

MAPPING THE ABSHERON PENINSULA USING HIGH-RESOLUTION SATELLITE IMAGERY

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Abstract

In recent years, the development of new technologies has opened up wide opportunities for the joint use of UAVs and geodetic measurements in the preparation of high-precision digital maps in the field of geodesy and mapping. This approach differs from traditional methods. Surveys conducted over large areas allow for the joint integration of UAVs and geodetic measurements to obtain faster and more accurate results.

The creation of digital maps over large areas is especially important, and for this purpose it is required to obtain higher quality data. There are many methods and areas of application for the creation of high-precision digital maps based on geodetic measurements. It is possible to systematically compile this data.

Aerial photographs taken by UAVs flying from high altitudes are considered more effective in mapping areas. The obtained photographs are first georeferenced, in the next procedure the data is combined, a 3D model and digital orthophoto plans are prepared. The data received through UAVs allows us to analyze the terrain, the condition of infrastructure facilities, and other information.

Keywords: *Caspian Sea, digital, map, level, Absheron*

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Introduction

One of the most densely populated regions of Azerbaijan is the Absheron Peninsula. The Absheron Peninsula accounts for more than 70% of the industrial potential of our republic. The impact of climate and water balance directly affects the Absheron lakes ecologically. The ecological conditions of the lakes located on the peninsula directly affect the life and health of the population. The climatic features of the Absheron Peninsula are unique.

There are more than 200 lakes on the Absheron Peninsula. Saline lakes of various volumes and sizes characterize the hydrographic network of the peninsula. The Absheron Peninsula has practically

no freshwater resources. For this reason, the peninsula has had an acute need for water since ancient times. Therefore, artificial water bodies have been created in order to prevent water shortages on the peninsula. The ecological situation in the lakes located on the Absheron Peninsula has been changing rapidly in recent years [1-4].

The widespread development of the oil industry on the peninsula can be cited as a reason for the deterioration of the ecological situation. The increase in oil-containing discharges from households and mines is also related to this. As a result of the previous rise in the water level in the Caspian Sea, the ecological situation in the lakes located on the Absheron Peninsula had a negative impact on the water regime.

For this reason, the rise in the water level in the sea caused the areas of the lakes located on the Absheron Peninsula to rise several times. Recently, decreases in the level of the Caspian Sea have been observed. Although the decrease in sea level does not directly affect climate change, in some cases it can have indirect and local effects. The dominance of water exchange and evaporation in the Absheron lakes is directly related to the decrease in the level of the Caspian. Salinity in the Boyuk Shor and Masazir lakes has recently increased, experts associate this with changes in sea level.

Research method. Data received from UAVs in geodetic measurements increases accuracy, allows for more accurate results in compiling digital maps. Using GNSS (Global Navigation Satellite System) and laser scanners, it helps to accurately determine the point coordinates of the area and implement geodetic measurements. In the processing of the terrain, in the compilation of maps, aerial photographs and geodetic data are processed with various software. Using these data, high-precision digital models and digital orthophoto maps are prepared. In this process, modern photogrammetry and geodetic methods and techniques, as well as various GIS (Geographic Information System) programs are applied. Our research object is the Absheron Peninsula, which is directly connected to the capital of the Republic of Azerbaijan, Baku, and is of great importance.

Since the Absheron Peninsula is a region with a geographical location and rapidly developing urbanization processes, there is a need for high-precision digital maps. Digital maps prepared on the basis of geodetic measurements provide more accurate information about the territory, play an important role in revealing environmental changes and opening up wide opportunities in the field of infrastructure projects.

The application of these methods for mapping the Absheron Peninsula is considered an important tool. Data for multispectral images are obtained using spectral imaging equipment installed on a space satellite, unmanned aerial vehicles, or special devices that allow taking pictures in the field. Some types of shooting have a number of advantages compared to space images. However, it is possible to determine the condition of the area we need using shooting equipment installed on space satellites [5-8].

