THE USING GEOINFORMATIONAL SYSTEM (GIS) AND DATA OF REMOTE SENSING (RS) TO ESTIMATION OF RISING OF LEVEL OF CASPIAN SEA

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ABSTRACT

It is considered the problems of the estimation of dynamics of the change for the shore line of the Caspian Sea from 1977 to 2000 for selected sites of the territory of the Azerbaijan Republic. It is also showed the forecasted estimation of the change of the water level for a period by 2010. It was created the electronic maps of inundated zones and it was conducted the accounts of the inundated squares on years from 1977 to 2010.

It was initised the large-scale topographic sheets of scales from 1:25000 to 1:100000 as input data for creation of the digital model of the locality, which was basic for simulation and prediction of inundated zones. Moreover, it is showed the function blocks and the basic principals of the developed geoinformation system of simulation and prediction of the drowned territories of the coastal zone in connection of the rising level of the Caspian Sea.

1 INTRODUCTION

The Caspian Sea is subjected to the periodic oscillations with sharp overfalls of the water level. Up to the middle of the 19th century the Pricaspian region was not in the number of densely populated regions of the world and just for this reason such natural cataclysms did not result in disastrous consequences for the person. However, in connection with the beginning of fissile mastering of oil pools of the Pricaspian zone of the Azerbaijan Republic and then the Caspian shelf, beginning since the middle of past century, the human activity in this region has increased. After 30-40 years of the slump of the water level, beginning since the 70s the sea level has become to increase and consequences has become to gain disastrous nature. The scientific researches of the physical nature of the Caspian Sea by the Azerbaijan scientists and other Pricaspian countries demonstrate that the rising of the water level will be till 2000 and to this time the water level will rise for 1 metre. Azerbaijan has faced before instant necessity to accept resolute measures for decrease of consequences of this phenomenon. For fast acceptance of optimal solutions it is necessary to create the controlled system of the scalene, authentic and operatively updated information. The development of geoinformation system is the most suitable variant for acceptable solution of the arisen problem.

2 CONCEPTS OF CONSTRUCTION OF GIS "CASPY"

2.1 Basic characteristics of the geographic data

In the considered case GIS is a particular form of intelligence system used of topographic, remote and geographic data. The main purpose designed GIS is to take a decision about the change of the level of the Caspian sea. The used geographic data include those data which have a space binding. Main aspects of the geographic data are:

a) A space binding is a location of space bound objects which are defined in geographic coordinate system (a cartographical projection);

b) Attributes are descriptive information about spatially distributed objects (SDO);

c) Space relations are quantitative or logical relations between SDO;

d) Time is the time for data gathering and the life time of space and attributive data.

2.2 Description of GIS "Caspy"

At solution of the task about the creation of GIS of Pricaspian region was taken that facts that in the considered case it is necessary to use unclaimed potential of the own programmers. Thus is resolved to rest on own developments of all software, except for the programme of input of cartographical data (for input are used the AutîDesk, AutoCad programme).

Created by us GIS represents a collection of software, joined in the uniform programme complex and consists of four automous programmes. The complex includes the following programme units:
- block of the analysis of the space data;
- block of simulation and prediction of inundated zones on the basis of creation of digital models of the locality and cartographical simulation;
- control block databases of GIS;
- data processing block of remote sensing (RS).

3 FUNCTION BLOCKS OF GIS "CASPY"

3.1 Block of digital simulation of a relief.

At creation of bases of the digital cartographical bases and the subject - contents of maps it is necessary to take into account miscellaneous scale to provide possibility of transition from small-sized to larger scales. For this purpose it is created a system of the digital cartographical bases of base scales from which can pass to other scales on the basis of an automatic generalization. For the territory of the coastal zone of Azerbaijan such base scales are:
- 1: 100 000 – providing the render of territories, with characteristic natural and climatic, social and economic trend;
- 1:50000 – providing the render of territories with administrative division;
- 1: 10000 - permitting to give the detail large-scale basis for construction of digital model of locality, as the standard for simulation of inundated zones of the coastal areas.

The designed programmes allow effectively to decide the tasks of automation of processes of creation of the large-scale schedules and electronic maps.

3.2 Block of simulation and prediction of inundated zones

The designed software package allows on a given regular grid to make the following problem and oriented operations:
- Construction an isoline of a level on the digital model geofields;
- Construction of zones of watercollector on the crossing locality;
- Automized definition and logical selection bound with the sea of sites of a coastal zone.

The polygons, subjected to splashing down at given the water level are selected in the vector format. At the following stage of areas, subjected to splashing down are painted over in conditional colours in the interactive mode. The area and volumetric characteristics of the inundated sites are defined on isolated complex polygons.

Main features of algorithm are:
- Stable running in the most complex and diverse conditions;
- Linewise scanning of input data in the operational memory and deleting after processing;
- Control of closure of lines on polygons and the interpolation decrease of the step of a grid.

3.3 Control block with data banks

This block, grantiving its services to other constituents GIS represents an independently working software media. In this blocks there are all standard for similar systems the functions, such as creation, data manipulation, inquiries and reports.

The data bank represents the relational database. The bank bases on an information image of social and economic object of a coastal zone with cartographical or administrative binding of the object.

In the bank there are the following categories: 1) settlements; 2) industrial objects; 3) objects of farmland; 4) communications; 5) hydrographic networks; 6) hydraulic engineering structures; 7) sources of ecological contaminations; 8) guarded territories and reserves.

