footprints and continuously improving the method for the watercourse detection.

The project for the building development leveraged the AI model to identify buildings from the input data of true orthophotos, digital elevation model (DEM), and digital surface model (DSM). The AI-derived buildings served as reference data, enabling a comparison with building polygons from the TDB to recognize location deviations and missing and demolished buildings. The AI team in the NLS developed algorithms to identify the differences between the AI-derived building polygons and TDB building footprints. The deviation included both the location shift and the rotation angles between two polygons. The TDB buildings shifting greater than 1m or a rotation angle greater than 3 degrees were corrected. Fig. 1 shows an example of TDB building errors.

Figure 1. *The test results in Jyväskylä area. From left to right: AI-derived buildings (Red), TDB missed buildings (Magenta), buildings with location deviation (Green), TDB demolished buildings (Red)*

Throughout the project, datasets from eleven regions were tested for identifying/correcting the TDB building locations including moving/rotation operations, covering a total area of 1628 km^2. Additionally, within the area of 1008 km^2, the missed/demolished buildings were recognized from the TDB data. For the final assessment, three specific areas—Riihimäki (Southern Finland, 144 km^2), Jyväskylä (Middle of Finland, 144 km^2), and Oulu (Northern Finland, 144 km^2)—were examined. In the Riihimäki area, 1104 out of 11333 building locations were corrected. 175 missed buildings and 1003 demolished buildings were recognized. In the Oulu area, 2041 out of 24276 buildings were corrected. 209 missed buildings and 3261 demolished buildings were identified. In the Jyväskylä area, 425 missed buildings and 2253 demolished buildings were found while 1929 out of 22081 buildings were corrected.

In the AI4TDB project for building development, we conducted a thorough analysis of the TDB building vectors and tested the functionality of the AI model in real-world applications. The project was successful with the collaboration of the AI development team and the mapping team in the NLS. Throughout the project, the algorithm was continuously improved by acquiring feedback from the mapping teams. In addition, essential information of each test area was estimated, including 'area', 'number of buildings', 'corrected buildings', 'one-to-one moved/rotated cases', 'buildings with significant differences in polygon areas', 'absence of the nearest TDB buildings', 'one-to-many cases', etc. Such information offers insights into the overall status of TDB buildings and aids future decision-making processes.

As previously mentioned, inaccuracies in the TDB buildings could arise from technical limitations, varying accuracy requirements across different periods, and potential errors stemming from operator oversight or carelessness. From an AI methodology perspective, numerous factors influenced the model's predictions, including the quality of data sources (such as true orthophotos and LiDAR data), the environmental context (urban or forested areas), and the AI model's robustness and adaptability to new datasets. Notably, the project garnered positive feedback from the organization's mapping teams, endorsing its effectiveness in improving data accuracy. Mappers found value in the project as it significantly reduced manual workload by utilizing AI-derived buildings as guiding references.

Regarding the AI4TDB Hydrographic development, the main overall aim was to enhance the correctness and connectedness of the recognition results for the small watercourse network achieved in the previous ATMU project. The work on hydrographic features has focused on two main tasks; i) to improve the feature detection and extraction of small waterbodies developed in the ATMU project; ii) to extract small unmapped waterbodies, particularly those features that have watercourses running to and/or from them, mainly small ponds of stagnant water between ditches and small natural streams. For both tasks, the neural network system was modified and a significant amount of new training and validation data were digitized. In addition, the label data produced in the ATMU project was slightly corrected and improved. Fig.2 illustrates the detection results of watercourses and ponds.

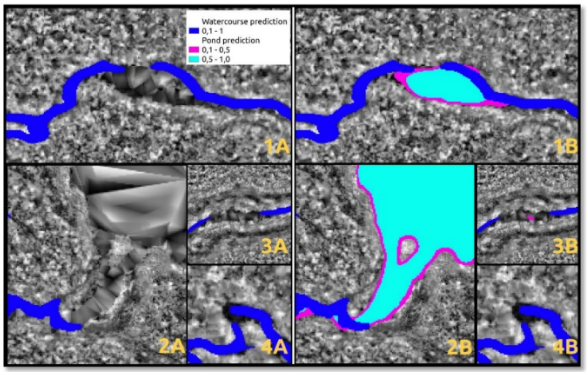


Figure 2. Large detected waterbodies connect well to watercourses when a 0.1 threshold value is used (1A/B, 2A/B), while wide watercourse sections (3A/B) and small ponds between watercourses (4A/B) remain a challenge.

Overall, successful results of recognizing small watercourses and their connecting ponds were achieved with numerous rounds of iterative training trials. Numerical result scores of the prediction

runs became relatively high and visual assessments of the results proved that most of the significant watercourse features were detected. Challenges of achieving similar results to a human digitizer fell on resulting gaps of small watercourses that are mostly real in the ground truth, such as vegetation and bridges on top of watercourses. One potential solution for filling the gaps was found by using different thresholding of the prediction surfaces. Another possibility is to run trained networks several times in order to get slightly different results that complement each other.

For the pond recognition, challenges were related to false positives of shadows on input images and potential improvements include detecting water edges instead of entire ponds, and scaling the training data tiles in the neural network system, and using other loss functions. The sensitivity of neural network training to terrain types was observed in the training trials, particularly for small watercourses that were better detected with respective training data for each area than with all the training data together. For small watercourses, it may be worthwhile to identify the terrain types that require separate training.

The next steps in constructing a correct and connected watercourse network by neural network recognition would be testing the trained networks with more varied terrain types, vectorizing the achieved results and finding means to connect the resulting vectors successfully together. For this, more precise definitions of mapped watercourse features are to be formed, and more descriptive and accurate assessments of results are to be determined.

Despite encountering challenges in both buildings and watercourses, the project proved instrumental in gathering valuable insights and lessons for the future. Emphasizing a collaborative approach between humans and AI, the project advocates for a symbiotic relationship in production processes. Looking ahead, this collaborative model is posited as the optimal solution, acknowledging the strengths of both human expertise and AI capabilities.

3. Artificial Intelligence Applied to the Production of Landcover Products : IGN-F's Current Strategy

Eva Bookjans, Anatol Garioud, IGN-France/SIMV , firstname.lastname@ign.fr

The French Mapping Agency (IGN-F) has been tasked with creating a nationwide reference map, the "OCS-GE" (= Occupation du Sol à Grande Echelle) as a tool for measuring and monitoring the artificialization of the French territory. By the end of 2024, the OCS-GE will cover all of France providing a detailed description of both the land cover and the land use (see Figure 1). It will allow France to meet its objective of reducing the rate of artificialization to net zero by 2050, which is part of the French climate and resilience law passed in 2021.

In order to accelerate the production of the land over component of the OCS-GE, the IGN-F has worked on the implementation of an artificial intelligence (AI) model, which relies on semantic segmentation to predict the land cover from aerial images with 4 channels (red, green, blue, infrared) and a spatial resolution of 20cm (more precisely the BD ORTHO, also a product of the IGN-F) and the elevation (equal to the difference : digital surface model – digital terrain model). A big challenge in creating a robust nationwide, or "France-wide", model are the variations in landscape across the territory (for example, urban versus rural, oceanic versus mountainous). Consequently, the model was trained with annotations covering a variety of zones throughout metropolitan France and with varying acquisition dates to ensure that both the spatial and temporal heterogeneity of the territory are featured in the model, i.e. the different types of landscapes as well as their seasonal changes. In total over 2500 km² of aerial images were annotated by photo-interpreters.

The French-wide AI model, currently in production, fits 16 landcover classes with an accuracy of 78% and an mIoU (mean Intersection over Union) of 58%. As part of its ambition to further improve the "French-wide" AI model, the IGN-F has called on experts by launching the scientific challenge FLAIR #1 (see https://ignf.github.io/FLAIR/ for more details), whose results are very promising and are integrated into production. In this context, the IGN-F has published a series of pre-trained AI (semantic segmentation) models on the IGN-F Hugging Face page (https://huggingface.co/IGNF), which make it possible to classify landcover on BD ORTHO images.

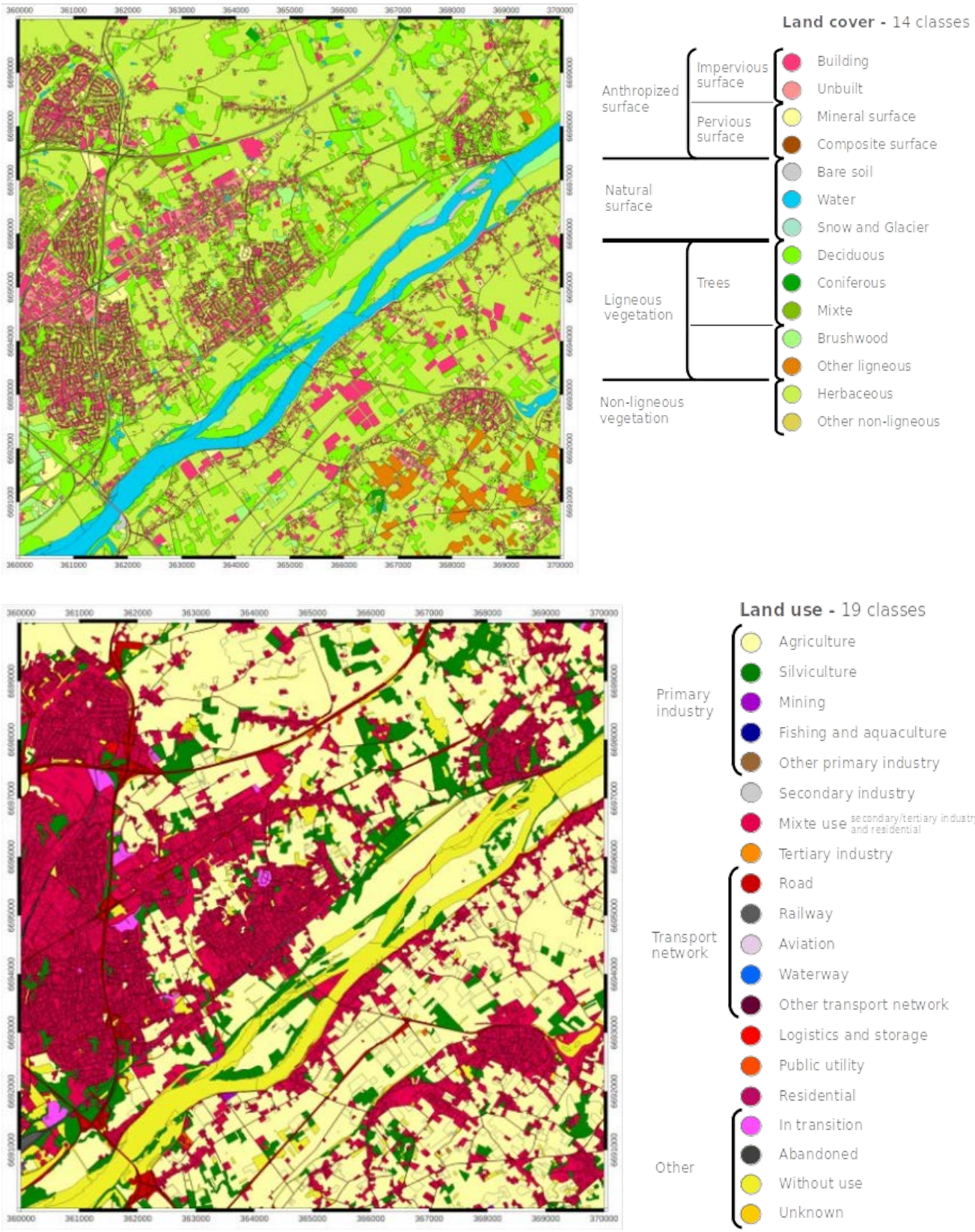


Figure 1. Example of the OCS-GE with 14 land cover classes (top) and 19 land use classes (bottom)

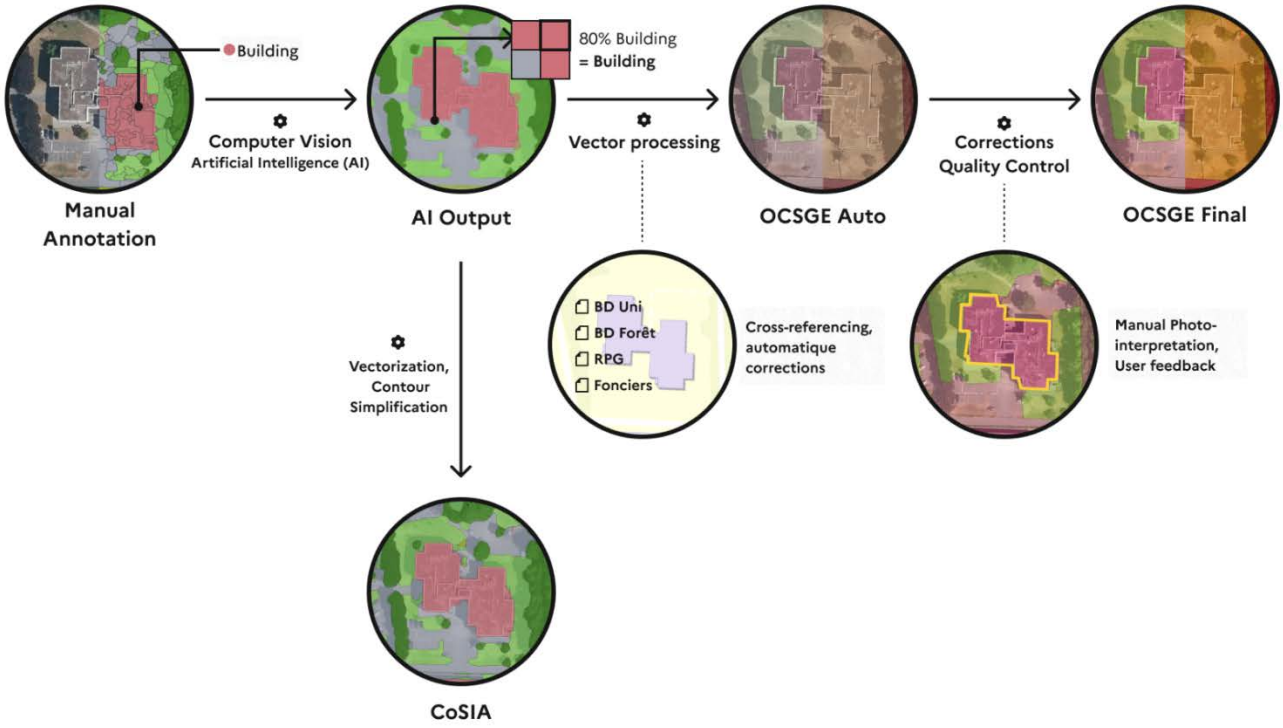


Figure 2. Schematic illustrating the production process of the OCS-GE and CoSIA.

Besides being an important input for the production of the OCS-GE, the output of the French-wide AI model has given rise to new product : “CoSIA” (= Couverture de Sol par Intelligence Artificielle) (see Figures 2 and 3). These maps are produced fully automatically and without the stringent specifications of the OCS-GE, and therefore they can be made available more rapidly, while keeping the spatial resolution of BD ORTHO arial images (see Figure 4 for a comparison between CoSIA and the OCS-GE). CoSIA is expected to be updated every 3 years, in sync with the production of the BD ORTHO. CoSIA has solicited interested from a variety of potential users, such as French regional governmental services, environmental non-profit associations, urban planning agencies, and researchers. Although CoSIA is the un-corrected direct output of the AI model, its geographic level of detail and 16 landcover classes make it a valuable input for different use cases, such as identifying nature in urban areas, mapping out ecological corridors, urban planning and investigating links between people’s health and their surroundings, just to name a few.

Figure 3. Example of CoSIA with 16 land cover classes.

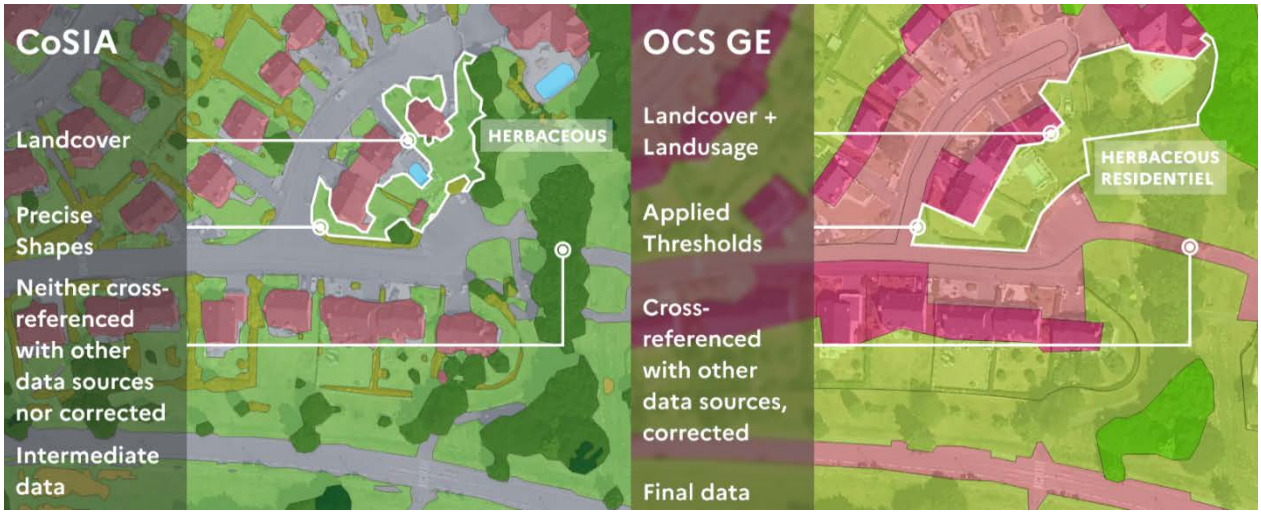


Figure 4. Comparison between the two land cover products of the IGN-F : CoSIA and OCS-GE.

Figure 5. Examples of use cases.

In summary, the IGN-F has implemented an AI model to accelerate the identification of the French landcover and is making the maps and models publicly available, fostering the development of new

applications and allowing policy makers and the public to better and more quickly respond to the current ecological and socio-economic challenges.

4. The Norway Mapping Authority bolsters its commitment to Research and Development

Reidun Kittelsrud, Kartverket Reidun.kittelsrud@kartverket.no

In 2023 The Norwegian Mapping Authority (NMA) achieved recognition as a research organization at The Research Council of Norway. This enables us to more extensively pursue funding opportunities and spearhead projects aimed at shaping the future of geographical infrastructure, as well as fostering increased and novel utilization of geographical data.

As of the beginning of the year, this entails the establishment of a dedicated department with research as its core activity. Staffing includes individuals tasked with both administrative coordination of research funding activities, and expertise and capacity to lead projects aligned with the evolving competence demands we foresee for the future.

The vast potential inherent in adopting new technologies necessitates greater exploration and experimentation than ever before. Collaborating with internal subject matter experts, we scrutinize emerging trends and forces that will impose fresh demands on how we produce and disseminate geodata. Technologies such as artificial intelligence, big data, and high-performance computing not only offer significant opportunities to modernise and automate our own and other data owners' production lines but also engender new needs and user groups capable of leveraging geodata in novel ways to tackle critical societal challenges.

It's imperative to comprehend how technology can enhance the way we collect, manage, and share data presently, and how we can ensure that what we deliver seamlessly supports users' processes in the most automated manner possible.

Through collaborations with academia, other public entities, and the private sector, we are gaining insights into how maps and positioning must interplay in the future and the foundational data requirements therein.

When engaged in research and development, it's crucial to look far enough ahead and dare to challenge conventional wisdom. Consequently, we engage in various areas perceived as pivotal for the future integration of maps and positioning.

Our projects span domains such as automated transportation, climate adaptation, and technologies facilitating precise object geolocation for a broader range of users.

We also aspire to take a greater part in international projects, particularly through the Horizon Europe program, and would be keen to discuss collaboration opportunities with others in this domain!

Below, you can find more information about one of our research projects. This project has been particularly relevant for climate adaptation in the Arctic regions, and the collaboration has provided us with a greater understanding of the needs within research communities and public administrations working in this field.

