

# Using Spaceborne Data and GIS-technology for Research of Coastal Zone in Azerbaijan

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**Abstract-** The given work submit the geoinformation model which uses spaceborne data and GIS-technology for research of Caspian Sea territorial - water area in Azerbaijan. In model, represented by us, the reliability of the data is provided by the following ways: fixing of events through the data of remote sensing (on the last and present dates), presence of a cartographic material, field measurements, application of expert knowledge, observance of the greatest accuracy of geographical binding of an initial material. The similar inter influence is shown by the example of modification of a coastal zone and sleeves of delta Kura river.

**Keywords:** remote sensing, GIS-technology, processing image, integration data, sediment conservation, delta of Kura river, modification, geoinformation model, interpretation.

## 1. INTRODUCTION

In the last century, the anthropogenic modifications of the coastal areas due to the increasing of human activities and to the exploitation of hydrological and sediment resources of rivers have caused diffused beach erosion and more in general substantial modifications of the coastal asset.

Azerbaijani Caspian Sea coast region is characterised by most concentration oil and gas industry, of population, overweening loading life and economic person activity, where technical actions on optimisation an landscapes render alongside with positive influence, as well as negative, breaking their structure, transforming high potential geocomplexes in new, low fertile landscapes, with broken ecosystems. Taking into account a degree and scales of the phenomena occurring in coastal areas it is obviously, that the most essential problem is concluded in an establishment of interrelations between condition of natural processes in region and condition of sustainable development of region. That is, it is necessary to have the structured information on parameters of an environment for modelling of various modifications of the natural phenomena. The purpose of such modelling is the analysis and control of development of various ecological situations.

The given work submit the geoinformation model which uses spaceborne data and GIS-technology for research of Caspian sea territorial - water area in Azerbaijan. The main requirement at modelling is the reliability of the data. In model, represented by us, the reliability of the data is provided by the following ways: fixing of events through the data of remote sensing (on the last and present dates), presence of a cartographic material, field measurements, application of expert knowledge, observance of the greatest accuracy of geographical binding of an initial material.

As we see in Fig. 1. for perfection by process of information management, the structure of geoinformation model contains three levels of the description of environmental parameters: the first level corresponds to the description of parameters in small scale (in the basic description of such large homogeneous areas as a surface of

the sea); the second level corresponds to average scale (1:100 000) and third to larger scale (1: 50 000, 1:25 000).

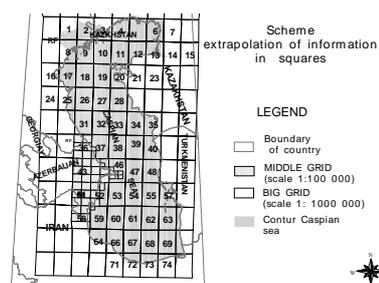


Figure1. Scheme extrapolation of all information

According to this structure the territory is divided into squares, each square contains spatial-temporal information and geographical binding to district by a uniform cartographical projection. Such approach provides flexibility of structure and facilitates search system. The methods of local diagnostics of an environment can not give a complex estimation of a condition of natural object or process. Especially in the case when researched objects take vast areas (for example- the sea water surface) or locate in places difficult of access. It is well-known, that in such situations the role of the data received by devices and methods of remote sensing, satellite monitoring is very important. The satellite information in structure of model is systematized under the spectral resolution and is submitted by dates corresponding to development of such natural phenomenon as a rising of the Caspian Sea level. In similar way the geo-ecological information was systematized through various scales.

The most difficult problem at construction of geoinformation model in a digital type in the requirement of the greatest accuracy for geographical binding, for which performance was, developed the special technology for transformation of the data in a uniform cartographic projection. There was used GIS-technology.

The coastal zone in the model is considered as object of inter influence of processes occurring on the sea and the dry land. The similar inter influence is shown by the example of modification of a coastal zone and sleeves of delta the Kura river. The space image coincident through dates with development of events, connected with rise of the Caspian Sea level and also information on antropogeneous influence on resources of the Kura river were taken as a base of supervision of modifications.

