

CARTOGRAPHY IN HUNGARY 2015–2019

**Prepared by the
Hungarian National Committee (HNC) of ICA
edited by**

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Thanks for all contributors

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1. National (government) topographic and cadastral mapping in Hungary

National mapping (civilian): Lechner Knowledge Centre

Lechner Knowledge Centre – systems and applications

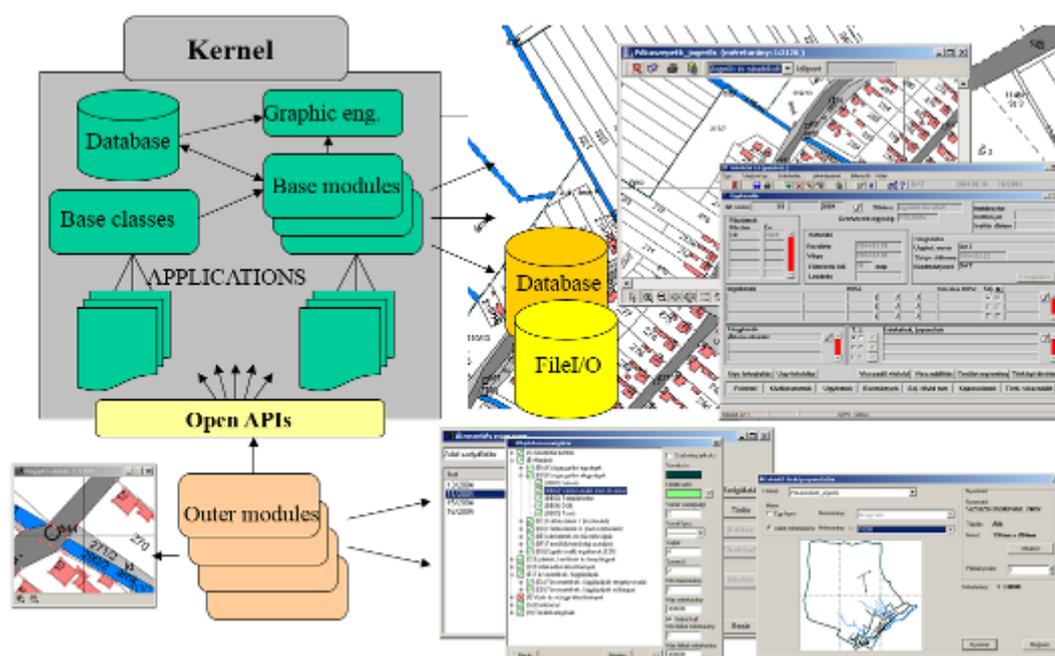
On the 1st of April, 2019 two prestigious and well-known Hungarian institutes were integrated: Government Office of the Capital City Budapest Department of Geodesy Remote Sensing and Land Offices – former Institute of Geodesy Cartography and Remote Sensing (FÖMI) – and Lechner Knowledge Centre.

The professionals of this new Lechner Knowledge Centre (LTK) have a very wide-ranging experience in the field of cadastre, remote sensing and GIS, furthermore several architectural surveys.

In our Institute, one of the first established system was the **Land Registry**. Hungarian Land Administration has an old tradition: the Cadastre-Land Registry was established in the Austro-Hungarian Monarchy, in the mid-19th century. Till the beginning of the Second World War all the land of the country were surveyed and registered. Management of Cadastre-Land Registry was continuous even in the times of socialism.

In 1972 the *Unified Hungarian Land Registry* was established. Furthermore, Cadastral Mapping and Land Registry was transferred under the authority of Land Office Network. The Institute of Geodesy, Cartography and Remote Sensing (FÖMI, our former institute) became the overall responsible of research and development, maintenance and data service.

In the mid-1990s important *IT developments on Land Administration* started. First, the legal part of the Unified Land Registry was developed (TAKAROS), then Network of Land Administration Sector (TAKARNET) and its services. In 2009 a new integrated IT system, DATR (both the legal and cadastral part) was set up.



DATR – Integrated IT system for Land Administration

TAKARNET is a restricted computer network providing computerized connections of Land Administration organizations and enabling outside users (e.g. Public Administration, Local Governments, Notaries, Lawyers, and Banks) for remote data access to Land Registry, Cadastral Map and Land Leaser Database.

Users can exclusively access to the approved network services via digital security gates. Outside users has been able to connect to TAKARNET Services since April 2003.

Today more than 9000 outside users enlist TAKARNET Services operatively. They can have access to the following services:

- Non-authentic Copy of Land Record as electronic document
- Electronically authenticated copy of Land Record as electronic document
- Electronically authenticated copy of Cadastral Map as electronic document
- Message (SMS or e-mail) about the change of a Land Record
- Electronically authenticated copy of Land Lease Sheet as electronic document

Within the frame of the TAKARNET24 project, the new electronic data service of Land Administration “FÖLDHIVATAL ONLINE” was established by 2011. Users can get authentic information about Land Registry Data and its data-changes, anytime and anywhere via Governmental Portal’s Central Clients Gate. Users need a registration at Central Clients Gate.



Lechner Knowledge Centre is responsible for the development, operation and the IT system support of District Offices, which includes Land, Cadastre and Agricultural authoritative tasks as well. All the Hungarian land records are computerized and available digitally. Lechner Knowledge Centre continuously develops the IT Systems of Unified Land Registry, Farmer-and Land Lease Register, also manages the nation-wide processing of Land Administration Data, the development and operation of Land Information Systems and data warehouses, the provision of connections and continuous data-exchange with other IT systems. Lechner Knowledge Centre is responsible for storing, managing and serving the State Base Data (Land Registry, Land Lease Registry, and Farmer's Registry).

To continue the development of the Land Administration, a new project is being launched, the **E-property registry**.

The objective of the E-property registry project is to reduce the lead time and cost levels of land administration (property registry, plot formation, property transaction, land protection) procedures in Hungary, thereby alleviating administrative burdens to further increase the competitiveness of the domestic economy.

As a solution to issues arising from land and property management procedures, the development activities of the E-property registry project allow for the establishment of a modern ICT-based (database management, procedures support, automatization, GIS, etc.) electronic registry system that enables the management of great amounts of data as well as the up-to-date tracking of data changes, thereby supporting the online management of land administration procedures.

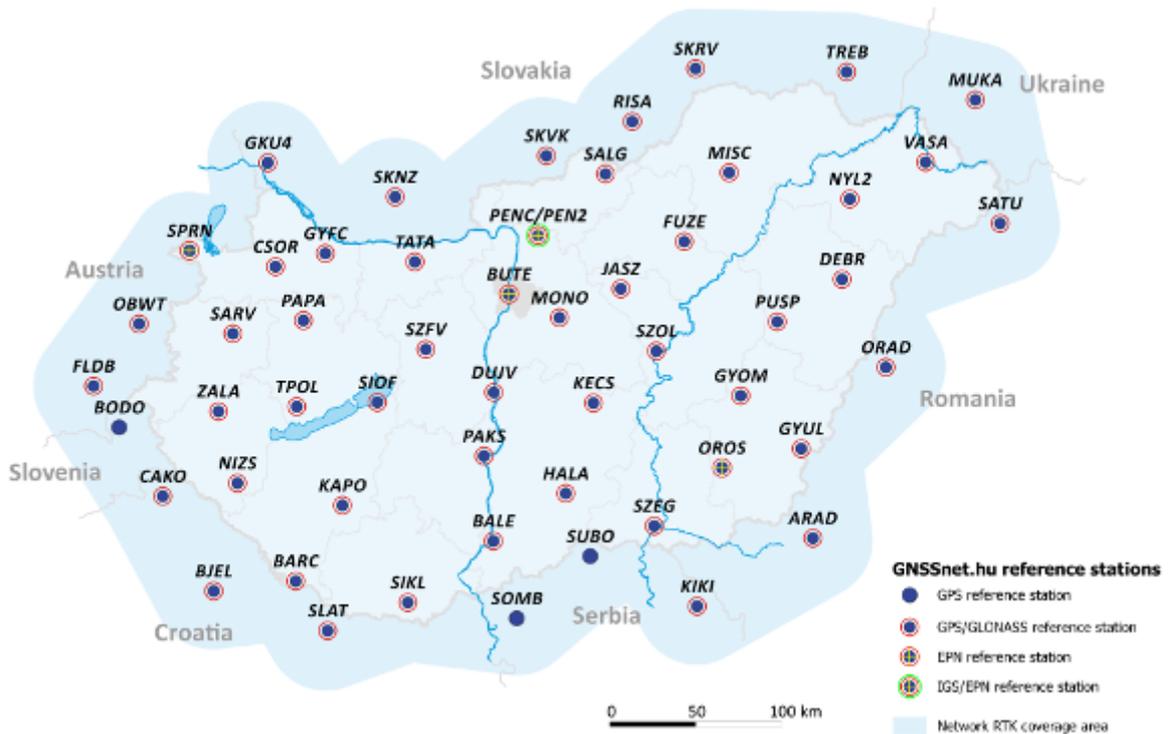
The project would achieve the introduction of client-oriented electronic land administration services, leading to the creation and widespread introduction of new e-solutions and communication channels, while expanding electronic administration and contact opportunities for public administration clients. One of our specific objectives is the electronic reorganization of the internal processes relating to land administrative procedures, involving the creation of new specialized system functions and the development of procedure orders that provide a more

effective workflow support for the execution of internal, background operations and the reduction of their lead time. Furthermore, the development would produce a rationalized regulatory environment, resulting in the uniform management of the public property registry and the establishment of a centralized property registry.

Reliable and precise maps and database cannot be produced without highly accurate, robust positioning system. Lechner Knowledge Centre has a Satellite Geodetic Observatory not far from Budapest.

The **Satellite Geodetic Observatory** (SGO) is operating the **GNSS Service Centre**, which is responsible for the maintenance of the Hungarian GNSS reference station infrastructure (GNSSnet.hu) and the related services. GNSSnet.hu consists of 35 Hungarian GNSS reference stations extended with 19 stations from the neighbouring countries in order to ensure the homogeneous service coverage within Hungary.

At all Hungarian stations GPS+GLONASS equipment are installed and 7 units track the Galileo signals as well. The average distance between the stations is some 60 kilometres. One Hz rate observation data is collected, verified and processed in real time. The Geo++ GNSMART software estimate and model the distance-dependent errors like ionosphere, troposphere and orbits by network processing and provide real-time networked corrections with homogeneous nationwide coverage. Using the network corrections the users can get centimetre accuracy positions in real-time anywhere in the country.



The Hungarian Active GNSS Network – GNSSnet.hu

The service is commercial and fulfils all users' demands in terms of data types, pricing models and special requests. In 2018 the number of users exceeded 2400. Most of the users are surveyors but the increasing of other application areas like precision agriculture, forestry, and water management

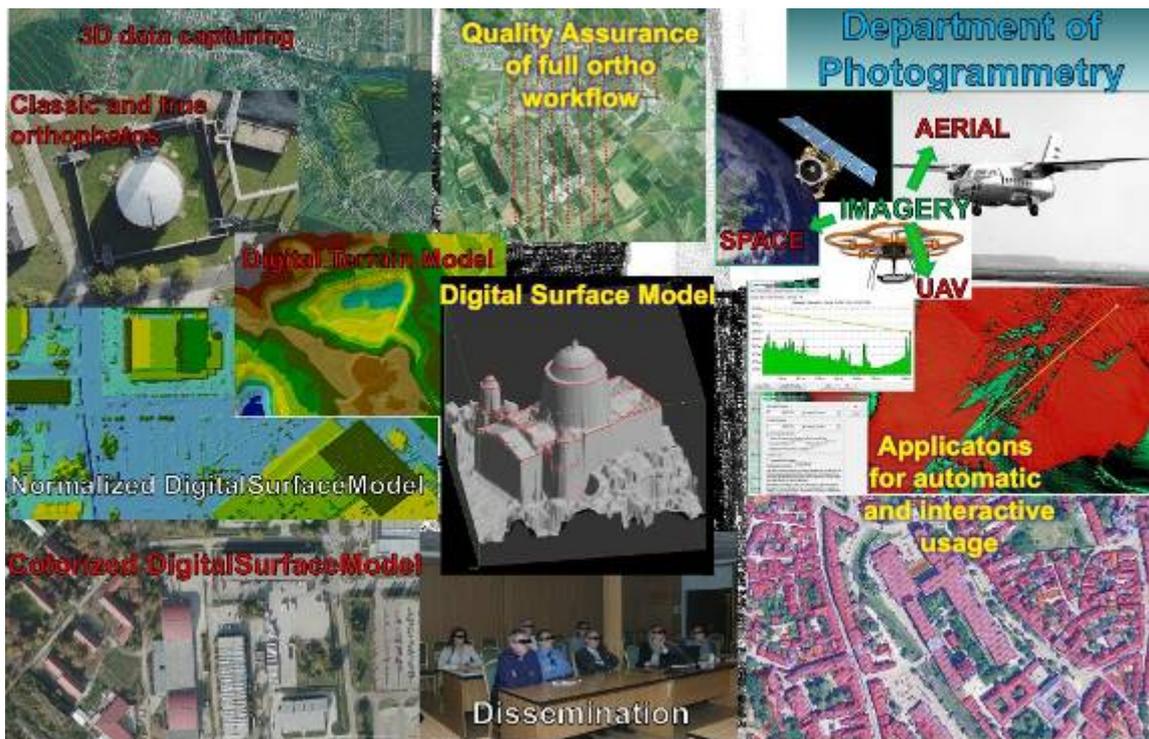
are seen. The government plans the support of the precision agriculture users with free access of our correction service.

Lechner Knowledge Centre has many experiences gained not only on the area measurements but also on three-dimensional surface and building models produced by **photogrammetric techniques**.

We have developed the state acceptance procedure of aerial remote sensing data and geospatial products such as *orthoimagery*. Based on these, several rules are enforced during the aerial mapping campaigns to ensure the quality of the products involved (The orthoimage production process is constantly monitored from flight planning to the final orthophoto product. In each phase of the production various quality checks are carried out to ensure that professional standards are kept.) Quality guaranteed by the State this way and also provides special legal environment regarding data usage for further governmental institutions and the public sector.



Lechner Knowledge Centre produces by photogrammetric techniques and uses in many way the *Digital Terrain Model (DTM)*, *Digital Surface Model (DSM)*, normalised surface model (nDSM) and the colored surface model (cDSM) for the whole country.



LOD1 building model for the whole country



Automatic LOD2 building model preparation



Elevation data for flooding analysis,



and for special agricultural tasks.



Aerial and space-borne remote sensing data, point-clouds and special orthoimagery derived from point clouds, automatically generated LOD2 building models for cadastral data monitoring and update

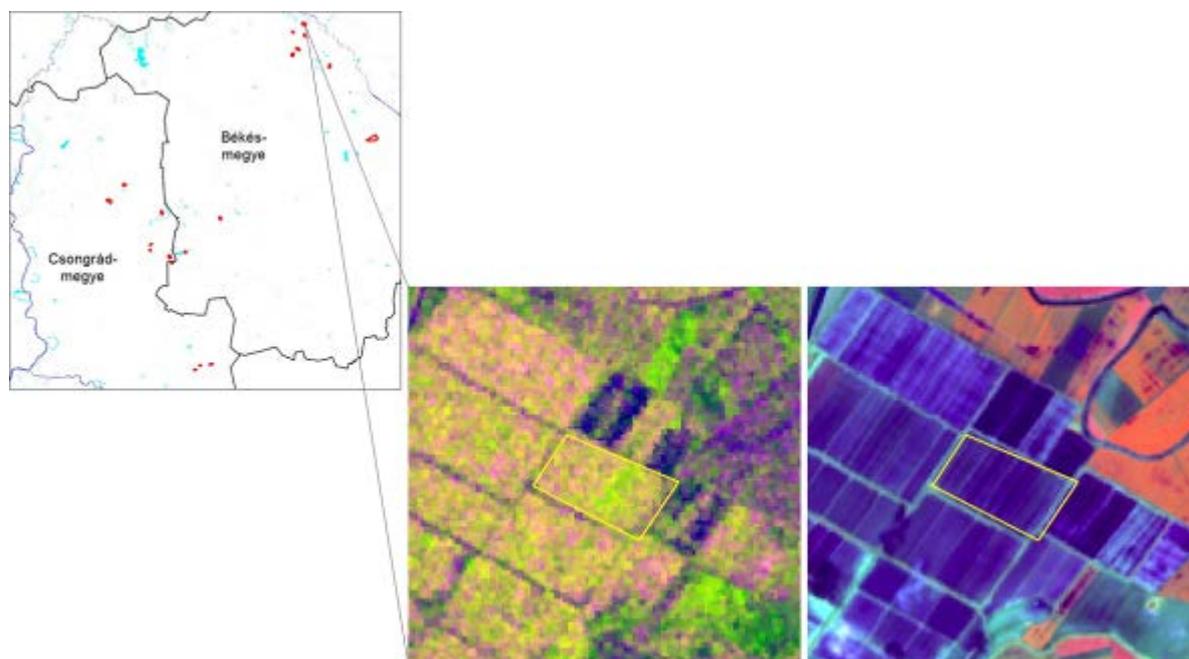
Lechner Knowledge Centre – by former FÖMI – has more than 20 years of experience with **remote sensing applications** also with optical and radar imagery concerning environmental problems like floods, drought etc.

Country-wide appearance of inland excess water, waterlogging, spring-frost damages and summer drought events collectively can affect 30-40,000 farmers in Hungary. Obviously, it is impossible to provide operational real-time ground-based observations for the assessment of loss compensation claims. Thanks to the timely and frequent availability satellite imagery from different sources, not only the affected territory becomes measurable, but the temporal evolution of the events can be monitored as well.

The objective of the ***Agricultural Risk Management System project*** was to support the setup of an information development which should meet all the requirements of a damage liability system entirely. Its accentuated aim is to level up services provided for stakeholders (individuals, enterprises, companies), to support administrative liabilities of contributors involved.

With the Agricultural Risk Management System now being operational, Lechner Knowledge Centre regularly produces thematic maps of land surfaces affected by extreme water conditions and drought, derived from satellite products. The maps are uploaded and the affected territories are available to all members: the Hungarian Paying Agency, the Research Institute of Agricultural Economics, the Hungarian Meteorological Service, the General Directorate of Water Management, and the Ministry of Rural Development. Thus, the need for on-the-spot controls decreases, official administration is reduced, and deadlines of procedures are shortened.

