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Evaluation of the hydraulic and morfometric connections of the riverbed with using GIS

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Evaluation of the hydraulic and morfometric connections of the riverbed with using GIS

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Abstract. Currently, in the country developed models with using on GIS technologies are mainly based on linear schemes of location and mapping of water resources, and there is no database for determining the state of water resources, hydraulic structures, and river and riverbed deformation. The main problem with the use of GIS models in water management is their low accuracy, the fact that created models were based on low-resolution satellite imagery and used old analytical techniques. Models in irrigation systems which used GIS technologies are one of the problems waiting their solution. In this article analyzed possibility of GIS estimation of deformation processes in the river bed (in case of Sokh River). The processes in the riverbed were analyzed based on satellite data and compared with field experiments. Given conclusions based on analysis.

1. Introduction

It is very important to study the dynamics of river sedimentation under the influence of deformation processes in rivers and to apply their results in practice. The planning and construction of hydraulic structures and canals should take into account the sedimentation and transportation of the sediments and the effect of sedimentation on the exploitation condition of hydrologic structures [1, 2, 3]. Scientifically based, economically-effective and environmentally safe solutions of these problem, brings to directly sediment management, quantitative and qualitative estimation, development of new technologies in water sector, eventually, brings to the national economy with natural, ecologically safe and inexpensive raw materials [4,5]. It should be noted that the regime of river sediments, its annual and long-term volatility, sediment size, fraction and chemical composition are very important data for construct and maintain large and small reservoirs, main canals, drainage structures and other river sediment structures efficient exploitation and prediction of river deformation [6].

2. Materials and methods

Two-phase flow along the river constantly changes the river morphometric parameters. The main morphometric connections in the river are the width, depth and slope of the river bed. These changes can be seen in the cross-sectional surface, the longitudinal section and the cross section [7]. Morphometric changes in river flow over time also cause changes in flow hydraulic elements (consumption, average velocity, etc.). This is because in the course of the movement of slopes and bottom sediments in the stream, they sometimes sink to the bottom in some lengths, and in some cases, to the river. These processes, in turn, lead to a change of river bed and a decrease in the capacity of water. One of the most important issues is the rapid detection of these changes in the river and accurate assessment of the situation. The practical application of existing theoretical developments and computational techniques is often reflected in computational methods, which represent the distribution of sediments by the depth and length of flow [8]. For many years, two theories diffusion and gravity theory have widely used. New theories are now being developed to accurately evaluate these processes.

As a solution to the aforementioned issue, the most widely used GIS is currently available. The ability to easily analyze the RS data in GIS has increased its use in various fields. These images also explore areas that are difficult to navigate and explore [9,10]. However, initially they were of low resolution and were not available in the water sector[11, 12]. Therefore, to date, there has been little research on the use of water in the water. GIS is a ground-breaking analysis of ground changes based on satellite data [13,14]. Today there are more than 300 satellites in the space, each of which has its own mission area. Existing satellites differ in their applications, such as scope, accuracy, quality and speed of data[15,16]. Sentinel 2 satellite satellites were selected to study and analyze the changes in the river bed.

The goal of choosing Sentinel 2 satellite is the following:

3. Spectral Bands and Resolution

The MSI measures reflected radiance through the atmosphere within 13 spectral bands. The spatial resolution is dependent on the particular spectral band:

- 4 bands at 10 meter: blue (490 nm), green (560 nm), red (665 nm), and near-infrared (842 nm).
- 6 bands at 20 meter: 4 narrow bands for vegetation characterization (705 nm, 740 nm, 783 nm, and 865 nm) and 2 larger SWIR bands (1,610 nm and 2,190 nm) for applications such as snow/ice/cloud detection or vegetation moisture stress assessment.
- 3 bands at 60 meter: mainly for cloud screening and atmospheric corrections (443 nm for aerosols, 945 nm for water vapor, and 1375 nm for cirrus detection).

Table 1. SENTINEL-2 Radiometric and Spatial Resolutions

Band Number	Central Wavelength (nm)	Bandwidth (nm)	Spatial Resolution (m)
1	443	20	60
2	490	65	10
3	560	35	10
4	665	30	10
5	705	15	20
6	740	15	20
7	783	20	20
8	842	115	10
8a	865	20	20

9	945	20	60
10	1375	30	60
11	1610	90	20
12	2190	180	20
TCI	RGB	Composite	10

In this study, was used the ArcMap application of ArcGIS software. At first Sentinel 2 Satellite images were downloaded for free from GloVis US official website. Although there are several sites where satellite images can be downloaded, their usage status is different. Each site has its own requirements for its use. The Global Visualization Viewer (GloVis) is an Internet application launched by USGS, with the ability to easily download all satellite images of the United States. The United States Geological Survey (USGS) was founded March 3, 1879. USGS is an organization that provides RS data, which is important for monitoring ecosystems and natural health, natural factors, natural resources, climate and changes in the Earth's surface. USGS collects, monitors, analyzes and conducts scientific analyzes of changes and problems in the state of natural resources. The ArcGIS software was downloaded and implemented using the ArcMap application to create a map of the study area. Non-invariant sediments were selected for the length of the river and the dependence of water consumption on each reservoir was determined by the width of the water level [17, 18].