In order to compile satellite maps of the area we are studying, we will conduct monitoring of the Absheron Peninsula. Depending on the purpose of the research conducted using multispectral images, bands 4, 5, and 6 are used:

- red "Red" (800 nm) is used to assess the general condition of plants;
- if the soil does not have enough fertilizer - green "Green" range (550 nm);

- if the soil does not have enough oxygen, far red “Red Edge” (720 nm).

Analysis of data obtained from images obtained from space cameras, as a rule, requires the use of various spectral indices. Geographic information programs are an excellent tool for carrying out these procedures. These tools are obtained using raster calculators calculated by combining the wavelength ranges indicated above into special ranges, or using special services that allow obtaining ready-made index values.

When using surface cameras or equipment that allows obtaining multispectral images, the analysis is carried out either in geographic information systems or using special software for processing multispectral images. As initial data, a Sentinel-2A satellite image of the Absheron Peninsula was taken, dated August 2024. The bands belonging to these images, i.e. color and black and white images, were taken [12-14].

When performing soil and vegetation processing procedures, it is considered more effective to work on color images. To carry out the processing process, information about the coordinates, geographical location, soil and climate characteristics of the study area was obtained. The image shows a panchromatic and multispectral high-resolution satellite image of the Absheron Peninsula (Fig. 1; Fig. 2).

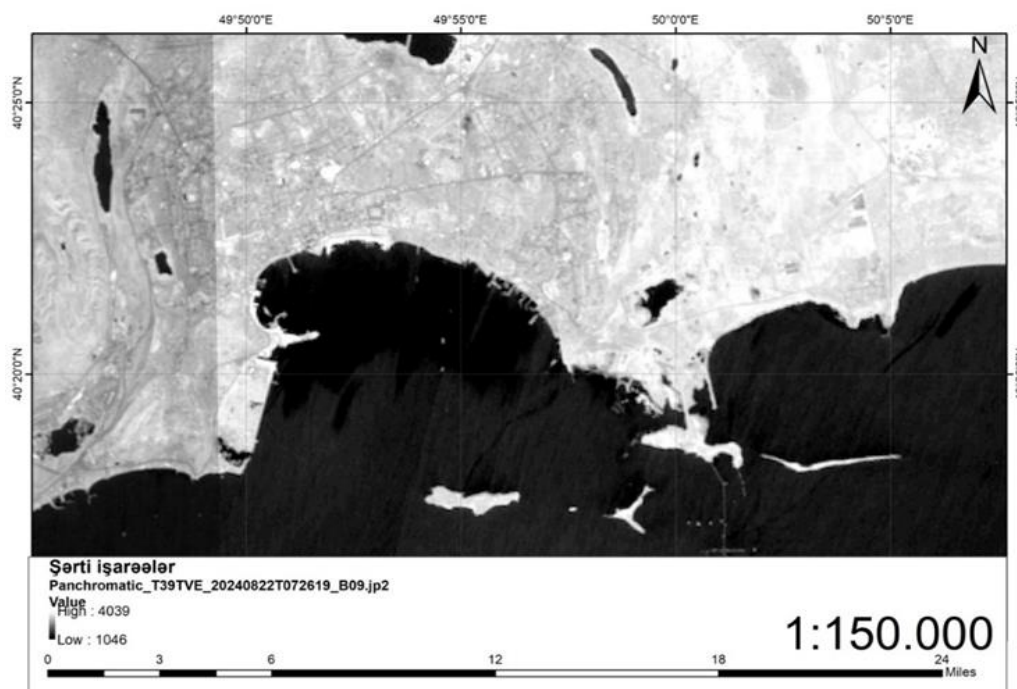


Figure 1. Sentinel 2A panchromatic satellite image of the Absheron Peninsula

In order to ensure the clarity of the issues under investigation, processing procedures were carried out using satellite images of the area and a topographic map, and the final images prepared based on Arc GIS 10.6 software are presented below [9-11].

