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Satbayev University

# Х А Б А Р Л А Р Ы

# ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

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# DETERMINATION OF THE RUNOFF CHARACTERISTICS OF THE YESIL RIVER BASIN BASED ON GIS TECHNOLOGIES

**Abstract.** The article examines the effectiveness of GIS-technologies in Kazakhstan for determining and clarifying hydrographic characteristics (e.g. catchment area, river length, location, lakes and reservoirs), the analysis of hydrological processes and phenomena, as well as the creation of a cartographic and attributive database of water bodies. Yesil River, the main waterway of the central and northern part of Kazakhstan, is one of the least hydrologically studied catchments in the region. To address this research and information gap data was obtained from remote sensing and runoff depth based on the Kazhydromet network for the period 1945 to 2016. A topographic and river network map (1:1,000,000) of the Yesil River basin, including locations of gauging stations as well as depth and runoff coefficient maps were created using ArcGIS software. These maps provide a very useful tool for water resource management and economic policy decision making.

**Keywords:** ArcGIS, hydrological modelling, Yesil river, water resource management.

**Introduction.** Currently, the geographical sciences are adopting and developing a range of new geoinformation technologies (GIS-technologies), which have enormous capabilities to represent, analyze and model geographic objects and phenomena compared to traditional methods.

Now it is possible to use modern information technologies in the creation of cartographic and thematic databases, especially through the development and implementation of geographic information systems (GIS) with different hierarchical level and territorial coverage. [1]. The cartographic method has been used in hydrology since the first half of the last century, and is based on creating and using maps that reflect the spatial characteristics of hydrological data. However, this method has not been widely used in Kazakhstan due to the complexity and time consuming nature of manual cartographic analysis. The cartographic method has again become more widely adopted in hydrology for spatial data processing as the result of the development of new computer technologies [2].

GIS is a powerful tool in the study of water resources, including watershed delineation and morphometric analysis [3]. Digital elevation models (DEMs) are widely used to determine topographic characteristics, which are among the key requirements for obtaining hydrological, river network and terrain attributes. Also, the hydrological characteristics of arid basins and drainage systems can be modelled using DEM. In hydrological studies, DEM is often used to determine river network, catchment area and the morphometric characteristics of a drainage basin [4]. Morphometric analysis of a drainage basin is a quantitative description of a basin and an important aspect to know the character of the basin [5]. The Shuttle Radar Topographic Mission (SRTM), because of its global coverage of the Earth's surface with acceptable accuracy supports DEM, is widely used for watershed delineation distribution and hydrological studies [6].

To be found in the works aimed at the possibility of GIS technology application in hydrology and the fundamental hydrological characteristics of the Yesil River basin [7,8,9,10,11,12], etc., and most of these works address the issues of GIS technology application in case of insufficient hydrological data, determination of hydrological characteristics of reservoirs, graphic and cartographic display of hydrological information.

**Justification of the topic choice. Aims and objectives.** Defining and specifying the hydrological characteristics of a river basin using a GIS has significant advantages, including data processing capabilities, new versions are available for online download, and it is publicly available.

This study explores the use of GIS-technology for cartographic representation of hydrological data of the Yesil River basin. The Yesil River, Kazakhstan, is located at 50°38′05" N, 73°11′41″ E and 55°23′15" N, 69°21'46" E. The length of the river is 2450 km, the catchment area is 177 000 km$^2$, including the active basin area of 141 000 km$^2$[13]. The Yesil River, which is the main waterway of the central and northern part of Kazakhstan, belongs to a hydrologically understudied area.

**Literature review and methodology of scientific research.** Using GIS-technologies in hydrological studies begins with the choice of the cartographic base of the investigated area. Base map of the area can be obtained from the following pages: https://earthexplorer.usgs.gov/, https://earthdata.nasa.gov/, http://www.sasgis.org/sasplaneta/. In the process of work, https://earthexplorer.usgs.gov was selected from the above pages. To download a base map, click on the link provided and mark the desired area on a geographical map of the Earth's surface. To select and download digital elevation properties, the GMTED2010 digital map was chosen from the Digital Elevation parameter of the Data Sets function and all images displayed in the Results function were downloaded.

