

Work Package 4 – Histories – history of ecological networks

## Historical maps in Central Europe from 18th to the 20th century

### Introduction

Since the mid-18th century until the end of the World War I, most of present day countries of Central Europe were composed of Habsburg and later Austro-Hungarian Empire. At the beginning of the 20. century it was stretching from latitude 42'0 N in south Dalmatia to latitude 51'0 N in the north of Bohemia and from 9,5'0 longitude east of Greenwich to 26'0 longitude in the east Carpathian mountains. In 1913, in this empire lived 55.6 million inhabitants. With regard to area the Austro-Hungarian Empire was the second largest, with regard to population the third largest country of Europe. The area of this empire covered a great variety of types of landscape and 11 different languages were spoken. The river Danube, the real link with all the various parts, between Passau in the west and Orsova in the southeast, was 1.307 km in length and therefore the Austro-Hungarian Empire was also called the Danube Monarch (Kretschmer, 1991). Figure 1 shows great parts of Central Europe in Habsburg Empire.

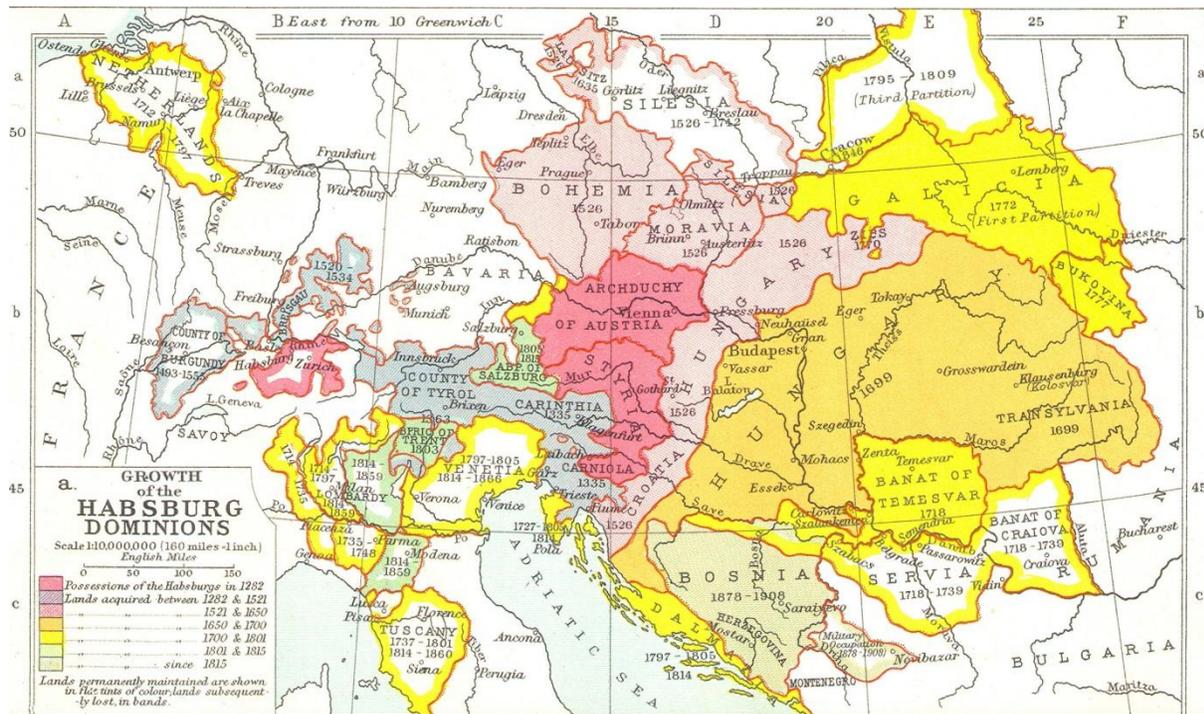


Figure 1. Growth of the Habsburg Monarchy 1282-1908 (Wikipedia)

## **First military survey (Josephine military map), 1763 - 1787**

In the area of the Habsburg monarchy the first maps started emerge at the end of 18th century (Podobnikar and Kokalj, 2007; Podobnikar, 2008) due to seven-year war with Prussia (1756-1763) which monarchy lost mainly due to difficulties in orientation in unknown areas.

For more successful operations military units has always struggled to gain knowledge on the strategic, topographic, road, as well as the economic characteristics of the territories, which could become scene of military operations. By the mid-17.<sup>th</sup> century maps made by private cartography were used, for the purposes of direct military conflict as well as maps of small areas that have been made by individual military units. With the introduction of a permanent army in the 17th century, the knowledge of the territorial characteristics had been spread in peaceful times, if they wanted to organize the installation of the units, their maneuvering and reasonable choice for the army ordered spaces. Since the second half of the 17.<sup>th</sup> century among the cartographers were increasing number of officers, mostly engineers, who were almost completely ousted private, civil cartographers. By institutionalizing the military, government cartography, however, did not occur, as was the case in France, where the National Observatory, which was founded by Colbert in 1667, among other things, also made the first accurate measurements of longitude. Such plans, in Austria, not only failed due to the continuing lack of money, but also because of disbanded of the General Command after every war, which was responsible for reconnaissance. Such methods also prevent the necessary continuity for the mapping. Wars in the first half of the 18.<sup>th</sup> century have shown that the incumbent work methods did not meet the goals and that the basis used were not sufficient, because existing maps did not show the details necessary for military action. Maria Theresa in 1763 ordered the military topographical measurement of her vast and diverse regions. Advance a condition for carrying out this task was implemented five years earlier by transformation of the main headquarters in the permanent establishment

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of topographical issues which could be entrusted to a large cartographic project. Despite the decision of the Empress, the work in practice and in science enforced by the name of Josephine military map. Certainly not without reason, because co-ruler, who, after the death of his father in 1765 took the supreme management of military affairs, had always been a personal advocate for the advancement of mapping and military geographic support base, which was institutionalized in the 1764. To speed up the work, it was necessary to take advantage of a period of peace, which was not known how long it would take. Therefore, cartographers did not only shun a single leadership, but also the common triangulation, a common method and common cartographic symbol. In order to complete map within a reasonable time, they decided to use existing cartographic bases for countries. This resulted in differences in quality of work.

Josephine military map was divided into sections within the political subdivisions (Fig. 2). With rare exceptions, map was made in the same scale, in 1:28.000. In general it was plotted with the uniform colors. Significant progress had been made when drawing the terrain, old way with hills and perspective had been abandoned and replaced with a ground plan. Landscapes were drawing with crosses, angled lines and shading (Fig. 3). Since the maps and descriptions were produced for military purposes, it was important that the terrain has been presented very precisely (slopes and the flat sides, mountain slopes and valleys ...). Prevalence of forests, the course of water, arable land and other properties were presented in detail. Cultivated landscape was also carefully presented: all types of settlements, buildings and roads, and signs on them.

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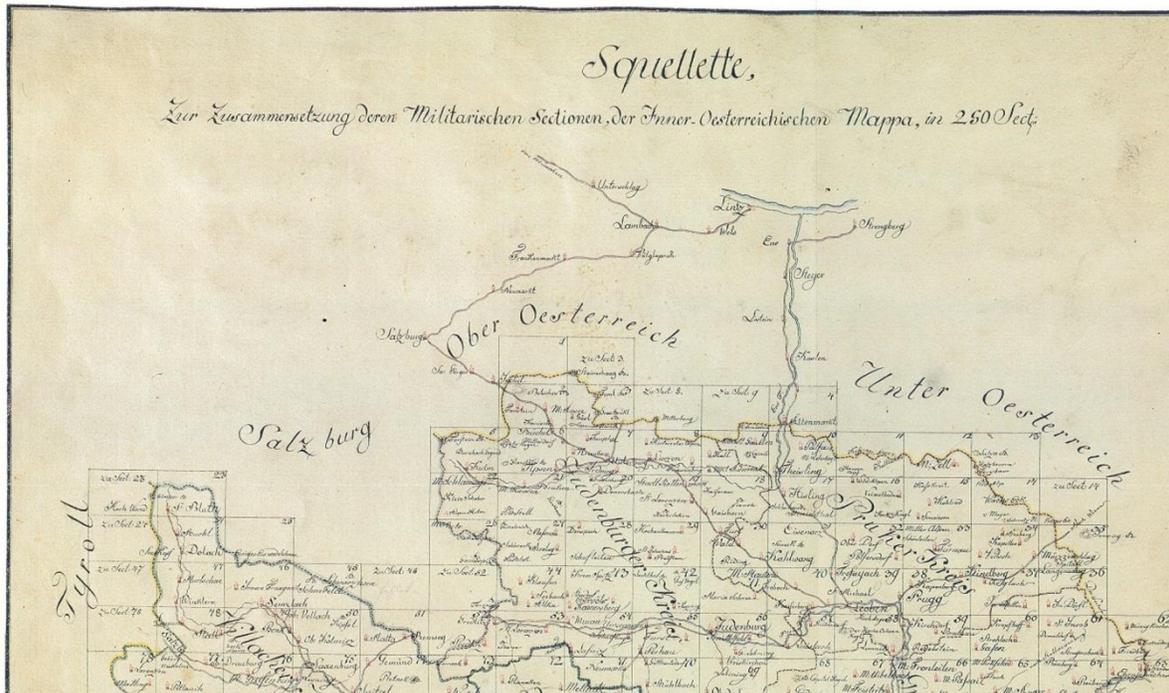


Figure 2. First military survey. A section of division into sections within the political unit Inner Austria (Slovenija na vojaškem zemljevidu, 1995)

The original and the copy were made for each of the 4.685 sections, both in color. Maps of sections are large 42 x 62 cm, shifts of sections are difference by size. Copies are slightly higher, due the surrounding frame. Number of section was written in the upper left corner of the map, the same as the name of the county; the scale in steps was written on the upper right corner (Fig. 3). District boundaries were plotted on the original and the copy. Volume with all data which was not sufficiently shown on the map was attached as a supplement to the map to each section i.e. location of the mountains or the military option of shelling strategic importance areas. The main part of the project was completed in almost 25 years, supplements were added to the end of the century. For the whole Hapsburg possession the work was done until 1787. Mapping was carried out on the political division of the country: Austrian Silesia, Czech Republic, Moravia, Hungary, Banat of Temesvar, Transylvania, Upper Austria, Moldova, Austrian Netherlands, Bukovina, Lower Austria, Banska Krajina, Generalitat of Karlovac, Galicia,

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Slavonia Military Frontier (Militärgrenze), Varaždin Generalitat, civil Slavonia, civil Croatia and Inner Austria (Slovenija na vojaškem zemljevidu, 1995).

