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Lithuanian historical maps: periods, methods, accuracy and perspectives

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Summary

The first cartographic images of territory of Lithuania have appeared in Antique time (2nd age). From then, all development of Lithuanian cartography can be divided into stages: low accuracy (until the first half of the 16th century); general cartography (the second half of 16th century—first half of the 18th century); professional topography, modern topography, thematic cartography, modern cartography. Each period has its own characteristics in terms of representation methods, level of detail and accuracy. Different classifications of historical maps serve as a base for creating an information system of national cartographic heritage. Such information system so far only exists as a project, but the place for it has been foreseen as a part of Lithuanian Geographic Information Infrastructure.

Introduction

The first cartographic images of territory of Lithuania have appeared in Antique time. For this long period a lot of known cartographers, mainly foreigners have created numerous maps, carried out topographical surveys, and made astronomical and geodetic measurements. The result of these activities was a large number of compiled maps, which were compliant to the requirements of that time (Česnulevičius, 1999).

Development of cartographic activities was closely connected to the achievements in geographical cognition of the environment. Vilnius University became the center of the both cartography and geography in the territory of Lithuania. The scientists of the University could generalize practical works and create the theoretical preconditions for the further development of both sciences.

Analysis of old maps of Lithuania was carried out on the collection of Vilnius University Library, National museum of Lithuanian History and the Library of the Academy of Sciences. The analysis was made based on comparison of accuracy of geographical environment elements in various cartographic images. The level of detail, accuracy and “informativeness” of entire cartographic image and of its details were estimated in this analysis. The estimation of maps elements accuracy was based on comparison of coordinates, lengths and areas. The indices of accuracy may be expressed by characteristic of dispersion.

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Periods of Lithuanian cartography

The first cartographic image of Lithuania territory was the map by Claudius Ptolemy –*Sarmatia pars*. It was compiled in the 2nd age. A long period from the first cartographic image can be divided into several stages (Fig. 1).

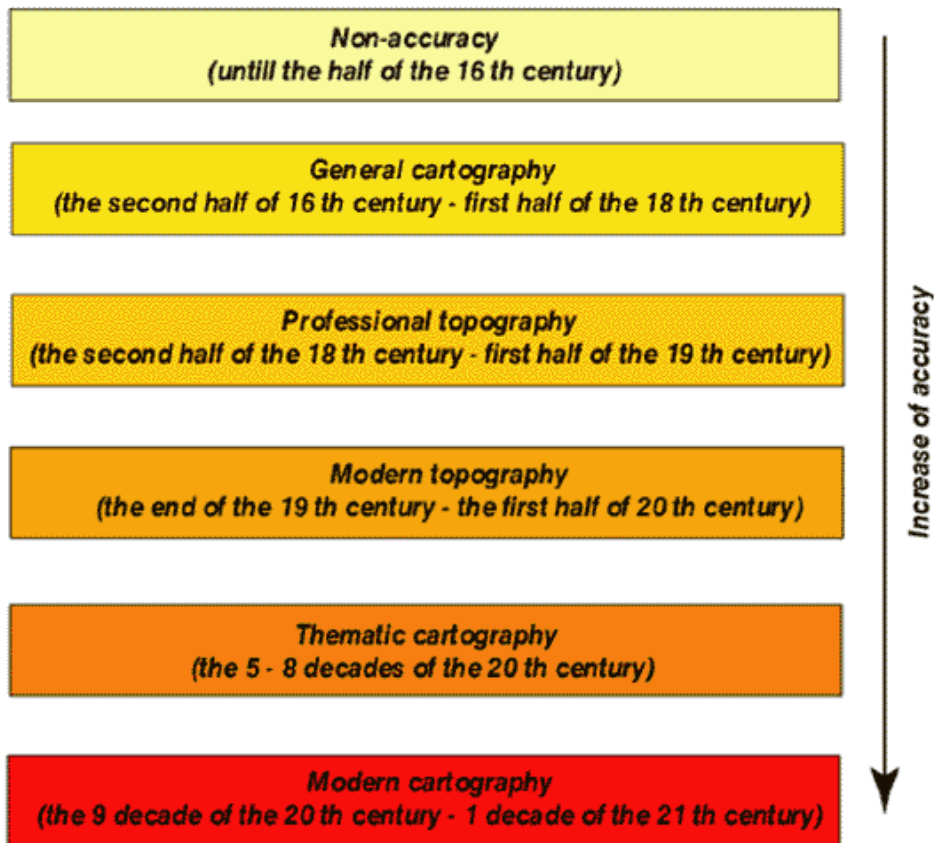


Figure 1. Periods of Lithuanian cartography.