The ArcGIS software was chosen as the software tool, which has all the main advantages of any instrumental GIS. These include input and editing of graphic information, automatic generalization, spatial and practical analysis using overlay operations, use of a different scale of information material, creation and manipulation of thematic databases with the possibility of spatial reference to geographical objects, creation of thematic maps and in the end obtaining a finished cartographic product. GIS technologies allows the determination of the hydrographic characteristics of water bodies, such as catchment area, river length, number of tributaries, the order of their location, the area of lake and reservoirs, as well as mapping of water bodies and their basins at a given scale quickly and with maximum accuracy.

In ArcGIS, the images are combined when the selected area includes several images and other territories and then study area is clipped. The images are added to ArcMap and transferred from the Data Management Tools in the ArcToolbox to the Raster Dataset of Raster tools. The Raster Dataset is an organized array of pixels that can be one or several bands. This tool group offers tools to copy, add and create raster data. The Mosaic to New Raster tool can combine several raster datasets into a new raster dataset. The Raster Processing toolset in the Raster tool group facilitates data manipulation, one of which is clipping. This Clip tool cuts out a portion of a raster dataset, mosaic dataset, or image service layer (figure 1).

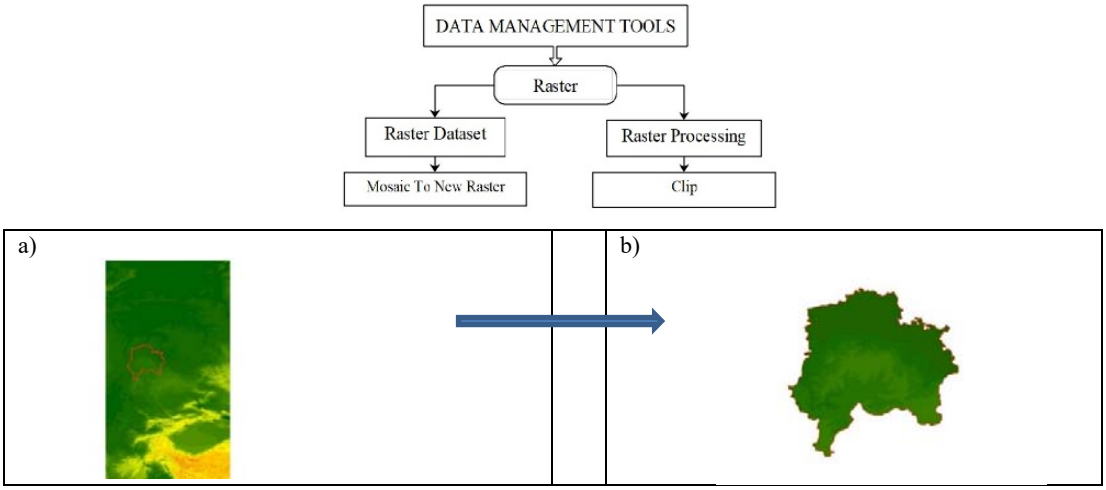



Figure 1 – (a) Data Management Tools model; (b) A cropped image of the Yesil River water basin

**Research results and discussion.** The ArcGIS program has produced a map at scale 1: 1000000, including the location of gauging stations that provide information on the physical, geographical and statistical hydrological characteristics of the Yesil River Basin (figure 2), as well as digital maps of the middle depth and flow module (figure 4).

During the production of the map, the watershed of the Yesil River catchment, as well as lakes and reservoirs were presented in polygon format. The objects created in this way allow the display of the shape and size of the basin, and the rapid calculation of areas. The layer of rivers is represented as a linear object and is optimal for determining the length of the river and the number of tributaries. It was carried out using two methods: traditional and computer technology. The gauging stations were specified as a point object and enables the relative distance between stations, the distance from the river mouth or the source to be calculated.

