



THE ROLE OF GIS IN ENVIRONMENTAL MONITORING

Sajjan kumar, Research scholar Deptt. of Geography MD University, Rohtak.

Abstract: *The paper tries to analyze the role of GIS in environmental monitoring. When it comes to GIS environmental modelling applications, in many respects GIS software can be considered comparable to a programming language. Unfortunately, however, the typical environmental GIS users are focused on environmental issues and only rarely do they have the additional technical knowledge necessary to develop new GIS applications. As a consequence, most domain experts are forced to work with GIS that have predefined underlying data structures and 'standard' interfaces. We will try to understand the issues to be considered by the designers and programmers of such turn-key applications within the areas of environmental issue related monitoring. Some characteristic examples of applications will be given together with a closer look at the demands that the individual applications make. First it is useful to distinguish between the various types of environmental monitoring methods. In monitoring methods emphasis is placed on data collection, pre-processing, and quality control. Analysis techniques focus on using tools to manipulate and model data. Information systems, on the other hand, are more concerned with the storage and management of data.*

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1. Introduction:

GIS, not surprisingly, has a very important role to play in environmental monitoring. GIS is ideally suited as a tool for the presentation of data derived from distributed measurement stations. Unfortunately, however, most GIS have some severe shortcomings when it comes to dealing with the typical data obtained from such measurements, namely time series data. The techniques for dealing with time series data are covered more thoroughly elsewhere. In a nutshell, time series are long consecutive runs of data, such as the temperature measured every half hour at a certain point. Since most standard GIS software packages do not possess adequate tools for handling temporal data, they must be extended or auxiliary applications interfaced. The time series data routinely collected for environmental monitoring very often have two significant analytical and display problems. First, they typically relate to points, when data based on areal units would often be more useful. Second, the temporal sampling incidence is often too frequent, resulting in large volumes of data. GIS offer relatively simple means of dealing with each of these problems. First, with regard to spatial resolution, a measurement point may be permanently assigned to a representative area using a simple point-to-area transform. A different option is to use standard GIS gridding and contouring facilities to interpolate between the point measurements across the whole study area. Second, with regard to temporal resolution, standard database selection capabilities may be used to extract data pertaining to a time value corresponding to other data to which it must be compared. Alternatively, standard descriptive statistical functions may be used to reduce data volumes. Any of these approaches may be used alone, or in combination. The illustrated system is a rather complex example implemented as a multi-user, client-server configuration. Apart from showing the basic system architecture, the figure also demonstrates how many functions may be involved in a GIS-based monitoring system. In particular, it should be noted how much of the system is actually dedicated to collecting, processing, and storing data rather than explicit spatial analysis and display operations.

Essentially GIS is only used at user workstations, whereas the major part of the system is dedicated to other tasks. This distribution is in most cases reflected in the corresponding implementation and running costs. As a rule of thumb at least 90 per cent of the cost involved in setting up an environmental monitoring system is related to the measurement program, the quality control, and processing of data; only a minor part is related to the programming of GIS-based analysis and display functions. Often the simple data analysis functions provided by standard GIS software packages are insufficient for dealing with the data monitoring requirements of environmental problems. The reasons for this are many, the most common being:

- » The economic aspects of a project do not allow sufficient data to be collected to 'feed' the analysis tools;
- » The characteristics of the data make simple extrapolation inappropriate;
- » Several parameters are interconnected and the required data cannot be measured directly.

In such cases more complex techniques are needed to reflect the expected environmental situation. In such circumstances, the task of environmental monitoring goes much further than can realistically be achieved within a standard GIS.

2. Objectives of the Study:

1. To understand the environmental monitoring.