Is GIS useful in small system management?

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What is a GIS?

A Geographic Information System (GIS) is a computer system that is capable of assembling, storing, manipulating, and displaying geographically referenced information. A GIS allows users to integrate, manage, and analyze large volumes of spatially referenced data and corresponding attribute data.

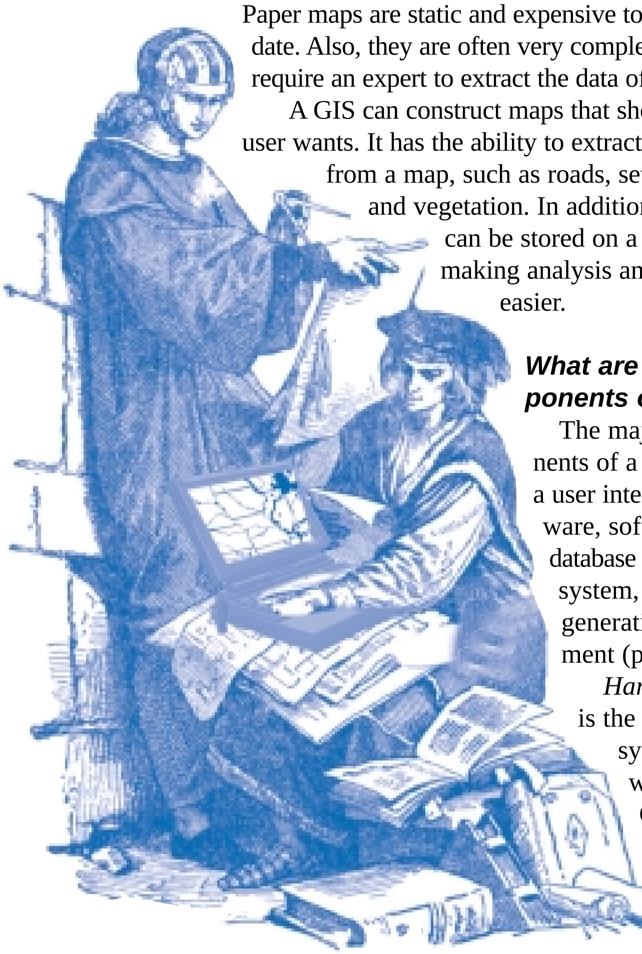
A GIS can link spatial data with geographic information for a particular location on the map. For example, water samples can be collected from locations A and B, and later combined with information regarding their water quality parameters.

A GIS lets the user analyze data visually, such as seeing patterns, trends, and relationships that might not be visible in any other form. All GISs incorporate a database management system. In fact, this is the main difference between a GIS and drafting a map. GIS may be very useful in various water system operation, maintenance, and planning applications.

Why use a GIS when I have maps?

A GIS is the electronic equivalent of a map. Paper maps are static and expensive to keep up-to-date. Also, they are often very complex and may require an expert to extract the data of interest.

A GIS can construct maps that show what the user wants. It has the ability to extract information from a map, such as roads, settlements, and vegetation. In addition, the data can be stored on a computer, making analysis and modeling easier.



What are the components of a GIS?

The major components of a GIS include a user interface, hardware, software, database management system, and display generation equipment (printers).

Hardware: This is the computer system on which the GIS operates. The hardware supports the GIS software and includes a computer, monitor, and printer. Hardware can be centralized computer servers, desktop computers, or a networked computer system. The advantage of a desktop GIS is that it allows users at all levels to access the GIS via PCs.

Software: The software integrates geographic coordinates and their attributes or characteristics. It also lets the user analyze and manipulate relationships between geographic data and attribute data. The user also may interact with data and produce high-quality maps. Software costs can range from a few hundred to a few thousand dollars.

Data: Data is the most important component of a GIS. The system can manage a wide variety of data that are essential to environmental decision-making. Data in the GIS can be classified into two parts: a) the geographic data that represents physical places, such as cities, rivers, and lakes; and b) the attribute data that describes the characteristics of the geographic features, such as population, length, and area. Combining each unique geographic feature with its corresponding attribute data is the essence of a GIS. The geographic data and the related attribute data can be developed in-house or purchased from government agencies. The data can be collected using satellite imagery and a Global Positioning System (GPS).

