

Geodesy, Cartography and Cadastre Authority of the Slovak Republic



Topic of the conference

Land Management Systems: Challenges, Applications and Cadastre Approaches Based on Modern Technologies and Artificial Intelligence

41st conference of surveying and mapping authorities of Austria, Bosnia and Hercegovina, Croatia, Czechia, Friuli-Venezia Giulia, Hungary, Slovakia, Slovenia, Trentino and Southern Tyrol

17th – 19th June 2026

Dušan Hanus, Michal Leitman, Martina Behuliaková

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1) Considerations and potential AI applications within the GCCA SR



2) Innovative and modern methods for updating of the cadastre



3) The GCCA SR - 1.5 year after the cyberattack



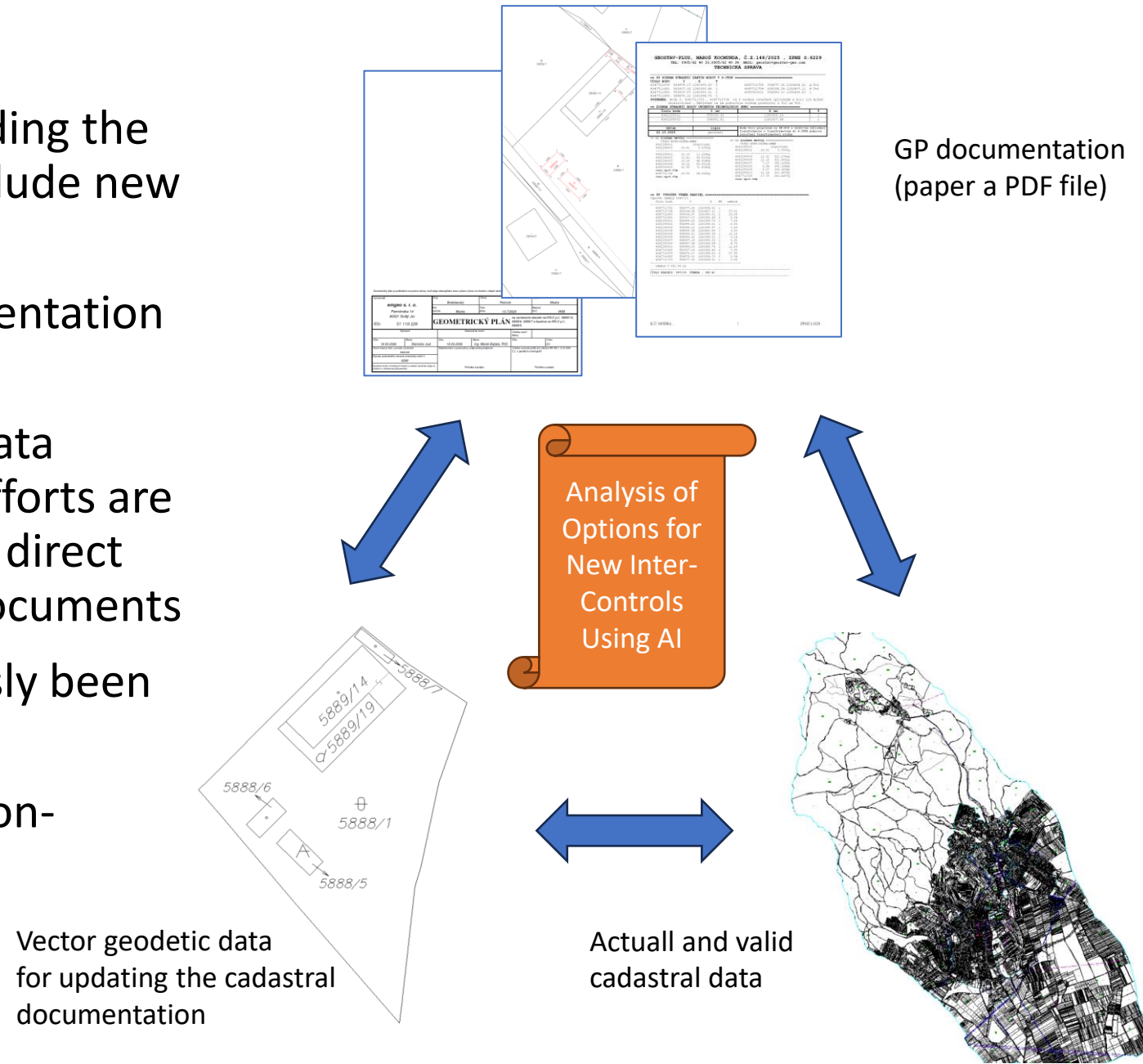
4) Development activities of the GCCA SR
and strategy until 2040



AI in the GCCA SR

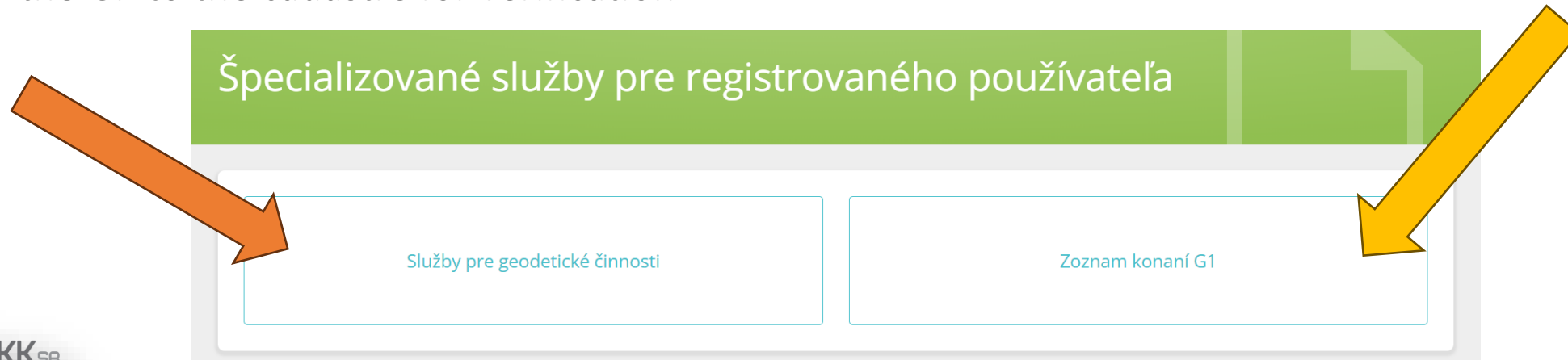
- Analysis of new possibilities for expanding the existing precise model of checks to include new capabilities using AI
- Improved cross-checking of GP documentation components
- Today, only the verification of vector data against cadastral records is possible; efforts are underway to expand checks to include direct verification against analog (PDF file) documents
- Use of AI for checks that have previously been performed by humans
- Use AI to analyze the reasons for GP non-verification and return for correction

Example of internal controls of GP documentation



Analysis of AI use in GP verification

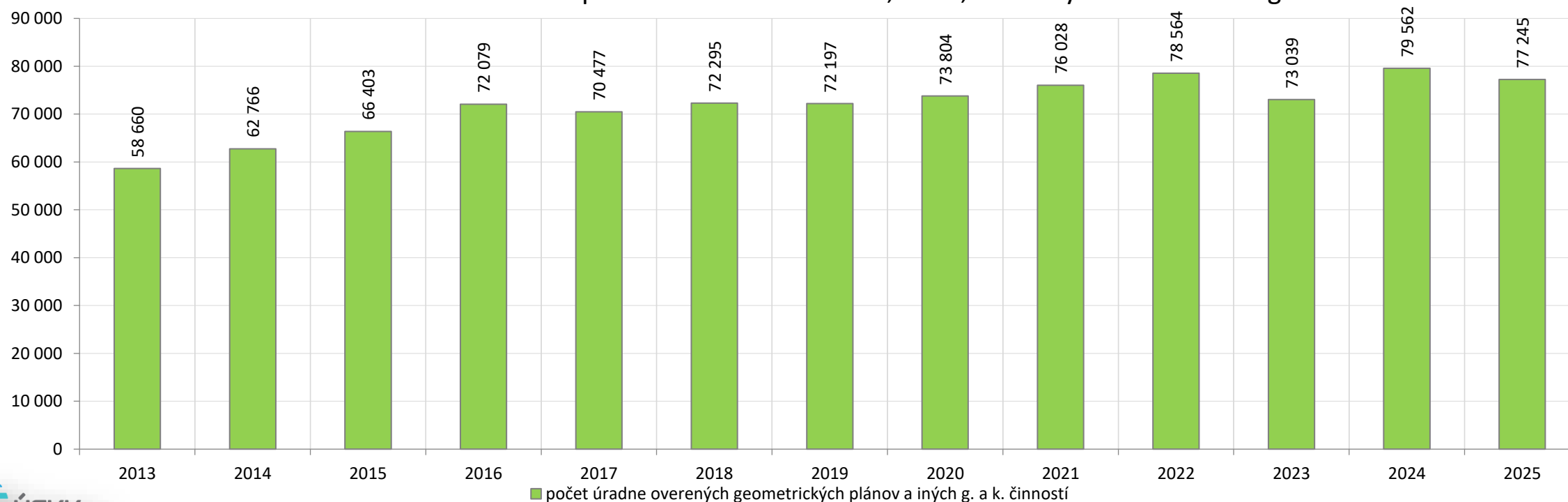
- GP as the fundamental tool for managing and updating the cadastral record
- Approximately 70,000 GPs are produced annually in Slovakia (2025: 77,245 GPs)
- Each GP undergoes authorisation and official cadastral verification (quality control, qualification checks and alignment with the current cadastral state)
- Since 2020, GCCA SR operates the „G1 Proceedings List“ service for cadastres as the main tool ensuring control and data quality of GP data imported into the cadastre.
 - Service for the cadastre – process recording, control, output generation and control reporting
 - The GP producer can use the same checks in a similar service to eliminate errors before submitting the GP to the cadastre for verification