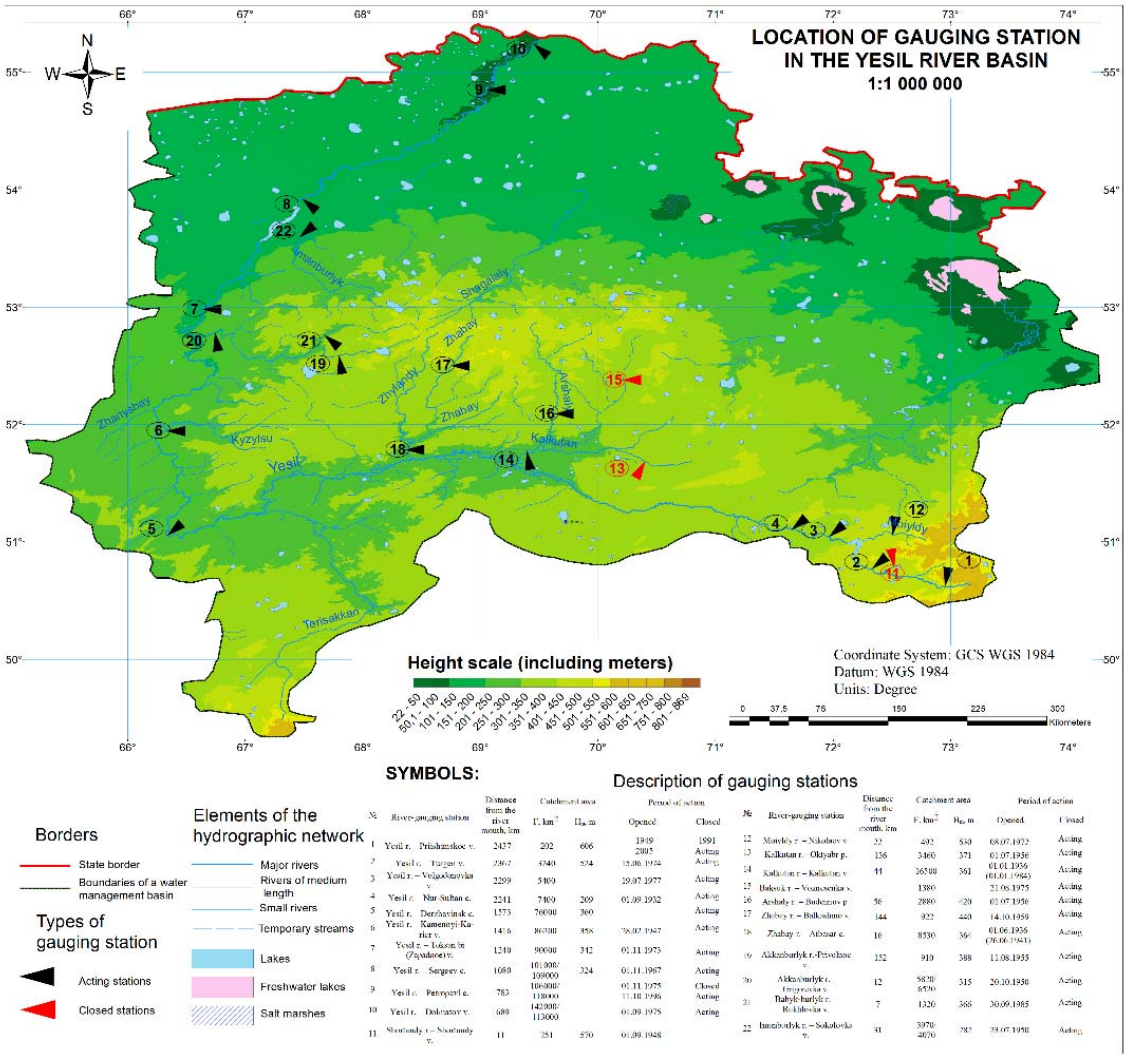



Figure 2 – Physiographic and hydrological map of the Yesil River basin

The hydrological series of runoff from the Yesil River basin has been compiled from publications of the Kazhydromet network 1945 to 2016 (Surface water resources of virgin and fallow lands areas. Akmola region of the Kazakh SSR. - Hydrometeoizdat, 1959; The main hydrological characteristics. Basin of the Yesil River. - 1963-1980; State Water Cadastre of the Republic of Kazakhstan. Long–Term Data on the Regime and Resources of the Land Surface Waters. Part 1. Rivers and Canals. Issue 1. Basins of the rivers Irtysh, Ishim, Tobyl (upstream) - Almaty, 2004; State Water Cadastre of the Republic of Kazakhstan. Annual Data on the Regime and Resources of the Land Surface Waters. Rivers and canals. - 2000-2016).