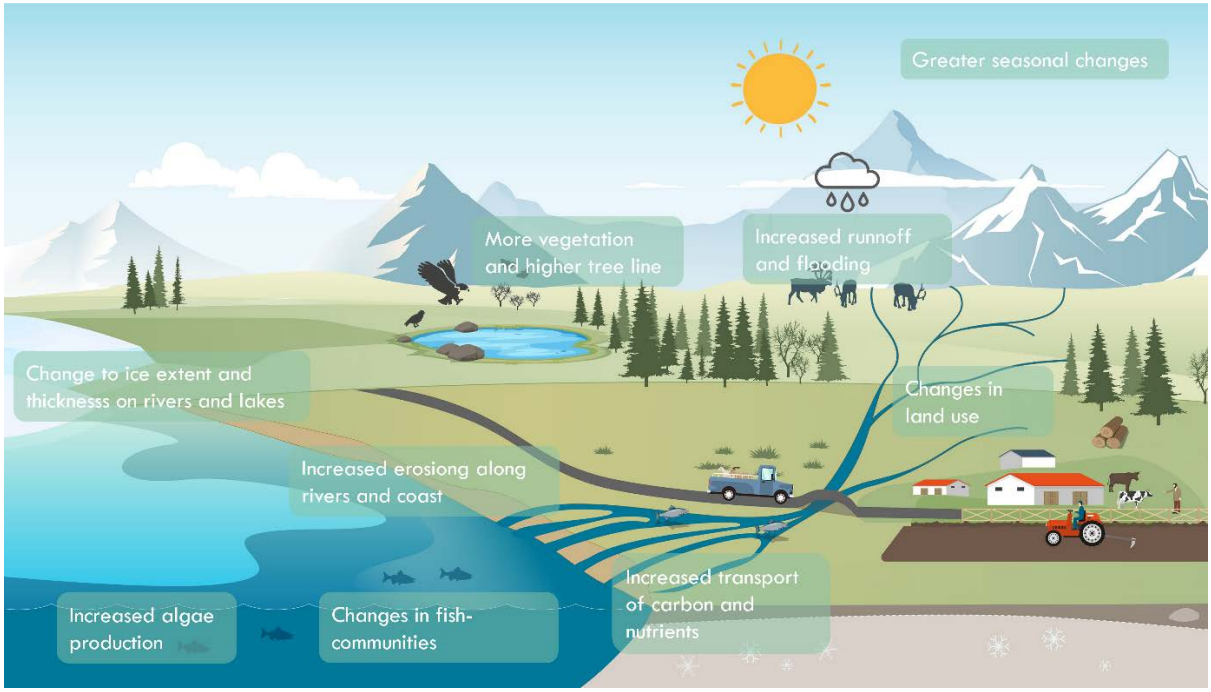
Catchment to coast

The Norwegian Mapping Authority is part of the research project "Catchment to Coast", which aim to understand cross-ecosystem mechanisms and climate change impacts from catchment areas in the mountains, to the fjords and seas.

The research group investigate the flow of carbon and nutrients from the terrestrial system to the aquatic system with seasonal changes.

Within the project framework, NMA assumes a crucial role in establishing a comprehensive drainage network spanning from the mountainous regions to the coastal areas. By leveraging digital elevation models and orthophotos, we have meticulously mapped an additional 9500 km of drainage lines across the test areas in the Tana, Målselv, and Komagelva river basins – an effort that ensures the completeness and accuracy required for robust modeling of cross-ecosystem changes.

Beyond enhancing our understanding of cross-ecosystem dynamics, our mapping endeavors offer multifaceted benefits. Local municipal administrations now possess a better foundation for informed land-use planning, equipped with insights into potential water accumulation areas during runoff and melting seasons, particularly in the high north. Additionally, our mapping serves as a vital resource for modeling and mitigating flood risks.



Project Catchment to Coast, Illustration by Eva Setsaas, NINA (The Norwegian institute for Nature Research)

5. Poland's NMCA Activity:

Prepared by Office of Geodesy and Cartography

The Head Office of Geodesy and Cartography (GUGiK) is constantly expanding its portfolio of available data and services, as well as improving the quality of its platforms. In 2023, several steps were taken in this regard, including the launch of a refreshed version of the website www.geoportal.gov.pl and the introduction of new tools.

5.1. National Geoportal Website Refreshed

In 2023, the Head Office of Geodesy and Cartography (GUGiK) released a refreshed version of the geoportal.gov.pl website. It was based on a modern Content Management System (CMS), which ensures clear graphic design and full responsiveness. The introduced modifications will provide comfortable access from both desktop computers and mobile devices.

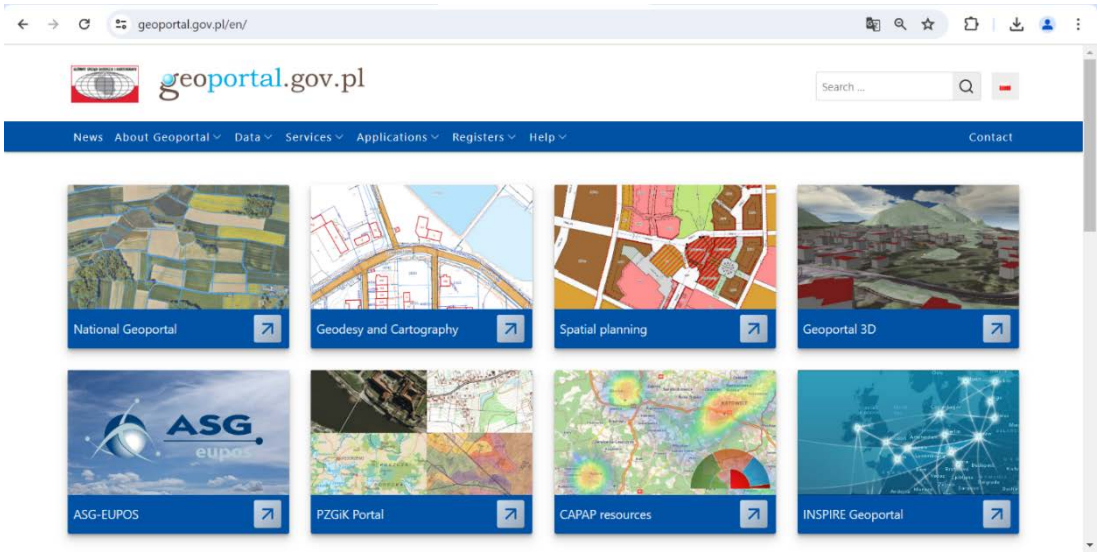


Figure 1: Home page of National Geoportal on desktop

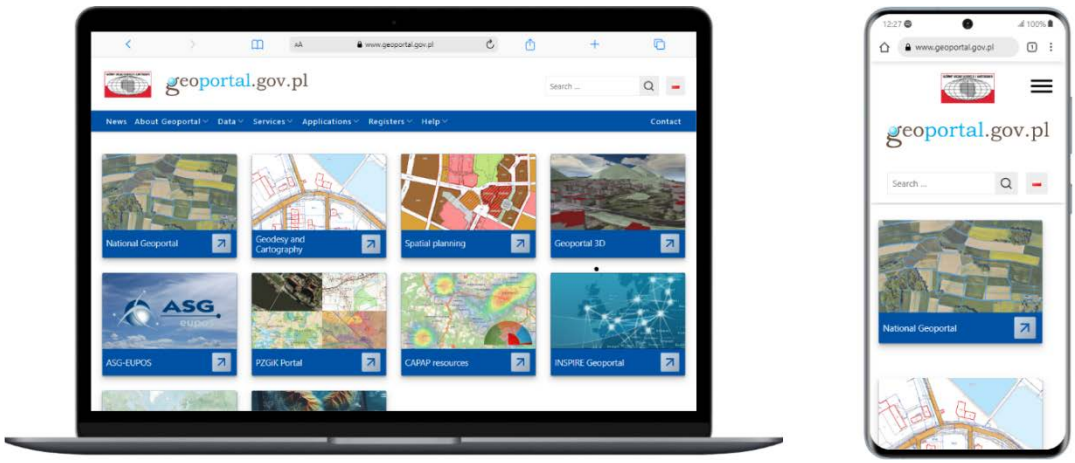


Figure 2: Home page of National Geoportal on mobile devices - with iOS (left) and Android system (right).

5.2. Parcel Report – New Tool in National Geoportal

Last year, a new tool called Parcel Report (*in Polish: Raport o działce*) was provided on the website www.mapy.geoportal.gov.pl. With this tool we can quickly and easily gather information about any selected parcel and its immediate vicinity. The Parcel Report, depends on parcel's localization, includes from 4 to 7 thematic sections, such as:

- elementary information about parcel,
- landscape planning,
- Digital Terrain Model (DTM),
- information about risk of noise pollution,
- information about risk of flood,
- up-to-date view of orthophotomap,
- archival view of orthophotomap.

Thanks to this information, interested person can easily and straightforward obtains the most necessary information about the parcel. These pieces of information can be used to determine permitted or prohibited actions on the parcel (from landscape planning documents), assess investment potential or contribute to the decision-making process of buying parcel.

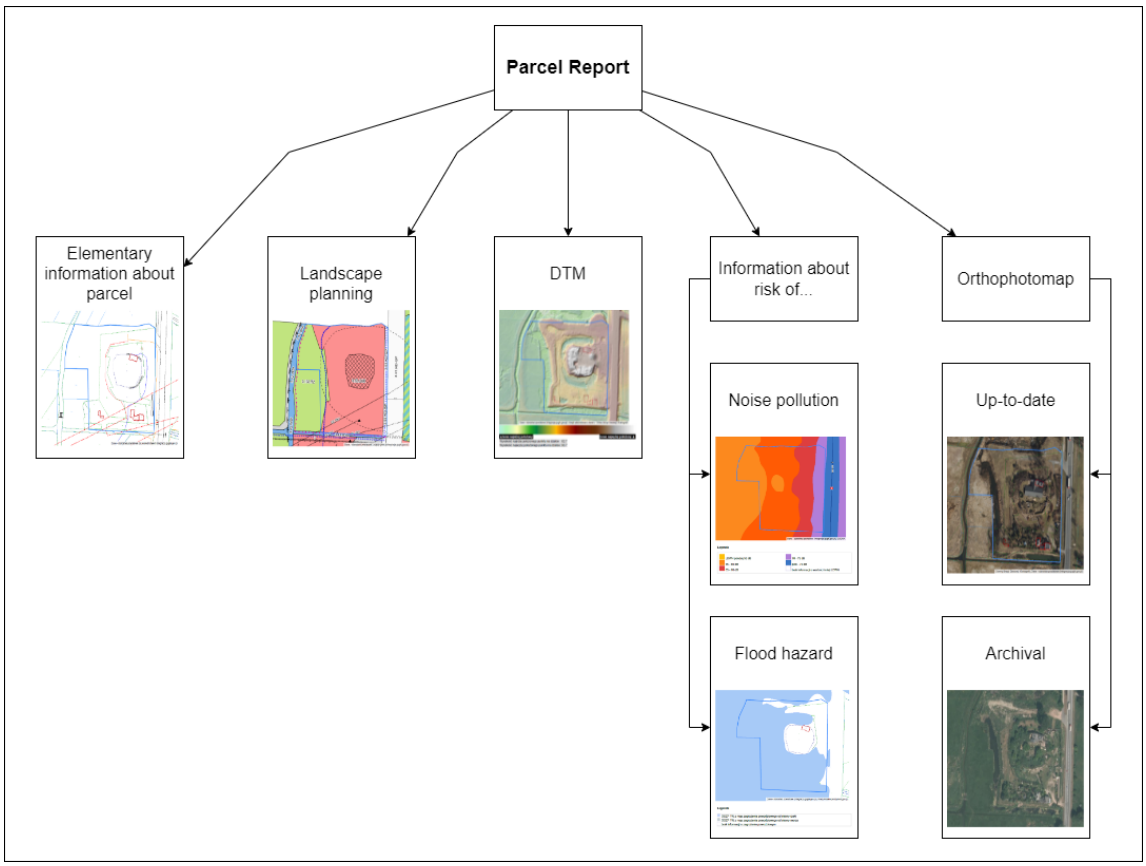


Figure 3: Subparts of Parcel Report tool

Elementary information about parcel

The first element of the Pprcel Report tool is a section presenting basic information about the parcel, such as parcel ID, administrative unit information, parcel number, parcel areas, parcel address. This section also includes a map showing the parcel numbers and boundaries and the utility network.

Landscape planning

The next element of the report is the Landscape planning section, which presents information in the form of a map with the boundaries of the areas that have been included in the local development plan adopted by the municipalities. Below the map are tables with links to the source documents for the land use maps.

Digital Terrain Model

In Digital Terrain Model (DTM) section presented a map showing the terrain on the parcel and in its immediate vicinity. Below the map window, information on the highest and lowest point on the parcel is provided.

Information about risk of noise pollution

Another element of the Parcel Report tool is the section presenting information on noise pollution. It presents information on the level of the LDWN noise index. The noise data has been processed on the basis of source data provided by the General Directorate of National Roads and Motorways. This is one of the optional sections - if there is no noise pollution for a given parcel of land, or there is no such study yet, this section will not be included in the report.

Information about risk of flood

The next element of the Parcel Report tool is the flood risk information. It shows the areas particularly at risk of flooding once in 100 years (1% probability of flooding) as defined by the Water law (Act of July 20, 2017 Water law) from 2017. The information has been processed on the basis of source data in the form of Flood Hazard Maps made available by the State Water Holding "Polish Waters" (in Polish: Wody Polskie). This is an optional section of the report, similar to the section treating noise risk - if there is no flood risk for a given parcel of land, or there is no data on flood risk, then this section will not be included in the report.

Orthophotomaps' views

The final element of the Parcel Report tool is the section on orthophotomaps. It consists of two sections - the view of current orthophotomaps and the view of archived orthophotomaps. The section showing the view of the up-to-date orthophotomaps presents the most recent version of the orthophotomaps available at www.geoportal.gov.pl. The archive orthophotomaps view section is displayed on request and presents a collection of all orthophotomaps available on the www.geoportal.gov.pl website by year.

5.3. The New Map Composition on National Geoportal Website

In the second half of 2023, on the National Geoportal website was available the new map composition called **Spatial planning** (in Polish: Planowanie Przestrzenne). The purpose of implementing such a composition was to facilitate users. access to specialized spatial planning-related data. The new composition uses a new mapping engine, which allows for smoother and more efficient operations.

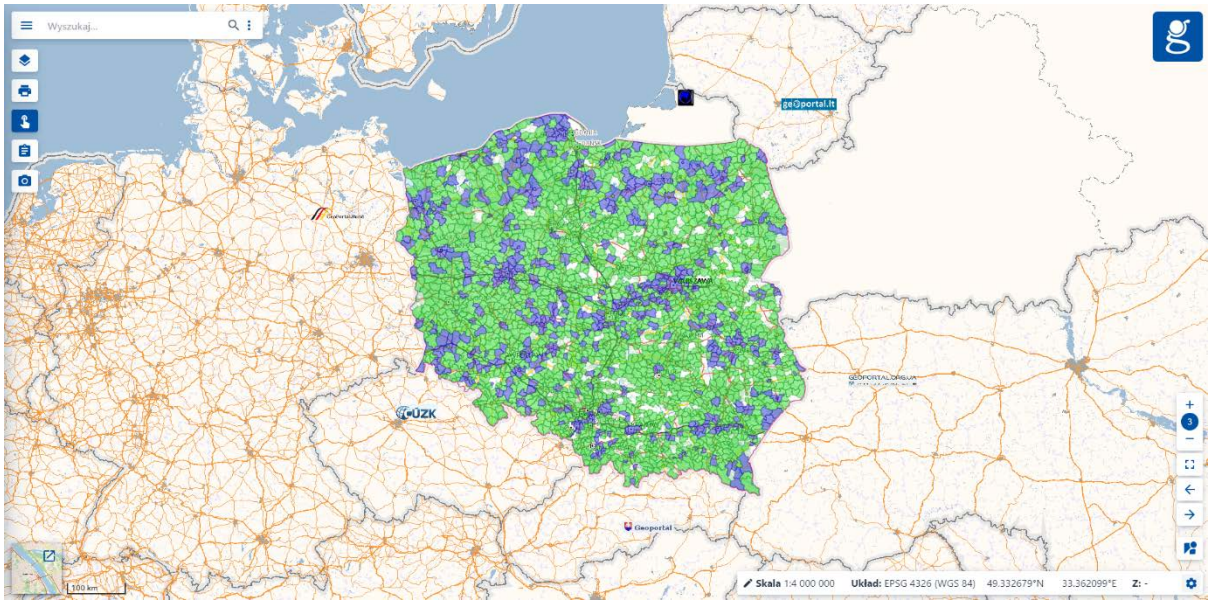


Figure 4: The map composition „Spatial planning" – opening screen on desktop

Fig 5: The view of the map composition on desktop (left) and mobile device (right).

5.4. Cartographic Visualizations of the Topographic Objects Database in 1:25 000 Scale

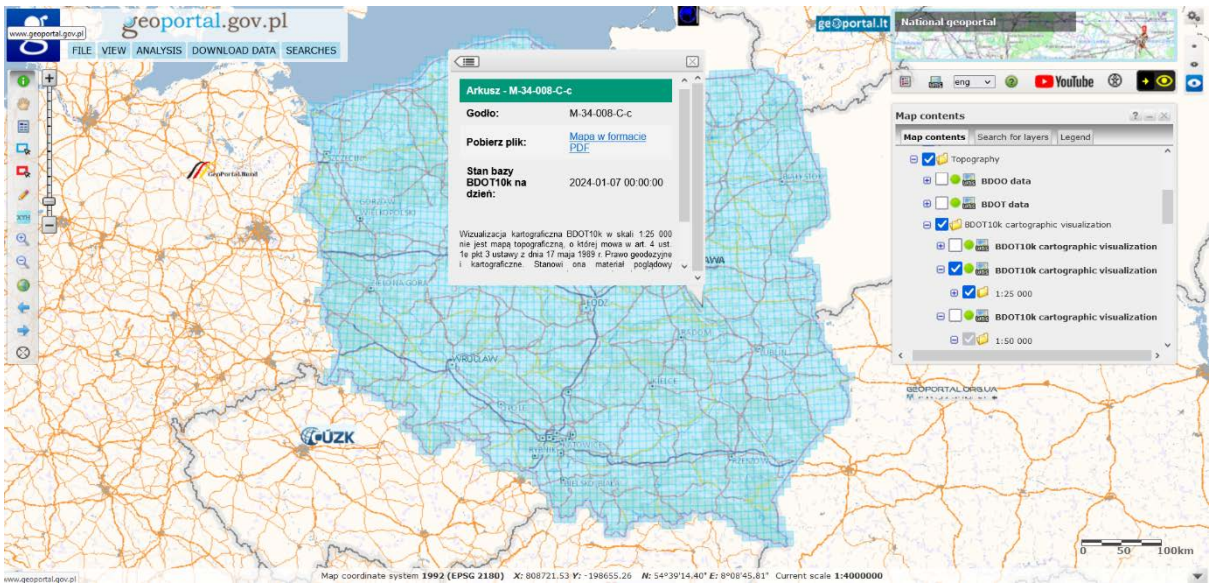
Pursuant to Art. 7a sec. 2 of the *Act of May 17, 1989 Geodetic and Cartographic Law*, The General Surveyor of the Country and the Minister of National Defense cooperate in the implementation of tasks in the field of geodesy and cartography of importance to the country's defense, including the creation of standard cartographic studies. Part of this cooperation, taking into account the geopolitical situation (state of war in Ukraine) and the military's need for topographic maps, is the development of tools for the automatic production of standard cartographic studies in 1:25,000 scale. The activities undertaken by the Head Office of Geodesy and Cartography, as part of its own work, started in 2022, continued with promising results in 2023.

Although, at this stage, the cartographic visualizations are not a topographic map, as referred to in Article 4, paragraph 1e, point 3 of the *Act of May 17, 1989 Geodetic and Cartographic Law*, the goal is to refine tools and include the final visualizations in the state geodetic and cartographic resource as legitimate, full-fledged, legal topographic maps, providing up-to-date (up-to-dateness correlated with the one of the source data) and homogeneous study for the entire country. Since automatic map generation seems to be a necessity today and at the same time a "golden mean" between rational spending of public money, user needs and manual map production, the tools are continued to be improved.

It is already the third iteration of the visualization covering area of the whole country, that has been generated by the end of 2023. As the effect of ongoing improvement process (partially based on collecting comments from users) many significant changes have been implemented. Only to mention some, there are:

- contour lines (generated in FME Software; based on the current DTM),
- shading (70% transparency; generated in FME Software, based on the current DTM),
- improved geodetic coordinates generating process,
- off-frame content (administrative division units' numeration and description placement) corrected,
- railways generalization and road lanes alignment improved,
- missing cartographic abbreviations, descriptions, objects added,
- more suitable symbolization, font styles, sizes, lines width (and directions), placement of descriptions, legibility introduced.

The currently generated 1:25,000 scale cartographic visualizations of the topographic objects database can be downloaded directly from the www.geoportal.gov.pl website by selecting the *BDOT10k cartographic visualization* layer within the *Data to download - Topography* layer group. Download .pdf file option appears as a result of selecting the sheet and clicking on its area in the map window.