Analysis of AI Use in GP verification

- GP as an important and fundamental tool for managing and updating the cadastre
- Understandable interest in AI application in this area

Comparison of the number of officially certified geometric plans and other surveying and mapping activities in the Slovak Republic as of December 31, 2025, for the years 2013 through 2025



 ÚGKK SR
Úrad geodézie, kartografie a katastra
Slovenskej republiky

- Percentage of GPs failing the first-time check: approx. **30%**

Errors due to non-compliance with quality parameters, evaluated by human operators

Errors due to non-compliance with quality parameters, evaluated by human operators

Errors from automated machine verification

Analysis of AI Use in GP verification



- Errors due to non-compliance with quality parameters, evaluated by human operators
- Opportunity for AI use – this is where we see potential
- Analysis of the verification process and reasons for returning GPs for correction
- Machine learning of verification results, analysis, classification and quantification
- Statistics (from location-based to personnel-level)
- The outcome enables a set of new GP checks and evaluated materials for employee methodological support

The screenshot displays the ÚGKK SR (Úrad geodézie, kartografie a katastra Slovenskej republiky) web application. The top section shows a list of GPs (Geodetic Points) with columns for ID, Name, ZPMZ, and Status. Below this, a detailed view for GP G1-241/2026 is shown, including the name of the surveyor (Ing. Juraj Horváth), the date of the survey (01.04.2026), and the status (Overené).

Číslo konania	Názov katastrálneho územia	ZPMZ	Stav konania
G1-248/2026	Pezinok (846163)	10139	Vrátené na opravu
G1-247/2026	Dubová (813303)	923	V overení
G1-246/2026	Veľké Trnité (869554)	648	Overené
G1-244/2026	Pezinok (846163)	10096	Overené
G1-243/2026	Pezinok (846163)	10141	Overené
G1-242/2026	Veľké Šenkvice (860778)	2467	Vrátené na opravu
G1-241/2026	Modra (838039)	6306	Overené
G1-240/2026	Pezinok (846163)	10140	Overené
G1-239/2026	Slovenský Grob (856657)	2757	Overené
G1-238/2026	Slovenský Grob (856657)	2756	Overené

Detail konania G1-241/2026

NÁZOV KATASTRÁLNEHO ÚZEMIA: Modra (838039) | ZPMZ: 6306 | STAV KONANIA: Overené

Vyhovovateľ

- Vyhovovateľ: Ing. Juraj Horváth
- IČO: 31112374
- Telefónne číslo: 0905352993
- Email: geodethorvath@gmail.com

Informácie o konaní

- Účel: na zameranie rozostavanej stavby parc.č. 8347/754
- Vyhovovateľ: Ing. Juraj Horváth
- Vyhovovateľ dňa: 01.04.2026 00:00
- Autorizačne overil: Ing. Juraj Horváth
- Autorizačne overil dňa: 01.04.2026 00:00
- Úradne overil dňa: 06.05.2026 16:29
- Počet protokolov: 1

Overovateľ

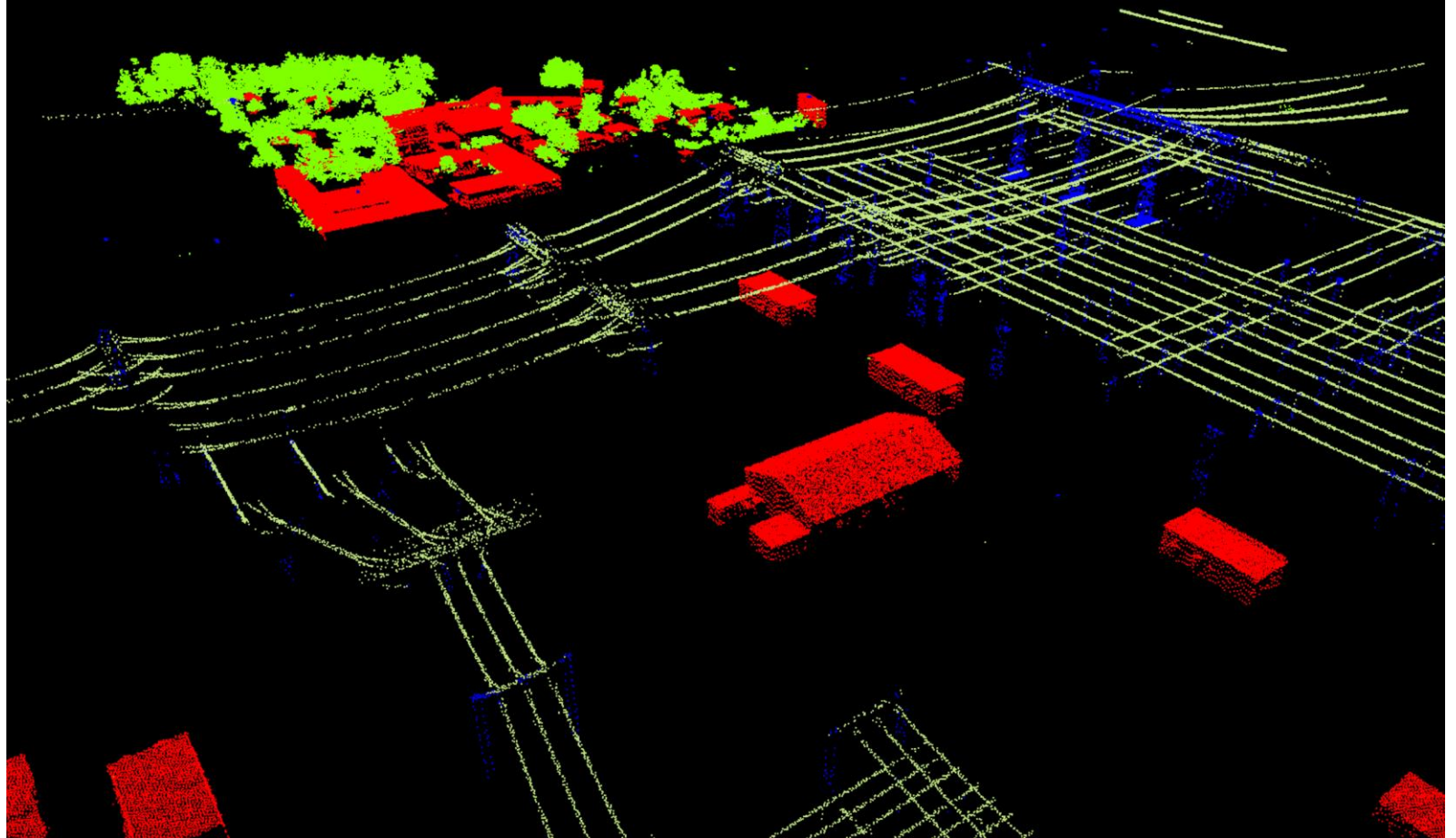
- Overovateľ: Ing. Helena Vargová
- Pracovisko: SKPK
- Telefónne číslo: -
- Email: helena.vargova2@minv.sk