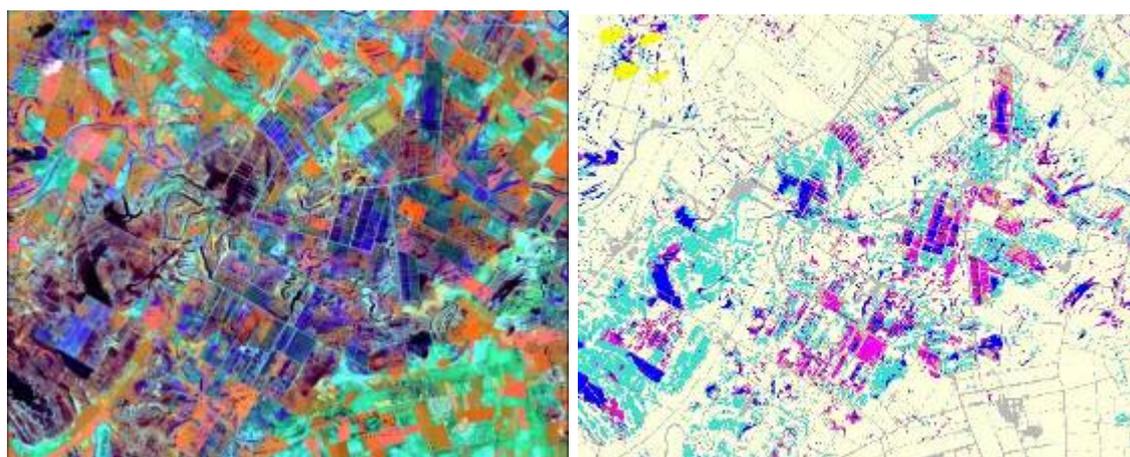
Waterlogging is operationally monitored by using optical satellite imagery (mostly Sentinel-2 and Landsat). In periods where optical images are not available, Sentinel-1 radar images are also used for the detection of open water surfaces.



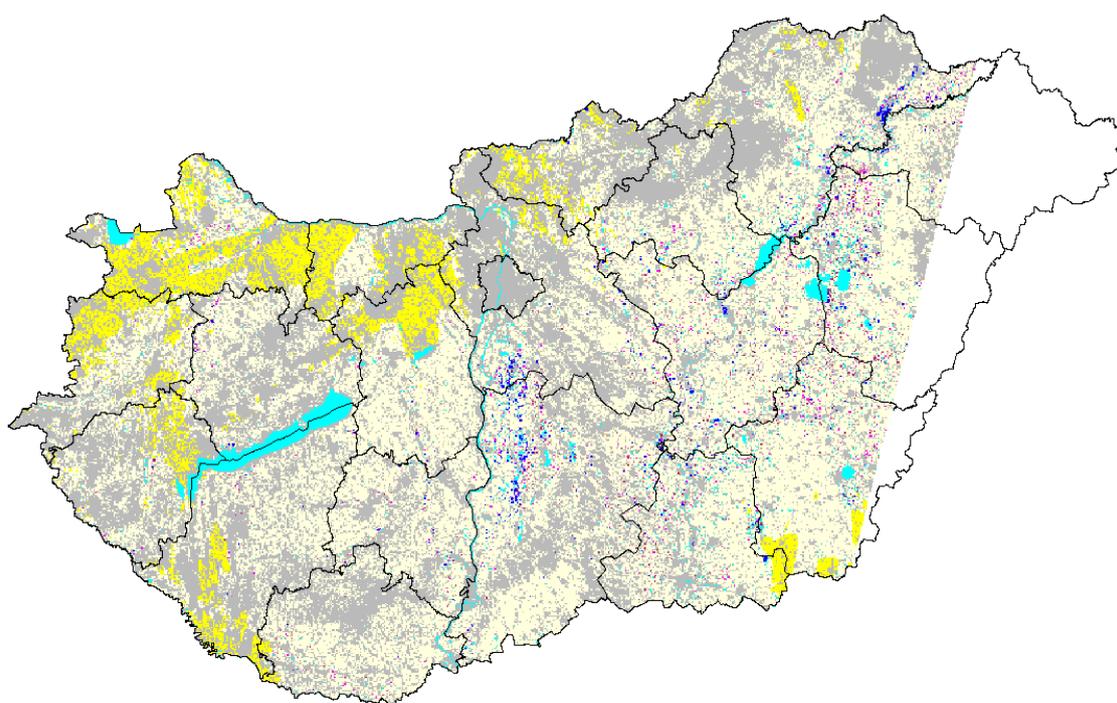
Parcel affected with waterlogging in 2018 on radar (left) and optical image (right).



On the spot checking of waterlog in 2018



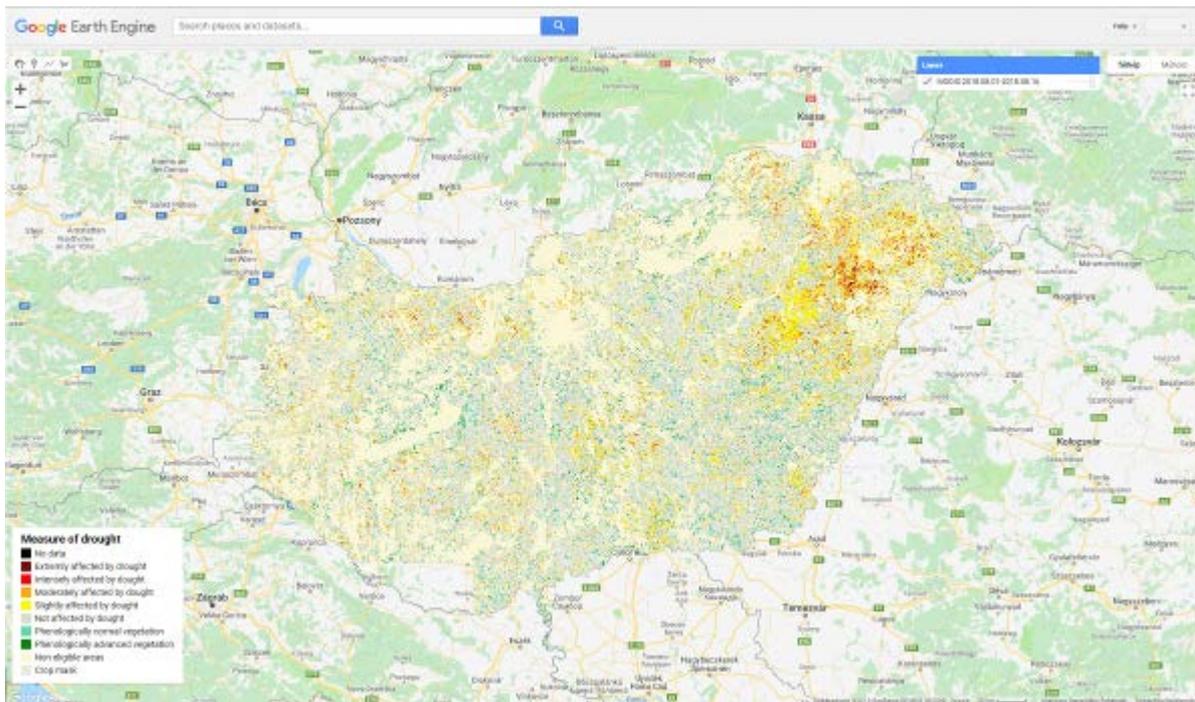
Subset of Sentinel-2 optical satellite image (left) and the generated waterlog map (right) for 02/04/2018



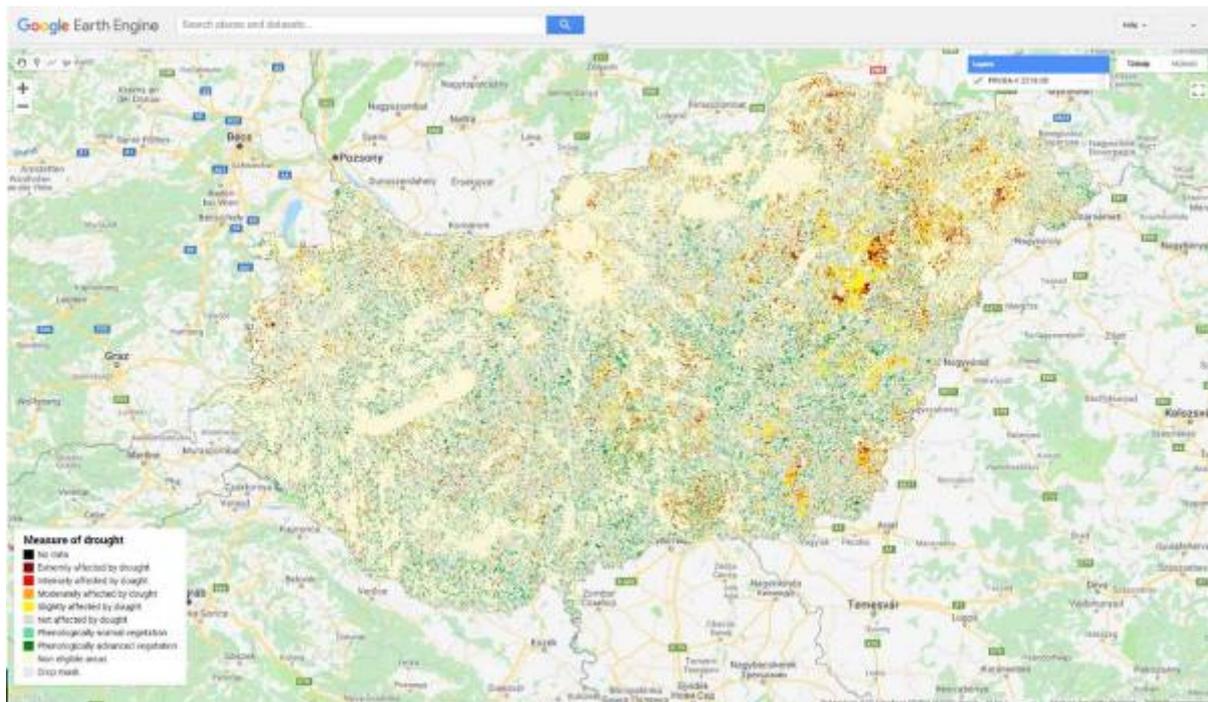
Country-wide waterlog map for 08/04/2018

The provision of quick, objective, reliable and homogenous information about ***development and impact of*** these kind of ***disasters*** is very imperative at local and regional scale. Remote sensing is an excellent tool for this purpose. We use daily MODIS imagery for the detection of anomalies in vegetation conditions, based on comparisons with archived data for pre-determined reference periods.

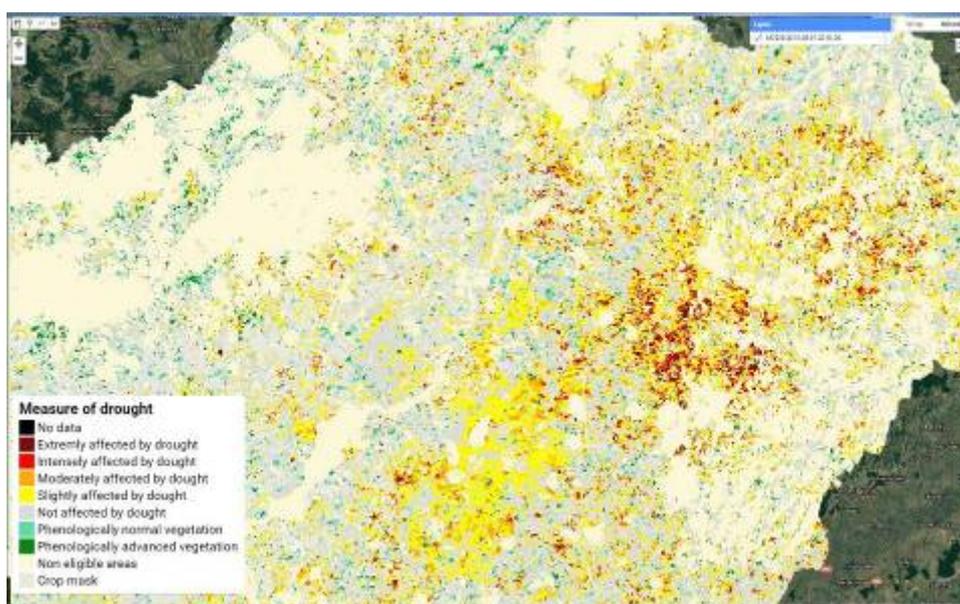
Recently, our colleagues have also implemented the **drought mapping** workflow under a cloud platform (Google Earth Engine) to speed up and enhance the process.



Drought map for the period of 01-16 August 2018



Country-wide drought map for the period of 01-16 August 2018



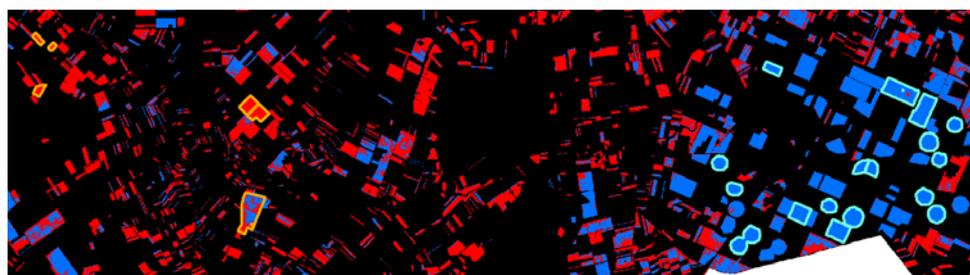
Zoom-in on the drought map for the period of 01-16 August 2018

In Hungary, the large majority of surface waters and the totality of subsurface waters is the sole property of the Hungarian State. Their exploitation and all activities leading to qualitative or quantitative changes thereof are subject to authorisation.

Lechner Knowledge Centre takes part in the *project “Development of the Agricultural Water Usage Information and Control Framework”* aimed at diminishing the administrative burdens of users by developing a fully electronic process for water usage authorization. The system will also provide actual, reliable water usage data for authorities and relevant environmental data for farmers to facilitate irrigation planning.

Our main task is the provision of authoritative geospatial data ensuring the efficient usage of the decision support system developed to facilitate irrigation planning for farmers. These data are derived from various sources including the national cadastral data base, digital elevation model, infrastructure networks and remote sensing. Lechner Knowledge Centre extends its Geoshop portal to provide a one-stop solution for irrigation investment planning offices to obtain all relevant authoritative geospatial data by a single electronic transaction.

Moreover, we are developing a methodology based on the analysis of Earth Observation to enable the separation of irrigated and non-irrigated arable parcels. Surveys based on this methodology are planned to be involved in the authoritative control of irrigation as well as in the development of future irrigation strategies.

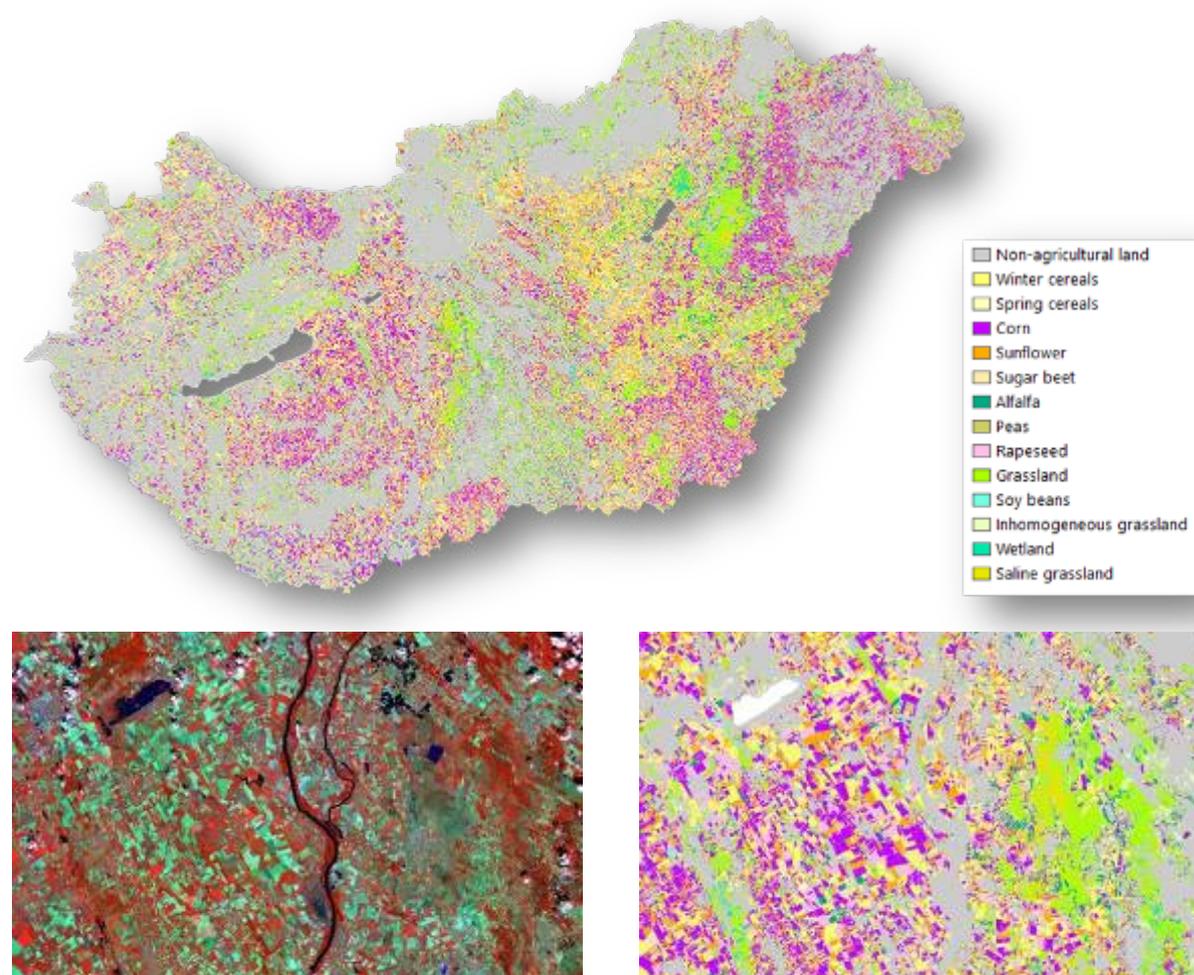


Classification results along with reference parcels at a study area in south-western Hungary.