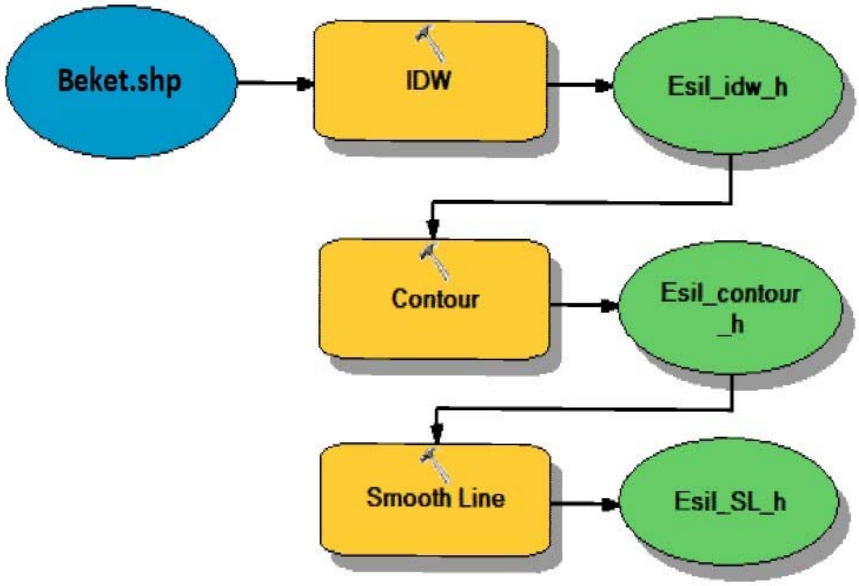



Figure 3 – Diagram of the geo-processing model created in the additional program ModelBuilder

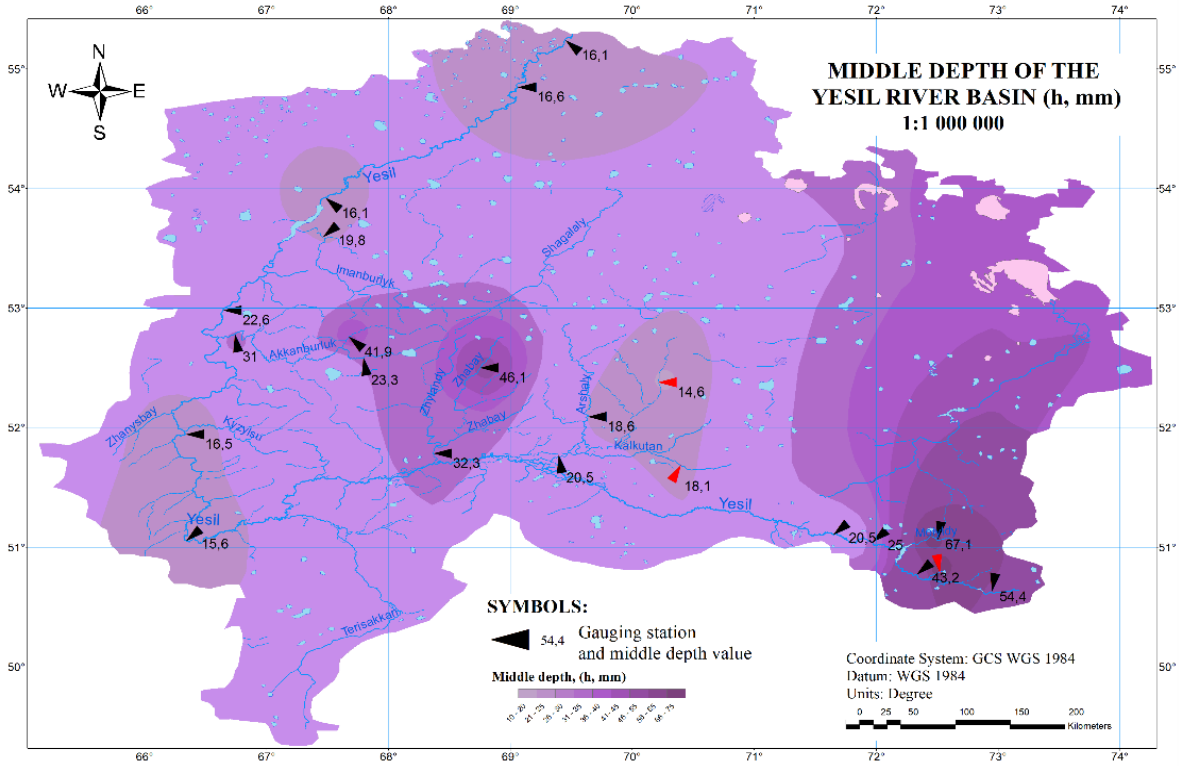
Measurement of hydrological parameter values using traditional methods for objects and phenomena observed at each point of the study object is time consuming and extremely difficult. However, using new information methods, it is possible to predict values that can be assigned to all territories.