Spustené kontroly

Čas spustenia	Stav
06.05.2026 15:53	Bez chýb

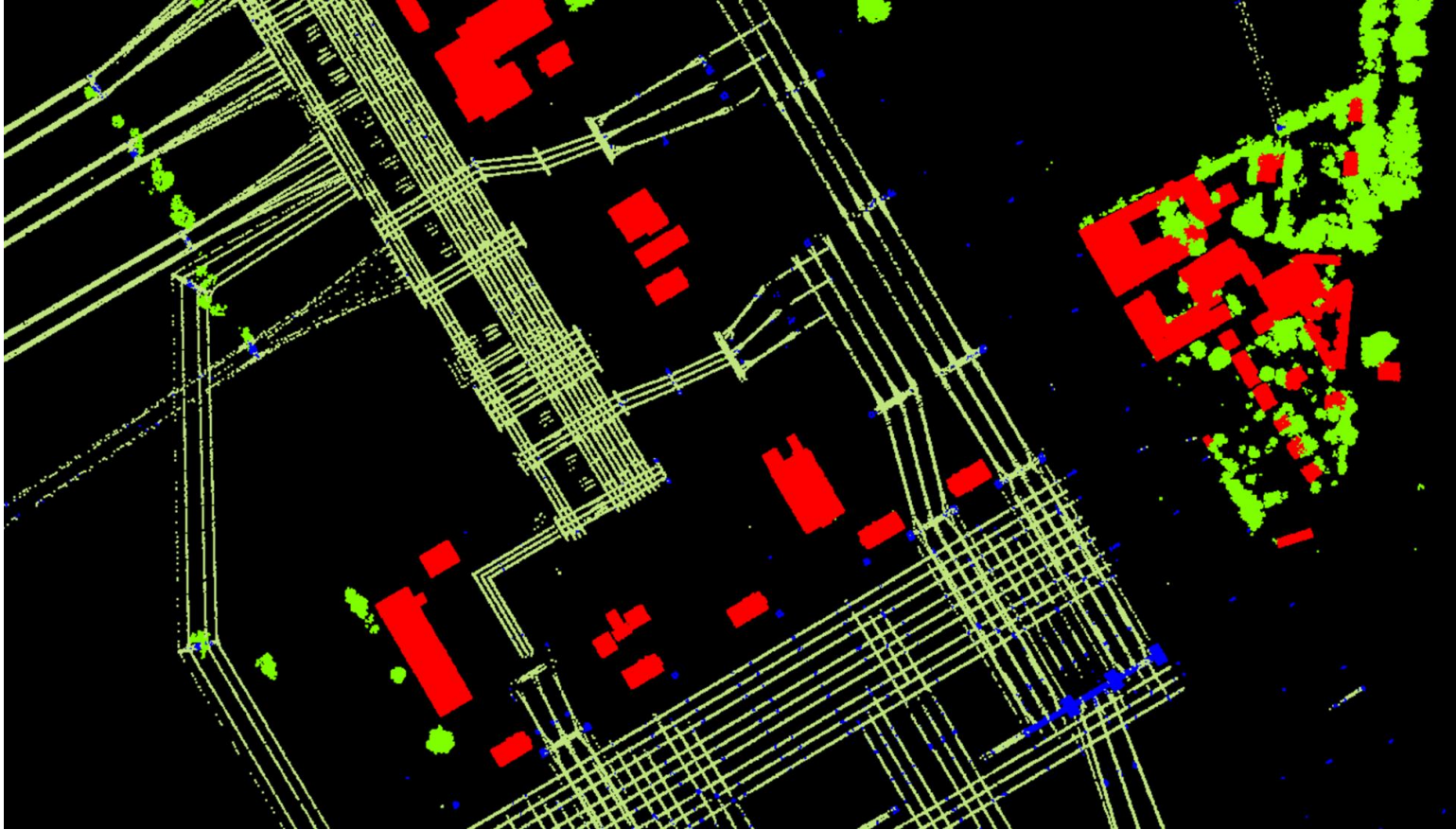
AI in Airborne Laser Scanning

- Pilot use of „deep learning“ for detection and classification of objects in point cloud of points from ALS
- Use of deep neural networks (e.g. PointCNN, PointNet) for classification or segmentation of points in LiDAR cloud of points



An example of a classified cloud of points from the 2nd cycle of the ALS, classified using this method into categories of buildings, vegetation, and power lines from the area of the power station near Podunajské Biskupice

AI in Airborne Laser Scanning

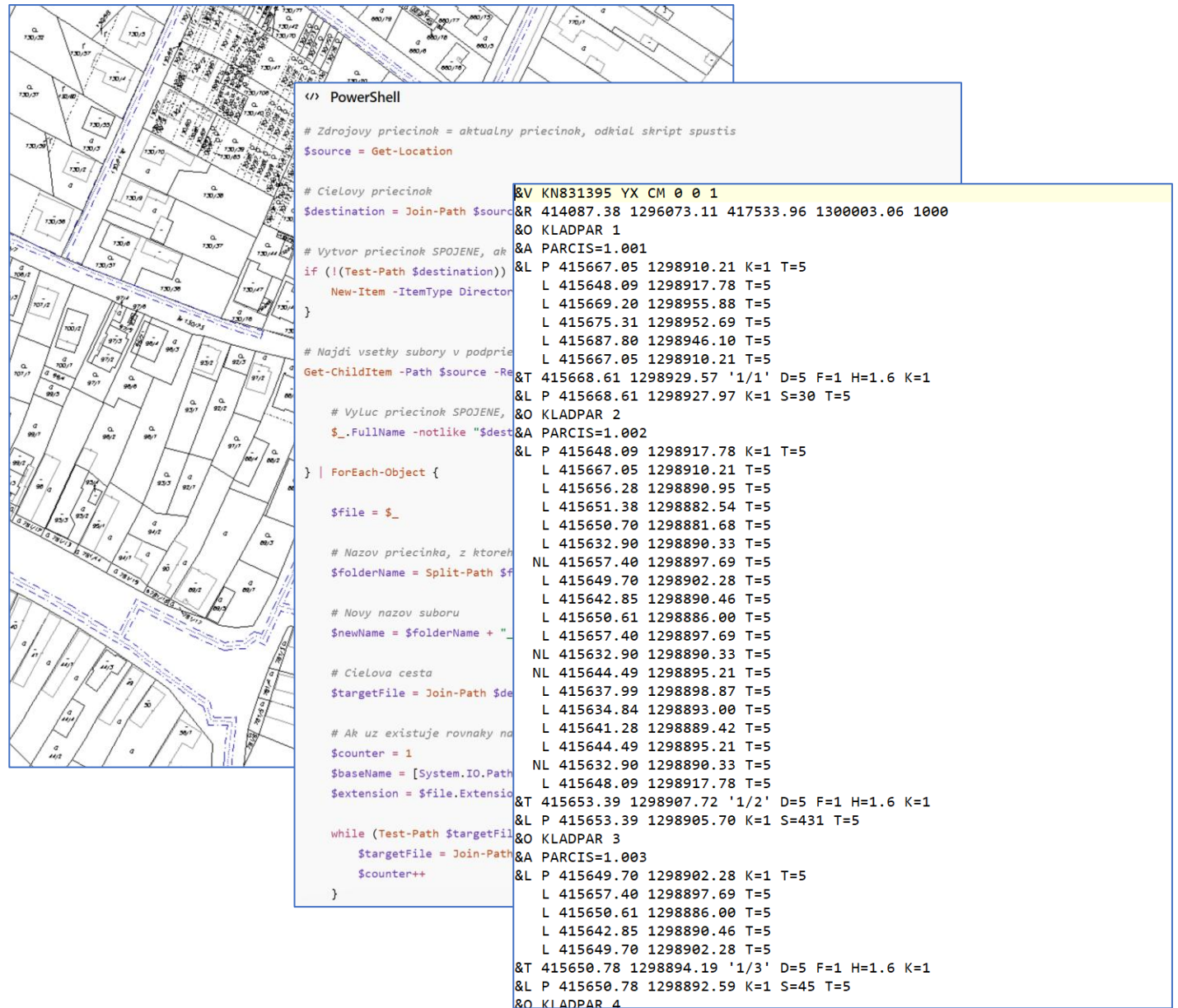


An example of a classified cloud of points from the 2nd cycle of the ALS, classified using this method into categories of buildings, vegetation, and power lines from the area of the power station near Podunajské Biskupice

- The model „learns“ to recognise objects (buildings, vegetation, power lines...) from examples where the correct answer is known, and gradually adjusts its internal parameters.
- The more precise the guidelines, the more reliable the outputs.
- The training itself is time-consuming (approx. 17 hours per epoch)

Current use of AI

- AI language models
- AI for accelerating code writing and finding solutions when creating scripts
- Analysis of maps (a map is a text file) and for generating basic statistics
- Batch processing of maps and vector data (VGP, PDF)
- AI as an excellent tool for support tasks

