

Preface

The design problem of geoinformation monitoring systems needs the solution of a wide spectrum of tasks incoming to the competence of many areas of knowledge. The complex character of this problem is stipulated by the assembly of heterogeneous and differently systematic and applied research that is realized in many countries in the framework of national and international environmental programs. The basic goal of all similar researches consists in the attempt to answer the unique basic question: What structure and working regime of the observation system are to be in order to guarantee the reliable assessments of its current state and the prognosis of its evolution in the nearest and perspective future? Unfortunately, present science does not give an affirmative reply to this question. Ecoinformatics tries to answer this question by developing new informational technologies and producing a theoretical base for a new stage of the environmental science developing.

Ecoinformatics is the science of information in ecology and environmental science that integrates environmental and information sciences. Ecoinformatics tries to create the tools for the assessment and analysis of natural systems that exist under different conditions. In this context, ecoinformatics develops computer technologies relevant to the management of ecological data and information delivered existing and planned geoinformational systems. As a result ecoinformatics proposes new tools based on the coupled use of ecological, geophysical, and mathematical knowledge to integrate information, data, methods, algorithms, and computer technologies for providing ecological data to scientific or policy making processes.

Ecoinformatics is studying the problems that arise due to use of informatics methods for solution of environment control tasks. It is developed areas such as elaboration of new informational technologies for monitoring data processing, making and development of algorithms for spatial–temporal interpolation, analysis of correlation functions in the nature–anthropogenic systems taking into account hierarchy of spatial and temporal scales, and search for the most efficient methods for the synthesis of monitoring system structures.

Ecoinformatics devotes priority to technologies in the framework in which the informatics methods are used for research of dynamic characteristics of environmental systems, assessment of large-scale consequences of anthropogenic activity,

and prognosis of biogeochemical processes from local to global scales. This field of study also includes a creation and application of mathematical models for natural and anthropogenic processes, search of criteria for reliable assessment of human living condition quality, and detection of causes stimulating the disturbances of sanitary epidemiological conditions in the environment.

Ecoinformatics studies theoretical and applied tasks that are aimed at understanding the role of mathematical modeling methods, theory of complex systems, nonlinear programming, computer cartography, remote sensing technology, and expert systems in the study of processes happening in the environment.

Ecoinformatics joins knowledge from such areas as physics, mathematics, biology, chemistry, sociology, ecology, economics, and law that solve environmental problems. It helps to find answers to many questions on the conflicts between nature and human society. Most experts suggest that an efficient way to resolve these conflicts would be creation of a unified planetary-scale adaptive geoinformation monitoring system, which should be based on knowledge bases and global datasets that are constantly updated. The adaptive nature of such a system should be provided by continuously correcting the data acquisition mode and by varying the parameters and structure of the global model.

This book develops ideas and technologies that could help solve many environmental problems and describes a simulation system based on sets of computer algorithms that process data from global and regional monitoring. The book has ten chapters that consider various aspects of the environmental problems and develops information-modeling technologies for operational diagnostics of environmental processes including stressful natural phenomena. In particular, the book discusses the following topics:

- Natural catastrophes as a dynamic category of environmental phenomena;
- Remote sensing and mathematical modeling for effective forecast of large-scale land territories and water areas behavior;
- Practical applications of microwave radiometric technologies along with other remote sensing technologies in different situations in hydrology for underground water mapping and for fire hazard determination in forested and peat bog environments;
- Decision making in complicated conditions;
- Evolution modeling in ecology and hydrometeorology;
- Arctic Basin pollution dynamics under intensive anthropogenic forcing due to a variety of industrial activities;
- Target-oriented models that may be effective in socioeconomic areas; and
- Regional and global ecological monitoring functioning based on the fundamentals of the noosphere paradigm.

The book discusses the global implications of environmental degradation—a model for predicting anthropogenic influences on global environmental change and for incorporating monitoring data into the predictions. Global problems of the nature–society system dynamics are considered and the key problems of ensuring

its sustainable development are studied. Emphasis is placed on global geoinformation monitoring, which could provide a reliable control for the development of environmental processes by obtaining prognostic estimates of the consequences of the realization of anthropogenic projects. Ecoinformatics tools developed in this book offer a new approach to the study of global environmental changes, focusing on it as an area of study involving many scientific disciplines. These tools provide a unique insight into the social context of global changes in biogeochemical cycles, and is a timely contribution to the current debate into global warming and sustainable development of the nature–society system.

The book is aimed at specialists dealing with the development of information-modeling technologies to protect the natural world. Global modeling, climate change, problems inherent in relationships between society and nature, geopolitics, international relations, and methodology of interdisciplinary studies are studied in-depth. It is of special interest to designers and users of information-modeling technologies in the field of population protection from natural disasters.

<http://www.springer.com/978-3-319-13977-7>

New Ecoinformatics Tools in Environmental Science
Applications and Decision-making

Krapivin, V.F.; Varotsos, C.A.; Soldatov, V.Y.

2015, XXXIII, 903 p. 289 illus., 120 illus. in color.,

Hardcover

ISBN: 978-3-319-13977-7