КАСПИЙСКИЙ РЕГИОН: ЭКОНОМИКА И ЭКОЛОГИЯ

UP-TO-DATE METHOD FOR THE DEFINITION OF THE VARIABILITYAREAS ON THE DIFFERENT LEVELS OF THE CASPIAN SEA COASTAL ZONES

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The Caspian Sea fluctuations are periodic which are caused by various natural factors. In the situation of the Caspian Sea level decrease, marine costal constructions become unutilized and in case of the Caspian Sea level increase, the dry land territories are being flooded what causes destroy of infrastructure[1,2]. It is very important to make correct planning of future coastal infrastructure and prediction of possible accidents. For the realization of these goals it is inevitable to make appropriate reliable instrument working with accurate technological principles and supporting decision makers in their everyday activities related with the sustainable development of coastal zones. But it is very important to define all possible spatial data sources suitable for safe navigation, coastal resource management, coastal environmental protection and sustainable coastal development. In this article was researched one of the reliable data sources as high-resolution satellite imagery which can be compared with the aerial photography which was always suitable for the purposes of the coastal management[3]. But taking into account the fact that the Caspian Sea fluctuations impact on the costal area is too fast and significant it is necessary to select the source of data that can be easily and more periodically obtained as high-resolution satellite imagery.

As the territory of the research was taken the eastern part of Absheron peninsula called Shakh-Dili represented on the fig. 1. Source materials used for accurate precise stereo model, digital elevation model and digital ortho-photo map preparation are represented below: 1 m high-resolution IKONOS Standard Stereo Imagery (EPIPOLAR) – Pan-Sharpened Multispectral (PSM), Bands: Red, Green, Blue and Near Infrared. Standard accuracy of the source IKONOS stereo satellite imagery is approximately the following: Horizontal – ±11,5 m (RMSE), Vertical – ±13 m (RMSE)[4].

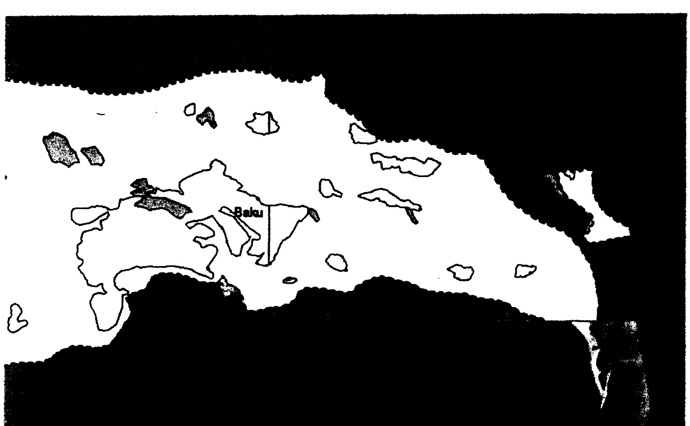

Fig. 1. Satellite imagery for the research area

For the improvement of accuracy of standard stereo product to the level of precision stereo and application of prepared products it was important to pass the following photogrammetry processing stages represented on the fig. 2.

