Geographic Information Systems Essay, Research Paper

Geographic Information Systems

Geographic information systems (GIS) technology can be used for scientific investigations, resource management, and development planning. For example, a GIS might allow emergency planners to easily calculate emergency response times and effected areas of the ocean during an oil spill based on the spills location. You may ask, what is GIS? In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system.

A geographic information system (GIS) works in a series of steps, First there is the relating information from different sources. If you could relate information about oil spill location to the oceans surface currents, you might be able to tell where to start clean up based on how long the oil has been in the ocean. A GIS, which can use information from many different sources, in many different forms can help with such analyses. The primary requirement for the source data is that the locations for the variables are known. Location may be annotated by x, y, and z coordinates of longitude, latitude, and elevation and any variable that can be located spatially can be fed into a GIS. Several computer databases that can be directly entered into a GIS are being produced by Federal agencies and private firms. Different kinds of data in map form can be entered into a GIS. A GIS can also convert existing digital information, which may not yet be in map form into forms it can recognize and use. For example, digital satellite images can be analyzed to produce a map like layer of digital information about marine life productivity. Likewise, sea-grass data can be converted to map-like form, serving as layers of thematic information in a GIS.

Next Step for Geographic information systems (GIS) would be to Capture the data If the data to be used is not already in digital form, that is, in a form the computer can recognize, various techniques can capture the information. Maps can be digitized, or hand-traced with at computer mouse, to collect the coordinates of features. Electronic scanning devices will also convert map lines and points to digits. A GIS can be used to emphasize the spatial relationships among the objects being mapped. While a computer-aided mapping system may represent a shoreline simply as a line, a GIS may also recognize that shoreline as the border between ocean and land, and correctly display the tidal differences of the shoreline based on its location on the earth. Data capture, putting the information into the system, is the time-consuming component of GIS work. Identities of the objects on the map must be specified, as well as their spatial relationships. Editing of information that is automatically captured can also be difficult. Electronic scanners record blemishes on a map just as faithfully as they record the map features. For example, a fleck of dirt might connect two lines that should not be connected. Extraneous data must be edited, or removed from the digital data file.

After the data is collected we must integrate the data. A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analyze new variables. Before the digital data can be analyzed, they may have to undergo other manipulations – projection conversions, for example – that integrate them into a GIS. Projection is a fundamental component of mapmaking. A projection is a mathematical means of transferring information from the Earth’s three-dimensional curved surface to a two-dimensional medium – paper or a computer screen. Different projections are used for different types of maps because each projection is particularly appropriate to certain uses. For example, a projection that accurately represents the shapes of the continents will distort their relative sizes.

Since much of the information in a GIS comes from existing maps, GIS uses the processing power of the computer to transform digital information, gathered from sources with different projections to a common projection. Can a seabed map be related to a satellite image of marine life, as indicator of the importance of seabed to marine life productivity? Yes, but since digital data are collected and stored in various ways, the two data sources may not be entirely compatible. So a GIS must be able to convert data from one structure to another. Image data from a satellite that has been interpreted by a computer to produce a marine life productivity map can be “read into” the GIS in raster format. Raster data files consist of rows of uniform cells coded according to data values. Raster data files can be manipulated quickly by the computer, but they are often less detailed an may be less visually appealing than vector data files, which can approximate the appearance of more traditional hand-drafted maps. Vector digital data have been captured as points, lines (a series of point coordinates), or areas (shapes bounded by lines). GIS to convert data into different formats can perform data restructuring. For example, a GIS may be used to convert a satellite image map to a vector structure by generating lines around all cells with the same classification, while determining the cell spatial relationships, such as adjacency or inclusion. Thus a GIS can be used to analyze seabed information in conjunction with marine life information. It is difficult to relate multiple sets of data using conventional means, however a GIS can be used to depict two- and three-dimensional characteristics of the Earth’s surface, subsurface, and atmosphere from information points.

How is the GIS data used? GIS is powerful and Information retrieved from GIS can be very useful. What do you know about the current status of the different parts of the ocean? With a GIS you can “point” at a location, object, or area on the screen and retrieve recorded information about it from off-screen files. Using scanned aerial photographs as a visual guide, you can ask a GIS about the geology or hydrology of the different areas of the ocean. This kind of analytic function allows you to draw conclusions about the oceans environmental sensitivity.

GIS can also help in site selection. For example the U.S. Geological survey (USGS), in a cooperative project with the Connecticut Department of Natural Resources, digitized more than 40 map layers for the areas covered by the USGS Broad Brook and Ellington 7.5-minute topographic quadrangle maps. This information can be combined and manipulated in a GIS to address planning and natural resource issues. GIS information was used to locate a potential site for new water well within half a mile of the Somers Water Company service area. To prepare the analysis, digital maps of the water service areas were stored in the GIS. Using the buffer function in the GIS, a half-mile zone was drawn around the water company service area. This buffer zone was the ?window? used to view and combines the various map coverage relevant to the well site selection. A GIS was used to select undeveloped areas from the land use and land cover map as the first step in finding well sites. The developed areas were eliminated from further consideration. The quality of water in Connecticut streams is closely monitored. Some of the streams in the study area known to be unusable as drinking water sources. To avoid pulling water from these streams into the wells, 100-meter buffer zones were created around the unsuitable streams using the GIS, and the zones were plotted on the map. A map showing the buffered zone was combined with the land use and land cover map to eliminate areas around unsuitable streams from the analysis. The Connecticut Department of Natural Resources records point sources of pollution. These records consist of a geographic location and a text description of the pollutant. To avoid these toxic areas, a buffer zone of 500 meters was established around each point. This information was combined with other relative GIS layers to produce a new map of areas suitable for well sites.

The condition of the Earth’s surface, atmosphere, and subsurface can be examined by feeding satellite data into a GIS. GIS technology gives researchers the ability to examine the variations in Earth processes over days, months, and years. As an example, the changes in vegetation vigor through a growing season can be animated to determine when drought was most extensive in a particular region. The resulting graphic, known as a normalized vegetation index, represents a rough measure of plant health. Working with two variables over time will allow researchers to detect regional differences in the lag between a decline in rainfall and its effect on vegetation. These analyses are made possible both by GIS technology and by the availability of digital data on regional and global scales. The Advanced Very High Resolution Radiometer or AVHRR produces the satellite sensor output used to generate the vegetation graphic. This sensor system detects the amounts of energy reflected from the Earth’s surface across various bands of the spectrum for surface areas of about 1 square kilometer. The satellite sensor produces images of a particular location on the Earth twice a day. AVHRR is only one of many sensor systems used for Earth surface analysis. More sensors will follow, generating greater amounts of data. With this type of technology, scientist not only have the resources to help preserve our earth, they also have the proof of destruction at a global scale derived from GIS.

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