THE DEVELOPED CONCEPT OF GEOIMAGES

A.M. BERLYANT

Department of Cartography
and Geoinformatics
Faculty of Geography
Moscow State University
Vorobyevy Gory
Moscow, 119899, Russia

Abstract

The experience gained through the combined use of various geoimages shows that they constitute a certain integral system. Geoimages exist in both fixed and program-driven graphic environments. They are formed using three groups of graphic variables - geometric, optical and temporal ones. The notion of hyperimages as a complex multidimensional graphic model integrating both geometric, dynamic, and stereoscopic parameters and such features as brightness, etc., is suggested. The structure of geoiconometry which is a discipline concerning the methods of making measurements from geoimages is described.

1. Geoimages and Geoiconics - Definitions.

A geoimage (georepresentation) is any spatial-temporal generalized model of terrestrial (planetary) objects of processes which has a scale and is presented in graphic patterns [1]. Major properties common to all geoimages - scale, generalization and presence of graphic elements (signs, patterns) - are highlighted by this definition. Currently 3 classes of geoimages are distinguished:
1. Flat or 2D (and 2.5D) geoimages: maps, electronic maps, scanner, radar, TV imagery, etc.;
2. Volumetric or 3D images: stereomodels, anaglyphs, block diagrams, holograms, etc.;
3. Dynamic 3D or 4D images: animations, motions, computer films; movies atlases, etc.

Within each of these classes there are dozens of variations: maps having various contents, photos in different spectral bands, 3D models of different foreshortening. Besides there are many combined images characterized by features of different classes and types, such as photomaps and ortophotomaps, iconomaps, TV photographs, display stereophotographic models and anaglyphs, TV holograms and many others.

The use of various geoimages (especially in GIS environment) requires studying their advantages and shortcomings, as well as a possibility of combined use and techniques permitting to gain qualitative and quantitative information. This favors elaboration of a new branch of science - geoiconics, as a synthetic discipline representing the theory of images and methods of their analysis, transformation, recognition, perception and application for

scientific and practical purposes [2].

Geoiconics is to be conceived as a discipline linking cartography, remote sensing and computer graphics (Fig. 1). The structure of the discipline will acquire shape further, though three basic branches can be distinguished already:

- theory of geoimages;
- geoimages creation, designing and recognition;
- interpretation of geoimages (applied geoiconics).

Presently, geoiconics appears to constitute a supersystem. However, dialectics of its development and strong support by geographical cartography will lead in future to geoiconics becoming a part of renewed and integrated system of cartographic disciplines.

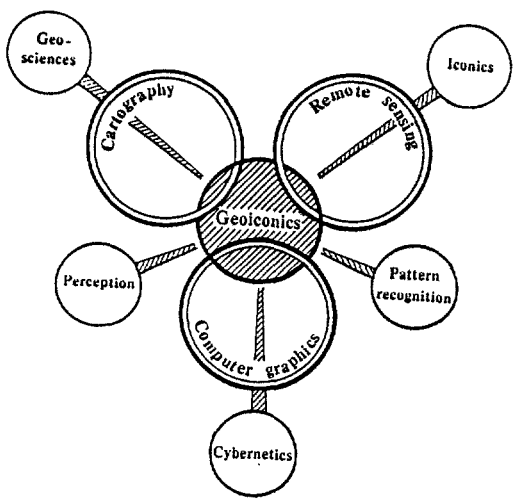

Fig. 1. Geoiconics in the system of sciences.

2. System of geoimages.

The circular diagram (Fig. 2) reflects the principal conceptual system of geoimages and transitions between maps of aero- and space imagery, block diagrams and animations, properties of which change more or less gradually. It is obvious that this plain scheme cannot offer the exhaustive picture of diverse transitions between models in their different

combinations and variety of characteristics.

The set of images presented on the petals of the graph in not exhaustive and can be supplemented by many other kinds of geoimages. This graph is only one of the models of the geoimages system representing just the most general regularities by demonstrating objective intermodel relations, gradual changes of their properties and their mutual transitions.

For example, in transition from maps to images their symbolic character declines little-by-little while their copyistic or "photo" properties grow. The same situation is observed in direction images - block diagrams, where the properties of copyism decrease but 3-dimensionality gradually increases. The sector "map-films" is characterized by the increase of dynamic properties of cartographic representation through electronic maps and animations, etc.