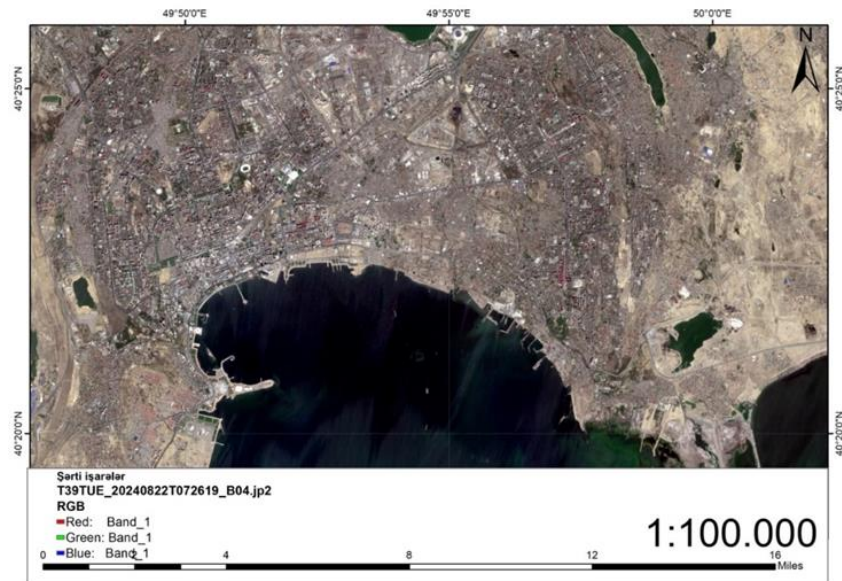


Figure 2. Multispectral satellite image of the Absheron Peninsula at a scale of 1: 100,000

The image below shows a Sentinel-2A satellite image of the Absheron Peninsula. The image is at a scale of 1:400,000. The first image shows a zoomed-in satellite image of the Absheron Peninsula, and the second image shows a zoomed-in image (Fig. 3).

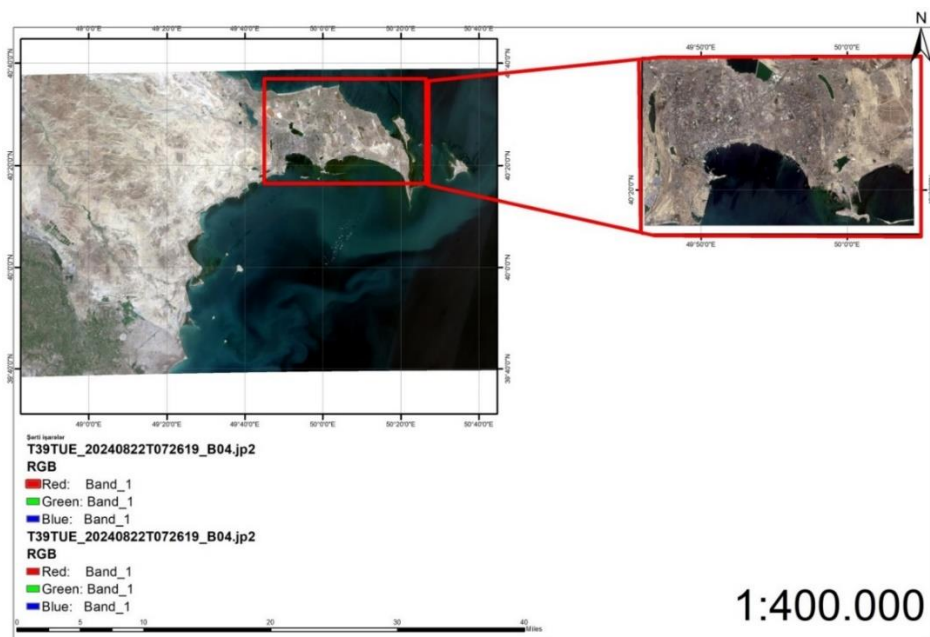


Figure 3. 2024 1:400,000 multispectral satellite image of the Absheron Peninsula

The application of new technologies ensures that the work to be done is carried out more effectively and efficiently. The use of high-precision digital maps is considered even more efficient in order to study the current state of the area to be studied. The use of these technologies allows for the assessment of the current state of the areas.

