IMPLEMENTAION OF GIS TECHNOLOGY IN THE NILE AND ITS WADIS

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ABSTRACT

Traditional methods have been used for several years for map production of the Nile and its Wadis.Currently; GIS technology provides more representative maps for the riverbed profile. In the traditional methods data were collected using local coordinate instruments such as theodolete, and Falcon systems. GPS (Global positioning system) instrument is using the global coordinates through connection with 27 satellites covering the earth 24 hours per day. Thousands of data points for the riverbed are being collected using the new technique. These data are the main item for production of high quality maps. This paper describes the different steps of using GIS technique for map production. Based on the results obtained using GIS, it is recommended to extend the implementation of GIS technology in the different reaches of the Nile, its Wadis and the banks.

Introduction

GIS is the complex process of building database for geographic information system. This process called data conversion and it generally consists of converting existing information, predominantly paper maps and records. Because GIS has graphic display and output functionality and because the graphic database is much more powerful than conventional mapping system, GIS has made inroads into the world of mapping to such an extent that many GIS applications have replaced the need to refer to conventional map formats and conventional map areas and scales. In addition to maps, organizations utilize large quantities of location specific information that can be related to a map. This type of information usually comes in the form of a nongraphic record or a graphical sketch.

Why GIS is an Important Issue? And the Need of GIS Implementation in NRI

A GIS has the capability to use any logical combination of data layers for analysis. It has strong and specialized polygon processing capabilities that support automated analyses between separate map layers. Typical GIS functions require spatial relationships to be stored among specific map features during the database design. These spatial relationships are extended to include features representing areas. These relationships are known as topological relationships, or collectively as topology. The implementation of topology or other information linkages in database is called adding intelligence to the database. For all these reasons it is logic for NRI (Nile Research Institute) to implement GIS in the map production for Rossetta Branch.

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A- The Progress of Hydrographic Survey Methods

One of GIS tools is hydrographic survey. This is one of the most important surveys that come into existence recently. In the beginning collection of field data was implemented by some traditional methods and devices such as: Survey Balance (level) and Rod, Total Station. These methods were realized to be unable to cover large areas in high accuracy. Therefore other devices such as Falcon systems were developed. In addition due to the rapid and continuous development of technology Global Positioning System (GPS) systems were introduced.

Aerial mapping companies are beginning to use GPS devices to provide direct means of determining latitude, longitude, and elevation coordinate values from the measurements of satellite positions. These devices receive signals from several satellites and compute coordinates positional information based on the signal with the help of portable or in office processors**.** The number of points that can be collected by using GPS ranges form 25**,**000 to 60**,**000 points. This will increase the quality of the produced maps. There are two types of GPS: the first is GPS and the second is DGPS. Data through GPS is observed from one ray only travels between satellite and GPS receiver, so this device considers post processor. Data through DGPS is observed and computed through two rays travel between two GPS receivers and the same set of satellites simultaneously; where most of the atmospheric effects cancel out.

B- The Progress in the Corresponding Office Software

The first feasible applications based on graphic databases were developed to support a variety of design and drafting tasks. This led to general acceptance of computer-aided drafting CAD and computer- aided drafting and design CADD systems, which utilize computer graphics technology to automate the traditional drafting and design techniques required in engineering and technical drawing. Drawings made using CAD can be three–dimensional models or simply a digital replication of manually drafted drawings. When using CAD the user can begin creating a digital map without first having to complete and code an extensive data base design for capturing the map. This is one reason why CAD systems can be used to create graphic data for a GIS, even if the data will have to be translated into the GIS format in a subsequent process.

Geographic information system utilizes automated mapping and DBMs or RDBMs technology to relate data to digital maps and to allow for the creation, storage maintenance, retrieval, analysis And display for various geography and tabular information. As in an AM/FM system, layers of accessed for analysis and display representative sample layers as shown in figure 1.

