

MAPPING SERVICES IN THE CZECH REPUBLIC

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ABSTRACT

The paper describes the State Map Set of the Czech Republic. Scales, map contents and availability for users are presented. Map publishing on Geoportals, access to present and historical maps, remote sensing data and map updating are hot topics in the last few years. The Czech Republic as a country of the European Union not only follows the Union rules and recommendations, however, it also develops relations between end users and data providers at a world level with free Open Access to Cadastre. A new system of basic registers – Register of Inhabitants, Register of Persons, Register of Land Identification, Addresses and Real Estates, and Register of Rules and Rights connecting, unifying and harmonizing personal, spatial and other data are in the full functionality in the Czech Republic.

INTRODUCTION

Mapping history is very long in the world. The second half of the 20th century marked an important change with world computerisation. However, it was already the first half of the 20th century, which brought a new data source for mapping – aerial imagery and the second half of the century satellite imagery. The previous classic methods of mapping were enlarged by new methods using computer tools – digital vectorisation and image processing.

The history of the Czech Republic mapping system is strongly influenced by the history of the country. The Republic was a part of the Austria-Hungarian monarchy. The mapping of the monarchy was performed both in a large scale as cadastre maps and medium scale of military mapping. Both map types were used even in newly created Czechoslovakia after 1918. A new political situation after the 1948 also led to a new policy of mapping services in the country.

Czechoslovakia split mapping services into two different lines – a civilian and military ones in 1969. The civilian line is available for all users from 1:5 000 to 1:500 000 scales. They are used also as a topographic base for thematic layers. The Topographic Service of the Czechoslovak Army processed the mapping after the World War II up to 1969. Since 1969 two different mappings were performed; civilian and military. The civilian maps were open for selected organisations and did not comprise coordinates; the military were marked as secret for all except for the Army. The lines differ by their content, areas of map sheets and map sheet layout graphic outlook. The civilian map series was open to public after 1990.

STATE MAP SET OF THE CZECH REPUBLIC

The State Map Set of the Czech Republic is map sheets covering the whole country. Their processing respects unit rules, is performed by a state organisation and in the name of public needs. The Set comprises of basic state topographical maps and thematic state maps.

The State Map Set covers a large range of map layers starting by cadastre maps as the large-scale base maps. The cadastre of real estate is a collection of data on real estate in the Czech Republic including its register, description and its geometric and spatial determination. It includes a registry of ownership and other material rights and additional rights to real estate provided by law.

The base of cadastre maps can be found in the Stable Cadastre made in 1826-1843 (the Bohemian part) and 1824-1836 (Moravia and Silesia). The Stable Cadastre comprised of three parts – a part called “evaluating” classifying the land to determine land price, a written part with data about individual real estates and maps – Imperial Imprints. The Imprints used a 1:2880 scale, cities were mapped in more detailed scales – either 1:1440 or even 1 : 720. Two thirds of the present cadastre maps are in the digital vector format and the rest in the raster format (scanned). A certain number of cadastre maps – were newly mapped after 1918 - is at 1: 1000 or 1: 2000 scales.

The following large-scale map layer is the State Map at 1:5000. The layout of the map sheets is defined by division of each 1:50 000 map sheet to one hundred of 1:5 000 map sheets. The topography of these maps is a result of a generalisation of cadastre maps and heights are derived from 1:10 000 maps. The Republic is covered by 16 301 map sheets of this scale.

Base maps of the Czech Republic being a set of medium-scale maps of topographic character, are at scales of 1:10 000, 1:25 000, 1:50 000, 1:100 000 and 1:200 000. The maps contain planimetry, altimetry and lettering. They are processed in a uniform layout of map sheets specifically designed for the purpose of their compilation considering optimal coverage of the territory by map sheets. Individual map sheets are trapeze-shaped and oriented approximately in geographic directions. The 1:10 000 map scale has become a base for a row of the base map scales where 1 : 25 000 maps are a result of the 1:10 000 map data generalization, the 1:50 000 map layer is derived from the 1:25 000 layer by generalization and so forth.

The maps use Bessel's ellipsoid and the Czech coordinate system - S-JTSK (Křovák) data.