A digital map of the distribution of the runoff and the flow module of the Yesil River basin was produced using GIS technology. The map was created with the assistance of ModelBuilder application, which allows creating a geo-processing model in the ArcGIS system. A group of Interpolation tools was selected from Spatial Analyst Tools. It creates a continuous (or predicted) raster surface from values measured at reference points. A raster surface from points is interpolated using an inverse distance weighted (IDW) technique. This IDW tool is used for visualization and numerical expression of terrain forms. To create a class of contour objects on the raster surface from the Surface tool group, select the Contour tool. To improve visual and cartographic quality of lines and smooth corners Smooth Line tools from Generalization tool group of Cartography tools was used (figure 3).

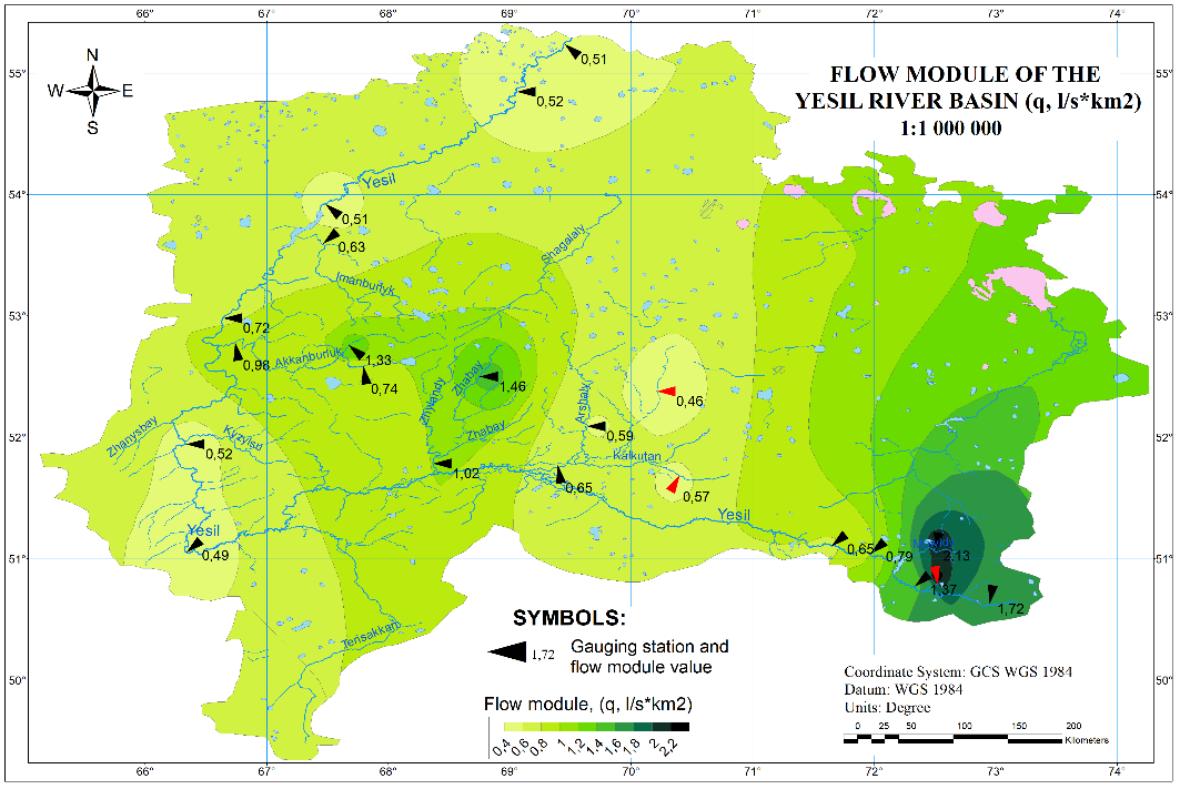
One of the capabilities of GIS-technologies in hydrological research is to create a predicted map of possible hydrological characteristics at all points (territories) of the investigated area using observation data at hydrological stations. In ArcGIS program, by clicking the Identify button at any point (area) of the forecast map, within a very short time in the Identify window it can see the value of the expected middle depth at this point. The water regime map clearly shows the quantitative runoff characteristics and their distribution of the space.