Blue: pixels classified as “irrigated”; Cyan: irrigated reference parcels; Red: pixels classified as “non-irrigated”; Orange: non-irrigated reference parcels.

For the administration and control of agricultural subsidies received from the European Union, country-wide thematic information on permanent grasslands is required. Moreover, up-to-date information on crop types actually present on agricultural parcels is of increasing importance due to the current trends towards agricultural monitoring.

Hence, **country-wide grassland and crop type maps** are produced based on time-series of radar (Sentinel-1) and optical satellite imagery (Sentinel-2 and Landsat 8, among others). Reference data is collected and integrated from multiple relevant, up-to-date GIS data bases, and machine learning methods are used to provide thematic crop and grassland maps all over the country. An example for 2018 is shown on the figure below.



Above: Country-wide grassland and crop type map for 2018, based on machine learning applied on time-series of radar and optical satellite data and reference GIS data bases.

Below: Subset of Sentinel-2 optical image for 13/08/2018 and the resulting grassland and crop type map.

Increasing availability of frequent, high-resolution satellite imagery makes it possible to **monitor agricultural activities, deforestation and environmental phenomena** such as desertification in a highly accurate manner. This is illustrated through a simple example on the figure below, where a subset of Sentinel-2 imagery over the Binh Thuan region is shown for two dates after the wet and the dry period, respectively. Significant difference in the abundance of photosynthetic (green) vegetation can be evidently observed. Moreover, permanently dry areas, probably subject to desertification can be detected in the south-eastern corner of the image and their extent can be included in a monitoring process.

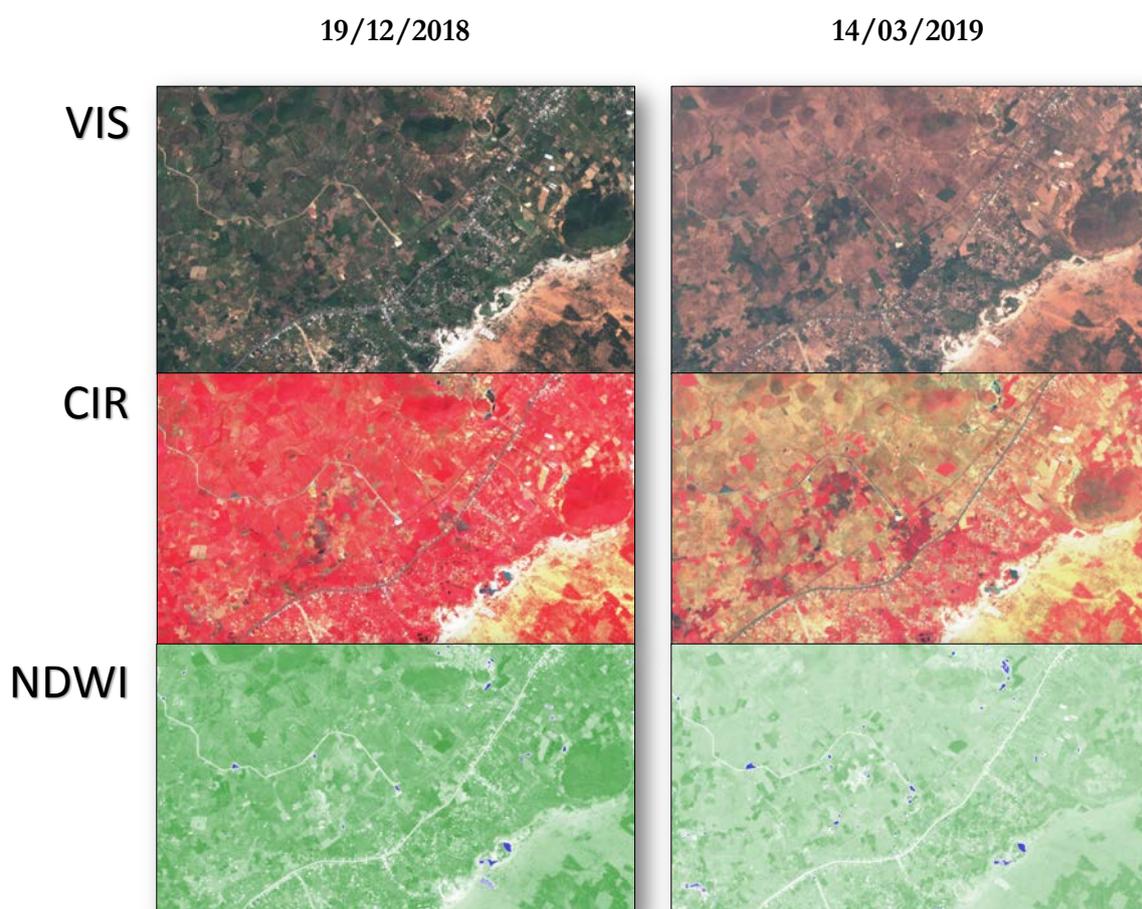


Illustration of seasonal water shortage and desertification effects on Sentinel-2 OLI images in Binb Thuan coastal region, Southern Centre area, Vietnam

Left: Abundant vegetation in December 2018 after the wet period.

Right: Lack of green vegetation at the end of the dry period in March 2019.

VIS: visible color composite

CIR: color infrared composite

NDWI: normalized difference water index

The main R&D task of Satellite Geodetic Observatory is the studying of **satellite technologies for monitoring of surface deformations** caused by either recent large scale geophysical processes or local scale anthropogenic activities (water pumping, dams).

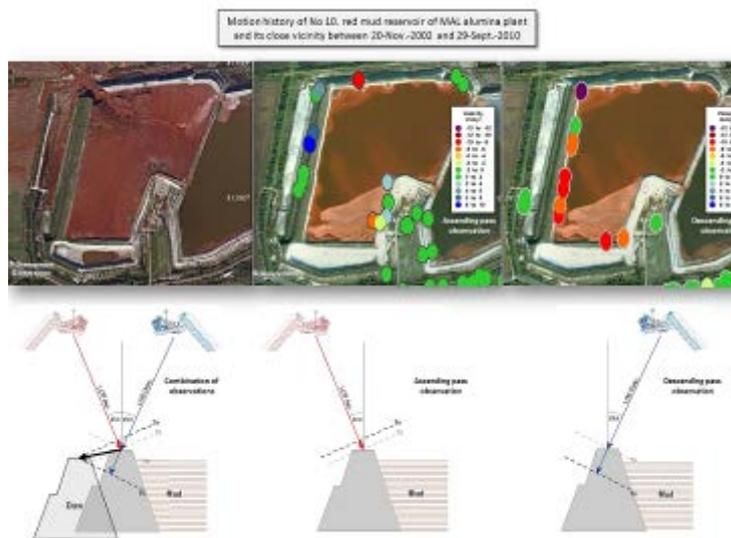
The main satellite-based tools used are (1) GNSS and (2) Synthetic Aperture Radar Interferometry (InSAR) technique.

- (1) We installed and on long term maintain a GNSS-based geokinematic network (MGGA), which is the bases of our tectonic interpretation of the geophysical processes in and around of the Pannonian basin. We also operates the EPN Densification program, which integrates all European permanent GNSS networks and delivers a homogeneous velocity field for the European continent and help us to extend our geophysical knowledge.
- (2) Our InSAR research is based on Permanent Scatterer Interferometry (PSI), where we use the professional GAMMA software and the freely available ESA's Sentinel 1 data. This

technology is appropriate to analyse the stability and motion progress of built environment (industrial, technical facilities, buildings). Well known example is our historic monitoring solution of the red mud reservoir at Ajka Alumina Plant, which collapsed in 2010. The combined PSI analysis of the site proved that the motions could have been detected with both land-based and space-based geodetic measurements several years prior to the catastrophe.

InSAR can also be used to model large-scale elevation changes and based on this feature we are developing technology for the sustainable maintenance of the Hungarian geodetic reference networks with special regard on the height network (EOMA).

Our research also concerns the study of active and passive SAR point targets.



Color-coded velocity map from ascending and descending pass ENVISAT observations 2002 -2010, around the No. 10 red mud reservoir. The actual observation geometries and their combination are shown below. The combined velocity example is from the later-collapsed NW corner at the western dam wall



Experts of Lechner Knowledge Centre have many years of practical experience of **Environmental Land Monitoring**.

Land monitoring services provide geographical information on land cover and land use as well as on variables related to, for instance, the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, and agriculture and food security. The objective of the *Copernicus Land Monitoring Service* is to provide European land cover information to users in the field of environmental and other terrestrial applications. Our Department plays a key role in the national and - as member of supporting institutional network of the European Environmental Agency (EEA) - in the European land monitoring as well.

National activities:

- Production of land cover maps applying advanced remote sensing techniques & visual photo-interpretations;
- Land cover change and time-series analysis;
- Validation and verification of various land cover products;
- Creating derived national statistics and indicators.

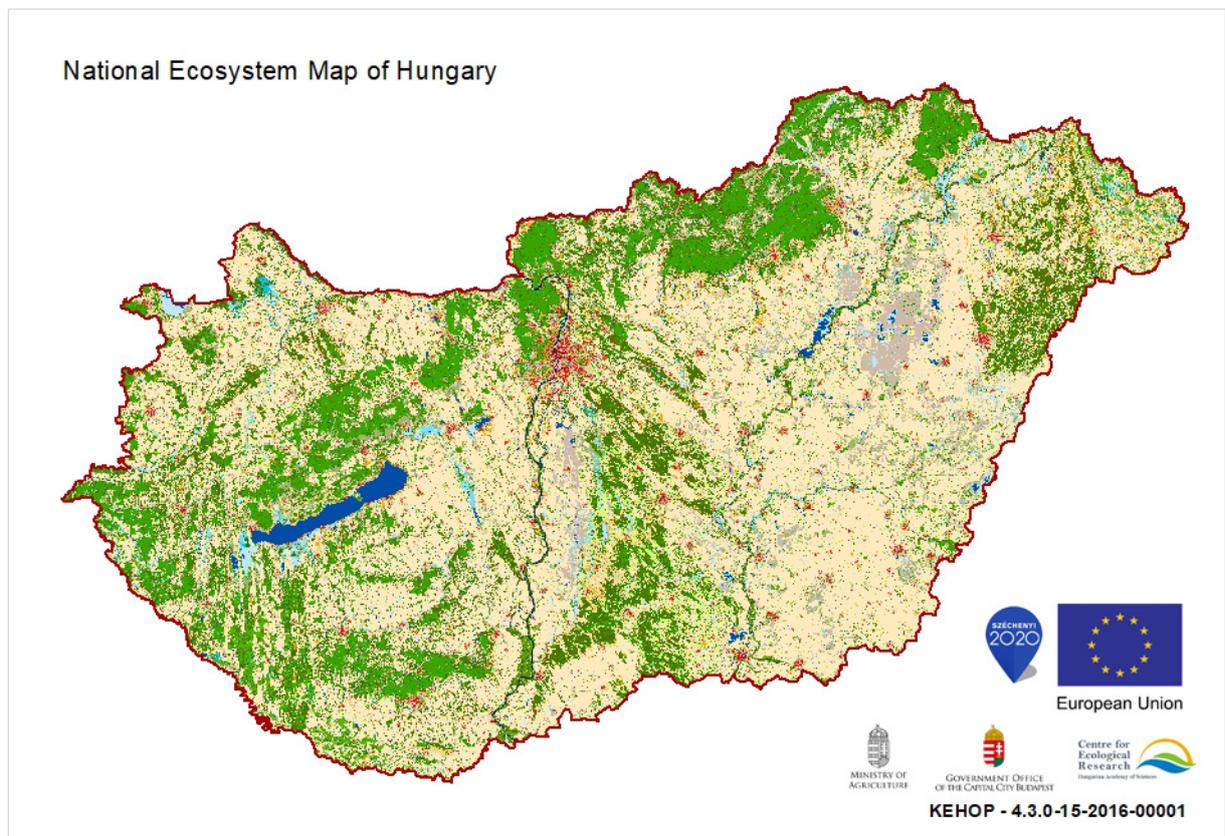
Supporting European land monitoring:

- Preparation, technical coordination and QA of the CLC2018 mapping project in the 39 participating European countries;
- Creating technical guidelines;
- Development of CLC2018 Support Package software;
- Training and support of national teams and verification of results;
- Cooperation in definition & QA of various European land cover products;
- Copernicus High Resolution Layers;
- Hot spot mapping (Urban Atlas, Coastal Zones, Natura 2000, Riparian Zones);
- Cooperation in development of European indicators (imperviousness, land take);
- Cooperation in long-term strategic development and planning of land monitoring in Europe, within the scope of EAGLE (Eionet Action Group on Land Monitoring in Europe) working group.

Lechner Knowledge Centre is involved in national programmes of ***nature conservation***.

The European Union Nature Conservation Strategy Project includes four development fields:

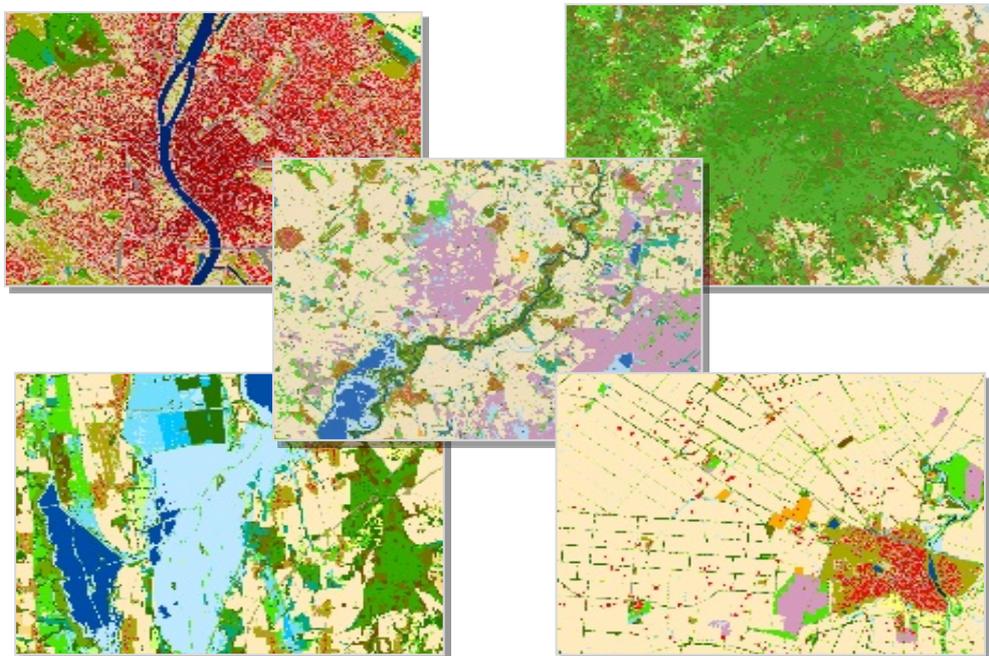
- Natura 2000 mapping,
- Ecosystem services mapping and analysis,
- Landscape character typology and evaluation,
- Green infrastructure network mapping and analysis



As a key contributor of mapping tasks, we have prepared the first National Ecosystem Map of Hungary in 20m raster resolution based on the intelligent combination of national in-situ digital maps and databases supported by semi-automatic classification results of active and passive remote sensing satellite imagery.

The Ecosystem Map depicts the country with six main categories following EUNIS / MAES classification:

1. Urban
2. Cropland
3. Grasslands and other herbaceous vegetation
4. Forests and woodlands
5. Wetlands
6. Rivers and lakes



Fine thematic detail is represented altogether in 57 third level sub-classes harmonized with the National Habitat Classification. The applied methodology demonstrates a new concept in the use of geospatial data and an efficient collaboration of several institutes of Hungary.

