

## THEORETICAL ASPECTS OF CARTOGRAPHIC MODELLING.

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The report gives an account of the essence of cartographic modelling, structural definitivity of the object and means of cartographic modelling, the system of modifications and stages of cartographic modelling process.

### 1 The essence of cartographic modelling.

Theoretical cartography deals with the regulating of different systems of concepts as well as the concepts related to the cartographic modelling.

Cartographic modelling is an integral theory which on the new methodologic basis unites the already acknowledged methods of projecting, making and use of maps for the investigation of the objects of the real world by means of the system regulating and transference of the information of these objects. In this sense cartographic modelling provides the combination of cognitive and communicative functions of maps as the real world models.

### 2 Structural definitivity of the object of the cartographic modelling.

The notion "system - original" has constituted the initial conception in the comprehension of the object of cartographic modelling. It should be mentioned that theoretical cartography considered the correlation between the object of science and its scientific method; the concept of "object" was often substituted by the polysemantic term "subject". The object of cartographic modelling is defined by its three major characteristics. Structural definitivity considers its essential, spatial and temporal definitivities. Essential definitivity involves characteristics of various formations (objects, their groups, totalities, taxons), processes, their substantial properties and relations. Spatial definitivity is manifested in the transference of spatially coordinated information in the discrete and continual form, spatial characteristics of the objects (their position extent and relations), topologic - geometrical forms of spatial structures. Temporal definitivity is manifested in the reflection of objects in statics, dynamics, in retrospect, in their present state and in prognosis (Fig.1).

### 3 Means of cartographic modelling.

A map as a model doesn't reflect the objects (system - originals) themselves. It reflects the ideas of them (their logical models) which are the result of the perception and logical processing of

OBJECTS AND PHENOMENA					PROCESSES				RELATIONS		
R E A L					I D E A L						
VISUALLY OBSERVED					VISUALLY UNOBSERVED						
SUBSTANTIAL PROPERTIES											
PHYSICAL		CHEMICAL		BIOLOGICAL		ECONOMIC		SOCIAL		TECHNICAL	
Objects	Sets	Systems	Taxones	Main	OTHER PROCESS OF				between the territory and phenomena	between taxones	between objects
					changing territorial structure	changing the component structure	vertical structural	chrono-structural			
<i>elementary</i>	<i>combinations groups networks</i>	<i>geosystems geocomplexes geocomponents</i>	<i>area zone region</i>	<i>movement development functioning diffusion relocation</i>	<i>differentiating mosaic structure levelling concentrating absorption diffusion agglomerating polarization</i>	<i>polarization diversification integration desintegration</i>	<i>stratification</i>	<i>growth development</i>	<i>location density dispersion capacity potential</i>	<i>congruence cover concentration hierarchy neighbourhood disconnection</i>	<i>impact interaction distance link gravity convergency repulsion exclusion attraction proportionality</i>
class $\rightarrow$ family $\rightarrow$ species $\rightarrow$ element of object											
Q U A L I T Y					Q U A N T I T Y						
E S S E N C E											
STRUCTURE AND ORGANIZATION											
TOPOLOGICO-GEOMETRICAL FORMS OF SPATIAL STRUCTURES											
A lot of discrete elements - point, linear, areal and vector ones				Networks, roads, trees, cycles, cells, boundaries, axes of direction, frontal lines				Surfaces and fields - discrete, continual, scalar			
D I S C R E T E						C O N T I N U A L					
S P A T I A L L Y D E F I N E D											
T E M P O R A L L Y F I X E D											
R E T R O S P E C T				P R E S E N T S T A T E				P R O G N O S I S			
S T A T I C S						D Y N A M I C S					

Figure 1: The scheme of structural definity of the cartographic modelling object (essence, space, tempo)

information. Having been materialized in the map - model this idea (image) is defined specifically and substituted by the cartographic systems of symbols. There is no coincidence (direct and full) between the map and the system - original just because they are mediate through the map (the language of the map). The cartographic system of symbols is a formalized graphic language of cartographic modelling. It represents one of specially scientific systems of symbols.

The ideas of objects are formed in the process of cartographic investigations which depend on their methodology regulated in correspondence with the deductive transference from generally scientific complex of methods to the limited generally scientific complex among which modelling together with its system approach, mathematic methods, informatics and cybernetics stands out. Farther on the transference to complex of geographic methods is completed by the specially scientific methodology of cartography. As to the formation of cartographic modelling and its connections with other methodological complexes the necessary elements should be picked out of each complex to form it. Thus we defined the connections of cartographic modelling with other elements in methodologic system of cartographic researches.