User: The user is the person who manages the system and develops plans for tackling real-world problems. Users can be technical specialists, who can design and manage the system or who use the system to help them perform their day-to-day work.

How is a GIS used in water systems?

Water systems can use GISs for a variety of operation, maintenance, and planning applications. A GIS can integrate water-related information, such as water mains, pumps, reservoirs, and aerial photography. A GIS allows the system management to view spatial areas of high water consumption, and possible contamination sources.

The most important aspect of a GIS is the opportunity to store, retrieve, and communicate environmental information effectively in rapid time. A GIS can be used to answer simple questions like: How many people live in an area that a particular contaminant affects? Or, how much of a site's area does a particular contaminant impact?

Many states use GISs for various purposes related to water system management and water quality maintenance. A GIS can be used in source water assessment, susceptibility assess-

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ment, characterization of disinfection byproducts, vulnerability assessment, delineation of contaminant contributing areas, determination of salt water contamination, contaminant occurrence assessment, and determination of aquifer characteristics.

Once a GIS is prepared, the user can query the attribute data regarding issues, such as chemical contamination in water and soil, the possible sources of these contaminants, and other facts related to contaminants. For example, the user can observe a pattern that many highly contaminated wells are in proximity to a particular industry. Or the user could even draw information about how many water wells may become contaminated, and how many people are potentially at risk.

A GIS can determine the suitability of various sites for development, evaluate environmental impact, and identify the best location for a new facility. A GIS can explore relationships between permitting data, geology, soil types, and the results of water quality sampling for wells. They can identify areas of groundwater that are susceptible to pollution. The GIS can incorporate spatial interactions to determine the extent of potential pollution loading on the basis of area and land types.

A GIS can be handy for county governments that need to integrate multiple land uses into planning and deal with issues that have spatial components, such as property boundaries, costs associated with distance to utilities, and environmental issues.

Another area in which a GIS may be helpful is watershed analysis. The attributes of watershed features stored in a GIS database can be used to develop a hydrologic model to determine the runoff hydrograph. Using this model, the effect of any change in watershed characteristics on the magnitude or spatial distribution of runoff from the watershed could be evaluated.

More than 50 percent of the pollution entering the nation's waters comes from non-point sources, and it is responsible for almost two-thirds of pollution of the water resources. Groundwater contamination can be determined and stopped with proper prediction of movement of pollutants in soil. Models of pollutant transport developed using a GIS may be used to predict contaminant movement in soil.

A GIS also may be used to store and manage historical data of a system. Data about system management issues, such as low pressure, main breaks, and rusty water complaints can be collected and stored. If a problem is noticed, it can be noted on the map with the associated data for historical purposes.

The Long Island Water District in New York has been using a GIS for maintaining customer service/billing data. Each connection in the district is located on the map and this data is integrated with the details, such as the mailing address and water meter locations.

The Florida Water Management District has been using a GIS for conducting groundwater assessments. Low-level groundwater contamination from chlorinated pesticides and volatile organic compounds affects the water quality. Spatial data about the wells and details of well construction as well as water quality details were collected. A software package is being used to integrate these two sets of data to predict the contaminant transport and the risk of wells becoming contaminated.

In today's high-tech world, information may be obtained in many ways. The more information one has, the easier it is to make a better and informed decision. To make a better decision, one has to be able to access accurate and up-to-date data, as well as be able to effectively use this data. A GIS allows the user to apply this information and to make a better decision more quickly.

GPS: Is a constellation of 24 satellites that provides worldwide accurate position coordinates. The GPS uses satellites and computers to compare positions anywhere on earth.

Non-point source pollution: It is the pollution originating from urban runoff, construction, hydrologic modification mining, agriculture, irrigation return flows, solid waste disposal, atmospheric deposition, and individual sewage disposal.

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