د بست

علمي او څېړنيزه مجله

کال	ګڼه	ټوک
۱۴۰۲	لومړی	دوهم

بسم الله الرحمن الرحيم

بُست علمي او څېړنيزه مجله

بُست پوهنتون

دوهم ټوک – لومړی ګڼه

کال – ۱۴۰۲

بُست علمی او څېړنیزه مجله
بُست پوهنتون

د امتیاز خاوند: بُست پوهنتون

مسؤل مدیر: پوهنمل دوکتور ناصر ضیا ناصری

کتنپلاوی:

ډیزاین: د بُست پوهنتون دخپرنیزو او فرهنګي چارو مدیریت

د خپرولو کال: ۱۴۰۲

پته: بُست پوهنتون، لښکرګاه،هلمند، افغانستان

د بُست پوهنتون د رئیس پیغام

په ننې ژوند کې د یوې علمي مؤسسې یو له مسؤلیتونو څخه دا دی ، چې نه یواځې خپل محصلان د پوهې په ګانې سمبال کړي، بلکې د پوهنتون د لوړو زده کړو لرونکو پوهانو او استادانو د علمي زیرمتون څخه داسې څه وخت په وخت راوباسي، چې د ټولنې د ژوند د اړتیاوو د پوره کولو لپاره او یا لږ تر لږه د ټولنې د لوستې قشر د خبرولو او که وکولای شي له هغوی څخه د عمل په ډګر کې د ګټې اخیستنې په موخه ، په کار واچول شي.

و دې موخې ته د رسیدلو لپاره پوهنتون باید یو داسې علمي خپرندویه ارګان ولري، چې په هغه کې د پوهنتون ټول با صلاحیته منسوبین که هغه استاد وي، که کارکوونکی او که زده کړه یال ، خپلې علمي او څېړنیزې مقالې او لیکنې د کاغذ پر مخ باندې کښیښودلای شي.

زما په شخصي آند پدې مجله کې لکه له نوم څخه چې یې ښکاري، باید داسې مسائل را برسیره شي، چې نه یواځې په پوهنتون پورې راګیر پاتې شي، بلکې په عام ډول سره د افغانې ټولنې او په ځانګړې ډول سره د هلمند ولایت د اوسیدونکو و ننې او سبا ژوند ته په کتلو سره، بریالیتونونه، ستونزې ، وړاندیزونه او د حل لارې-چارې ، وړاندې کړل شي.هغه وخت به د بُست پوهنتون علمي مجله یواځې د بست پوهنتون نه، بلکې د ټول هلمند ولایت ، آن د سیمې او ټول افغانستان په کچه د پوهې او څېړنې په برخه کې د وخت د غوښتنو سره سم ، د پاملرنې وړ او و ځوان نسل ته د یوې سمې لارې د ښودلو په موخه ، یوه محبوبه او پر زیاتو خلکو باندې ګرانه مجله وي او په ټول هیواد کې به خپل مینه وال ولري.

دا مجله به د بُست پوهنتون د مشرتابه، استادانو ، محصلانو ، فارغانو او ټولو مینه د علمي او څېړنیزو مقالو د خپرولو لپاره که هغوی د پوهې په هر ډګر کې چې وي، یو خپرنیز ارګان وي،چې و خپریدلو ته به یې ټول مینه وال په تمه ناست وي.څومره به پرځای او ښه خبر وي، چې د ټولنې لوستی قشر په تیره بیا د بست پوهنتون محترم استادان ، فارغ شوي او بر حاله محصلان د علمي او څېړنیزو مقالو و لیکلو ته و هڅول شي.

زه د بُست پوهنتون د ټولو منسوبینو په استازیتوب ویاړ لرم ، چې د بُست پوهنتون د علمې مجلې د خپریدلو له امله د محترم مؤسس، محترم علمي مرستیال او د څېړنې له محترم آمر او همدا رنګه د مجلې له ټولو کارکوونکو او پرسونل څخه د زیار او زحمت په ګاللو سره چې مجله یې و خپریدلو ته چمتو کړې ده ، مننه او قدرداني وکړم، ټولو ته د زړه له کومې مبارکي وایم او هیله لرم چې د بُست پوهنتون د علمي مجلې کارکوونکي به خپل رسالت د پوهنتون او ټول هلمندې ولس او په اخرې تحلیل کې د ټول افغان ملت پر وړاندې په پوره او ټینګ عزم سره سرته ورسوي.

په درنښت

ډیپلوم انجنیر محمود سنګین

د بُست پوهنتون رئیس

سریزه

بُست پوهنتون ویاړ لري چې د خپل علمي پرمختګ په لاره کې يې يو بل ډير مهم او اړين ګام پورته کړ او هغه د بُست د علمي او څېړنيزي مجلې د دوهم ټوک، لومړی ګڼه خپرېدل دي . تر هر څه دمخه د پوهنتون ټولو استادانو، محصلانو او د علم او پوهې د لوی کور مينه والو ته د بُست د علمي او څېړنيزي مجلې د خپرېدلو مبارکي وړاندې کوم او ددې سره جوخت د ټولو ملګرو څخه چې ددې مجلې د جواز په تر لاسه کولو، ترتيبولو او خپرولو کې يې نه ستړې کېدونکې ونډه اخيستې ده د زړه له کومې مننه کوم.

د علمي کور کهول او اړوند کسانو ته ښکاره ده او پوره باور لري چې د ننني نړۍ هر اړخيزه پر مختګ د پوهانو د علمي څېړنو د زيار له برکته ممکن سوی او د لوړو زده کړو مؤسسې، اکادميک انستيتوتونه او څېړنيز علمي مرکزونه پکښې مرکزي او پريکنده رول لوبولی دی.