4. Results

Based on the created map, was identified the shoreline with the danger of flooding, and the trend was reversed over time (Figure 1, 2).

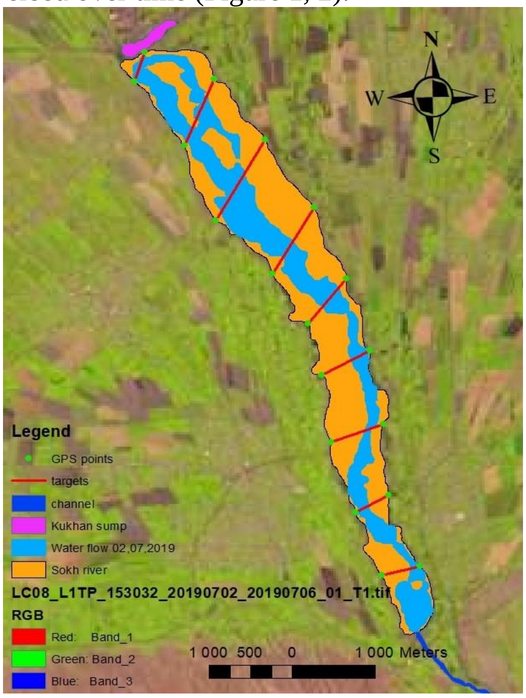

Figure 1. Condition of the Sokh Riverbank (July 2)

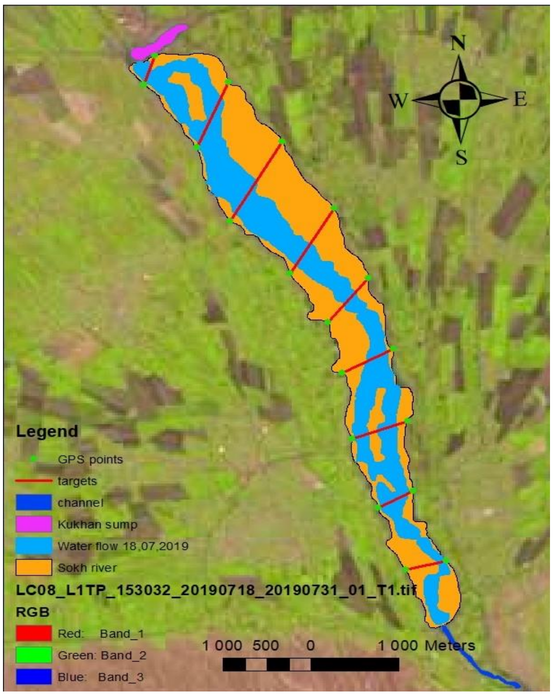

Figure 2. Condition of the Sokh Riverbank (July 18)

From the above picture, it can be seen that on July 2 (water consumption 80 m3 / s) the main flow is almost along the river, and on July 18 (water consumption 89 m3 / s) the main flow is moving along the left bank. Similar fluctuations in stream flow along the length of the river can be observed in each picket. For example, in PC 40 it can be seen that the flow has changed its movement within 16 days. It can be observed that between PK 80 and PK 90 the flow has changed its course. In the PC-52 section of the stream, the main stream was flowing along the right bank. This flow caused the right coast to be washed off the PC-48-PC-55 interval during the year. Washing is happening on the right bank. This has been investigated and analyzed on the spot. It was observed that 500 meters of the right bank washed, 6 meters inland (Fig. 3).

Figure 3. PC-52 right bank

Figure 4. PC-22, PC-50 coast washing process

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Based on the created maps, one can see PC-22 and PC-50 and their banks (Fig. 4). In this section, the main flow moves along the right bank, and the velocity in this section is relatively high, with a relatively small width of free surface of water flow (Fig. 5).