The map of the Czech Republic at the scale of 1:500 000 is a general geographic map of a small scale showing the entire territory of the Czech Republic on a single map sheet.

All map layers are processed using digital technology.

The maps are maintained by the Czech Office for Surveying, Mapping and Cadastre.

MILITARY MAPS OF THE CZECH REPUBLIC

The country was mapped as a part of the Austria-Hungarian Monarchy by three Military Mappings. The Third Military Mapping was performed between 1874 and 1880 at 1:25 000, in military important areas even 1 : 12 500 . The generalized maps of the Third Military Mapping to 1 : 75 000 were used with Czech lettering even in Czechoslovakia between two World Wars up to 1956. However, the two independent military mapping campaigns covering the whole territory of the country were performed after the WW II: mapping at 1:25 000 scale between 1952 and 1957; and mapping at 1:10 000 scale between 1957 and 1971.

A new system of military maps was developed after 1969 after the division of civilian and military mapping Map series at 1:25 000, 1:50 000, 1:100 000, 1:200 000, 1:500 000 and 1:1 000 000 scales have been processed. They used Krassovski's ellipsoid and Gauss-Krieger's coordinate system. The map layers were produced and maintained by the Topographic Service of the Czechoslovak Army.

THEMATIC MAPS

Thematic maps are produced by state organizations like the Czech Geological Survey, Czech Hydrometeorological Institute, Regional Authorities, etc. All maps using various scales (usually from 1: 25 000 to 1: 2 500 000) are based on the civilian maps.

The Czech Geological Survey has a database of 13 map layers at 1:5 000, 33 map layers at 1:25 000 and 1:50 000,

FROM ANALOG TO DIGITAL MAPS

The period of 90's of the 20th century was a period of paper map conversion to digital maps. The digitisation was performed in two steps. The first one was scanning of map and raster maps were offered as geocoded maps sheets. The second step was their progressive vectorization. The process concerned both of topographic – civilian and military, and thematic maps. The map vectorization was in fact a process of transformation from analogue maps to maps in geographic information systems.

The Cadastre maps are in the raster format for the whole country. There are two vector format data available. The first one - Digital Cadastral Maps (DKM) are cadastral maps in S-JTSK datum created by the renewal of the cadastre documentation by new mapping on the basis of land adaptation results, by change of the file of geodetic information (with exception of digitized Cadastre Maps) or by transfer of its numeric representation to digital form.

The second one - Digitized Cadastre Maps are cadastre maps in S-JTSK datum created by the renewal of the cadastre documentation by revision – transfer of analogue map to digital form (KMD) or (KM-D), i.e. digital form of a cadastral map is created according to former rules, especially in Gusterberg or St. Stephen datum.

The Basic Maps of the Czech Republic at 1: 10 000 were a base for ZABAGED,

Digital Geographical Model of the Czech Republic having the data types equivalent to the 1 :10 000 scale. The data object categories form eight groups:

1. Communes, economic and culture objects
2. Transport network
3. Underground utilities
4. Water bodies
5. Land units including protected areas
6. Vegetation and land cover
7. Terrain relief
8. Geodetic points

ZABAGED comprises 122 basic types of geographical objects and more than 350 attributes. Fig. 1 shows a spatial and table form of electricity network.



Kategorie objektů:	3. ROZVODNÉ SÍTĚ A PRODUKTOVODY			
Typ objektu: <small>(s pořadovým číslem)</small>	3.03 ELEKTRICKÉ VEDENÍ			
Kód typu objektu:	AT030			
Definice objektu:				
Uspořádání vodičů, izolačních materiálů a konstrukcí pro přenos elektrické energie mezi dvěma body elektrické sítě.				
Geometrické určení objektu:	linie			
Geometrická přesnost:	B			
Zdroj dat geometrických:	původní zdroj: ZM 10 letecké měřičké snímky, ortofoto, šetření v terénu, dokumentace ČEPS, a.s.			
Zdroj dat popisných:	dokumentace ČEPS, a.s.			
Atributy:				
Název atributu	Datový typ	Předmět atributu	Hodnota atributu	Význam hodnoty atributu (identifikátor)
NAZEV	VARCHAR2(30)	označení vedení		-
NAPETI	VARCHAR2(5)	nejvyšší napětí v kV		-

Fig. 1 Vector and attribute parts of ZABAGED

The ZABAGED data are updated from aerial orthophotos regularly in the 3-year cycle. The data are generalised for Base Maps of the Czech Republic at 1:25 000 scale.