Defence Mapping in Hungary

Overview on the national (government) topographic and cadastral mapping in Hungary, characteristics of the Hungarian topographic (military v. civilian) map series

Characteristics	Military topographic map series	Civilian topographic map series
Datum	WGS-84 (EUREF-89) a = 6,378,137 m b = 6,356,752 m	IUGG67 a = 6,378,160 m b = 6,356,774 m
Projection	Universal Transverse Mercator (UTM)	'Egységes Országos Vetületi Rendszer' (Unified National Projection System), EOVS
Prime meridian	Greenwich	Gellért-hegy, Budapest, Hungary
Spherical longitude of centre point of the projection	0° (Equator)	E47°06' (Gellért-hegy, Budapest, Hungary)
Type of projection; Projection zones	Equatorial (transverse), Secant, conformal, cylindrical. Sixty 6° ellipsoidal bi-angles, each of which forms an independent co-ordinate system	Oblique, secant, conformal, cylindrical. One co-ordinate system for the whole territory of Hungary
Way of projection	At each 6° for every ellipsoidal bi-angle	'Double projection' i.e. from IUGG67 through Gauss sphere to the plan
Projection co-ordinate system	Portray of the Equator: N: Y = 0; S: Y = 10,000,000 m X = Parallel to the portray of the central meridian and 500 km West thereto	Y = 0; 200 km South to the centre point of the projection X = 0; 650 km South to the centre point of the projection
Height datum	Baltic (Kronstadt)	Baltic (Kronstadt)
Geodetic Datum	Unified Geodetic Network ED-50 or WGS-84 – EUREF-89	Hungarian Datum (HD-72); independent, relative
Sheet size	1:50,000 / 15' x 10' 1:200,000 / 1° x 40' 1:250,000 / (2° x 1°)	1:10,000 / 6 x 4 km 1:25,000 / 12 x 8 km 1:100,000 / 48 x 32 km 1:200,000 / 96 x 64 km

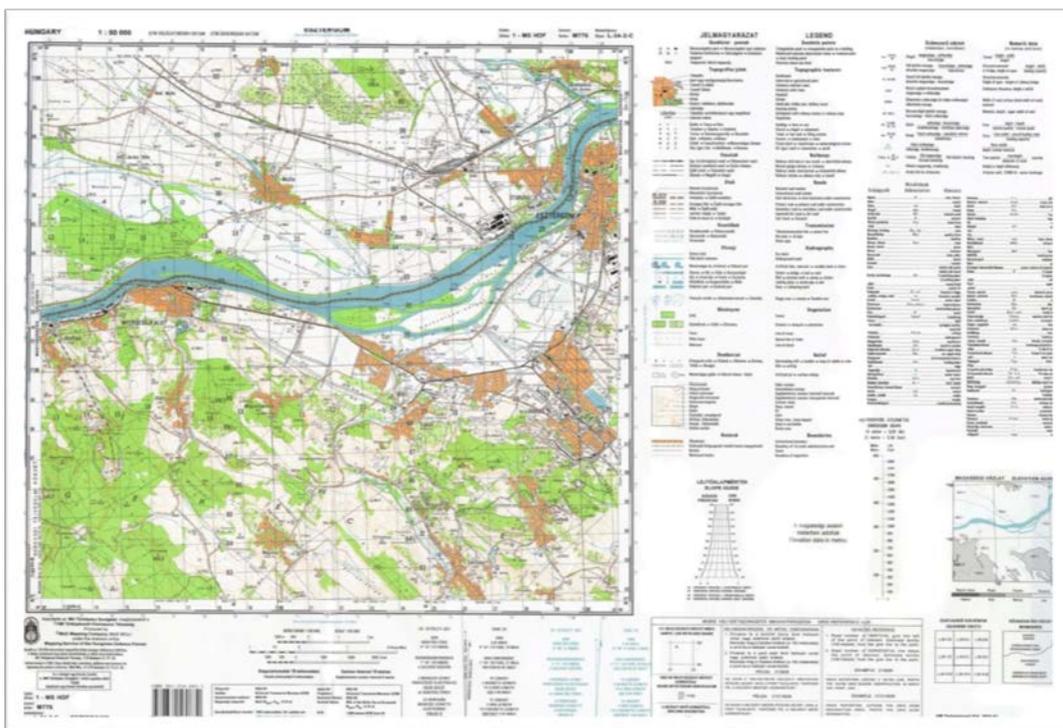
Defence mapping activities, including all state mapping operations at scales smaller than 1:10,000, are carried out by two military organisations in Hungary; the Geoinformation Service of the Hungarian Defence Forces (GEOS HDF) is responsible for the management and technical

supervision while the MoD Zrínyi Mapping and Communication Servicing Non-profit Limited Company (MoD Zrínyi Non-profit Company) is in charge for the actual map making. Nevertheless, carrying out some geo-related (however, not merely mapping) tasks, e.g. the creation of military geographic products, education and training etc., falls also in the responsibility of GEOS HDF.

Topographic and Thematic Mapping Activities

Analogue Topographic Maps

Hungary has been producing standard military topographic map series according to NATO STANAGs, i.e. in UTM projection, on WGS 84 datum and with a Hungarian-English bilingual marginalia, since 2004. One of them is the 1:50,000 scale map series, a mandatory scale in NATO, the base of which was the DTATM-50 Digital Mapping Database (the establishment of a new database is in process now). A civilian version of the above map series supplemented with EOV Hungarian (civilian) national standard grid is also available. The production of Joint Operational Graphics (both ground and air versions), another NATO standard map series, is also maintained but due to its scale, 1:250,000, it cannot be characterized as merely a ‘topographic’ one.



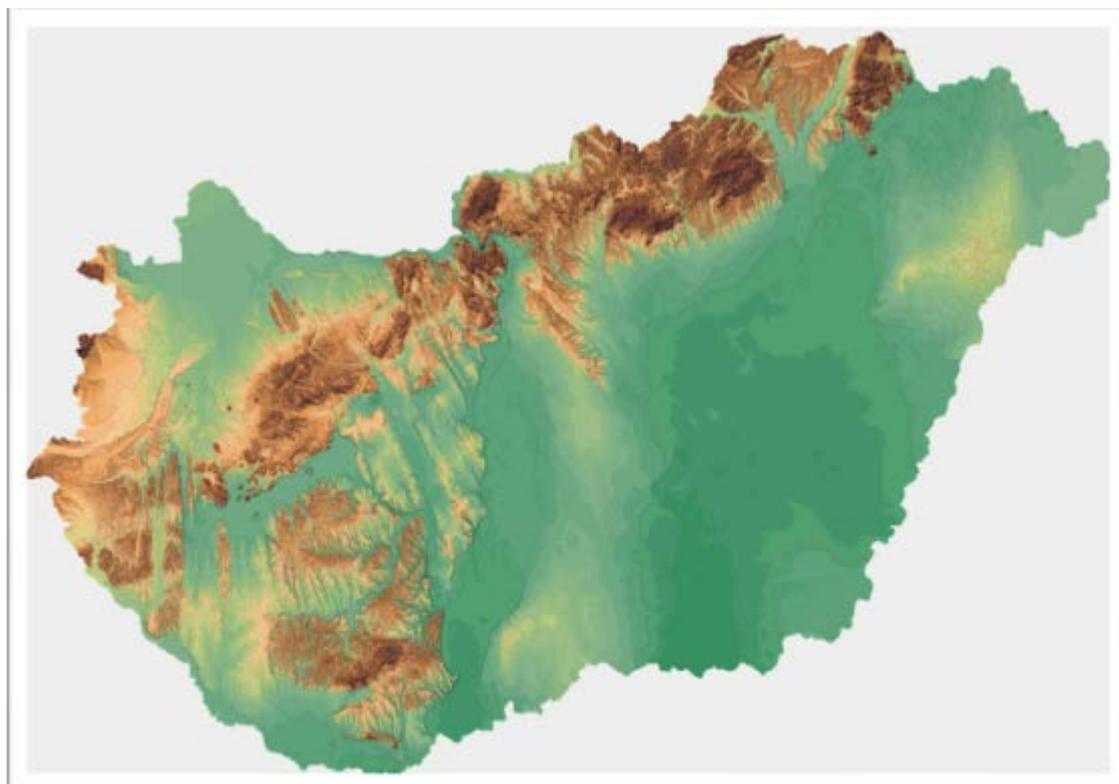
1:50,000 scale topographic map sheet

Digital Databases

The legal ancestor of GEOS HDF started establishing digital databases in the early 1980's. As a result of this activity, a number of databases and elevation models have been produced and made available for the users in various sectors, e.g. governmental, defence and public, by now.

DDM-10 and DDM-50 - Digital Elevation Models

DDM-10 and DDM-50 Digital Elevation Models hold elevation data for the territory of Hungary in grid format with 10×10 m and 50×50 m density, respectively. The database is available in NATO standard DTED Level 1 and Level 2 formats as well.



Representation of the Digital Elevation Model

DTA™-50 - Digital Mapping Database

‘Digitális Térképészeti Adatbázis’ (Digital Mapping Database, DTA™-50), the first digital military mapping database in Hungary, was created on the strength of the 1:50,000 scale military topographic map series with an aim of rendering the automatic processing of topographic maps possible, on one hand, and become a base of future GIS applications, on the other. Although the product is still in use, it will be replaced by Digital Topographic Database, DITAB-50, and therefore, it will not be maintained in the future.

DITAB-50 Database

The preparatory works of the ‘Digitális Topográfiai Adatbázis’ (Digital Topographic Database, DITAB), project, the aim of which was the creation of a new topographic database with a data content answering to the 1:50,000 scale maps but with an accuracy corresponding to the 1:25,000 scale maps in geometry, was completed in 2013 with the commencement of the actual works in 2014. The database is designed in a way that it is suitable for creating a cartographic output. Depending on the availability of future financial sources DITAB can be enhanced to have a data accuracy of the 1:25,000 scale maps. The estimated date of the completion of the work is the end of 2020.

Digital Raster Maps

For defence and other law enforcement purposes, 1:50,000 and 1:250,000 scale military topographic maps are available in raster format, too. For non-governmental users a number of raster format maps can be obtained of which the civilian version of the 1:50,000 scale topographic map series (called RTA) series can be mentioned.

Thematic Maps

In addition to topographic maps a number of thematic maps and charts, military and civilian ones, are produced every year. NATO standard products such as Low Flying Charts (LFC), Transit Flying Chart (TFC) and Joint Operation Graphic (JOG), both air and ground version, are published regularly. Other products like military city maps, photomaps and charts and various maps and map series designated for special purposes such as maps for training areas/shooting ranges etc. are available as well. Among non-military products the ICAO aeronautical chart of Hungary can be mentioned.



1:250,000 scale Transit Flying Chart (TFC)

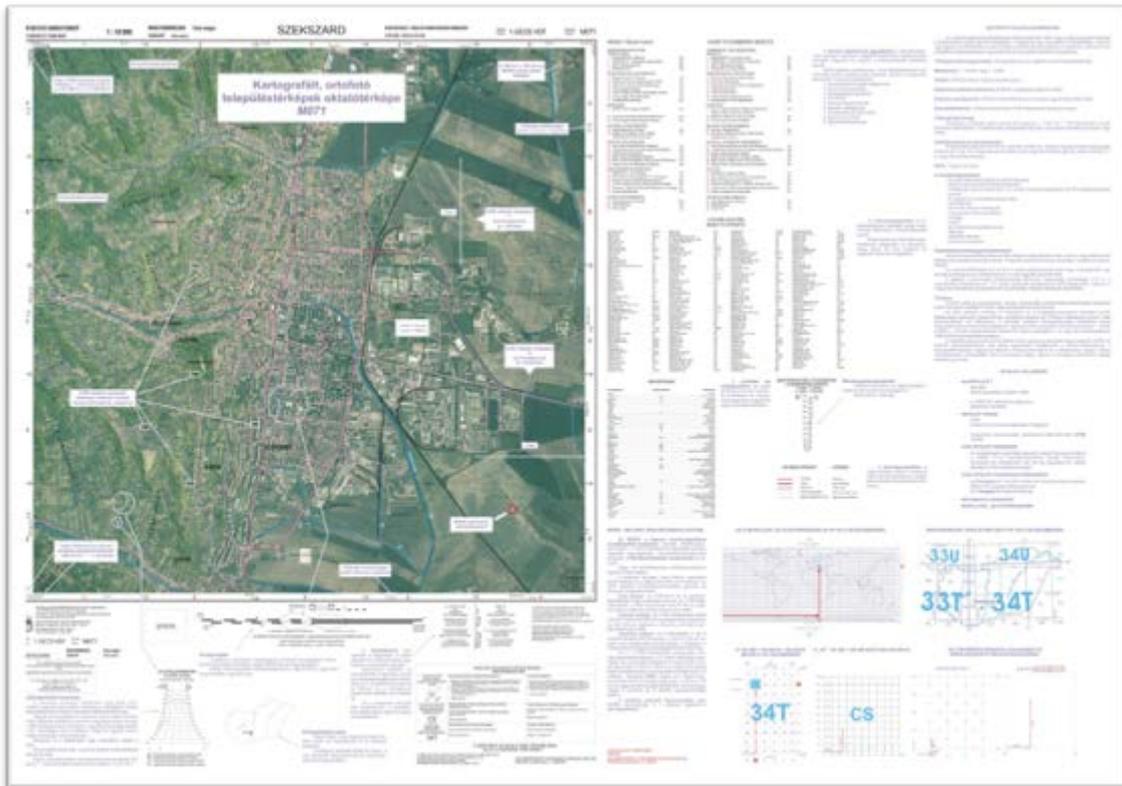
Ortophoto city maps

Ortophoto city maps designed explicitly for military purposes have also been in production for more than twenty years with an objective that troops can be provided with urban area information in a relatively short time. Due to the very limited amount of added information and the poor cartographical enhancement these products may have they can hardly be called ‘real’ maps but they have proved their usefulness and effectiveness when an emerging need for rapid map production is revealed.

Training maps

In order to assist military personnel to learn how to read and understand military maps, parallel with the production of the most frequently used maps and charts, training versions of those maps have also been generated for educational purposes. The maps are identical with the ‘original’ ones both in map face and marginalia but are supplied with additional explanatory information so that the trainees could learn and practice map reading without difficulty.

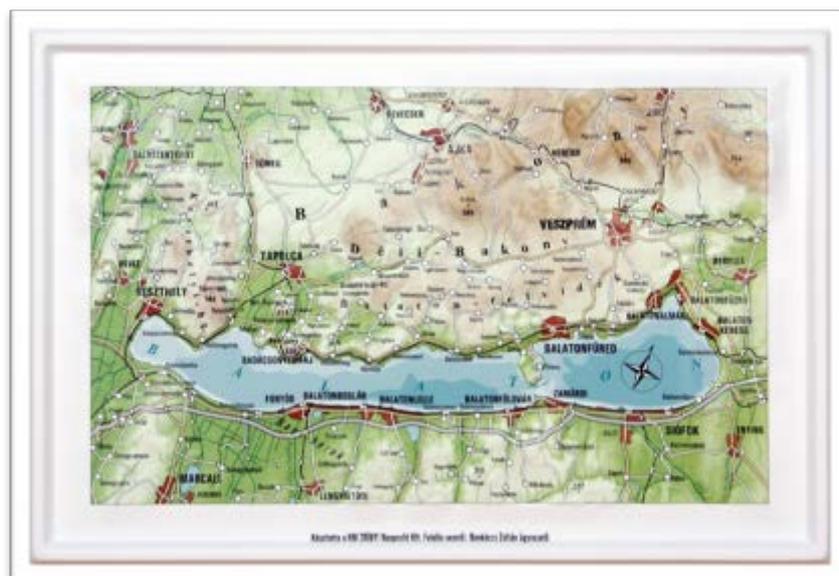




Orthophoto city map and orthophoto training city map

Maps for the public and other products

Hungarian defence mapping has long standing traditions in providing the public with various maps and charts. As a continuation of this practice a variety of tourist maps and road atlases of Budapest and Hungary are maintained. Other products, like wall maps, relief maps, historical and facsimile maps and calendars, tourist and pilot maps etc., have also been in production for decades.

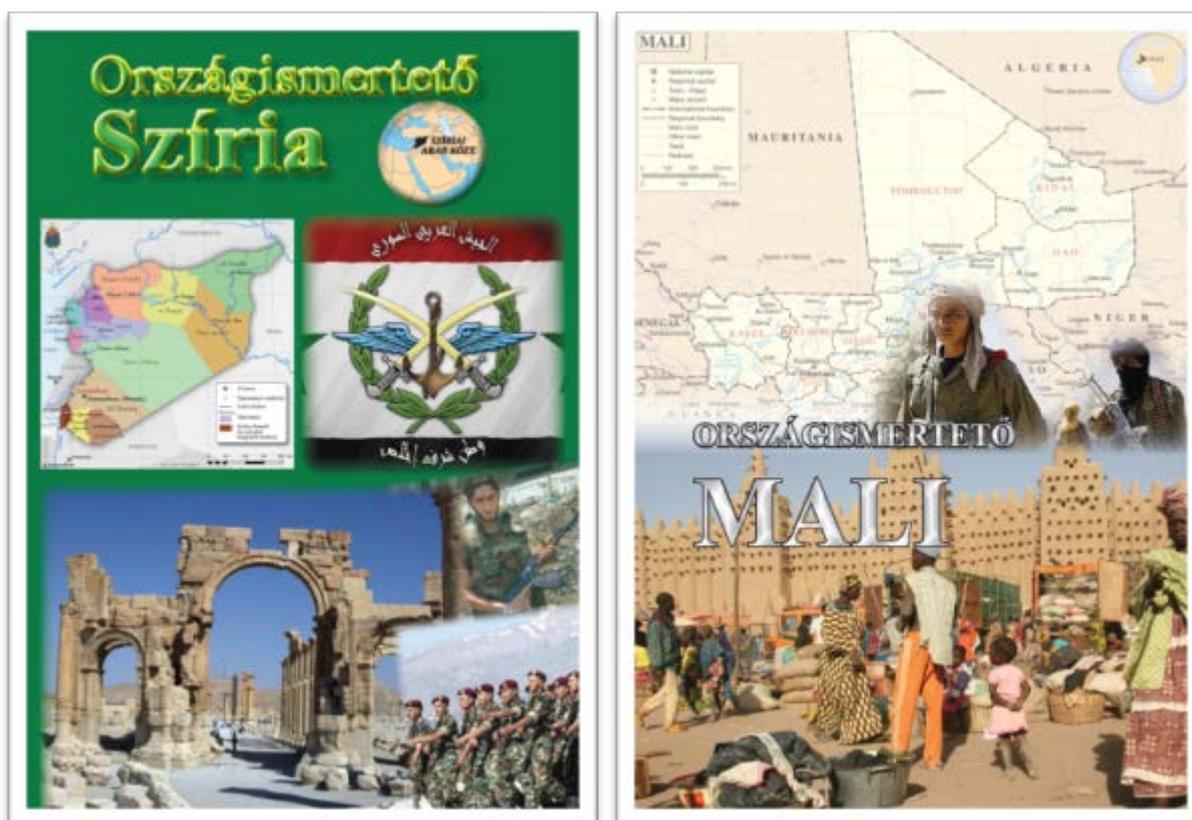




Relief, facsimile and pilot maps of Lake Balaton

Military geographic products

The production of military geographic information in analogue and digital forms has a two folded goal: first, to train Hungarian soldiers and officers in preparation of their future military career and, second, to give them actual and up-to-date support in peace keeping missions. A variety of publications, including 63 country, region and area descriptions, mostly for the crisis areas, were produced by the end of 2018. They are available in the Hungarian language; however, an English summary is attached to the most of these portrayals.