The first geographical data about the territory of Lithuania are found in the works of Ancient Greeks and Romans. In the third book of the “Geographical Guide” by Claudius Ptolemy there is a description of the Baltic area. Unfortunately, the original map has not survived until recent time. At the present we know several maps of Central Europe compiled according to the data given by Ptolemy (Fig. 2). In the Middle Ages these sparse and inaccurate data of the Antique geography about Lithuanian territory were almost lost. Only some maps of that time, such as Al-Idrissi of the Hereford maps, do represent the main rivers of Lithuania. In the magnificent map of Fra Mauro (15th century) the name of Lithuania has been mentioned. The first and more detailed cartographic view of Lithuania since the Antique times, appeared in the second half of the 15th century, in the epoch of the Renaissance and geographical discoveries. It was marked on the map of Nicolaus Cusanus where, on the basis of the Antique geography, new physico-geographical and socio-economic objects were shown (Fig. 3). In the first half of the 16th century, due to the new administrative distribution and development of com-

mercial relations, the rulers of Lithuania needed new maps. These maps had to show the administrative borders, waterways and important settlements. The authors of such maps were Wenceslaus Grodeccius (*Poloniae finitimarumque locorum descriptio*) Bernard Wapowsky (*Mappa Regni Poloniae et Magni Ducatus Litvaniae*), Antonio Vydus (*Moscovia*). The new maps of Lithuania are in the atlases by G. Mercator, A. Ortelius and other.

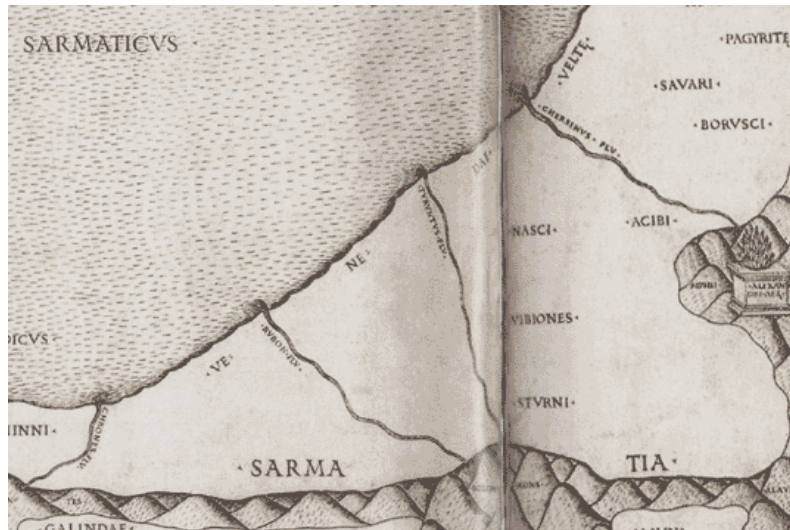


Figure 2. Fragment of the Claudius Ptolemy map *Sarmatia pars*. Copied by Maximus Planudes.

The second period relates to the formation of the basics of theoretical cartography. Vilnius Academy (University) was established in 1579 but natural science was not taught in it yet. Only in the early 18th century astronomy and geodesy lecture courses were given. The most outstanding map of this period is the *Magni Ducatus Lithuaniae, caeterarumque regionum ili adiacentium exacta descriptio* by Mikalojus Kristupas Radvila and Tomasz Makowski (1613, Fig. 3). During the 17th–18th centuries several general maps of Lithuania were designed: *Partie de Lithuanie* (1665), *La Curlande Duche et Semigale ...* (1659) by Nicolas Sanson d'Abbeville, *Magni Ducatus Lithuania ...* by F. de Witt (1680), *Magni Ducatus Lithuania ...* by J.Nieprecki (1749). In the late 18th century as a result of undertaken local topographical survey, city plans of Vilnius, Tauragė, Kėdainiai, Svėdasai were drawn. At the very end of the 18th century a professor of Vilnius University S.B.Jundzilas compiled a geobotanical map of Gardinas surroundings, few years later a similar map for Vilnius surroundings was made by university professor Emanuel Jilibert.