The values of middle depth and flow module at 22 hydrological stations in the Yesil River basin were taken as a hydrological characteristic in the research (figure 4). It should be noted that using statistical methods in hydrology, the values of insufficient series of observation data H, mm were reconstructed using annual average runoff data [14]. This is because the density of the relationship between the mean annual runoff data and the middle depth was high, and proof of this is also stated in [15]. As a result, using the formula [16] of the middle depth data, a multi-year flow module of the Yesil River basin gauging stations (1945-2016) was calculated.

The change in the values of the river basin's middle depth in recent years was compared with previous research works (table). Published data for the 1960s and given for the reporting period 1945-2016 as a result of the comparison revealed that the deviation of the middle depth values (h, mm) in the river basin ranged from +6.02 to -12.1%. In general, it is noted that the values of the middle depth have increased in recent years. At the same time, one can notice that the variability of the coefficient of variation has decreased from -6.59 to -32.9%.




A)




B)

Figure 4 – (A) digital map of the distribution of the middle depth and the (B) flow module of the Yesil River basin

The Yesil River runoff depth parameters' (of calculation period 1945-2016) comparison with the data [17,18,19]

| No. | River-gauging station | Data [17,18,19] | | Calculation period , 1945-2016 | | Deviations of parameters of the reporting period (1945-2016) from data [17,18,19], % | |
|---|---|---|---|---|---|---|---|
| | | h, mm | $C_v$ | h, mm | $C_v$ | h, mm | $C_v$ |
| 1 | Yesil r. – Udarnoe v. | 49,3 | 0,99 | 54,4 | 0,81 | +9,37 | -22,2 |
| 2 | Yesil r. – Nur-Sultan c. | 23,0 | 0,97 | 20,5 | 0,91 | -12,1 | -6,59 |
| 3 | Yesil r. – Kamennyi-Karier v. | 13,5 | 1,13 | 16,5 | 0,85 | +18,1 | -32,9 |
| 4 | Yesil r. – Petropavl c. | 15,6 | 1,09 | 16,6 | 0,83 | +6,02 | -31,3 |
| 5 | Kalkutan r.– Kalkutan v. | 10,6 | 1,08 | 20,5 | 1,08 | +97,7 | – |
| 6 | Zhabay r. – Atbasar c. | 19,7 | 0,92 | 32,3 | 0,76 | +39,0 | -21,0 |
| 7 | Akkanburlyk r.–Vozvyshenka (Grigorevka) v. | 17,0 | – | 31,0 | 0,68 | +45,1 | – |
| 8 | Imanburlyk r. – Sokolovka v. | 15,6 | 1,02 | 19,8 | 0,90 | +21,2 | -11,7 |

In figure 4, the middle depth and flow module of the Yesil River basin are not evenly distributed. It shows that the middle depth values (h) are within the range 15.6-73.1 mm, the flow module (q) is within the range of 0.46-2.13 l/s·km$^2$. And this is explained by two main characteristics - physical and geographical features of the area of the study with an uneven distribution of the middle depth and flow module.