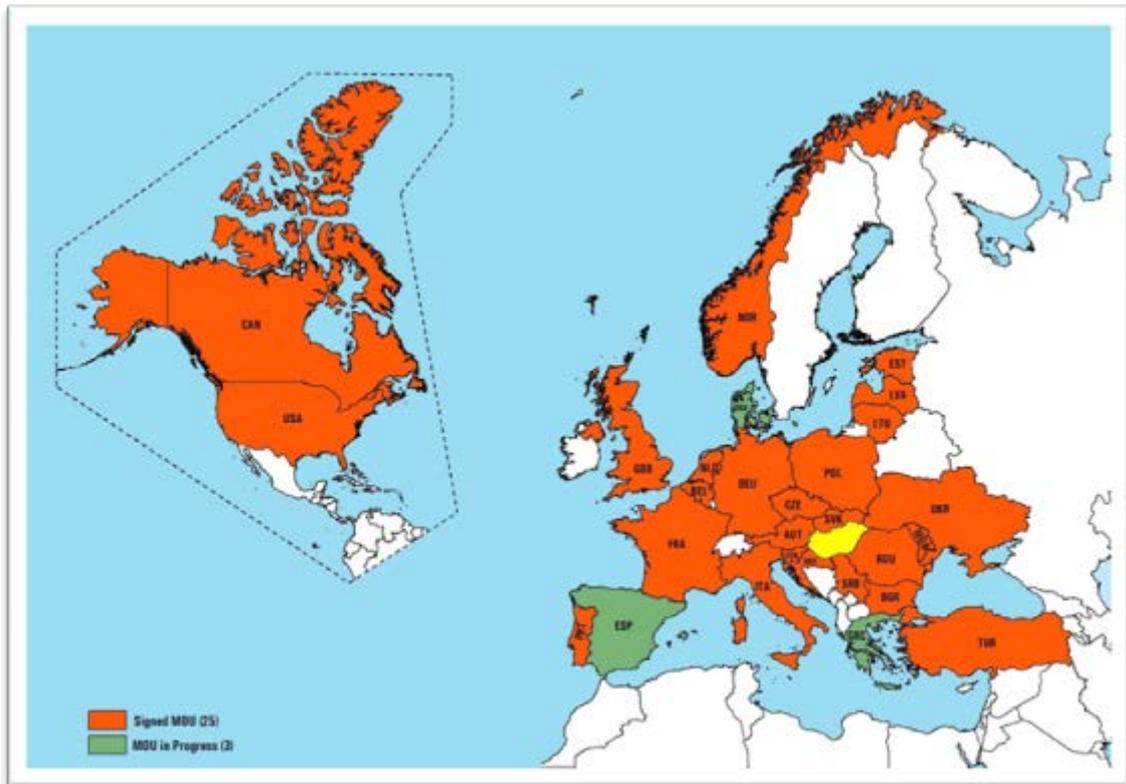


Military Geographic publications

Other Activities

International Relations

Hungary maintains extensive relationships not only with its most important strategic partners but also with other NATO and PfP nations. As a consequence, Hungary has concluded bilateral geospatial agreements with 25 countries so far and continues to make efforts to widen its international relationships with other countries, too. We are maintaining relations with governmental organizations in more than 30 countries throughout the world.



International Relations: Countries with whom GEOS HDF has entered in bilateral mapping agreements

Research and Development

Although a predominant part of the technical background, i.e. machine and equipment park, owing to the nature of its activities belong to the MoD Zrínyi Non-profit Company, GEOS HDF has also had a leading role in R&D activities for a long time. One of the latest undertakings in process is surveying the opportunities in utilising UAV technologies.



One of our latest developments: Use of UAVs (fixed and rotary winged)

Education and Training

It is our explicit goal not only to get our experts acquainted with the latest results and developments in mapping and map making technologies but also to make young people show an interest to our profession. Therefore, besides training and education, games and quizzes are also regularly held in, mainly, secondary schools.



Training

Summary

Achievements between 2015 and 2018

In the period between 2015 and 2018 the Hungarian military mapping has realised a number of its goals, of which the following achievements are mentioning worth:

- has built a new topographic database in order to render a more accurate and up-to-date military mapping possible;
- has familiarized with new technologies, e.g. UAV flights and copters to promote the replacement of field works and, by this, make the actual map making faster and easier;
- has enhanced its engagement in the MGCP project by assuming the elaboration of additional cells;
- has issued new military geographic publications;
- has widened its international relations with a number of new countries and international organisations;

2. Activities of the Hungarian Society of Surveying, Mapping and Remote Sensing, ICA Hungarian National Board

Hungarian Society of Surveying, Mapping and Remote Sensing

The Hungarian surveying and mapping community keeps rich international contacts, takes actively part in the work of international associations, unions and organisations at governmental, scientific and technology development levels.

- Hungary has been a member of the **International Cartographic Association** represented by the Hungarian Society of Surveying, Mapping and Remote Sensing since 1964.
- Hungary is represented by the Hungarian Society of Surveying, Mapping and Remote Sensing in FIG (**International Federation of Surveyors**). The Óbuda University, ÁMK, Institute of Geoinformatics is an Academic member. The Government Office of the Capital City Budapest is an affiliate member.
- Hungary has been a member of the **International Society for Photogrammetry and Remote Sensing** (ISPRS) for more than 80 years.
- Our newest representation is the membership in the **Council of European Geodetic Surveyors** (CLGE), together with the Section for Surveying and Geoinformation of the Hungarian Chamber of Engineers (MMK GGT) and the Association of the Hungarian Geoinformatic and Geodetic Surveying Enterprises (MFGVE).

Chronology of activities developed by Hungary in the ICA in the period 2015-2019

1. Joint ICA Symposium on “Cartography beyond the Ordinary World”

Event organized at the Institute of Geosciences of the Fluminense Federal University in Niterói, Rio de Janeiro previously to the 27th International Cartographic Conference, on 21 and 22 August 2015. Four ICA commissions participated in the event:

- Cartography and Children,
- Maps for Blind and Visually Impaired People
- Planetary Cartography
- Cartography for Early Warning and Crisis Management

The Scientific Committee was led by José José Jesús Reyes Nuñez, Assoc. Prof at ELTE Dept. of Cartography and Geoinformatics and then Chair-person of the ICA Commission on Cartography and Children.

Hungary was represented with three oral presentations and one poster:

- László Zentai: Cartography 2.0 - are we there? (keynote)
- Mátyás Gede – Henrik Hargitai: Country movers – an Extraterrestrial Geographical Application
- José José Jesús Reyes Nuñez Nunez, Maria Isabel Castreghini de Freitas: Short course on Map-based Geovisualization at the São Paulo State University
- Krisztina Irás: From Thematic Maps to GIS – in School Cartography



Hungarian participants in the symposium

José Jesús Reyes Nuñez was Chair-person of the Opening Ceremony and the second Keynote Speech, as well as also edited the Digital Proceedings of the Symposium (on CD).

2. Participation in the 27th International Cartographic Conference (Rio de Janeiro, 23-28 August 2015)

Hungary was represented by six delegates presenting 15 works in this conference:

- Hargitai, H.; Gede, M.; Zimbelman, J.; Kőszeghy, C.; Sirály, D.; Marinangeli, L.; Barata, T.; López, I.; Multilingual narrative planetary maps for children

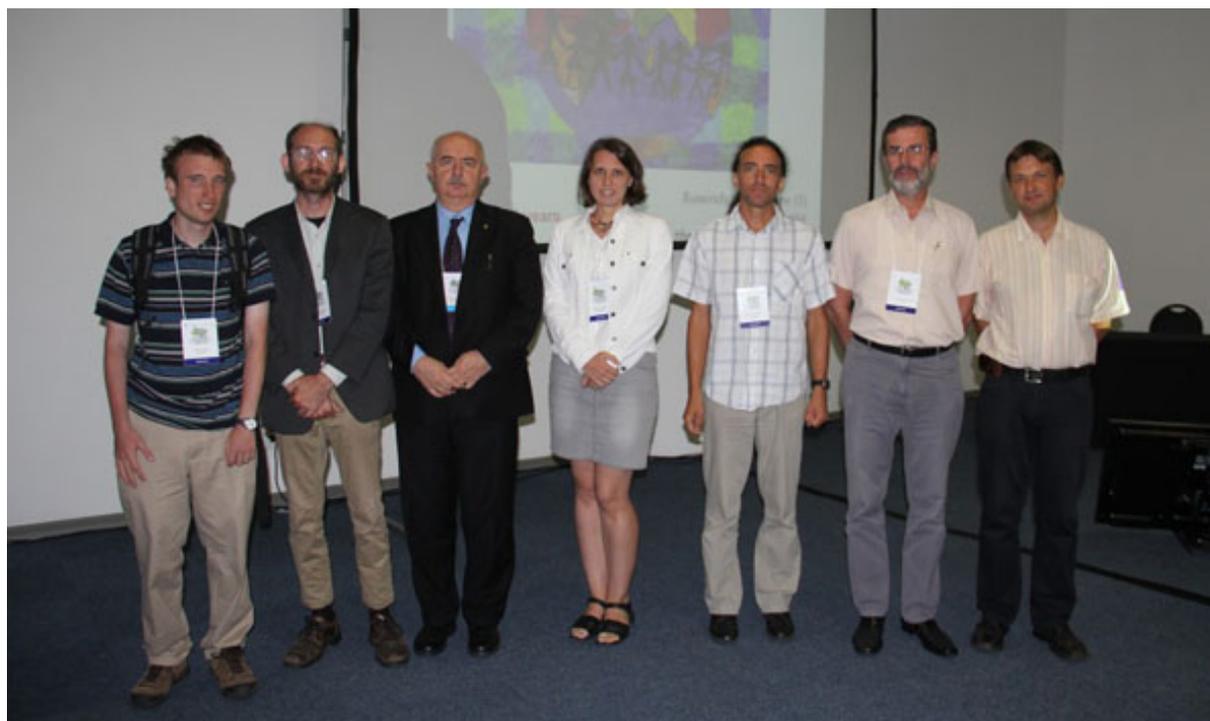
- Gede, M.: Thematic Maps on Virtual Globes
- Irás, K.; Nguyen Thai, B.: Positioning and Spatial Search of Maps with undeterminable Projections
- Reyes Nunez, J.J.; Juhász, B.: Hungarian Survey on the Use of Cartograms in School Cartography
- Harkányiné Székely, Z.; Waltner, I.; Vekerdy, Z.; Zentai, L.: Selected Examples of Potential Early Cartographic Data Sources for the Carpathian Basin
- Pődör, A.; Zentai, L.; Révész, A.; Dobos, M.: Thematic Maps in Analysing the Prejudice and Preconception in the Fear of Crime of Citizens of a Typical Hungarian Small Town
- Zentai, L.: Generalization Problems of Orienteering Maps
- Faragó, I.; Jeney, J.: Landscape Systems in Cartography
- Jeney, J.: Ethnic Map of Hungary by Jenő Cholnoky

Posters:

- Ungvári, Z.; Gede, M.: Estimation of the real elevation values on flood basins and lowlands based on SRTM and CORINE data
- Albert, G.; Ungvári, Z.; Merk, Z.; Gede, M.: Map of ancient tectonic forces on Mars - Visualization of a global stress-field model based on the new geologic map of the Red Planet
- Castreghini de Freitas, M.I.; Reyes Nunez, J.J.: Course on Geovisualization at the Paulista State University, Rio Claro (Brazil)
- Kis, R.; Czifra, M.; Gede, M.: Literature History and Cartography – Kazinczy's Correspondence and Its Cartographical Demonstration
- Jeney, J.: Problems Caused by Generalisation on Ethnic Maps
- Jeney, J.: Ethnic Maps in the Workers Atlas by Alexander Radó

Session chairs:

- Mátyás Gede: Cartographic Heritage 4
- José Jesús Reyes Nuñez: Cartography and Children 2,
- László Zentai: Geointelligence and Crime Maps, Orienteering Mapping



Hungarian participants in the conference



José Jesús Reyes Nuñez was awarded by the Diploma for Outstanding services to ICA and follows his activities within the Commission on Cartography and Children as Vice-Chair. Furthermore, José Jesús Reyes Nuñez as member of the Judging Commission participated in the evaluation of entries sent to the Barbara Petchenik Competition that were presented in the International Exhibition. The 16th General Assembly re-elected László Zentai for another four years as Secretary General of the International Cartographic Association. Mátyás Gede was asked to act as vice-chairman of the Commission on Cartographic Heritage into the Digital.

Georg Gartner (ICA President) and José Jesús Reyes Nuñez after opening the Barbara Petchenik Exhibition

3. Meeting of the ICA Executive Committee and Commission Chairs and EuroCarto Conference at the Vienna University of Technology

The ICA meeting held on 8 and 9 November 2015. Hungary was represented by László Zentai (ICA Secretary-General), José Jesús Reyes Nuñez (Vice-Chair of the ICA Commission on Cartography and Children), Henrik Hargitai (Chair of the ICA Commission on Planetary Cartography) and Mátyás Gede (Vice-Chair of the ICA Commission on Cartographic Heritage).



Exchange of opinions between representatives of ICA Commissions on Cartographic Heritage and Cartography and Children, from left: E. Livieratos (Greece), M. Gede (Hungary), J. Reyes (Hungary) and C. Sena (Brazil)

The EuroCarto Conference was organized immediately after the meeting (10-12 November 2015). Hungary was represented by:

- Györffy J.: Some Remarks on the Question of Pseudocylindrical Projections with Minimum Distortions for World Maps
- Barancsuk Á.: A Semi-automatic Approach for Determining the Projection of Small Scale Maps based on the Shape of Graticule Lines
- J. Reyes: A Forgotten Atlas of Erwin Raisz: “Atlas de Cuba”
- L. Zentai: The Effect of the Political Transition of Hungary on Map Publishing

Posters:

- J. Reyes: Results of the Barbara Petchenik Children’s World Map Drawing Competition
- Kiss T.: Changes of Landscape in the Sió-Sárvíz Valley (Transdanubia, Hungary) due to Human Activity. Analysis of Old Maps and Historical Data
- Ungvári Zs.-Irás K.: Web-based Reconstruction of Old Educational Instruments of Geography
- Szigeti Cs.-Albert G.: Measuring the Adequacy of Maps for Field Use
Gede M.-Ungvári Zs.-Kiss K.-Nagy



Hungarian participants in the EuroCarto Conference

- G.: Open-source Web-based Viewer Application for TLS Surveys in Caves
- J. Reyes: Results of the Barbara Petchenik Children’s World Map Drawing Competition
The Cartoheritage section is chaired by László Zentai

4. ICA conference celebrating 60 years of a university cartography programme



Event organized by the ICA Commissions on Atlases and on Education and Training at ETH (Zurich, 1-2 September 2016). László Zentai (ICA Secretary-General) presented a paper in representation of Hungary.

Participants in the event

5. 6th International Symposium on the History of Cartography

International event organized in Dubrovnik (13-15 October, 2016). Hungary was represented by Assoc. Prof. Zsolt Gy. Török with the paper “Revising, rectifying and regulating the Danube” and his PhD student, Merve Arkan (Cyprus) presenting her work on „Invariable image of Cyprus: Reproduction of siege maps of Nicosia and Famagusta”.

6. 8th Cartographic Science Congress

Event organized at the National Geographic Institute in Buenos Aires, Argentina, in November 2016. László Zentai represented ICA with the paper entitled: Modern cartography according to the International Cartographic Association.

7. 1st Scientific Day of Cartography



On 9 December 2016 the Cartographic Commission of the Hungarian Academy of Sciences and the Department of Cartography and Geoinformatics at Eötvös Loránd University organized the 1st Scientific Day of Cartography as part of the activities of the International Map Year in the headquarters of the Hungarian Academy of Sciences.

Georg Gartner (Technical University of Vienna), former president of the ICA, was specially invited to open the event. During his stay in Budapest, he also visited the Eötvös Loránd University and gave a paper in the meeting of the Cartography Section of the Hungarian Society for Surveying, Mapping and Remote Sensing.

Georg Gartner during his presentation in the 1st Scientific Day of Cartography

8. ICA Executive Committee Meeting in Budapest

The Department of Cartography and Geoinformatics hosted the meeting of the ICA Executive Committee at the Eötvös Loránd University between 13 and 15 February 2017.



ICA EC Meeting in Budapest, Hungary

8. Participation in pre-conference workshops in Washington DC, USA

Different workshops were organized by the commission before ICC 2017 in Washington. Hungary was represented in the following workshops:

ICC Joint Pre-Conference Workshop: Charting the Cosmos of Cartography: History – Names – Atlases, (28-30 June 2017).

L. Zentai: Transformation of relief representation from hachures to contour lines on the topographic maps in Hungary (presentation)

ICC Pre-Conference Workshop: Mapping Tools for Non-Mapping Experts: Incorporating Geospatial Visualization Tools in Libraries. (1 July 2017)

Participant: Mátyás Gede

ICC Pre-Conference Workshop: Different fields – one cartography, (1 July 2017)

Reyes J.: An old Hungarian School Atlas (presentation)

ICC Pre-Conference Workshop: Generalisation & Multiple Representation (1 July 2017)

Participants: Albert Gáspár, Csaba Szigeti



Participants in the Different fields – One cartography workshop (Washington DC, 1 July 2017)

9. Participation in the 28th International Cartographic Conference (ICC 2017), Washington DC, 2-7 July 2017.

Hungary was represented by the next colleagues in this event: Gáspár Albert, Mátyás Gede, Jesús Reyes, László Zentai and Csaba Szigeti (PhD student).

Papers and posters presented by them:

- Albert G.: How hard is it to design maps for beginners, intermediates and experts? (presentation)
- Gede M.: Using Cesium for 3D Thematic Visualisations on the Web (presentation)
- Gede M., Farbinger Anna: Displaying annotations for digitised globes (presentation)
- Gede M., Hargitai H.: An Online Planetary Exploration Tool: “Country Movers” (presentation)
- Hegedüs Ábel–L. Zentai: Adventures of a world atlas – History of the publication of the Debes Atlas in Hungary (presentation)
- Kerkovits K., Gede M.: Web-based Decision Support System for Choosing the Appropriate Map Projection (poster)
- Klinghammer I. – Reyes J.: Brief retrospection on Hungarian School Atlases (presentation)
- Pődör Andrea–L. Zentai: Educational aspects of crowdsourced noise mapping (presentation)
- Szigeti Cs.: On the Way to Create Individualized Cartographic Images for Online Maps Using Free and Open Source Tools (poster)
- L. Zentai: The evolution of printing technologies in the development of orienteering maps (presentation)



Hungarian map drawings in the Barbara Petchenik Exhibition (Washington DC, 2-7 July 2017)

Our colleagues also chaired the following sessions:

- Mátyás Gede: Cartographic Heritage into the Digital Cartoheritage on the Web VII. 5.
- Mátyás Gede: Planetary Cartography Craters and Projections VII. 6.
- Jesús Reyes: Cartography and Children Children’s mental thinking VII. 4.

- László Zentai: Education and training University educational programs VII. 5.
- László Zentai: History of cartography Historic maps of Africa VII. 4.

