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Soil and water assessment tool model for runoff reaction to land use variations by SWAT model package

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Hydro-climatic degeneracies, for example moist and dissipations, have most likely enlarged owing to climatical modification and could due to diffident possessions on socio-economic, mechanical and ecological regions. To plan and concept most hydraulic structures, e.g., dams, it is vital to regulate the runoff of the rivers. If the river absences any position to live the yield, the hydraulic mockups are frequently used to estimate it. SWAT is one of the greatest widely-applied computerized models. In this prototypical, we'd like to feed such influential climatological data as precipitation, temperature, wind speed, radiation and ratio, also as, watershed data including the Curve Number (CN) and roughness coefficient to calculate the watershed runoff. Some watershed contains few weather stations, and there is a risk that the registered data in a station do not represent the whole watershed. Consequently, the amount of the runoff estimation error needs to be determined. The obtained results indicate that with a 32.07% decrease in the average monthly precipitation, sunshine, relative humidity, wind and temperature, we witness 65.36% decrease, 116.82% increase, 46.78% decrease, 127.16% increase, and 39.52% increase in modeled runoff, respectively. The wind speed and therefore the radiation are the foremost sensitive and temperature is that the least sensitive components within the runoff approximation.

KEY WORDS: Meteorological Parameters; Rainfall Runoff; Sensitivity Analysis; SWAT model; Curve Number (CN)

Introduction

So as to shape a dam, it is energetic to regulate the monthly and annular yields of the river to compute the volume and the height of the dam (Varga et al., 2023). A gage station can measure the input water of the dam. In the nonappearance of the gage station, a computerized model, e.g., SWAT, are often want to estimate the present and therefore the input runoff. The high-tech mockups can make accurate and complex designs in a short period. So as to compute the watershed runoff on the one hand, the prototypical needs such powerful climatological information as precipitation, temperature, wind speed, solar radiation and relative humidity, and on the opposite hand we'd like the watershed basin information including the curve number and therefore the roughness coefficient (Khaleghi et al., 2011, Rabiei et al., 2022).

The same perfect was applied and verified from 1999 to 2006.Data from 2007 to 2010 was used to examineing the precision and in the together phases of confirmation and authentication the consequences were acceptable. The SWAT model keeps the ability to produce varied situations to study different decision-making issues. The obtained results indicated a higher sensitivity of the model to the over land roughness coefficient (Behtari Nejad, 2012). It was used SWAT to stimulate the river current in the Gharesar sub-basin northwest of the Karkheh River. The research showed a higher analytical sensitivity to the curve number parameter (Behtari Nejad, 2012). It was dealt with the stimulation of the daily discharge, water balance and land application in Haraz watershed. The results provided by the model were sensitive to the period, that is, the annual and the monthly periods yielded more reasonable results in comparison with the daily period (Saadati, 2003, Ghashghaie et al., 2022). Alavinia and Nasiri-saleh utilized the SWAT model to estimate the discharge and approved the efficiency of the model (Behtari Nejad, 2012, Alavinia and Nasiri Saleh, 2011).

Material and methods

The case to be studied is limited to Haraz watershed (located in Northern forests of Alborz mountain in Iran). The revision zone of this research is situated between 549,026 to 623,239 Eastern longitude and 3,926,045 to 4,012,211 north latitude in zone 40 of UTM. Haraz watershed with a zone of 401932.9 hectares is situated to the south of the area and in the locality of Amol Town. The least height of 300 meters and an extreme height of 5800 meters are the height restrictions. The area of Haraz watershed is approximately 66.81 square kilometers and the main river stretches for 16.8 kilometers. The geographical coordinates of the rivers are as follows: latitude from 36˚-06' to 36˚-15' N, and longitude from 53˚-15' to 53˚ -29' E. Fig. 1 shows the position of Haraz watershed. The mentioned statistical parameters were retrieved from Karehsang, Chelav and Razan, Panjab places. Haraz River shows a significant part in the exists of the persons of this area, particularly in their agronomic segment. The Haraz plain is located in the Mazandaran province, one of the northern provinces of Iran between the Caspian Sea and the Alborz mountains. This seaside basic is located between the Amlash and Babol rivers (Shrestha et al, 2020). The southern district of the plain is enclosed by mountains and highlands (Schuol et al., 2006). The zone covers from the Damavand peak (5675 m a.s.l.) as the highest height in the highlands to the deepest region with -25 m a.s.l. in the plain. The study zone (6850 km^2) is drained by the two foremost streams Haraz and Babolroud (Bačová Mitková et al., 2023). These stable streams instigate from the Alborz elevations and grasp the Caspian Sea after passing through forestlands, rangelands, urban zones and agronomic land in the Haraz plain. In terms of geomorphology, the Haraz plain can be