همدې اصل او ارزښت ته په کتو سره بُست پوهنتون غواړي د پرمختللو اکاډميکو نورمونو په رعايت د تدريس، علميڅېړنو او نوښتونو له لارې مسلکي کادرونه وروزي او د معياري تحصيلي اسانتياوو او زمينو په برابرولو سره د ټولنې ځوانانو ته معياري او د لوړ کيفيت لوړې زده کړې وړاندی او د علميڅېړنو پر بنسټ د کره پوهنيزو اثارو د توليد زمينه برابره کړي ، ترڅو د لوړو زده کړو او مسلکي پوهې په ډګر کې د ګټوړو مهارتونو په تر لاسه کولو او د خپلو ښتينو اهدافو په لاسته راوړلو سره د ټولنې او هيواد په پرمختګ او رغونه کې رغنده ونډه واخلي او د ښتيني خدمت جوګه شي.

ژمن يو چې د هلمند ولايت، ګاونډيو ولايتونو او په ټول هيواد کې ځوان نسل ته د اسلامي ، ملي او کلتوري ارزښتونو په رڼا کې معياري د علمي او مسلکي لوړو زده کړو او پراخو علمي څېړونو زمينه برابره او ټولني او هيواد ته ژمن او روزل سوي کادرونه وړاندي کړو.

د اوس لپاره د بُست علمي او څېړنيزه مجله يوازي د **سائينسي علومو** په برخه کې علمي او څېړنيزي مقالي او ليکني د چاپ او نشر د تګلارې سره سم مني او خپروي او هيله مند يو چې په راتلونکې کې به نوري برخي هم ور زياتې کړل سي.

ډاډ لرم چې د بُست پوهنتون استادان، محصلان او علمي کارمندان به انشأالله، نن، سبا او په راتلونکې کې د خپلې علمي څېړنيزي مجلې د خپرولو له لارې خپل دغه دروند خو ويارلی دين (پور) ادأ کړي. همدا ډول ټولو د علم او پوهې څښتنانو او مينه والو ته په مينه سره بلنه ورکوو چې ددی علمي او څېړنيزي مجلې او د بُست پوهنتون د پرمختګ په لاره کې خپلې علمي او څېړنيزي ليکنې، آندونه، وړاندیزونه او رغنده نيوکې او مرستې د تل په شان راولوروی او د علم ددې ستر کور په ودانولو کې د خپلې دينې، او ملي برخې د ادايې ويار راوبخښی.

مور هوډ کړيدي او هيله مند يو چې انشآ الله د وخت په تيريدو سره به د خپل هيواد و بچيانو او ځوان نسل ته د تدريس ، ښه روزنې او څېړنيز هاند لپاره اړيني او د پام وړاسانتياوي برابري کړو تر څو په لومړي پړاو کښې خپلو هلمندوالو بيا د سهيل لويديځې حوزې او په پای کښې و ټولو هيوادوالو ته د يو داسې چوپړ مصدر وګرځي چې زمور د ځوريدلي اولس او ويجاړشوي هيواد اقتصادي، فرهنګي، سياسي او ټولنيزي ستونزي حل او افغانستان د نړۍ د پرمختللوهيوادونو په ليکه کې ودريږي.

لړليک

Rainfall-Runoff Modeling of Arghandab River Basin in Afghanistan

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Abstract

Water as the fundamental needs of life is very important for various purposes viz, domestic, agriculture, industrial, recreational, etc. while, other factors, population growth, urbanization, economic growth, globalization of trade, climate change and variability are the various driving forces on water force the civilization to manage the sources of water and use it in a sustainable manner. Rainfall-runoff modeling an important hydrologic technique vastly used in water resources development and management is very important for both gauged and ungauged watersheds. Soil map, Climate data, DEM image and Land use/Land cover map are the main data that has used in the SWAT for runoff estimation of this river basin. The values of R^2 for calibration period is 0.86, it indicates a good correlation between observed and simulated value. The NSE for the calibration period is 0.81 that demonstrate a good performance the model. PBIAS is -6.51 for a model that indicates around 6% accepted overestimation from the observed value. After the adjustment of sensitive parameters in the calibration, the calibrated parameter has run on the model for another period for which runoff data is not available. 34-years monthly basis runoff from the year 1981 to 2014 has generated at the outlet of the basin (Qali-I-Bust). The results suggest that the SWAT hydrological model will be a useful tool which can produce significant catchment surface-runoff predictions to aid water management decision.

Key words: land cover, soil map, sensitive parameters, and surface runoff.

Introduction

Water at a place is nature's valuable gift that sustains life on the earth preserve the prime requirement for the existence of life and thus it has been humankind's effort from time immemorial to utilize the available water resources. History has instances of civilization that flourished with the availability of dependable water supplies and then collapsed when the water supply failed (Subramanya, 2005). Under urbanization development, land cover and land use have been changing from permeable to impermeable resulting in reduction of groundwater recharges and increase in surface runoff. These variations affect water storage of the watershed, the nature of runoff and the hydrological response of the watershed. Two kinds of overflow are normally generated: infiltration excess and saturation excess depending on runoff mechanism. The infiltration excess or Hortonian flow occurs when rainfall intensities exceed the rate at which water can infiltrate into the soil, while saturation excess runoff is generated when rainfall encounters soils that are approximately saturated or fully saturated. Saturation excess runoff is considered the main mechanism for a runoff in areas having a humid climate as well thick vegetation and permeable soil" (Singh, 2009). Mostly, hydrological study for a watershed is based on the long-term observed flow at its outlet. For catchments, having no or limited records of flow, the hydrological response of the watershed is difficult (Toronto et al., 1997).

1-1 Objectives of the Study

The main objective of the Rainfall-Runoff modeling for Arghandab river basin is reorganization of the hydrological system in order to provide reliable instruction for managing water resources in a sustained method to support the managerial process about the future development of the water resources in this River basin. Therefore, the objectives of the present study are:

1) To examine the applicability of SWAT model in Arghandab river basin.
2) To estimate surface runoff for the Arghandab river basin for around 34 years on monthly basis for water resource assessment, planning and development, and management.
3) To calibrate Arc-SWAT model parameters with a small data set of observed runoff data of the Arghandab River.