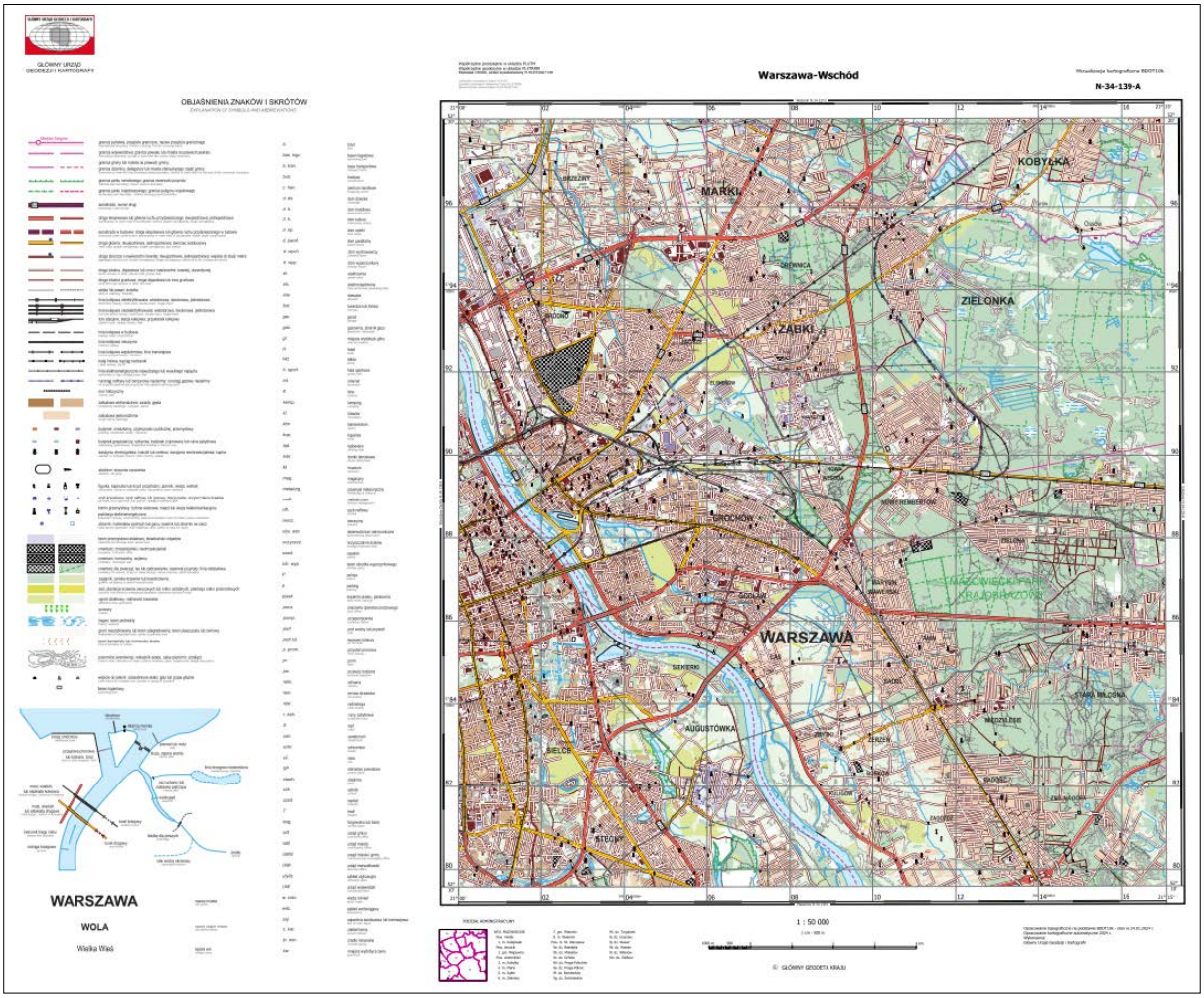
Automatic map generation tools, developed by the Head Office of Geodesy and Cartography are constantly being improved, in order to find the best way to solve the problems faced (e.g. production of the 1:25,000 scale visualization, requires proper generalization of different objects of BDOT10k), meet

user's needs and provide the highest quality. The iteration presented is another step bringing one closer to goal achievement.

5.5. Cartographic Visualizations of the Topographic Objects Database in 1:50 000 Scale

Not only 1:25,000 scale topographic maps are to be generated automatically. By the spring of 2023 the Head Office of Geodesy and Cartography took action aimed at 1:50,000 scale topographic maps automatic development.

The tools are provided by the external contractor company Globema (selected in public procurement and tender). Using them, the studies are carried out fully automatically. The cartographic generalization and editing processes are performed in the FME Software by Safe Software. Also contour lines are generated by that tool. Final visualization as a .pdf file is prepared in the free QGIS Software. The source data is the current one available in the National Geodetic and Cartographic Resource (i.e. the topographic objects database BDOT10k, Digital Terrain Model DTM, National Register of Geographic Names PRNG).



Not only first but already second iteration of 1:50,000 scale cartographic visualization of the topographic objects database have been produced by now. Again, the results do not yet constitute topographic maps

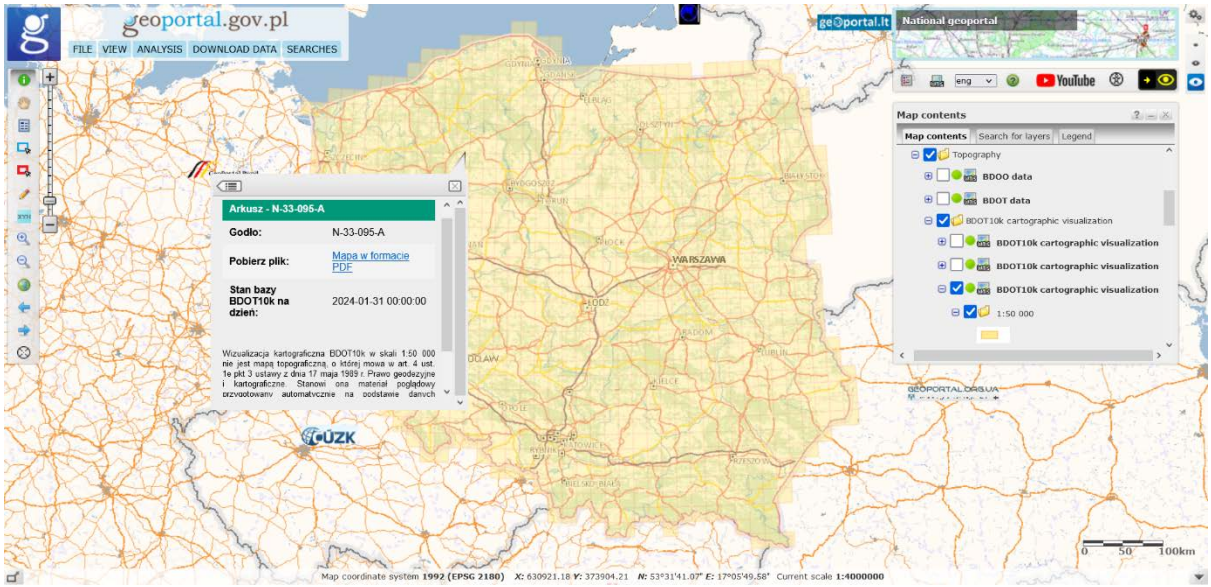
referred to in Art. 4 section 1e point 3 of the *Act of May 17, 1989 Geodetic and Cartographic Law*. Tools and processes are being improved so that their results ultimately become full-fledged topographic maps.

The newly generated .pdf format files are available shortly after visual control and successively updated while next iteration appears.

In the currents (second) version of the visualization, several corrections have been already made, both regarding:

- map content, such as: generalization and symbolization of the road network (collision-free intersections); styling of the river network (names of watercourses, flow direction); descriptions and labeling positioning (cities, parts of the cities, villages, protected and special areas); generalization and symbolization of point objects; generalization of contour lines;
- off-frame content: illustrative administrative division units scheme improvement.

Newly generated cartographic visualizations of BDOT10k at a scale of 1:50,000 can be downloaded directly from the website www.geoportal.gov.pl by selecting the *BDOT10k cartographic visualization* layer in the *Data to download - Topography* layer group.



The intention is again, to enable automatic creation of standard cartographic studies in 1:50,000 scale (homogeneous for the entire country) that could be included into National Geodetic and Cartographic Resource.

5.6. Administrative Map of Poland

With its own resources the Head Office of Geodesy and Cartography has prepared thematic cartographic study - new administrative map of Poland in 1:500,000 scale. Fulfilling previous year's declaration of annual update, 2023 version of map appeared in July.

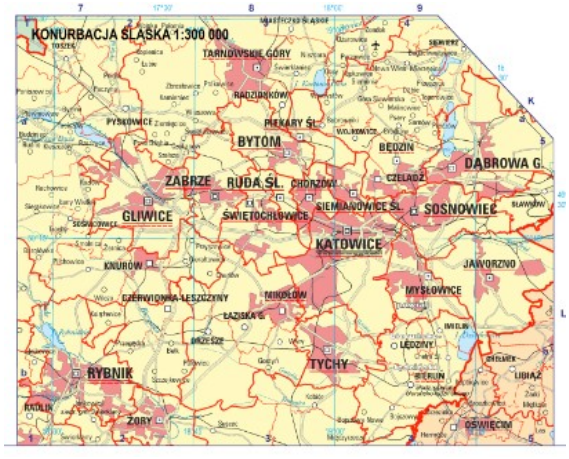
Since included in the National Geodetic and Cartographic Resource (July 4, 2023) new administrative map of Poland in digital form is available on request.

The plan of an annual update is to be continued.

In general, the state as of January 1, 2023 was presented on the latest map.

The map was prepared, among others, based on the National Register of Borders PRG, the general geographic objects database BDOO and the topographic objects database BDOT10k. The general information for neighboring countries (main roads, railways, rivers, lakes, cities and towns over 1,000 habitants) was gathered and selected both from Euro Global Map (for Germany, Czech Republic, Slovakia, Ukraine, Lithuania) and Open Street Map (for Belarus, Russia and complementarily for Ukraine and Lithuania.

Prepared at 1:500,000 scale, is 133 x 142 cm (outer frame of the map) size – corresponding to a wall map with a map content window of 131 x 140 cm (analogue form of drop-down wall map on a roller can be printed out – as the one published by GUGiK in 2011).



The PL-1992 rectangular plane coordinate system was used, based on the Gauss-Krüger projection, with an axial meridian of 19° east longitude, and cartographic grid of meridians and parallels drawn every 30'. As in the earlier version of the map, additional side maps at a larger scale (1:300,000) were created for the areas of the Warsaw Agglomeration and the Silesian Conurbation, where the cartographic grid was condensed to 15'.

The level of detail of the source data forced the definition and application of selection criteria and appropriate generalization. To ensure appropriate readability of the study at a scale of 1:500,000, the road network consists of, for example, highways, national roads and provincial roads (both existing and those under construction). Among the water reservoirs, those with an area greater than 2 km^2 are presented, and those with flowing waters – main rivers and their tributaries and others with a length greater than 5 km. Channels that are extensions of natural waterways are also marked on the map.

Cities and towns were also selected, based on their administrative function (the seat of the voivodship office, the voivodship assembly, the county office, the commune office), the number of inhabitants (division into groups:

- cities: over 1,000,000, from 500,000 to 1,000,000, from 250,000 to 500,000, from 100,000 to 250,000, from 50,000 to 100,000, from 25,000 to 50,000, from 10,000 to 25,000 inhabitants,
- towns and villages from 1,000 to 10,000 inhabitants,
- towns and communal villages with less than 1,000 inhabitants,
- other towns);

location (at road intersections, along longer communication routes), other advantages (major tourist destinations, health resorts, towns serving as border crossings or former border crossings). In addition, the built-up areas of cities with a population of over 25,000 have been presented in terms of area as surface 'blocks'.

Also included civil airports for passenger transport, seaports - commercial and passenger, passenger and car river ferries connecting water and land routes.

Due to the specificity of the map content, the update consisted mainly of updating the road network and introducing changes of the boundaries and names of the administrative division units that have taken place over the year. Never the less, not only above, changed on latest version of the map. The nomenclature of the objects outside the country has been enriched. To the original nomenclature, for the ones that also have a Polish name (exonyms), those are described under the original name (Germany,

Czech Republic and Slovakia). In the territories of Russia, Lithuania, Belarus and Ukraine, the transliteration of name descriptions in Cyrillic is used. In Belarus, a triple nomenclature is used (the Russian name described under the Belarusian name, and the Polish name (exonym) – described under the Russian one).

The study was prepared in the QGIS software (with the support of FME Desktop by Safe Software and ArcGIS by ESRI) in raster format (as tiff and geotiff).

The map in full resolution in geotiff format can be purchased by submitting an appropriate application. For illustrative purposes only - map thumbnail (file with a reduced resolution) can be downloaded

(https://opendata.geoportal.gov.pl/Mapy/Tematyczne/2023/administracyjna_2023.jpg).

5.7. Land Cover Map of Poland

Another thematic study published by the Head Office of Geodesy and Cartography in 2023 was update of the land cover map of Poland in 1:500,000 scale. In contrary to the previous year's version, the latest one was prepared as GUGiK's own work, with its own resources only.

As a spatial reference system, the PL-LCC flat rectangular coordinate system on the GRS80 reference ellipsoid (with the modification of the geodetic length parameter of the origin of the coordinate system from 10°E to 19°E) was used.

The map includes the following thematic layers:

- boundaries (state, voivodships, territorial sea),
- the main categories of land cover related to the physical and biological use of the country's surface, i.e. anthropogenic land, agricultural land, forests, wetlands, etc., hydrographic network, road and railroad route network, nature conservation (national parks, scenic parks),
- selected high points, passes, caves, rocks,
- the settlement network including nomenclature,
- relief based on a digital elevation model (shading method).

The content of the map also consists of the names of physical-geographical units (sub-provinces and macroregions levels) and the names of larger forest complexes.

The main sources of data for the development of the land cover map were: National Register of Borders (PRG), the National Register of Geographical Names (PRNG), the topographic objects database (BDOT10k), the general geographical objects database(BDOO), the Official List of Polish Geographical Names of the World, General Directorate for National Roads and Motorways, Digital Terrain Model DTM), EuroDEM, etc.

The map update concerned the administrative division of the country, the settlement network, roads and protected areas.

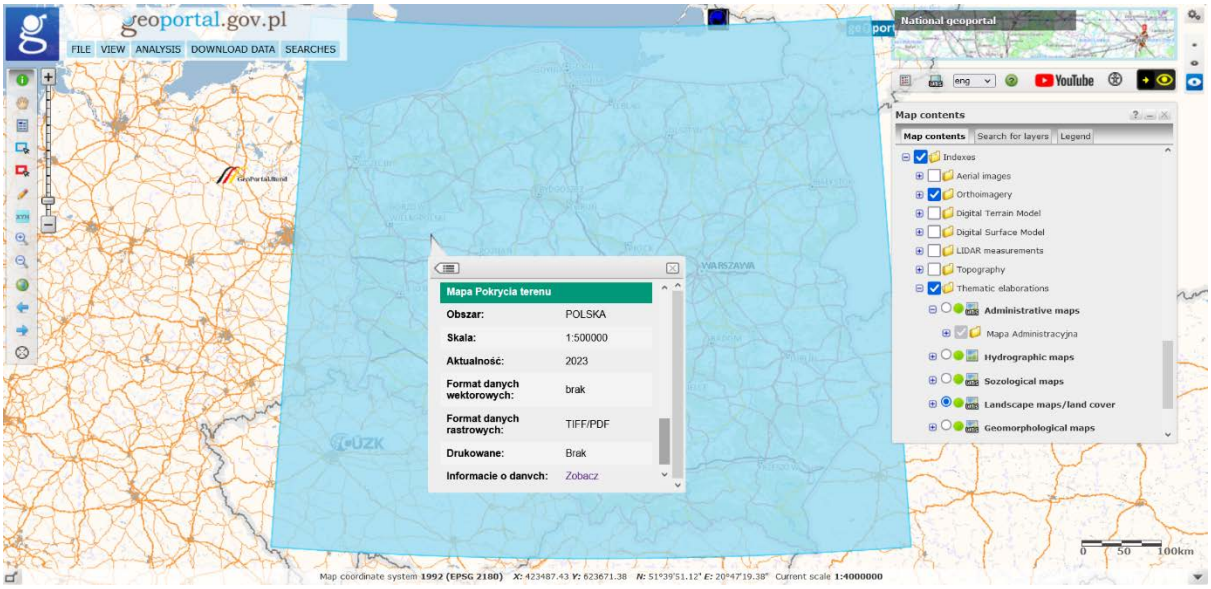
Like the previous edition (2022), the 1:500 000 scale map was prepared in the a digital form - geotiff format. Is was incorporated into the National Geodetic and Cartographic Resource on September 29, 2023.

Same as the administrative map, the land cover map is provided in raster form in .geotiff and .pdf formats, upon request, for a fee (standard tasks) or free of charge (public tasks and scientific or educational purposes). A thumbnail of it

(https://opendata.geoportal.gov.pl/Mapy/Tematyczne/2023/Mapa_Pokrycia_PL_2023_miniatura.tif)

is available on the website of the Head Office of Geodesy and Cartography for reference purposes only.

Information about thematic cartographic study available in the National Geodetic and Cartographic Resource can be found in the indexes at www.geoportal.gov.pl.



5.8. Uml Model for Soil and Agricultural Maps

Due to the law - Art. 7a section 1 point 14 letter e of the *Geodetic and Cartographic Law Act*, implementing regulations – *Regulation of the Council of Ministers of October 3, 2011 regarding the types of thematic and special cartographic studies* – the duties of Chief Surveyor of the Country include development of maps such as: hydrographic, sozological, geomorphological, soil and agricultural, land cover, land use, technical infrastructure, average land transaction prices, territorial divisions of the country, atlases of the territory of country. These studies for the area of voivodships may also by prepared by the relevant marshals. Taking into account obligations, limited public funds, in order to ensure that the critical needs of the users are met first, by the end of 2022, the Head Office of Geodesy and Cartography started coordinating the development of thematic maps, also aimed at preparing multiannual plan of it. As a result of the analysis of the needs identified by key users, the soil and agricultural maps at a scale of 1:5 000 were considered a priority.

Starting 2023, series of actions has been taken to ensure:

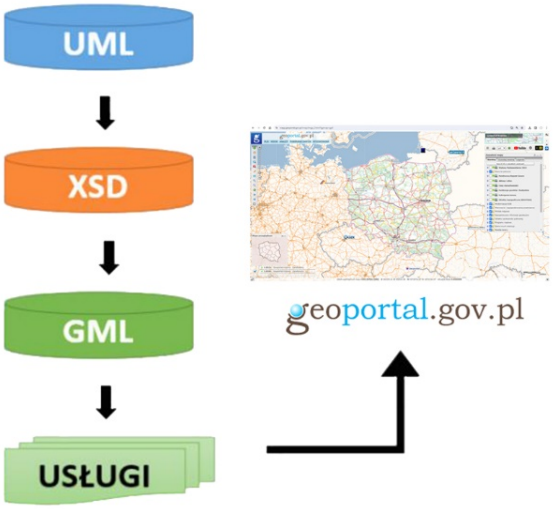
- comprehensive inventory of studies in vector form (1:5 000 scale) already available in the geodetic and cartographic resources at all administrative levels,
- analysis, summary and indication of conclusions regarding existing studies (up-to-dateness, area coverage, layers, attributes, formats, standards).

As a result the first goals regarding soil and agricultural maps, have been defined:

- create conceptual model of the database along with the GML application scheme – to ensure uniform vector maps on a national scale,
- develop technical guidelines,
- prepare maps for a pilot area (based on model and guidelines defined earlier).

Acquiring professional knowledge was essential. Taking into account the extensive experience and knowledge of the Institute of Cultivation, Fertilization and Soil Science – National Research Institute (IUNG) in the area of related work with the development of soil and agricultural maps on a scale of 1:25 000, preparation of profiles, soil tests – an agreement on mutual cooperation was signed on January 16, 2023. The training for GUGIK employees was conducted allowing for knowledge and experiences

exchange and a substantive support in the development of a conceptual model, application scheme and technical guidelines in particular was provided.