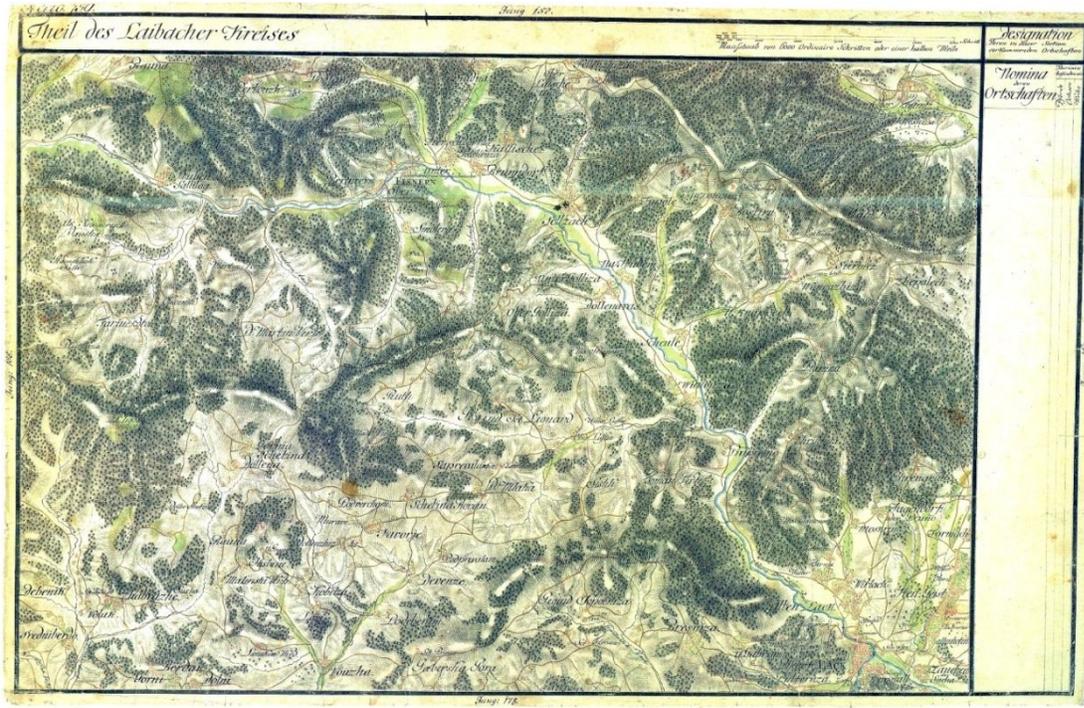


Figure 3. First military survey. Section 159 (Slovenija na vojaškem zemljevidu, 1995)

Josephine military mapping is one of the first state map in the large scale worldwilde. With this first national mapping, Austria outperformed all similar activities of other countries in the 18.<sup>th</sup> century, as a famous map of France, which was completed around that time as a Josephine military map. This precisely drawn and described map remained outside the military circle, to whom was designed, unknown and with no impact on cartography and science. Because of national security the map has been protected as a strict military secrecy. Usage was originally connected to the emperor's personal permission and was granted only to selected persons, but also that only after extensive formal procedures. Only after the abolition of security measures, the science could devote Josephine military map. First, it was used only for military scientific research, but then its value for civil affairs was realized. Josephine military map can serve as a source for a number of questions about the history of countries, from

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vegetation, soil composition, to economic history (Slovenija na vojaškem zemljevidu, 1995).

### **Second military survey (Franciscan military map), 1806 - 1869**

The second military survey (also known as the Franciscan - by Francis I.) is a masterpiece of the map tile series, which was carried out between 1806 and 1869 in order to replace Josephine military map. Mapping were also performed on a scale 1: 28.800 (Podobnikar, 2009) but, the less resolution maps, Spezialkarte on a scale 1:144.000, and Generalkarte on a scale 1:288.000 were also published.

During the survey the geodesy as discipline has extremely advanced, so the survey was outstanding in quality regarding its data content, cartographic design and aesthetic appearance. A triangulation was used for the first time between 1807 and 1829 and improved methods from 1848. Although the series is uniform in its content and in its implementation due to the extended period of time of the mapping, according to recent experience in its present-day usage, its map sheets are fairly well applicable even today. The excellent geodetic base of the map made possible to compare the recent and former topographic features in specific study areas with acceptable accuracy (Timar, 2009).

The survey covers about 3.300 map sheets. For a long time, the original map sheets treasured in the Austrian state archives (Military Archive) were only available for the closed group of professionals.

The survey was carried out by Topographisch-lithographische Anstalt des k. u. k. Generalquartiermeisterstabs, the precursor of famous k.u. k. Militärgeographische Institut.

The literature suggests that the second (Franziscan) survey can be characterized by the Cassini projection. The geographic coordinate system was indicated on the map frame, the prime meridian was Ferro.

The sheeting and numbering of the Spezialkarte on the scale 1:144.000 were the followings: the columns were marked by letters, the rows by numbers and the projection center was the geometric center of the sheet (Timár, 2004). Maps on the scale 1:28.800 were also structured into rows (Sectio) and columns (Colonne). The projection center was the geometric center of the sheet. The columns were marked by Roman numbers, so the title of the referred sheet was 'Sectio 44 Colonne XXI'.

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For the first time the hachures were used to represent relief. It resulted in optically dark depiction of mountainous areas. Additionally all names were written in black, which makes map hard readable (Wikipedia).

At the right edge (Designatio) information about districts, parishes, villages, number of houses, stables and inhabitants were written.

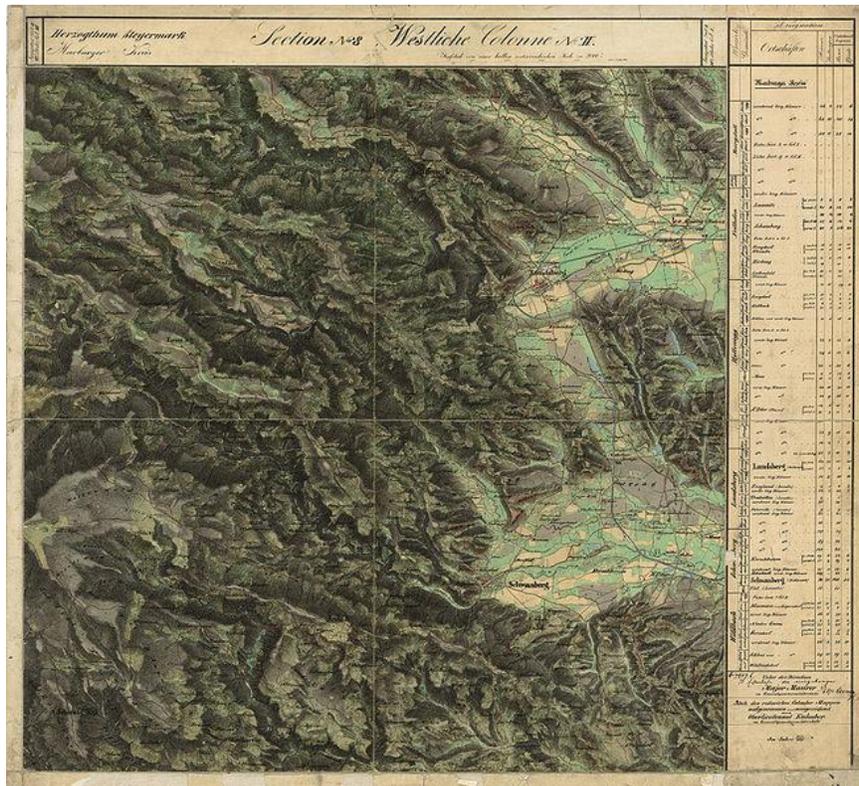


Figure 4. Second military survey. Section 7, Colonne II, 1834/35 (Wikipedia)

**Third military survey, 1869 – 1887 and cartography till the end of First World War (1918)**

At the end of the 19th century the whole area of the then Austro-Hungarian Empire was covered by the results of the third survey, which was finished as a plane table survey on the scale 1: 25.000 in only 18 years (1869-1887), based on a new framework of horizontal and vertical control points with regard to the standards of the Europäische Gradmessung. The reproduction of the multicoloured original sheets 1: 25.000 followed in black by the use of photolithography. Each sheet covered an area of 7,5 minutes in latitude and 15 minutes in longitude. Relief was

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represented by hachures with contour lines of 100 m vertical interval and schematic rock drawing.

For the publication of a map series on a derived scale in 1872 a 'topographical' (in the sense of cartographical) school had been established to train draughtsmen and by this it was possible to publish the map series Spezialkarte der Osterreichisch-ungarischen Monarchie 1: 75.000 within only 16 years, 1873-1889. During this period with the help of 333 individuals, engaged in drawing the paper originals used for heliogravure, 752 sheets (= 140 m<sup>2</sup> drawing area) in an uniform cartographic style were published (Fig. 5). In these 16 years every week one sheet (on an average) had come to the public. Each sheet in the scale 1: 75.000 showed an area of 4 sheets of the original map series 1: 25. 000. Relief was represented by hachures and contour lines with 100 m vertical interval. The first edition was printed in black and white. Revision of this map series started in 1885 and 1887/88 the second edition of this large map series came into being (Kretschmer, 1991).