1-2 Application of Remote Sensing and GIS in Hydrologic Modelling

GIS and Remote sensing data have a crucial role in the development of water resource and dynamic with advancement in technology. Public accessibility to the data that is need for hydrological modeling by GIS, improve the importance and usage of the techniques. Land used/land cover, soil type, and climate data are the key parameters and have a most important role in rainfall-runoff. The greatest advantage of using remotely sensed data for hydrological modeling is its talent to generate instruction in the spatial and temporal domain (Jagadeesha, 1999). Remote sensing and GIS applied by Tan et al. (2001) for assessment of runoff coefficient in irrigated regions, they specified that remote sensing and GIS are excellent tools for acquiring and organizing spatially distributed data.

1-3 Rainfall-Runoff Modeling based on Arc-SWAT Technique

Land use and land cover (LULC) is an essential parameter of the runoff process that affects infiltration, erosion, and evapotranspiration. Aeronautical Reconnaissance Coverage Geographic Information System (Arc-GIS) software commonly used in practice to simulate water and sediment fluctuations in watersheds, SWAT and Hydrologic Engineering Center Geospatial Hydrologic Modeling (HEC-GeoHMS) are main Arc-GIS tools that can be used for surface runoff modeling.

Ghoraba and Shimaa (2015) successfully applied the SWAT hydrological model for Simly Dam watershed located in the Saon River basin at the northeast of Islamabad. For simulation of streamflow, establish the water balance, and estimating the monthly volume of Simly Dam. Its outcomes shown that properly calibrated SWAT model can be used efficiently in the semi-arid region to support water management policies.

1-4 Site Description

Afghanistan, a mountainous landlocked nation within in Central Asia is neighbored by Tajikistan, Turkmenistan, and Uzbekistan to the north, Iran in the west, Pakistan in east and south with poorly marked Durand Line border, and it has a small stretch of border in northeast with China. It has five major river basins such as Amu Darya, Northern, Harirod-Murghab, Helmand and Kabul. However, Afghanistan is not able to utilize properly its water potential due to lack of comprehensive strategic plans related to water issues. The Helmand River basin is one of five main river basin in Afghanistan that is located in the south of the country. Arghandab river basin is the main tributary of Helmand basin, and it is one of the most important areas of agriculture in the south zone. Its geographical coordinates are latitudes 30.39 to 33.57 N and longitudes 64.25 to 69.34 E as illustrated in the Fig. 1. Arghandab River by itself has three sub-tributaries such as, Dori, Arghastan, and Tarnak rivers. Tributaries viz. Tarnak, Dori, and Arghastan rivers are intermittent rivers, in which water flows only in winter and spring season or when a storm occurs. Civilization in the Arghandab river basin has been facing several problems such as inefficient life facilities like (transportation system, least access to education, no electricity, limited health centers, etc.), water shortages, interwar and lack of security. The main problems of the Arghandab River basin related to the water resources can be summarized as follows;

a) Due to no-managements, even the basin is faced with water scarcity, a huge quantity of surface water is lost per year.
b) Lack of storage structures and no existence of dams to capture the rain floods during the rainy season in order to use later.
c) Conflict among the people related to use of water generally during the summer, due to lack of proper irrigation systems.
d) In addition, Water pollution is an ongoing problem from surface water in some particular locations due to non-care with municipality waste.

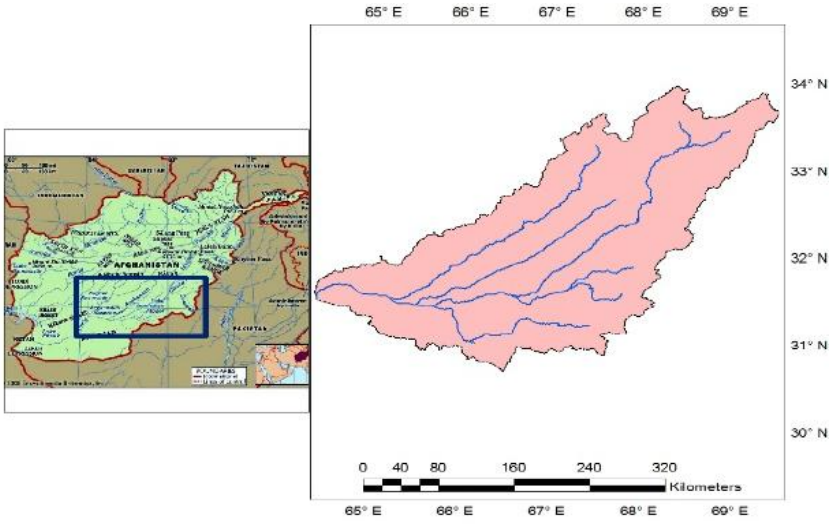


Fig. 1: Location of Arghandab river basin with its various tributaries

1-5 Model Description

1-5-1 Soil and Water Assessment Tool (SWAT)

SWAT is a theoretical/hydrological model that works on daily, and monthly time steps. The main objective of the improvement of the SWAT model was to calculate the effect of sediment transport, water quality, and its management in large gauged/ungagged basins. The SWAT model is based on the principles of the water balance (arnold al., 1998).

$$SWt = SW + \sum_{i=1}^{t}(R_d - Q_s - E_e - W_{se} - Q_r)$$

Where SWt is the soil water content at time t, SW is the initial soil water content, t is the time in days. R_d is the daily rainfall, Q_s is the quantity of surface overflow, E_e is the evapotranspiration, W_{se} is the volume of water entering the unsaturated zone (contains of the infiltration degree minus the capillary growth), and Qr is the volume of flow that return. All units that are used in this equation in mm.