José Jesús Reyes Nuñez was member of the jury on Barbara Petchenik children's drawing competition. (6 July 2017)

10. Atlases, Cognition, Usability Joint ICA Meeting

The joint meeting of three commissions of the International Cartographic Association was organized at Olomouc University (Czechia) and László Zentai gave the lecture entitled „Development of Hungarian school atlases in the last decades”.

11. 15th Greek Cartographic Conference (31 October 2018)

László Zentai was the invited speaker in this event organized in Thessaloniki. He presented a paper entitled „Modern cartography – ICA's view”

12. Ceremony Doctor et Professor Honoris Causa at ELTE (Budapest, 8-9 November 2018)

Georg Gartner, Professor of the Technical University of Vienna, ex-president of the International Cartographic Association was awarded with the title of Doctor et Professor Honoris Causa of the Eötvös Loránd University in Budapest, Hungary.



Georg Gartner receives the diploma from the Rector of the university



13. Participation in systematic events related to ICA

13.1. International Workshops on Digital Approaches to Cartographic Heritage

11th International Workshop on Digital Approaches to Cartographic Heritage (Riga, 20-22 April 2016)

Papers representing Hungary:

- Darányi N.: Changing pattern of land use on the lower part of Ipoly river drainage basin
- Barancsuk Á.-Gede M.: An online tool for semi-automatically recognizing unknown map projections on small-scale maps
- Mészáros J.: The projection system of early flood control projects and its legacy in post WWII era in Hungary
- Gede M.: Automatic reconstruction of old globes by photogrammetric methods and its accuracy questions

Mátyás Gede chaired Section 1 (Preamble).

12th International Workshop on Digital Approaches to Cartographic Heritage (Venice, 26-28 April 2017)

Papers representing our country:

- László Zentai: A crypto-cartophilatelist's thoughts on cartographic heritage. (presentation)
- Mátyás Gede – Zsuzsanna Ungvári – Gábor Nagy: Assessing the accuracy of photogrammetric reconstruction by comparison to laser scanned data. (presentation)
- Sarin P.–N. Ulugtekin–R.N. Celik–Gede M.: Database of maps in Turkish journals. (presentation)

Mátyás Gede (Commission Vice-Chair) was chair of a session.



Moments before the opening ceremony of the workshop in Venice

13th International Workshop on Digital Approaches to Cartographic Heritage (Madrid, 18-20 April 2018)

The event was organized by the Spanish Instituto Geográfico Nacional. The papers presented by Hungarian participants were:



Hungarian participants in the event

- L. Zentai, Gercsák G.: A Case Study on the Connection of Digital Humanities and Cartography: Hungarian place-names in English language maps
- Oláh K., Gede M.: Presentation of changes in the legend of celestial globes using virtual 3D models
- Irás K., Ungvári Zs.: Wheels of Geography – Interactive Renewal of Antique Educational Instruments
- Gede M.: Online annotation editor for virtual globes

- Darányi N., Gede M., Bíró M.: Using historical maps in order to detect habitat change on the Great Plain (Hungary), between the 19th and 21th century

Mátyás Gede chaired a session in this event.

14th International Workshop on Digital Approaches to Cartographic Heritage (Thessaloniki, 8-10 May 2019)

Hungarian presentations in this event:

- Gede M.: Matching old maps with reality
- Kiss V.–Gede M.: A comprehensive database of cartographic heritage conference papers
- L. Zentai: Preserving our national atlases
- Timár G., Biszak E.: Projection analysis and georeference of Russian Shubert's „3-verst” topographic maps (late 1800s)
- Galambos Cs.: Estimation of projection and datum metadata of the early country maps of Hungary.

Mátyás Gede and László Zentai chaired one-one session of the workshop.



13.2. International Conferences on Cartography and GIS

6th International Conference on Cartography and GIS (Albena, 13-17 June 2016)

Papers from the department:

- Ádám Barancsik and Gáspár Albert: A Web-Based Application for Modelling Lithospheric Stress from Geological Map Data
- László Zentai: ICA's Modern Cartography (keynote)
- José Jesús Reyes Nunez: The First Physiographic Map Made by Erwin Raisz
- Gáspár Albert, Virág Ilyés, Dávid Kis, Csaba Szigeti and Dávid Várkonyi: Testing the Map Reading Skills of University Students
- Mátyás Gede: Thematic Mapping with Cesium
- Krisztián Kerkovits: Handling Boundary Cuts While Reprojecting GIS Vector Data

Session chairs: László Zentai (GIS Technologies and Related Disciplines), José Jesús Reyes Nuñez (Cartography and GIS in Education).



Hungarian delegates in the conference

7th International Conference on Cartography & GIS (Sozopol, Bulgaria, 2018)

The event was organized by the Bulgarian Cartographic Association between 8 and 23 June, 2018. The presented Hungarian works were:

- Pál Márton (MSc. Student) – Albert Gáspár: Identifying outcrops for geological hiking maps.
- Kiss Judit (MSc. Student) – Jesus Reyes: Testing the use of Google MyMaps in a Hungarian secondary school.
- Kerkovits Krisztián – Szigeti Csaba (PhD Students): Relationships between the distortions in map projections and the usability of small-scale maps.
- László Zentai: ISOM2017: The new specification of orienteering maps (an insight).
- László Zentai – Mihály Szabolcs – Remetey-Fülöpp Gábor – Palya Tamás: Geospatial data and services to support the UN Agenda 2030 implementation: Hungarian Activities.
- Szigeti Csaba (PhD Student) – Kis Dávid – Albert Gáspár: Measuring the map reader's interpretation of hypsography.
- Nyőgéri Gábor (MSc. Student) – László Zentai: A Hungarian on-line map service based on GIS data and visualised by cartographic approach.
- Vörös Fanni (MSc. Student) – Benjamin Van Wyk de Vries – Székely Balázs: Geomorphometric descriptive parameters of scoria cones from different DTMs: a resolution invariance study



Kerkovits Krisztián was awarded with the ICA Scholarship. Jesus Reyes chaired the Annual Meeting of the ICA Commission on Cartography and Children.

14. Barbara Petchenik Children's Map Competitions

Barbara Petchenik Children's Map Competition 2015

The Barbara Petchenik International Exhibition and Competition 2015 was organized during the 27th International Cartographic Conference in Rio de Janeiro, Brazil. In this edition the Hungarian map drawing entitled “Let the music for everyone”, author Valentina Sturcz (14 years, Fazekas Mihály Elementary and Secondary School, Budapest) won the 2nd prize in the age group above 12 years.



MAP LEGEND

•The map title is quote from **Zoltán Kodály** (1882-1967), who was a Hungarian composer, ethnomusicologist and pedagogue. He's best known internationally as the creator of the Kodály Method, to teach music for children.

•The musical notes above the map can be considered the inspiration motto of my work. It's a fragment recorded by **Bela Bartók** (1881-1945), a Hungarian composer and pianist. He was one of the founders of comparative musicology which later became ethnomusicology. The English translation of the text is as follows:
 „I left my beautiful country, famous little Hungary...”

•The swimming letters in the Oceans, are internationally used musical notes: **C-D-E-F-G-A-H-C** from these Kodály made the solmization keynotes: **do-re-mi-fa-so-la-ti-do**. He wanted to children could learn music easier and playfully.

Winner Hungarian map drawing in 2015

Barbara Petchenik Children's Map Competition 2017

Hungary has been organizing the Barbara Petchenik Competition from the first edition in 1993, when a Hungarian drawing also won one of the first awards. In the 2017 national edition participated 19 educational institutions from 16 settlements with a total of 191 map drawings. The Jury selected six entries to represent the country in the international competition:

- Butterfly effect. Author: Dóra Kizsel, 9 years. School: Gazdagrét-Törökugrató Elementary School (Budapest)
- The World as I see it. Author: Ákos Vajk Nagy, 10 years. School: Farkas László Elementary School (Kelebia)
- No title. Author: Réka Dancsó, 12 years. School: Hartyán Elementary School (Budapest)
- The world that surrounds me. Authors: Írisz Kubus, Véda Rajmond and Réka Répási, 13 years. School: Fazekas Mihály Elementary School (Kiskunhalas)

- World sport. Authors: Zsombor Fodor, Tekla Jáger and Réka Szakál, 13 years. School: Fazekas Mihály Elementary School (Kiskunhalas)
- Mother Earth. Author: Veronika Tóth, 14 years. School: Eötvös József Lutheran Secondary School (Sopron)



Butterfly effect, author: Dóra Kiszel



The World as I see it, author: Ákos Vajk Nagy



No title, author: Réka Dancsó



The World that surrounds me, authors: Írisz Kubus, Véda Rajmond and Réka Répási



World sports, authors: Zsombor Fodor, Tekla Jáger and Réka Szakál



Mother Earth, author: Veronika Tóth

Barbara Petchenik Children's Map Competition 2019

In the 2019 national edition participated 29 educational institutions from 22 settlements with a total of 114 map drawings. The Jury selected six entries to represent the country in the international exhibition and competition to be organized during the 29th International Cartographic Conference in Tokyo, Japan:

- My imagination. Author: Luca Kunos, 7 years. School: Újpesti Szűcs Sándor Elementary School (Budapest)
- Drops from the world. Author: Márton Nemes, 11 years. School: Kálvin téri Calvinistic Elementary School (Veresegyháza)
- Life and death of the Earth. Author: Zsombor Váradi. School: Öveges Kálmán Elementary School (Győr)
- It happened with the Earth. Authors: Luca Encs, Luca Kovács, 14 years. School: József Nádor Elementary School & School of Arts (Üröm)
- No title. Authors: Viktória Alexa, Luca Heidt, Eszter Erzsébet Vezsenyi, 14 years. School: Apáczai Csere János Elementary School (Váchartyán)
- The face of the Earth. Author: Anna Horváth, 15 years. School: Eötvös József Secondary School (Sopron)



My imagination, author: Luca Kunos



Drops from the world, author: Márton Nemes



Life and death of the Earth, author: Zsombor Váradi



It happened with the Earth, authors: Luca Encs, Luca Kovács



*No title, authors: Viktória Alexa, Luca Heidt,
Eszter Erzsébet Vezsenyi*



The face of the Earth, author: Anna Horváth

The Jury also gave six national prizes and two special mentions. Prizes were given during the Neumann Day at Eötvös Loránd University, 9 May 2019.



Awarded children and teachers after the award ceremony at Eötvös Loránd University, Budapest (9 May 2019)

3. Cartographic training and research

Activities of the Department of Cartography and Geoinformatics, Eötvös Loránd University (ELTE), Budapest

The status of the Department was changed last time in 2003: the Department of Cartography was named Department of Cartography and Geoinformatics and moved to the newly formed Faculty of Informatics. The three basic duties of the Department are as follows:

- training of cartographers at BSc, MSc and PhD levels (both in Hungarian and in English),
- teaching cartography to future teachers of geography, to geography students, to Computer Science MSc students, and to students of environmental sciences and programmers,
- supplying of maps, digital images, webmaps and professional advice for educational and scientific activities of the university's faculties.

The staff of the Department (full time and lecturers on contract) numbers 15. Subjects of the cartography syllabus that require other professional qualification than the Department staff has are taught by noted Hungarian and foreign scholars (giving a full course, an optional course, or just a few lectures). Altogether about 20 foreign experts and visitors contributed to the training of cartography undergraduates and graduates between 2015 and 2019. The training activities of the Department were expanded within the Doctoral School of Earth Sciences, Cartography Sub-programme: Eight candidates got the PhD in cartography in the last 4-year period. Within the past four years, the Department received 15 students and sent 10 students on mostly Erasmus mobility.

László Zentai, the head of the department served as a Vice-Dean of the faculty between 2012 and 2016, and started to serve as a Vice-Rector of the university in 2017. Gábor Gercsák also served as a Vice-Dean between 2017 and 2019.

The website of the department (<http://lazarus.elte.hu>) was opened in 1995. For long this was the starting point of the Hungarian cartography.

Training

The first independent university department of cartography was established in 1953. The first training syllabus was prepared in 1955, and it formed the basis of the training of Hungarian cartography students until the early 1970s.

In 1973, cartography training was changed as part of the general reform of university training. Cartography training continued to be a 3-year programme.

The Hungarian Act on Education of 1986 made it possible that cartography training became a 5-year programme. The first 10-semester programme was launched in the 1988–1989 academic year. The Department continuously modernized its curriculum after 1990 to introduce digital cartography. A new curriculum was formed in 2001.

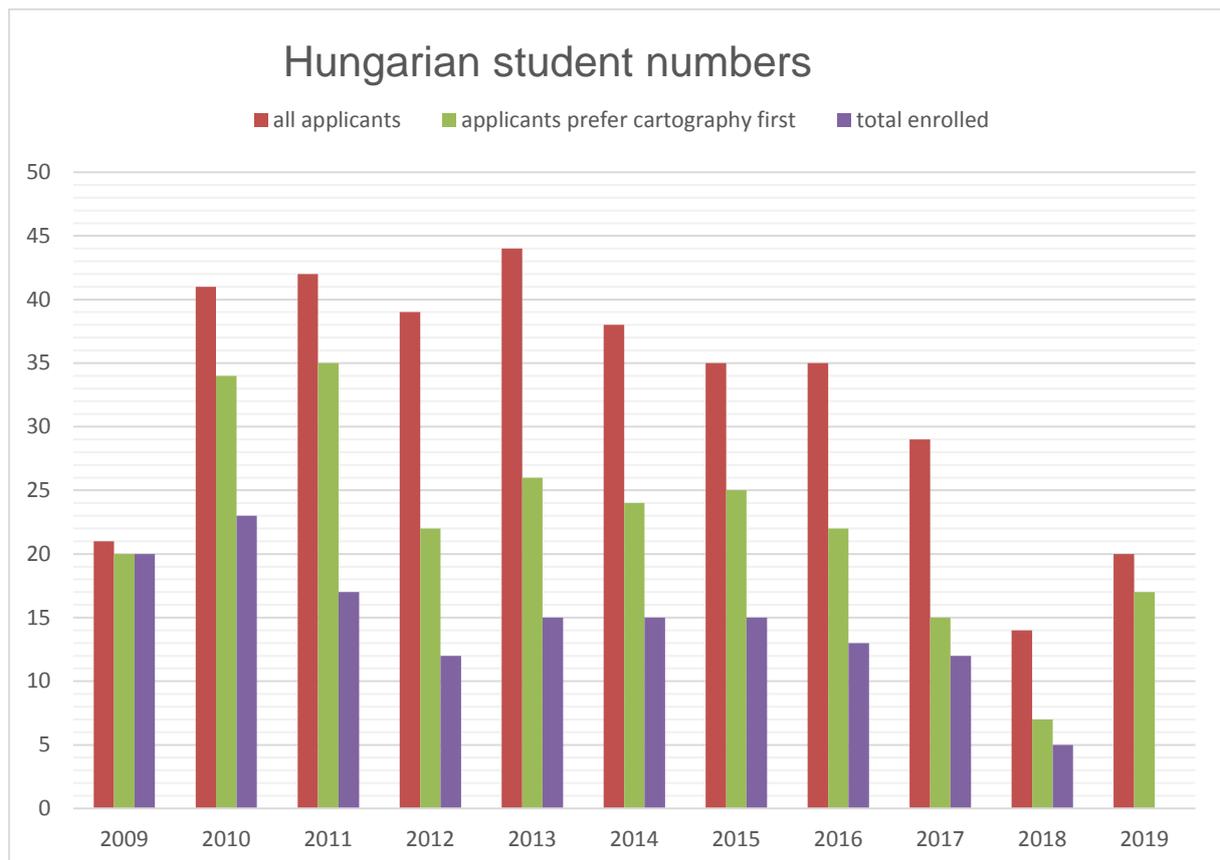
The multi-cycle system according to the Bologna model started in all fields of studies in Hungary as of 1 September 2006. This process was not consistently linked to the establishment of the programmes of the second cycle (master level). The specialization in cartography (starting after the second semester) is available in the Earth Sciences BSc programme; the whole BSc programme is

of 6 semesters. Based on the bachelor degree, the students can apply for the MSc programme in cartography (4 semesters), which is unique in Hungary.

The teaching of the processes and methods of computer-assisted cartography (automated surveying methods, computer graphics, computer-controlled technologies) are supported by a range of technical acquisitions of the Department (GPS receivers and base station, scanners, output devices, computer software).

The MSc system for cartographers was introduced in 2009 after a short preparation period. After five years, a reformed structure was accepted as of September 2014 to follow the world trend of computerizing, to meet the changing demands of the labour market, to harmonize the system with the international practice, to change the rate of credit/contact hour, and to require more individual research work. Old and new courses were put into a basic (mandatory) and four flexible (three mandatory) modules, which can be taken according to the students' professional interest. Some courses are offered also in English. The best students are involved in the research projects of the department, the professional profile of which is also modernized by employing new teachers who represent the professional interest in geoinformatics.

The English language version of the cartography MSc was started in 2016. The number of enrolled students is continuously increasing (only about 15% of the applicants are able to pass the entry test and/or approved by their sending countries).



Sub-programme for Cartography of the Doctoral School of ELTE

Cartography is traditionally related to several disciplines. Historical events, social or economic changes, geological formations, meteorological phenomena, and ocean currents are all chances for communication of cartographic information.

If you visit the homepage of the Department of Cartography and Geoinformatics, you can get a sample of this variety by taking a view of the degree theses and their themes chosen by the PhD students.

The Department does not plan a radical change in the practice of training doctoral students, but it is susceptible to any new tendency arising. The purpose is to go before the prevailing challenges and guide the way to those who work in practical cartography. Indeed, most of the students, including the majority of PhD students, will find employment in the field of cartography (or in fields related to it, e.g. informatics, environmental conservation, public administration); some of them had even worked in these fields prior to being a student at the Department.

Most of the staff of the Department – researchers, professors, and teacher-engineers – participates actively in education, research and practical cartography. In the publication lists, beside traditional maps, you can find electronic atlases and multimedia cartographical publications financed by domestic or foreign superiors (companies, funds, offices). Their preparation includes theoretical and practical work of the staff of the Department.

Modern education, especially doctoral schools and workshops surpassing even the higher education, needs the intensive development of technical resources. This is the only way to keep pace with the development of the general level of techniques.