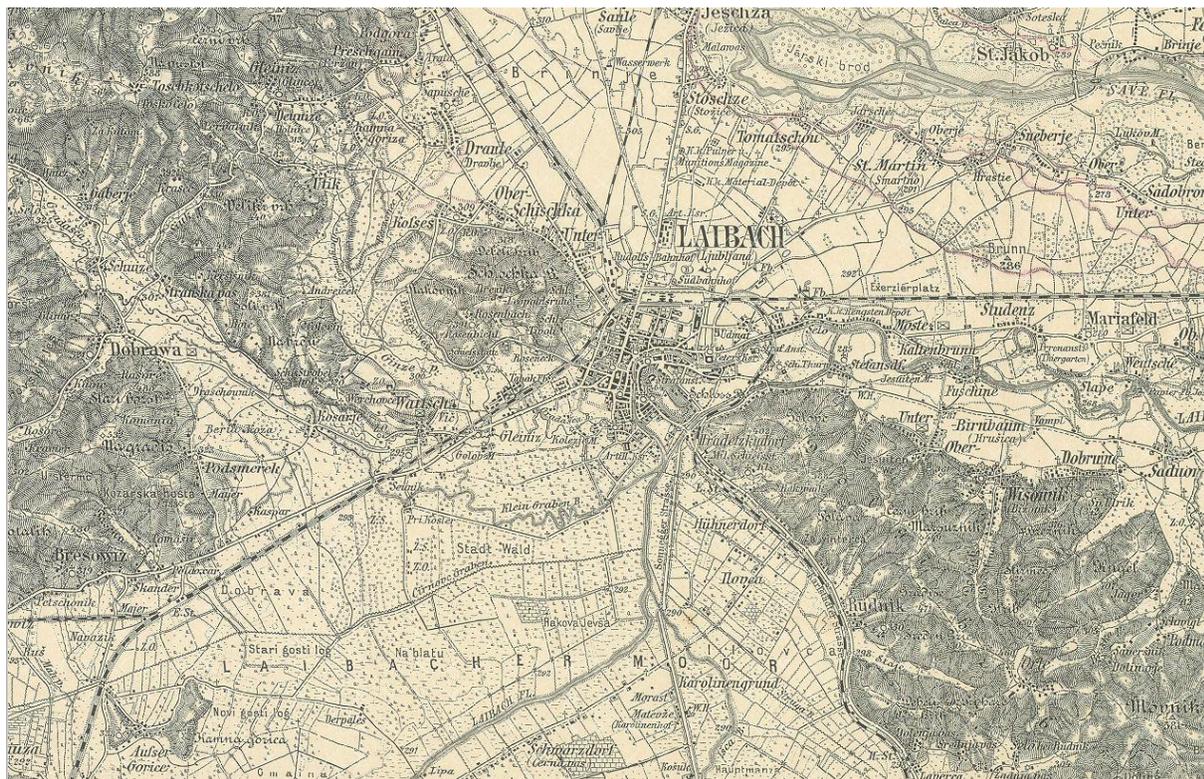


Figure 5. Spezialkarte der Osterreichisch-ungarischen Monarchie 1: 75.000. A section of sheet 5553, Laibach (NUK)

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Starting with 1887 a further map series at a smaller scale was derived and in 1889 the first sheet of the Generalkarte von Mitteleuropa 1: 200.000 was published (Fig. 6). Each sheet covered an area of 8 sheets in the scale 1: 75.000 and therefore one degree in latitude and longitude (polyeder projection). The 265 multicoloured sheets (brown for hachures and rock drawing, blue for waters, black for settlement, communication network and geographical names, green for woodland) covered the area from Switzerland to the Black Sea and from the middle part of Central Europe (today Poland) to the northern part of Greece and therefore became important also for the Balcan peninsula (Kretschmer, 1991).



Figure 6. Generalkarte von Mitteleuropa 1: 200.000. A section of sheet 32°46° Laibach (NUK)

Since 1889, in response to a special request, an Austro-Hungarian geodetic group had been sent off to Greece and this was the largest Austrian survey at any time done in a foreign country.

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This map series at a scale of 1: 200.000 also covered the area of present day Albania, but only 23 sheets are needed to cover the area of modern Austria.

With the help of this new Generalkarte von Mitteleuropa 1: 200.000, another map series Ubersichtskarte von Mitteleuropa 1: 750.000 (conic projection in accordance with Heinrich Christian Albers) was started, as an older map series in this scale (published 1882-1886, projection in accordance with Rigobert Bonne, 45, later 54, sheets) had become out of date. One sheet of the new map series 1: 750.000 covered an area of 12 sheets 1: 200.000. Up to the First World War 12 multicoloured sheets of this new map series have been published, but this series remained incomplete.

Nevertheless in 1900 the Austro-Hungarian Empire seemed to be the only country of Europe to be completely covered with topographical map series in the metric scales 1: 25.000, 1: 75.000, 1: 200.000 and 1: 750.000. The map series 1: 75.000 had been started in the second edition and the map series 1: 200.000, printed in colour, covered large areas beyond the borders of the empire (Kretschmer, 1991).

But in the last decades of the 19th century, claims to large scale topographic maps rapidly increased in parallel to the development of settlement, the communication network and tourism. These prompted the start of the fourth Austrian survey in 1896, the first period of which unfortunately came to an end in 1915. With this fourth survey, called 'Prazisionsaufnahme' (precision survey) tacheometric distance measurement was introduced and numerous measurements of altitude, mostly based on trigonometrical observations, were used to revise the interpolated contour lines. Since 1895 the measurement instruments used in the field were equipped with telescopes in which stadia lines were engraved for tacheometric purposes. Besides these reforms after 1890 the use of photogrammetry for topographical survey in mountainous areas was studied. This method of surveying, for topographical purposes first used in about 1850 in France, 1872 in Italy, 1880 in Canada, 1882 in Sweden and 1888/89 by the well known Bavarian mathematician Sebastian Finsterwalder for the survey of the Vernagt glacier in Tyrol, was not unknown in Vienna, but in Austria it was then only used for the construction of railway lines. In 1890 photogrammetry for the first time was mentioned in the annual report of the military geographical institute in Vienna. The first experimental application for topographical survey was undertaken in 1891 in the surroundings of Vienna and since that time the technique was developed independently in Vienna. The Austrian Arthur von Hubl (1852-1923) devoted his time to the construction of photogrammetric instruments, more suitable for use in the field and published his experience in the annual reports of the institute. In 1893 and 1894

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photogrammetric survey was tested in the Tatra mountains and already by 1895 the Austrian instructions for topographical survey in its second part included general rules for the use of photogrammetric techniques. In the following summer, the institute used photogrammetric surveying on the Dalmatian coastland (1896) and, in 1897/98, in the Julische Alpen. One year later it was employed in the south of Tyrol. In 1899 Arthur von Hiibl summarized the results of these experiences and gave a description of the instruments then in use. Still in 1899 Hiibl was of the opinion, that photogrammetry could not be used independently but only together with plane table survey and tacheometry. He recognized, however, that in mountainous areas photogrammetric surveying was superior to classical methods, in particular in regard to the accuracy achieved by photography. The time-consuming process of transforming the data for drawing at that time however was a disadvantage. Nevertheless the application during the fourth survey was continued in 1901 and 1902 in the south of Tyrol. But after the invention of the optical floating mark by F. Stolze in 1892 and the construction of the stereocomparator by C. Pulfrich in Jena in 1901, the new method of stereophotogrammetry was immediately appreciated in Vienna. Already in 1902 in the south of Tyrol a series of stereoscopic pictures had been taken and in the same year a stereocomparator was acquired by the institute to be used for stereoscopic evaluation point by point. Between 1902 and 1907 the military geographical institute used a stereocomparator for drawing contour lines of parts of the south Tyrolean Alps and in the same year (1903) the instructions for topographical survey already indicated the accuracy obtainable by photogrammetry:  $\pm 7$  m for position and  $\pm 2.5$  m for altitude. In 1908 the Austrian cartographer Eduard von Orel (1877-1941) in Vienna developed a new instrument for stereoscopic evaluation, called 'Autostereograph', which enabled the direct recording of lines true to scale. Now with stereophotogrammetry and the useful stereoscopic evaluation of lines, cartography since 1908 has had available exact contour lines, which served as strict geometrical bases for rock drawing. In this way a new kind of rock drawing for large scale topographical maps could be developed, which in the following years was also used by the Austrian alpine club (Kretschmer, 1991).

After 1909 the institute used a second instrument, the 'stereoautograph' of C. Zeiss, Jena, and after 1910 stereophotogrammetry was introduced as a permanent method of topographical surveying. In 1909-1911 field work was undertaken in the North Tyrolean Alps and in 1912/13 in the high mountains 'Hohe Tauern'. For taking stereophotogrammetric pairs of pictures from a ground station however, topographers needed a clear long-distance view. Therefore for taking pairs of pictures from the ground, only high mountainous areas with useful viewpoints were

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suitable at that time for stereophotogrammetric surveying. Flat areas or hilly areas covered with woodland had to be continued by plane table survey and tacheometry. This was the reason that prompted the Austrian Theodor Scheimpflug (1865-1911) as early as 1897 to investigate the possibilities of optical transformation of air photos, then taken by balloons, into plane photographs true to scale. In 1899 he invented the principle of double projection, which after 1918 served as a basis for the construction of photogrammetric universal plotting instruments. With these results the Austrian photogrammetric innovations, which remarkably increased the geometric accuracy of large scale topographical maps, became internationally known. In 1910 the International Society for Photogrammetry was founded in Vienna, where in 1913 the first international congress for photogrammetry took place.

After the turn of the century great innovations in the field of map reproduction can also be observed in Vienna. The year 1910 saw the introduction of the offset rotary press, Vienna being the first location on the European continent. This represented an epoch-making advance in printing techniques, the output was 4-times that of the old mechanical presses. During the First World War seven additional rotary presses were mounted and with these the total of all prints in the military geographical institute in 1915 has been rising to more than 35 millions. Between 1914 and 1918 65 million map sheets were printed, which means a tower of paper 43 times the height of St. Stephans Cathedral (tower) in Vienna (137 m).