1-5-2 **Surface Runoff**

The SWAT model provides two approaches to estimate surface runoff; the Soil Conservation Service (SCS) curve number (CN) (SCS-CN) method (USDA SCS, 1972) and the Green & Ampt infiltration (1911) method. The SCS-CN method is a simple predictable and theoretically constant method for assessment of direct runoff depth, which depends on only CN. "It is a well-established method, having been widely accepted for use in the USA and many other countries (Subramanya, 2005)". The surface runoff volume predicted in SWAT using the SCS – CN method. The SCS – CN equation is:

$$Q_s = \frac{(R_d - 0.2S)^2}{(R_d + 0.8S)} \quad (2)$$

$R > 0.2S$

Where Q_s is the daily surface runoff, R_d is the rainfall depth for the day, and S is retention parameter, all unit used are in mm. The overflow will occur when $R_d > 0.2S$, the retention parameter S is different due to changing water content in soil, The parameter S is associated to curve number (CN) by the SCS equation (USDA-SCS, 1972).

$$S = 254\left(\frac{100}{CN} - 1\right) \quad (3)$$

Where CN is Curve Number and the constant 254 is used to express in mm.

$$CN = {}^{25400}/_{(S + 254)} \quad (4)$$

Moreover, Curve number has a range of $100 \geq CN \geq 0$. A CN value of 100 symbolizes a situation of zero potential retention, while CN zero value characterizes a situation of an extremely abstracting catchment with, $S = \infty$.

Material and Method

2-1 DEM Data

Advanced Space born Thermal Emission and Reflection Radiometer (ASTER) digital elevation model (DEM) of 30-meter resolution is download from https://earthexplorer.usgs.gov/. DEM is a generic term for the digital cartographic representation of the elevation of the land at regularly spaced intervals in x, y and z directions. All forms of DEM data are useable to model and analysis the earth's topography in three-dimensions

2-2 Soil Data

The soil data are required to define soil characteristics, attributes, and is another important aspect that has extremely affect the runoff response of a catchment. Unfortunately, there is no specific soil map available for the study area; therefore, world soil map was the only one option to use for this study. ISRIC- World Soil Property Estimates for Broad-Scale Modeling (WISE30sec) soil data has been used for the study area.

2-3 Land Use/Cover Data

Land cover is a composition of the characteristics of the elements that cover the land surface such as (urban, transportation, residential, water, forest, agriculture etc.). Composed elements of land use/land cover do not remain constant that illustrate the contact of humankind with the environment, these changes have an important effect on the hydrological cycle. The European Union Global Environmental Monitoring land use/land cover data, which was prepared in the period December 2004 to June 2006, have used in this study.

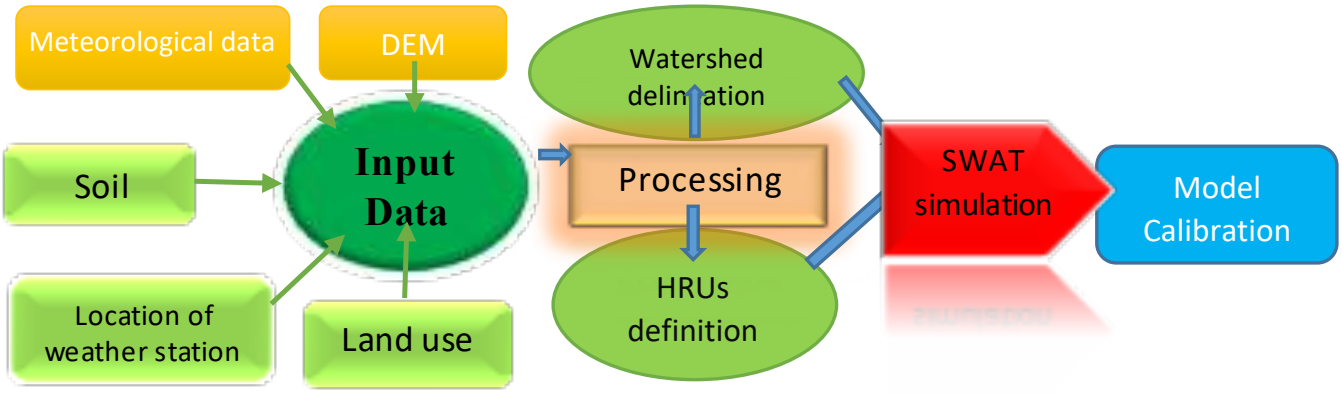
2-4 Meteorological Data

Generally, no long-term metrology records of the Afghanistan are available, after 1979 all metrological center in the country either destroyed or stopped. Recently few meteorological stations have been installed in some parts of the country. Afterward in the year 2010, two meteorological stations are installed in the Arghandab river basin, in the Tarnak Farm and Inside University of Kandahar campus. The global weather data, which has 36 years records and freely available has been used for this study

2-5 Calibration and Validation

The fourth and last one is the calibration and validation stage; to know whether the simulated runoff is validated or not, observed data is needed to compare with the simulated data. SWAT-CUP software is used to calibrate the simulated runoff and to define the most sensitive parameters of the catchments. Fig. shows working procedure of SWAT.

Fig. 2: Sub-watersheds of the Arghandab River basin shown in different colors



2-6 SWAT Model Set-Up and Data Processing

2-6-1 Watershed Delineation

Digital Elevation Model (DEM) defines the topography of the watershed, it has used to calculate basin parameters such as the boundary of sub-basin, slope, stream order, and to define the stream networks. For the present study from SWAT model, Arghandab River basin's area, perimeter and length have been found as about 76,583 km2, 3037 km and 829 km respectively. The elevation of the basin ranges from 735 m to 4584 m high above sea level. The entire watershed is segmented in a total number of 21 sub-watersheds depending on the topographic characteristics as given in Fig. 3.

2-6-1 Land Used and Soil

The soil and land cover make important responding units and the same are accomplished by SWAT model by subdividing the watershed into areas having a unique land use, soil and slope combination, which is called as Hydrological Response Units (HRU). The European Union Global Environmental Monitoring land use/land cover map that has 23 different classes was a clip for the study area. Eleven major classes identified for the entire

watershed is shown in Fig. 4.