## 2. METHODOLOGY

The overall methodology used for the study is presented in chart given in Figure 2.

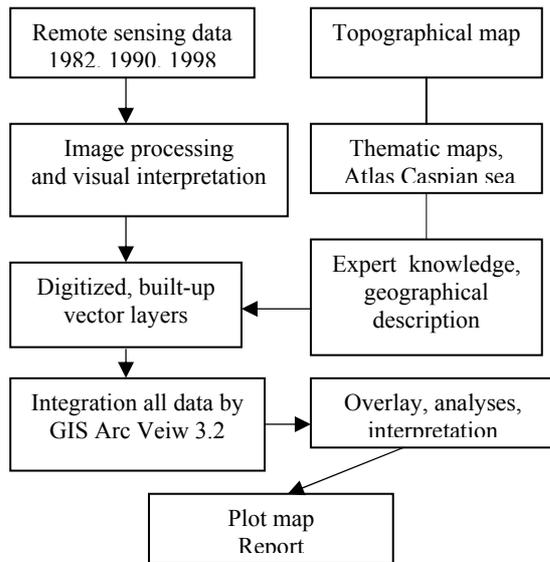


Figure 2. Flow chart of methodology.

This methodology is based upon:

1. Processing and interpretation remote sensing data to obtain modification the coastal zone as on 1982, 1990, 1998, 2000y;

2. Arc Veiw 3.2 GIS based to integration of thematic information from Atlas Caspian sea and map of land capability associations to develop modification map of coastal zone;

3. Analysis of existing infrastructures of coastal zone by processing the satellite and another information by overlay method.

4. Creation of information model of researched district:

-Space images of 1982 (Landsat MSS), 1990 (Resurs), 1998, 2000( Landsat 7TM)years;

-Cartographic data and layers: topographical maps in scale 1:100 000, 1:200 000, thematic maps in scale 1:500 000; Atlas Caspian sea 1998 y[[]];

4. Geographical description of region.

5. Results of processing of an initial material:

Layers displaying the information on a condition of pool of the Kura river delta according to condition in 1982; on 1990; 1998;

Dates from a map and space image approximately coincide with the periods of a beginning and greatest rise of a level of the Caspian Sea, stabilization and slow recession. These events have aggravated dynamic abrasion processes which have reduced the area of a land in low parts of delta almost twice. On space images the change of the scheme for bearing-out of the basic flow river sediments in the Caspian Sea is also traced.

### 3. INFORMATION MODEL «DELTA OF KURA RIVER»

In the given work the geoinformation model of delta Kura river is offered as an example. The influence of the natural and antropogeneous factors on the change of a river sleeves in its delta is considered here. The interest to this area is caused by the fact, that the existing maps have not been updated for a long time as a result of known political changes (the Republic of Azerbaijan has become independent the ambassador of disintegration of the Soviet Union). The delta of Kura River is traditionally shown on

the previous maps with three main sleeves (Fig.2, map of 1982). However, space images of 1998, 2000 show, that now sleeves of Kura River in the lowermost part of its delta (Fig.4, the space image of 1998) has essential changed.

For supervision and analysis of the factors influencing on changes of sleeves of delta Kura River the information model "Delta of Kura River" was constructed. The very important detail of model is the opportunity of integration of remote sounding data, of the geographical and cartographical information for reception of the reliable information about a condition of delta in the different periods of time and the making of the forecast for the future. The model is constructed on the data in various shooting dates and composition of the initial information. They are comparable and equitable in spatio-temporal aspect.

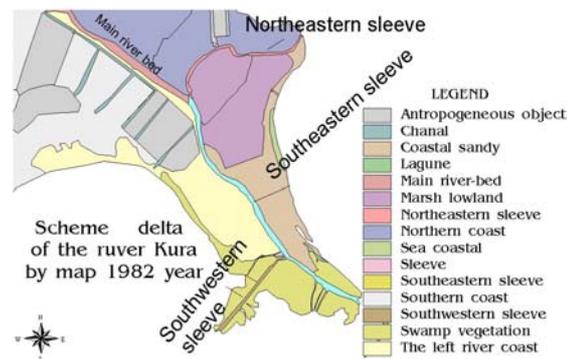


Figure3. Delta of Kura River is traditionally shown on the previous maps with three main sleeves.