Research

The Department has undertaken research in the following fields of subjects:

- Aspects of representation in thematic cartography (digital maps, atlases)
- Map projections
- History of cartography
- Toponymy
- GIS, webGIS
- Virtual Globes Museum
- Participation in editing the new National Atlas of Hungary
- Autonomous vehicle navigation systems

Other universities

Two major universities offer MSc or BSc degrees in professional areas related to cartography. The **Budapest University of Technology and Economics** has a three-semester programme of Land Surveying and Geographical Information Systems Engineering, and Óbuda University (in Székesfehérvár) offers a 7-semester BSc programme in Land Surveying and Land Management Engineering in Hungarian and in English and a 4-semester postgraduate course in Geoinformatics.

Óbuda University Alba Regia Technical Faculty, Institute of Geoinformatics (<http://amk.uni-obuda.hu/index.php/en>) were established in 2014 as the successor of the University of West

Hungary, Faculty of Geoinformatics. The main profile of the institute is on education of surveying engineering, geoinformatics, remote sensing, geodesy, land management engineering in Hungary. Research activity is performed in the field of GISciences (GISc), GNSS, satellite gravimetry, engineering surveying, remote sensing, photogrammetry, land management it also offers specialisation in geoinformatics for BSc students.

Although the education of the BSc students is focusing on large-scale mapping and topographic mapping cartography and map-design plays an important role in the curriculum. Also geovisualisation and cartographic design have a prominent role in education of GIS in postgraduate level.

In its present and past form it has been involved in numerous international research and educational projects, many of them was supported by the EU. It is worth mention that some colleagues of the institute worked in the Geographic Information - Need to Know (GI-N2K) project where visualisation and map design were a key element to elaborate.

The geospatial engineering, geoscientific educational and research activity of the Institute is embedded to a supportive environment provided by the other engineering profiles of the Faculty, such as electrical engineering, mechatronics engineering, mechanical engineering, engineering management. OU has a well-recognized PhD school on Applied Informatics.

Recently the head of the institute is Andrea Pődör, who is a cartographer, and strengthen the cartographic “line” in the institute. There are several other institutions in Hungary that have various PhD programmes available for those students who have an MSc degree in our profession, including earth sciences, environmental sciences and even forestry. They are as follows: Budapest University of Technology and Economics, University of Debrecen, University of Miskolc, University of Sopron (former University of West Hungary), University of Pécs, University of Szeged, and Szent István University in Gödöllő.

The Specgroup of Military Cartography and Geography represents a distinct color spot in domestic professional training. As a part of Faculty of Military Sciences and Officer Training (FMSO) at the National University of Public Service (NUPS) the group educates —through BA and MA programs— professional military officers for the Hungarian Defense Forces, and other faculty students of NUPS as well. The specgroup’s educational portfolio consisting of all necessary cartography and geography related subjects and basic knowledge that must be mastered by future military leaders, disaster managers, public administration officials, national security specialist, etc.

Student competition organized annually by FMSO is also worth mentioning. Students coming from different institutions of Hungarian higher education are very enthusiastic about this event where they can compete for specific prizes in the field of cartography, geography and land navigation. The ELTE’s students regularly rank well in the strong field on this annual event.



Teams during introduction on student competition held on the occasion of the centenary of Hungarian Military Mapping.

Cartographic Activities at the Geographical Institute of the Hungarian Academy of Sciences

The Geographical Institute of the Hungarian Academy of Sciences is an important workshop of Hungarian thematic mapping. As such it is also a significant user of maps as it adds its thematic content to existing (topographic, geological) maps. The cartographic presentation of research results forms the most important responsibility of the Cartographic Department, although similar works are being done at other departments of the Institute, too. Other duties of the Cartographic Department include the edition of publications.

The National Atlas of Hungary (MNA) was published first in 1967, then in 1989. The new edition of the Atlas in four volumes in Hungarian and also in English wishes to present the dynamic spatial structure of nature, society and the economy not merely for Hungary, but wherever the required data are available, for the Carpatho–Pannonian Area. In favour of keeping relations with the broader public and meeting the requirements of the time, the Atlas – in addition to its impressive printed form – will be published also in digital version (e-MNA) in Hungarian and English.

A national atlas is the given country's 'identity card,' one of its most significant national symbols in addition to its flag, coat of arms and national anthem. It is usually a series of maps complemented with textual explanations and various illustrations, which show the given state's natural, economic and social features through logically and proportionally constructed maps using a well-defined scale and uniform cartographic iconography.

The first volume of the new Hungarian National Atlas is headed by an introduction to Hungary's natural environment. On the one hand, this publication gives an overview of the state of the lithosphere, hydrosphere and atmosphere, as well as of the biosphere in Hungary. On the other hand, there are synthetic chapters and topics that analyse how the natural and human environments are interconnected and how they interact (e.g. landscapes, environment protection, nature

conservation, and natural hazards). Leafing through the thematic maps grouped together, we are informed about such diverse themes as engineering geology, earthquakes, expected changes in the elements of the climate, weather records, groundwaters, karstic, mineral, medicinal and thermal waters, the main features of soils, land quality, types and characters of landscapes, Hungary's amazingly rich flora and fauna, the current state of the environment and waste management, protected areas, ecotourism, and the country's main natural hazards, namely floods, excess waters, droughts, soil erosion, the spread of invasive species and pollen allergies.

In our days, most countries in the world have national atlases as far-reaching national symbols. They were generally compiled first time during their strife for national independence or shortly after achieving it, and are usually updated every two or three decades. The 1980s saw the beginning of a new era in the history of national atlases, which is primarily due to reasons of marketing. The increasingly sophisticated national atlases were now intended for the educated public and actors of public and higher education.

Still based on scientific research, since the late 1980s the more market-oriented, more mass-consumable atlases have been issued electronically as well as in hard copy. The birth and fast spread of personal computers revolutionised cartography, including atlas cartography, all over the world. Thanks to the changes in production and information technologies, modern atlases issued since the 1990s have been able to fully meet all of the various functions emphasized in different periods of the past century of atlas making. The first electronic development was the appearance of CD-ROM versions accompanying conventional print atlases. Subsequently, the first internet and web-based national atlas was marketed in Canada.

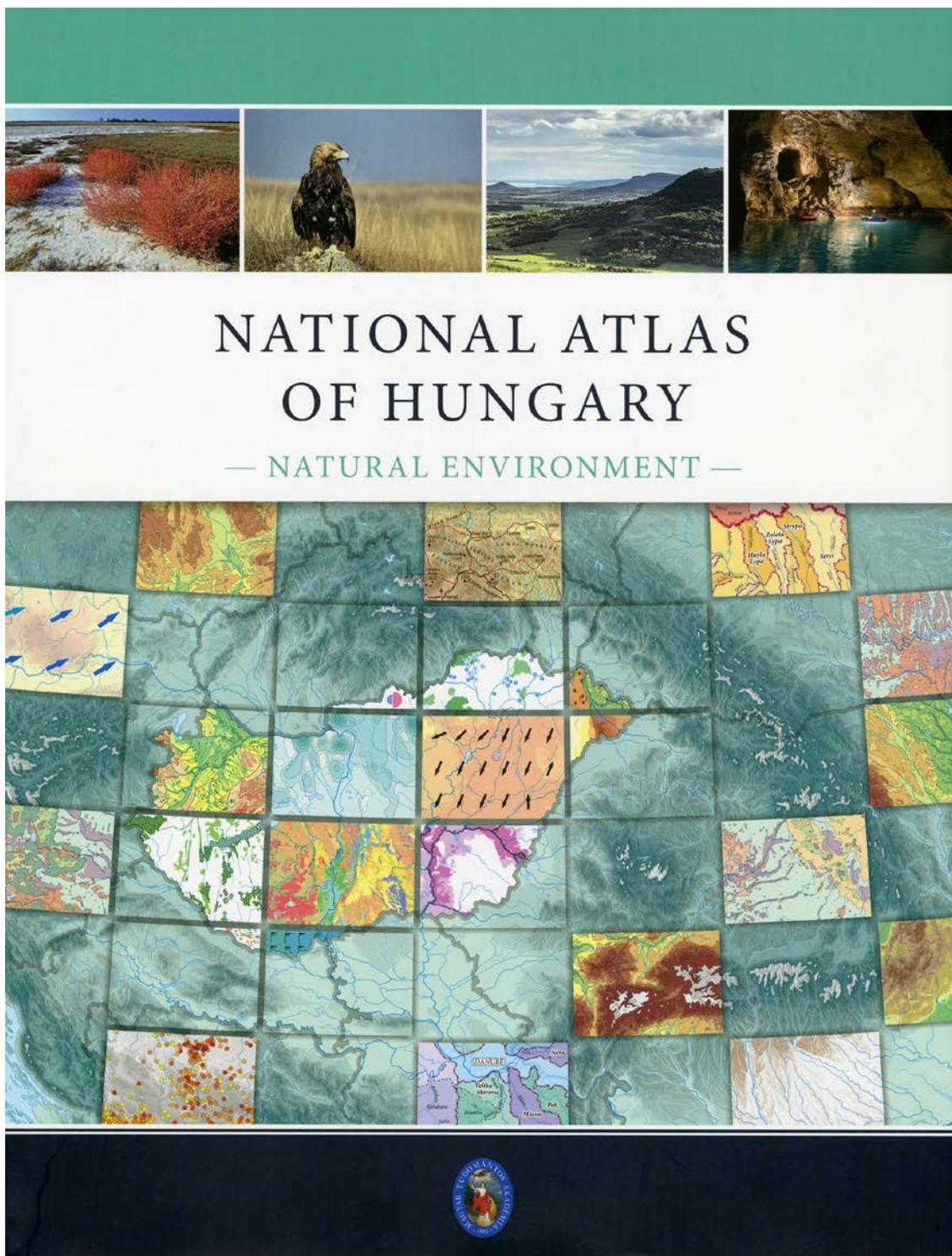
In the case of national atlases published over the past two decades, traditional print atlases have definitely been pushed to the background compared to their electronic versions, which contain almost unlimited amounts of multimedia elements (e.g. photos, videos, animation, and World Wide Web hyperlinks). However, paper-based atlases, that 'we can still use at times of blackouts', have not disappeared as outstanding period documents of the given state's geographic environment. Instead, they have been completely revived, becoming more interesting and more fascinating in the course of their competition with electronic mass communication. Meanwhile, electronic atlases have become primary sources and tools of obtaining and analysing regional information. The easy access to and up-to-the minute nature of web-based atlases on the internet make them attractive because of their practically unlimited capacity to store data and maps.

In 2013 preparations for the new (conventional) edition of the Atlas of Hungary were started – under the coordination of the Geographical Institute of the Academy's Research Centre for Astronomy and Earth Sciences, enjoying the support of the former president of the Hungarian Academy of Sciences.

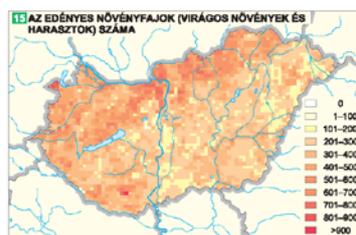
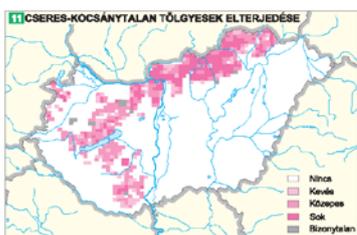
It is a unique novelty of our aims that the 2018 edition of the Atlas of Hungary wishes to present the dynamic spatial structure of nature, society and the economy not merely for Hungary, but wherever the required data are available, for the entire Carpathian Basin and its neighbourhood (the Carpatho–Pannonian Area), thus covering a territory of some half a million km² and 34 thousand settlements in twelve countries.

The traditional paper-based edition will cover the most important topics in four volumes (The Hungarian State and its Place in the World; Natural Environment; Society; Economy) and in representative quality. It will serve mainly awareness-raising and information provision rather than academic research. Naturally, we know that paper-based volumes, whose production takes a long time, may contain less up-to-date information at the time of their issue, therefore many present-day readers find them less attractive. Nevertheless, future generations will see them as significant

records of the period. In contrast, practically up-to-the-minute information and contact with the wider public will be ensured by the digital version (e-MNA) available at www.nationalatlas.hu.



The cover page of the new national atlas (English language version)



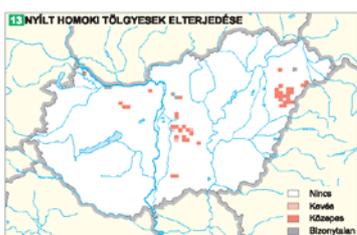
5 Változatos szerkezetű úde erdő gazdag gyepszinttel

A középhegységeket és a dombságokat a kiterjedt, jellegzetesen pannon cseres-tölgyes zóna köti össze 11. Az Alföld nagy része az erdősztyepp birodalma, azé az erdősztyeppé, amelynek számos eleme kelet felől mélyen benyomul ugyan Közép-Európába, de társulásainak sokfélesége, faji gazdagsága a Pannon-térségben bontakozik ki utoljára a maga teljességében. Nagy sík-



6 Jellemzően pannon táj a középhegységek lábán

ságainkon a növényzet gyakran finom mozaikok formájában jelenik meg (pl. homokbuckások, szikes puszták, árterek erdei, rétjei, mocsarai, lápjai). A homoki árvalányhajas évelő nyílt homokpusztagyep 12 pannon



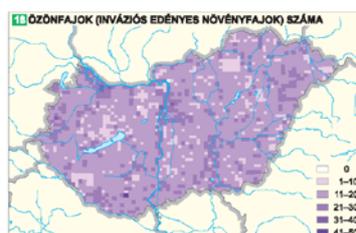
társulás, benne számos pannon bennszülött növény- és állatfaj él. Hasonlóan a többi erdősztyepperdő-típushoz, a homoki tölgyesek 13 is nagyon megritkultak mára.

A Kárpát-medence déli irányú nyitottsága a növényzetben jól megmutatkozik. Dél felől három erdőzóna befolyása is kimutatható. Az erdősztyepp zónája Oltenia felől türemkedik be némi megszakítással a Pannon-régióba. Ugyanakkor Észak- és Kelet-Balkán hatása egy kétágú villa formájában jelentkezik a Kárpát-medencében: egyrészt száraz, fészaráz kelet-balkáni erdők nyomulnak fel elszegényedett formában a pannon erdősztyepp keleti peremén, főleg a Partium területén, másrészt egy jelentősebb ágban – nagyobb fajgazdagságban és többféle típusal, például ezüsthárs-tölgyesek formájában – jelentkezik a Dunántúl dél-keleti felében. Harmadikként a Nyugat-Balkán hatása mutatható ki a Nyugat- és Dél-Dunántúl gyertyános-tölgyeseiben és bükköseiben. A Balaton-felvidék keleti felében, valamint Külső-Somogy zárt tölgyesei és a Mezőföld erdősztyeppje között – Közép-Európában egyedülálló jelenségként – száraz, zárt szubmediterrán molyhos tölgyesek alkotnak erdőket 14. A molyhos tölgyesek bokorerdői balkáni rokonságúak. Különlegességük, hogy ahol a délies elterjedési fajokból álló lombkoronaszint felazul, sztyeppfajokban gazdag gyepszint jelenik meg. A déli hatás kiterjed az alföldi – elsősorban a Duna–Tisza közti – növényzetre is, ezért tekintjük ezt a vegetációt az erdősztyepp keleti, kontinentálisabb megjelenésétől eltérő szubmediterrán erdősztyeppnek.

A pannon növényzet jellegzetességeit három szempont szerint mutatjuk be 15. A szabályszerűség a növényzet térbeli elrendeződésének ismétlődő jelenségei, ezek helyi vagy táji léptékűek is kialakulhatnak. A devídó az, amikor ez a rend megtörik, amikor nem a „várt” (az országos mintázatok alapján előrejelezhető) növényzeti típusok jelennek meg. Ennek általában vegetációtörténeti, mezoklimatikus és termőhelyi okai vannak. A pannon növényzet egyediségét azok a vegetációtípusok adják, amelyek a régió sajátjai, a szomszédos alpesi, kárpáti és balkán régiókban nem vagy alig fordulnak elő. (Megjegyzendő, hogy az áttekintés korántsem teljes.)

A flóra jelen állapota és változása az elmúlt évszázadokban

Egy adott terület flórája természetes körülmények között is folyamatos változásban van, összhangban a környezeti tényezők változásával. Bár ma is zajlanak részben természetes folyamatok, az elmúlt néhány évezredben Európa nagy része, így Magyarország flórájának formálódásában mégis az ember okozta (antropogén) hatások váltak a legfontosabbakká. A számottevő átalakulásokat előidéző legjelentősebb okok között az élőhelyek megváltozása, megszűnése, új élőhelyek kialakulása említhető, de egyes fajok esetében a célzott gyűjtés, illetve irtás, vagy éppenséggel a telepítés, ülte-



tés is meghatározó lehetett és lehet. A terjedő vagy viszázhuzódó őshonos fajok mellett meghatározó szerephez juthatnak távoli tájakról (gyakran más kontinensekről) származó idegenhonos (adventív) fajok, amelyek vélt vagy valós gazdasági előnyök mellett számos ökológiai, környezeti, gazdasági és társadalmi problémát okozhatnak. A fajok számáról pontos adatokat az eltérő tudományos megközelítések (pl. fajfelfogások) és a flóra állandó változása miatt nehéz megadni, ráadásul az új tudományos eredmények (pl. fajleírások) is folyamatosan átírják a korábbi tapasztalatokat, de összességében a napjainkban Magyarországon vadon élő őshonos és idegenhonos fajok száma együttesen 2400-ra tehető, ebből mintegy 700 idegenhonos;

4. Libraries, Map rooms

The Map Collection of the National Széchényi Library

The Map Collection of the National Széchényi Library is basically a *hungarica* collection. Being part of Hungary's national library, our aim is to collect, with as much integrity as we can, all the Hungary-related printed and manuscripts cartographic documents as well as digitally produced maps, atlases, celestial spheres and globes, etc. As part of a stock comprising over 300,000 items, our collection holds, in addition to the so-called *hungarica* maps, a rich and highly valuable collection of works of the entire European history of cartography, too. In 1802, Count Ferenc Széchényi donated his famous collections including a collection comprising approximately 6,000 units of maps and atlases to the Hungarian nation. As a collection of graphic documents, this collection has been handled separately since the age of foundation.