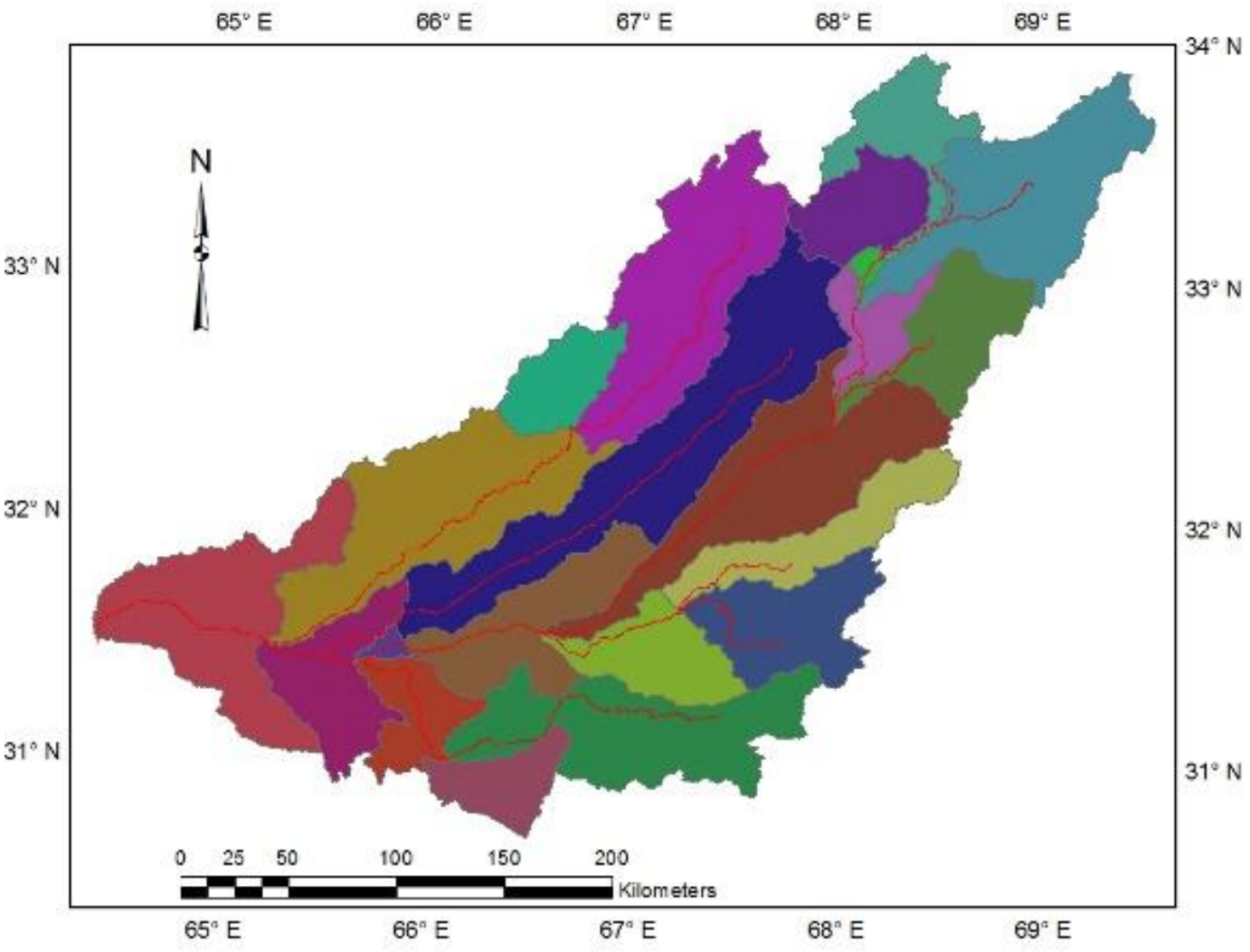


Fig. 3: Sub-watersheds of the Arghandab River basin shown in different colors

As illustrated in the Fig. 13, barren land covers most of the area around 71.5%, but water covers only 0.01% area, while agriculture is covering 1.52% of area. Orchard, Forest evergreen, Forest-Mixed, Pasture, Range-Grasses and Urban cover 8.06%, 0.005%, 2.07%, 7.59%, 8.52% and 0.75%, respectively. The soil is one of the most important aspects that has a direct impact on the watershed response. ISRIC- World Soil Property Estimates for Broad-Scale Modeling (WISE30sec) has been used and it illustrates that the Arghandab River basin has seven different soil classes such as NELLIS, MACHIAS, CARDIGAN, MADAWASKA, WEIDER, WILMINGTON and SUN. Six of these soil groups, which cover around 99.7% of the total area, are from B group soil, and seventh soil group, which cover 0.3% of the total area, belongs to D group soil as shown in Fig. 5.