**Conclusion.** Utilization of geo-information technologies in hydrology is ideal for identifying, gathering and analyzing many hydrographic characteristics, modeling hydrological processes and phenomena, as well as for solving many applied tasks. By using these capabilities, water bodies can be rapidly studied and quantified, as demonstrated in this study through the modelling catchment surface runoff.

The hydrological assessment of the Yesil River basin with the assistance of GIS-technologies can be used in water management and planning, as well as by water industry practioners for flood risk assessment and the design of hydraulic structures.

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## ГАЖ ТЕХНОЛОГИЯЛАРЫ НЕГІЗІНДЕ ЕСІЛ ӨЗЕНІ АЛАБЫНЫҢ АҒЫНДЫСЫНЫҢ СИПАТТАМАЛАРЫН АНЫҚТАУ

**Аннотация.** Мақалада гидрографиялық сипаттамаларды (су жинау алабы, өзендердің ұзындығы, олардың орналасу реті, көлдері мен су қоймалары және т.б.) анықтау және нақтылау, гидрологиялық процестер мен құбылыстарды талдау, сондай-ақ әртүрлі гидрологиялық ақпаратты қамтитын су нысандары мен олардың алаптарының картографиялық және атрибутивтік деректер базасын құру үшін ГАЖ-технологияларын қолданудың тиімділігі қарастырылған. Қазақстан Республикасының орталық және солтүстік бөлігінің негізгі су артериясы болып табылатын Есіл өзені гидрологиялық тұрғыдан аз зерттелген аймаққа жатады. Осы ғылыми-ақпараттық олқылықты жою үшін қазгидромет желісі негізінде 1945-2016 жылдар аралығында қашықтықтан зондтау және ағынның тереңдігі деректері алынды.

Нәтижесінде бағдарламалық құрал "ArcGIS" негізінде масштабы 1:1 000 000 болатын Есіл өзені алабының физикалық-географиялық және бекеттердің орналасу картасы, сонымен қатар алаптың ағынды қабаты мен ағынды модулінің карталары жасалды. Бұл карталар су ресурстарын басқару және экономикалық саясат саласында шешім қабылдау үшін өте пайдалы құрал болып табылады.

**Түйін сөздер:** ArcGIS, гидрологиялық үлгілеу, Есіл өзені, су ресурстарын басқару.

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# ОПРЕДЕЛЕНИЕ ХАРАКТЕРИСТИК СТОКА БАССЕЙНА РЕКИ ЕСИЛЬ НА ОСНОВЕ ГИС-ТЕХНОЛОГИЙ

**Аннотация.** В статье рассматривается эффективность применения ГИС-технологий в Казахстане для определения и уточнения гидрографических характеристик (например, площади водосбора, длины рек, местоположения озер и водохранилищ), анализа гидрологических процессов и явлений, а также создания картографической и атрибутивной базы данных водных объектов. Река Есиль, главная водная артерия центральной и северной части Казахстана, является одним из наименее гидрологически изученных водосборов региона. Для устранения этого научно-информационного пробела были получены данные дистанционного зондирования и глубины стока на основе сети Казгидромета за период с 1945 по 2016 год. С помощью программного обеспечения ArcGIS была создана топографическая и речная сетевая карта бассейна реки Есиль (1:1 000 000), включающая расположение гидрометрических станций, а также карты глубин и коэффициентов стока. Эти карты являются очень полезным инструментом для управления водными ресурсами и принятия решений в области экономической политики.

**Ключевые слова:** ArcGIS, гидрологическое моделирование, река Есиль, управление водными ресурсами.

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**REFERENCES**

[1] Kalinin V.G., Piankov S.V. Some aspects of the application of geographic information technologies in hydrology // /Meteorology and hydrology. December 2000 (in Russ.).

