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REDUCE OF NATURAL DISASTER CONSEQUENCES BASED ON FITTING ENGINEERING SOLUTIONS AND SPACE TECHNOLOGY APPLICATIONS

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Abstract- There is no doubt that up to date space technology and Geographic Information System (GIS) technology applications play a significant place in mitigation of disasters. Distinguish modern technology application of air and space-based technologies with use of the Earth observation satellites, communication satellites, meteorological satellites and global navigation satellite systems have played an important role in risk reduction and disaster management processes. Those tools are making to carryout of the comprehensive hazard and risk assessments, response, relief and disaster impact assessment. Space-derived and in-situ geographic information and geospatial data are extremely important and useful technologies during times of emergency response and reconstruction, especially after the occurrence of major events such as earthquakes or floods as well any other kind of natural disaster. Remote sensing and GIS can be used in many areas such as:

- Assessment of crop area extent;
- Management of water resources;
- Yield assessment studies;
- Land suitability assessment for agriculture;
- Disaster Management;
- Precision agriculture;
- Urban Planning Space;

Information indicated above and outcomes from remote snsing data processing and developed GIS technology are effectively being used for early warning and monitoring of slow onset disasters as well as rapid onset disasters.
The fact is that remote sensing and GIS technology opens opportunity to manage of the process of natural disaster with integration of engineering advances for reduce of consequences og naturlal disaster impact.

In this paper has investigated of natural disaster with pattern of river flood in the selected sensitive area of Azerbaijan Salyan district. It has been demonstrated space technology advances application with modeling of 3D elevation of the area. An approach used for the flood consequences made available preferable natural disaster risk minimization and offering engineering solutions for it.

Keywords: Natural Disaster, Space Technology, Remote Sensing, Geographic Information System.

I. INTRODUCTION

Earth observation through satellite information is the bases for investigation of the problems of environment and natural disasters. The main aim of the monitoring for environment and natural disaster is to provide appropriate information and collection of database related to the Earth system. This information and database have to be bases for decision makers to formulate polices directed to managing process of the monitoring with purpose of environment and natural disaster forecasting and prevention.

Presence of the whole, reliable and duly information demonstrating condition and tendency of change both natural sphere and its separate objects will allow to provide efficiency of nature protection actions. For this purpose have to be created information system of multi-purpose monitoring of condition consisting of the system of regulated supervision with programmed spatial, time and component resolution.

II. INVESTIGATED AREA

It has been selected Kura River basin in Saylan district of Azerbaijan (Figure 1). The area comprises approximately 24 km^2. The Kura watershed is one of Azerbaijan's most important agricultural production areas. During the last 10 years, it was affected by 5 excessive floods, causing a lot of damage to people and properties. The one of major source of Azerbaijan freshwater is the Kura River. The mean discharge of 1,144 m^3sec^{-1} for the Kura River is the highest among the main rivers in Azerbaijan, representing 39% of the total discharge from this lowland region. Mean precipitation in the Kura River drainage system is 885 mm $year^{-1}$, which may range from less than 400 to more 1,800 mm during any one year.

III. SPACE TECHNOLOGY APPLICATION / SATELLITE IMAGE PROCESSING

ALOS imagery was used for selected area study. The image was georeferenced to UTM zone 39 North, WGS84 using a first degree polynomial rectification algorithm with 30 ground control points (GCPs) extracted from a digitized topographic map at the scale of 1:100 000. The root mean square (RMS) error was equal to 0.5 pixel (5 m) [1, 2].

The image was classified between follow general classes:

1. Urban or Built-up Land
2. Agricultural Land
3. Garden
4. Scrub
5. Open area
6. River
7. Stream
8. Canal
9. Road
10. Railroad

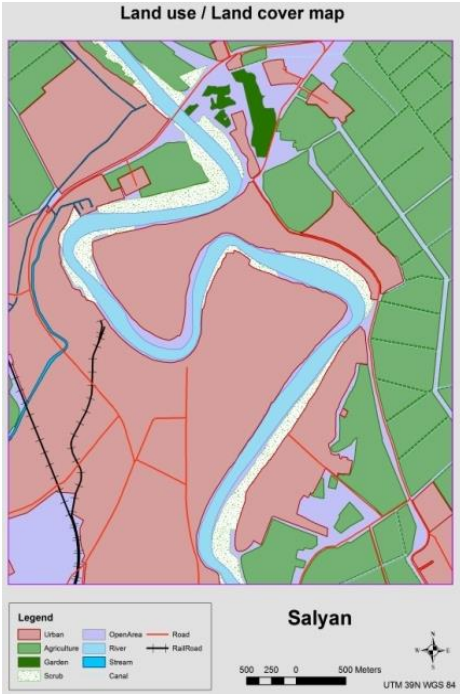

Figure 1. Selected area for study [1]

It has been used AutoCad Landscape software for 3D modeling in definition and classification of the selected area as reflected in Figure 2. There is actual existing elevation data of the selected area, which made available to merge the height points with further development of the picture. As a result of such merging it has been visually developed of the relief of the selected area. For the detailed study of the relief the area was artificially divided into the L-L sectional elevation and demonstrated relief of the section depends of the elevation. A green line shows a points calculated height marks. The red marks reflect actual height data of the selected area.