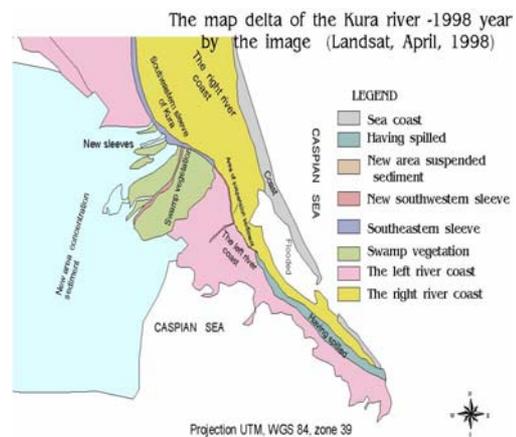


Figure4. Information layers of the Kura river by space image 1998 year.

### 4. RESULTS OF THE INITIAL INFORMATION ANALYS

The Azerbaijan coast of the Caspian sea is characterised by a variety of its geomorphologic structure. Distinction of a geological structure, tectonic mode and hydromorphological conditions originally influence on formation and dynamics of the coast. Low Kura area corresponds of the same name through cavity in respect of the structure and is characterised accumulative forms of relief. Subregion of the Kura river delta is completely accumulative formation. Now volume of

a firm stream is no more than 10 million tons per year. The dry land made 1/4 parts of delta after intensive rise of the Caspian Sea level which had begun in 1978.

The delta area has reduced almost twice last years in result of abrasion and flooding of its low parts. Now frontal part continues to be exposed abrasion. The entrance of drift toward coast of the river has decreased in process of growth of Kura river delta and its moving toward sea that has resulted in erosion of its east coast. The north part of this coast is exposed abrasion (Fig.3 and Fig.4). Except deficit of drifts this fact was promoted by different depth of Bottom Sea. Naturally intensive rising of a sea level has aggravated dynamic processes.

In 1980 the small strait has been formed on the bottleneck of spit as a result of long abrasion and rise of a sea level 0.5 m (Fig 4). Now the most part of a southern half of spit, having accumulative genesis, is flooded by the sea water. The one third part of its area was kept. Small amount of a material, incoming here from abrasion site, is saved in a shallow zone. Before the width of a strait was 2 km., now the width of a strait makes more than 10 km, the depth is 3,5m. (Fig.3 and Fig.4) [1].

The result of an intensive rising of a sea level and, certainly, the erosion of its coast by a flow going through a strait in the Gizil-Agach gulf is shown on Fig. 3. In view of a weak flow of drifts in the area of sea coast spit the reunion of its two parts it is improbable at the fall of a sea level on 1-2m. On the Fig.5 and Fig.6 are shown modification of delta and site of suspended sediment concentration at the near sea bottom by a image of 1990 and 1998 years.

As a result of holding up of drifts of the Kura river, which were flown out to the sea by its southeast sleeve, now flowing out of drifts is carried by new sleeve as it is visible from space images.

In conclusion it is possible to confirm, that the scientific – reasonable and coast safety actions were not accepted for long-term sediment and abrasion of coast zone in Republic. As result the ground resources, fertile fields, structure coastal line are lost, there was a repeated transfer of a railway route of Baku- Astara.

## 5. CONCLUSION

Thus is shown, that the coastal zone should be considered as uniform object, which is under influence of processes occurring on land and the sea.

In conclusion it is possible to confirm, that the scientific – reasonable and coast safety actions were not accepted for long-term sediment and abrasion of republic coast.

Development of remote sensing and GIS- techniques provides such an important tool to overcome most of these problems.

## 6. REFERENCES

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