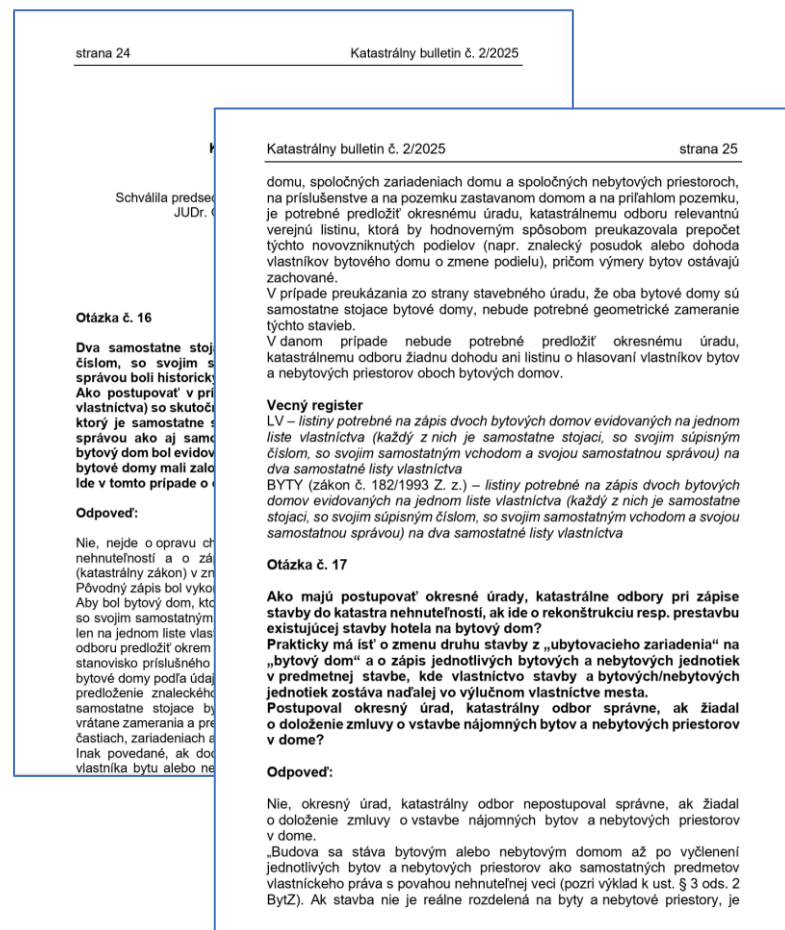


analyses, statistics, batch processing of vector data, batch processing of PDF versions of GP

Analysis and possibilities of AI use

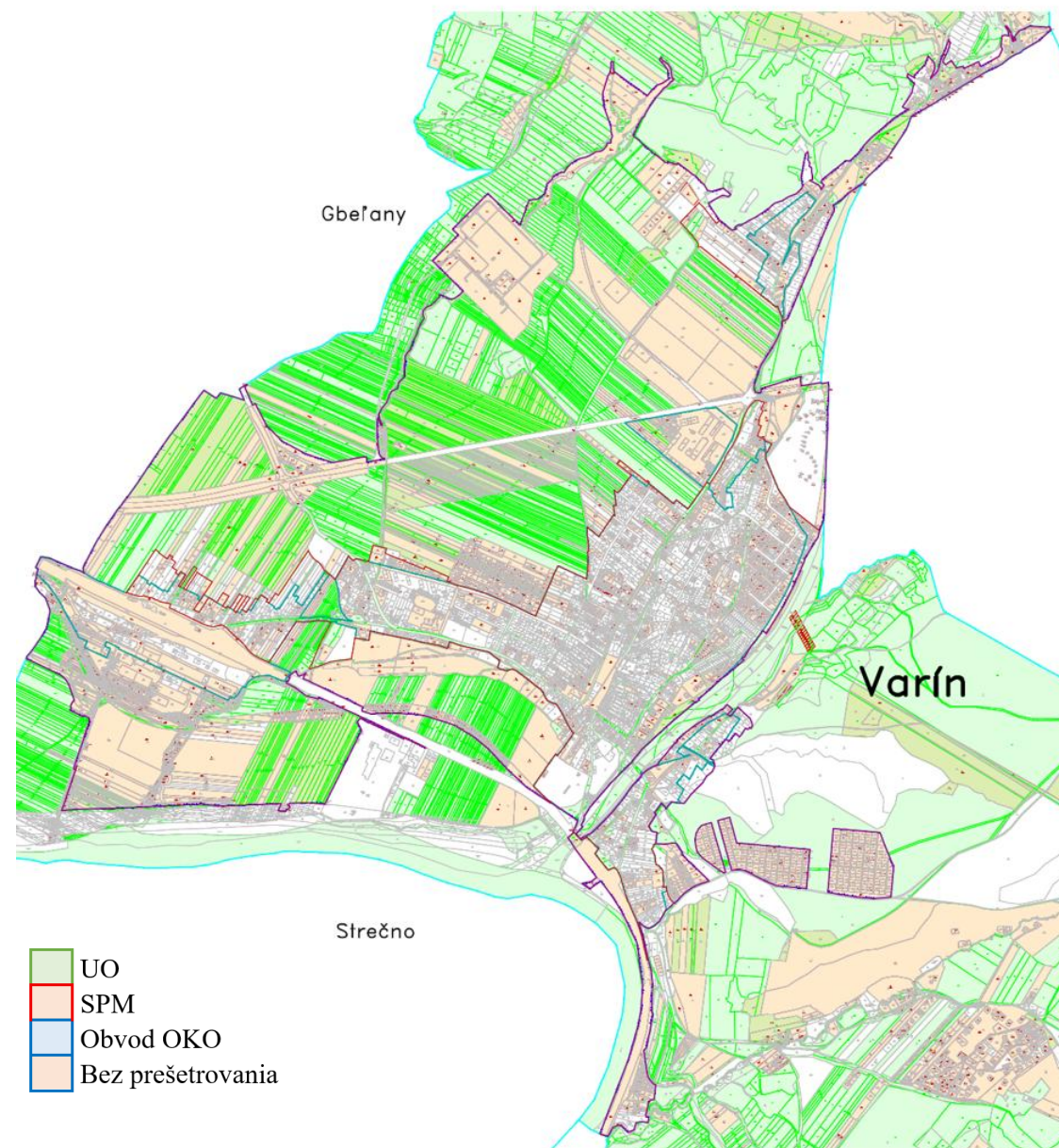
- Creation of the **knowledge base for managing descriptive data and cadastral proceedings**
- Possibilities of using AI to learn from existing GCCA documents
- Summary of methodological documents (cadastral bulletin, directives, guidelines, positions addressing professional issues in cadastral management)
- Possibilities of using AI for searching and drafting standpoints, research and texts on given topics
- **Role of the GCCA SR as a methodological leader in the field of geodesy and cartography**
- The GCCA SR provides guidance in the area of cadastral proceedings as well as technical cadastre
<https://www.skgeodesy.sk/sk/ugkk/technicke-predpisy-ine-akty-riadenia/>

Cadastral
Bulletin, years
1994 – 2025 (91
issues in total)



Improving of the cadastre – new technologies

- Extensive quality improvement of the cadastre across Slovakia through mapping using new data collection methods
- Preparation of materials for the renewal of the cadastre through new mapping
- The GCCA has modern methodological resources and is committed to improving its methodologies through the use of new technologies
- Total planned volume of approx. €15 million for 50 localities
- The goal is high-quality data, and a high-quality and homogeneous cadastre
- Easier subsequent cadastral updates, significantly strengthened certainty in the registration of property rights



Innovative data collection methods for mapping

Data collection – laser scanning and photogrammetry in mapping

- Equipment – Platforms and Sensors

- **Emesent Hovermap ST-X**

- universal: handheld, backpack, car, boat, dron
- SLAM technology
- 3-return echo
- range 0.5 – 300 m
- scanning speed 1.9 million points/s
- without GNSS, requires control points
- supplementary camera – colourisation of the cloud of points
- weight 1.7 kg
- **od 1.7. RTK korekcije z DJI Dronu**
- **by year end: RTK corrections from GNSS equipment**

- **Microdrones mdLiDAR1000HR**

- Weight: 6.5 kg
- LIDAR Velodyne 16
- field of view up to 90°
- georeferencing GNSS + IMU Trimble APX-15 IMU
- 2-return echo
- flight time 25 min
- 5 Mpix - ofarbenie skenov
- horizontal and vertical accuracy of 0.04 m without control points



Innovative data collection methods for mapping

- **Equipment – Platforms and Sensors**

- **Lidaretto**

- universal: handheld, backpack, car, boat, dron
- LiDAR HESSAI – 32 channel
- 3-return echo
- range 0.5 – 300 m
- georeferencing GNSS + IMU
- supplementary camera – colourisation of the cloud of points
- weight 1.5 kg