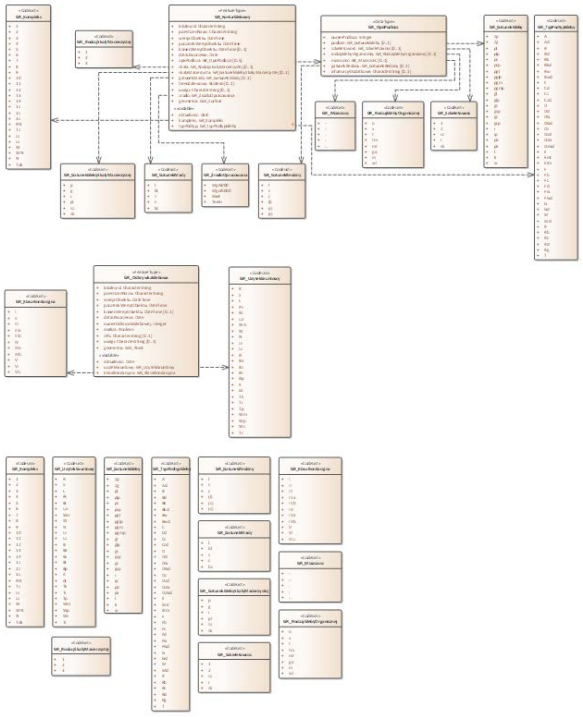


Finally, in May 2023 (following consultation with the Ministry of Agriculture and Rural Development) in cooperation with Institute, conceptual database model and a GML application scheme for a soil and agricultural map at a scale of 1:5 000 was published and documents as below are available:

- conceptual model with a catalog of objects

https://opendata.geoportal.gov.pl/Mapy/Tematyczne/Glebowo-rolnicza/MapaGlebowoRolnicza.docx

Model UML



Klasa: GR_Szkieletowosc		
	Definicja:	Rodzaj szkieletowości.
	Stereotypy:	«CodeList»
Atrybut:		
	Nazwa:	1
	Nazwa (pełna):	1
	Definicja:	Utwór słaboszkieletowy 10-25% szkieletu.
Atrybut:		
	Nazwa:	2
	Nazwa (pełna):	2
	Definicja:	Utwór silnie szkieletowy 25-50% szkieletu.
Atrybut:		
	Nazwa:	sz
	Nazwa (pełna):	sz
	Definicja:	Utwór bardzo silnie szkieletowy 50-75% szkieletu.
Atrybut:		
	Nazwa:	r
	Nazwa (pełna):	r
	Definicja:	Rumosz skalny > 75% szkieletu.
Atrybut:		
	Nazwa:	sk
	Nazwa (pełna):	sk
	Definicja:	Lita skała.

Klasa: GR_UzytekGruntowy		
	Nazwa:	Użytek gruntowy
	Definicja:	Rodzaj użytku gruntowego.
	Stereotypy:	«CodeList»
Atrybut:		
	Nazwa:	R

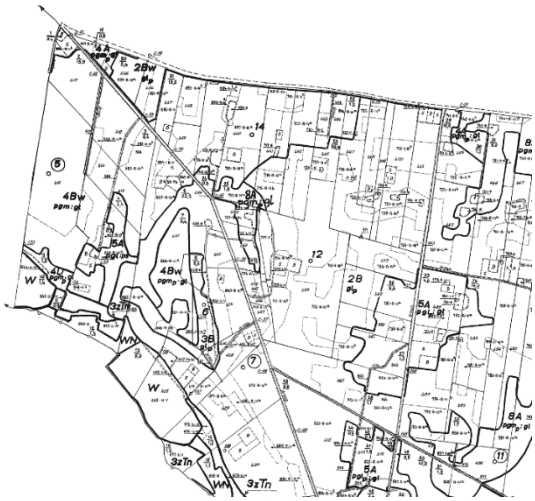
- conceptual model in Enterprise Architect format

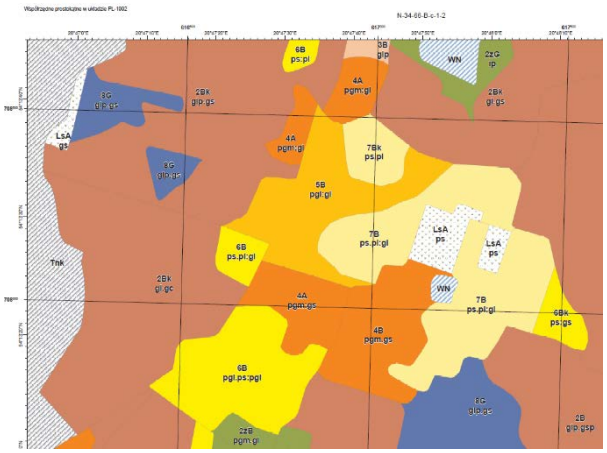
https://opendata.geoportal.gov.pl/Mapy/Tematyczne/Glebowo-rolnicza/MapaGlebowoRolnicza.eapx

- application schema

https://opendata.geoportal.gov.pl/Mapy/Tematyczne/Glebowo-rolnicza/MapaGlebowoRolnicza.xsd

Most of the soil and agricultural maps at a scale of 1:5 000 were developed in years 1960-1980 in analogue form and although great majority of have been vectorized, the quality differs a lot across the country.





Considering above, the Head Office of Geodesy and Cartography has taken action in two ways: standardizing existing vector maps to a new scheme at a national level (in 2023 work was being carried out for Wielkopolskie Voivodship) and processing raster studies into a vector form, in accordance with the new scheme (starting with Opolskie Voivodship in 2023 with plan of extension to include Mazowieckie and Śląskie Voivodeships in 2024).

5.9. The Topographic Objects Database Bdot10k Compatible with New Application Schema

The topographic objects database is commonly known as BDOT10k and it is a vector (object) database of spatial location of topographic objects along with their descriptive characteristics. It's content and level of detail complies with 1:10,000 scale topographic map.

As the *Act of May 17, 1989 Geodetic and Cartographic Law* indicates, the scope of information collected in the topographic objects database, procedure and technical standards for creating, updating and sharing it is to be determined by the regulation of appropriate minister.

The first extensive and detailed description of BDOT10k was provided in *Regulation of the Minister of Internal Affairs and Administration of November 17, 2011 on the topographic objects database and the general geographical objects database, as well as standard cartographic studies*. Over 360 pages of A4 were needed to introduce object catalog and UML application schema and GML schema of BDOT10k and BDOO (the general geographic object database).

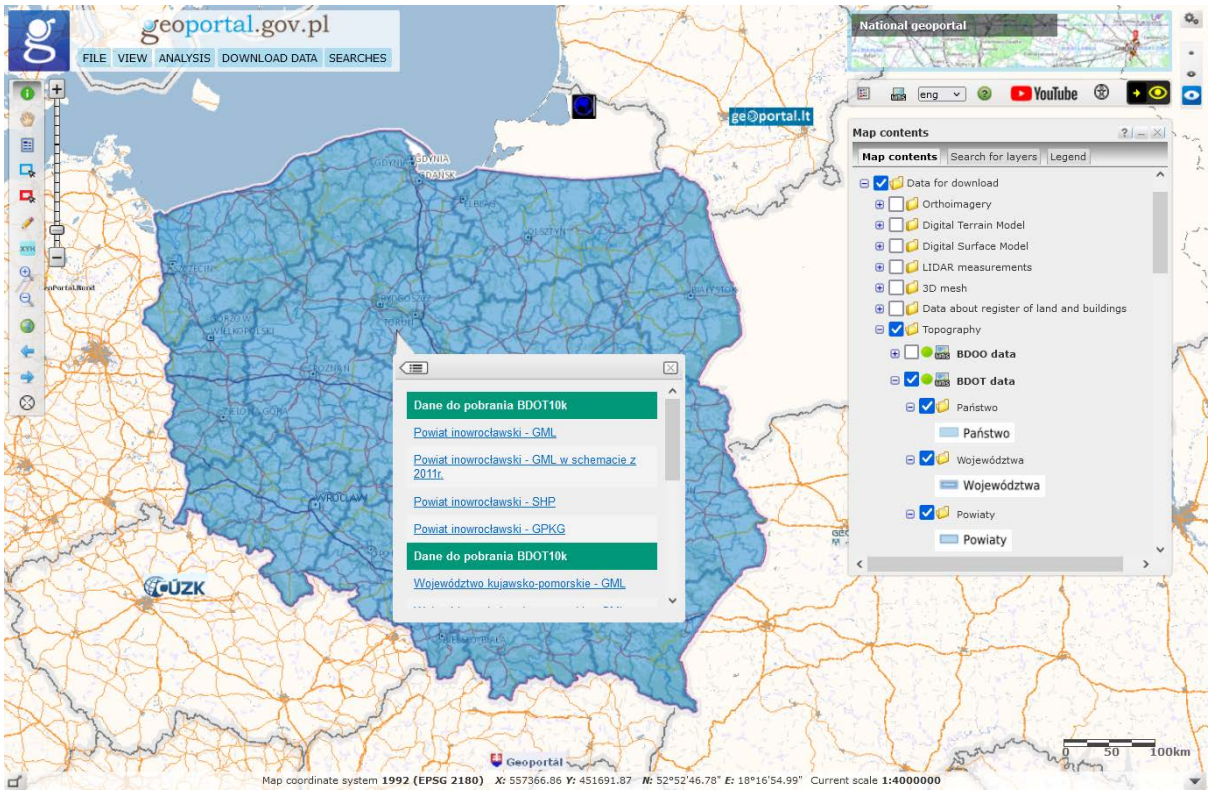
Almost decade later, in the wide process of changes in geodetic and cartographic law, a new regulation was published. Regulation of the *Minister of Development, Labor and Technology of July 27, 2021 on the topographic objects database and the general geographic objects database, as well as standard*

cartographic studies entered into force, causing significant changes both in BDOT10k and BDOO descriptions.

There was land relief as a separate object category (two object classes: OT_RTLW – elevation line, OT_RTPW – elevation point) added in BDOT10k. Specification of a conceptual database model was included while publishing the GML application scheme for sharing data from both databases (consistent with the specification) is responsibility of Chief Surveyor of the Country. Model, schema and object catalog have been greatly simplified (interoperability portal).

Due to the adapting, transitional and final provisions, the topographic objects database created and maintained (on the basis of the previous regulations) before the date of entry into force of new regulation was to be aligned with the new regulation no later than 31 December 2023 (the same date applied to update work).

All that meant that all the data of BDOT10k available in the National Geodetic and Cartographic Resource needed to be adapted to new model and schema by the end of 2023. With its own resources the Head Office of Geodesy and Cartography after appropriate conversion, published all the topographic objects database data in a new GML schema and ever since provided free of charge (for any purpose), it can be downloaded from the www.geoportal.gov.pl (within the *Data for download* section and *Topography* group) – for the relevant county, voivodship or entire Poland.



At the same time, the WMS and WFS services enabling browsing or downloading this data have been updated. Although by default the services are connected to www.geoportal.gov.pl, they can also be connected to any software that supports such standards. The key services in this fields include:

https://mapy.geoportal.gov.pl/wss/service/WMTS/guest/wmts/BDOT10k

https://mapy.geoportal.gov.pl/wss/service/pub/guest/kompozycja_BDOT10k_WMS/MapServer/WMSServer

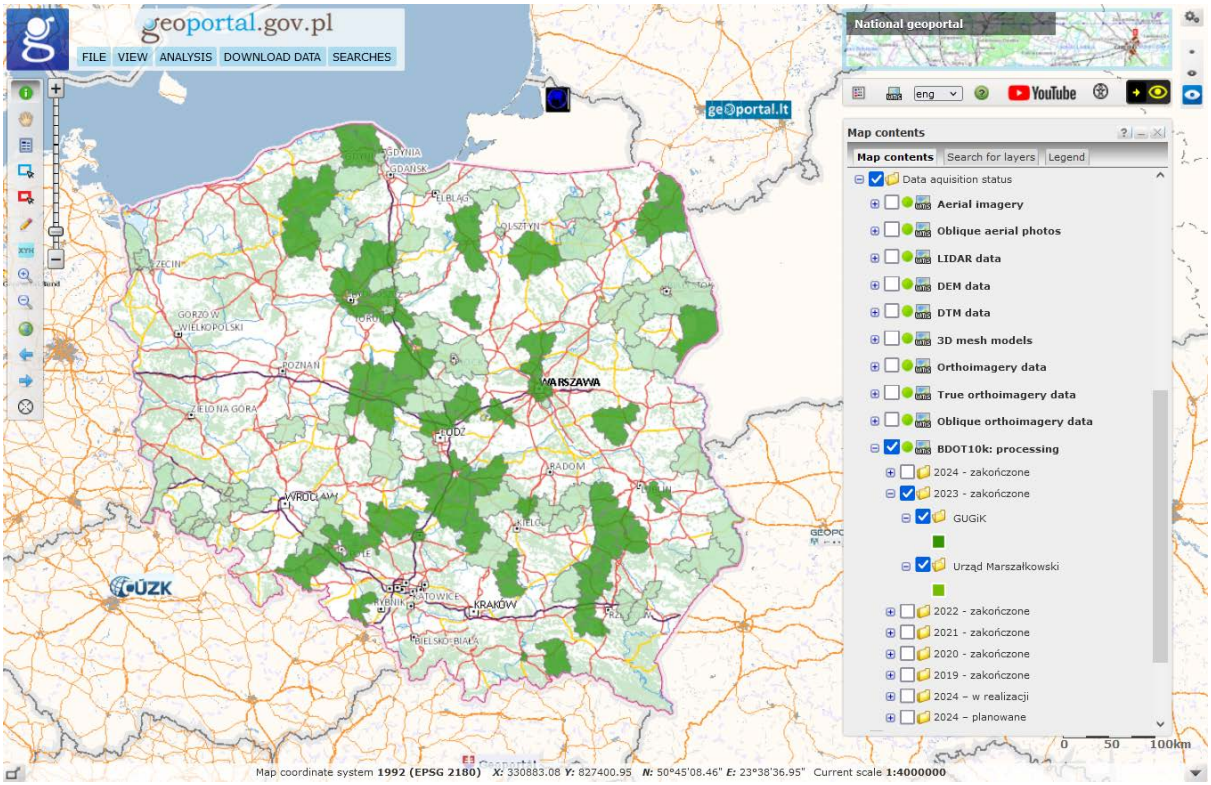
Information on all services related to BDOT10k managed by the Head Office of Geodesy and Cartography can be found in the main menu of www.geoportal.gov.pl under tab *Services* and *View services* (WMS and WMTS).

Topographic data

Service type	Service name	Show in geoportal	Service URL
WMTS	*Baza Danych Obiektów Topograficznych (BDOT10k)*		Copy URL
WMS	*Baza Danych Obiektów Topograficznych (BDOT10k)*		Copy URL
WMTS	*Mapa podkładowa BDOO i BDOT10k*		Copy URL
WMTS	*Baza Danych Obiektów Ogólnogeograficznych (BDOO)*		Copy URL
WMS	*Baza Danych Obiektów Ogólnogeograficznych (BDOO)*		Copy URL
WMTS	*Baza Danych Obiektów Ogólnogeograficznych 2015 (BDOO)*		Copy URL
WMTS	*BDOO Cieniowanie*		Copy URL
WMS	*Państwowy Rejestr Nazw Geograficznych*		Copy URL
WMS	*Statystyki budynków i budowli w BDOT10k*		Copy URL
WMS	*Statystyki sieci komunikacyjnej w BDOT10k*		Copy URL
WMS	*Statystyki sieci wodnej w BDOT10k*		Copy URL
WMS	*Statystyki obiektów innych w BDOT10k*		Copy URL

5.10. The Topographic Objects Database Bdot10k Update

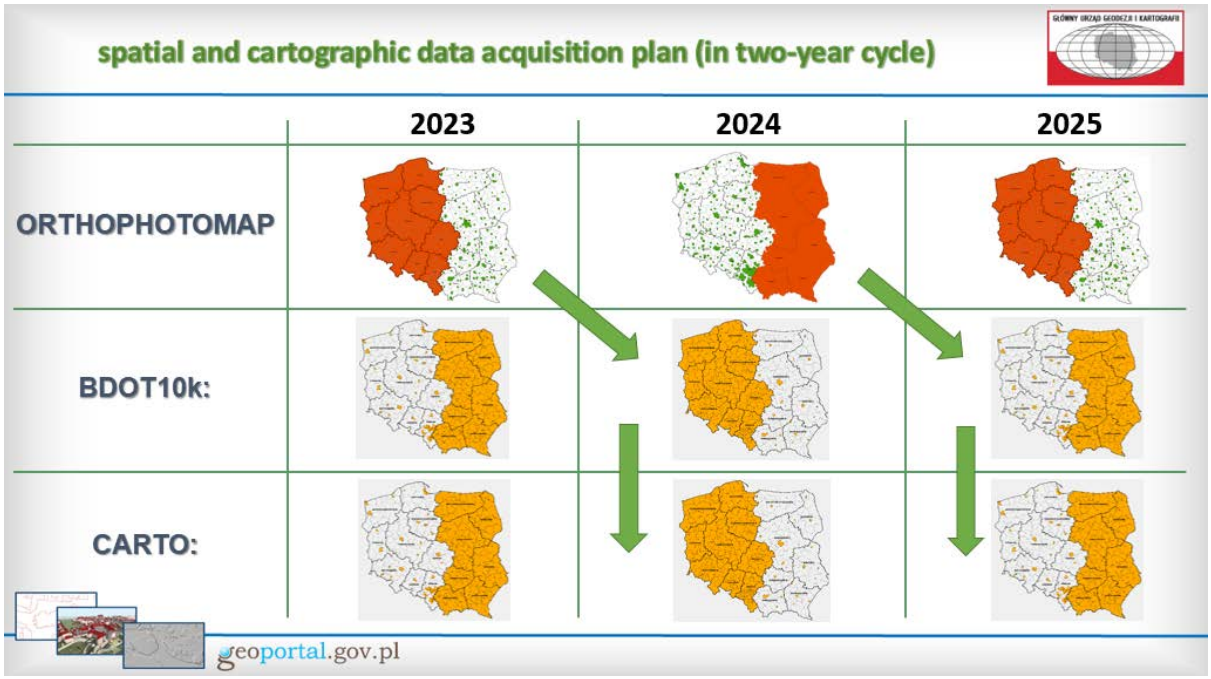
In 2023, 71 counties were covered by proceedings public procurement leading to selecting external contractor companies to update the topographic objects database, as shown on the map below (dark green – commissioned by the Head Office of Geodesy and Cartography; light green – commissioned by Marshal of Voivodship).



Supporting marshal's offices in updating BDOT10k is aimed at achieving goal set in long-term data acquisition plan – 2-years update cycle of the BDOT10k (GUGiK strives to ensure that the topographic objects database update will take place in the year following orthophotomap's update).

Proper realization of the data acquisition plan, will provide up-to-date and complete photogrammetric data sets (as orthophotomap or altitude data, obtained from airborne laser scanning) for the country followed by updated BDOT10k.

The plan is to update the general geographic objects database BDOO and cartographic studies in parallel to the topographic objects database.



Current realization and plans for obtaining all kinds of data can be verified on an ongoing basis on the www.geoportal.gov.pl in the *Data acquisition status* layer group.

5.11. Photogrammetric Databases Update and Introducing New Types of this Data in The National Geodetic and Cartographic Resource

In 2023 a new photogrammetric regulation entered into force (Regulation of the Minister of Development and Technology of December 16, 2022 on databases regarding aerial and satellite imagery, orthophotomaps and digital terrain models (Journal of Laws of 2023, item 89)), which introduced new types of photogrammetric data into the national geodetic and cartographic resource, particularly oblique imagery and 3D mesh models. The content of the photogrammetric databases is presented in the illustration below:

AERIAL AND SATELLITE IMAGERY	DIGITAL TERRAIN MODEL	ORTHOPHOMAPS
• photogrammetric aerial imagery - vertical - oblique • photogrammetric satellite imagery • materials used to develop them	• ALS • DEM • DTM • 3D mesh models • materials used to develop them	• Orthophotomaps: - classic - true - oblique • materials used to develop them

Fig 6: Division of data according to the new law

In 2023 in the scope of work carried out on behalf of Chief Surveyor of Poland, the following photogrammetric data was accepted:

photogrammetric data developed upon GGK	number of pieces/sheets	area (km^2)
vertical aerial images	118 792	16 452
oblique aerial images	5 984	168
ALS	66 072	51 767
DEM	10 103	51 941
DTM	10 103	51 941
3D mesh models	625	25
classic orthophotomap	2 151	11 000
oblique orthophotomap	20	24
intensity images	10 103	51 941

Fig 7: Scope of processed data in 2023

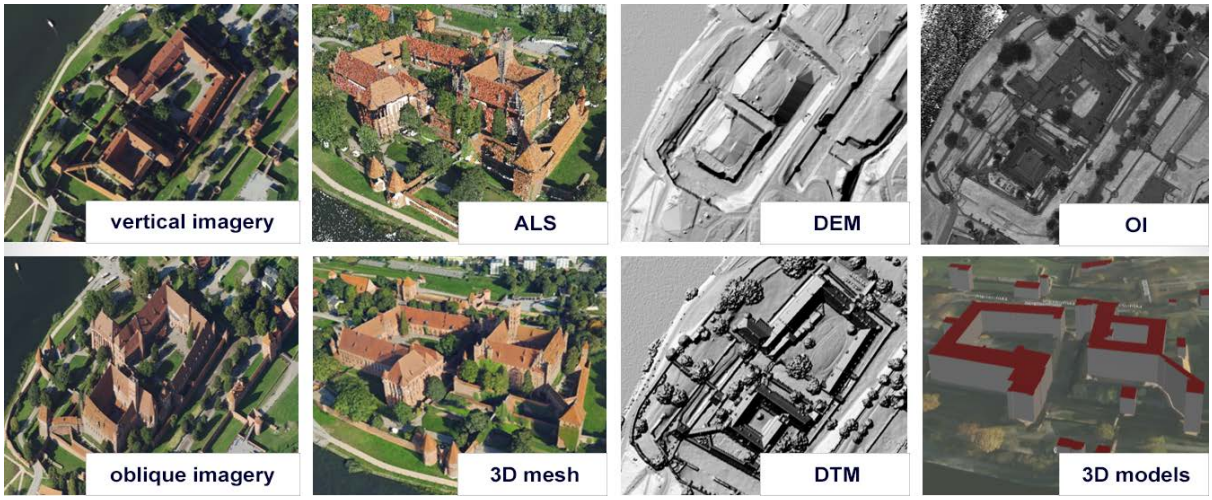


Fig 8: Types of data

The list of **all works carried out in 2023** is presented on the website www.geoportal.gov.pl

in the group of layers **Monitoring data acquisition** and includes the development of, among others:

- Vertical aerial photos/vertical orthophotomap for an area of approximately 180,000 km^2,
- DTM for an area of approximately 220,000 km^2,
- Point clouds and DTM for an area of approximately 60,000 km^2.