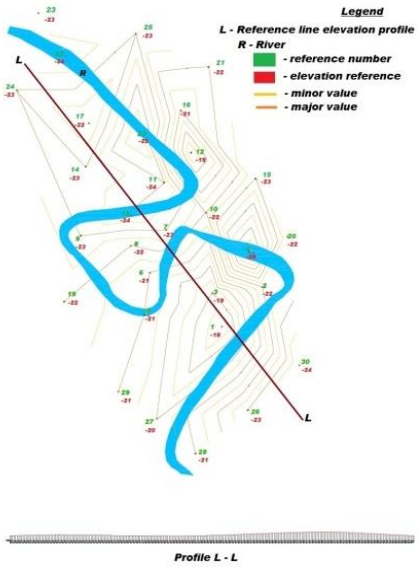

Figure 2. 3D modeling of selected area

Based on visualized data it can be supposed of the consequences of expected natural disaster impact for the selected area. In the other hand evaluation data with reflection of the relief can be play a vital place in preparedness, forecasting and protection of human life, properties with minimizing of the natural disaster impact by construction appropriate engineering facilities in place.

The lines of yellow and orange colors with defined interval are modeling the surface. The orange lines were identified as the main height marks with the whole numbers and yellow lines were identified as the secondary lines locating between the main height points. The high density of the lines in the figure demonstrates a clear fall steps in this piece of the area than in the places where the lines are diverging.

The Figure 3 has been developed on processing of IKONOS space image with spatial resolution of 1 m. It has been developed 3D modeling of the selected area as per reflected in Figure 2 based on the processed space image. Figure 3 shows how the height point were taken corresponding to the marks. Based on this data it has been created a relief of the selected for study area.

The study and identification of the potentially flood inundation areas in advance is a useful and important aspect of the natural disaster impact reduction [3, 4].

As it has been seen from the Figure 1 the areas potentially flood inundation with a high probability of flooding has been developed and mapped. In this measurements and calculations the starting point as the benchmark has been taken as -26 m.

The result reflects the potential flood inundation areas based on the height data supposed being as -22 m. The result of data calculation and processing from DEM has been demonstrated in a Figure 3. This methodology can be successfully applied for potentially flood inundation areas after implementation of geodetic measurements related to the river level for acceptance of the high accuracy data.

Figure 3. Space image processing potentially inundation area [2-4]

IV. CONCLUSIONS

In this chapter have been reflected aspects of the use of space science and technology achievements in Earth observation systems. Furthermore it is described currently advances of space technology systems for study natural disaster consequences with offer of engineering solutions for risk prevention and forecasting.

One of the main targets is to develop of an advance tool for monitoring, data collection, data processing, review and report on progress and challenges in the implementation of disaster risk reduction and recovery actions undertaken for further engineering activities. An advance tool has been undertaken of the use and application of modern achievements of space science and technology for the natural disaster events particularly the river flood.

It has been used an approach of 3D modeling of the selected area for study made available to consider impacts of the any expected flood areas and evaluate scale of damages – human an properties. It can be timely prevented based on engineering solutions oriented data processed by use of modern achievements of space science and technology advances.

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BIOGRAPHIES

Sevil R. Ashumova was born in Baku, Azerbaijan in June 1990. She received B.Sc. and M.Sc. degrees in Mechanical Engineering from Azerbaijan State Oil Academy, Baku, Azerbaijan in 2011 and 2013, respectively. She has completed an internship as an engineer of Manufacturing Processes Automation in 2012. Currently she works as an engineer in Encotec Company, Baku, Azerbaijan. Her engagement within the company embraces for development of layout for project design based on use of appropriate engineering software package of 3D AutoCAD modeling and Bentley ProSteel/Pro Structure. She is involved for project execution "Fibro-cement Plant" design and project management. At the same time she successfully integrates her software abilities for integration of space and filed data for engineering solutions.

Maral H. Zeynalova was born in Baku, Azerbaijan, on November 14, 1956. She has completed her higher education at Azerbaijan State University, Baku, Azerbaijan in 1979. She has passed two years 1980-1982 training at Russian Research Institute of Biology, St. Petersburg, Russia and completed her Ph.D. at the same institute in 1987. She is the author of 5 books published by the Europe and United States famous publishers and more than 20 scientific papers.

Rustam B. Rustamov was born in Ali Bayramli, Azerbaijan, on May 25, 1955. He is an independent expert on Space Science and Technology. In the past, he was in charging of the Azerbaijan National Aerospace Agency activities as an Acting Director General. He has mainly specialized in space instrumentation and remote sensing and GIS technology. He has graduated Ph.D. at the Russian Physical-Technical Institute, S. Petersburg, Russia. He was invited for the work at the European Space Agency within the Framework of the United Nations Program on Space Applications at the European Space Research and Technology Center, The Netherlands. He has appointed for the United Nations Office for Outer Space Affairs Action Teams (member, Vienna, Austria), United Nations Economical and Social Commission for Asia and the Pacific (national focal point, Thailand), International Astronautically Federation (Federation's contact, France), Resent Advances in Space Technologies International Conference Program Committee (member, Turkey). He is an author of 10 books published by the European and United States famous publishers and more than 100 scientific papers.