- **DJI Mavic 3 Enterprise + RTK modul**

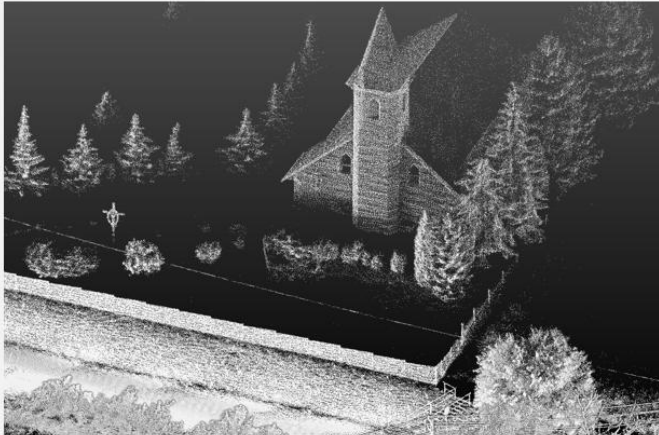
- Integrates a 20 MP wide-angle camera with a 4/3 CMOS sensor with pixel size 3.3 μm
- RTK
- pixel size 3.3 μm



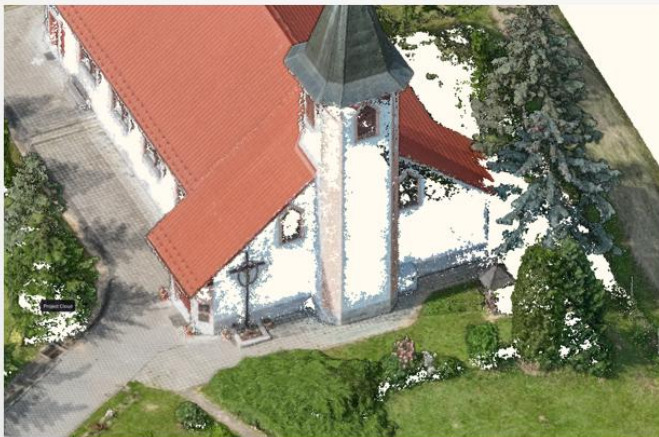
Innovative data collection methods for mapping – - a comparison of methods

Porovnanie - Kostol

STX



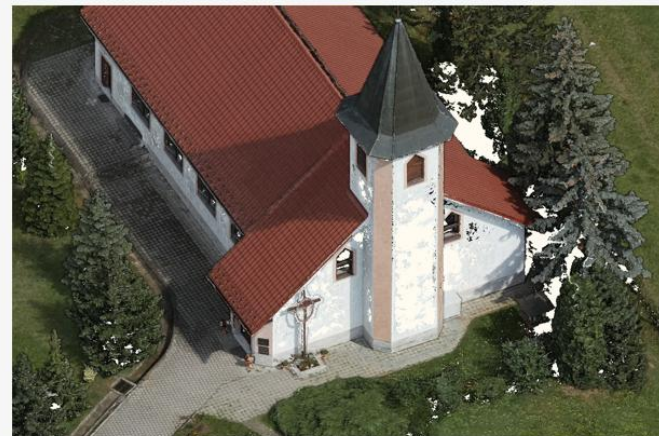
Mavic



Lidaretto



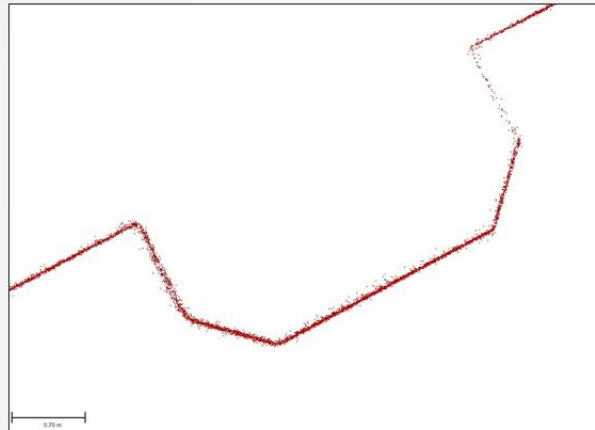
P1



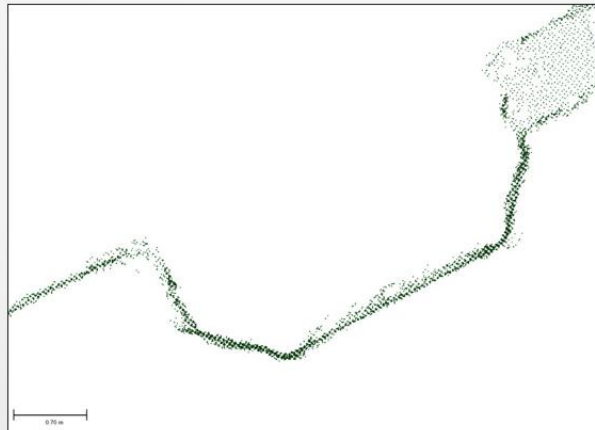
Innovative data collection methods for mapping – - a comparison

Porovnanie - Kostol

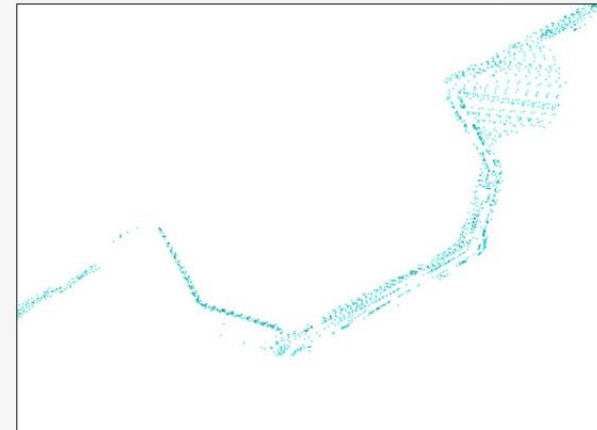
STX



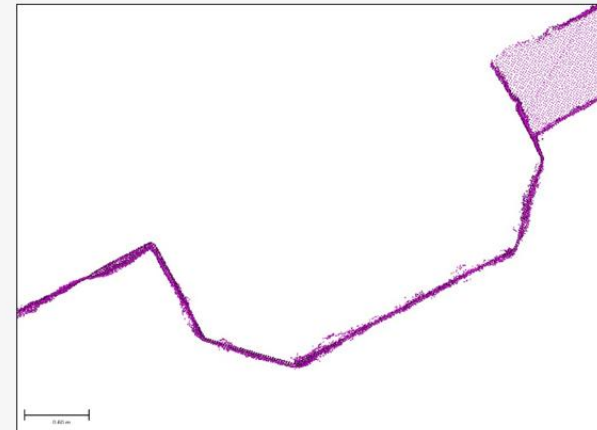
Mavic



Lidaretto

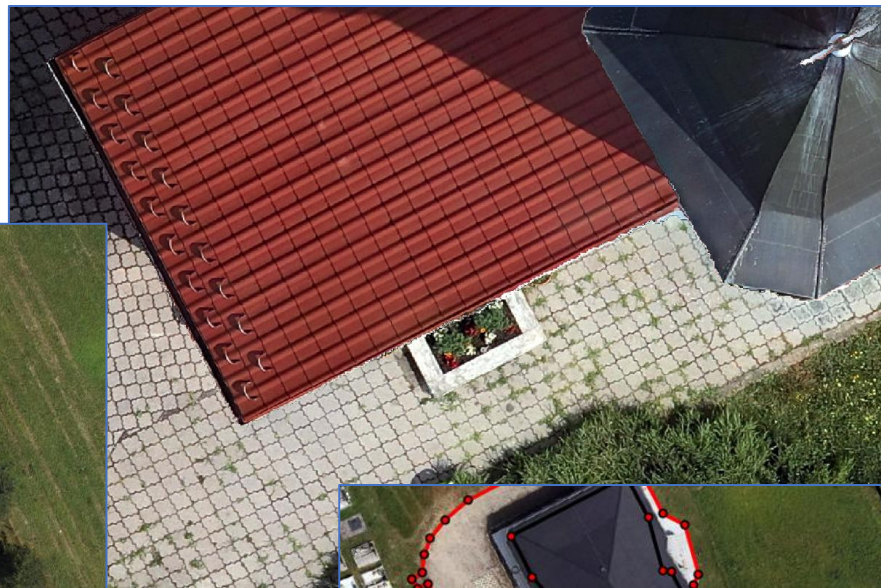
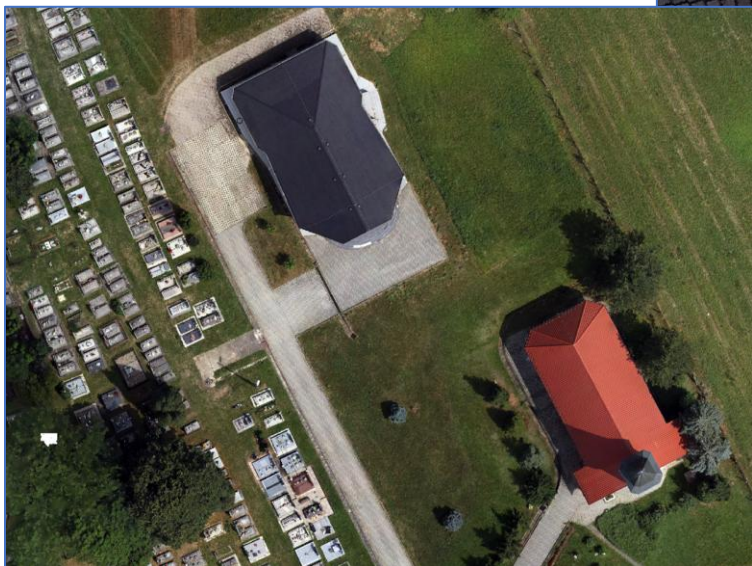