During the 19th century, in addition to entities of legal deposit, the Map Collection was significantly enriched by way of receiving donations and by making acquisitions. To mention just the most notable ones, there was the donation of Count István Illésházy (208 items, 1835); the acquisition of a several hundred-piece map collection of the renowned book and map collector Miklós Jankovich (1836); the purchase of a 300-piece collection of the famous professor of linguistics István Horváth; a highly valuable present (circa 2,200 items, 1895) of Enea Lanfranconi, an excellent water engineer, who lived in Bratislava. In the early 20th century, leaders of Library recognized the value of large-scale topographic maps in various historical researches, so they made efforts to purchase Hungary-related maps of this kind. As a result of these steps, from the middle of the 1920s onwards, a great volume of large-scale maps arrived in the Library's Map Collection. These maps were manuscript and printed maps (cadastral and feudal fee management maps, maps on land utilization, military maps, etc.) but, at the same time, several smaller-scale maps on a variety of topics (county, town, village, etc.) had also been acquired.

In the first half of the 1940s, a great number of unused school maps and atlases from church and secular schools have found their way into the Map Collection of the National Széchényi Library. As a result of the communization of baronial and church collections, a bulk of cartographic documents got into the Library's Map Collection.

Since 1945, the decisive majority of the annual growth of stock has been provided by entities of legal deposit. However, making purchases of missing *hungarica* maps also play an important part in the development of the Library's Map Collection.

Since 1939, the Map Collection has been a separate department within the organizational structure of National Széchényi Library.

Publications

- FÖLDABROSZ. map history blog, commencing year 2016., <https://blog.oszk.hu/foldabrosz>
- Térképtörténeti Közlemények 1. (2016) Budapest, National Széchényi Library, 2017.
- Térképtörténeti Közlemények 2. (2017) Budapest, National Széchényi Library, 2018.

Exhibitions, events

- 2015

- *Az I. világháború térképeken 1. Propaganda* (Exhibition)
- 2016
 - *A Magyar Királyság általános térképe, 1804–1810.* Memorial exhibition on the cartographic work of János Lipszky, on the occasion of the 250th anniversary of his birth. National Archives of the National Archives of Hungary and the Institute and Museum of Military History. (Exhibition)
 - *A Magyar Királyság általános térképe, 1804–1810.* Memorial exhibition on the cartographic work of János Lipszky hussar officer, on the occasion of the 250th anniversary of his birth (Conference)
 - Participation in the events of „The Night of Museums” and of the „The Night of Researchers.”
 - *Az I. világháború térképeken 2. Háborús hétköznapok* (Exhibition)



Opening of the Lipszky Conference and Exhibition by István Klinghammer, 2016

- 2017
 - *Szép Magyar Térkép 2016* (Exhibition)
 - *Kincsek gróf Széchenyi Ferenc gyűjteményéből 6. Németalföld aranykora* (Exhibition), https://szechenyiterkepek.oszk.hu/hu/nemetalfold_aranykora
 - *Az I. világháború térképeken 3. Válogatás a gyűjteményből* (Exhibition)
 - Participation in the events of the „The Night of Museums” and of the „The Night of Researchers.”
- 2018
 - *Szép Magyar Térkép 2017* (Exhibition)
 - *Az I. világháború térképeken 4. Határviták* (Exhibition)

List of selected publications, other scientific works

- 2016
 - Danku, György: *Is This the Original? A Manuscript Map of the Mexico Valley by Adrián Boot*. In: *Imago Mundi* 2016, Vol. 68, Part 1: 79–87.
- 2017
 - Danku György: *A Széchenyi Könyvtár Térképtárának új szerzeménye. A New Mapp of the Kingdom of Hungary and the adjacent countries by Phil. Lea*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 1–14.
 - Danku György: *Luigi Ferdinando Marsigli. Fordulat Magyarország térképi ábrázolás-történetében*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 31–42.
 - Pászti László: *Lipszky János Tabula generalis Regni Hungariae című térképének utóélete*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 39–46.
 - Pászti László: *Hungarika-térképek a Humboldt Egyetem Földrajzi Intézetének térképgyűjteményében*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 59–94.
 - Pászti László: *Edmund von Zuccheri Magyarország-térképei*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 115–127.
 - Pászti László: *Kiegészítés a Lipszky-térképek és feldolgozásaik jegyzékéhez*. In: *Térképtörténeti Közlemények* 1. Budapest, 2017. 129–144.



The Beautiful Hungarian Map exhibition, 2017

- 2018
 - Danku György: *Pierre Duval Carte de la Hongrie a l'Autriche című térképének állapotai*. In: Térképtörténeti Közlemények 2. Budapest, 2018. 33–44.
 - Danku György: *Gróf Széchenyi Ferenc térképgyűjteménye a számok tükrében. Gyűjteményrekonstrukció és eredményei*. In: Tanulmányok egy évforduló tiszteletére. Szerk. Deák Eszter – Dede Franciska. (Bibliotheca Scientiae et Artis XI.), Budapest, 2018.
 - Danku György – Oláh Krisztina: *Novissima et accuratissima totius Angliae, Scotiae et Hiberniae tabula*. *States of the single-sheet map of the British Isles by the Danckerts*. In: Journal of the International Map Collectors' Society, 2018. június, 16–25.
 - Oláh Krisztina: *Presentation of changes in the legend of celestial globes using virtual 3D models* (13th ICA Conference on Digital Approaches to Cartographic Heritage. Madrid)
 - AUTH CARTOGEOLAB 13 2018. 257–263 (társszerző: Gede Mátyás)
 - Oláh Krisztina: *Felülragasztott földgömbök a 20. század közepéről* In: Történelemtanítás online történelemdidaktikai folyóirat. 2018. december 14. (Társszerző: Méreg Martin) <http://www.folyoirat.tortenelemtanitas.hu/2018/11/mereg-martin-olah-krisztina-felulragasztott-foldgombok-a-20-szazad-kozeperol-09-03-08/>
 - Pászti László: *Greipel Edvárd, egy 200 éves magyar nyelvű világatlasz készítője és kiadója*. In: Térképtörténeti Közlemények 2. Budapest, 2018. 59–70.

The Cartographic Collection of the Map Room of the Hungarian Institute and Museum of War History

This Map Room of War History was founded in its present form in 1954. The backbone of its total collection was made up of two sets of earlier materials:

- a fifty thousand-piece collection rightfully belonging to Hungary was transferred from the War Archives (Kriegsarchiv) of Vienna to the Hungarian Royal Archives of War History (later: War Archives) after the first world war;
- a sixty thousand-piece set of objects of the Royal Hungarian Cartographic Institute (later: Defence Mapping Institute) was founded following the first world war.

The collection of the Map Room grew steadily partly by old maps (heritages, materials of other discontinued collections), partly by new acquisitions (military map series, aerial photographs, other civilian maps). The total collection now numbers nearly 500,000 items (maps, atlases, globes, relief maps, professional journals, books, aerial photographs), and by sheer size it constitutes the largest cartographic collection in Hungary.

Subdivision of the Cartographic Collection

The majority of maps are grouped according to the following geographical-regional divisions:

- maps of the heavens, of the world - historical, geographical atlases;
- maps of the continents
- maps of cities and their vicinities, travel guide books
- maps of war history - maps showing battles, campaigns, military events - are further grouped according to chronological sequence, following the classification of major historical epochs.

Within the territorial divisions there are the following thematic classes:

- general political, administrative maps
- physical maps
- special thematic maps

One of the most important parts of the collection of the Map Room is made up of the military series based on detailed field surveys, showing both Hungarian and foreign territories. In Hungary only the Map Room possesses complete series of the first military survey (1772–1784), second military survey (1806–1869) and the third military survey (1869–1884). These maps are available on the Mapire website (www.mapire.eu).

The collection consisting of the military series published by the Royal Hungarian Cartographic Institute, established after the first world war, can also be considered as complete, both for basic survey and derived scales.

The Map Room's collecting interests also cover military series of different scales and publishing years published after the Second World War in a different mapping and projection (Gauss–Krüger system).

The 120,000-piece collection of aerial photographs also has considerable value. A smaller part of them was made before the Second World War, while most of them are copies of air photos made for mapping purposes during the 1950s, '60s and '70s.

On the website hungaricana.hu there are 11,000 records, 23,000 maps from the material of the map room, from the 16th, 17th, 18th, 19th and the first part of the 20th century.

The Map Room is a public collection open to the research from 9 a.m. to 3 p.m. from Tuesday to Thursday. The digital copies of maps are available on order.

The Map Room took part in the organization of different exhibitions of the War History Museum by lending maps.

List of selected publications, other scientific works:

- 2015
 - Jankó Annamária: Tóth Ágoston, a térképész. In: Tóth Ágoston honvéd ezredes, a katona és a térképész 1812-1889. 25-42. o. HM Zrínyi Térképészeti és Kommunikációs Szolgáltató Közhasznú Nonprofit Kft. 2015.
 - Jankó Annamária: Polgári és katonai felmérés II. József korában. In: Térképtörténeti Közlemények, digitális folyóirat. 2016. május.
- 2018
 - Buga L., Hegedüs Á., Jankó A., Mihalik J., Rojkó A., Suba J., Szabó B., Szabó Gy., Sz.-né Szalánczi E., Tremmel Á., Várszegi L.: A magyar katonai térképészet 100 éve. 1919-2019. 100 years of Hungarian military mapping. 1919-2019. Budapest, 2018. 484 p. + DVD.
 - Jankó A.: A Hadtörténeti Térképtár. In: száz éves a Hadtörténeti Intézet és Múzeum. 1918-2018. Budapest, 2018. 212-237. p.
 - Jankó A.: A digitális Eperjesy katalógus. In: Hadtörténelmi Közlemények 131 évf. 2018. Különszám. 33-62. o.
 - Jankó A.: Az első katonai felmérés alapján készült 1:230 400 méretarányú térképek, avagy mit nem használt térképének elkészítéséhez Lipszky János. Térképtörténeti Közlemények 2. Budapest, 2018. OSZK. 12 o.

- Suba János: Az Állami Felmérés szerepe a trianoni határ kitűzésében felmérésében magyar-osztrák határszakaszon. In: *Catastrum* V. évf. (2018) 2. szám. 39 -57. p.
- Suba János: A Magyar Királyi Honvédség speciális térképművei a Hadtörténeti Térképtárban. In: *Hadtörténelmi Közlemények* 131 évf. 2018. Különszám 184-214.p.
- Suba János: Hadifelmérés az Osztrák-Magyar Monarchia hadseregében az I. Világháború idején. In: *Történeti Földrajzi Közlemények* 2018. 6 évf. 2. szám 95-105.p.

5. Literature, journals

Geodézia és Kartográfia

The only professional journal of Hungarian surveyors and cartographers is *Geodézia és Kartográfia* (Geodesy and Cartography), published since 1949 and at present by the Hungarian Society of Surveying, Mapping and Remote Sensing.

This periodical is publishing scientific articles and other items from geodesy, surveying, geoinformatics, cartography, land registration, remote sensing, photogrammetry, and from other related areas if their content fits in the professional profile of the journal. *Geodézia és Kartográfia* publishes only original papers that had not been published in other journals.

The journal wishes to help the Hungarian Society of Surveying, Mapping and Remote Sensing to achieve its objectives set in its statutes [II. 2. § (2)] by

- publishing the research results of Hungarian professionals living in or outside the home-country and of other foreign scientists,
- presenting new professional achievements, techniques and tools,
- publishing reports and news on professional and social events and programmes as well as announcements and commemorations,
- introducing and popularizing the activity of professional teams, institutions, civilian and state organizations active in the main fields of interest.

In ethical questions, *Geodézia és Kartográfia* follows the international standards of the Committee for Publishing Ethics (COPE), <http://publicationethics.org/resources/flowcharts>.

Geodézia és Kartográfia is published bimonthly in colour printed form on (regularly) 48 pages in format A4.

- 1949–1961: four volumes/year.
- 1962–1995: six volumes/year (various numbers of pages, occasional double volumes).
- The journal was printed in black and white until 1995 (A/4 size).
- 1995: volume 5 was printed in A/5 size (colour cover page), no volume 6 in this year.
- 1996–2010: twelve volumes/year (A/5).
- Since 2011: all pages printed in colour (A/4 size, ten volumes/year, 32 pages/volume).
- 2012–2016: six double volumes.
- Since 2017: six volumes (alternating number of pages: 32-48).

1. DOI (Digital Object Identifier) since 2018

The journal became a user of the CrossRef's metadata system with the introduction of the DOI. This makes the referencing to its articles easier and unambiguous, which is beneficial to the reputation of the printed or online journal.

2. The availability of the complete archive of *Geodézia és Kartográfia* in a database

The complete content is made available for the readers with a delay of one month. According to a contract with Arcanum Database Ltd., all the published editions of the journal will be digitized in the first half of 2019. The material will be entered into the Arcanum Digitheca, which will increase the digital visibility of the content. The processed editions have now been available at <https://adtplus.arcanum.hu/hu/collection/GeodeziaEsKartografia/>. The complete content will be available from the homepage of the Hungarian Society of Surveying, Mapping and Remote Sensing. At present, the contents of the issues published in the past six years, the abstracts of papers and the reviews are available at <https://www.mftt.hu/mfttportal/index.php/geodezia-es-kartografia/a-laprol>.

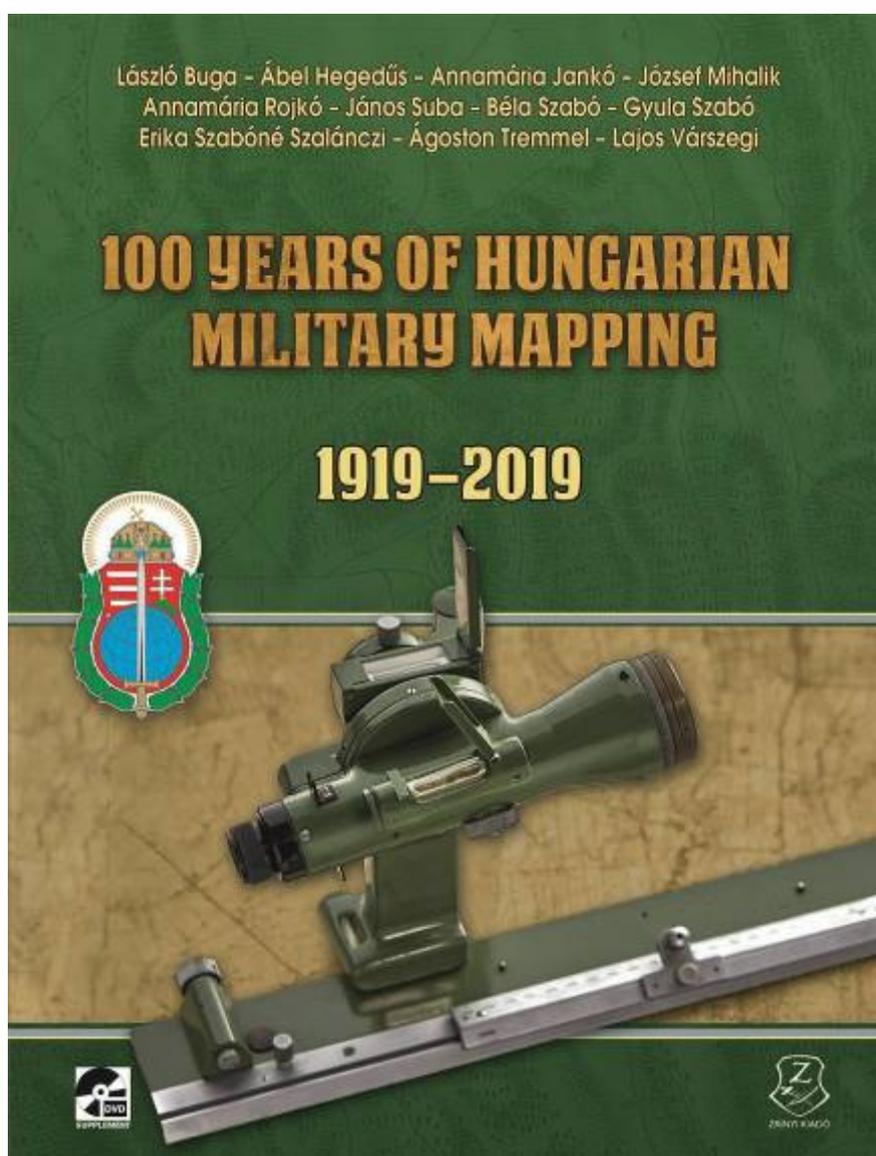
Geodézia és Kartográfia has been indexed by Scopus. At present, the data content of *Geodézia és Kartográfia* is available for 1979 to 1981, from 1988 to 1989, from 1991 to 1992, from 1995 to 2017: <https://www.scopus.com/sourceid/28609?origin=resultlist>.

100 years of Hungarian Military Mapping (commemorative book)

The beginnings of Hungarian military mapping go back to the mid-18th century, but the first organization of independent Hungarian military mapping was established only after the dissolution of the Austro-Hungarian Empire. Nevertheless, the transition was almost smooth, which shows well that their high-level expertise and their commitment to the profession have always helped our military cartographers to get through the storms of history. This book presents their work and commemorates the historic activity conducted by them in the last 100 years. The DVD supplement to the book contains excerpts from military topographic and thematic maps as well as maps made for the public that were produced at the Mapping Institute during the last 100 years.

Authors: Buga László (editor), Hegedűs Ábel, Jankó Annamária, Mihalik József, Rojkó Annamária, Suba János, Szabó Béla, Szabó Gyula, Szabóné Szalánczi Erika, Tremmel Ágoston, Várszegi Lajos.

484 pages+DVD supplement.



6. Private companies

Company name	Website
Arcanum	https://www.arcanum.hu
Belma	http://www.belma.hu/
Cartographia	http://cartographia.hu/
Cartographia Tankönyvkiadó	https://www.cartographia.org/
Civertan	https://www.civertan.hu/
Dimap	http://www.dimap.hu/
Frigória	https://www.frigoriakiado.hu/
GiziMap	https://www.gizimap.com/
Hibernia Nova	http://www.hibernia.hu/
Magyar Térképház	https://terkephaz.hu
Nyírkarta	http://www.nyirkarta.hu/
Schwarcz Térképkészítő Műhely	www.schwarczterkep.hu
Stiefel	http://www.stiefel.hu/
Szarvas Térképek	https://www.map.hu/