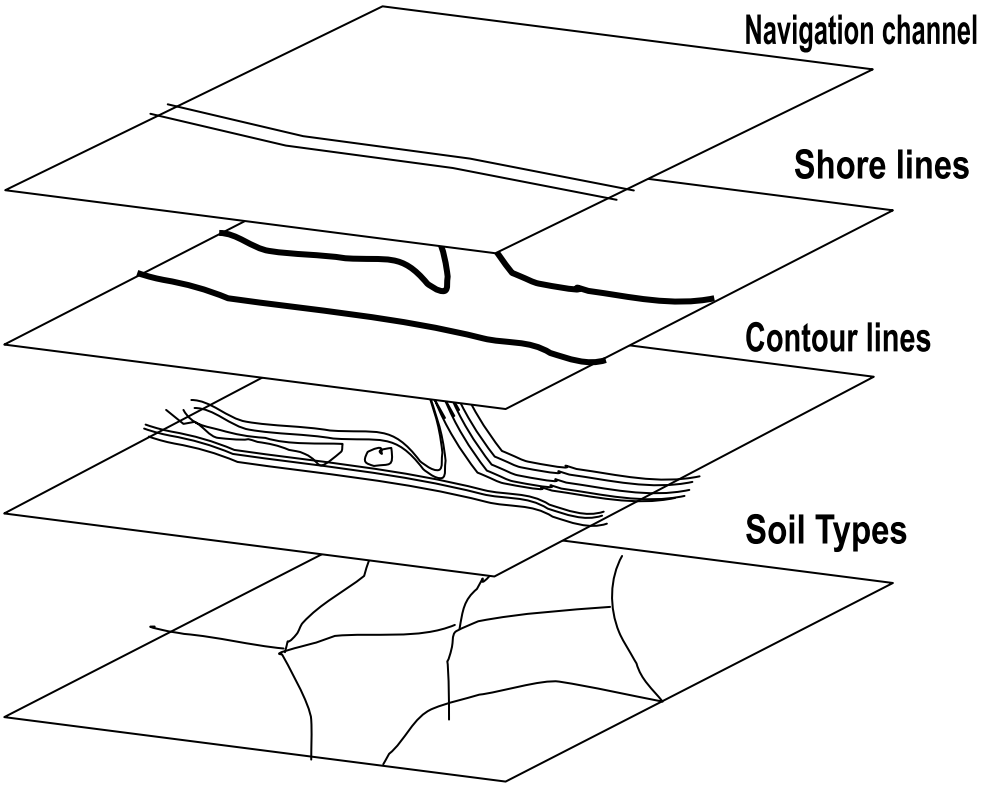

Figure 1: GIS Data Layers

Application of GIS on Rossetta Branch

GIS techniques have been used for map production of Rossetta branch. This branch is 240-km length has been covered by 192 maps in scale 1:2000. These maps represent the different features in the water path and its two banks for a distance more than 500 m in each side. In other words, these maps represent the Nile and its wadis. To produce maps represent Rossetta branch the following steps from 1 to 8 have to be executed. We use the existing charts for the same region, and collect data from the survey of the same region using GPS. Extracting information from different existing sources of data consists of digitizing Maps and digitizing Ortho-photo maps.

1- Data Collection for the Area of Study:

. Digitizing Maps: This process is used for conversion of available paper charts in different scales (1:50,000, 1:10,000, 1:5000) of Rossetta Branch.

. Digitizing Ortho-photo maps that produced from aerial photos (of Rossetta Branch) to get a clear view of land features which describe the Wadi of the Nile along Rossetta Branch, shore line and to determine zones which changes in topography and land features.

The existing charts and ortho-photo maps are useful for extracting Rods, Channels, Buildings, Mosques, Churches, etc.

. Field survey data: There are two types from data field

A- Shoreline data x, y, z (Longitude, Latitude, Elevation) represents the land survey.

B- Soundings x, y, z (Longitude, Latitude, Elevation) represent the depth of water, i.e., the distance from the water surface to the river bottom.

2- Importing of Soundings:

Data collected by the field instruments as x, y, z (Longitude, Latitude, Elevation) and soundings are transferring to the office format where it can be post processed.

3- Soundings Selection

Sound Selection that adequately meets the requirements of the chart user. The degree of difficulty the cartographer faces in producing a good sounding selection is more influenced by the nature of the river bottom and by the nature of the source data. Purposes of sounding selection are to:

1) Define and bring attention to dangers to navigation due to the nature of the river bottom.
2) Show the available draft for safe navigation.
3) Portray the general configuration of the bottom.

4- Soundings Suppress

The compilation process has determined this sounding is not to be shown on the chart.

5- DTM (Digital Terrain Models) for Rossetta Branch

DTM are used to represent surfaces it can be constructed from three-dimensional data including spot heights, soundings, points along 3D lines and points defining contours. Different types of DTM: Regular grid, Global surface fit, and patchwise surface fit triangulated irregular networks.

6- Topography

Facilitates were operation such as finding points in polygons and overlaying polygons. Also topology may also used for network or connectivity analyses.

7- Contour Maps

Contour production is one of the most widely used applications of DTM; traditionally contour creation has been performed manually. With the advent using DTM contours can be generated automatically quickly and at any vertical interval.