P1



Innovative data collection methods for mapping

- Orthophotomosaic

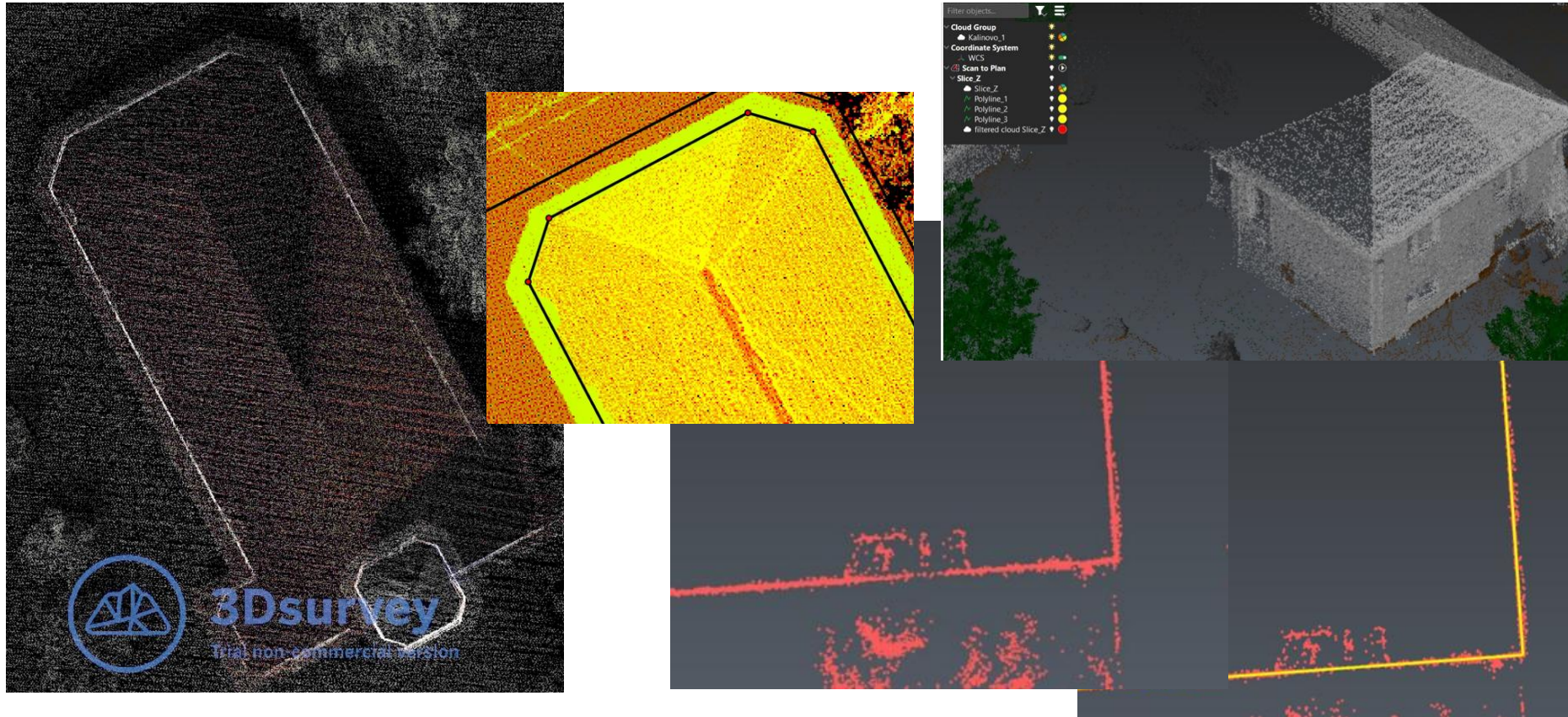


- Comparison with terrestrial mapping



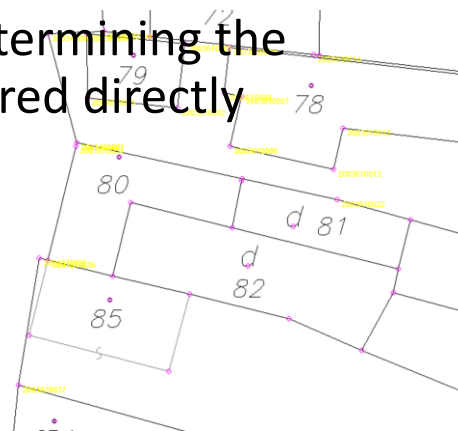
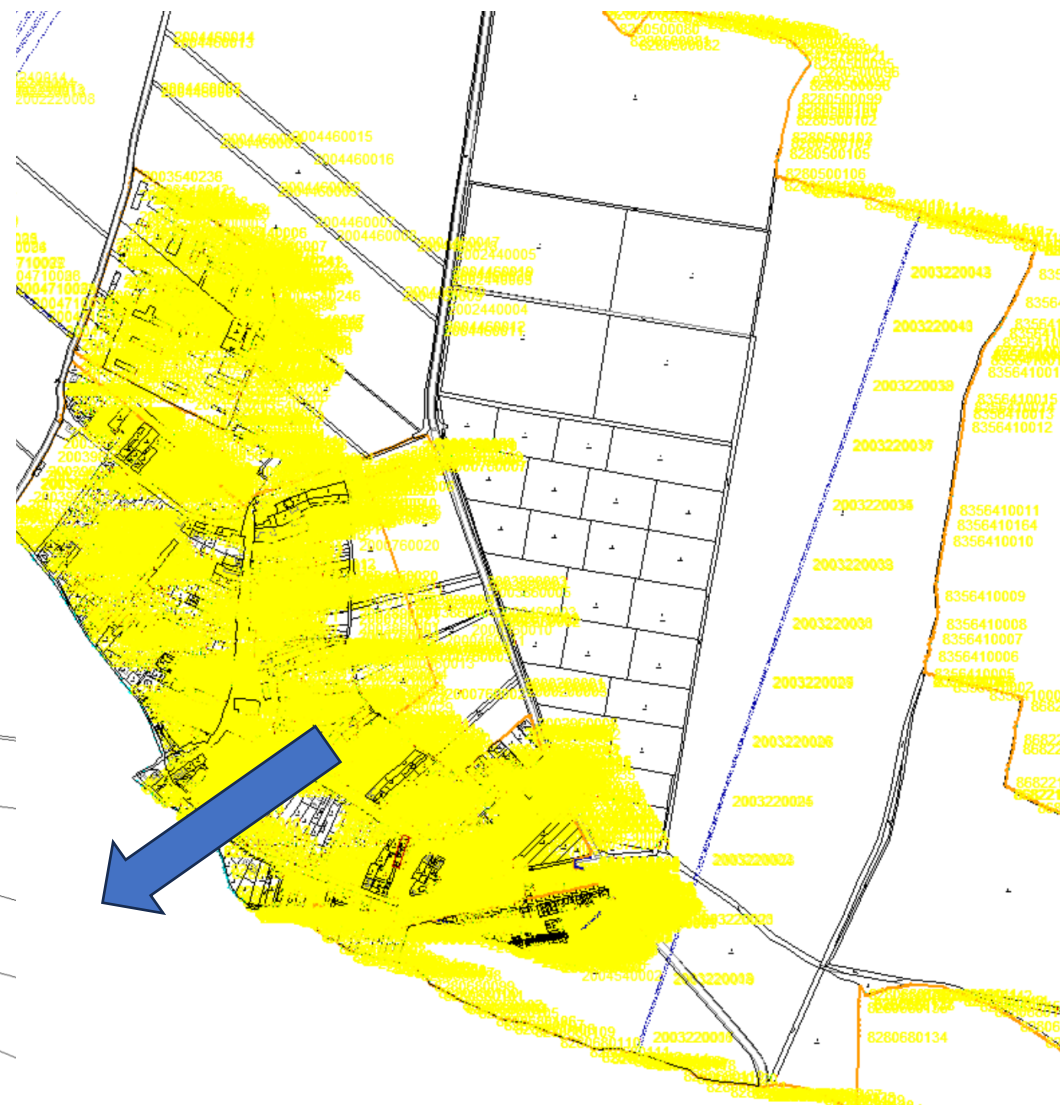
Innovative data collection methods for mapping – - analysis

