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Preface

When creating models in geography, it is necessary to take into account the specific character of this science whose objects and subjects of enquiry are identical to those used in almost all other sciences. By and large, geography addresses itself to natural, economic and social phenomena occurring across the globe and in its individual regions as well as territorial structures and processes on other planets. On the other hand, an inherent characteristic of geography is a special insight into research problems implying data-knowledge coordination, and this applies not only in the spatio-temporal context of determining geographical coordinates, because the spatial extent and temporal variability is recorded cartographically both in physics, in biology, and in economics. The case in point is coordination in the broad sense that involves assigning data, knowledge and models to a particular field of science, a given type of geographical situations, a specific kind of information source, and to a definite class of users. Here, geography represents a practice-oriented science which is closely associated with the reality and assures a correlation of dissimilar information in relevant coordinate systems of connections. Geographical approach in modeling requires that a whole variety of informative elements and their connections be taken into consideration both individually and in the aggregate, which reflects the specificity of geographical accuracy as the expression of the quality of geographical research. In a sense such an understanding of accuracy is extended to other sciences and to the practice and reveals itself in the systemic expression of knowledge and presentational clarity of problem situations. On the other hand, borrowing information from different areas of knowledge and activity, geography would situationally accurately display it on the map, both in the spatio-topological location and in substantive-typological contents reflected in cartographic legends and their interpretations. The advantages of geographical science are that it permits a correct identification of the spatio-temporal situation which, in turn, ensures a quantitative and qualitative (structural) identification of mathematical models. In this sense, mathematical models of physical or economic processes are geographical to such an extent to which they are tied to a particular locality and to which they take its inhomogeneity and variability into account.

In this context, the basic idea of modeling is expressed in the thesis: everything is one and the same to within some functional transformations (morphisms). One geographical system and its model spills over into another (they are homologous) with a change of the locality index and the type of situation.

This issue of the journal principally presents the latest novel research results obtained by the Siberian school of geographers and mathematicians on modeling of natural phenomena and pro-

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cesses. This school has been shaping itself over the course of nearly five decades in various Siberian cities and in the Institutes of the Siberian Branch of the Russian Academy of Sciences. The authors are represented by scholars from the V.B. Sochava Institute of Geography SB RAS, and by their colleagues from other research institutions, who were involved at different times in the implementation of joint research projects. This issue includes also the research submitted by scientists from Morocco and France.

A.K. Cherkashin in his article outlines the fundamentals of polysystem analysis of geographical information, and of synthesis of different-type theories for modeling of territorial objects. He demonstrated the similarity and difference of models in solving geographical problems. By considering an example of analyzing dendroclimatic series, he aptly illustrated the homology effect of natural processes and the method of constructing polymodels for phenomena. The article of E.A. Istomina examines one of these types of models, namely, the models of landscape complexes having their origins in the theory of complex systems and the categorical-functorial mathematical apparatus of modeling. To validate the model uses mathematical technologies of processing multichannel satellite images.

The methods of modeling dynamical systems were implemented by I.N. Vladimirov and A.K. Popova, who considered an example of the study of the dynamics of forest resources, by V.V. Kozlov, who presented a case study of the diffusion processes of dissolved substances in water bodies, and by V.A. Shlychkov in modeling the dynamics of river watercourses for channels of complicated spatial configuration. A paper of M. Chakira et al. uses the shallow water equations to simulate the flow through the Strait of Gibraltar as a problem of two-layer hydraulic exchange between the Atlantic Ocean and the Mediterranean Sea. The authors provide calculations for the particular spatially extended objects, and calculation results are presented in graphical and cartographic form. M. Serhani et al. model the dynamics of the wastewater treatment system with the robust feedback control when the specific functions for the coefficient of nonlinear ordinary differential equations are not well known.

Models for regulation mechanisms are used by S.I. Myasnikova in her article in the study of the rehabilitation processes in the polydominant mountain-taiga forests of the Baikal region. The author performed the identification of the model, carried out predictive calculations and solved optimal control problems with the use of a GIS and the Pontryagin maximum principle. The A.I. Gurman and V.A. Baturin ecologo-economic regulation model describes the nature-economy-population interaction in the Baikal region. A.V. Myadzelets models the socio-economic development of territories in terms of generalized potentials having regard to their individual geographical characteristics. She substantiates the existence of a multilevel indicative function reflecting the hierarchy of economic-geographical conditions, and the development tendency. In his paper A.D. Kitov presents a structural model for geographical space of the Earth in the form of a multilevel discrete grid structure The model is used in developing the schematic of the natural geoinformation system of the globe in the form of a grid of reference points and elementary cells with discrete topology connected with the observed network of geological faults and river channels.

Nowadays mathematical modeling in geography has the role of a form of validating research conclusions, ensuring the uniqueness of judgment and improving reliability of research findings, and serves as the basis for verification of hypothesis and provides the theoretical background to geographical science and to related sciences. It opens the way to mathematical technologies, i.e. to the solution of applied problems using accurate methods.

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