GENERAL PROBLEMS OF GROUND USE CHANGES MAPPING

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This paper presents problems faced when elaborating maps of changes in time and caused by new objects type. Exemplification refers to ground use maps in large scale.

Mapping in large scales (1:5 000 - 1:10 000) aims - as a rule - at informing about current state of the terrain only. Cartographic resources that become outdated are permanently updated or withdrawn from circulation. Consequently maps being in use represent the state of terrain in a single, possibly the newest time profile. Hence we may say that this information has a static character.

Nowadays - besides knowledge of current state of the terrain - also more detailed information about the past and about changes in time is more and more necessary, for instance for natural resources protection. Hence the static terrain model on large scale maps should be completed by a dynamic one [1].

Elaboration of large scale maps of changes in time creates some problems at:

1) source data acquisition and estimation,
2) data processing and
3) data storage and transmission.

Examination of changes is founded on comparison of states in two different time profiles. However the following older and older maps are not fully comparable. The older is a map, the lower is its accuracy and detailness. There occur also differences in their scope of content.

Data processing depends mainly on bringing information from different sources to one set of reference. Here the main problem is to identify elements on both maps in order to transform the content of older map to a newer one. Some problems of data storage and transmission connected with map elaboration will be discussed in this paper on example of ground use maps.

Content of each ground use map is composed of surface objects (arable grounds, meadows, forests, waters etc.) separated by contour lines and refers to one time profile. However a set of these maps made in different time profiles conveys - as a whole - information about changes of ground uses in a time interval.

Construction of a map, that would inform about ground use state in some different time profiles and consequently about changes in time, depends on overlapping the content of an older map to a newer one. As the result some contour lines can overlap, whereas others remain separate.

Hence contour lines on this map will designate limits in profile I, either in II or in profiles I and II at the same time. The density and variety of contour lines increase when the number of time profiles is bigger and bigger. At the 3 time profiles I, II, III there can be 7 kinds of lines:

I, II, III, I-II, I-III, II-III and I-II-III.

Notation of so many kinds of lines on map would not facilitate reading and seems needless. Hence it is advised to mark all the lines in the same manner and to draw attention to surface objects delimited by the contour lines.

Whereas a typical object on the classic ground map represents a kind of use in a single time profile, on two profiles map objects are characterized by a defined sequence of two kinds of ground uses: in the newer and older time profile.

Number of objects types depends before all upon the number of ground use kinds. At 4 kinds of uses (a, b, c, d) we can obtain up to 16 unrepeteable sequences, i. e. 16 types of objects:

aa, ab, ac, ad, bb, bc, bd, ba, cc, cd, ca, cb, dd, da, db, dc.

Secondly it depends upon the number of time profiles. If we mark the number of use kinds by "u", the number of time profiles by "p" and the possibly highest number of types of objects by "o", we may write the equation:

$$o = u^p$$

In case of 3 time profiles and 4 kinds of ground uses there are 64 types of objects. Although as a matter of facts this number is lower, simultaneous visual presentation on map of all types of objects is inexpedient (see Map No 1).

Hence the characteristic features of each surface object are registered in a data base adminstered by a computer program. To these features belong: identification sign, area and kind of ground use in each time profile (see Table 1). Some ground uses data can be completed by qualities of wetness and scrubness.

Table 1 Structure of data base

Ident. No	Area ha	Kind of ground use TProf.1	TProf.2	TProf.3	TProf.4
A1.13	2,71	w	s	m	a

w - water, s - swamp, m- meadow, a - arable ground

By means of computer program we are able to make some analytical operations, for instance to calculate the area of each ground use in a time profile and the changes of specified kinds of ground between two time profiles. On the grounds of these operations we can indicate the main tendencies of ground use changes.

Changes of each ground use are composed of losses and additions of area. Losses of a given ground use happen by assignement of a part of its area to other kinds of ground use, for instance after drainage of swamp area. Additions - on the other hand - depend on acquisition of some area at the cost of other kinds of ground uses, for instance augmentation of arable ground by deforesting.

Analysis of losses and additions enables a deeper study of ground use changes. Details are exemplified on meadows changes in Świerczyna village between the years 1890 - 1975 (see Fig. 1). Generally meadows area diminished by 10 % (see Fig 1a). However this change is composed of loss of 35 % of former meadows area and of addition resulting from installation of new meadows at the cost of other ground uses (see Fig. 1b) on 25 % of area (with reference to meadows state in 1890).