- A cloud of points



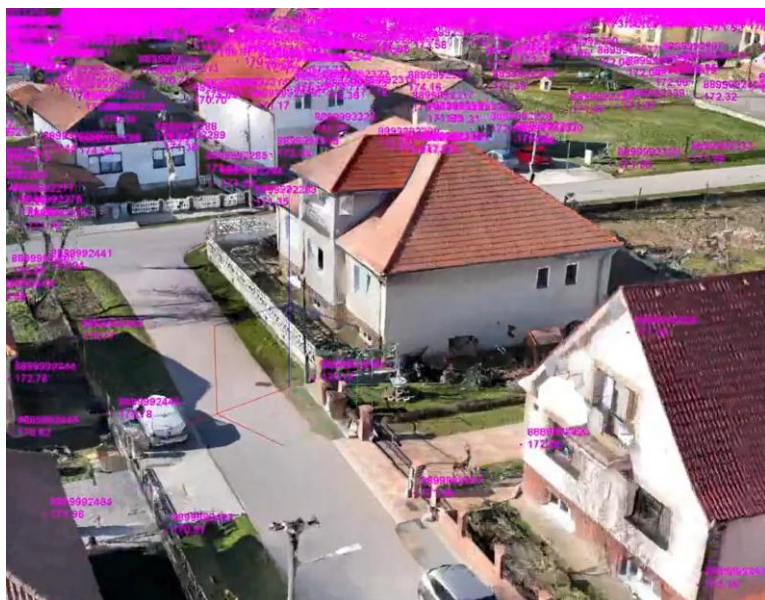
Improving of the cadastre – a new combination of technologies

- Improving the quality of cadastral records by creating cadastral maps that incorporate numerical measurement results complemented by coordinates from a 3D model
- The maps are based on original non-numerical maps complemented by existing terrestrial surveys, which can rapidly improve the map's accuracy and quality
- Approximately 30 localities per year on an ongoing basis
- Of the total of 4,265 cadastral maps, 694 have been implemented
- New method—improving accuracy by determining the positions of points that cannot be measured directly (T5) using aerial surveying



Improving of the cadastre – new technologies

- Pilot projects, DJI Mavic 3 drone used in the creation of the implemented map
- The result of the image processing was a 2D orthophoto and a 3D terrain model
- The coordinates of the matching points were obtained using the Kokeš program (2D orthophoto) and the 3D Survey program
- The map is created by combining the implemented terrestrial numerical measurement results from standard GP surveys with coordinates derived from the model (only for points that were not directly measured)
- A new method for locations where mapping is not possible for some reason



Example of identification, evaluation and determination of point coordinates
in the national coordinate system

The cyberattack in January 2025 – Where do we stand one year later?

- Gradual renewal of services following a cyberattack
 - Taking into account the technological, procedural, and application-related interdependence of the subordinate organizations of VÚGK and GKÚ with GCCA SR
- All organizations share a single network infrastructure, data centre, domain, and application software within the site
- As part of the system renewal – security measures implemented – the infrastructure meets the requirements and enables the operation of the ÚGKK's information systems and services in a secure and sustainable way
- Architecture of the infrastructure based on principles
 - defense in depth
 - zero-trust
 - microsegmentation
 - comprehensive protection of workstations and servers
 - comprehensive network protection and access control to external segments
 - secure infrastructure management
 - secure Active Directory implementation
 - comprehensive backup

Changes in components

- Network infrastructure
- Software architecture
- Endpoint security
- Security monitoring



The GCCA SR development activities

Recovery and Resilience Plan – Component 17 “Digital Slovakia”

- Implementation of an eGovernment solution covering 16 complex real-life situations for EU citizens and businesses



Project - Developing real-life situations for the GCCA SR

Goal - improving services and integrating them, particularly into real-life situations



The GCCA SR is implementing 3 Life Situations

ŽS2 – purchasing and owning of residential property



ŽS6 – Moving



ŽS15 – Registration of marriage



Zazmluvnená výška prostriedkov mechanizmu

1 944 776, 84 € s DPH

 **Financované
Európskou úniou**
NextGenerationEU



MINISTERSTVO
INVESTÍCIÍ, REGIONÁLNEHO ROZVOJ
A INFORMATIZÁCIE
SLOVENSKEJ REPUBLIKY

- Portal upgrade in IDSK 3.0
- Citizen's private zone (eID login)



- Unified data exchange infrastructure
- Connection to central government components: CPDI, ÚPVS, CNM, KAV



- Support for submissions from the DSKN portal

[Získať zmluvu a zápisník](#)
[Prílohy \(PDF a JPG\)](#)
[Získať súbor dokumentu](#)

Zoznam el. zásielok pre eSchránky

[Prílohy novú el. zásielku](#)
[Prílohy novú PDF a JPG](#)
[Získať súbor dokumentu](#)

Filter

Číslo konverzného... Názov el. zásielky Stav Vyhľadanie od Oblasť od Doručenie od

El. el. zásielky OPA a ZPMS Typ dokumentu Vyhľadanie do Oblasť do Doručenie do

Q Získať el. zásielku Q Získať filter Rozšírené filtrovanie

Prílohy el. zásielok

Základ > zmluvy

Číslo konverzného	Názov el. zásielky	Stav	Vyhľadanie	Oblasť	Doručenie	Typ dokumentu	Akcie
V-12305	Isar el. zápisník 10052	Ukončená	28.05.2020 12:47:28	28.05.2020 10:37:52		Rozhodnutie	↶ ↷ ↻
R-330205	Odpoveď na pod... U	Ukončená	08.05.2020 12:51:46	08.05.2020 12:56:53		Rozhodnutie	↶ ↷ ↻
V-952055	Odpoveď na pod... U	Ukončená	29.04.2020 14:39:40	29.04.2020 15:02:22		Rozhodnutie	↶ ↷ ↻
V-123055	Odpoveď na pod... V	Všetchny	28.04.2020 14:54:31			Rozhodnutie	↶ ↷ ↻

- For citizens

- Electronic proposal for registration without visiting the office in the IDSK 3.0 design
- Pre-filled forms – the “once-only” principle based on data from reference registries
- Overview of properties and proceedings in the personal area
- Proactive notifications about the status of submissions
- Getting feedback



- For GCCA SR

- A unified integration platform for all the resort's information systems
 - A single point of access for providing data to other public administration bodies
 - Connection to reference registers (RFO, RPO, government components
 - Service monitoring
 - Higher security and reliability of the solution
 - Basis for future development (ISKN 2.0)
- 



Planned delivery date: Q2/2026

Development Strategy until 2040



- 1) Transformation of Cadastral Systems - ISKN 2.0
- 2) Updating of the cadastre through new mapping and optimizing the processing of vector cadastral maps
- 3) The Development of the ZDPM SR (Basic Digital Terrain Model of the Slovak Republic)
- 4) Digitalization of documents and GP

Transformation of Cadastral Systems - ISKN 2.0

Key Activities



- Agregation of data from 75 cadastral offices
 - creation of a central aggregated database at the GCCA SR
- Development of a new central information system
 - single database
 - electronic processing of submissions
- Security enhancing
 - new safety standards
 - protection against cyber threats

Expected outcomes



- Central Cadastral Information System with a Unified Database
 - Elimination of data fragmentation, improvement of data quality
- Real-time online services
 - Up-to-date information for citizens, business owners, surveyors, and public administration bodies
- Process Automation
 - Faster processing of proceedings, less systems for employees
- The basis for modern e-services and support for the „once and done" Principle
- higher reliability and security of the cadastral information system