The result of the fourth survey of the Austro-Hungarian Empire in the time 1896 to 1915 have been nearly 400 sheets 1: 25.000, which again have been published as multicoloured Spezialkarte 1: 75.000, the first sheet of which was printed in 1912. In parallel efforts were made to keep all sheets 1: 75.000, resulting from the third survey, up to date. At the end of the First World War (1918) only 6 % of the area of today Austria was covered by the fourth survey (parts of Tyrol and Carinthia), because up to 1915 most of the field work has been done in areas of countries, that after 1918 succeeded the monarchy. In 1918 also the existence of the Military Geographical Institute in Vienna, where all official topographical and cartographical activities in the period 1840 to 1918 had been organized, became uncertain and in 1920 it had to be disbanded. The members of the former institute not only found employment with the organization of surveying and mapping in the countries that succeeded the monarchy, but also in Italy, Spain, Turkey and Brazil.

Referring to official thematic mapping the 'Geologische Spezialkarte ...' 1: 75.000 must be mentioned, a geological map series printed in colors in Vienna since 1898. Up to the First World

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War 98 sheets had been published. The printing of these sheets marked an important progress in the cartographic representation of geosciences in Austria.

Private cartographic agencies in the first two decades of the 20.<sup>th</sup> century were engaged in the production of railway maps and road maps for the use of cyclists, later also for motorists and in the production of maps showing the distribution of languages and ethnic groups of the monarchy, like G. Freytags Villker-und Sprachenkarte von Osterreich-Ungarn (Kretschmer, 1991).

#### **Cartography in Austria since 1918 till today**

From 1918 to the end of Second World War (1945) the new form of government after 1918 also found its expression in a reorganized form of surveying. The geodetic and topographical departments of the former military geographical institute were affiliated with the Bundesvermessungsamt (founded 1921), since 1923 called Bundesamt für Eich- und Vermessungswesen, situated in Vienna. The departments for cartography and map reproduction of the former institute now constituted the Kartographisches, friiher Militair-geographisches Institut. But in spite of this very unfavourable organisation and bipartition of official topographical surveying and mapping since 1920 decisions on the necessary reorganisations of topographical map series of the new area of Austria have been taken quickly. Besides the efforts of updating the sheets of the old Spezialkarte ... 1: 75.000 a new multicoloured map series in the scale 1: 25.000 and a series in the derived scale 1: 50.000 were decided, in the year 1928 entitled 'Osterreichische Karte 1: 25.000' and Osterreichische Karte 1: 50.000. In 1933 a new index sheet and a new sheet numbering system were introduced, which are valid up to now. In this period topographical surveying, making use of terrestrial photogrammetry, was concentrated upon mountainous areas (mainly the federal territory of Salzburg) and it was possible to cover nearly 20% of the new area of Austria until the work was interrupted again by the Second World War. In the years 1945 to 1950 field work was started to be continued using these methods.

In the period 1920 to 1945 in spite of economic difficulties and war important thematic maps of Austria have been published. Nearly unsurpassable up to now is the Geologische Karte der Republik Osterreich und der Nachbargebiete (1: 500.000, Vienna 1933) by Hermann Vettters, reprinted three times without corrections. Adalbert Klaar compiled the thematic map 'Sied-

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lungsformenkarte der Ostmark' (1: 200.000, Vienna 1942) showing types of field parcels, settlement and farmhouses, which is used as source material up to now (Kretschmer, 1991).

After the catastrophe of Second World War all fields of cartographic activities had to be reorganized. In 1945 the Bundesamt für Eich-und Vermessungswesen was reestablished, now being the office for all kinds of official cadastral and topographical surveying and mapping in Austria. At the beginning of the 1950s technology was developing rapidly, in particular being marked by the introduction of aerophotogrammetry. In consequence the up to then incomplete fourth survey had to be entirely reorganized. But at that time for about 75 % of the area of Austria only the results of the third survey were available, being used in a provisional edition of the Österreichische Karte 1: 50.000, which represented an enlargement of the old Spezialkarte 1: 75.000. In order to replace these nearly useless sheets as fast as possible an important decision had to be made: In 1959 the edition of the Österreichische Karte 1: 25.000 was suspended to speed up the survey for the scale 1: 50.000. On the one hand this limitation certainly was unfavourable for map users, on the other hand it was the supposition for a quicker finish of the map series 1: 50.000 seriously needed and for updating these 213 sheets in time. Between 1950 and 1976 those 75 % of the area of Austria, only covered by the results of the third survey (finished 1887) were now given priority by the fourth survey using aerophotogrammetry and between 1976 and 1987 also those 25 % finished between 1896 and 1950 were reiterated with respect to homogeneous accuracy. Therefore at the end of the 1980s Austria has got a complete new map series 1: 50.000 based on uniform modern aerophotogrammetric data, meeting all demands of map users. Using the ellipsoid of F. W. Bessel and the Gauss-Kruger projection each of these 213 sheets in the scale 1: 50.000 is covering 15 minutes in longitude and latitude, which results in ca 520 km<sup>2</sup> per sheet. All sheets using contour lines with 20 m vertical interval and additional hill shading are available in three different editions and in a tricoloured version for thematic mapping. From 1963 till 1991 the derived map series Österreichische Karte 1: 200.000 was produced. This series contains 23 sheets, all available in two editions and in a fourcoloured version for thematic mapping.

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Since 1968 the whole area of Austria is represented cartographically in the scale 1: 500.000 on one sheet, using a conform conic projection (Lambert). This sheet is available in a topographical and in a political edition and in two additional versions. The map elements (rivers, railway lines, roads, boundaries, settlement) of this sheet 1: 500.000 are also stored in digital form.

In order to extend this succession of scales used in Austrian national mapping the mentioned map series are also available as photomechanical enlargements without any significant cartographical alterations. The outcome of this process, now more easily to read, are the map series OK 25 V (produced since 1976), OK 100 V (three versions) and OK 300 V. For the environs of Vienna and some other touristical interesting regions special sheets in the scales 1: 25.000 or 1: 50.000 are produced, being useful for tourism.

In the mid 1970s Austria started the production of orthophotomaps. The first series, the Österreichische Luftbildkarte 1: 10.000 contains 3,654 sheets and were finished in 1995. The orthophotos are equipped with a selected number of geographical names, symbols, grid lines and marginal informations. With regard to the production of orthophotos since 1976 a digital relief model has been worked upon, which is finished in the first version at the end of the 1980s. Sophistication is continued in the 1990s.

To meet the demands of economy and planning in the mid 1980s Austrian national mapping started the production of Österreichische Basiskarte 1: 5.000. These sheets consist of three elements (orthophoto, contour lines and cadastral elements). Priority is given to urban regions to meet planning requirements.

Official thematic mapping after 1950 increased rapidly. The Austrian Geologische Bundesanstalt (founded as the Geologische Reichsanstalt in 1849) following the recommendation of Gustav Gbtzinger (1880-1969) in 1955 started the production of the Geologische Karte der Republik Österreich 1: 50 000, which is still produced (Kretschmer, 1991).

## Cartography in Slovenia since the beginning of 20.<sup>th</sup> century till today

Until 1991 systematically topographic and cadastral survey of Slovenia had been integrated into the Austrian, Austro-Hungarian and Yugoslav cartography. Almost all official cartography was produced at military-geographical central institutions of above-mentioned countries, excluding certain cartographic works of significant individuals, as it *Zemljevid slovenskega ozemlja* (Map of Slovene Territory), published by Slovenska matica.

At the beginning of the 20th century, the members and editorial board of Slovenska matica, an organization established to support and foster the Slovene identity, realized it was necessary to produce a new and high quality map of Slovene territory. Work on the new map, which began at the end of the 19th century and was based on one of the Austrian general headquarters maps, was protracted due to internal problems at Slovenska matica and came to a complete halt with the start of World War I in 1914. Work continued after the war, and in 1921 the 1 : 200,000 scale *Zemljevid slovenskega ozemlja* («Map of Slovene Territory») was published, and a year later the *Index of Settlements on the Map of Slovene Territory*. The map features a great density of place names and is therefore somewhat difficult to read (Gašperič, 2007).

The Military Geographical Institute (MGI), located in Belgrade is founded on the 5.<sup>th</sup> February 1876 as the Second (since 1878 Geographical) department of General staff of Serbian Army. Until 1990 it was the main surveying institution in the Kingdom of Yugoslavia and latter Republic of Yugoslavia.

During the Balkan wars and First World War, MGI gave contribution to Serbian Army and allies, making and printing maps of SE Europe, in various scales. Cartographic works are done during retreat of Serbian Army, then in Corfu and then in Thessalonica. During the period between two world wars, MGI created unique geodetic basis on the whole territory of the Yugoslav Kingdom (triangulation and levelling). And on the basis of surveying in scale 1:50.000 topographic map scale 1:100.000 is made as well as the whole number of topographic maps of smaller scale. In this period, MGI with its

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personnel and material staff is becoming strong institution which has been present in various projects of International geodetic and geophysics union, International Geographical Union and other international organizations, besides satisfying domestic military and state needs. MGI was initiator of big international geodetic scientific projects – degrees measuring along the 22nd meridian and the 45th parallel, and took part in other international geodetic and cartographic works and projects.

After the Second World War, MGI continued and finished work on the basic geodetic networks. Topographical and aerial surveying scale 1 : 25.000 is done, and on the basis of this survey numerous topographic and geographic maps scales of 1:25.000, 1 : 50.000, 1 : 100.000, 1 : 200.000, 1 : 300.000, 1 : 500.000, 1 : 750.000 and 1 : 1.000.000 were made, so as many special maps for military, educational, scientific and other needs (Vojnogeografski institut).