In the second half of 18th century general and physical geography was already taught in Vilnius University (by Karol Wyrwycz), and the astronomic observatory had been established. At that time first geography manuals were written by the professors of the University (K. Holowka, 1743, F. Paprocki, 1754, K. Wyrwycz, 1768, 1770). These manuals also contained the basics of geodetic survey and elements of cartography. In 1820 the department of Geodesy was founded in Vilnius University. The specialists and postgraduate students of this department took part in building the triangulation network for Lithuania and in topographic survey of Lithuanian towns. The university professor Jan Sniadecki prepared the manual of topography, which was for a long time used in higher educational establishments of the Russian Empire. In the early 19th century professor Joachim Lelewel made an

abundant collection of old maps and atlases, which became the core of the cartographic collection of the University. In the second half of the 19th century a survey of Lithuania was performed and maps at scale 1:84 000, 1:42 000 and 1:21 000 were compiled.



Figure 3. A fragment of the map by Mikalojus Kristupas Radvila and Tomasz Makowski (1613).

The period of modern topography began in the second decade of the 20th century, after the First World War. Geodesy, astronomy, geography and topography subjects were taught in Vilnius University and in Vytautas Magnus University in Kaunas. The scientists of these universities took part in geological (Juozas Dalinkevičius), geomorphologic (Česlovas Pakuckas, Mieczyslaw Limanowski) hidrometrical (Steponas Kolupaila) and topographic (Antanas Krikščiūnas) mapping. The famous maps of this period are *Map of Lithuania* (by A.Krikščiūnas); *Map of dialects of Lithuanian language* (by A.Salys) and other. In 1923 instrumental topographic survey of Lithuanian territory began. Until 1938 topographic maps at scale 1:100 000 were compiled for the whole territory together with 92 sheets at scale 1:25000.

In the second half of the 20th century many thematic maps were compiled: a wide spectrum of geological maps (stratigraphic, quaternary geology, hydrogeology, minerals and tectonics), geomorphologic, climatic, hydrological, soils, forestry, biogeography, land use, demography, economy, agriculture. In 1981 *The Atlas of Lithuania SSR* was compiled and published. It was a comprehensive work, which represented many natural and social phenomena and processes.

The period of modern cartography began in the last decade of the 20th century. Meanwhile modern technologies are used in information accumulation, design and publishing of maps and atlases. The main feature of this period is a wide application of GIS technologies.

Accuracy of the old Lithuanian maps

A real position of objects, their length, width, shape and area serve as the main characteristics to determine accuracy of the old maps. There are some indicative elements, which may be used in estimation of map accuracy: relief, forest areas, bogs, settlements, roads and the cartographic network (parallels and meridians). On charts of the 17th century relief was represented only for mountainous territories, mainly outside the former Grand Duchy of Lithuania. On the maps of the 18th century it is represented throughout the map although with some discrepancies.

Hydrographical network is another important natural element. On the 17th century maps the areal hydrographical elements, such as lakes and bogs, are almost absent. Also the river network is represented with insufficient precision. The 18th century maps have more detailed and precise river network. The lakes and bogs are amply represented on these maps.

Essential changes in qualitative aspect have taken place concerning position of the settlements. In the 18th century maps average inadequacy of settlement position is only 0,4 % compared to the real coordinates. Such improvement of accuracy had resulted in much wider application of the maps. General and especially local maps were applied not only for world-viewing, teaching, but also for more practical purposes: choice of manufactory sites, equipment of fortified military camps and construction of post roads (Wyrwycz, 1770).

