Chapter I

Environmental Informatics—Methods, Tools and Applications in Environmental Information Processing

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INTRODUCTION: THE ROLE OF MACHINE ENVIRONMENTAL INFORMATION PROCESSING

The protection of our environment remains one of the greatest challenges in industrialized societies. This challenge is addressing politics, economy as well as technology and research. It is clear that the various problems in environmental protection, environmental planning, research and engineering can be only solved on the ground of a comprehensive and reliable information basis. State and dynamics of the environment are described by biological, physical, chemical, geological, meteorological, and social-economic data. This data is *time* and *space dependent* and addresses past or current states. The processing of this data and the production of *information* on the environment, on its stress factors, and on mutual influence mechanisms are fundamental for any kind of environmental planning and preventive measures. Therefore, environmental problem solving is mainly an information processing activity handling a wide range of environmental data. Solutions to our environmental problems are strongly dependent on the quality of accessible information sources. Certainly, information is a very critical factor in making decisive political actions and in changing people's attitudes on the environment. This information on environmental aspects is just as important as basis for decisions on actions in environmental protection as for gaining knowledge in environmental research.

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Meanwhile the application of information technology has become vital in the environmental domain in industry and public administration for providing the required environmental information on the appropriate level of detail, completeness, accuracy and speed. However, here is a straight forward data storage for environmental mass data not at all sufficient. Rather the filtering of meaningful and up to date environmental information on the state of the environment from this data storage is required to support administrative and planning tasks in environmental protection. In this way, one of the main goals of environmental information systems is addressed, namely to prepare the mass of collected environmental data in such a way that they can be used for routine operational environmental administration tasks as well as for political-strategical decision making.

Environmental information processing has recently focused on the following trends:

- environmental monitoring by means of remote sensing and the combination of data streams from all over the world,
- a policy for sharing and integrating environmental information across political, technical and organizational boundaries making wide use of Internet technology,
- advanced model-based data analysis techniques, shifting the focus from data to dynamic system structure,
- industrial applications of environmental information processing, aiming at higher ecological efficiency of the economic system

It is obvious that advanced computing technologies play an important role in these developments.

Information processing in the environmental domain has been lacking a sound conceptual and scientific basis, since there has not been a significant research in this special domain for a long time. This is certainly not only a matter of applied Informatics, but an interdisciplinary task where many scientific disciplines should be involved (e.g. geo- and biosciences, environmental engineering, economics, law, measuring technology, management sciences, etc.). On the other hand, the growing field of environmental information processing is a great challenge to Informatics methodologies and their applications. From this process of mutual stimulation, some 10 years ago a new discipline emerged, named as *Environmental Informatics*.

A CLASSIFICATION OF ENVIRONMENTAL INFORMATION SYSTEMS

There is a wide range of environmental information systems in industry, public administration and science which can be classified based on the nature of the information and the type of processing. This classification introduced in Page and Hilty (1995) includes monitoring and control systems, conventional information systems, computational evaluation and analysis systems, planning and decision support systems, and integrated environmental information systems.

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