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The concept of spatio-temporal cartography: system, connections, functions

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Abstract:

The concept of spatio-temporal cartography is based on the conceptual system of metacartography. Metacartography itself is a doctrine of the subject, method, and language of cartography. It was this concept that adequately defined cartography as an academic science and determined its place in the general classification system of sciences. According to the concept of metacartography, the subject of cartographic research is a specific aspect of objective reality – the order of the relative positions of objects and events (concrete space) and its variability over time. The concept of metacartography developed a methodological system of cartography and the semiotics of map language. The author of this concept, Professor A. Aslanikashvili, separated cartography from the system of mapping methods and techniques, which is the competence of the practical, and operational part of cartography. He raised cartography to the level of an academic science that studies the universal spatio-temporal relationships of the phenomena of reality, both in relation to each other and within the framework of a spatial reference system.

For the mapping process, objective reality is represented by two parts: 1) the concrete space of visible objects and events of objective reality, and 2) the concrete space of visible, unobservable objects and events of objective reality. Both aspects of reality are reflected in spatio-temporal cartography, the logical methodological basis of which is geographic cartography. The general notion underlying spatio-temporal cartography is the category of measurement, which obeys the so-called “iron law” of cartographic representation. Like other conceptual systems (metacartography, cartology, graphic communication cartography, cartosemiotics, cartology, geoiconics, geoinformation concept), spatio-temporal cartography also has its own object, which it studies from a certain specific point of view. This is how real space-time is conceived, and as a result, all types of dynamic maps and other cartographic images are created. The content aspect of spatio-temporal cartography is replete with natural and anthropogenic geosystems and their complex spatio-temporal cause-and-effect relationships. The dynamic geosystem, as an object of spatio-temporal cartography, contains both visibly observable and unobservable phenomena of reality.

The subject of research in spatio-temporal cartography can be considered the concrete space of dynamic geosystems of reality and its temporal variability. The subject of research in spatio-temporal cartography can be represented by a structural-functional equation containing logical spatio-temporal connections:

$$GSt = Rst\ [Ssys, Remi\ \{l, a, h, b, n\}].$$

where GSt – dynamic geosystem at time t, or in a certain section.
Rst – spatio-temporal relationship between the elements of the system.
l – lithospheric element,
a – atmospheric element,
h – hydrospheric element,
b – biospheric element,
n – noospheric element.

The important components of space-time cartography are: a) geoinformation mapping, b) geographic cartography. This is the first stage of space-time cartography. In the second stage, the internal structure of spatio-temporal cartography distinguishes the so-called "component cartographies", which in the above equation represent the components of the dynamic geosystem.

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Based on all this, we come to the logical conclusion that the basic general notion (category) of space-time cartography is the category of dimension. Dimension, in general, denotes the metric characteristics (length, height, width) of any object or event existing in reality. It has been established in philosophy and, especially, in natural science since ancient times. An interesting stage in the establishment of dimension is the appearance of the categories of space and time. The issue of dimension in relation to time occupies an important place in philosophy in general, as well as in the natural and social sciences. Over time, its specific feature is its dynamism. The next specific feature of time is that time is a form of sequence, and space is a form of coexistence. Moments of time are located one after another, not next to each other. Here we see the very nature of time as an order of sequence of events. An important parameter of time is its duration. Duration refers to time, but also implies continuity of time and movement.

Having characterized the characteristics of space and time dimensions, we can discuss the four-dimensional continuum. Thus, both in spatio-temporal cartography and in the process of mapping, we are dealing with real space-time. Dimension as a concept fulfills its functions in spatio-temporal cartography.

In this conceptual system, all categories utilize dimension as a specific parameter or set of parameters by which they are established as general notions. Among them, the following categories related to the notion of dimension can be distinguished:

1) Concrete space – characterized by three spatial dimensions;

2) Time – one-dimensional and has one direction, containing the order of the mutual sequence of cartographic events over short, medium, and long periods of time;

3) A map – a subjective representation of objective reality, made in the language of a map, a metric image on which cartographic measurements can be made in all existing dimensions;

4) Structure – Cartographic images (map, cartogram, carto-diagram, block-diagram, physiographic model, volumetric model, animated image) reflect the structural units of an event that exist in reality, which have both spatio-temporal and metric dimensions;

5) Territory – associated with a concrete space and has all dimensions of both spatio-temporal and metric nature;

6) Movement – the displacement of an event, a change in location. In spatio-temporal cartography, this category can be considered as the replacement of one spatial localization of an event with another, which is reflected in the cartographic image and has spatio-temporal dimensions;

7) Reflection – the fixation of real knowledge about objective reality (the properties of objects and events) in human consciousness. This category is directly related to the process of spatio-temporal mapping. During this process, a specific space and its temporal variability are reflected on a map or other cartographic representation, which, in turn, is a spatio-temporal model;

8) Form and content – the extent (distribution) of objects and events of objective reality in time and space. These categories cannot exist without each other. An empty form is unthinkable without content. Form in spatio-temporal cartography can be understood as a contour depicted on a map, having a specific configuration. And content is the qualitative aspect of objects and events, encoded in this form (contour). Form and content, of course, have spatio-temporal and metric dimensions;

9) Time scale – the degree of generalization of the essence of development. This is the same as the means of transition from a frequent scale of cartographic time to a more sparse one. It is an effective means for conducting all kinds of measurements. Therefore, it is itself a dimension.

Thus, in the conceptual system of spatio-temporal cartography, dimension is of crucial importance. It plays a decisive role both in the study of a concrete space and its temporal variability, and in the process of mapping a certain aspect of reality. This category is formed in the form of three spatial and one temporal dimensions. Since dimension is an effective means of studying spatial, qualitative and temporal patterns of objects and events in reality, it can be considered as a category in spatio-temporal cartography.

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