ZABAGED is a fundamental vector and attribute data source for all other smaller scales. There are two databases created from ZABAGED as it is shown on Fig. 2.

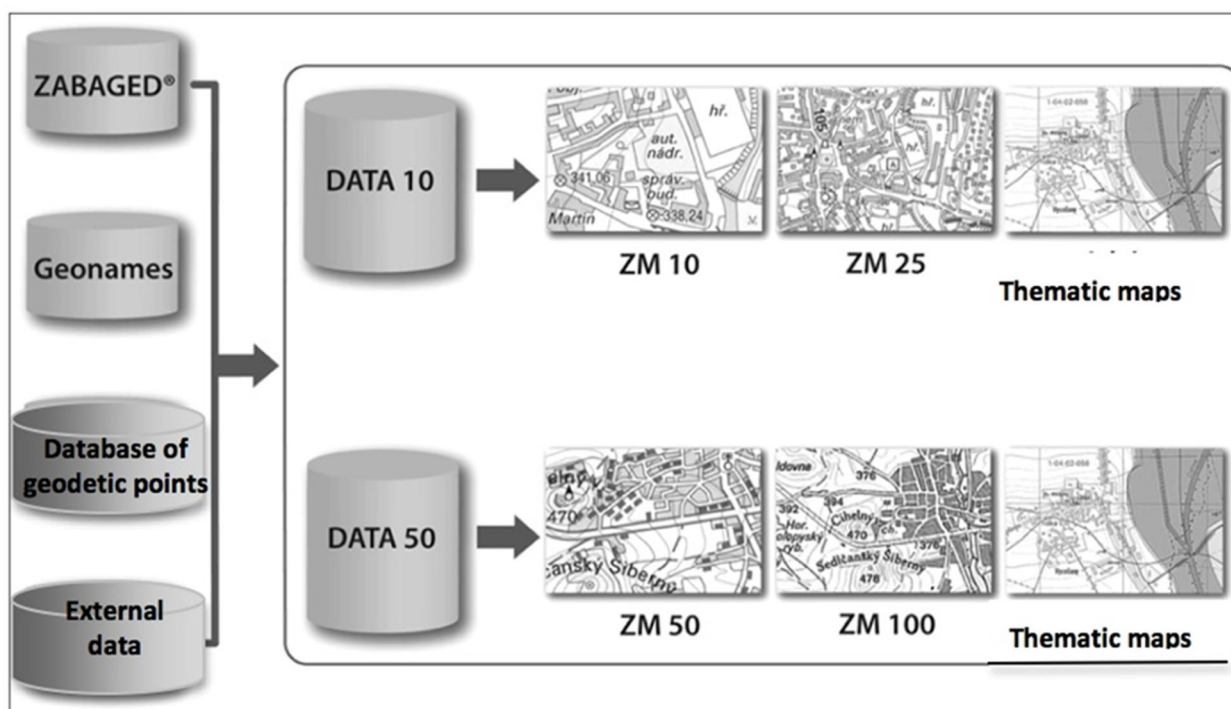


Fig. 2 Data structure for producing Base Maps at 1:25 000, 1:50 000, 1:100 000 scale from ZABAGED, Geonames database, Database of Geodetic Points and External Data

The Base Map of the Czech Republic at 1:25 000 (ZM 25) is the basic state map series of medium scale. It is a general geographic map, i.e., map of a topographic nature. Maps of this scale cover the whole republic by 773 map sheets. Their dimensions and indexing are derived from the map layout of 1:50 000 Base map by a division into four sections. The ZM 25 maps contain planimetry (settlements and individual objects, communication networks, hydrology, administrative and cadastral boundaries, boundaries of protected areas, vegetation and soil surface), altimetry (contour lines and terrain steps) and lettering. Map lettering includes toponymy of objects, standardized geographic nomenclature, contour values, height values, border information and external information - for the territory of the Czech Republic only.