8-Volume Estimation

In some applications volume calculations are very important. CARIS DTM can be used to determine volumes above a specified datum or by calculating the volume for different time period say (1998- 2000) or by calculating the volume at 1998 separately and calculating the volume at 2000. The cartographer can define the erosion or deposition by comparing different values of volume above the same datum. Atypical charts for Rossetta branch at km 100 is shown in figure 2, which show maps for different contours of bed form and two banks of the Nile path.

Nautical Charts for Rossetta Branch Using GIS

The same steps used for map production are used for nautical chart production. Nautical chart can be defined as a map designed specifically to meet the needs of marine navigation by: -

1) Showing depth of water and submarine physiography with particular emphasis on danger to navigation
2) Describing the nature and extent of the foreshore and the nature of the river bottom
3) Indicating the various aids to navigation

Features Shown on Nautical Charts of Rossetta Branch

1-Shore line: It is the boundary between land and water. In nautical chart high water level is used

2-Foreshore And Drying Area: This is the area that lies between the elevation of high water and the elevation of chart datum

3-Soundings and drying Heights: These are the figures representing the vertical distance from the water surface to the river bottom in areas permanently covered by water.

4-Depth contours: These are lines joining points of equal depth below a specified plane of reference.

5-Quality of the Bottom: The type and the consistency of the material composing the bottom of a body of water being charted are often identified on the chart. So symbols based on English language abbreviations are used to identify materials and consistency, e.g. R for rock, M for mud, etc.

6-Aids to Navigation: Device or system, external to a vessel, which is provided to help a mariner determine his position and safe navigation path.

7-Landmarks: Landmark is a natural feature or an artificial structure on land, which the marines can use to determine a direction or position

8-Topography and other cultural features: These are shown on the nautical charts only to extent that they are useful in assisting navigation

Figure 3 shows a typical navigational chart with two lines in red color define the most safe navigation path.

Discussion

NRI conducts hydrographic survey of the River Nile, which extends for about 1500 km from the Sudanese border in the south to the Mediterranean Sea in the north. Beside hydrographic survey, NRI comports a variety of responsibilities based on the hydrographic data and other data gathered from the field. Among those are: sedimentation in lake Nasser, River bank protection, aggradation and degradation, monitoring of sediment transport, water quality studies and protection of hydraulic structures. It is thus clear that hydrographic survey is the corner stone in the activities of the Nile Research Institute. This fact has been realized by the implementation of GIS techniques on production of charts and thematic maps beside hydrographic survey. Through the use of GIS system, it became easy to archive large data sets and to manipulate these data. Also, through the use of GIS system, It was possible to execute the hydrographic survey and produce contour maps for the whole length of Rossetta branch in very high quality. These processes of hydrographic survey and map production using GIS techniques took short time comparing with the same processes using the traditional methods. These contour maps enable to carry out several studies with respect to aggradation and degradation, bank protection. Also, these contour maps are used for improving navigation in the River Nile. The implementation of GIS techniques will play pivotal role in the following:

- Updating of 1978 hydrographic survey from Aswan to the Mediterranean Sea.

- Periodic updating of hydrographic survey for the critical reaches and reaches under specific studies.
- Production of navigational charts for the River Nile.
- Continuous improvements through importing and introducing new techniques in regard to hydrographic survey, DGPS, GIS, and navigation.

- Production of thematic maps.

Contour maps will give a big hand in studying the following:

- Aggradation and degradation of the River Nile.
- River regime including; bed level and water surface level.
- Management lines of the river.
- Suitability of new sites for new hydraulic structures.
- The development of the river for navigation.
- Physical response of the river to new structures or man made development.

Conclusion

GIS technique is implemented to produce 192 maps for Rossetta branch. These maps are in very high quality comparing with the old fashion paper charts for Rosetta Branch. Consequently, the transfer from old fashion methods for hydrographic survey and map drawings based on the appearance of GIS technology made it easy to produce maps in a very high quality for the River Nile and its two branches. Application of GIS technology also facilitates: -

1. More effective analysis of geographic and more availability of faster technology that can accelerate work processes.
2. Capability to produce specialty maps at any desired scale and ability to easily produce reports.
3. Reduction of information storage requirements in a variety of physical forms.
4. Ability to evaluate a greater variety of design or planning alternatives.

Recommendations

1- Continuos improvements through importing and introducing new techniques into hydrographic survey.

2- The Navigational charts should be produced for the whole length of the Nile.

3- Arrangement of twinning program for technology transfer and exchange of information should take place.

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