The current status of the above-mentioned databases is presented in the illustration below:

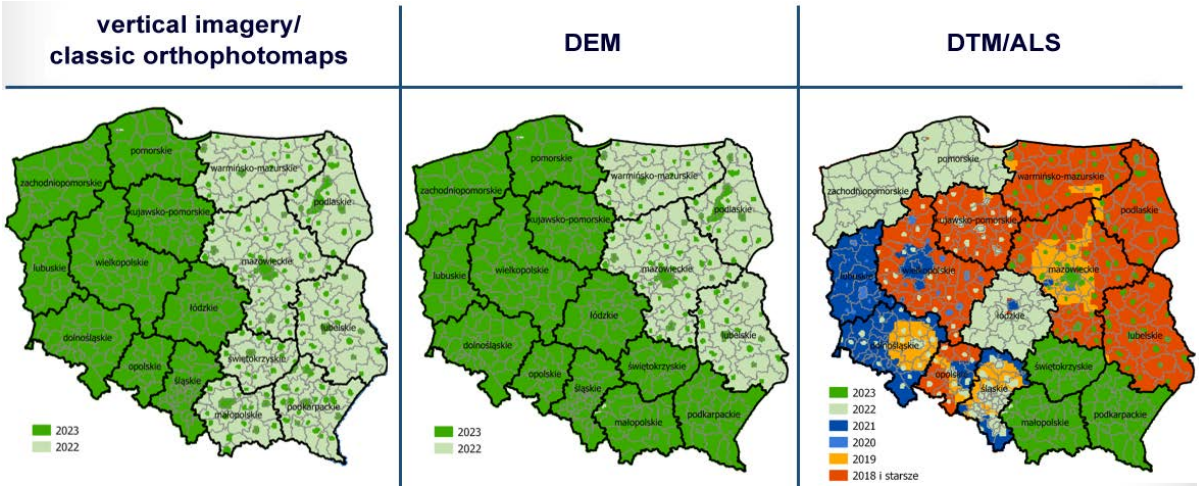


Fig 9: Up-to-dateness status at the end of 2023

All the data (apart from aerial images) are available free of charge for public use through the service www.geoportal.gov.pl. In the group of layers **Data for download**.

5.12. Mesh Models (3D Mesh)

In 2023, 3D mesh models of Malbork were developed at the request of Head Office of Geodesy and Cartography. The 3D mesh models were created in the PL-1992 coordinate system in modules with a side of length 200 m and in the OBJ format. The data preserves the geometry of the terrain and is covered with an texture derived from aerial imaginary in real RGB colors.

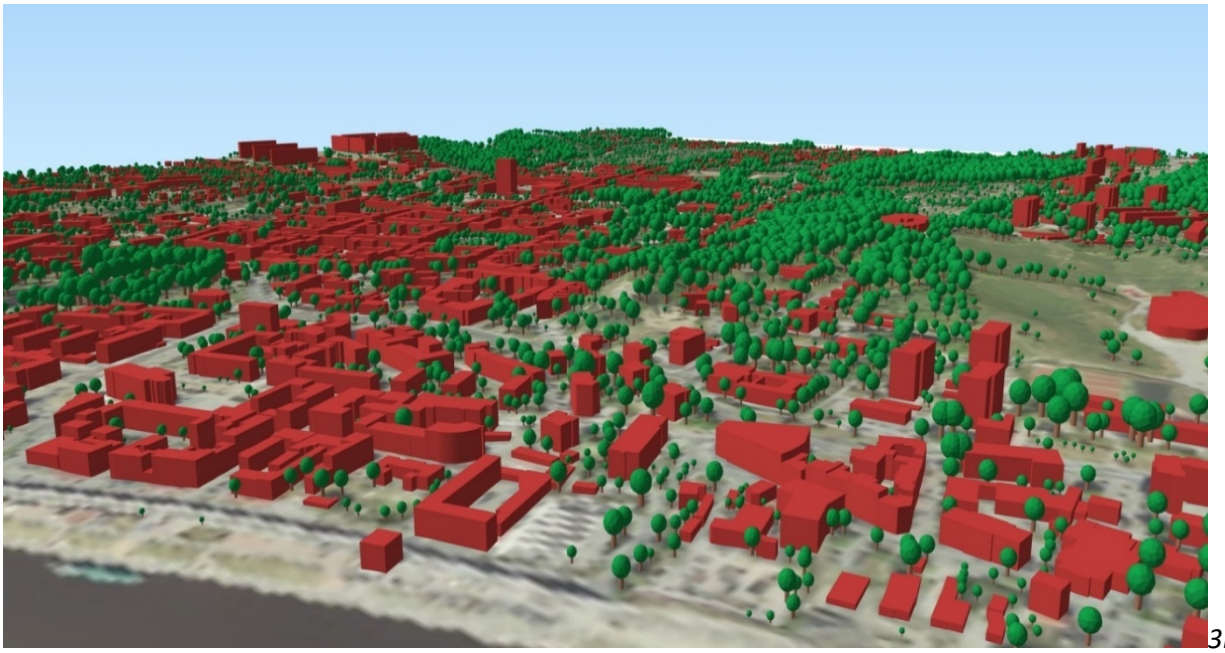
3D

Fig 10: mesh model of Malbork Castle

The 3D mesh models of Malbork are available free of charge for public use through the service www.geoportal.gov.pl. In the group of layers **Data for download** - **3D mesh models** section.

5.13. 3D Tree Models

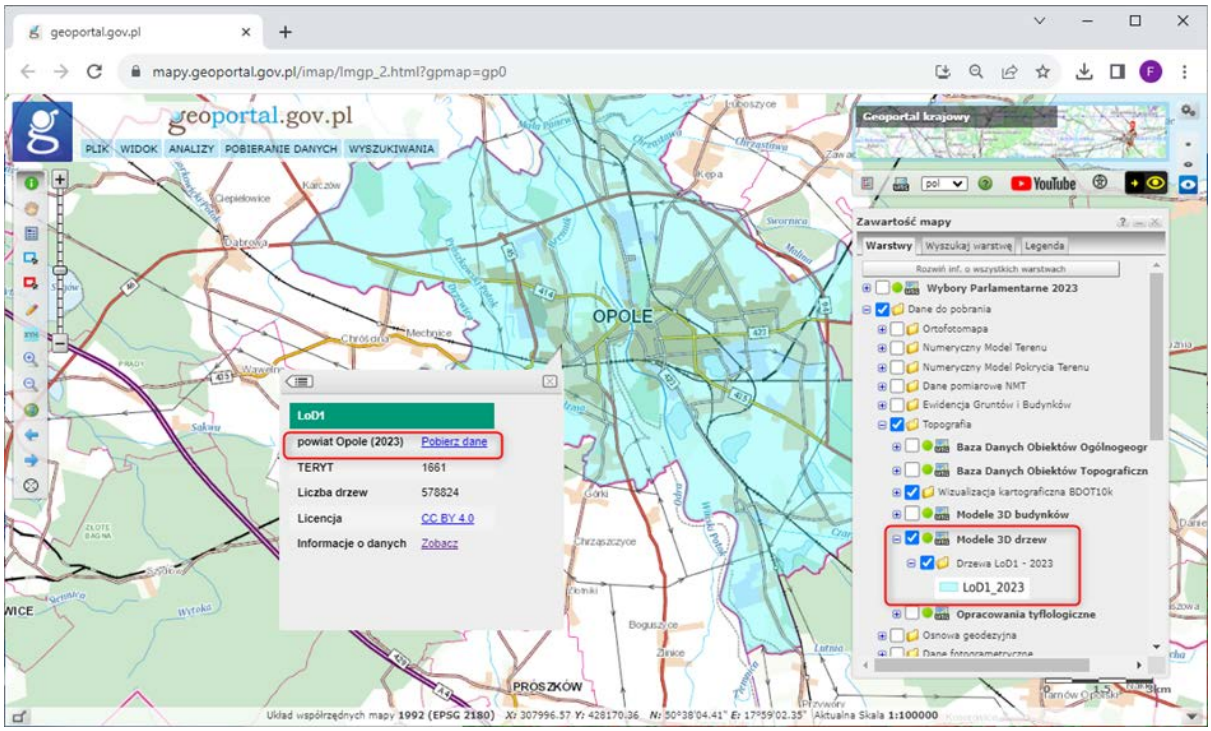
3D models of trees represent trees with a height of over 4 meters. To indicate the location and maximum height of individual trees, a 1-meter grid was created from airborne laser scanning (ALS) points of high vegetation (by rounding the X, Y coordinates to whole meters). This allowed for the isolation of individual tree and determination of their maximum height along neighborhood analysis. 3D tree models in City GML format, following the LoD1 standard, were prepared as part of Head Office of Geodesy and Cartography own work using Safe Software's FME software.



3D

Fig 11: models of trees - the city of Gorzów

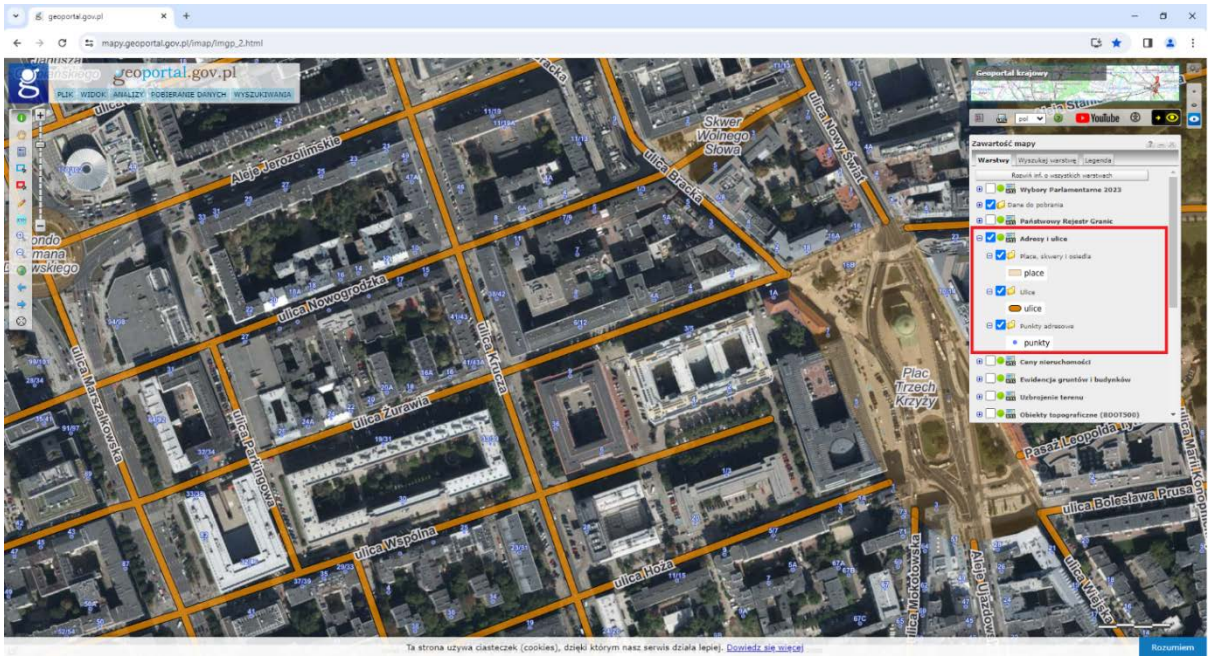
The 3D tree models are available free of charge for public use through the service www.geoportal.gov.pl. In the group of layers **Data for download** - **Topography** section, there is a WMS service called Modele 3D drzew containing the **Drzewa LoD1 – 2023** (**Trees LoD1 – 2023**) layer. By using the identification tool and clicking within the borders of the county for which you want data, you can download 3D models of trees.



5.14. National Register of Boundaries

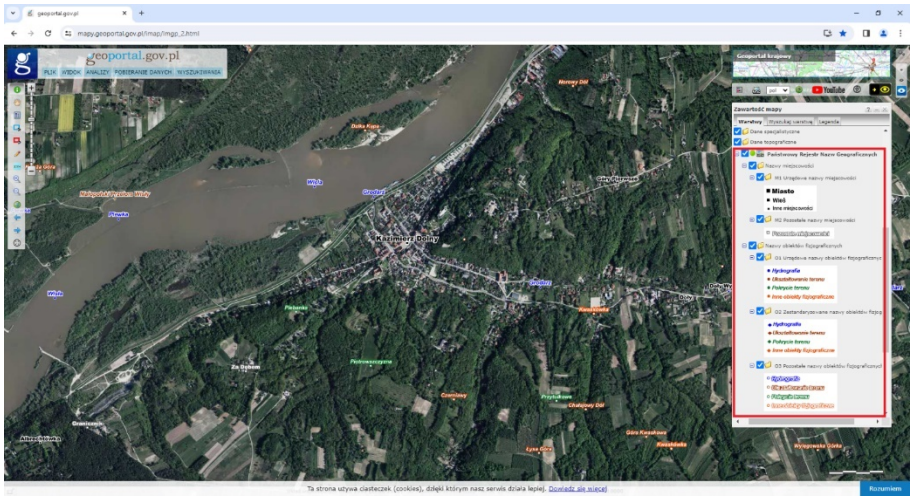
In 2023, we updated the National Register of Boundaries (PRG) on the basis of legal act regarding changes of the boundaries of administrative units and granting city status to the localities effective from January 1, 2023. Throughout the year, we have been successively updating the boundaries of the fundamental three-level administrative division of the country (i.e. communes, counties, and voivodships) on the basis of data from the Land and Building Register (EGiB)

In terms of real estate numbering, we have been monitoring the quality of data and we have updated the PRG database based on the Register of Localities, Streets and Addresses (EMUiA) maintained by communes.



5.15. National Register of Geographical Names - The Register of Geographical Names of Poland

In 2023, we made over 57,500 modifications to the National Register of Geographical Names (PRNG). In terms of names of localities, we have been verifying the location of the main points of named object and other attributes on the basis source materials. The most important tasks included updating the PRNG on the basis of legal acts including regulation on establishing, changing and abolishing the official names of localities and physiographic objects and regulation on changes of the boundaries of administrative units and granting city status to the localities effective from January 1, 2023. In terms of updating the names of physiographic objects, we have verified, among others, the location of the mountain peaks and the names of road junctions on high speed roads. Moreover, we have started verification of the names of watercourses.



5.16. National Register of Geographical Names - The Register of Polish Geographical Names of the World

In 2023, we updated the Register of Polish Geographical Names of the World with the *'parent object'* attribute for geographical objects in Europe, the names of buildings and other urban objects in Asia, Africa, South America, North America, Australia and Oceania, as well as current changes resulting from the resolutions of the Commission on Standardization of Geographical Names Outside the Republic of Poland (KSNG).

In 2023, the Surveyor General of Poland published the 7th edition of *'The Official List of Names of Countries and Non-Self-Governing Territories'*. The publication contains names of 195 countries recognized by the Republic of Poland (i.e. 193 member states of the United Nations Organization, Kosovo, and Vatican City) and 69 non-self-governing territories. Attached is a list of three territories with an undetermined or disputed international status. The correct spelling of the names of countries and their capitals has been provided, which the Commission on Standardization of Geographical Names Outside the Republic of Poland (KSNG) recommends for common use in Polish texts and particularly on maps.

6. 3D Buildings Data in Real Estate Cadastre, Topography and BIM

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University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia

Research project V2-2155, financed by the Slovenian Research Agency and
the Surveying and Mapping Authority of the Republic of Slovenia (2021-2023)
Project title: GeoBIM and national geodetic data
Project page: https://gis.si/raziskovalni-projekti-sl-predstavitev-projektov-v2-2155/

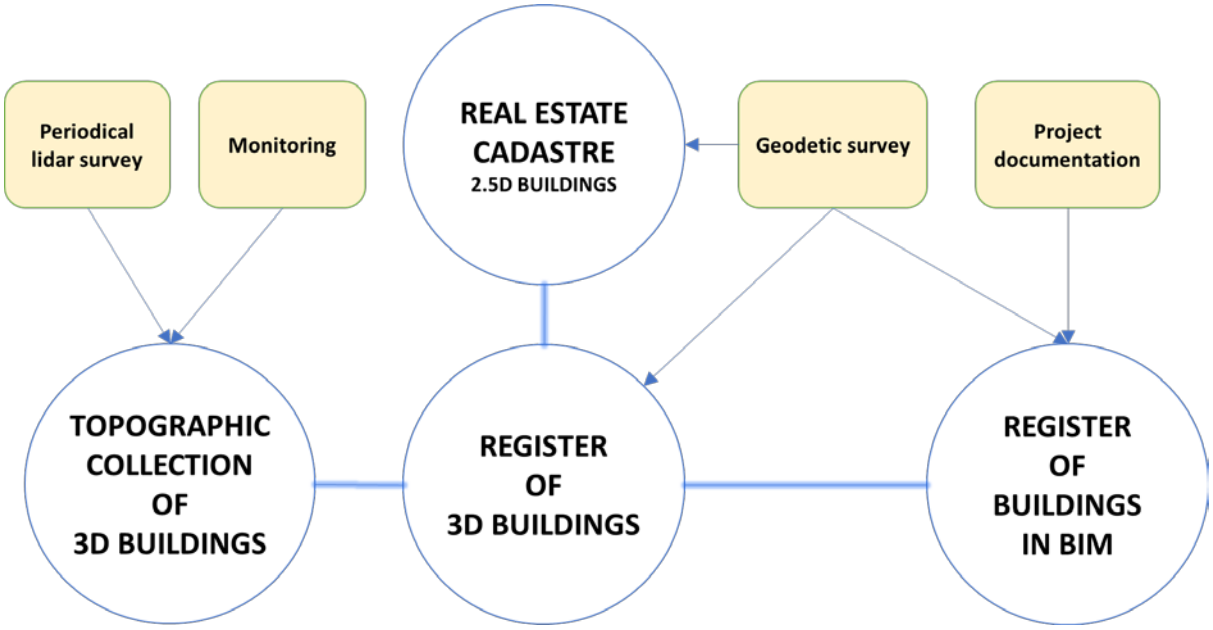
Keywords: real estate cadastre, buildings, 3D data, BIM, topography, LiDAR.

Recently, the Surveying and Mapping Authority of the Republic of Slovenia adopted a new law on the real estate cadastre, which enables the combined management of all real estate data in a single information system (plots, buildings, infrastructure, spatial units), where buildings are now traditionally kept in 2.5D, whereby the height of the building is an attribute. A project of periodic aerial survey and scanning with LiDAR technology is also ongoing in parallel. This opens up the possibility to automatically recognize 3D buildings for the entire country with machine learning algorithms which were already tested. Due to the new possibilities, the project of designing the parallel setting of the real estate cadastre with 3D buildings data is underway. However, LiDAR data for buildings are treated as topographic while cadastral data are administrative and depend on the owners who order geodetic surveys of their property. Additionally, the evolution of cadastre has seen several legal changes and data migrations in the last couple of decades. Since automatic algorithms are still far from perfect in generation of topologically correct building models in LoD 2.x, certain research is underway to optimally pair topographic and cadastral data of different origin and data quality.

Additionally, the new construction law in Slovenia prescribes the mandatory use of the BIM approach for the production of project documentation from 2025 onwards in the construction of buildings of public importance. This fact presents major challenges both when transferring construction data from BIM to update geodetic real estate data collections, as well as vice versa, when builders could use data from the geodetic profession for BIM. In both processes, it is necessary to carry out a series of substantive and technical data adjustments. In this regard, the mentioned 2.5D cadastral data on buildings are currently the most suitable data for connection to BIM.

This includes the possibility of generalizing BIM data for new buildings and formation of a new register of buildings which were projected in BIM. Different IFC and CityGML file formats were tested, as well as the suitability of different levels of detail (LoD), which is also related to the subsequent connection of 3D building data with the new collection of floor plans. When converting data from BIM and when changing from 2.5D to 3D, topological problems, semantic differences and differences in geometric accuracy were observed. We assume that it will be necessary to prescribe a mandatory connection of the 3D building in BIM with the 3D model of this building in the forthcoming Register of 3D Buildings as part of the real estate cadastre.