The Base Map of the Czech Republic at 1:50 000 (ZM 50) is the basic state map series of medium scale and a synoptic geographic map. The entire territory of the Czech Republic is covered by 211 map sheets. Their dimensions and indexing is derived from the map layout of 1:100 000 Base map of the Czech Republic by splitting into four sections.

The ZM 50 contains planimetry, altimetry and lettering – the same as at ZM 25, however, both for territory of the Czech Republic, and neighbouring states on appropriate sheets. The ZM 50 layer is the most used base map for thematic maps.

The Base Map of the Czech Republic at 1:200 000 (ZM 200) is the basic state map series of medium scale. It displays the entire territory of the Czech Republic in a continuous map layout in 18 map sheets. Their dimensions and indexing represent a basic map layout used for all basic map layers of the Czech Republic. The ZM 200 contains planimetry (settlements and individual objects, communication networks, hydrography, boundaries of regions and districts, boundaries of protected areas, land cover and soil surface), altimetry (contour lines and terrain edges) and lettering (only at the territory of the Czech Republic).

The Map of the Czech Republic at 1: 500 000 (MČR 500), the base state map, is a synoptic general geographic map covering the Czech Republic on a single map sheet.

The MČR 500 contains planimetry (settlements, transportation highways, speedways and 1st class roads, hydrology, state and regional boundaries, vegetation and land surface - forests), spot heights, geographic coordinate grid, description and the map legend.

Since 1999 when the Czech Republic became a member of NATO, military maps in digital format, which are produced by the Geographic Service of the Czech Republic Army, serve for military purposes only; 1:200 000 scale was replaced by 1:250 000 scale. The maps use WGS-84 system. Digital Mo

Map of Land at 1:25 000 and 100 000 from 2007 are open to public.

Altimetry data of the Czech Republic territory, maintained by the Land Survey Office, are recently stored in ZABAGED and provide height information on terrain relief.

The ZABAGED altimetry uses 3 types of contour objects with 1, 2 or 5 m basic intervals: The contours are three-dimensional vectors. The other altimetry data type is a digital terrain model in 10 x 10 m regular grid. The data were a result of vectorisation of contours of 1:10 000 Base map of the Czech Republic (ZM 10). These contours mostly from 1957 – 1965 period photogrammetric processing were updated in 2005 – 2009 period by photogrammetric processing. The final product is 10 x 10 m grid of 3D points.

New altimetry has been measured since 2010 by aerial laser scanning. Two digital models of relief are produced: they are called the Digital Terrain Model of the 4th Generation (DMR 4G) and the Digital Terrain Model of the 5th Generation (DMR 5G). DMR 4G is an altimetry system using the regular 5x5 m grid. The layer covers two thirds of the country and it is planned to be complete in 2013. The DMR 5G is created by TIN. The TIN model is planned to be finished in 2015; 30 % per cent of the Czech Republic territory has already been processed. The last altimetry data is Digital Surface Model of the Czech Republic of the 1st Generation (DMP 1G) whose processing should be finished by 2015.

MAP AVAILABILITY IN THE 3RD MILLENIUM

The period after 2000 can be called as an access to the map data from distant computers via the Internet. A new element, geoportals, offer their data including map data. The map portal service is twofold; open access using WMS tool to raster map data and usually paid access to vector map data. The portal services are redundant as the same data/maps are placed in several servers. The portals are organized by individual data providers and by regional and state organisation grouping data from different data/map providers.

The civilian topography map data provided by the Czech Office for Survey, Mapping and Cadastre (ČÚZK) are on its Geoportal (see the introductory page of the ČÚZK Geoportal on Fig. 3).

The geoportal opens an access to all base maps and cadastral maps also using information tables of individual products. The Czech Office for Survey, Mapping and Cadastre created the Information System of Cadastre of Real Estate. The basic information about cadastral maps of the system is shown on Fig. 4. The same table type information is available for all base map layers with updated information on the present state of data.

These data are presented on the ČÚZK Geoportal in two types of services for access to the cadastre data.