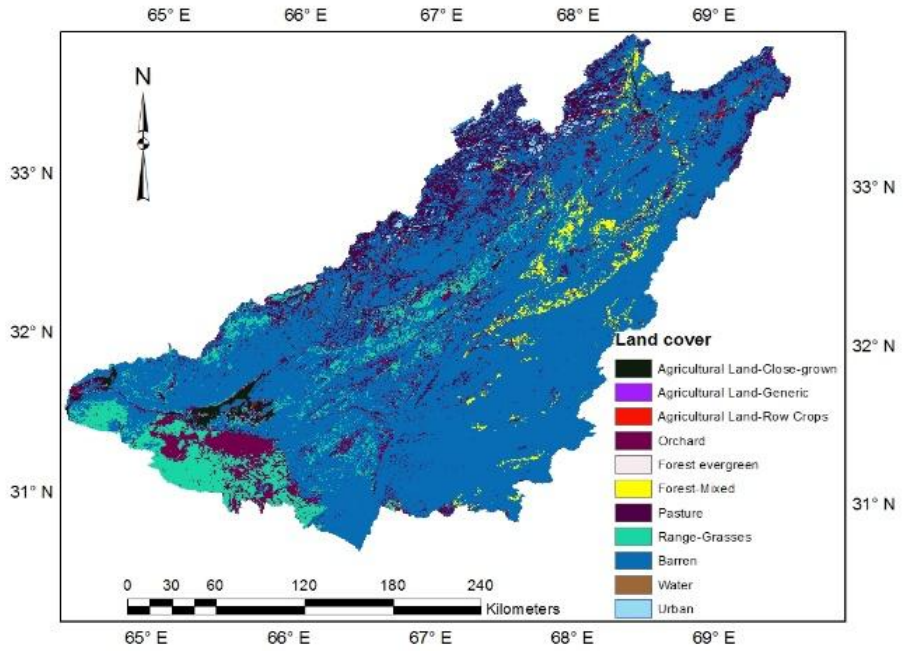


Fig. 4: Land use/Land cover map of the Arghandab River basin

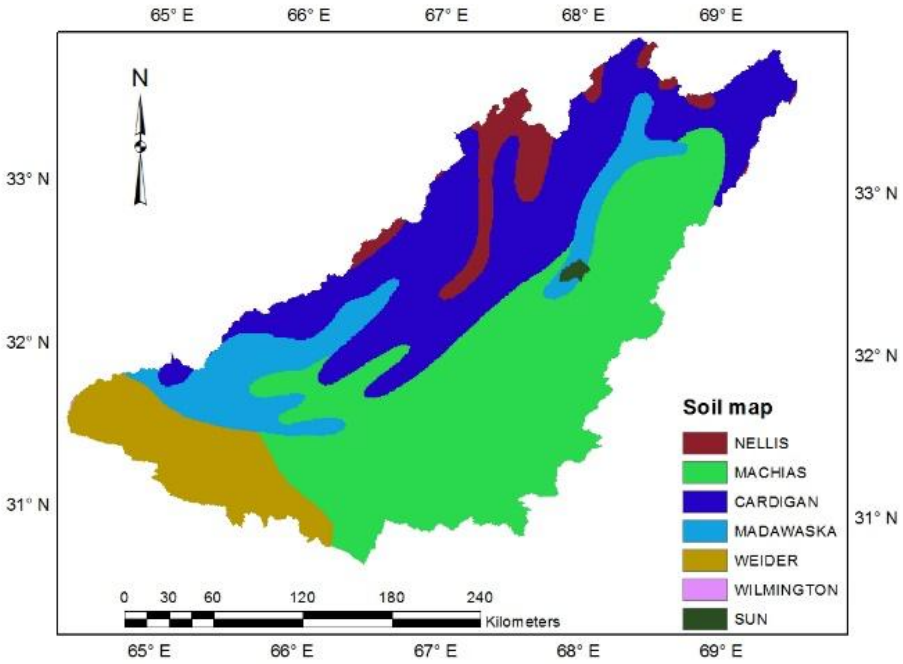


Fig. 5: Soil Map of the Arghandab River basin

2-6-1 Model Calibration and Validation

Calibration is an effort to optimally estimate parameters a model to a given set of local conditions, thereby reducing the prediction uncertainty of the models (Perry et al, 2014). For this research, SWAT-CUP software used for sensitivity analysis of the model, moreover, two years stream flow record from 1979 to 1980 at the outlet point of the basin was use for calibration of simulated runoff. The description ranges of the parameters for the considered catchment have been given in Table 1. Validation describes as a process of representative a given site-specific model is capable of making sufficiently accurate simulations, although sufficiently accurate results can vary based on the project goals (Arnold et al., 1998). Validation is a re-running simulation process of adjusted parameters in calibration process as input data, without any changing for a different time series.

Table 1: The parameters that have used for sensitivity analysis for Arghandab River basin

NO	Parameters	Description	Unit	Range
1	CN2.mgt	Curve number condition 2	-	35-90
2	ALPHA_BF.gw	Base flow recession constant	day	0-1
3	CH-K2	Effective hydraulic conductivity in channel	mm hr^{-1}	-0.01-500
4	SOL_K () sol	Saturated hydraulic conductivity	mm hr^{-1}	0-2000
5	CH_N2.rte	Manning coefficient for channel	-	-0.01-0.3
6	GW_DELAY.gw	Ground water delay time (d)	day	0-50
7	SOL_AWC (...).sol	Soil available water capacity	mm mm^{-1}	0-1
8	ESCO hru	Soil evaporation compensation factor	-	0-1
9	GW_REVAP.gw	Groundwater Re-evaporation coefficient	-	0.02-0.2
10	GWQMN.gw	Threshold water level in shallow aquifer for base flow	mm	0-5000

Results and Discussion

This chapter deals with the results obtained by the methodology that has discussed in the previous chapter. Runoff modeling with SCS-curve number method by making use the remote sensing and Arc-SWAT performed to simulate direct runoff. Moreover, other input parameters such as water area, land use/cover, soil, curve number and initial abstractions were analyzed and determined by SWAT.

3-1 Calibration

Physically based distributed watershed models must be calibrated before they are used in the simulation of the hydrologic response in order to decrease the uncertainty of the model predictions. Runoff estimation for the Arghandab River basin has done

by Arc-SWAT. The basin has further divided into 21-sub basins in order to increase the accuracy of the model. Two-year calibration from 1979 to 1980 has done for the model based on the comparison of the simulated runoff with the observed streamflow record at the outlet of the Arghandab River basin (Qali-I-Bust). The monthly streamflow record of Qali-I-Bust water-gage station that was active from October 1, 1947, to September 30, 1980, has been used for this study as shown in Fig.21. The most sensitive input parameters of model have been changed several times in the calibration phase to achieve the sensible agreement between observed and simulated runoff. The model efficiency and correlation between observed and simulated stream flow has been checked by three different statistical methods such as, Coefficient of Determination (R^2), Nash–Sutcliffe Efficiency (NSE) and Percent Bias (PBIAS). Calibration has been stopped, after attaining equitable stream flow from the model for the study area, the same value of hydrological parameters that, has been adjusted during the calibration was used for another 34-years to estimate surface runoff for the Arghandab river basin. The validation has not been done due to lack of observed streamflow record as discussed earlier to evaluate the performance of the model with calibrated parameters to simulate the hydrological operation of the watershed over another time that has not been used in the calibration phase.