One of the purposes of transitioning buildings to 3D is also the possibility of more accurate modeling of the interior of buildings. In doing so, the interior can be modeled in another level of detail as exterior or the shell of the building, if only the floor plans topologically correspond to the shell. For the interior of the buildings, it will be according to the current needs appropriate level of detail LoD 0 (floor plan at a given height) or LoD 1 (floor plan divided by parts of the building or even by rooms). With the introduction of 3D buildings, floor plans will become increasingly important due to the possibility of linking more detailed data to the floor, part of the building or individual interior space, especially in the case of important public buildings and infrastructure.



6.1. Geo Slovenia – Joint Spatial Information Infrastructure

Ministry of Natural Resources and Spatial Planning, Surveying and Mapping Authority of the Republic of Slovenia

Keywords: geospatial data, geospatial data infrastructure, location framework, green deal, sustainable development

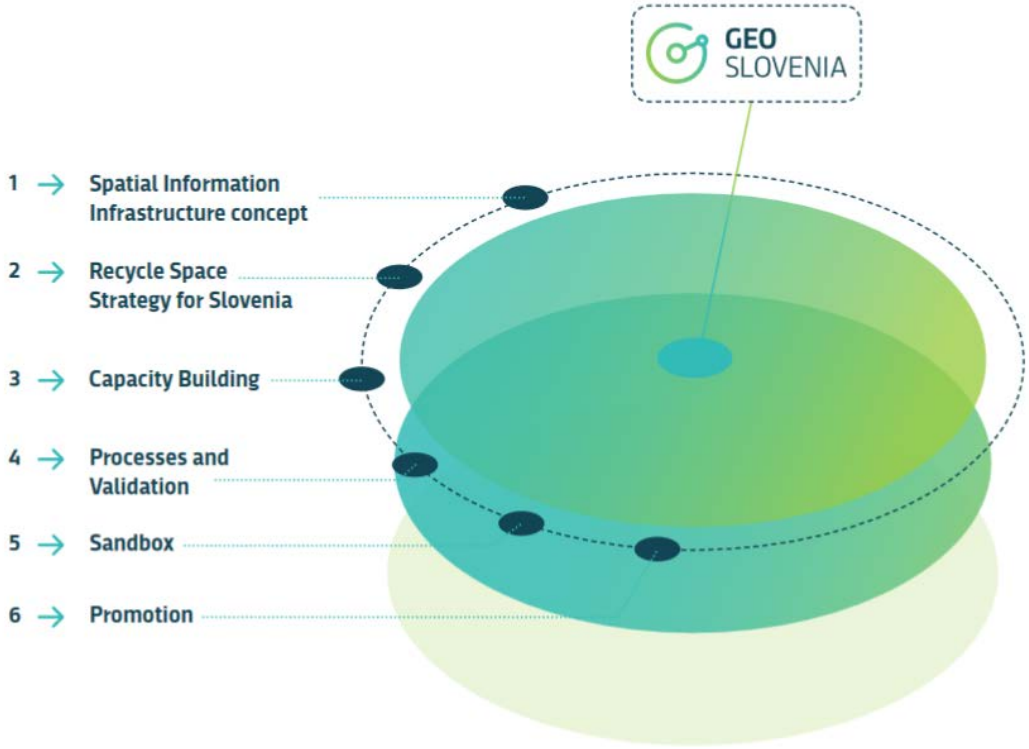
The joint Spatial Information Infrastructure project (GEO Slovenia) was implemented within the Green Slovenian Location Framework Programme (SLO4D), which is based on the Strategic Plan for Digitalization of Spatial Information and Environment, published by the former Ministry of the Environment and Spatial Planning and funded within Recovery and Resilience Plan (RRP) and the Climate Fund. The GEO Slovenia

project, which was realised in 2023, aimed to address the main challenges under SLO4D. The work was organised in six key pillars:

- **Spatial Information Infrastructure Concept**: one of the main goals of the project was the preparation of a strategy and action plan for setting up the Joint Spatial Information Infrastructure. This aim is consistent with global trends, as all advanced geoinformation societies, including Slovenia, today face the challenges of "where to go after INSPIRE" alongside horizontal integration of dispersed databases and information systems. The importance of this topic has also been recognised by the United Nations, which introduced its Integrated Geospatial Information Framework (IGIF).
- **Recycle Space Slovenia**: In accordance with European guidelines, defined in the Circular Economy Action Plan, Slovenia recognized circular economy as a strategic development priority. Reusing "space" must serve as the focal point for all activities related to spatial development. Support for reusing land and real properties requires measures in the area of spatial planning, organization, financing and economics. As part of this project pillar, steps and activities were undertaken, and a Circular spatial management strategy plan was prepared, which also includes evidence-based decision-making with spatial information infrastructure.
- **Processes and Validation**: The project involved the directorates and bodies at the Ministry of Natural Resources and Spatial Planning and the Ministry of Environment, Climate and Energy, each with its specific requirements. In order to establish a uniform and efficient Spatial Information Infrastructure, it is necessary to ensure coordinated and comprehensive planning. The acquisition of data and setting up/upgrading of information systems should be carried out in accordance with a jointly agreed model of horizontal integration, which is the strategic goal of the Joint Spatial Information Infrastructure project. As part of this project pillar, a general process model for the above-mentioned agencies was established. Based on the agreed joint infrastructure rules and standards, tools were created to validate databases and applications, which enable horizontal integration, with the aim of connecting processes and transmitting data.
- **Sandbox:** As part of the Green Slovenian Location Framework programme, numerous digital databases and IT solutions will be established using widely diverging technologies. It is important to set up common building blocks to enable horizontal integration. Due to the great importance and complexity of the joint information infrastructure, setting it up was planned through the process of checking and evaluating solutions in a "sandbox". The sandbox represents different environments in which ideas, standards, advanced technologies, content products and technical platforms are tested. For this purpose, a prototype web portal was established to demonstrate modern spatial data processing and visualization technologies.
- **Capacity Building:** This is a key concept for the Joint Spatial Information Infrastructure project, which includes resources for ongoing, targeted training of experts and executives. The priority for this pillar was to strengthen knowledge and a unified understanding within the geoinformation community in Slovenia. At the same time, tools and training material have been prepared that are accessible to all users of spatial data via the GEO Slovenia web portal.
- **Promotion:** The Ministry of Natural Resources and Spatial Planning of the Republic of Slovenia has carried out a series of acclaimed projects, which are not only important for the Slovenian society, but can also be highly ranked among the successful digitization and digital transformation projects in Europe.

The broader SLO4D programme, within which the GEO Slovenia project was realised, aims to digitally interconnect the domains of spatial planning, environmental management, real estate, water management, and nature resource management to enable better and smarter spatial development and management of the built and natural environment. Key results expected from this project by 2026 are:

- Linked spatial and environmental digital data and common geospatial information infrastructure in order to connect key processes and databases in the area of spatial planning, environmental management, and management of water and nature resources;
- Digital data and geospatial information services with transparent accessibility;
- Set up the fourth component of the national geospatial reference coordinate system as a basis for digitalization;
- Provision of the missing digital data for the national geospatial and environmental data infrastructure.



Source: https://www.gov.si/assets/organi-v-sestavi/GURS/Projekti/SLO4D/GEO-Slovenia-brochure.pdf

7. Computing Sustainable Development Goals Indicators Using Geospatial Reference Information of The National Geographic Institute of Spain

Julián Delgado, Marta Carranza, Gonzalo Benayas and Samuel Parada
National Geographic Institute of Spain (IGN)

Keywords: Settlements, Land Use, Land Cover, HR SIOSE, IGR-Poblaciones, Sustainable Development Goals.

INTRODUCTION

In 2015, the 2030 Agenda for Sustainable Development set out a 15-year plan to accomplish the so-called Sustainable Development Goals (SDGs). These are a set of 17 interconnected goals and 169 targets, together with 231 indicators which are related to economic, social, and environmental areas. SDGs are understood as a call for action to eradicate poverty, protect our planet and improve our daily lives [1]. Since SDGs highly depend on the geographic location, having location-based data is key for their quantification.

The main objective of this work was to use of data from the Land Cover and Land Use Information System of Spain (SIOSE) [2] and the Geospatial Reference Information of Settlements (IGR-Poblaciones) [3] in order to implement a set of SDGs indicators in local entities in Spain. This work has been accomplished in coordination with the National Statistics Institute of Spain (INE) [4] that deals with the official calculus of the SDG indicator for entire country, and are been published in the national access node.

In particular, two of the SDGs indicators have been computed, Indicator 11.3.1: Ratio of land consumption rate to population growth rate and Indicator 11.7.1: Average proportion of the built-up area of cities that is dedicated to open spaces for public use. The data processing procedure has been carried out by combining the inhabitants statistics from INE together with the information on land use and land cover in the population settlements obtained from the IGR-Poblaciones dataset.

IGR-Poblaciones, SIOSE and INE inhabitants provide information much detailed than at municipality level, for that reason this procedure allows for an increase in the level of detail showing how the indices behave in each population settlement within the same municipality. This work is a clear example of the results that can be achieved thanks to the collaboration between two different national institutions.

METHODOLOGY

The methodology considered for the computation of the aforementioned SDG indicators is based on the reference metadata information provided by the UN System [5].

SDGI 11.3.1 is defined as the ratio of land consumption rate (LCR) to population growth rate (PGR), and it is expressed as a percentage. LCR is understood as the growth of urbanization or artificialization of the land, and the indicator generally represents a measure of land use efficiency (LUE), as established by the United Nations documentation.

The LCR provides a measure of compactness of the city, indicating a progressive spatial expansion. Mathematically speaking, it can be computed as

$$LCR = \frac{(A_{t+n} - A_t)/A_t}{T}$$

where A_t is the total extent of land area consumed during the first year (extent of the human settlement, quantified as built-up area), A_{t+n} is the total extent of land area consumed in the last year, and T is the number of years between A_{t+n} and A_t.

The annual PGR is computed using the total population within the urban area as follows

$$PGR \stackrel{\text{def}}{=} \frac{\ln(Pop_{t+n}/Pop_t)}{y}$$

where $\ln()$ is the natural logarithm value, Pop_t is the total population within the urban area or city in the past/initial year, Pop_{t+n} is the total population of the current/final year, and y stands for the number of years between the two measurement periods.

Finally, after obtaining LCR and PGR, the indicator is simply computed as

$$LCRPGR = \frac{LCR}{PGR}$$

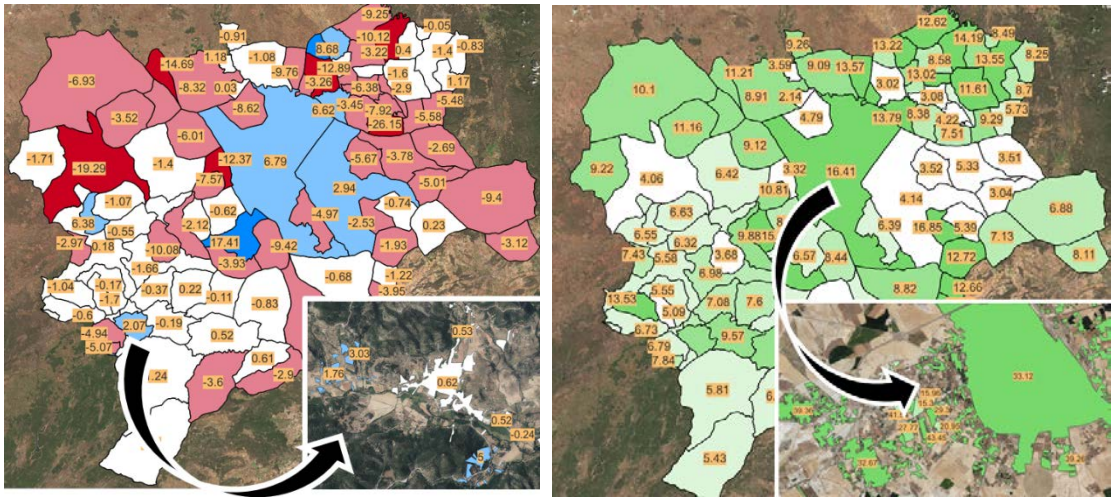
SDGI 11.7.1 corresponds to the average proportion of the built surface of cities that is dedicated to open spaces for the public use of all, broken down by sex, age and people with disabilities. It is also expressed as a percentage and, essentially, it refers to the availability of open public space and its accessibility by the population.

The computation of the indicator is performed by using the following formula.

$$SACUP(\%) \stackrel{\text{def}}{=} \frac{STEP + STDC}{STAC} \cdot 100$$

where SACUP denotes the percentage of open built surface dedicated to public use, STEP is the total surface of open public space, STDC is the total surface of land allocated to streets and STAC is the total area of the city. Unfortunately, statistical information about people with disabilities were not available for entire country, and this component was not calculated.

RESULTS



Results for the province of Albacete. Left: 11.3.1 for the years 2014 and 2017, in red the municipalities with a higher rate of land consumption than the rate of population increases and in blue the municipalities with the highest rate population increase than land consumption rate. In the detail it is possible to see

the individual indicators values per each settlement inside municipalities. Right: 11.7.1 (right) for the year 2017, in greener higher values of the indicator per municipality. In the detail it is possible to see the individual indicators values per each settlement inside municipalities. All this kind of results are available for entire country in graphical representation (GIS files) and in table accounting (Excel files).

SETTLEMENTS DATASET

Nowadays, knowing the location of the population is one of the fundamental issues for the SDGs set by the UN-GGIM [6]. This Committee officially defines settlements as sets of buildings and associated elements where a community carries out socioeconomic activities. Along with buildings, population settlements are considered as very relevant geospatial information for SDGs 9, 11, 12 and relevant for SDGs 1, 3, 4, 6, 7 and 13.

As a result, the IGN Spain has been developing a project to generate the Geospatial Reference Information of Settlements (IGR Poblaciones) [3]. Its main objective is to manage and maintain the location and geometric shape of the settlements, their statistical code, and their official place name. The project includes entities called settlements, defined as groups of one or more buildings and their associated spaces known by a common name. These groups of buildings are geometrically defined by the cadastral parcels according to their land use and integrate the code of the statistic entity of the NSI to which it belongs, the geographical name that identifies it, the representative population use, as well as other characteristics that are interesting from the population point of view.

During 2023, the version with reference date 2020 has been published through the IGN/CNIG download centre IGN/CNIG Download Centre, on which a significant effort has been made in the review and improvement of visual characteristics with the aim of being able to ensure higher quality in subsequent versions. Among the possible uses of the product, we can highlight the following ones: cartographic representation of settlements, georeferenced statistics, address model of the General Administration, computation of SDGs indicators, emergencies, and geomarketing.

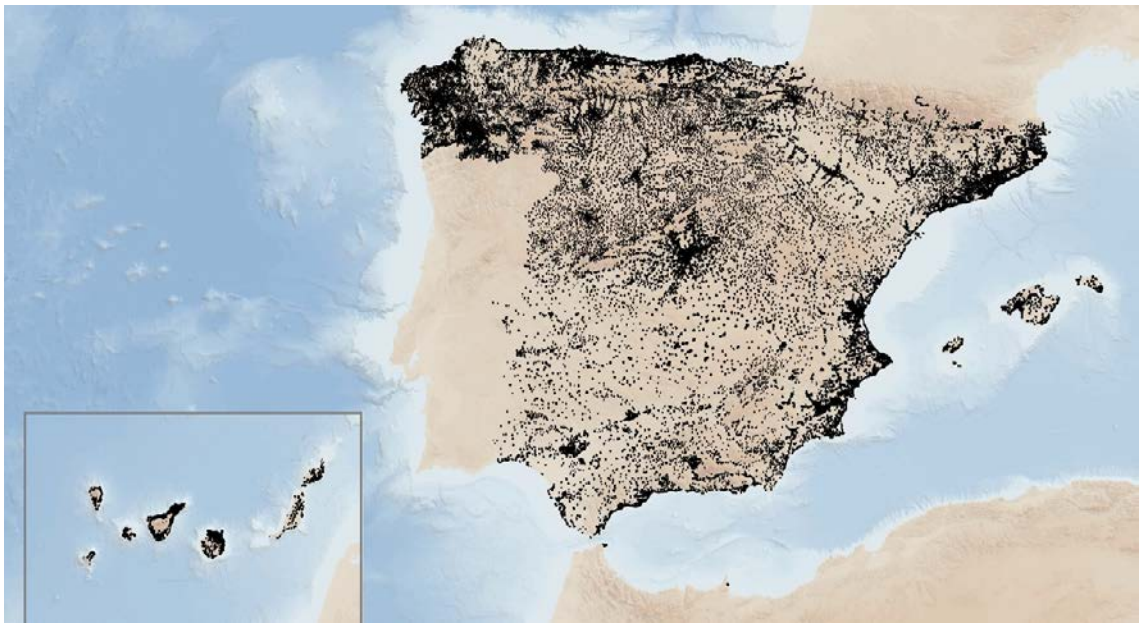


Fig1: Distribution of settlements in Spain - IGR Poblaciones 2020.

HIGH RESOLUTION SIOSE

IGN Spain represents the EIONET national contact point 'Support to Copernicus'. As a result, the main objective of the IGN is to cooperate with the European Environment Agency (EEA) and other European authorities to coordinate and disseminate information on land cover and land use. In order to fulfill this task, the Land Use/Land Cover department developed the so-called Land Cover and Land Use Information System of Spain (SIOSE) [2].

The purpose of SIOSE is to offer a LC/LU vector database to describe all landscape typologies for the whole country. This is achieved after integrating different types of geographical information available from both the National and Regional Public Administrations in Spain. The first version of the project dates back to 2005 and, since then, several updates of the database were published in 2009, 2011 and 2014. This original product offered LC/LU information at 1:25,000 scale.

However, the user needs (regional, national and international) have experienced a rapid increase over the last decade. Specifically, users demand more detailed data in terms of geometric, thematic and temporal aspects. Consequently, a new production strategy was developed based now on reference data integration rather than on classical manual photointerpretaion processes. The resultant product was named High Resolution SIOSE (HR SIOSE), and its main objective is the integration and homogenization of official data sources in order to establish a benchmark product on LC/LU in Spain and Europe.

From a technical perspective, HR SIOSE incorporates in a sole LC/LU database high resolution data from national and regional official authorities, e.g. Cadaster data (which provides the basic delimitation of parcels and buildings), the Land Parcel Identification System (SIGPAC) [7], Farmers declaration data of the Common Agricultural Policy, the National Forest Map [8], LiDAR data, the Geospatial Reference Information on Transport, Settlements and Hydrography [9] developed at IGN.

During 2023, the las version HR SIOSE at reference data 2017 has been published through the IGN/CNIG download centre [IGN/CNIG Download Centre]

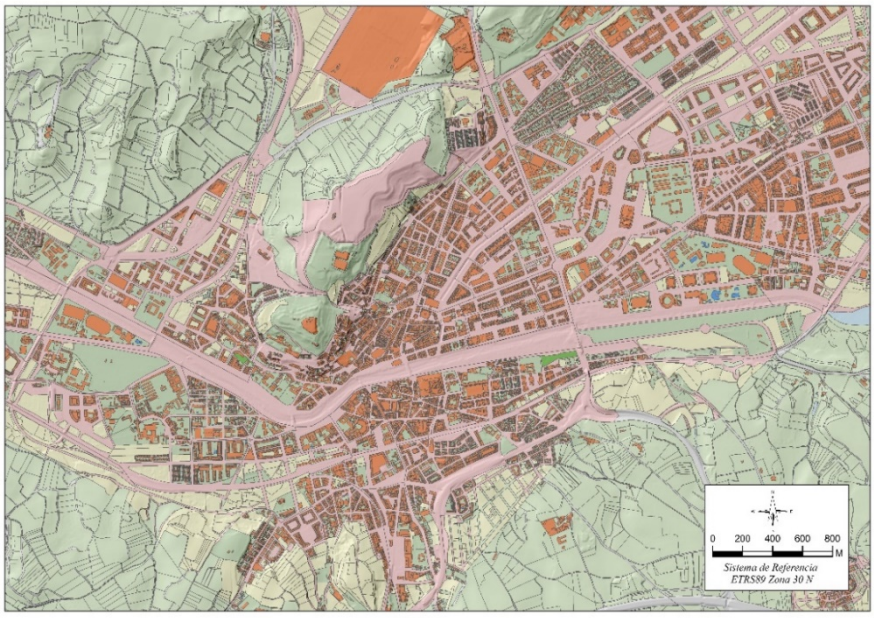


Fig 2: High Resolution SIOSE of Burgos

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Report by the Secretary-General

Joep Crompvoets

This report reviews the annual Board of Delegates meetings happening in the framework of EuroSDR in 2023, the appointments of (new) delegates, the activities related to our partner associations and some logistics.

