ABOUT SOME ASPECTS OF ENVIRONMENT CHANGES COMPUTER MAP EDITION

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Abstract

Old cartographic materials are to be wealthy source of information about the human environment in the past. One type of some forms of thematic cartographic applications are maps of selected elements of environment changes in certain periods of time. They permit to find the quantitative and qualitative changes of some objects and determine the dynamics of the changes.

In the paper some selected aspects of works on this type of thematic maps are described. The choice of vectorisation method, range of generalisation of details and modification of graphic symbols are pointed out. Exemplary solutions of these problems are illustrated by some results of research on selected area of test field, on which water regulations had been made in the 19-th century.

1. Introduction

Correct formation of environment elements requires some oriented activities based on knowledge and deep analysis of its state and on changes that occurred in a certain period of time. One of the most abounding sources of information on human environment in past years are maps of investigated area. Specially useful are topographic, middle-scale maps.

The material very helpful to examine dynamic of changes seemed to be, elaborated on the basis on sources, thematic maps containing summary information about selected elements of investigated area. It is proposed to prepare computer maps of changes of selected environment elements, containing data about their distribution in the space and their dimensions in various points of time. Considered maps should combine content of various source maps made in different projections with different accuracy and different generalisation of details.

In computer maps edition there are some specific problems. The most important of them, in my opinion, are: the way of introducing the data, the choice of content and final form of graphical presentation of result maps. These problems are the subject of the paper. They are considered independently of used hardware and software.

2. The ways of data collection

The data from source maps, differing in form and a range of content, must be introduced to the computer system in the way to be equivalent elements of edited thematic map In technical aspect, the data can be collected by method of digitalisation of source map or of vectorisation of their raster image.

The fundamental element of digitalisation process is to fit the map into the mathematical net defined in computer system. Depending on the type of system it is possible to use various types of transformation equations. It is necessary from the system to make it possible to do orthogonal transformation including translation, rotation and change of scale. The system of Intergraph (i.e. MicroStation 4.0.3) also reduces affine errors (non-perpendicularity and different division of co-ordinate axes). AutoCAD R.12, apart from orthogonal and affine functions, realises perspective transformation. These mechanisms make possible the elimination of map errors caused by paper contraction and unparalelity of referenced planes. They do not suffice when there are non-linear deformations or when projection of source map needs conversions of higher degree.

In respect on accuracy, digitising depends on some errors, among which the precision of digitiser is the least significant element. Conclusions from practical tests show that concerning old maps the biggest errors inhere in localisation of objects. For example, on analysed Prussian maps of 18-th century [source map a] the mean error of position of points is greater than ±100 m (i.e. ±4 mm in scale of 1:25000), and on older maps it is much bigger.

Presented in paper [1] results of analyses of transformation of maps estimate mean error after fitting ±1,25 mm from which generalisation error is equal to ±1,0 mm, error of media deformation is ±0,4 mm and ±0,4 mm is caused by transformation itself. Using computer technique the last ingredient of this error greatly grows smaller.

Another method of collecting data into system is vectorisation. The work goes then in two stages: first we must scan the map and put the raster image into system and then it should be translated onto digital form. There are three factors that we must consider from the point of view of described here subject matter:

- scanning,
- transformation of raster image,
- the way of vectorisation.

The scanning effect depends on used scanner, its efficiency and assumed resolution. In my opinion the useful resolution in GIS applications is between 200 and 400 dpi. The image file is then not too big and lines in the picture are 2-6 pixels thick. We can use the same transformation procedures as described earlier (like in set of AutoCAD-KAMISCAN) or the algebraic polynomial transformation (like in I/RAS B of Intergraph). The use of polynomials of second degree is enough for our purpose. The use of higher degrees can sometimes lead to false results.

The vectorisation process can be made manually or in automatic way. We can also vectorise by half-automatic method.

3. Selection of objects and generalisation of details

We can assume the problem of generalisation in two meanings:

- qualitative generalisation.
- quantitative generalisation.

The qualitative generalisation refers to the definition of the range of content. On topographic maps of 17-18 -th centuries three groups of structures are generally shown : building areas, forests and agriculturally used grounds. On Prussian maps from the first half of 19-th Century [source map b] we can also find parks, some special buildings, various types of forests and grass-lands. The indicator of the moisture and marshes is introduced. On maps from the end of 19-th century [source map c] the boundaries are univocally signed and the individual buildings are shown.

A similar distinction can be introduced in quantitative sense. While on the old maps the boundaries between objects are not clear, from the beginning of 19-th century they are univocal and the number of vertexes shows that they were measured accurately.

An indirect factor of generalisation is the accuracy of survey and map edition. The rough survey methods used in 18-th century speak for the weak accuracy.

Selection of the content of the „map of changes" depends on qualitative generalisation used. When we want to compare, for example, newer maps to the oldest ones, we must choose objects having similar features.

Therefore, the use of hierarchical repatrition of structured objects from the maps is proposed. On the base of common partition including arable grounds, forests and buildings a tree structure can be created. Certain objects can then be grouped in order to compare the proper objects from older maps.

4. The form of maps of changes

The final form of map presentation contains frame, description, legend and the main image. In described technology the final thematic maps have called „maps of changes of ... (certain environment element)". Practically two types of maps are provided. They are:

a) a full map of a given point of time with objects of interest from other points,

b) a map of changes of chosen specific objects from all analysed moments.