One access is called Open access to (Previewing) the Cadastre and it is a free service for any user. The data are informative only. A user is allowed to:

- 1) find real estate and its parcel number, commune, area, parcel type, map sheet, land use, type of land use, owners, protection, soil type and other data,
- 2) find information about neighbouring parcels,
- 3) find information about other real estates of the parcel's owner,
- 4) use various map background – cadastre map, cadastre map and aerial orthophoto mosaic, map of the land cadastre, map of the land cadastre and aerial orthophoto mosaic

Figs. 5 and 6 are examples of the attribute and spatial data a user is allowed to find on the ČÚZK Geoportal.

The second access is called Remote Access to the Cadastre and it is a paid service for registered persons only. The data are referenced data. "

Military maps are produced from two map databases – DMÚ 25 and DMÚ 100. These databases – Digital Model of Land at 1:25 000 and 1:100 000 are on IZGARD geoportal maintained by the Military Geographic and Hydrometeorological Office. DMÚ 25 comprises 190 objects of 20 categories, DMÚ 100 comprises 102 objects in 15 categories. Maps of other scales are available only for military purposes defined by the NATO rules. Fig. 7 shows the military portal IZGARD. 1:25 000 maps are updated from aerial orthophotos and the other map scales are produced by generalisation of this scale

Final map sheets for printing are processed from the digital objects of the databases.