Meetings

The 142nd Board of Delegates meeting took place on 24 – 26 May 2023 at the headquarters of Estonian Land Board (Wednesday 24 May) and L'Embitu Hotel (Thursday 25 and Friday 26 May) in Tallinn (Estonia). The event was hosted by the Estonia Land Board. 50 persons attended this meeting. The highlights of this meeting were: the excellent country days, keynote presentation 'open/private satellite data and services for NMCAs' by Stuart Marsh (Nottingham University), keynote presentation 'NMCA common topics' by Jeroen Leusink (Het Waterschapshuis), and the special sessions on the topics of the keynotes. As part of the social program, a great ice-breaker party as well as wonderful dinner at R38 were organized.

The 143th Board of Delegates meeting took place on 4 - 6 October 2023 at the Head Office of Lantmäteriet (Wednesday 4 October) as well as Elite Grand Hotel (Thursday 5 and Friday 6 May) in Gävle (Sweden). The event was hosted by Lantmäteriet – the NMCA of Sweden. 50 persons attended the meeting. The highlights of this meeting were the presentations of the EuroSDR PhD Award winner, a keynote presentation on Digital Cameras by Michal Cramer (Uni. Stuttgart), the keynote presentation about

Data/Data Governance by Jordi Escriu (EC JRC). During the meeting, a great welcome reception took place at Elite Grand Hotel and a delicious dinner was served at the rooftop bar 'Tak'.

In preparation for these two Board of Delegates meetings, the Executive Management Team organized two meetings. The first one took place in Venice (Italy) 6 – 8 March 2023. The second one took place in Lipica (Slovenia) from 26 until 28 June 2023.

Delegates

In 2022, the following appointments were approved:

Andreas Hadjiraftis as Prime Delegate of Cyprus; Katarina Ritz (Agency for Data Supply and Infrastructure) as the Prime Delegate for Denmark; Jamal Jokar Arsanjani as Danish delegate representing Academia; Jorge Delgado García (University of Jaen) as the Spanish Delegate representing Academia; Adrien Gressin (University of Applied Sciences of South Western Switzerland) as the Swiss Delegate representing Academia; David Henderson (Ordnance Survey Great Britain) as Prime Delegate of the United Kingdom

Appointments of Eija Honkavaara (National Land Survey of Finland) as Chair of Commission 1 Data Acquisition, Conor Cahalane as the Secretary-General, Joep Crompvoets (KU Leuven) and Jantien Stoter (TU Delft) as Vice-Presidents Research; Re-appointments of Frédéric Cantat (IGN France) as Chair of Commission 4 Business Models and Operation, Anka Lisec (University of Ljubljana) as Chair of Commission 5 Knowledge Transfer, and Martijn Rijsdijk (Kadaster) as Chair of Commission 3 Information Usage and Visualization.

Partnerships

EuroSDR continued collaborating with its key partner associations in 2023: Association of Geographic Information Laboratories for Europe (AGILE), EuroGeographics, FIG, ISO TC/211, International Society for Photogrammetry and Remote Sensing (ISPRS), and UN-GGIM Europe.

Some examples indicating our successful collaborations with our partner associations are the following:

- Attending the General Assembly of EuroGeographics in Malta (12 – 14 March 2023).
- Presentation by Nils Hempelmann during the EuroSDR BoD meeting in Tallinn (26 May 2023)
- Organizing AGILE workshop on "How can GI Science Advance the Value of City level and National Digital Twins?" (Delft, Netherlands, 13 June)
- Croatian Cartographic Week (Zadar, Croatia, 7-9 September)
- Joint EuroSDR/EuroGeographics 3rd Workshop on Artificial Intelligence for NMCAs with EuroGeographics, 26 – 27 September, hybrid
- 4th Edition of the International Workshop on Spatial Data Quality (11 - 12 October 2023, Brussels, Belgium)

Logistics

Regarding the associated logistics, the secretariat was among others strongly involved in preparing the meetings, processing the minutes, decisions and actions of each meeting, organising EuroSDR events (e.g. workshops, webinars, EduServ e-learning courses), editing publications and the annual report, financial accounting, auditing, updating the EuroSDR website, managing social media, etc.

At the end of the BoD 143, the formal handover of the EuroSDR Secretariat took place. The secretariat moved from Leuven (Belgium) to Maynooth (Ireland). The secretariat was based for 12 years in Leuven (with Joep Crompvoets as Secretary-General and Anneke Heylen and Tatjana Van Huyck as his assistants. Conor Cahalane of Maynooth University serves as the new Secretary-General and Neasa Hogan as his assistant.

I would like to end my report as Secretary-General with some keywords. EuroSDR was and is for me: inspiring, motivating, constructive community, great network, wonderful collaboration, fun and joy. I wish the new Secretary-General and his assistant all the best with taking up this new role,

Joep.

Commission I: Data Acquisition

Jon Mills

The mission of Commission 1 is to investigate, test and validate platforms, sensors, algorithms and human sources to acquire geospatial data, with emphasis on precision, accuracy, reliability and standardisation of primary data acquisition procedures.

2nd Geobench Workshop

The 2nd Geobench Workshop (Evaluation and BENCHmarking of Sensors, Systems and GEOspatial Data in Photogrammetry and Remote Sensing) was held from 23-24 October 2023 in Krakow, Poland. The highly successful event was jointly organised by researchers from FBK Trento, Technical University of Darmstadt, Warsaw University and AGH Krakow. 33 full papers were published in the ISPRS Archives (See https://isprs-archives.copernicus.org/articles/XLVIII-1-W3-2023/index.html) and there were four invited talks, 20 oral presentations, 13 posters, and six demonstrations. Further details can be found at the workshop website, https://geobench.fbk.eu/.

RPAS benchmark

Key findings from the EuroSDR Commission 1 remotely piloted aircraft systems (RPAS) benchmark study were presented at the 2nd Geobench workshop in Krakow during October (see above). The results have subsequently been published as a paper in the ISPRS Archives (https://isprs-archives.copernicus.org/articles/XLVIII-1-W3-2023/107/2023/). All data from the project has now also been released as open access via Zenodo (https://zenodo.org/record/8309679) for wider use by the community.

Satellite-borne high resolution stereo imagery benchmark

The findings from the joint Commission 1-2 benchmark to investigate the use and potential for satellite stereo imagery by NMCAs were reported at the 142nd BoD meeting in Tallinn, Estonia. Results were also presented at the 2nd Geobench workshop in Krakow (see above) and published as a paper in the ISPRS Archives arising from the workshop (https://isprs-archives.copernicus.org/articles/XLVIII-1-W3-2023/47/2023/).

PhD on "Multispectral LiDAR and 3D imaging"

As approved at the 140th BoD in Dublin in May 2022, EuroSDR is funding a PhD in multispectral LiDAR and 3d imaging. PhD candidate Narges Takhtkeshha from Iran officially started her studies in March 2023 with supervision from FBK Trento, TU Wien and the Finnish Geospatial Research Institute. Current activities include a review of multispectral LiDAR and imaging sensors, data collection, and coding for data processing. An oral presentation was made at the SilviLaser conference in London during September 2023 and a review paper has been submitted to ISPRS Journal.

PhD candidate Narges Takhtkeshha

Centre for Doctoral Training (CDT) in Geospatial Systems

The Engineering and Physical Sciences Research Council (EPSRC) Centre for Doctoral Training (CDT) in Geospatial Systems recruited its final cohort of 14 students in September 2023. This brings the number of enrolled students in the CDT to 50. The Centre has the support of EuroSDR and a number of its members, including Ordnance Survey, Finnish Geospatial Research Institute, and IGN France. Continual opportunities exist for NMCA collaboration, including student placements, with further details available via the CDT website at https://geospatialcdt.ac.uk/.

Bid for a new CDT in LOCation Unified Solutions (LOCUS)

In 2023 EuroSDR and several of its members supported Newcastle and Nottingham Universities in a bid for a new £7.6M CDT. Unfortunately, following invitation to submit a full bid in the summer of 2023, and a subsequent interview, LOCUS was ultimately not selected to receive funding from EPSRC in this CDT funding round.

Commission 1 Chair

The 143rd EuroSDR BoD Meeting in Gävle, Sweden, held on 4-6 October, 2023, marked the end of Jon Mills' third term as Commission 1 Chair. Jon thanked everyone involved in EuroSDR for their support over the last six years – EuroSDR is a network of incredibly warm, welcoming and wonderful people and it has been a privilege to serve as Commission Chair. Jon handed over the Commission 1 reigns to Eija Honkavaara of the Finnish Geospatial Research Institute in Gävle, wishing her all the best for her EuroSDR journey (see https://www.maanmittauslaitos.fi/en/research/contact-information/staff/eija-honkavaara).

At the 143rd EuroSDR BoD Meeting in Gävle, Sweden, Jon Mills reviewed some of the events and activities he has been involved in over the last six years as Commission 1 Chair.

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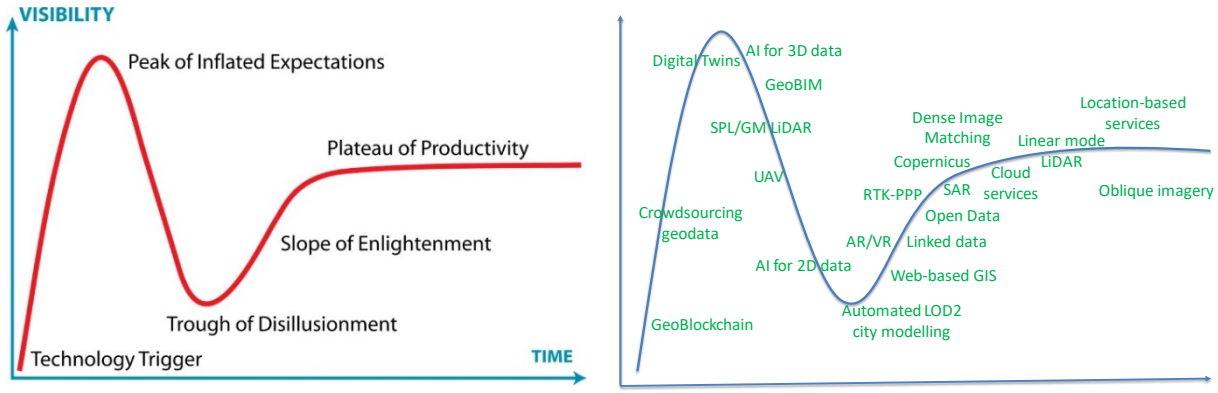
Commission II: Modelling, Integration and Processing

Norbert Haala

The mission of Commission 2 is to investigate, demonstrate and evaluate the generation, processing, structuring, integration and maintenance of spatial information. The focus is on algorithms, including machine learning, Cloud-computing and upscaling.

Recent developments

Rapid developments in Artificial Intelligence (AI) and Deep Learning still trigger an enormous progress in modelling, integration and processing of data in the geospatial domain. This will considerably influence the work of National Mapping and Cadastral Agencies (NMAs) and results in an ongoing need for knowledge transfer as a key task of EuroSDR. This is also the reason why the topic "AI for 3D data" was identified as a main topic in the discussions of the EuroSDR Geospatial Hype Cycle during the last BoD meetings. As one outcome of these discussions, current EduSERV courses tackle related topics like automatic classification and change detection based on 3D data.



Phases of Hype Cycle for emerging technologies (left) and Geospatial Hype Cycle 2023 (right)

EduSERV Courses

3D Point Cloud Classification for Mapping Purposes

The course on 3D Point Cloud Classification for Mapping Purposes held in 2022 and 2023 covered the current developments and solutions for 3D point cloud classification, with particular emphasis on mapping needs. While starting from traditional yet functional Machine Learning solutions, the course mainly focussed on more recent Deep Learning methods. Organized as a mix of offline and live lectures and labs, especially the practical work examples, implemented on Google Collab were very much appreciated by the participants. These labs covered topics like image segmentation and feature computation of 2.5D data, semantic segmentation of 2.5D DSM data, Random Forests for image and 3D point cloud classification as well as image classification with Deep Learning. The course was attended by more than 50 participants in the first edition and about participants in the second edition.

From traditional to AI-based 3D scene capture and modelling

Neural Radiance Fields (NeRFs) seem to become a game changer in photogrammetric 3D reconstruction. They apply an implicit, neural-network-based scene representations, which enables 3D reconstruction by

minimizing the difference between real and rendered views of the respective scene. Techniques like NeRFs or 3D Gaussian Splatting efficiently encode high-resolution scene information and can be used to capture precise 3D models while additionally being more compact than scene representations like 3D point clouds or voxel block models. In view of this emerging technique, an EduSERV course on AI-based 3D scene capture and modelling was prepared for 2024.

While the topic AI for 3D data was located at the peak of inflated expectations in the Geospatial hype cycle, the topic of Automated LOD2 city modelling appears in the trough of disillusionment. Technologies overloaded with expectations require a realistic assessment. This can be achieved by knowledge transfer from academia to NMA e.g. by EduSERV courses. In contrast, techniques at the trough of disillusionment can be brought forward to the plateau of productivity by the exchange of information while discussing best practise models of its users. This was the motivation to organize the

Virtual Workshop on LoD2 Building Model Generation under the EuroSDR umbrella.

EuroSDR

University of Stuttgart

FONDAZIONE BRUNO KESSLER

Workshop on

LOD2 BUILDING MODEL GENERATION

13th November 2023

14:00 - 17:00

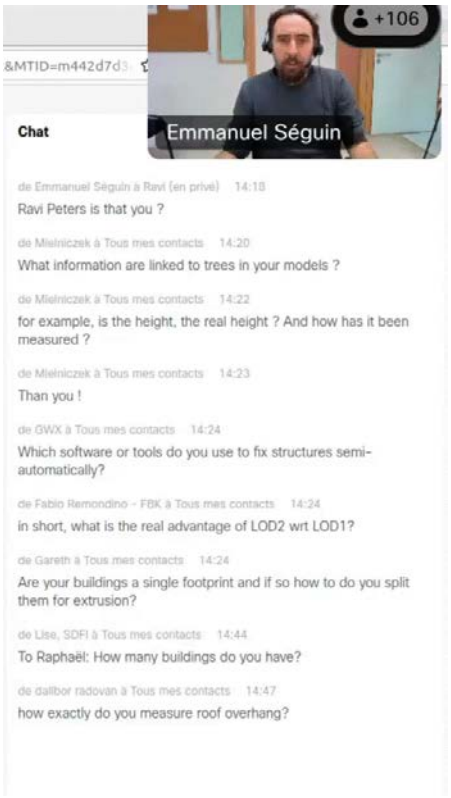
online

3D buildings models are normally divided into multiple levels of details (LoDs), with different geometric and semantic information for varying levels of application. LOD2 models, which add simple or detailed roof structured to basic LOD1 models, are more and more requested and the availability of higher resolution geospatial data and automated methods is opening new avenues for the generation of such products.

The EuroSDR workshop wants to shed some light on data and methods for LOD2 generation and usage in NMCAs. The aim is to understand the status-quo of LOD2 products within European mapping agencies, which data are used, which data are used, which modeling procedures are in place, which uses and applications are made.

Program

14:00	*Welcome* Norbert Haala, Fabio Remondino
14:05-15:30	*LOD2 Building Data Production in Estonia* Andres Kasekamp (Chief Specialist at Estonian Land Board, Estonia)
	3D buildings in a topographic landscape model Raphael Bovier (Head of Geodata Distribution at swisstopo, Switzerland)
	LOD2 building reconstruction benchmark using LIDAR data Emmanuel Séguin (Project Manager IGN, France)
	3D meshes or LOD models? Paul Kane (General Manager Surveying Remote Sensing and Geodesy at Ordnance Survey Ireland)
15:30-15:40	*Short break*
15:40-16:40	*Digital geoTwin – city modelling of buildings and beyond* Hubert Lehner (Head of Division, 3D-Modelling and 3D-Services, Vienna City Administration, Austria)
	Current status of the availability of LoD2 building models in the Netherlands from the Kadaster perspective Jantien Stoter (Professor Delft University of Technology, Netherlands)
	BuildingReconstruction – A tool for LoD2 building reconstruction Lutz Ross (VirtualCitySystems)
16:40	*Closing remarks*



This half day event took place on November 13th, 2013 with representatives from the European mapping agencies in Switzerland, Netherland, Estonia, France, Ireland and the Vienna City Administration presenting their current work, including methods for data collection and applications. During the workshop, 100+ participants from academia, industry and NMAs were online. The very interesting presentations were followed by lively discussions, which clearly showed the great benefit of mutual information information exchange within EuroSDR.

Impact of the evolution of digital camera on the quality of photogrammetric products

At the 143rd BoD Meeting in Gävle Michael Cramer, University of Stuttgart, discussed in his keynote the question *Does camera design influence the quality of products?* Changes in the design of digital aerial cameras are currently triggered by the necessary change from CCD to CMOS sensor technology. As an exemplary impact motion blur cannot be avoided any longer by electronical forward motion

compensation (TDI), which is limited to CCD sensor technology. Thus, alternative techniques like mechanical forward motion compensation or software-based multi-directional motion compensation by Adaptive Motion Compensation (AMC) come into play. Furthermore, image quality might be influenced due to the trend towards smaller pixel sizes, there are also ongoing discussions on the pros and cons of pan-sharpening versus Bayer pattern. The increasing technological variety of new aerial camera systems thus challenges NMAs during the evaluation of these systems for mapping purposes. In order to support this process, the National mapping agencies of Germany (AdV) initiated a test flight in cooperation with the system providers Vexcel, Leica Geosystems, IGI, and Phase One. The project lead is at the LVermGeo Schleswig-Holstein in Kiel, which is accompanied by the Institute for Photogrammetry & Geoinformatics in Stuttgart. Further cooperation also under the EuroSDR umbrella should be of interest.

Commission III: Information Usage and Visualization

Martijn Rijsdijk

The mission of Commission 3 is to explore, demonstrate and contribute to further increase the usage, access, distribution and visualisation of authorised geospatial data as well as to investigate better service mechanisms for the dissemination of geodata from database to end-users.

2023 was a full year for the committee in terms of workshops, webinars, activities and projects. Below is an overview of everything that was held in chronological order:

Project Linking Data in Europe

The Linked Data project still had lot of progression. Unfortunately some things the plan had to be changed; it was not succeeded to recruit a high quality master student to work out some research question as been mentioned. The plan is now to concentrate on scientific and pre-standardisation matters related to how to propose a core knowledge graph structure. However; there were some interesting results. For example the knowledge graph could be used to register and manage users feedback related to the linked data products which is a nice success. It had interest of OGC because they are looking for use cases of their standards; a mid-term report about the projec b4and its results will presented in May, The Netherlands, BOD144 in Zwolle.

Workshop Digital Twin, June 13, Delft

During this workshop perspectives from scientists, industry, and NMCAs were brought together. Interesting discussions during this workshop went about the relation between city-level and national Digital Twins. What should be needed to make it to a result? How can GI Science and NMCAs advance that field

The workshop was quite a success and gave the participants a brief insight into the actual technical state how digital twin could be used and technical problems could be solved to come to results.

Webinar the Sentinels Embedded/ Copernicus;

During this webinar in May actual developments in relation to Sentinel 1, 2a/b and 3 satellites from Copernicus and ESA were presented. Knowledge and experiences from different organizations was shared. Objective of this webinar was to raise awareness of the possibilities and to motivate ideas to make use of earth observation data; showing how scaling up phase in the Sentinel programme has been done. Some reflections after the programme where there is much achieved; already there is a wide range of new service components. There is also a numerous of new applications with huge impact and dynamic developments. This webinar presenting the actual state of sentinels was the 5th in a series and it should be the last one. EuroSDR started with a workshop almost 8 years ago.

Workshop-event 'Meta Data matters', Dessimination event;

In September 6th, Hilversum (NL) the workshop Meta Data Matters was organised. Objective was to present experiences and usecases about the usage of rdf metadata and data development. Presentations went about cross border query API, automatic datacube. generation for open data and production of quality dashboards. Conclusions and reflections at the end of the programme showed that the production of metadata is too much in silos and rdf could help. However; user-oriented access to datasets on the Web is not achieved yet. From the experts there was a big question for more national datasets and elements like windmills, tunnels and bridges. A mid-term report will be uploaded to the EuroSDR website.

Ideas and projects for 2024:

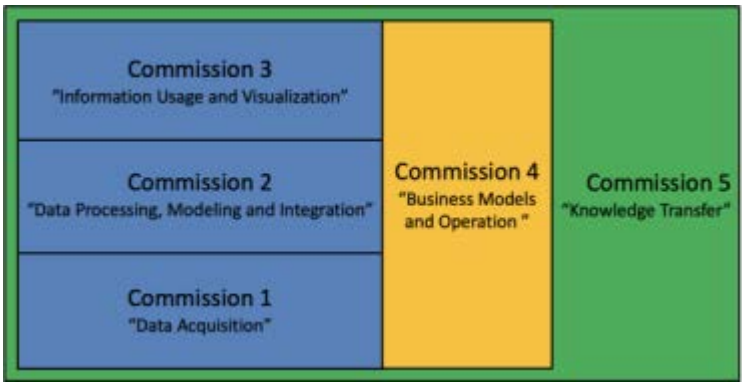
- Workshop on Geodata Discoverability, on-line, January 16th 2024, 13:30 to January 17th 2024, 12h30; Co-organised with Eurogeographics KEN INSPIRE; 2nd edition after first successful edition in 2022;
- Workshop on Historical data for SDGs, physical venue, date tbc around April 2024, venue : Zagreb. Call for participation has circulated on list, 4 presentations already, need for more.
- Workshop AI applications in the core processes of NMCA's, Oktober 2024.