#### 4 The system of the modifications of cartographic modelling.

The process of research involves the application of different types of models (airspace, structural - graphic, mathematical, geoinformational, etc.), observance of general scientific and specific principles: mathematic formalization, cartographic symbolization and generalization of cartographic models, temporal principles, estimation of the state of objects, etc. On this basis the system of different modifications of cartographic modelling is formed: it includes theoretical and experimental cartographic modelling, mathematical cartographic modelling, modelling based on the data of airspace and other types of monitoring of objects, basic geoinformational, geoinformational, dialogue cartographic modelling through computer simulation.

Theoretical - cartographic modelling is a kind of reflecting theoretical ideas about the object by means of cartoids - ideal highly abstracted cartographic images (or a kind of the formation of theoretic generalizations of the knowledge about the object on the basis of maps). The theories, hypotheses about the structure of the systems of real objects, prognoses of their transformation and development, extrapolation of their distribution in geospace are checked, concretized and specified by means of constructions of cartoids of different types.

Experimental cartographic modelling is a type of the opposite direction of search, namely the indicational and concretized one. Here the question is not about the experimental activities of the

mapper; the task of this search is the experimental investigation of the object which is modelled in laboratories. Cartographic experiment consists in modelling of the studied characteristics of the object of research and its connections with the elements of other systems of objects. All this is modelled in geospace. The experiment is conducted for establishing the geographic regularities of showing various characteristics and connections of objects. A great many of the objects of experimental researches may be of course pointed out. The maps will differ both in the character of their objects and in the scale of the experiment, and in the forms of observations which provide the information about objects. This type of cartographic modelling allows to solve the problems of extrapolation of the data of the experiment to the geospace of much more considerable extent. The experimental cartographic modelling can be considered as the means of accumulation of the data both of laboratory and field researches. In this case it will constitute the basis of the monitoring mapping, the data of which in their turn will serve the basis of the other types of cartographic modelling. The latter will transform the initial monitoring information.

In mathematical - cartographic modelling the features of mathematical and cartographic models are used in the process of the analyses and syntheses of the complex spatial - temporal information. Cartographic component extends and develops the mathematical model. Cartographic reflection of mathematic calculations gives an opportunity to visualize their results in the form optimum for the research; it also saves the mapper from mistakes and miscalculations; gives us an idea of the fidelity of mathematic modelling and its geographic trustworthiness.

The conjugation of airspace and cartographic modelling is one more sphere of modelling which is formed in the process of developing methods of photographic and photoelectronic registration of the reflected electromagnetic proper radiation of objects in different diapasons. Applying these airspace models would be limited unless the airphotointerpretation (the initial cartographic transformation which is necessary for perception and comprehension of the photographed objects) was done.

The primary task of the geoinformational modelling consists in making the informational base of cartographic modelling. The kernel of any data basis is the model corresponding to one of three approaches: hierarchical, netting or relational. The higher (conceptional) level of the geoinformational modelling contains the formalized description of the peculiarities of the objects which are subjected to cartographic modelling.

It depends on cartographic - geographic imitational modelling. This kind of modelling is theoretic means of investigation accented on the spatial - structural aspect while the research of the phenomena with maps.

## 5 Stages of the cartographic modelling process.

Specificity of cartographic research process contacts with the stages of cartographic modelling process. On the initial stage the task to search is defined (the connection with the specific scientific methodology of the research process, the object of modelling, the aim, tasks and its aspects are determined). On the second (theoretical) stage the process of scientific research (its programme) is modelled, the auxiliary models of object are made up, the main measures of cartographic modelling are defined, the paradigm of cartographic modelling (its theoretical structure) is suggested, methamodel is created (e.g. theoretical legend of the map). The information stage comes next. The information pre - cartographic model (statistic data are systematized in accordance with the theoretical model of the legend) or cartographic pre - model - the address map with the aid of which the data are geographically localized, systematized in the lists and columns of the tables is being made up. It's expedient to apply geoinformational technologies on this stage. On the fourth stage the cartographic model is made up with the system of symbols and other means of cartographic modelling. The final stage is based on the perception of a map as an "object" of investigation and includes the analysis of the cartographic model from the point of view of its correspondence to the "system - original" (the object of research) and the achievement of the aim of the investigation. The shortcomings are defined and eliminated through computer technologies. On this level new variants of the model are made up (approximation to the system - original in the selected aspects of the characteristics of the object of investigations).

Thus specification of the basic concepts of cartographic modelling and their relations, integration of complexes of methods with the process of cartographic researches into the object of modelling allows to ground theoretically the significant section of metacartography.