Managing Environmental Data – An Extension to the GIS Architecture

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1 Extended Abstract

Effective environmental management and research require environmental and socio-economic data, information and knowledge to anticipate and predict the impact of development. However, current information, while often extensive, is fragmented, inconsistent, under-utilized, and often inaccessible. These factors have led to "information gridlock" where the data and information are available but require inordinate amounts of time and expertise to begin the process of acquisition and assimilation. This paper describes architectural extensions to GIS to support an integrated environmental information system ("EIS") that contains the tools needed to help manage the process of acquisition and assimilation.

Computer-based tools already exist to assist with organizing and accessing data. Many users of the Internet[**?**] already use applications such as "FTP" and "Archie", "Gopher" and "Veronica", "WAIS" ("Wide Area Information Servers")[**?**] and "WWW" ("World-Wide Web"). Most of these tools require (at least) a moderate degree of computing expertise in order to be used effectively.

Others have identified these limitations and so several projects are underway to produce computer-based information systems focussed on environ-

mental information systems, including "CIESIN" ("Consortium for International Earth Science Information Network")[**?**], "ERIN" ("Environmental Resource Information Network")[**?**], "GENIE" ("Global Environmental Network for Information Exchange")[**?**], and "Lamont"[**?**]. The goals and interim results of these efforts seem to concentrate on accessibility of information (location, client software), and less on the information management problem. For an EIS to be successful, it must also provide information management tools.

A fundamental goal of an EIS is to enable its users, who often lack computing expertise, to locate, acquire and process information relevant to an environmental problem, and then present results in a meaningful fashion. To some degree, the functions performed by an EIS model that of a consultant: gathering, processing and presentation of information.

Informally, the major components of an EIS are: *resources* (data, information, knowledge and expertise), which are the input to a model or decision process; *transformations*, by which the resources are manipulated or used; and *location and access strategies* that are used to obtain the resources that are to be transformed. Since there already exist numerous data repositories and collections of tools and modelling systems, the major contribution of the proposed EIS framework is to define new access strategies that concen-

trate on the organization of the data and tools and on standardized access methods. Paramount in the organization is the ability to encode queries and data geographically.

The access strategies are implemented with four services: the *directory*, the *dictionary*, the *index*, and the *trusted agent*. The directory service provides information about databases, knowledge-bases and tools. A query might contain a request for a list of databases that contain information about a geographic region, or a request for a list of tools that pertain to a given keyword. A dictionary service contains information about geographic references. For example, in the query "what is the effect of toxic spills in Bloom County?", the reference "Bloom County" would yield a suitable geocoded description of the area. The trusted agent supports services required for security and access control. Recognition of the proprietary nature of the intellectual property contained in databases must occur if the commercialization of the framework is to be considered. Since a query based on a geographic reference may elicit a database covering a larger geographic area than required, there must exist a technique to refine the request. The service provided by the directory index supports this refinements process.

It is a simple task to describe the ideal EIS: implementation of such a system is not so easy. Practical realities require that consideration be given

to the real-world problems of incorporating existing geographic information into any computer-based EIS (the data legacy problem). This paper will describe the EIS components and the steps to be taken for implementation in a realistic set of applications.

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