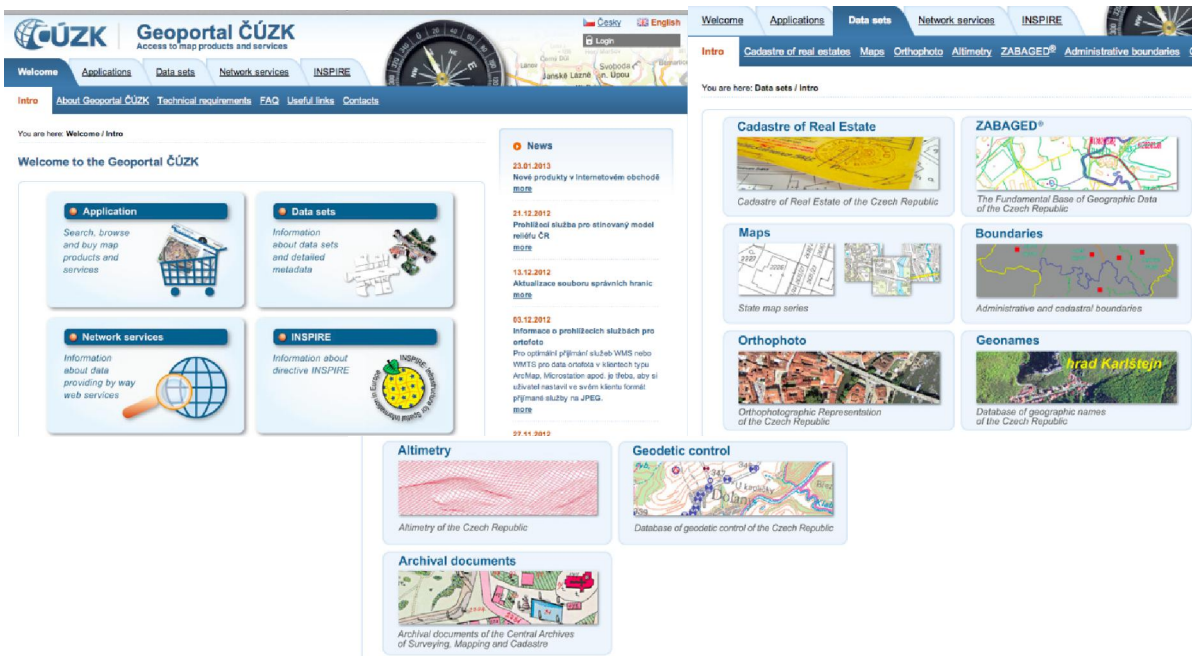


Fig. 3. Geoportal of the Czech Office for Survey, Mapping and Cadastre

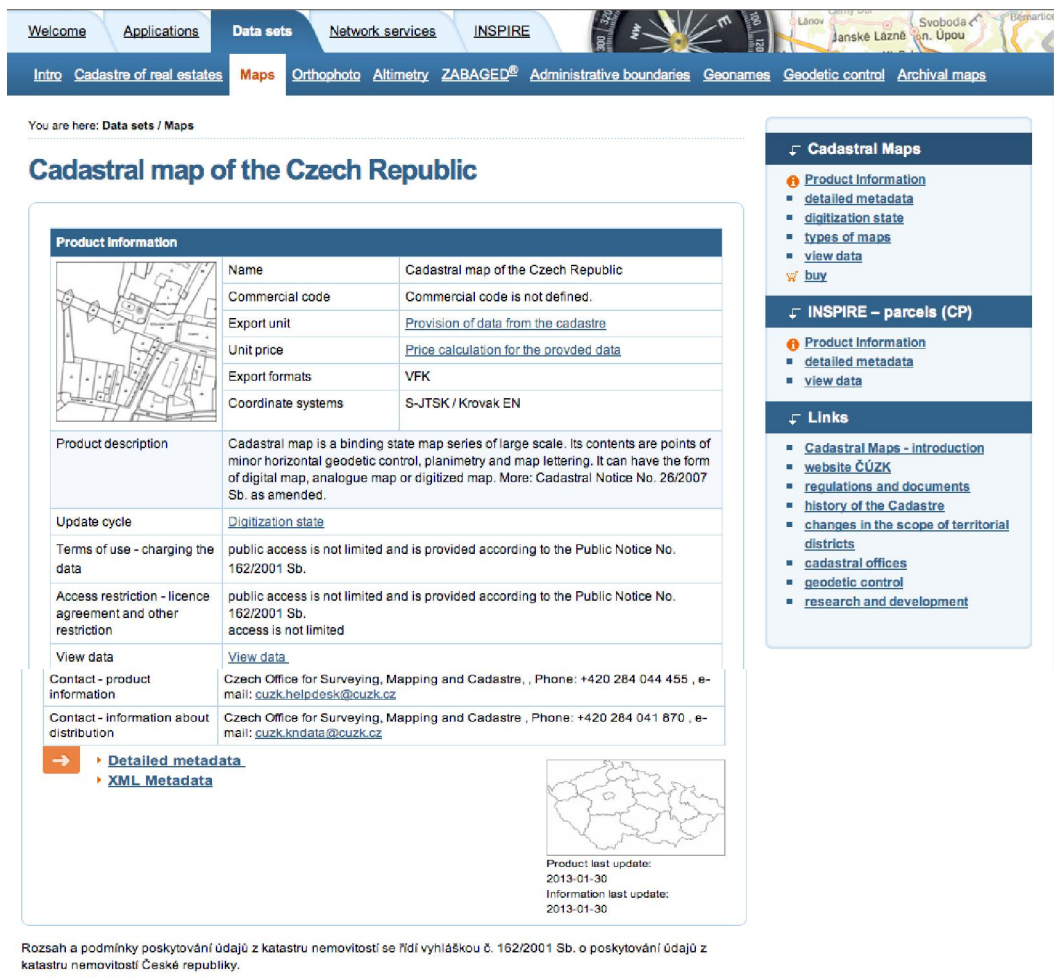


Fig.4. A part of product information on vector data of Cadastral maps on the CUZK Geoportal

Informace o parcele

Parcelní číslo:	1777/1
Obec:	Praha [554782]
Katastrální území:	Břevnov [729582]
Číslo LV:	2203
Výměra [m ²]:	327
Typ parcely:	Parcela katastru nemovitosti
Mapový list:	DKM
Určení výměry:	Ze souřadnic v S-JTSK
Způsob využití:	zeleň
Druh pozemku:	ostatní plocha