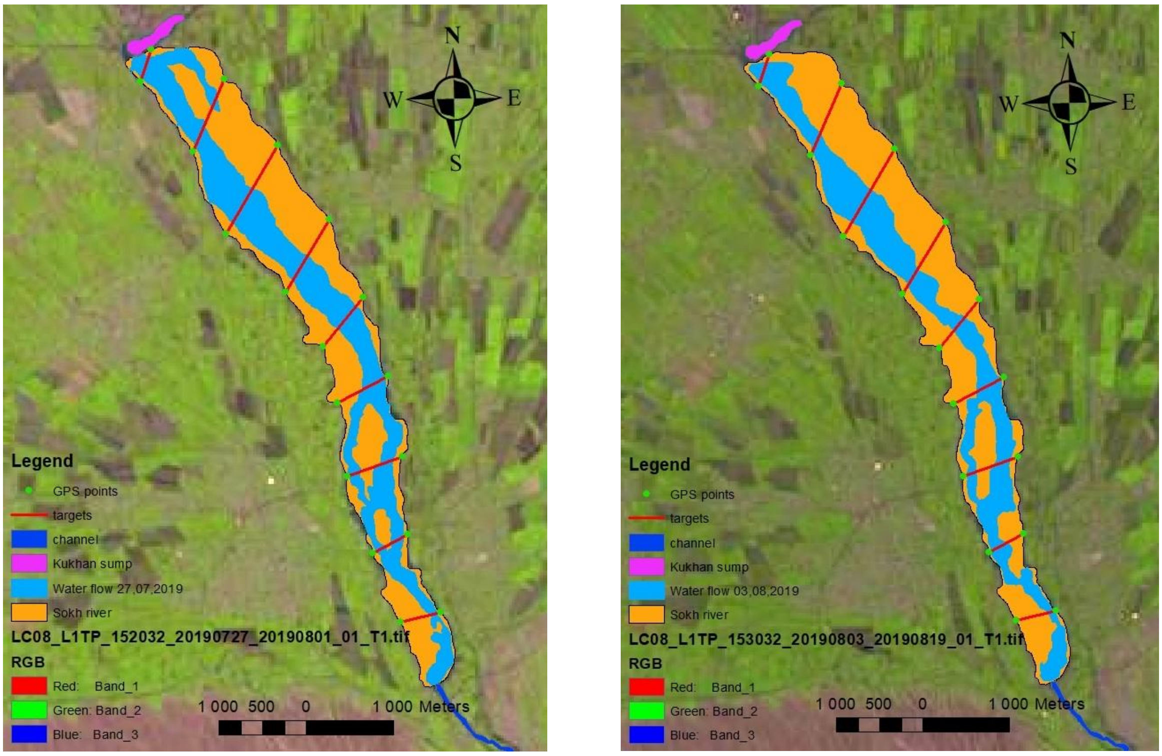

Figure 5. Flow condition in July 27 and August 3

For each picket, created a relation graph of water level with width (Q = f (B)). It can be seen that with the increase with increasing of water consumption to a certain extent, after one can seen decreasing the width of the water level. On the other hand, we can observe the trend of decreasing water levels as water consumption increases [19,20]. As a result, it is possible to estimate erosion and accumulative processes in the rivers due to the interdependence of water consumption and water level (Fig. 6).

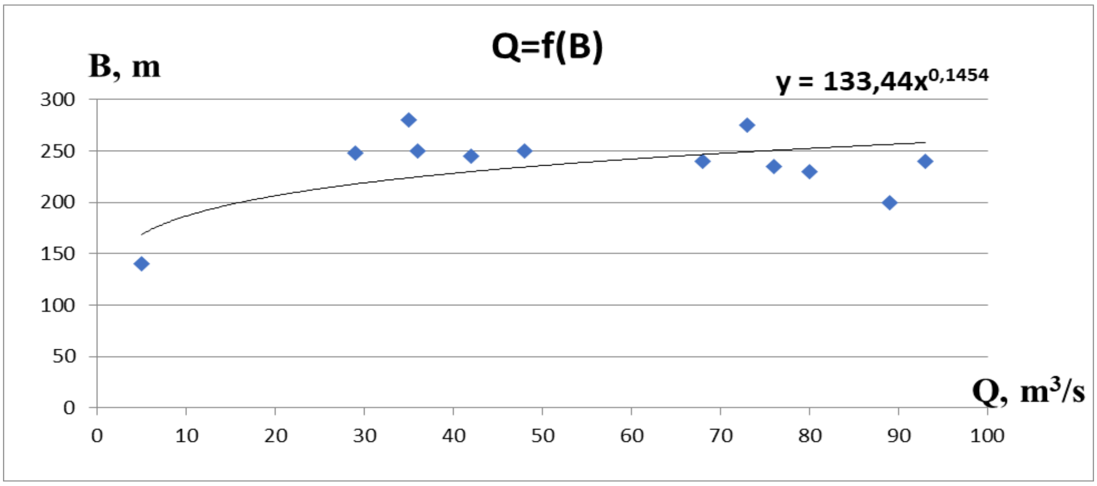

Figure 6. Graph Q = f (B) for part PC-92

5. Conclusions

In the field research, a map of the research site was developed using GIS technologies. On the basis of the compiled map, the graph of Q = f (B) is based on the width of the water level for each picket. It can be seen that with the increase in water consumption to a certain extent, the width of the water level increases. On the other hand, we can observe the trend of decreasing water levels as water consumption increases. The result is that it is possible to estimate erosion and accumulation processes in the rivers due to the interdependence of water consumption and water level. The graph shows that the width of the water level is not linear. As the sediments that are moving in Through the above link, it will be possible to determine whether it is erosion and accumulation in the rivers.

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