At the beginning of the 1960's, the Institute for Geodesy and Photogrammetry (Inštitut za geodezijo in fotogrametrijo FGG) and the Geodetic Department of Slovenia (Geodetski zavod Slovenije) started an extensive production of maps in Slovenia. After the first tourist, mountaineer and road maps, first official maps soon follow: basic state map at the scale of 1:5.000 and 1:10.000, topographic map at the scale of 1:50.000 and system of general maps of Slovenia on one sheet at the scales of 1:25.000, 1:400.000, 1:750.000 and 1:1.000.000. Due to the fact that military topographic maps of the Yugoslavian National Army (JNA) of that time, were treated as an official secret and their use was not possible outside the JNA, the Geodetic Administration of Slovenia ordered a reduced, so called economic version of the topographic map at the scale of 1:25.000 during the middle of the 1970's at the MGI. After reambulation in 1985 and 1986, Slovenia got printed sheets and copies of publishing originals from the MGI. If we add to this several printed copies of military maps of the MGI that was the state of official maps in Slovenia on the day of it became independent, when all contacts with the MGI were broken and all cartographic material, as well as other data, became inaccessible. The year of 1993 is also especially important for all map users in Slovenia, because that

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is when the Government of the Republic of Slovenia issued a regulation that made all maps in Slovenia public without a restriction of use (Petrovič, 2005).

The Geodetic Administration of the Republic of Slovenia (Geodetska uprava Republike Slovenije) is according to the law, authorized for establishing, managing and presenting geoinformation.

The basis of all geoinformation is the coordinate system. Slovenia took over the geodetic datum of SFRJ, the Gauss-Krüger projection of meridian zones, computing on the Bessel ellipsoid. Thanks to favourable geographic position and shape, the area of Slovenia is almost entirely in the 5.<sup>th</sup> meridian zone, so all the geoinformation are placed in the coordinate system of the 5.<sup>th</sup> zone, and for the needs of mapping, the zone is extended to 3°20'. The easternmost part of the territory, for which the coordinate system of the 6.<sup>th</sup> zone was used in SFRJ, was transformed into the 5.<sup>th</sup> zone.

At the beginning of production of Military topographic maps at the end of the 1990's, which yielded to NATO's STANAG standards, the UTM projections with the WGS 84 ellipsoid is introduced for topographic and general maps. The whole territory of Slovenia is located in the 33T zone (Petrovič, 2005).

Due to distortion in astrogeodetic network and difficulties of geodata exchange with other countries, in spring of 2004, the Government confirmed the Strategy of Basic Geodetic System, which defines the transfer to ETRS89 (European Terrestrial Reference System 1989) and EVRS2000 (European Vertical Reference System) in the following years.

The State Topographic-Cartographic System of Slovenia is a collection of all topographic data about the space in numeric or graphic, analogous or digital form. The main source of topographic data for maps and topographic databases are images of cyclic aerial surveying, which is carried out at the scale 1:17.500 in Slovenia. Lately, the surveying cycles is extended from three years to four or five years. Filed surveys, mostly by GPS measurements, are also performed within the scope of production of topographic maps.

According to the State Topographic-Cartographic System of Slovenia, the following series of official maps was provided for Slovenia, by scales: 1:5.000, 1:25.000, 1:50.000,

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1:100.000, 1:250.000, 1:500.000 and 1:1.000.000. Some of the maps at these scales were updated, some were transformed into digital form, and some were produced again during the last 10 years. First vector bases, whose content was harmonized with maps, were made by digitizing analogous maps. Further filling in of vector bases is carried out directly, and on some levels, vector data are the main source for preparing new maps. It is therefore the most adequate to create an overview by scales which includes both maps and topographic bases.

A systematic map of the largest scale in Slovenia is the Base Topographic Plan (TTN) with about 2.800 sheets. A larger part of the area of the country was mapped at the scale of 1:5.000 (TTN 5), while smaller settlements were mapped at the scale at 1:10.000 (TTN 10). Distribution into sheets follows the rectangular grid of the Gauss-Krüger projection, within TTN 5's sheet size being 2,25 x 3 km, and TTN 10's being 4,5 x 6 km. 50 sheets of TTN 5 are brought together into 22,5 x 15 km large trigonometric sections. The map places Slovenia into a small group of countries whose entire territory was mapped at such a large scale. The map was produced in the 1960's. The map was updated in a restricted scope and unsystematically and, after 1997, there was no updating at all. Many sheets still represent the state from 1960's. The map was produced with classical cartographic procedures.

Orthophoto (DOF 5), produced by digital procedures, offers a more up-to-date representation of the state of the land. A total of 3258 sheets of 2,25 x 3 km represent the whole area of Slovenia, the dimensions of pixels are 0,5 m, and the image is black and white. At the resolution of 300 dpi, the representation scale is 1:5.000, therefore the orthophoto is often used as a replacement for not up-to-date sheets of TTN 5. DOF sheets were produced for whole Slovenia, and new ones are produced every four or nine years, according to the interest (Petrovič, 2005).

In 1998 The Geodetic Administration of the Republic of Slovenia (GU) ordered a project of forming a digital topographic base with the accuracy and detail level that corresponds to the scale of 1:5.000. After various attempts and pilot projects, regular work by several geodetic companies started in 2000. The main source of data is the photogrammetric survey of cyclical imaging stereopairs, and some existing records, such as the building register, were overtaken. GU's branch offices perform the general filed review. Vector data for an area that covers about 800 sheets of 2,25 x 3 km have been formed so far. The creation of a base for an area of 500 more sheets is anticipated in the following two years, and one of the less populated territory is going to be made in case of special demands. The data are recorded as a topographic base in

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the shape format, while the cartographic visualization of a base is called the State Topographic Map at the scale of 1:5.000 (DTK 5). DTK is of somewhat reduced content in comparison to the content of TTN, especially considering the vegetation and smaller constructed objects. A suitable original TTN 5 is at the moment also used for the relief representation.

The map of the following scale, which represents the whole area of Slovenia, is the State Topographic Map at the scale of 1:25.000 (DTK 25). It consists of 198 7,5 x, 7,5,km sheets.

The basis of the map was the so-called economic variant of MGI's TK 25. As it was already mentioned, when Slovenia became independent, the copies of publishing originals existed in Slovenia with the contents from 1985. In 1993 GU started preparing the project of renewing TK 25 in cooperation with the Ministry of defence. The project anticipated the reambulation of existing copies of publishing originals by procedures of classical cartography technology. All 198 sheets were updated and printed until the middle of 1999 . Unfortunately, updating of the content was not complete due to time and financial restrictions; therefore DTK 25 could not retain all qualities of TK 25 produced by MGI, especially considering vegetation and trails. Further updating in the classical form will not be executed, and a complete transformation of the map into digital form or printing of DTK 25 sheets is also not anticipated (Petrovič, 2005).

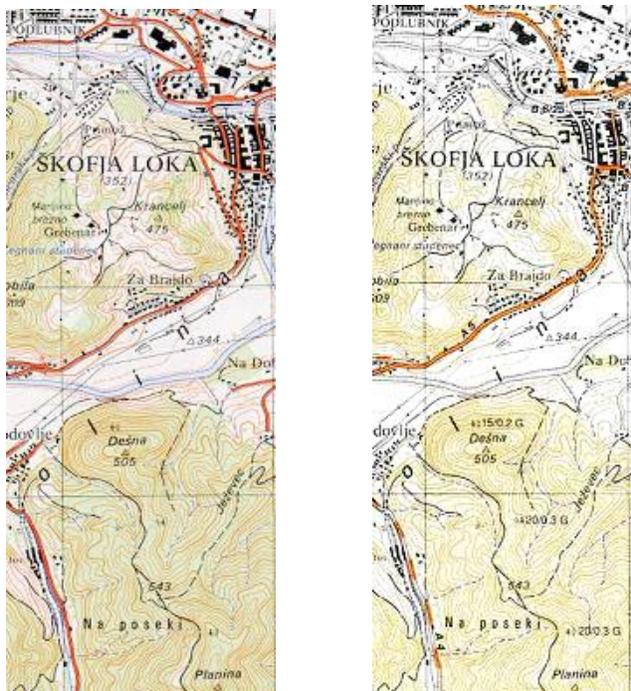


Figure 7. Sections from DTK 25, DTK 25 Ministry of defence (Petrovič, 2005)

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Ministry of defence upgraded DTK 25 with some thematic data important for the needs of defence and printed it as DTK 25 for the Needs of Defence (Fig. 7). Characteristics of roads and bridges, densities and types of forests were added and some significant objects were marked. Considering the state of the first sheets of DTK 25 (1994), classical production technology and uncoordinated with NATO standards, Ministry of defence ordered a project of production of a Military Topographic Map 1:25.000, which was started in 2005.

Combining vector and raster procedures produces the DTK/VTK 50 map (Fig. 8). In this way, the users have at their disposal not only printed sheets, but also the complete content of different resolutions in raster form, and also a part of the content of vector form which is not topologically processed into the form of topographic base.

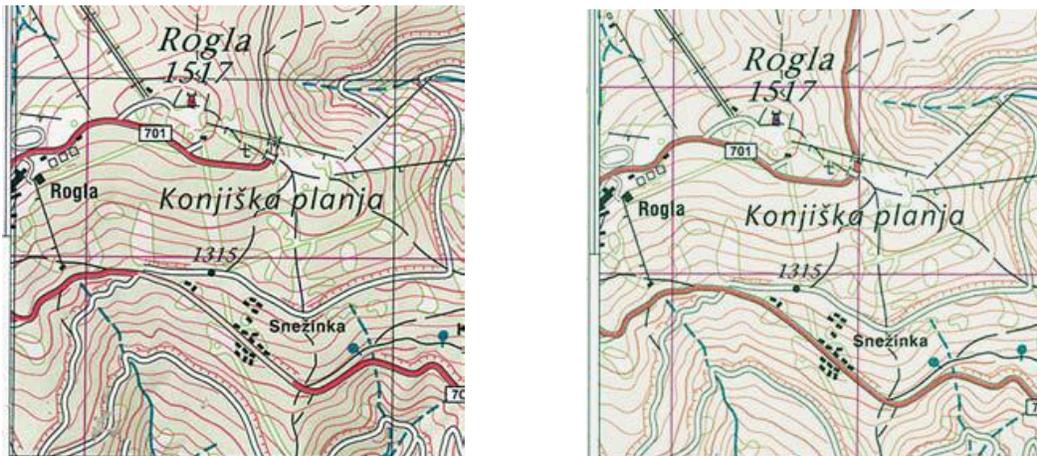


Figure 8. Sections of DTK 50, VTK 50 (Petrovič, 2005)

The 1:100.000 scale is not a standard scale in the NATO's system of maps, but it is extremely important for Ministry of defence as a basis for planning on regional level. 16 sheets for the entire area of Slovenia were produced between 2001 and 2003, and their appearance and way of production follow the production of the DTK/VTK 50 map.