Informace z RÚIAN Sousední parcely

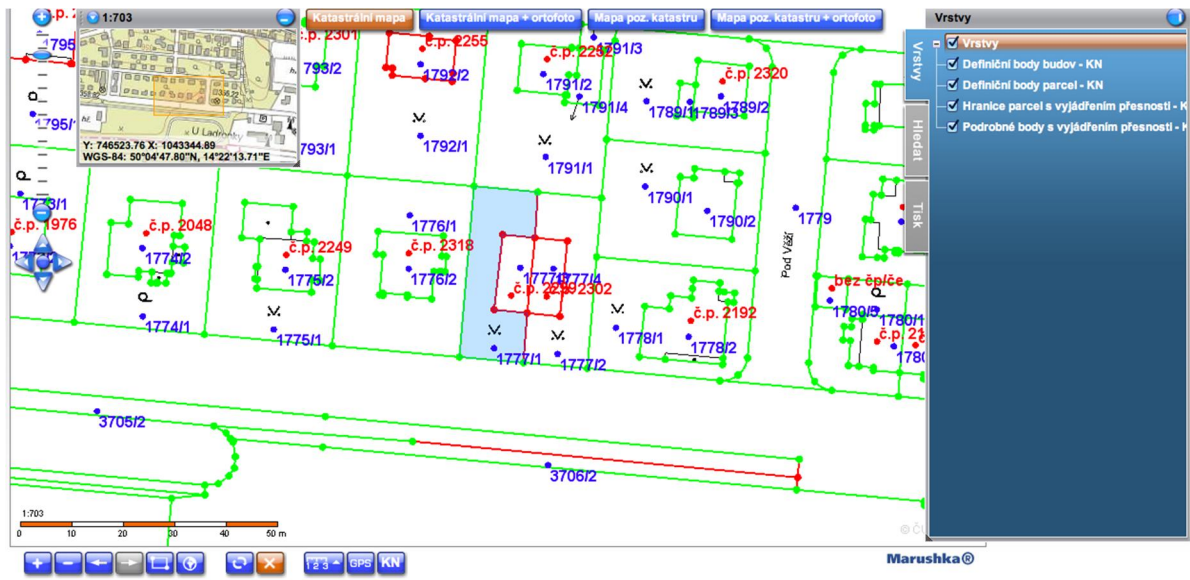
Vlastníci, jiní oprávnění



Zobrazení v grafickém prohlížeči



Fig 5. Information about a parcel and Cadastre vector data imaged with aerial orthophoto mosaic



Obsah katastrální mapy a mapy pozemkového katastru se zobrazuje od měřítka 1:5000. Podrobnější informace k používání mapy, aktualizaci dat a jejího obsahu jsou uvedeny v nápovědě (PDF formát).

Fig.6. Cadastre map of the Information System of Cadastre of Real Estates

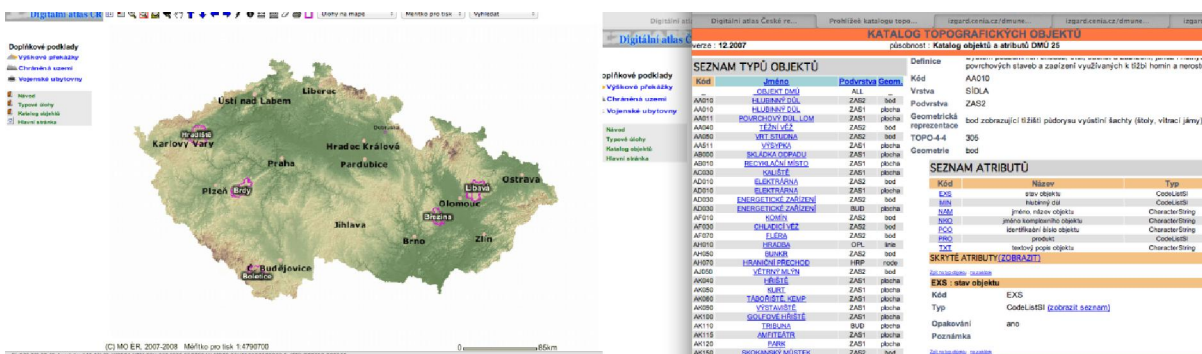


Fig7. First page of IZGARD geoportal, part of a list of object and one object attribute table

FROM INFORMATION SYSTEMS ON GEOPORTALS TO REGISTERS

The Information System of Cadastre of Real Estate has been interconnected in 2012 with four registers - Register of Land Identification, Addresses and Real Estate, which is another spatial information system and three non-spatial information systems Register of Persons, Register of Inhabitants, and Register of Rights and Duties. The registers were defined by Law 111/2009 and are managed by the Ministry of Internal Affairs.