The most expressive characteristic of map accuracy is a shape of the objects. The example clearly shows how the shape of Curonian Lagoon has changed in the 17th and 18th century maps (Fig. 4). A very informative characteristic is the length of rivers and position of the settlements. The declinations of these parameters across general maps of Lithuania, compiled during the 17th –18th century are shown in Fig. 5.

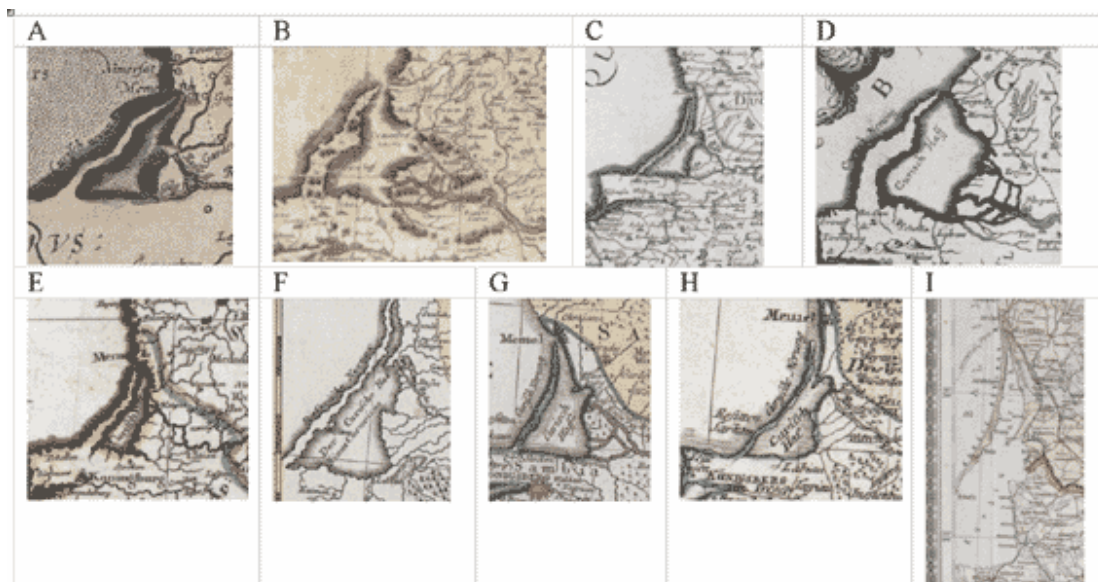


Figure 4. Shape of Curonian Lagoon in different maps: A – Mercator (1595), B – Radvila-Makowski (1613), C – Sanson de Abbeville (1675), D – Coronellis (1696), E – Senex (1719), F – Neprecki (1749), G – Lotter (1772), H – Mayer (1795), I – Lithuanian SSR (1955).