The Slovenian state cartographic system is continued by system of general maps. Maps PK 250, PK 400, PK 750 and PK 1000 existed as a single sheet before 1990 and were mostly used as a basis for numerous thematic representations. DPK 500 was the first general map in digital form, made by generalizing PK 250, which replaced former PK 400. Further generalization resulted in



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DPK 1000 and DPK 750. DTK 1000's data were also transformed to the EGM (European global map) form (Petrovič, 2005).



## Cartography of Czech Lands since 1918 till today

In 1918 the Czech Lands became part of the Czechoslovak Republic. In twenties and thirties of 20.<sup>th</sup> century the national geodetic reference system as well as a national cartographic projection were formed by Josef Krovák. In 1927 Czechoslovakia became member of the International Federation of Surveyors (FIG). In the same year the Act on the Cadastre of Lands came in force. Together with detailed technical instructions it gave start to dispatched forming of a modern cadaster (Šíma, 2000).

In the period between 1918 and 1945 military surveys or revision of previous maps were undertaken. From this period, four sets of military topographic maps can be distinguished. The first set is represented by revised maps of the Third Austrian Military Survey. The revision was conducted between 1921 and 1954 and the map sheets are at scale 1:25.000. The second set is the maps of provisional military survey from 1923 to 1933 at scales 1:10. 000 and 1:20.000. They were drawn in the Beneš's normal conformal conic projection and were completed only for a few percent of the state territory. The third set includes maps from 1934–1938, when a definite military survey was carried out. These 1:20.000 maps were completed using the Křovák's oblique conformal conic projection, covering again only a part of the state territory, in this case almost one tenth of it. Finally, the German maps called "Messtischblätter" (plane table sheets) were created during the German occupation of the Czech lands in the World War II at scale 1:25.000. They were created in the Gauss-Krüger transverse cylindrical projection and covered about 10% of the state territory, mainly in Moravia. All four map sets used the Bessel's ellipsoid (Skokanová, Havlíček, 2010).

Results of the World War II led to incorporation of Czechoslovakia into the East Block of Socialist Countries bringing some positive and some negative consequences. Benefit may be seen in fulfillment of the three basic goals of Czech surveyors from 1912, in the first line by establishing the Central Authority of Geodesy and Cartography in 1954 as a budget organization with own part of state budget. The president has been nominated by the government and also directly responsible to it. Other positive features of this epoch were the integration of fundamental trigonometric, levelling and gravimetric networks and unification of medium and small-scale map series in all former socialist countries. During forty years of communist rule the private sector of surveying and mapping became completely extinct (Šíma, 2000).

Czechoslovakia was splitted peacefully on the 1<sup>st</sup> January 1993 and the Czech Lands (Bohemia, Moravia and Silesia) became the Czech Republic. At the same time a central body of state

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administration was established — the Czech Office for Surveying, Mapping and Cadastre. Other survey and cartographic activities are carried out exclusively by private firms and by licensed surveyors.

In 1994 two basic concepts of long-time activities were defined:

- digitising of the Cadastre of Real Estates (1994 - 2006),
- creation of the Fundamental Base of Geographic Data (ZABAGED) as a topologic-vectorial basic layer to GIS and computer created medium and small scale map series.

Goals was fulfilled: the File of Descriptive Information of the Cadastre of Real Estates was fully digitised and ZABAGED covered 100% of the national territory.

The fundamental horizontal control was integrated into the European frame (EUREF) thanks to several international GPS campaigns during 1991 - 1994. In the large scale densification campaign DOPNUL the ETRF-89 coordinates of 176 stations were determined. The DOPNUL stations are regularly distributed over the entire territory with the spacing 20 - 25 km (Šíma, 2000).

The Czech Republic is a NATO member and the Military Topographic Service of the Army of the Czech Republic co-operates effectively on creating of unified map series in digital form (V-map). NATO standards are accepted, especially the World Geocentric System WGS84 in its more precise version, and the Universal Transverse Mercator Projection for creation of military maps. Since the beginning of 21.<sup>st</sup> century the Fundamental Base of Geographic Data (ZABAGED) has been updated in four years intervals. Since 2005 it has been represented the exclusive source of data for computer created medium and small scale maps.

According to the State Topographic-Cartographic System, the following digital map series were provided for the Czech Republic, by scales: 1:5.000, 1:10.000 (Fig. 9), 1:25.000, 1:50.000 (Fig. 9), 1:200.000 (Fig. 10), 1:500.000 and 1:1.000.000 (Stankova).

Since 1993 close relation between civil and military geographic data bases has been achieved.

Concept of development of national geoinformation infrastructure has been started in 2000. Its goal is to form legislative, standardised, organisational and technological environment suitable to acquisition, processing and distributing geographical information required by public administration and private sector (Šíma, 2000).

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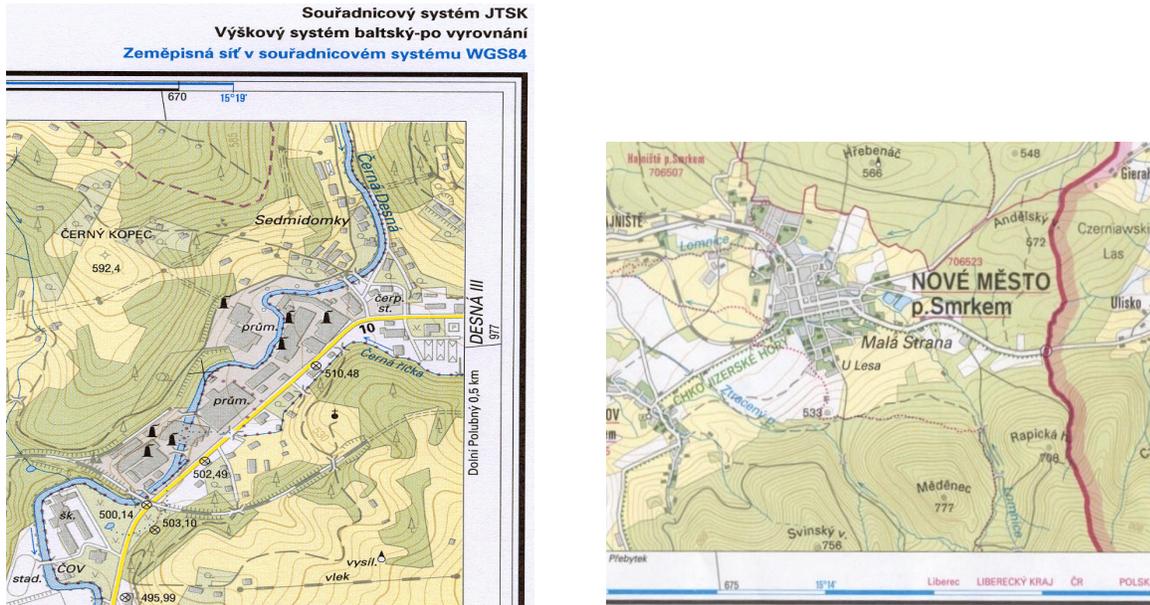


Figure 9. Sections of new basic maps 1:10.000 and 1:50.000, computer created on the basis of ZABAGED (k154.fsv.cvut.cz/~linkova/lect11.ppt)

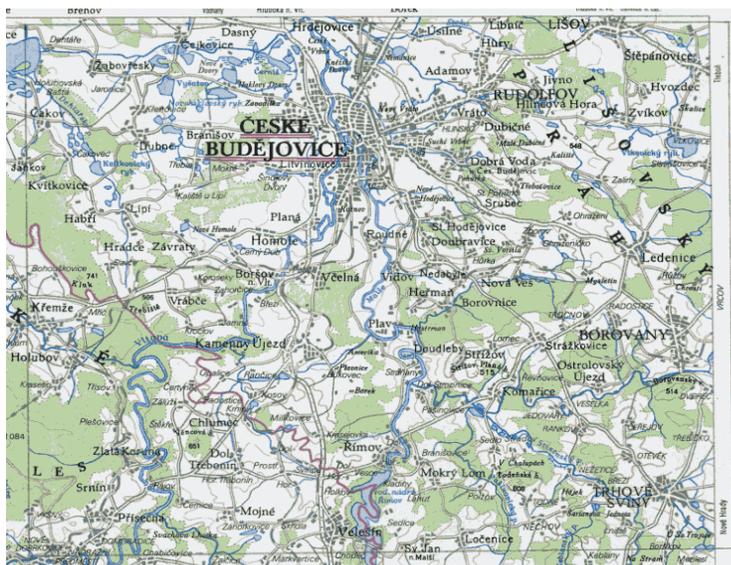


Figure 10. Section of basic map 1:200.000 ( k154.fsv.cvut.cz/~linkova/lect11.ppt)

## Cartography in Hungary since 1918 till today

The independent Hungarian military mapping dates back to 1919 when the Hungarian Military Mapping Group (Magyar Katonai Térképező Csoport) was established. The Royal Hungarian State Mapping Institute (Magyar Királyi Állami Térképészet) was established later in 1922 and the Institute of Military Cartography [Honvéd Térképészeti Intézet] in 1938. These authorities were responsible for local reambulation of the third military survey of the Austro-Hungarian Monarchy after the World War I. Later in 1927 a new survey was conducted. As a result of the revisions less than 50% of Hungary's territory became surveyed. The supervised sheets were circulated in multi-color versions while those not refreshed were issued as reprints of the third military survey in black and white editions. 403 sheets of Hungarian territory in the scale 1:50.000 were produced during the World War II, together with territories reattached to the country between 1938-1941 (Jankó, Bánfi, 2009).