Commission IV: Business Models and Operation

Frédéric Cantat

The mission of Commission 4 is to contribute to the development and implementation of business models describing the rationale of how mapping and cadastral agencies can create, deliver and capture value, in economic, legal, social, governance, cultural, sustainable or other contexts.

The role of Commission 4 within EuroSDR commissions works is transverse, as is Commission 5:



EduSERV 2023 course on Sustainable Business Models for Open Geospatial Data

The EduSERV 2023 course on Sustainable Business Models for Open Geospatial Data was given in the context that in the European Open data directive geospatial and earth observation data are labelled as High Value. As National Mapping and Cadastre Agencies (NMCAs) in Europe are key providers of these types of data and as there is no such thing as a free lunch, NMCAs are enforced to provide geospatial for free but at a cost for themselves. The objective of the course (pre-course given on February 14th 2023, and e-learning session from June 5th to 16th 2023) was to identify and analyse relevant business models that provide open data in a sustainable way. It was the intention that course participants build a sustainable open (geospatial/Earth Observation) data business model for their organisation or an imaginary one. The instructors were Joep Crompvoets, KU Leuven, Public Governance Institute (Belgium) and Frédéric Cantat, IGN France. 14 participants were registered (5 from NMCAs or LMCAs and 3 from Academia) and 8 got certifications. A back-to-back session of the course is planned for EduSERV 2024 (March and April).

Workshop on Data Ecosystems and Spatial Data Infrastructure (SDI), facilitators for data value creation

Set-up during Year 2023, a workshop on Data Ecosystem and Spatial Data Infrastructure (SDI), facilitators for data value creation stood on December 12th and 13th 2023 in Copenhagen (Denmark), hosted by Danish Agency for Data Supply and Infrastructure (SDFI). It was a Joint workshop of Danish Agency for Data Supply and Infrastructure, KU Leuven, TU Delft, IGN France, DAFAGO, and EuroSDR.

The set-up of the workshop was based on the following observations: the world is becoming more and more data driven; there are many ways to collect, analyse and disseminate data, and data ecosystems are among the most important environments given for facilitating this; spatial data is one of the data types in data ecosystems, and data ecosystems play a key role in further value creation of the spatial data created, maintained and shared in the SDI.

The workshop aimed at providing insights in data ecosystems in the context of spatial data infrastructure (SDI), identifying concepts and challenges to uncover relevant research topics, encouraging development of best practice recommendations and spur collaboration on use cases across domains and sectors. The workshop also made room for networking and knowledge exchange among the participants.

Structured around 3 topics (1. Moving from spatial data infrastructure (SDI) to data ecosystems (DE); 2. Value creation for all stakeholders – From supplier-driven to demand-driven; 3. Development of data ecosystems – New business and financial models), each of them having been the subject of breakout sessions, the workshop was fully booked and gathered 30 participants, among them 14 speakers from the Local and National Authorities from Norway, Sweden and Denmark, European organisations such as the European Commission Joint Research Centre (JRC), The Alexandra Institute, and researchers working from different domains like spatial data, energy transition and building infrastructure.

Fig 1: Workshop on Data Ecosystems and Spatial Data Infrastructure: photo by Ulla Kronborg Mazzoli (SDFI)

The detailed agenda and all presentations' support are available on EuroSDR's website1. An official EuroSDR workshop's report will be published in S1 2024.

Volunteered Geographical Information (VGI) Project

For many years, EuroSDR has monitored the topic of "Volunteered Geographic Information" (VGI) (a phrase coined in 2007 by Goodchild) specifically because National Mapping and Cadastral Agencies (NMCAs) could leverage VGI, at a time when they have to do more with less. The first EuroSDR Workshop took place in 2009 in Wabern, Switzerland (Crowd Sourcing for Updating National Databases?), In 2012-13, EuroSDR led a joint collaborative workshop and project with the Association of Geographic Information Laboratories in Europe (AGILE) which supported NMCA-driven research into using crowdsourcing in national mapping (Crowdsourcing in National Mapping, Mooney and Morley, EuroSDR official publication n°64). Further workshops followed on in 2017 and 2020 in Leuwen, Belgium.

After a call for volunteers launched during Board of Delegates meeting in Naters (Switzerland), BOD141, a small team was formed at the beginning of 2023 to set-up an EuroSDR project about Volunteered Geographical Information (VGI), as follow-up of previous actions, aiming to assess the current trends of VGI in NMCAs practices, to see how the field has advanced in this time, fourteen years after the first action.

A first state of the play was presented during BOD 142 meeting in Tallinn (Estonia), with feedbacks from Finland, United Kingdom, Ireland and France and delegates' agreement to set-up an online survey to dig deeply. The questionnaire was online from mid-November to end of December 2023: 25 answers were submitted, from 19 countries, e.g 100% of EuroSDR's members! The results of the survey will be presented during a specific workshop which will meet in Glasgow on June 4th 2024 during the AGILE 2024 Conference2 and the workshop outcomes will complement them. An official EuroSDR survey and workshop's report will be published in S2 2024.

Inventory of main open datasets from EuroSDR's members

As decided during the EuroSDR Board of Delegates meeting in Tallinn (BOD142), an inventory of main open datasets from EuroSDR's member was carried out from September to December 2023. As a first step, the inventory of them was done with the common filter of 'high value datasets' (HVDs) according to the Commission implementing regulation (EU) 2023/138 laying down a list of specific high-value datasets and the arrangements for their publication and re-use.

A form was sent to delegates and 13 answers were submitted. The compilation of responses will be sent to Delegates during S1 2024.

Geo-ethics project

Several exchanges with UN-GGIM member were led during Spring 2023 to adapt and extend a survey on Geo-ethics carried out in America to Europe (S1 2024) and to schedule a workshop on this topic (S2 2024). The first achievement of this project was the presentation done by Rosario Casanova, University of Montevideo, during EuroSDR Board of Delegates meeting in Gävle (BOD143).

[1] See http://www.eurosdr.net/workshops/workshop-data-ecosystems-and-spatial-data-infrastructure

[2] See workshop n° 6 (W6) https://agile-gi.eu/conference-2024/programme-2024/agile-workshops-2024

Commission V: Knowledge Transfer
Anka Lisec

The mission of Commission 5 is to provide educational services to support the transfer of knowledge from EuroSDR research projects to national mapping and cadastral agencies (NMCAs), academia and industry. The Commission also focuses on fulfilling specific NMCAs' demands for knowledge update, collection and dissemination methodologies, developed tools and other research outcomes in the form of EuroSDR's official publications and via EuroSDR's homepage.

Overview activities 2023

The core educational activity has traditionally been related to the organisation of online courses. The so-called EuroSDR Educational Service (EduServ) annually offers four two-week e-learning courses in the domains of geoinformation (GI) and geospatial technologies. The services have been designed for knowledge transfer from the research to the production domain. Related to educational and knowledge-transfer activities of EuroSDR, the synergy of Commission 5 activities with other EuroSDR commissions has to be emphasised: the EuroSDR projects and workshops organised within the Commissions 1-4 have already significantly contributed to the content of the EduSERV courses as well as to other training and knowledge-transfer activities.

In 2023, the EduServ courses addressed the current challenges and technological advances in (i) 3D mapping using point cloud data sources, (ii) GeoBIM related to bridging the gap between Building Information Modelling (BIM) and Geospatial Information Systems (GIS), (iii) Sentinel data analytics for change detection, and (iv) sustainable business models for open geospatial data.

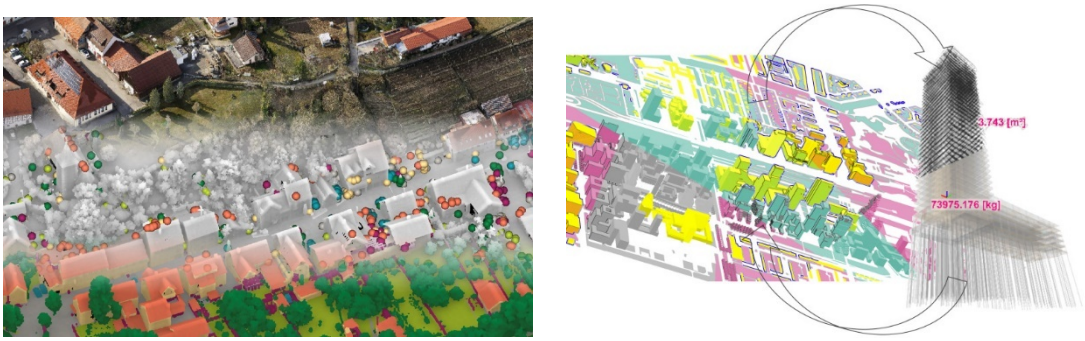


Fig 1: The EduServ21 courses also addressed point cloud processing (left) and GeoBIM (right), which have been research topics conducted by the EuroSDR Commission 1 and 2 (Sources: Koelle et al., 2023; Noardo and Arroyo Ohori, 2023)

Aiming to improve the EuroSDR education service, the EduServ participants were asked for their opinion on the EduServ courses they participated. The feedback was very positive. Within the questionnaire, the participants also proposed topics that would be interesting for future EduServ courses – these ideas were presented during the Board of Delegate meeting in October 2023. The topics that were highlighted in this context were, in particular:

- Autonomous creating 3D geospatial/building models from LiDAR or photogrammetric data; 3D object extraction from point clouds; Semantic enrichment of point clouds;

- City mapping: combining aerial (incl. oblique), mobile and terrestrial acquired data; oblique data processing and 3D modelling;
- 3D city and landscape models; Semantic enrichment of 3D city and landscape models; Integration of geospatial data into digital twins; 3D visualisation;
- Comparison of various IFC or BIM model conversion methods from and to CityJSON/CityGML; its implementation to the 3D database;
- Machine learning with Sentinel data or the VHR satellite data from Copernicus Contributing Missions: land cover mapping, feature extraction;
- Satellite (optical/SAR) data processing: topography/land cover/soil/change detection etc.
- AI and geospatial analytics for change detection;
- Quality in geospatial data/information;
- RPAS/UAS: georeferencing, data processing, data quality;
- UAS usages in various applications, such as precision agriculture, forestry etc.

In 2023, Commission 5 was further actively involved in follow-up activities concerning the topic of geospatial data and tools for education and research. In addition, due to the detected lack of human capacities in the geospatial domain, Commission 5 proposed a workshop and some further activities on how to motivate young people to become interested in the geospatial information profession. The workshop and follow-up activities are planned to be in 2024.

EduServ21

In 2023, EuroSDR Commission 5 for Knowledge Transfer continued to organise the EuroSDR Educational Service (EduServ) – a series of e-learning courses that reflect new trends in geospatial information science related to the needs of research, development and practice within NMCAs and industry. The 21st EduServ began with a pre-course seminar hosted by the University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia, from 13 to 14 February 2023. The four two-week e-learning courses were scheduled from March to June 2023 on the following topics:

- **Integration of 3D City Models and BIM: GeoBIM** (March 6–17, 2023)

  Tutors: Francesca Noardo (Open Geospatial Consortium Europe, Belgium), Ken Arroyo Ohori (Delft University of Technology, The Netherlands)

  The course was dedicated to the basic knowledge of GeoBIM integration based on the needs of use cases and showed two examples of conversion procedures that supported those who use cases. After introducing the basics of 3D city models and Building Information Models, students learnt a method to compare two datasets (a 3D city model and a BIM) in order to analyse their integration possibilities and define the actions necessary to get to an integrated dataset, useful for a use case. The practical part included two conversion procedures, one Geo to BIM and one BIM to Geo, in order to produce suitable data for two specific use cases.

- **3D Point Cloud Classification for Mapping Purposes** (April 17–28, 2023)

  Tutors: Michael Koelle, Norbert Haala (University of Stuttgart, Germany), Fabio Remondino (Fondazione Bruno Kessler, Italy)

  Point cloud processing techniques have been extensively investigated in the research community for various applications, and some commercial solutions have started to be frequently used in daily practices. In particular, geospatial point cloud classification methods are important, as assigning semantic information to 3D geodata allows for the widespread use of such geospatial

data. The course was dedicated to the latest developments and solutions for 3D point cloud classification, with particular emphasis on mapping needs, activities and purposes. Starting from functional Machine Learning solutions, the course focused on more recent Deep Learning methods. Theoretical aspects and practical work were coupled in order to provide a comprehensive and complete overview of the topic, from the classification of 2.5D DSM to 3D aerial point clouds.

- **Remote Sensing and Change Detection with Sentinel Time Series Data** (May 8–19, 2023)

  Tutors: Krištof Oštir, Bujar Fetai, Matej Račič (University of Ljubljana, Slovenia)

  Copernicus, the European Union's earth observation programme, is served by a set of dedicated satellites and contributing missions. Since the launch of Sentinel-1A in 2014, the European Union has set in motion a process to place a constellation of almost 20 more satellites in orbit before 2030. The course covered several aspects of processing dense time series data provided by the Sentinel satellites. The focus was on high-resolution radar (Sentinel-1) and optical (Sentinel-2) data, where data access services were also presented - both via classic download via Copernicus Open Access Hub and via Sentinel Hub. The basic processing was done with the open-source programme SNAP and the individual Sentinel Toolboxes. Particular attention was given to time series provision using Jupyter Notebooks and the Sentinel Hub Statistical API with the cases of simple machine learning classification.

- **Sustainable Business Models for Open Geospatial Data** (June 5–16, 2023)

  Tutors: Joep Crompvoets (KU Leuven, Belgium), Frédéric Cantat (Institut National de l'Information Géographique et Forestière, IGN, France)

  In the EU Open data directive geospatial and earth observation data are labelled as High Value. As National Mapping and Cadastre Agencies (NMCAs) in Europe are key providers of these types of data and as there is no such thing as a free lunch, NMCAs are enforced to provide geospatial for free but at a cost for themselves. The course on sustainable business models for open geospatial data was designed to identify and analyse relevant business models that provide open (geospatial) data in a sustainable way. The course participants built a sustainable open (geospatial/earth observation) data business model for their organization or an imaginary one.

A total of 62 participants attended the e-learning courses. The following table gives an overview of the number of participants who attended each course and the number of participants who successfully completed the courses and received certificates from EuroSDR.

Course title	Number of active participants	Number of issued certificates
Integration of 3D City Models and BIM: GeoBIM	21	14
3D Point Cloud Classification for Mapping Purposes	44	27
Remote sensing and change detection with Sentinel time series data	35	15
Sustainable Business Models for Open Geospatial Data	15	8

Fig 2: The EduServ precourse seminar took place at the University of Ljubljana from 13 to 14 February 2023.

EduServ22 announcement

Based on the information gathered by EuroSDR commission chairs, EuroSDR delegates and EduServ participants, the new EduServ courses for 2024 were proposed and announced:

- **Remote Sensing and Change Detection with Sentinel Time Series Data** (March 11–22, 2024)
  Tutors: Krištof Oštir, Bujar Fetai, Matej Račič (University of Ljubljana, Slovenia)
- **Sustainable Business Models for Open Geospatial Data** (April 8–19, 2024)
  Tutors: Joep Crompvoets (KU Leuven, Belgium), Frédéric Cantat (Institut National de l'Information Géographique et Forestière, IGN, France)
- **From traditional to AI-based 3D scene capture and modelling** (May 6–17, 2024)
  Tutors: Michael Weinmann (Delft University of Technology, The Netherlands), Dennis Haitz and Martin Weinmann (Karlsruhe Institute of Technology, Germany)
- **Point cloud processing with laser scanning** (June 3–14, 2024)
  Tutors: Juha Hyyppä, Joseph Taher, Matti Lehtomäki (Finnish Geospatial Research Institute, Finland)

The 22nd series of e-learning courses from EuroSDR will begin with a pre-course seminar hosted by the KU Leuven, Public Governance Institute, Leuven, Belgium, from March 4-5, 2024.

EuroSDR PhD award

To enhance collaboration between European academia and NMCAs, as well as to engage young scientists in its research endeavours, EuroSDR introduced in 2016 an annual competition for the best PhD thesis in the fields related to geoinformation science. In June 2023, the call for applications for the 2023 EuroSDR PhD Award was announced. We received 12 applications from candidates holding PhDs from universities in Austria, Belgium, France, Germany, Spain, Turkey, The Netherlands. The evaluation committee (Krzysztof Bakuła, Conor Cahalane, Joep Crompvoets, Julián Delgado Hernández, Anka Lisec, and Markéta Potůčkova) reviewed the applications, and the winner was announced in September 2023. The EuroSDR PhD winner in 2023 was:

Ana-Maria Loghin, PhD, with the PhD thesis titled »***Potential of very high resolution satellite imagery for 3D reconstruction and classification****", defended at the TU Vienna, Austria.*

The winner gave a presentation on the key findings of her research during the 143rd Board of Delegates meeting. More information is available at http://www.eurosdr.net/news/eurosdr-award-winner-2023

Workshops, Other activities

In collaboration with EuroSDR Commissions 4, we continued activities related to the 2020 survey on Data and tools for research and education. A report on the workshop in 2022 was published, while further activities to gather and share good practices are foreseen for 2024.

In addition, the initiative to start a discussion on how to promote the profession and attract young, motivated people to work in the geospatial information domain was supported. The lack of human capacities in the domain is evident all around Europe—in public, academic, and industrial sectors. A workshop on this challenge is foreseen for 2024.

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Publications

In collaboration with EuroSDR Commissions 4, we published the report on "*Data and tools for research and education*", the summary of a thematic workshop that was organised dedicated to this topic within the AGILE conference on June 14, 2022. The report was edited by Bénédicte Bucher, Frédéric Cantat, Joep Crompvoets, Anka Lisec, Markéta Potůčková, Conor Cahalane, Evelyn Uuemaa and Mathieu Chartier.

As a follow-up of the EduServ course entitled "*Automated Extraction of Topographic Map Data from Remotely Sensed Imagery by Classification and Cartographic Enhancement: An Introduction to New Mapping Tools*", which was offered in 2018 and 2019, the tutors, Joachim Höhle and Bharath Bhushan Damodaran, prepared the publication for self-learning. Now, the course material is open for self-learning, but teachers no longer give support. However, the course material has been adapted by the authors of the book to this new condition. This book describes the course material of this e-learning course, and it can be used as supplementary material to the course content that is available online. It may also serve as an example for designing new EduServ courses.

References:

Bucher, B., Cantat, F., Crompvoets, J., Lisec, A., Potůčková, M., Cahalane, C., Uuemaa, E.,Chartier, M.: Data and tools for research and education. EuroSDR official workshop report, 2023.

Crompvoets, J., Cantat, F.: Sustainable Business Models for Open Geospatial Data. EduServ21 training material, 2023.

Höhle, J., Bhushan Damodaran, B., Automated Extraction of Topographic Map Data from Remotely Sensed Imagery by Classification and Cartographic Enhancement: An Introduction to New Mapping Tools. EuroSDR official publication No 75, 2023.

Koelle, M., Haala, N., Remondino, F.: 3D Point Cloud Classification for Mapping Purposes. EduServ21 training material, 2023.

Noardo, F., Arroyo Ohori, K.: Integration of 3D City Models and BIM. EduServ21 training material, 2023.

Oštir, K., Fetai, B., Račič, M.: Remote Sensing and Change Detection with Sentinel Time Series Data. EduServ21 training material, 2023.

Workshops

- 3rd International Workshop on Point Cloud Processing – 26-27 January 2023 (Stuttgart, Germany)
- Use of EU Funding by EuroSDR Members– May 2023 (virtual)
- 5th Workshop on earth observation and monitoring with sentinel images "The Sentinels Embedded" (online) – 31 May – 1 June 2023
- How can GI Science advance the value of city-level and nationwide Digital Twins? – 13 June 2023 (Delft, Netherlands)
- Joint EuroSDR-GeoE3-PLDN Symposium Metadata Matters, What Role Does Linked (Meta)Data Play in the Geospatial World? – 6 September 2023 (Hilversum, Netherlands)
- Joint workshop on Artificial Intelligence for NMCAs– 26 &27 September 2023 (virtual)
- 4th International Workshop On Spatial Data Quality – 10-12 October 2023, Brussles, Luxemborg
- EuroSDR Workshop Lod2 Building Model Generation– 29 November 2023 (virtual)
- Workshop Data Ecosystems and Spatial Data Infrastructure – 12 & 13 December 2023

Publications

75	Höhle J., Damodaran B.B.: Automated Extraction of Topographic Map Data from Remotely Sensed Imagery by Classification and Cartographic Enhancement, 2023 94 pages
WR	Bucher B., Stoter J., Ellul C., Billen R., De Lathouwer B., Ollson P.: How can GI science advance the value of city-level and national Digital Twins?

All publications can be downloaded on the EuroSDR website.

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