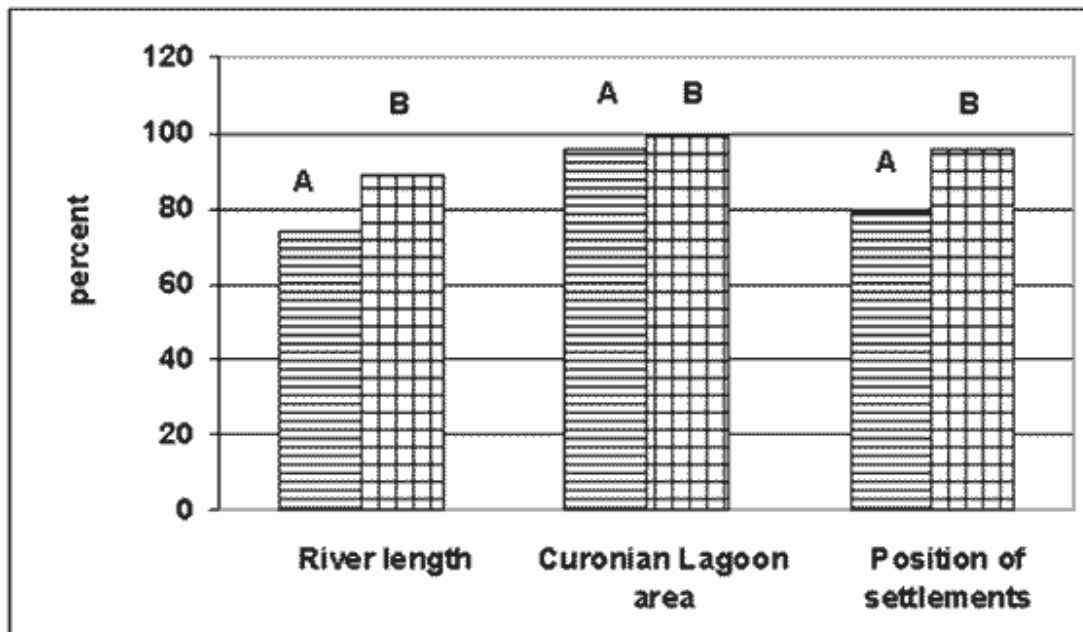


Figure 5. Reduction of positioning errors in general maps of Lithuania: A – 17th century maps, B – 18th century maps.

Cartographic heritage in Lithuanian Geographic Information Infrastructure

Geographic information has tremendous economic and social value for any society. It is very expensive to collect, process and maintain, yet ever easier to disseminate cheaply via Web-based services and products. The wide utilization of GIS software, the high production of GI and the exchanges of data among institutions but yet insufficient geospatial data re-use in Lithuania have witnessed the increasing demand for a more organized mechanism and infrastructure to benefit the whole country and ultimately to Europe. The main goal of Lithuanian Geographic Information Infrastructure (LGII) is to make harmonized and high quality geographic information readily available for implementing, monitoring and evaluating community policy and for the citizens to access regional and national spatial information. Development of explicit geographic information policy is a part of the national strategy to promote information-based society (LGII, 2004). Spatial data infrastructure based on modern information technology is a knowledge-gathering activity by its geographic nature. Such infrastructure is in the phase of implementation in Lithuania. Its principal scheme is shown in Figure 6.

The main components of LGII are:

1. Fully distributed geographic data system. All registered datasets are available on request, but stored where they are actually maintained.
2. Centralized geographic metadata system. Metadata on all registered datasets are collected from their sources and stored in central data bank. Metadata are updated regularly or on demand, depending on type and availability of the documented data source.