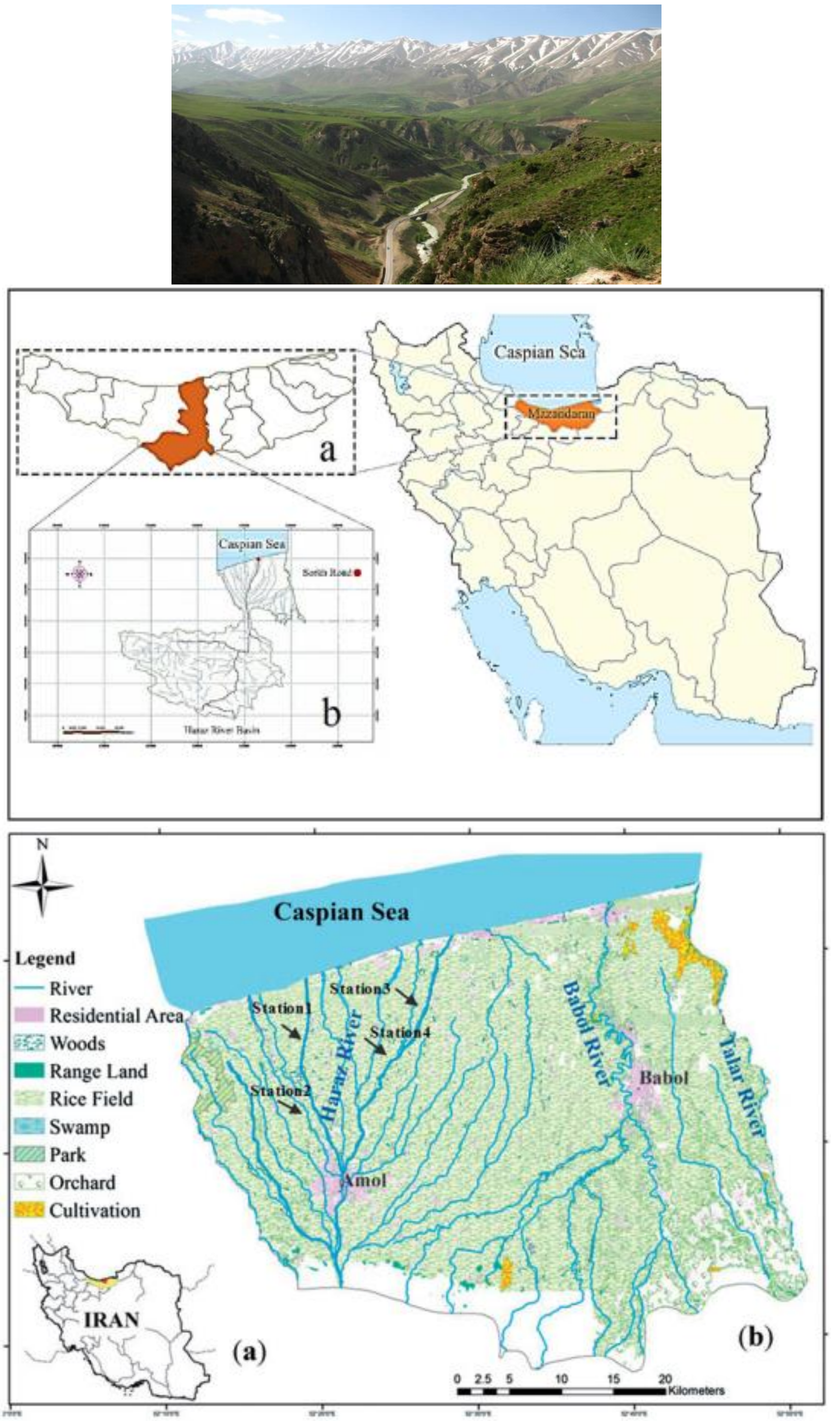

Fig. 1. Show the position of Haraz Watershed (Mazandaran Province, Iran). (Naeeji et al., 2020; Dadar et al., 2016).