The civil surveying and mapping activities and the land affairs in Hungary are administered by a governmental institutional network (consisting of one institute with nationwide competence and 136 land offices with territorial competence) and a public non-profit company, all being supervised by the Department of Lands and Mapping at the Ministry of Agriculture and Regional Development (DLM/MARD). This administration is responsible for establishing, maintenance and supplying of the geodetic control networks, the large scale base maps including the cadastral ones, the land registry, land protection and valuation, the topographic maps of selected scales and the remote sensing. Special emphasis is given to the tasks related to the implementation of the National Programme of the Adoption of the Acquis Communautaire (NPAA) (Pokoly, 2003).

The above mentioned works are carried out by the following organisations:

- Institute of Geodesy, Cartography and Remote Sensing (FÖMI) as governmental or-organisation with nation-wide competence,

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- 19 County Land Offices (CLO) and the Budapest Land Office as governmental organisations with territorial competence,
- 116 District Land Offices (DLO) and the Capital Districts Land Office as governmental organisations with territorial competence,
- Office for National Cadastral Programme, as non-profit organisation.

As of January 2001, the military cartography tasks are implemented by two independent military organisations.

The basic task of the Mapping Service of the Hungarian Defence Forces is to plan state base tasks and works in the responsibility of the minister of defence and having them implemented as well as carrying out official tasks in its sphere of authority. The Mapping Service of the Hungarian Defence Forces provides for the execution of the tasks necessary for defence map supply and professionally coordinates other sectors' defence related surveying and mapping activities including standardisation and regulation issues (Pokoly, 2003).

The basic task of MoD Mapping Company is to implement state base tasks and works in the responsibility of the minister of defence and having them implemented as well as safeguard, handle and provide state base data and maps.

The EOTR system of topographic map has been introduced in the 1970's by the civil Lands and Mapping Administration to meet the demands, which could not be satisfied earlier by military classified maps.

The recent status of the analogue topographic map sheets of the civil Lands and Mapping Administration is as follows:

- at scale 1: 10.000 4092 EOTR sheets (100%),
- at scale 1: 25.000 267 EOTR sheets (25%) (Terminated production),
- at scale 1:100.000 84 EOTR sheets (100%),
- at scale 1:200.000 23 EOTR sheets (100%) (Pokoly, 2003).

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The production of EOTR topographic maps at scale 1:25.000 earlier was terminated. At scale 1:10.000, the production and updating has been finished and restarted in 2000. Updating the scales 1:100.000 and 1:200.000 is continuous from 1995 – in digital form. The products at scales 1:10.000 and 1:100.000 have been supplied for the users continuously.

In the frame of the governmental base tasks and the EU-Harmonisation Programme the Ministry of Agriculture and Rural Development supported the scanning and georeferencing of 1:10 000 scaled topographic sheets. This task was carried out in 2000 for the whole area of Hungary.

In frame of the EU-Harmonisation Programme of the MARD the raster datasets of relief of 1400 sheets in scale 1:10 000 have been vectorized (Fig. 11). The vector data is used for the production of a high resolution (5m x 5m regular grid interval) Digital Elevation Model. As a first step a "preliminary" DEM is produced (in same resolution), derived only from the contour lines. The high resolution DEM will serve as a base for the digital orthorectification of the aerial photographs, created the frame of "National Aerial Photographic Programme 2000", and of the high information for the National Topographic Programme (Pokoly, 2003).

The 1:10.000 and 1:100.000 scaled topographic sheets of Hungary are available in digital (raster and vector) format. The 1:200.000 scaled topographic sheets of Hungary are available in raster format.



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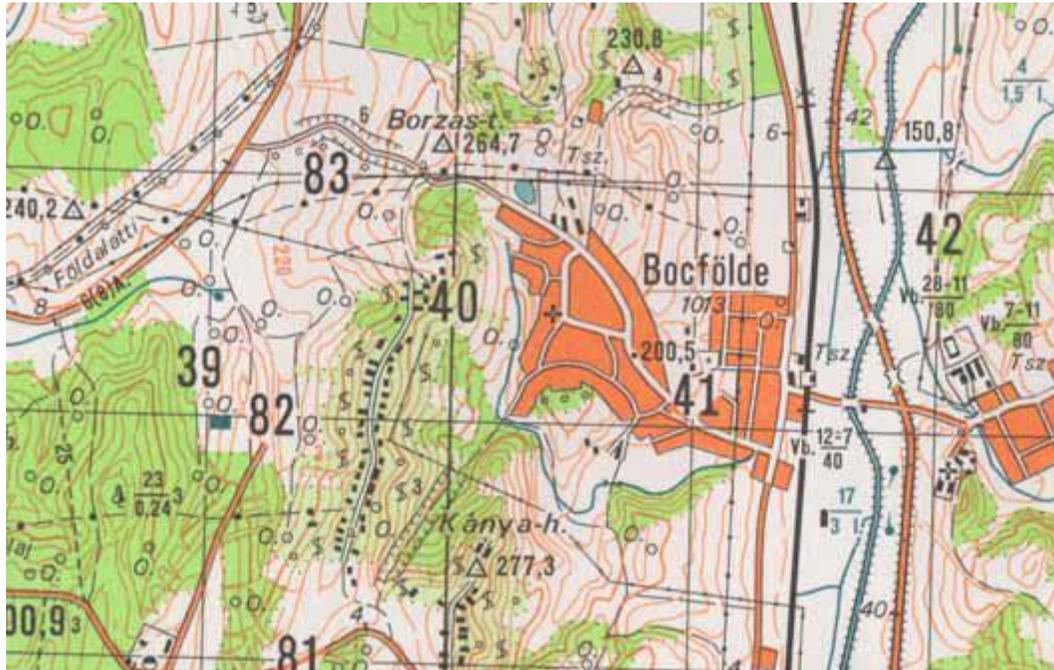


Figure 12. Section of the 1:50.000 scale updated topographic map sheet (Pokoly, 2003).

**Cartography of German Lands since the second half of the 18.th century till today**

Following the fall of Napoleon I of France, the Congress of Vienna convened in 1814 and founded the German Confederation (Deutscher Bund), a loose league of 39 sovereign states. After the French defeat in the Franco-Prussian War, the German Empire was proclaimed 1871 in Versailles, uniting all scattered parts of Germany except Austria (Kleindeutschland, or "Lesser Germany") (Fig. 13). The German Empire (German: Deutsches Reich, but also the called Kaiserlich Deutsches Reich or Kaiserreich by some German historians) refers to Germany during the "Second Reich" period from 1871 to 1918, when it became a federal republic after defeat in World War I and the abdication of the Emperor William II. The German Empire consisted of 27 constituent territories (most of them ruled by royal families). While the Kingdom of Prussia contained most of the population and most of the territory of the Reich. After 1850 Germany industrialized rapidly, with a foundation in coal, iron (and later steel), chemicals and railways. From a population of 41 million people in 1871 it grew to 68 million in 1913. From a

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heavily rural nation in 1815, it was now predominantly urban. During its 47 years of existence, the German Empire operated as an industrial, technological and scientific giant. After World War II the Weimar Republic was proclaimed in 1918, followed by the Third Reich in 1933. After 1945, Germany was divided by allied occupation, and evolved into two states, East Germany and West Germany. In 1990 Germany was reunified (Wikipedia).



Figure 13. Member states of German Empire (1871-1918) (Wikipedia)

During the same period of first, second and third military survey of Austro-Hungarian Empire similar surveys held in different German states. Military cartographers created maps covering extensive areas, amongst others also the Topographische Charte von Schwaben 1:86.400 (1828), the Carte de la Souabe 1:100.000 (1818-1821) and The Carte de l'Empereur (1808-1812) / Carte militaire de l'Allemagne (1822-1830) 1:100.000.

The map of Suabia («Charte von Schwaben») 1:86.400 marked the beginnings of precise geodetic and topographic survey in southwestern Germany. The first of the 62 map sheets were published in 1798 by editor Johann Georg Cotta in Tübingen and the last sheet appeared in 1828. The authors were J.G.F.Bohnenberger (1765-1813), I.A.Ammann (1753-1840) and later on E. H. Michaelis (1794-1873). Exemplary for this map was Cassini's topographic map series

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«Carte geometrique de la France» 1:86.400, published between 1756 and 1789 (and in 1815). The Map of Suabia is based on a network of fixed points which were determined astronomically and geodetically. The entire map series represents an impressive cartographic feat by a private enterprise dating from a period of transition to modern official cartography. The map sheets cover not only Suabia but also a remarkably extensive part of the surrounding countries. Most of the illustrations show the northeastern part of Switzerland for comparison (Fischer, 1993).

The Carte de la Souabe 1:100.000 (Fig. 14) covers the former Swabian area and the adjoining areas emerged during the French occupation of southwestern Germany. The work commenced in 1801 at the instigation of General Jean Victor Moreau (1763-1813), the Commander of the Rhine Army. It is limited in the north by the line Philippsburg am Rhein - Nördlingen, in the east by the river Lech, in the south by the line Füssen - Lake of Constance - Basel, and in the west by the Rhine. A small strip of Swiss territory along the Upper Rhine is depicted in the southern part of the map. Due to financial and political reasons, the printing of the Carte de la Souabe was delayed so that the sheets were not published until the years between 1818 and 1821. The systematic approach to the Carte de la Souabe was exemplary: establishing a trigonometric network for the topographie survey; the choice of a mathematically sound projection; clear directives for choosing symbols; using hachers for hill shading. However, because many of the military maps were usually hand-drawn and not available to the public for reasons of secrecy, their influence in the general development of official and private cartography remained almost insignificant (Fischer, 2003).