Two types of filling of closed areas are assumed:

- by graphic symbols similar to signatures used on original source maps,
- by the pattern such as lines or colours.

The first type is useful when we intend to show changes of one object in one period of time (fig. 1). The other one is better to illustrate dynamic changes in longer period including several points of time.

5. Conclusion remarks

Editing thematic maps as derivative source of information about certain occurrences or processes on analysed area is a difficult task. Described technical aspects of solving this task are very important from the point of view of surveyor and cartographer for whom the fidelity, the accuracy and the topicality are three main features of good edited maps.

Illustration of described problems will be shown on a poster. There are:

- the practical effect of transformation raster to vector,
- an example of hierarchical systematic of objects on different source maps,
- map of ground uses in the first half of 19-th century (as background) with forests from the end of 18-th century,
- map of changes of forests in three points of time.

All maps refer to Middle Obra Valley area near Poznań/Poland.

References and source maps

[1] Krzywicka-Blum E.: Studia metodyczne wybranych zagadnień redakcji map przyrodniczo-rolniczych. (Methodical studies of selected problems of edition of natural-agricultural maps), Zesz. Nauk. Akad. Roln. we Wrocławiu, Ser. Rozprawy 20, Wrocław 1980.

[2] Wyczałek E.: Badanie zmian środowiska rolniczego na podstawie analizy komputerowej archiwalnych map topograficznych. (Investigation of changes of agricultural environment on the basis of computer analyses of archival topographic maps), Roczn. Akad. Roln. w Poznaniu 1994, s.143-150.

Prussian topographic maps:

[a] 1:50000, by Gilly and Krohn (from years 1793-96).

[b] 1:25000, by Müffling (from years 1826-30).

[c] 1:25000, from about 1890.

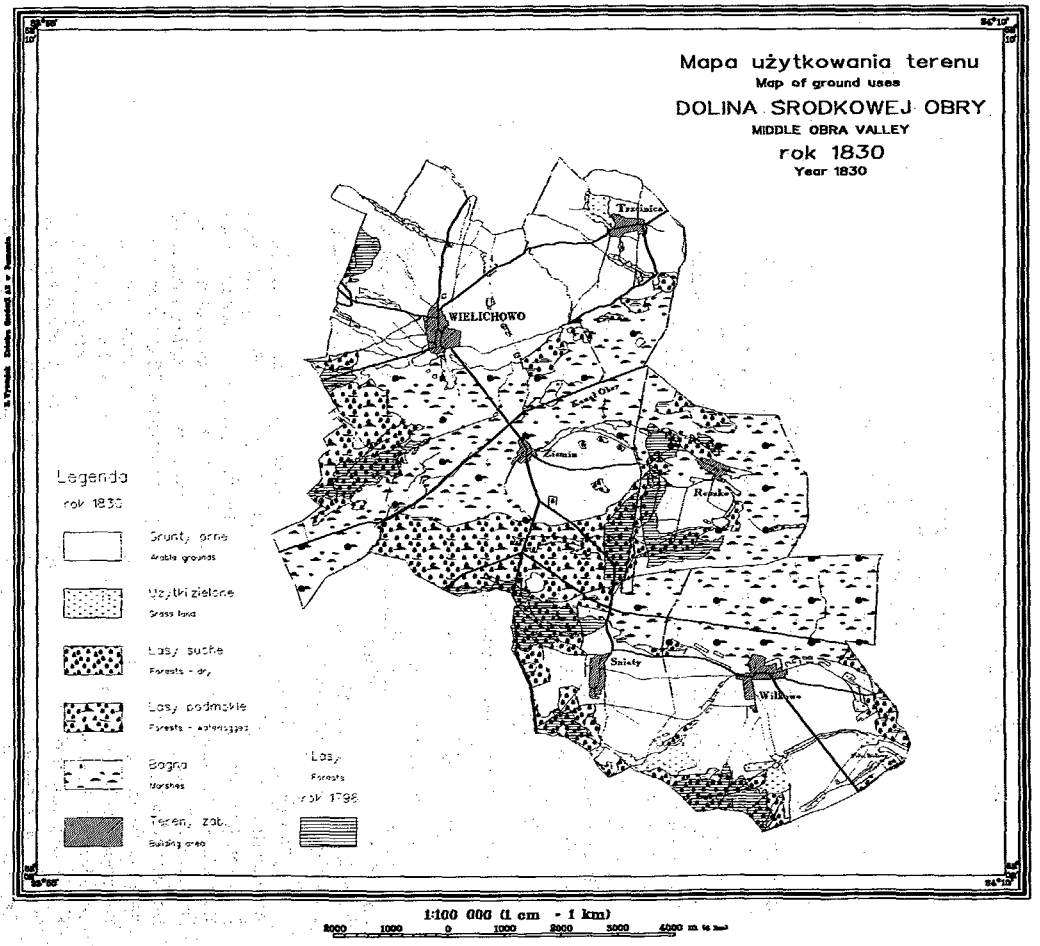

fig. 1. The map of ground uses in Middle Obra Valley in the first half of 19-th century with forests from the end of 18-th century.