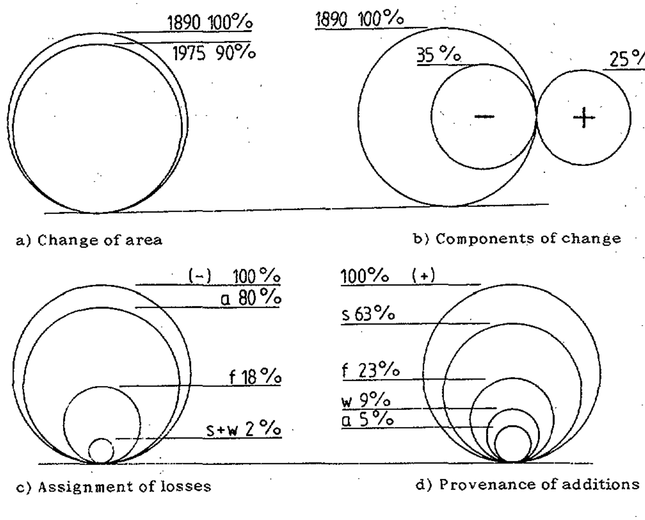
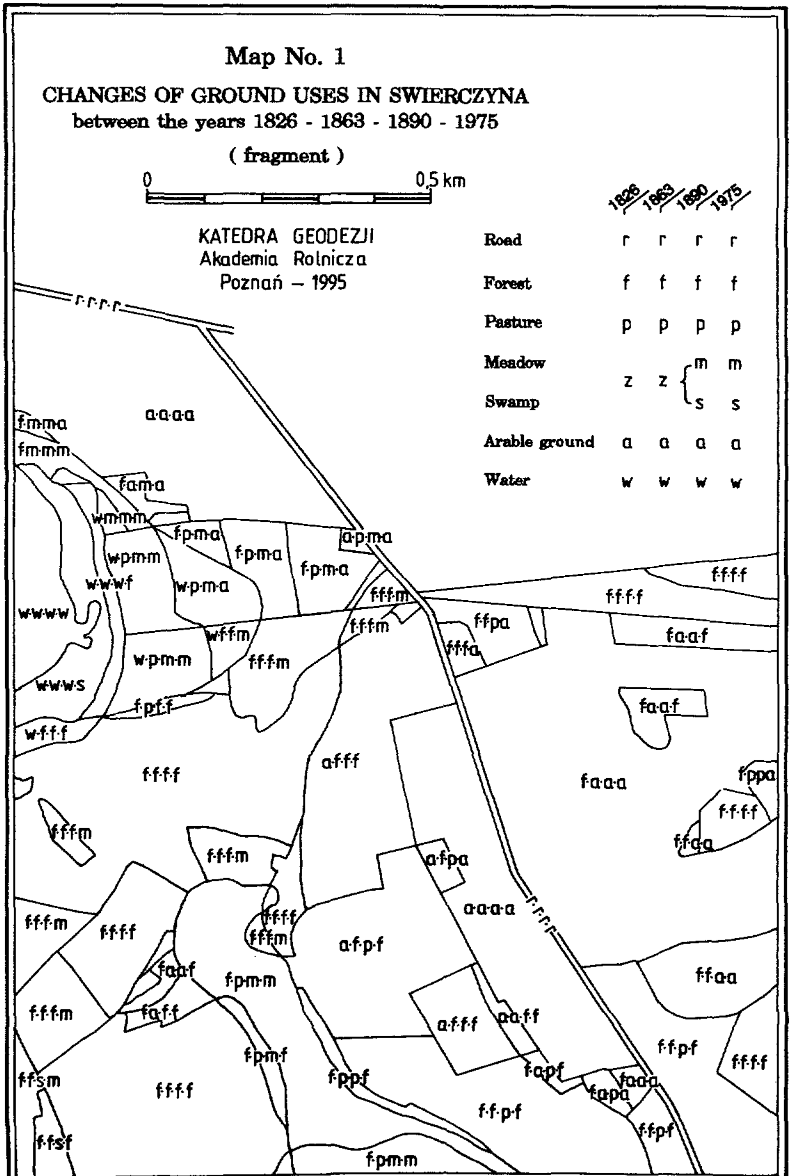


Fig. 1. Changes of meadows 1890 – 1975 in Swierczyna (%)
a– arable ground, f– forest, m– meadow, s– swamp, w– water.



Map No. 1

CHANGES OF GROUND USES IN SWIERCZYNA
between the years 1826 - 1863 - 1890 - 1975
(fragment)

Losses of meadows (see Fig. 1c) were caused mainly by changing into arable grounds (80 %) and by afforestation (18 %). New meadows (see Fig. 1d) were installed on former swamps (63 %), forests (23 %), waters (9 %) and arable grounds (5 %).

Numerical analysis of ground use changes is completed by a cartographical one. We can list surface objects which are distinguished by a specified sequence of ground use in some time profile, for instance: forest - arable ground, water - swamp - meadow. Then these objects can be represented on maps for spatial analysis of changes. Some examples of maps will be shown during poster session II.

Research of ground use changes proceeds in accordance with retrogression method. Starting with the newest source material we examine older and older source maps one after the other. This way we elaborate gradually a model of changes on the examined terrain. This model becomes guide in our researches aiming our attention at a given direction. However it must be verified all the time by investigation in what a degree the new facts confirm or deny our model.

References

[1] Gołaski, J., 1994. The Static and Dynamic Models of Terrain in Geodesy. Geodezja i Kartografia T.43, p. 33 - 40.