The use of new technologies has created broad opportunities for solving many practical problems quickly, effectively and with high accuracy. The application of these methods allows for more

accurate research when monitoring the environment, managing water and land resources, determining the boundaries of land plots, studying the state of soil pollution, etc. while increasing the efficiency of scientific research.

Image processing. The coastline of the Caspian Sea has experienced fluctuations from time to time. The reason for these fluctuations directly depends on the hydrodynamic, morphological and geographical characteristics of the coastal zone.

Various methods and techniques are used to determine the salinization of soils, the presence of vegetation, pollution in water bodies, etc. The most efficient of these methods, both in terms of time and finances, are images obtained from high-resolution satellites.

Using satellite images and spatial data, it is possible to study and diagnostically assess the damage caused by the lakes located on the Absheron Peninsula to the surrounding areas, as well as the current state of oil-contaminated soils in the areas, and to study issues such as level fluctuations of the Caspian Sea, etc. Using satellite images to assess the fluctuation of the Caspian Sea level of the Absheron Peninsula allows for more accurate results.

Satellite images were taken at different times, a decoding procedure was performed, and the coastline's advance or retreat towards the sea was shown in the map-scheme (Fig. 4), [11-14].

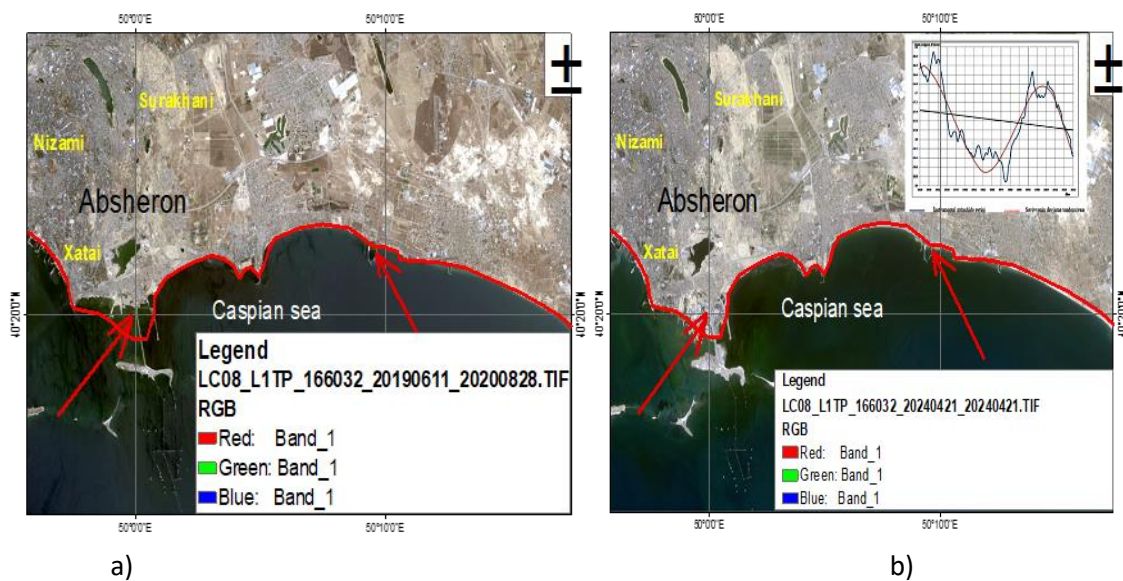


Figure 4. a) from June 11, 2019; b) Satellite image of the Caspian Sea level on the Absheron Peninsula, taken from the Landsat 8 satellite on April 21, 2024.

Conclusion

We compared satellite images of 2019 and 2024 to determine the detection of changes in the coastline using high-resolution satellite images. We compared the changes in the Caspian Sea in different years on the southeastern coast of the Absheron Peninsula [12].

This method will allow us to study the rise and fall of the Caspian Sea level in the future. During the study, satellite images of different years were compared. Based on satellite images received during

2019-2024, an assessment of the dynamics of coastline changes on the southeastern coast of the Caspian Sea of the Absheron Peninsula using object methods was made, and a map-scheme was compiled.

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