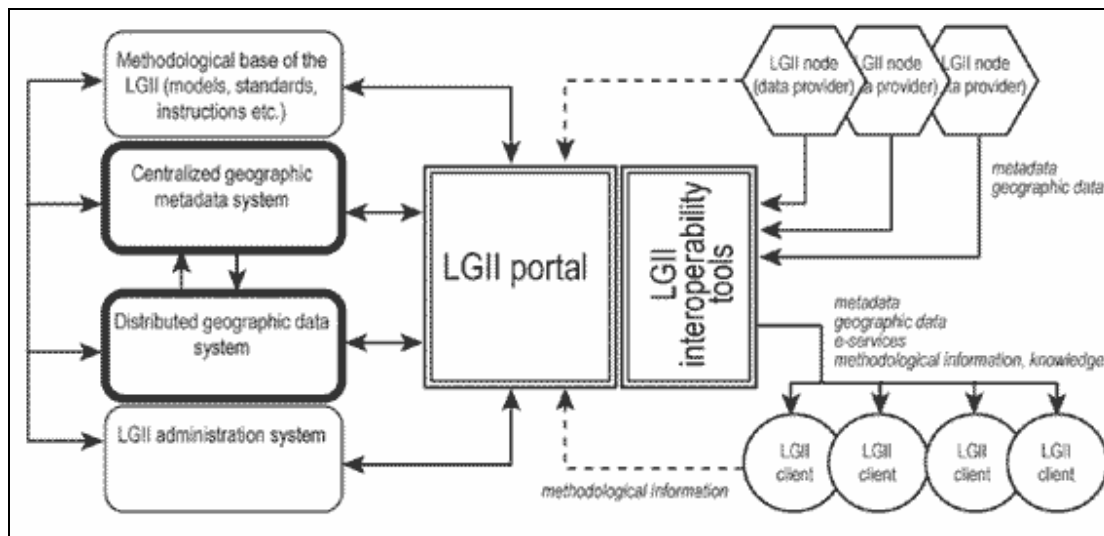


Figure 6. Structure of the LGII

Role of cartographic/GIS heritage in the LGII is still discussed. It is obvious that the newest and most intensely used geographic datasets are of the first importance to the LGII. However, the cartographic (recently also extended to digital geographic data) heritage from ancient times to just 15-20 years ago is a valuable information, that has to be given a place in the infrastructure and available through the one-stop Geographic information portal. First of all, the cartographic collection of Vilnius University Library, compiled of old maps (about one thousand items) and atlases (2237 printed items), must be made available for public. In modern society, cartographic heritage serves several purposes:

- Data source. Maps are practically the only source of historical geographic data. This function rather applies to the old maps with sufficient level of accuracy and reliability (i.e., starting from late 18th century), but also the more ancient maps are valuable sources of mental images of geographic space. The most of geographic databases do not yet have such historical value, however, it is just a matter of time when they will be necessary for measurements and analysis of changes in almost every field.
- Education and scientific purposes. Analysis of historical maps can reveal many facts not only about the progress of cartography science, but also about the level of geographic knowledge in the past.
- Source of design ideas. Contemporary cartographers can and often do use old maps as a source for new ideas for map design. That is often done in order to create more human feel about modern technology based map products, to form specific map styles etc.
- General information. Different surveys show that interest of general public in maps is increasing. Availability of information on cartographic heritage and, as planned in the future, of digital images, would foster even better promotion of cartography.

The structure of geographic information heritage information system (GIHIS) is similar to that of the LGII. GIHIS can be imagined as a single or compound (internal structure will be transparent to the end users) LGII data provider, serving metadata and cartographic data, as soon as they become available in digital form. The National Land Service, as an institution officially responsible for national geographic information policy, should logically become the owner of GIHIS and modern map and

geographic data archives whereas Vilnius University with its rich map collections would be the biggest provider of information on ancient maps.

Geographic metadata standard, adopted in the LGII and corresponding data structures will be easily extendable as to encompass information specific solely to historical maps. In order to provide additional search options (Lithuania on maps and maps of Lithuania in particular time), all historical cartographic data sources will be classified by the above-mentioned periods and by relationship to recent and former territory of Lithuania. Other states/territories can be linked to their cartographic heritage systems and/or to the maps stored in Lithuania (e.g., Vilnius University collections).

Different functionality of the LGII will be available for the geographic information heritage information system (Feasibility Study, 2004). The main functions are:

- Administration and support services, including information publishing;
- Search by different criteria and view of metadata (metadata of historical datasets are stored in the common metadata system). Search can be also based on named locations or user-specified area (bounding rectangle, polygons, center point and radius);
- Mapping (visualization) services, including typical map viewers' functionality, overlay with modern data sources and co-ordinate transformations (quite limited in this case);
- Transformation to different formats (technical interoperability);
- Data access (download and save).

As the absolute most of cartographic heritage in Lithuania is still stored in analogue form, it is very difficult to foresee different problems that can occur during implementation and use of such information system. Considering high costs of transfer to digital format and professional documenting, we expect that cartographic heritage data will be published in the LGII by relatively small portions and there will be time to make necessary adjustments.

Conclusions

From this study, the following conclusions could be drawn:

1. The maps of Lithuanian territory of the 17th and 18th centuries equal in accuracy and level of detail to the maps created in Western Europe.
2. The most accurate element in general maps is position of the settlements. It has been estimated generally using astronomic measurements.
3. The maps of the second half of the 18th century are much more precise in comparison with the 17th century charts. Errors of representation of linear geographical objects have decreased from 24 to 12 %, of areas of hydrographic objects – from 4 to 2 %, of position of the settlements – from 1 to 0.4 %.
4. Rich cartographic heritage of Lithuania is an invaluable source of historico-geographic knowledge. An information system, covering all categories of historical maps and databases available in Lithuania, has been designed as a future node of Lithuanian Geographic Information Infrastructure.

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