[2] Orlova V.E. Application of GIS technology to obtain hydrological characteristics of the catchment of the Vilyuy reservoir // Geography and natural resources. 2008. P. 134-138 (in Russ.).

[3] Nadia Ahmed Aziz, Zaidoon Taha Abdulrazzaq, Marwa Nagim Mansur GIS based watershed morphometric analysis using DEM data in Diyala river, Iraq // Iraqi Geological Journal. 4 February 2020. 53. P. 36-44.

[4] .Hancock G.R., Martinez C., Evans K.G., Molire D.R. A comparision of SRTM and high-resolution digital elevation models and their use in catchment geomorphology and hydrology: Australian examples. Earth Surface Processes and Landforms. 2006.

[5] Ismaylova L.A., Guliyeva S.Y. Morphometric analysis in GIS based of relief parameters mudflow basins // News of the National academy of sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2019. No. 4. P. 128-126. ISSN 2518-170X (Online), ISSN 2224-5278 (Print). https://doi.org/10.32014/2019.2518-170X.106

[6] Bhang K.J., Schwartz F. Limitations in the hydrologic applications of C-band SRTM DEMs in low- relief settings // IEEE Geoscience and Remote Sensing Letters. 2008. P. 497-501.

[7] Chen J., Hill A.A., Urbano L.D. A GIS-based model for urban flood inundation // J. Hydrology. 2009. 373. P. 184-192.

[8] Mussina A.K., Zhanabaeva Zh. A GIS-technology in the management of mudflow risk // KazNU Bulletin. Geography series. 2016. 42. P. 141-146.

[9] Orlova Elena Viktorovna. Development of information support for monitoring of water bodies on the basis of the GIS technology. China:0 GIS & RS in Hydrology. Water Resources and Environment, 2003.

[10] Borsch S.V., Samsonov T.E., Simonov Yu.A., Lviv E.A. Visualization of the hydrological situation in the basins of large rivers by means of GIS technologies. ResearchGate, 2013 (in Russ.).

[11] Moldakhmetov M.M., Makhmudova L.K. The main hydrological characteristics of the rivers of the Yesil basin. Taraz, 2018. P. 156 (in Russ.).

[12] Yakovchenko S.G., Postnova I.S., Zhorov V.A., Lovtskaya O.V., Dmitriev V.O. Zoning of the territory according to the degree of danger and assessment of flood risks using GIS technologies // Computational technologies. 2006. Vol. 11 (in Russ.).

[13] Medeu A.R. Water resources of Kazakhstan: assessment, forecast, management // River runoff resources of Kazakhstan. Renewable surface water resources of Western, Northern, Central and Eastern Kazakhstan. Almaty: Parasat, 2012. Vol. VII (in Russ.).

[14] Duskayev K.K., Mussina A.K., Ospanova M.S., Bazarbek A.T. Calculation of characteristics maximum flow of the river basin Yesil // Questions of geography and geoecology. Almaty, 2019. P. 44-55 (in Kaz.).

[15] Chigrinets A.G., Arystambekova D.D. Assessment of the runoff characteristics of the spring flood of the lowland rivers of Kazakhstan using the example of the river basin. Yesil // Hydrometeorology and ecology. 2017. P. 62-74 (in Russ.).

[16] SP-33-101-2003. Determination of the main design hydrological characteristics. M.: Gosstroy of Russia, 2004 (in Russ.).

[17] Surface water resources of virgin and fallow land development areas. Akmola region of the Kazakh SSR. L: Hydrometeoisdat, 1958. Vol. I. P. 790 (in Russ.).

[18] Surface water resources of virgin and fallow land development areas. Kokchetav region of the Kazakh SSR. L.: Hydrometeoisdat, 1959. Vol. III. P. 562 (in Russ.).

[19] Surface water resources of virgin and fallow land development areas. North Kazakhstan region of the Kazakh SSR. L.: Hydrometeoisdat, 1960. Vol. V. P. 420 (in Russ.).

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