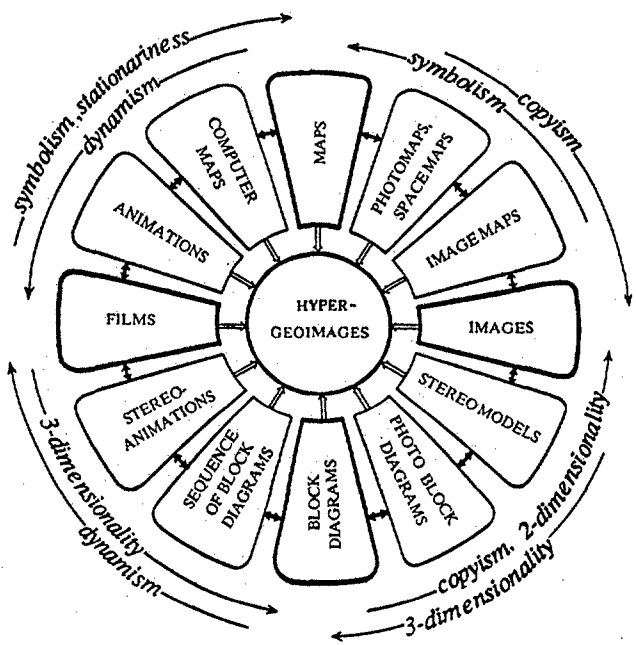

Fig. 2. The system of geoimages.

All geoimages exist within the graphic environment which is understood as an any system of visualization and modelling of iconic natural and/or social-economic geosystems suggested to be visually perceived by man or an intelligent device [3]. The graphic environment is characterized by the following properties:

- 4-dimensionality enabling to reproduce time and space situations;
- using of geometrical, optical and temporal graphic variables;
- ability to reflect real and abstract objects;
- interactivity which ensures optimal cooperation between man and means of visualization.

The following kinds of graphic environment, in which the system of geoimages exists, have been distinguished:

- fixed graphic environment - a system including traditional maps, photos and other geoimages on "hard" carriers;
- program-controlled graphic environment - a system of geoimages visualization on the basis of program and technical means of computer graphics;
- imaginary mental graphic environment in which mental or cognitive maps and patterns are being formulated.

3. Hypergeoimages.

The central part of the graph (Fig. 2) is occupied by complex graphic models which combine to varying degree properties of maps, photos, 3D and dynamic models. It seems worthwhile to introduce a new term "hypergeoimages" (or, shortly, "hyperimages") for them. By this a notion of common geoimage is generalized for the case of a complete multidimensional model which integrates geometric, dynamic, stereoscopic properties, as well as brightness parameters. As a rule, hypergeoimages are program-driven models and one can predetermine their particular properties and change them if necessary.

Examples of hypergeoimages are provided by computer-modelled photoimages of various real and abstract object which should be called "pseudophotoimages", by scenery maps which are specific stereomodels designed by means of computer graphics, etc. A prominent example of hypergeoimages are false color electronic space maps for the whole planet and large regions, sometimes stereoscopic ones, or as hardcopies.

One can speak now about specific "hypericonic visualization", along with monoiconic and multi-iconic ones. In this case objects are represented by means which combine different graphic variables and properties of different geoimages.

4. Geoiconometry.

Regarding geoiconics as a science on geoimages, it seems reasonable to distinguish

geoiconometry - a system of disciplines studying the general theory, methods and means of measurements according to geoimages [3]. Three branches of metric disciplines have been distinguished:

- geoplanimetry - measurements of 2D geoimages;
- geostereometry - measurements of 3D and 2.5D images;
- geochronometry of dynamic geoiconometry - measurements of 3D and 4D animated geoimages.

Geoplanimetry - the most developed branch of geoiconometry - consists of the following disciplines: cartometry, photogrammetry, morphometry (general, thematic and anamorphometry), photometry (including densitometry, microphotometry and structurometry), colorometry.

Geostereometry comprises the same measurement disciplines which are, however, referred to spatial geoimages: stereomodels, anaglyphs, block diagrams, holograms. The following branches are well-developed at present: stereophotogrammetry, stereophotometry, hologrammetry. In the future such disciplines as stereocartometry and stereophotometry, and stereocolorometry, may develop as well.

Geochronometry consists of dynamic cartometry, dynamic photogrammetry and cinehololograммetry. Dynamic morphometry, dynamic photometry and cinecolorometry are to be developed.

The suggested classification systematizes all geoiconometric disciplines known at present, places them in order, specifies spheres of their application, points out possibilities of growth and development, and is favorable to be approached as a separate scientific branch within geoiconics.

Geoiconometric indices make up separate databases for mathematical modelling and mapping by using GIS technologies. Contemporary Earth sciences need numerous analytical and synthetic quantitative parameters which are provided by geoiconometry.

References

[1] Berlyant A.M. 1988. Geographic Images and Their Properties. - Map Sciences and Remote Sensing. V.25, N.2, pp. 133-143.

[2] Berlyant A.M. 1990. Geoimages and Geoiconics. - M., Znaniye, 48 pp. [In Russian].

[3] Berlyant A.M. 1994. Graphic Environment and Geoiconometry. - Geography and Natural Resources, N.1, pp. 37-43. [In Russian].