The Register of Land Identification Addresses and Real Estate (RUIAN) is a free open access system on website of the Czech Office for Survey, Cadastre and Mapping. It does not comprise of any personal data. The data sources are:

- Information System of Cadastre of Real Estates
- Territorial Identification Address Register
- And other registers – Czech Post, Czech Statistical Office, etc.
- Spatial data from 1:10 000 topographic map database.

RUIAN unifies postal addresses (address points), parcel numbers and building objects as it shown in Fig. 8.

CONCLUSION

The Czech Republic offers a large range of maps of medium scale both in civilian and military mapping. All are available in raster and vector formats. The large-scale maps – cadastre maps are all in the raster format and a part of the country in the vector format (the vectorisation has not been finished yet). Updating of their vector and attribute part is performed in several hours after data validation. Complete updating for medium scale maps are three years. Map sheets are printed only if ordered from digital databases.

The present role of maps in the society has changed. They are stored, maintained and produced in and from the digital format. They permit the creation of an environment for models of parts of the Earth combined with many other data, originally not even planned to be linked up with. The link brings a new step of data quality and data update. Being stored in a unique record for all users is an enormous data storage savings, simplification of data handling thanks to their uniqueness, simplification of data updating, etc. The advantages are for all sides - data providers, end-users and inhabitants. Non-spatial data update is still easier and less time consuming; that is why it can be nearly in real time, unlike most maps.

Very important part of all above mentioned data are metadata, which were not mentioned in the paper. They form another important and indispensable part of all spatial data in the maps. They respect the rules of the European system INSPIRE and are available on geoportals.

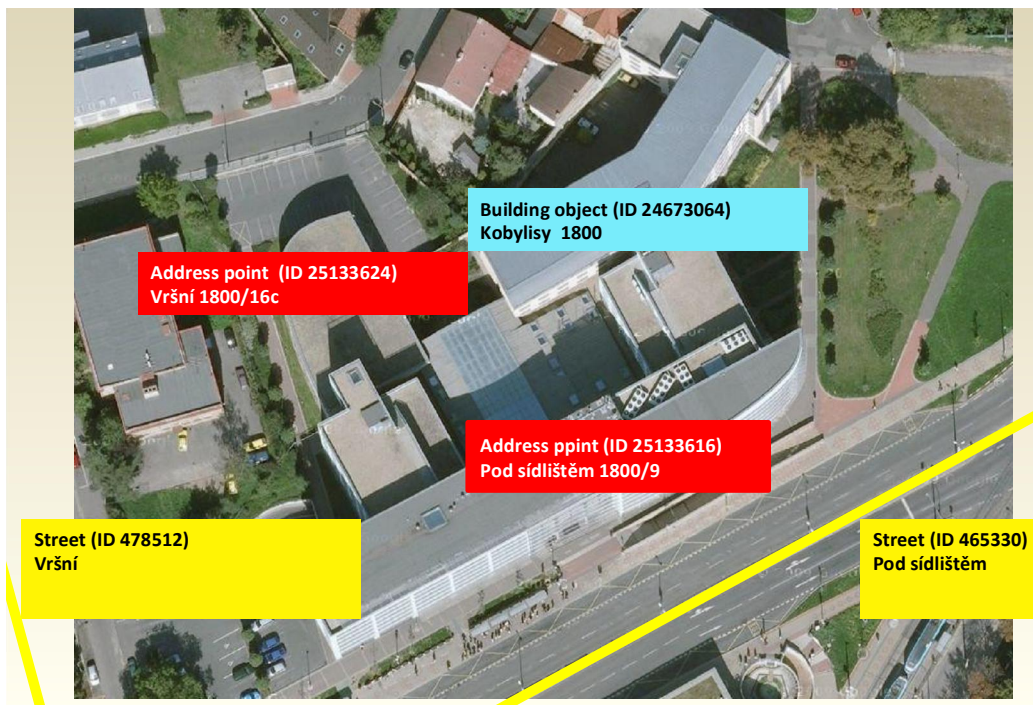


Fig. 8. Example of advantages of RUIAN – two address points in two streets refer to one building object

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