3-2 Runoff Estimation beyond year 1980

After the sensitive parameters adjusted in the calibration, the calibrated parameter values have been used to run on the model for another period that has not been run before. 34-years monthly basis runoff has been estimated for the Arghandab River at the outlet of the basin (Qali-I-Bust) as illustrated in Table 2. The stream flow hydrograph of the Arghandab River basin indicates that the discharge of this river has been reached to the peak point within the years of 1998 to 1999, while it reached to the lowest point within the years of 2001 to 2002 for this specific period of estimation as illustrate in Fig. 6. Overall, the hydrograph shows that the discharge of this river basin has been slightly decreased year by year.

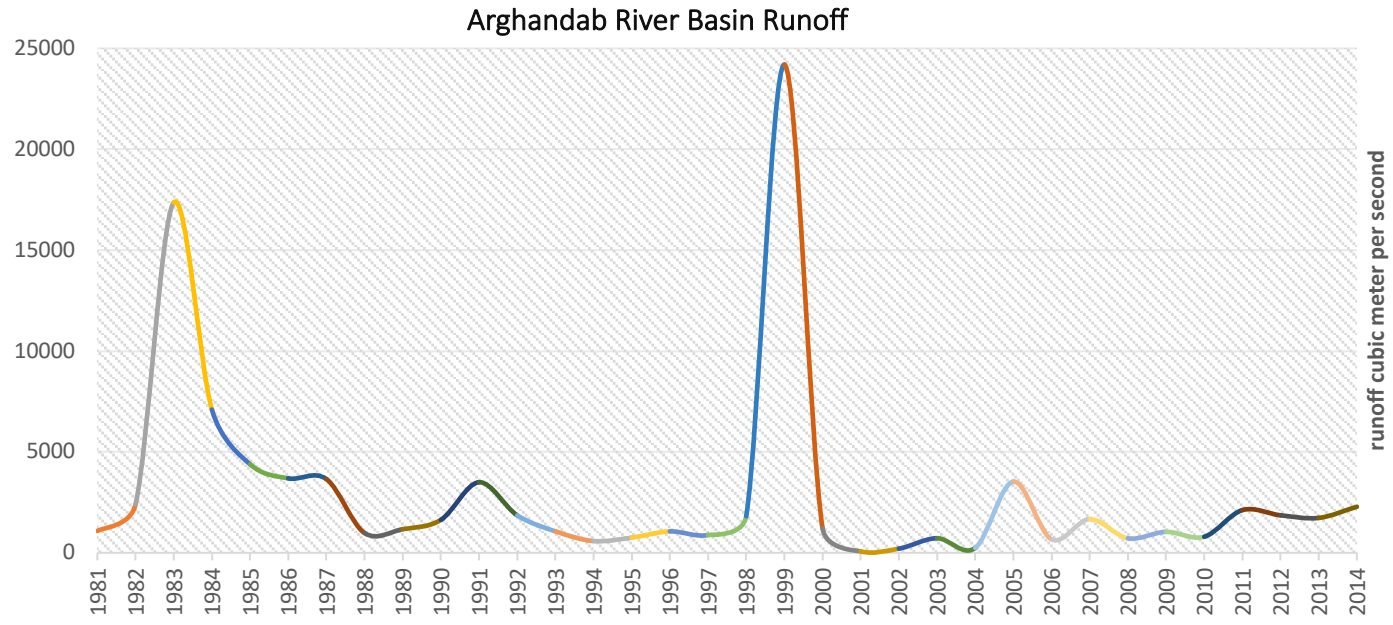


Fig. 6: Yearly basis hydrograph of the Arghandab river basin

Table 2: Monthly stream flow of the Arghandab river basin for 34-year

Runoff of Arghandab River Basin of 30-Years												
Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	159.5	130	432	324	30	0.3	0	0	0	2.5	0.66	2.1
1982	94.5	405	754	822	73.9	22.9	15.2	9.8	3.6	104.4	91.8	0.14
1983	42.4	205	422	1164	72	43.7	31.4	103	5830	7133	1049	1260
1984	1175	1000	1593	875	589	465	412.7	255	197.3	183	168	187
1985	173	148	203	169	78	0	3487	82.9	0	16	5.43	25
1986	49.4	154	514	645	96	45.3	0	88	0.1	0.9	54.1	2042
1987	488	543	1138	362	398	229.3	114.9	80.8	58.6	74.8	70.7	96
1988	190	128	544	54	0.9	0	0	0	0	0	0.1	63
1989	41.1	70.6	807	134	18.4	3.6	0.03	0	0.1	0.23	10.4	83
1990	175	378	704	171	53.8	6.9	0	0	0	0.8	25.5	116
1991	469	440	981	1195	105	67.5	49.5	33.5	26.7	27.4	46.1	56
1992	115	132	420	872	65	31.8	18.3	8.4	6.1	16.2	14.4	157
1993	153	102	335	446	19	1.5	0.1	0.12	0	0.33	2.3	4.4
1994	56.9	65.8	363	46.6	0.6	0	17.5	0	0	0	0.1	29
1995	11.3	16.4	237	260	15	0.4	108.2	0.26	0	3.8	0.58	98
1996	33.7	81.4	818	104	18.5	2	0	0	0	0.65	0.76	2.2
1997	49.7	8.6	375	239	85.2	2.1	0	0	0	47.4	22.9	49.9
1998	156	115	779	692	37.4	15.8	3.8	0.5	0.24	3.02	5.1	6.3
1999	3662	8257	3598	2143	1250	1177	1021	862	723	604.5	501.3	400
2000	360	282	248	118	46	29.3	9.9	3.1	6.5	11.8	28.7	68
2001	24.2	24	16	0.67	0	0	0	0	0	0	0	8.1
2002	5.3	44	47.6	37	0	0	0	0	0	0	27.5	44.5
2003	30	206	431	11	0	0	0	0	0	0	43.9	0.01
2004	66.2	0.4	7.3	0	0	0	0	0	0	0.21	5.	161
2005	118	319	1754	42	1276	0.02	0	0	0	0.4	13.9	7.7
2006	74.2	215	45.6	7.6	0	0	0.01	0	0	0	142	182
2007	39.7	379	791	337	21.4	66.5	7.6	0.34	0.42	2.5	4.2	20.7
2008	170	89.5	262	86	0	0	0	0	0	0	0	107
2009	263	299	121	250	10.1	3.2	0	0	0	1.3	6.5	85
2010	46.4	525	125	14	18.6	0	1.3	41.4	0	21.5	0.5	0.21
2011	33.4	956	759	291	4.3	0.1	0	0	3.4	7.6	60.6	2.3
2012	92.5	282	617	663	40	3.5	0	0	12.7	1.9	29	117
2013	91.4	467	770	205	48	9.8	2.5	17.8	0.17	1.7	107	8.4
2014	24.4	209	658	1066	260	37.3	27.3					