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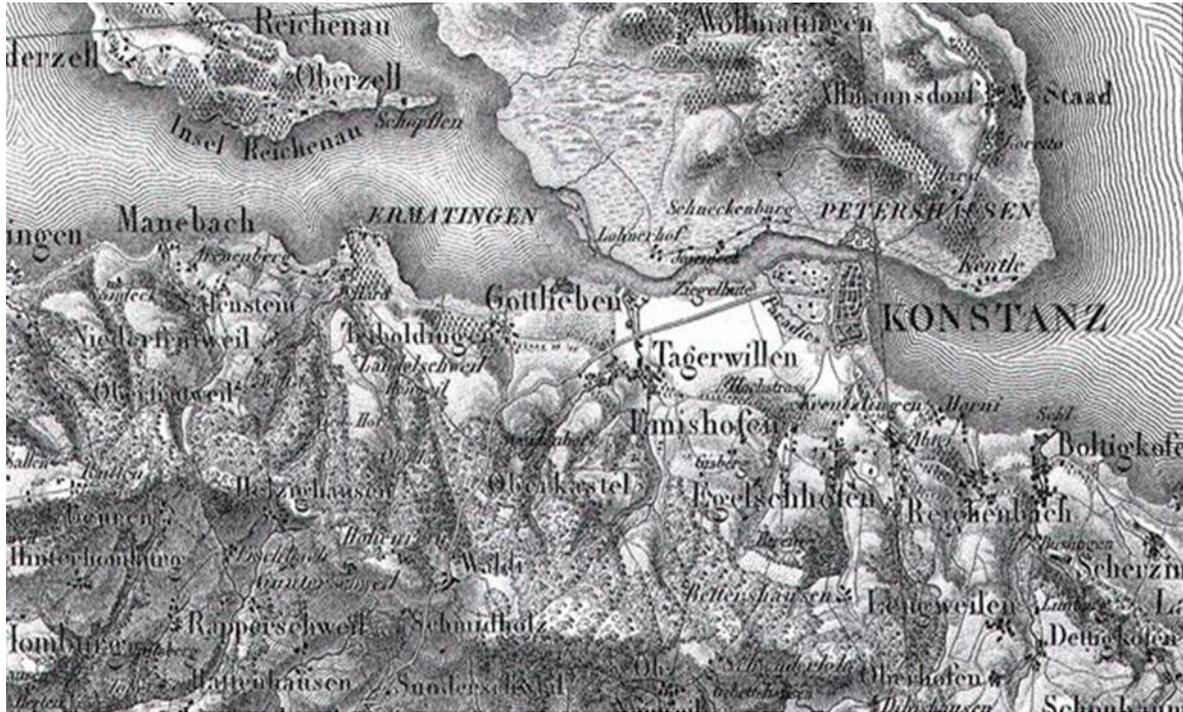


Figure 14. Carte de la Souabe, 1:100.000. A section of sheet Nr. NE 7-7/U-27, Konstanz. (Fischer, 2003)



Figure 15. Carte militaire de l'Allemagne, 1:100.000. A section of sheet Nr. 223 Schaff(h)ansen (Fischer, 2005)

In 1808 Napoleon ordered the production of a map of Germany, the Carte militaire de l'Allemagne at the scale 1:100.000 (Fig. 15), the most comprehensive map of that period. This

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manuscript map, in an extended version also known as the Carte de l'Empereur, was completed in 1809 and later on revised. During Napoleon's retreat from Russia in 1812, the only existing copy fell into Russian hands. From 1822 to 1830 the Prussian general staff produced copies of this map.

The Carte militaire de l'Allemagne consists of 278 hand-drawn sheets. Each sheet covered an area of 30' (ca. 56 km) in latitude and 1 minute (ca. 75 km) in longitude. The map covers German territory from Baltic in the north to the Alps in the south and from Rhine in the west to the Transylvania - Poland in the east. The main cartographer was Louis Albert Bacler Ghislain d'Albe (1761-1824) whose talent was demonstrated in many landscapes, battle paintings, engravings and litographs.

For this map same cartographic design elements were chosen as for the Carte de la Souabe: Paris initial meridian, scale 1:100.00, sheet size 80x50 cm, the columns were marked by letters and the rows by numbers (Fischer, 2005).

The Kingdom of Württemberg carried out surveying and mapping of the country from 1818 to 1840. The surveying resulted in the 15.572 cadaster maps at the scale 1:2.500. In 1820 the Royal Statistical-Topographical Bureau was founded. It began immediately with the topographic land survey resulted in 400 sheets of topographic atlas at the scale 1:50.000. First 55 sheets were published in 1826 and the last one in 1851 (Wikipedia).

The Kurhannoversche land survey was the first comprehensive land survey in the Electorate of Brunswick-Lüneburg ("Kurhannover"). The survey was carried out between 1764 and 1784 at a scale 1:21.333  $\frac{1}{3}$ . Later, military map at the scale 1:64.000 and general map at the scale 1:192.000 were issued (Wikipedia).

Between 1830 and 1865 the cartographic-geodetic measurements of the Prussian territory was led by the Prussian General Staff and performed by young engineer geographers. At first, for the maps at the scale 1:25.000 and 1:20.000 they measured the direction directly on the sketch maps without the use of theodolites. These maps were not published; they served as the basis for the military operation maps of the Prussian General Staff, at scales 1:80,000 and 1:100,000. Comprehensive geodetic-topographic survey of the Prussian territory was carried out in the period from 1877 to 1915. The goals of new measurement were to improve the method of cartographic presentations (contour lines, uniform height data) and to meet the higher demands for accuracy. It was conducted by the "Royal Prussian ordnance survey" formed in 1875. In this survey a total of 3307 map sheets at 1:25.000 were issued. All sheets, also known as a planetable sheets, were uniformly printed according to the geographic coordinate system. They

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are not rectangular, but trapezoid-shaped (with increasing latitude, the distance of each other meridians is smaller). The prime meridian was Ferro (Wikipedia).

Prussia introduced the metric system in 1872, which has since then been used in all geodetic and cartographic works.

The period between 1877 and 1915 was marked by the Prussian cartography progressive transition to modern geodesy and also by the transition to official maps of the German Reich.

1878 the States of Prussia, Saxony, Bavaria and Württemberg, decided the creation of an imperial map at a scale 1: 100.000 according to the Prussian official maps of the same scale. The map projection was polyhedral, the meridians and parallels were related to the Berlin Observatory. Each of the four states carried out its survey independently. The map sheets were numbered uniformly. Of a total of 675 map sheets, 545 covered Prussia.

The transition to the Empire enforced the extension of map production to general maps of various scales. In 1874 "special map of Central Europe"(also known as Reymannschen map) at the scale 1:200.000 was finally captured on 529 sheets and covered more than 1.1 million km<sup>2</sup> of Central Europe.

As the successors of Reymannschen map the "Topographic Map of the German Reich 1: 200.000" (TÜDR 200, first sheet issued in 1899) and the "Map of Central Europe 1:300.000" (ME 300, from 1893, first sheet issued in 1906) were prepared, edited and published almost simultaneously. TÜDR 200 was more civilian map, while the ME 300 was designed as a military operation map.

After the World War I, in 1921 "The Royal Prussian ordnance survey" renamed to the "Reich Office for National Surveying". Representatives from all German States participated in the "Board of Surveying", which replaced the "Central Board of the measurements in the Prussian State" .The Board was responsible for the implementation of Gauss-Kruger coordinate system and for the further unification of the geodetic bases of the national survey. During the Weimar Republic (1919-1933), most mapping projects due to the economic crisis were suspended.

Between 1935 and 1945 the following maps were published: basic topographic maps 1:5.000, "Deutsche Karte 1 : 50.000", and "Topographischen Übersichtskarte des Deutschen Reichs 1:200.000" (Krüger, Schnadt).

After 1945, Germany was divided and evolved into two states, East Germany and West Germany. In West Germany the official topographic mapping was constitutionally within the legislative competence of the states. In order to undertake higher-level geodetic tasks and

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especially for the supply of federal agencies with basic geographical data, the Federation has established the Federal Agency for Cartography and Geodesy (BKG), headquartered in Frankfurt am Main. The Agency has been responsible for all topographic maps and data at the scale 1:200.000 and smaller.

In DDR all responsibility for official cartography was carried on by: Topographische Dienst Dresden, Außenstelle für Photogrammetrie (Luftbildauswertung) in Leipzig, Topographische Dienst Erfurt and Topographische Dienst Schwerin. Since 1971 the Kombinat Geodäsie und Kartographie was responsible for national topographic description (Wikipedia).

In 1990 Germany was reunified.

In order to provide a Germany-wide standardized topographic description of the territory of the Federal Republic of Germany by Topographic Maps (TK), the German land surveying organizations are providing the following Topographic Map Series at different scales: Topographic Map 1:10.000 TK10, Topographic Map 1:25.000 TK25, Topographic Map 1:50.00 TK50, Topographic Map 1:100.000 TK100, Topographic Map 1:200.000 TK200 (Fig. 16), Topographic Map 1:500.000 TK500 (Fig. 16) and Topographic Map 1:1.000.000 TK1000. Topographic Maps are land maps describing places. They are the direct result of the topographic land survey carried out by the land survey authorities of the federal laender (TK10/TK25 - TK100) or the Federal Agency for Cartography and Geodesy (TK200 - TK1000). For each area of responsibility the maps are published - with blanket coverage,- at different scales,- with standard sheet lines,- mostly in a standard layout (symbolology, colors, design - see note below). Blanket coverage of the TK10 is only available for the new federal laender. As new Topographic Maps with new map graphics (derived from the corresponding ATKIS-DLM) are published step by step, differing layouts are to be expected in an transition period. In some details of the conventional maps of the TK25 - TK200 there are also some differences to be found between the western and eastern federal laender. Topographic Maps portray the relief of the earth's surface as well as its natural and cultural cover. Depending on the scale used the terrain, hydrography, vegetation, built-up areas, transportation lines and other cartographically relevant features are shown. The maps are characterized by- a high information density,- many details,- their accuracy, and- their topicality which is ensured by systematic maintenance (Federal Agency for Cartography and Geodesy).

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Figure 16. Sections of TÜK 200 and TK 500 (General Topographic Map)

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