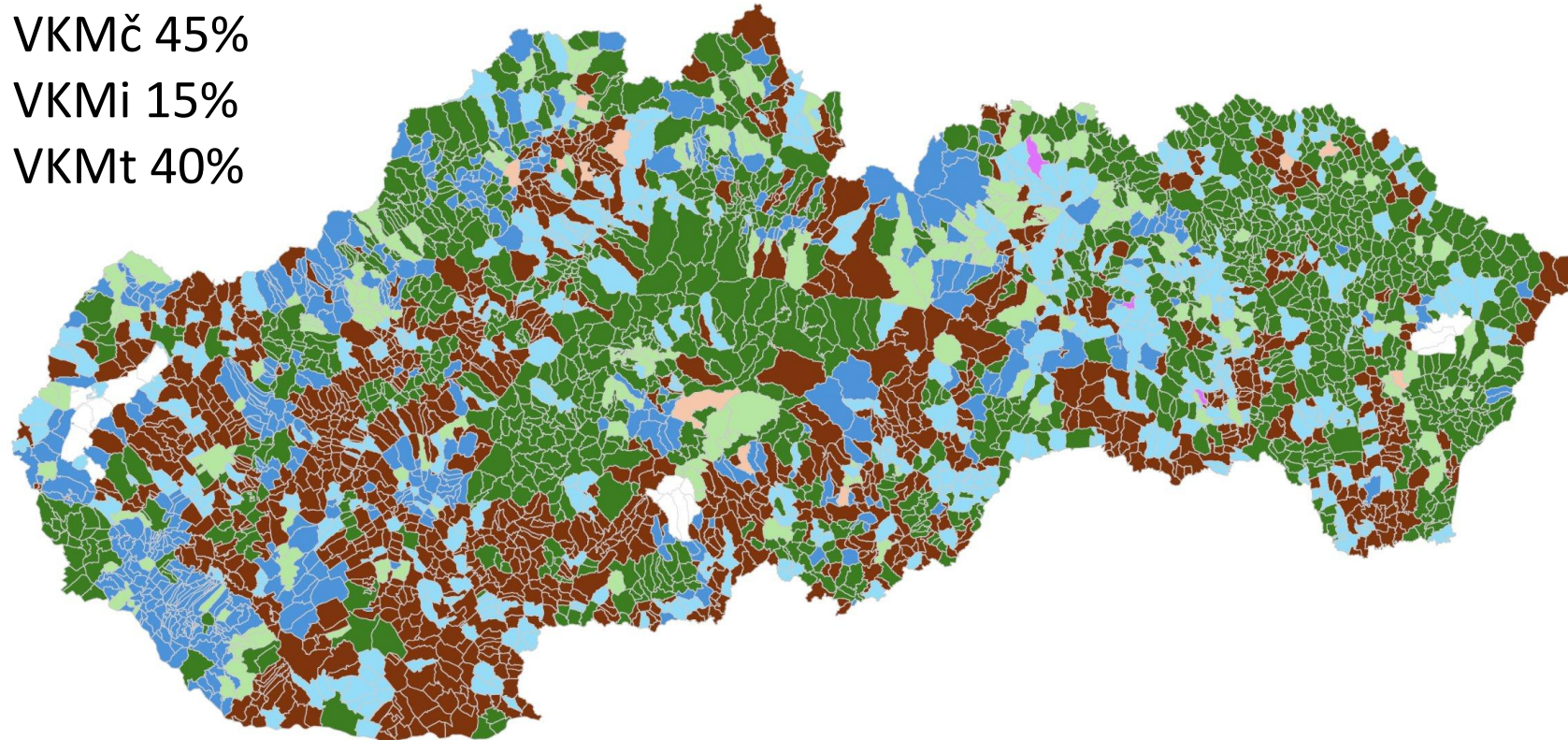
Planned project kick-off - Q1/2027

Planned completion of the project - Q4/2029

Updating of the cadastre through new mapping and optimizing the processing of vector cadastral maps

- VKMč 45%
- VKMi 15%
- VKMt 40%

- Creation of new VKM – photogrammetry, laser scanning
- Integration with national registries
- INSPIRE



■ len VKMč
■ len VKMi
■ len VKMt

■ VKMč, VKMi
■ VKMč, VKMt
■ VKMi, VKMt

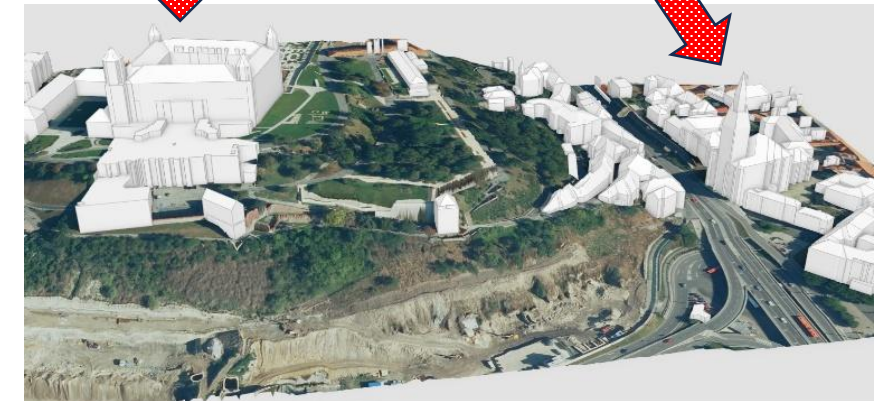
■ VKMč, VKMt, VKMi
□ vojenský obvod

The development of the ZDPM SR (Basic Digital Terrain Model of the Slovak Republic)

- LOD2 – Priority: Regional cities
- ZDPM SR integration into **ZBGIS®**
- Land-use planning, building permits, nature protection, power engineering, monitoring of agricultural grants
- Online updates by surveyors (post-construction surveying)
- The Core of the "Digital Twin of the Territory,,
- EU standards: INSPIRE, Green Deal, High-level datasets



LoD 1

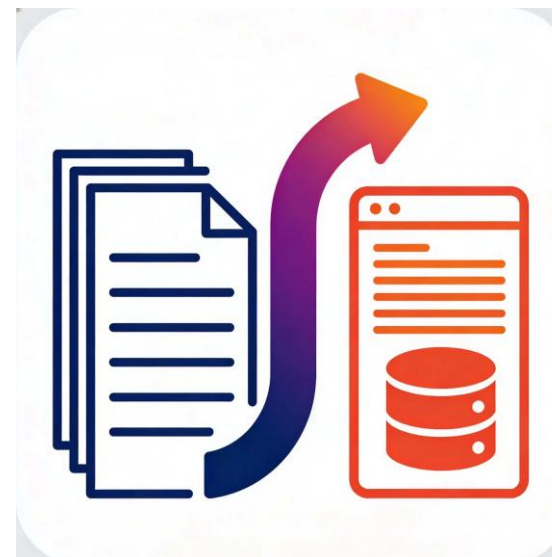
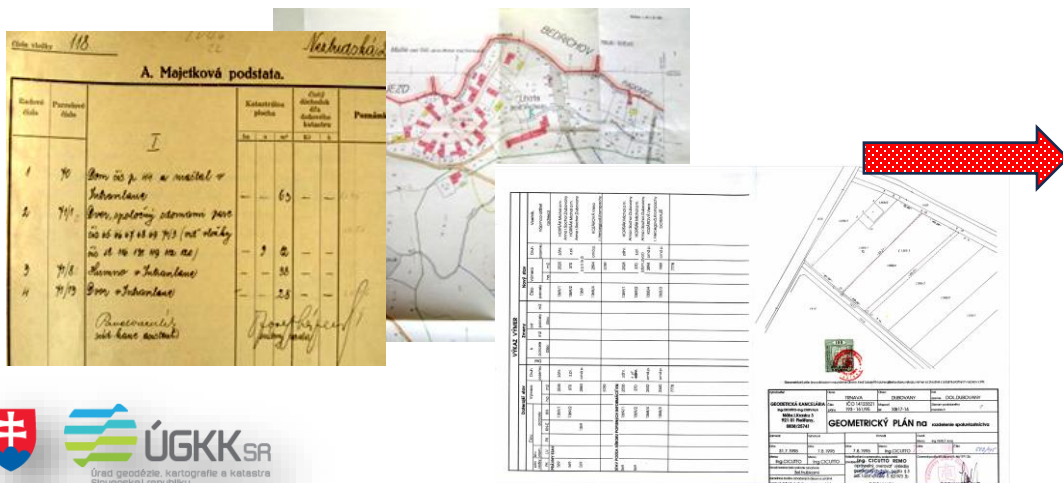


LoD 2 – the shape of the building, with an accent on the shape of the roof



Digitalization of documents and GP

- Cadastre – collection of deeds, ownership documents, geometric plans (GP)
- Collections of the Central Archive of Geodesy and Cartography
- Automated search
- Electronic access – electronic services
- Remote access for authorized entities
- GP – digitalization and georeferencing



Thank you for your attention

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martina.behuliakova@skgeodesy.sk