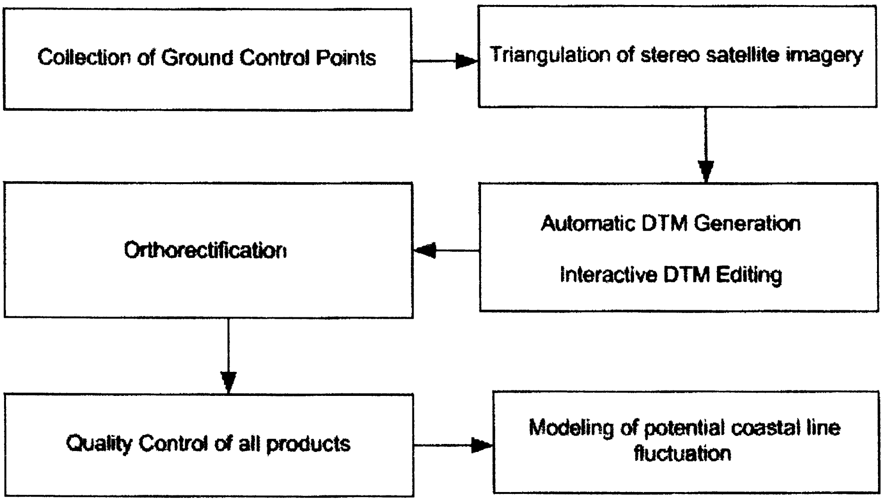

Fig. 2. Processing stages

STAGE 1. Collection of Ground Control Point. Preliminary planned positions of Ground Control and Check Point were identified in office conditions based on the standard stereo products for easier and exact planning of well visible point on the both of images of stereo pair for the further measurements by high-accuracy GPS systems. Accuracy, of measured GCP point met the following standards: Horizontal accuracy: 0,1 m ($1-\sigma$) in each of horizontal directions, Vertical accuracy: 0,1 m ($1-\sigma$) in vertical direction For every ground control point was prepared the protocol with the linking of the real position shown on the Figure 4. In the protocol for every GCP point was also added such data as identification number of the point, brief description of location area, data & time of measurement, equipment serial number, antenna type, antenna height above ground level, latitude & longitude in decimal degrees, standard deviation for latitude & longitude & elevation, vertical datum horizontal datum and person responsible for the measurements. For the measurement was used the GPS Receiver with following parameters: 2 frequency 24 canal Real Time (Leica RS530) where one GPS was in the role of base and the second in the role of GPS-rover. The coordinated were supplied in the geographic "World Global System 84" system and afterwards had been transformed into Universal Transverse Mercator Projection of 39 Zone with both WGS 84 vertical and horizontal datums. This coordinate system was selected because it corresponds to the original coordinates system of obtained high-resolution stereo satellite imagery.

STAGE 2. Triangulation and creation of Precise Stereo Model. The triangulation process is important for the improvement of original accuracy of Stereo Model, which is approximately the following: Horizontal – ±11,5 m (RMSE), Vertical – ±13 m (RMSE), by refining IKONOS satellite imagery supported vendor-provided rational polynomial coefficients[5]. This process was done using preliminary collected Ground Control and Check points along with the using of tie point calculated employing area-based matching using normalized correlation coefficients based on the images of stereo pair. As a result of the triangulation IKONOS epipolar imagery achieved the following accuracy: Horizontal – ±1 m (RMSE), Vertical – ±2 m accuracy (RMSE)[6]. Refinement of rational functions were done till the second level of polynomial order taking into account sufficient number of Ground Control, Check and Tie point.

STAGE 3. Automatic Digital Terrain Model Generation and Interactive DTM Editing. Generation of Digital Terrain Model was implemented based on the preliminary triangulated Stereo Model with improved accuracy using special Automatic Terrain Extraction mechanism working based on the area based image matching mechanism. Image matching refers to the automatic identification and measurement of corresponding image points that are located on the overlapping area of multiple images. Area based matching is also called signal based matching. This method determines the correspondence between two image areas according to the similarity of their gray level values. But taking into account the possibility of correlation errors there is the necessity for additional interactive terrain editing using stereo plotting techniques working in the stereo mode. Besides it is very important to include into the Digital Terrain Model the expressed relief features collecting polygonal and linear breaklines. Afterwards, based on the all three dimensional spatial data was generated triangular regular network which is later being converted to Grid Format flexible in usage with resolution of 1 m. As the original stereo model was oriented relative to WGS 84 vertical datum, the prepared Digital Terrain Model has also elevation values relative to WGS 84 datum, that's why there was also necessity for the recalculation of the surface elevation to geoidal height. The accuracy of the acquired Digital Terrain Model is the following: Horizontal – ±5 m (RMSE), Vertical – ±2m accuracy (RMSE).

STAGE 4. Orthorectification. This stage is implemented for the removal of relief distortions available in the satellite imagery and the important role in this process plays accurate Digital Terrain Model. The effects of topographic relief displacement are accounted for by utilizing a Digital Terrain Model during the orthorectification procedure. "An image or photograph with an orthographic projection is one for which every point looks as if an observer were looking straight down at it, along a line of sight that is orthogonal (perpendicular) to the Earth" as it is shown on the Fig. 5.

"The orthorectification process takes the raw digital imagery and applies a Digital Terrain Model and triangulation results to create an orthorectified image as it is shown (Fig. 6). Once an orthorectified image is created, each pixel within the image possesses geometric fidelity. Thus, measurements taken off an orthorectified image represent the corresponding measurements as if they were taken on the Earth's surface. Relief displacement is corrected by taking each pixel of a Digital Terrain Model and finding the equivalent position in the satellite or aerial image." A brightness value is determined for this location based on resampling of the surrounding pixels. The brightness value, elevation, and exterior orientation information are used to calculate the equivalent location in the orthoimage[7]. The accuracy of digital ortho-photo map was controlled by the used in the triangulation ground control and check points and as a result of quality control it was calculated that digital orthophoto map accuracy reached – ±2 m (RMSE).