3.4 Use of the data RS for creation of GIS "Caspy"

In developed GIS important place is selected to use of a processing techniques of remote measurements as operating and fast and renewed type of information about an environment in a regional scale. Depending on space permission of satellite facilities and recurrence of shootings above the same region it is possible creation of a special processing techniques of the multizone space information.

The use of methods of creation of composite snapshots under the data of the occurring at different time information causes the rigid requirements to objects of a surface which have to save stable spectral images. Designed by us the software package on processing the satellite multizone information allows to decide the tasks of operating monitoring of a state of a biomass of green vegetation, ecological situations of industrial regions, to inspect and to select the salted sites etc. It is created the thematic maps of different assignment on the basis of this information.

The programme is sixteen a bit valuable Windows - product and supports the multiple document interface. The structure of the programme can conditionally be divided into two parts - base for the graphics editors of the software and software oriented to processing of aerospace snapshots.

4 RESULTS AND TOTALS

The all coastal zone with depth not less than 20 kms was enveloped by the plane tables 1:100000. The localities characterized with the greatest levels of crossing, were paddingly treated by maps of a scale 1:10000. It was digitized the shore lines, isolines of levels of height and characteristic local heigh, piers, deep sites and others on all plane tables.

The shore lines and isolines of heights were digitized with a detail twice greater, than step of approximating of a programme module of a refacing. The technology of optimal choice of a way of digitization was fulfilled after numerous samplings, definition of different steps of an approximating grid and analysis of outcomes of restoring of known lines on a topographic sheet.

On the basis of the obtained results it is possible to make the following conclusions (including on system frameworks):
1. The common square of inundated zones in country till 1997 makes 700-800 sq. kms, that correspond to provisional valuations, introduced different organizations and local controls.
2. The common square of predictablis inundated zones till 2010 will make 500-550 sq. kms.

It is showed the designed maps of inundated zones of territory most suffering as a result of a rising water in figures 1 and 2. Topographic sheets of scales from 1:100000 till 1:25000. Were for input data for creation of these maps. For valuation social-economic and ecological repercussions of inundated of a coastal zone, it was made the data banks containing the vast subject informated about demographic, sanitary - epidemiological to conditions, agricultural, territorial - administrative, communication infrastructure, hydrographic network, landscaped-morphological data on all coast of Azerbaijan.

For collection of these data and the filling by them of data banks are used varied georaphical maps and results of observations of regional subdividings. There is being created a management system of data banks of GIS for output different on a level and a form of information, including the guidelines for making of desicions.

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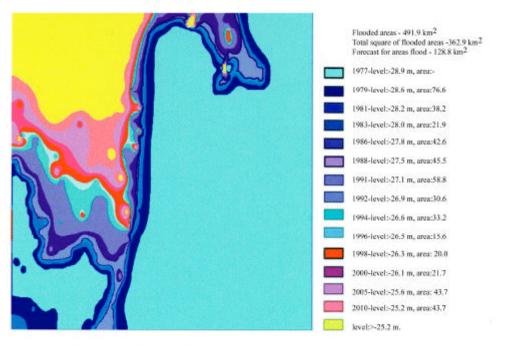
Flooded areas - 491.9 km^2
Total square of flooded areas -362.9 km^2
Forecast for areas flood - 128.8 km^2

1977-level:-28.9 m, area:-
1979-level:-28.6 m, area:76.6
1981-level:-28.2 m, area:38.2
1983-level:-28.0 m, area:21.9
1986-level:-27.8 m, area:42.6
1988-level:-27.5 m, area:45.5
1991-level:-27.1 m, area:58.8
1992-level:-26.9 m, area:30.6
1994-level:-26.6 m, area:33.2
1996-level:-26.5 m, area:15.6
1998-level:-26.3 m, area: 20.0
2000-level:-26.1 m, area:21.7
2005-level:-25.6 m, area: 43.7
2010-level:-25.2 m, area:43.7
level:>-25.2 m.

Fig.1. Flooded area in Neftchala district of Azerbaijan

Flooded areas -210.8 km^2
Total square of flooded areas -180.2 km^2
Forecast for areas flood - 30.6 km^2

1977-level:-28.9 m, area:-
1979-level:-28.6 m, area: 50
1981-level:-28.2 m, area:10
1983-level:-28.0 m, area: 4.5
1986-level:-27.8 m, area: 5.8
1988-level:-27.5 m, area: 18.2
1991-level:-27.1 m, area: 63.2
1992-level:-26.9 m, area: 10.3
1994-level:-26.6 m, area: 11.6
1996-level:-26.5 m, area: 5.8
1998-level:-26.3 m, area: 6.6
2000-level:-26.1 m, area: 5.5
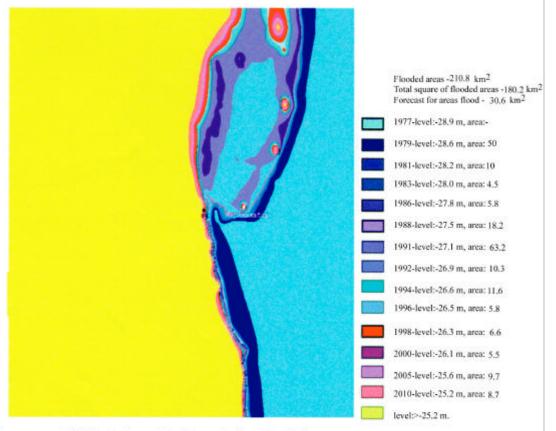2005-level:-25.6 m, area: 9,7
2010-level:-25.2 m, area: 8,7
level:>-25.2 m.

Fig.2.Flooded area in Lenkoran district of Azerbaijan