Conclusion

Characteristic and quantity of surface runoff depend on the magnitude and intensity of rainfall as well as on the morphometric parameters of the watershed. In the present study, an effort has been made to estimate 34-years surface runoff, as well as to comprehend the morphometric parameters of the Arghandab river basin that has a significant effect on the hydrological response of the basin.

Arghandab River basin, which has area of about 76,583 sq.km, and one of the most important agriculture lands in the south of the Afghanistan. The conclusions of this research have been mentioned below.

1) ISRIC (WISE30sec) world soil map has been used which indicates seven different soil types, six of these soil groups, which cover around 99.7% of the total area, are from B group soil, and seventh soil group, which cover 0.3% of the total area, belongs to D group soil. European Union Global Environmental Monitoring land use/land cover map is clipped for the study area and eleven major classes are identified for the entire watershed of which barren area covers about 71.5% of the total land.
2) Three recommended statistical coefficients namely, NSE, R^2 and PBIAS have been used to evaluate performance of the model. The values of R^2 for calibration period is 0.86, indicating good correlation between observed and simulated runoff. The NSE for the calibration period is 0.81 that is more than 0.75 and showing very good performance. Moreover, the value of PBIAS is -6.51 for the model that indicates around 6% overestimation from the observed value.
3) The adjusted sensitive parameters have been run in SWAT model for 34-years from 1981 to 2014 to estimate monthly basis runoff of the Arghandab River at the outlet point of the basin (Qali-I-Bust).
4) The hydrograph illustrates that stream flow of the Arghandab River for this specific period of estimation has reached two times to very high peak in the years of 1983 and 1999. While minimum flow outlet is in the years of 2001. It indicates that Arghandab river basin has been suffered two times from flood and once from drought in this period.
5) The results suggest that the SWAT hydrological model will be a useful tool which, once calibrated effectively, can produce significant catchment predictions to aid management decisions. The results gained indicate that catchment output simulated by SWAT are good.

Recommendation

1) For runoff modeling, soil, land use/land cover and climate data have a crucial role in the output result of the model. Therefore, the usage of country basis soil, land use/land cover map and climate data of the specific meteorological center in the basin for the future works will increase the accuracy of the model.
2) Sediment is another and very important issue associated with watershed management, so the division of the Arghandab river basin into sub-basin relative to their topography condition, SWAT can effectively use in order to know which part of the basin is more suffering from soil erosion or sediment transport.

Due to the current situation of the Afghanistan, runoff modeling based on SWAT software is the best option to estimate the surface runoff for all river basins of the country, especially for the period where there is no observed record of that river. It will be more helpful for related agencies; at least it will give an idea for the policy makers.

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په افغانستان کي د ارغنداب سيند سطحي بهير ماډل کول

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لنډيز

اوبه د ژوند د بنسټيزو اړتياوو په توګه د مختلفو موخو لکه کورني، کرني، صنعتي، تفريحي او نورو لپاره خورا مهمه ماد ده. په داسې حال کي چې نور عوامل، لکه د نفوس وده، ښاري کېدل، اقتصادي وده، نړواله سوداګري، د اقليم بدلون د اوبو مختلف فشارونه دي چې تمدن دې ته اړوي چې د اوبو سرچينې اداره کړي او په دوامداره توګه يې وکاروي. سطحي بهير يو ډير مهم هايدرولوژيکي متغير دی چې د اوبو د سرچينو په ډيری فعاليتونو کي کارول کيږي. د مختلفو هايدرولوژيکي معلوماتو د نشتوالي له امله، دا تخنيکونه په اغيزمنه توګه د اوبو ماډل کولو لپاره کارول کېدای سي، د مطالعې اوسنۍ موخه د ارغنداب په فرعي حوزې کي د جريان ماډل کول ده، چې شاوخوا 76,583 کيلومتره مربع ساحه يې پوښلې ده. د خاوري نقشه، ځمکې د پوښښ نقشه، د اقليم معلومات اود DEMانځور هغه اصلي معلومات دي چې په SWAT کي د دې سيندیزي حوزې د جريان اټکل لپاره کارول سوي دي. د تنظيم دورې لپاره د R2 قيمت 0.86 دی، دا د مشاهده سوي او ورته سوي قيمت ترمنځ ښه اړيکه په ګوته کوي. د تنظيم د دورې لپاره NSEقيمت 0.81 دی کوم چې د ماډل ښه فعاليت ښيي. د دې ماډل لپاره د PBIAS د -6.51 دی چې د ليدل سوي ارزښت څخه شاوخوا 6 سلنه د منل سوي حد ته زياتوالی ښي. د تنظيم په پروسه کې د حساس پيرامېټرو له ترتيب وروسته، ترتيب سوي پيرامېټر په ماډل کي د بلې هغې مودې لپاره استفاده سول چې معلومات يې شتون نه درلود. د کال 1981 څخه تر 2014 پورې 34 کلن مياشتنۍ بهير د ابغالي په وتوونکي نطقه (قلعي-بست) کي په لاس راغلي. د څېړنې پايلې ښيي چې SWAT هايدرولوژيکي ماډل يو ګټور وسيله وي چې يو ځل په صحيح ډول تنظيم سي کولای سي د مديريت د پريکړو سره د مرستي لپاره د پام وړ وړاندوينې وړاندي کړي.

کليدي کلمې: د ځمکې پوښ، د خاوري نقشه، حساس پارامترونه او سطحي جريان

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