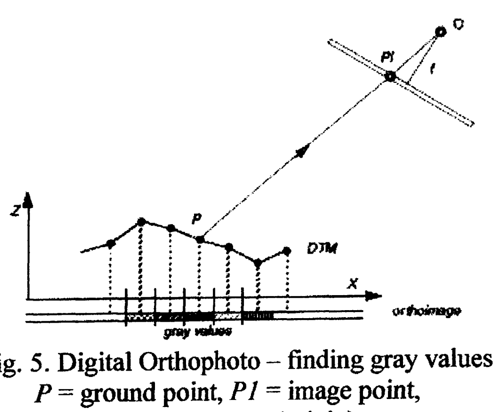

Fig. 5. Digital Orthophoto – finding gray values
P = ground point, *P1* = image point,
O = perspective center (origin)
X, Z = ground coordinates (in DTM file)
f = focal length)

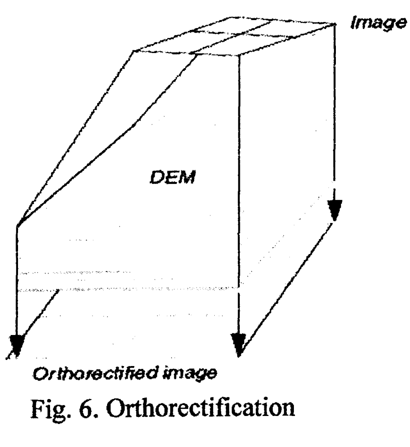

Fig. 6. Orthorectification

STAGE 5. Modeling of Caspian Sea level fluctuation by automatic interpolation. The accurate Digital Terrain Model affords us easily to interpolate the sections of the relief with the required height interval and represent the interpolation results in the linear form what can be overlaid over the accurate digital ortho-photo map obtained in the different periods.

The visualization modeling of the resulted interpolated data is possible both in two and three dimensional modes. This is the basic mechanism necessary for the modeling of the potential flooding of the costal areas. Based on these results it is easily possible to calculate area of the potentially flooded area. With potential level rises to -27 and -28 height levels. Total area of the research is 7,62 sq. km where in case of level rise to -27 will be flooded 2,48 sq. km, and in case of level rise to -26 will be flooded 4,11 sq. km. The software used for the modeling of the possible coastal areas flooding as a result of Caspian Sea fluctuation was ArcGIS 9.1 including such modules as Spatial Analyst and 3D Analyst.

The results of this research present that the processing of high-resolution stereo satellite imagery and preparation of precise stereo model, digital terrain models and digital orthophoto maps are absolutely suitable for the environmental modeling of potential Caspian Sea water level fluctuations. It means that it is possible to transform this photogrammetric methodology into the technological form that can be used by the decision makers and all other parties involved in the activities related with the coastal management. The high-resolution satellite imagery satisfied the needs of coastal environmental management giving almost the same results as aerial photography[8]. Besides nowadays acquisition of satellite imagery is easily accessible periodically what gives possibility for the permanent tracking of coastal line change dynamics. Using the advantages of high-resolution satellite imagery it is possible to extract majority of all relief topographical details along the coastal areas and over whole territory using stereo plotting techniques what is very important for the further Geographical Information Systems modeling of the potential Caspian Sea fluctuation.

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[1] ***An Introduction*** to the Caspian Sea and the Caspian Environment Programme. Artemis Creative Designers Co. Ltd., 2005.
[2] ***Vital*** Caspian Graphics, Published by UNEP/GRID Arendal. Norway, 2006.
[3] ***Kaichang Di***, Ruijin Ma and Ron Li Geometric Processing of IKONOS Geo Stereo Imagery for Coastal Mapping Application // Journal of Photogrammetric Engineering and Remote Sensing, USA, 2002.
[4] ***Space*** Imaging, LLC IKONOS Imagery Products – Product Guide. USA, 2002.
[5] Ibid.
[6] ***Bayramov E.R.***, Bayramov R.V. Preparation of Orthophotos from IKONOS Imagery for Cadastre Base Mapping of Nakhcevan Autonomous Republic Territory // Proceedings of ISPRS XXXV Congress, 12–23 July, 2004. Istanbul, 2004. P. 21–22.
[7] ***ERDAS*** Field Guide, Leica Geosystems GIS & Mapping. LLC, 2003.

ЭФФЕКТИВНОЕ УПРАВЛЕНИЕ ВЫСШИМ УЧЕБНЫМ ЗАВЕДЕНИЕМ ПРИ ПОМОЩИ СИСТЕМЫ БЮДЖЕТИРОВАНИЯ

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Становление новых рыночных отношений в процессе перехода от плановой экономики к рыночной положило начало процессам реформирования образовательной сферы и коренным образом изменило экономические условия функционирования государственных высших учебных заведений России. В ходе данного процесса были приняты законы, закладывающие основы рыночной экономики и, в том числе, определяющие новые институциональные основы российской системы образования. Развитие рыночных отношений в такой традиционно считавшейся нерыночной сфере, как образование, предопределило существенный рост экономической активности образовательных учреждений. С расширением экономических прав образовательные учреждения вынуждены были уделять большое внимание экономическим проблемам и проблемам управления собственным хозяйством. Приспосабливаясь к рыночным условиям, вуз приобрел характерные черты коммерческого предприятия. Эти условия характеризуются усилением конкуренции на рынке образовательных услуг и со-

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