confidential into six main units comprising highlands (1.25%), mountains (0.38%), piedmont plain (22.92%), stream sedimentary plain (10.52%), low terrestrial (7.32%), flood plain (52.32%) and beach low sand hills (5.82%). The Haraz natural obtains an average annual precipitation of 675 mm (850 mm in the highland watersheds) with a range of total maximum and minimum temperature among −10 to 38.3 and the mediocre annual moisture is 780% (depend on synoptic data 2000–2020 at Amol). In this plain, Haraz is the chief river with many branches and a extensively industrialised sedimentary fan. Owing to the fertile soil and available basis of superficial water and groundwater, the large quantity of the study zone is enclosed by paddy agronomy. Other foremost land routines are urbanized zones, forestry lands, rangelands, natural wetlands and fish farms. Inceptisols (58.92%), Alfisols (39.82%) and coastal sands (1.56%) are the foremost soil assemblies in the area (Ecological Defence Society, 2021). Soil, geology and digital elevation model maps for the study area are presented in accompanying information. Haraz Stream lies between longitude of 35º 536 and 45 º 62 and latitude of 35 º 463 and 36 º 163. (Mohammadi, 2023).

According to the relevant statistics, the coldest month of the year is from the middle of January to the beginning of February, and the minimum temperature occurred among the stations, according to the average of -95.8 degrees Celsius, corresponding to Haraz station was in the month of February (Amoakowaah Osei et al., 2019). The maximum temperature occurred between the climatology stations according to the absolute maximum of 38.5 degrees Celsius corresponding to Haraz station in the month of August and also according to the average maximum equivalent of 23.1 degrees Celsius corresponding to the Haraz station in the month of August which was recorded (Apostel et al., 2020). According to the available information about the monthly and annual temperature, the relationship between the average annual temperature and altitude is at a significant level of 0.01 based on equation 1. is below:

$$T = 1.68 - 0.0051H \tag{1}$$

In Eq. 1, T is the air temperature in degrees Celsius and H is the height in meters. Using relation Eq. 1, the average temperature of the lowest point of the basin in Haraz station with an altitude of about 1100 meters is approximately equal to 10.96 degrees Celsius and the average temperature of the highest point at an altitude of 3100 meters is approximately equal to 0.75 degrees Celsius (Chu and Shirmohammadi, 2004). According to this equation, the average gradient of the annual normal temperature drop in the Haraz basin is about 1.7 degrees Celsius per kilometer.

The number of SCS curve is a function of soil permeability, land application and the humidity already retained in the soil. Different types of curve number were considered for humidity condition II in diverse types of land from 69 to 78 based on the SWAT formulas tables and the optimum number for the region was obtained as 72 (SCS Engineering Division 1986, SWAT Theoretical Documentation Version 2009).

SCS runoff equation is an empirical model developed in 1950 after 20 years of studying the relationship between rain and runoff in the small American villages' watersheds. The model estimates the runoff in various land applications and different types of soil (Rallison and Miller 1981, SWAT Theoretical Documentation Version 2009).

Eq. 2 shows the curve number as follows (SCS 1972):

$$Q_{surf} = \frac{(R_{day} - I_a)^2}{(R_{day} - I_a + S)} \tag{2}$$

where Q_{surf} is the accumulated runoff or the excess of precipitation [mm], R day is the height of water per day [mm], I_a is the initial leakage of the surface reserve, the diffusion before runoff [mm], and S is the water saving [mm]. A change in saving parameter ends in changes in the type of the soil, land application, management, slope and soil content. Saving parameter is defined in Eq.3 (SWAT Theoretical Documentation Version 2009):

$$S = 25.4 \left(\frac{1000}{CN} - 10\right) \tag{3}$$

where CN is the Curve Number for day. I_a is approximately estimated as 0.25 and fed to Eq.1. to obtain Eq. 4 (SWAT Theoretical Documentation Version 2009):

$$Q_{surf} = \frac{(R_{day} - 0.2s)^2}{(R_{day} + 0.8s)} \tag{4}$$

Runoff occurs only if $R_{day} > I_a$. The graphical solutions for Eq. 4 with the numerical values of different curves are presented in Fig. 2 (SWAT Theoretical Documentation Version 2009).

Manning over land roughness coefficient value for the intended watershed region and related SWAT tables are in the range of 0.05 to 0.2. The optimum value for this region was calculated as 1 (Engman, 1983; SWAT Theoretical Documentation Version 2009).

The land current concentration time tov is calculated as Eq. 5 (SWAT Theoretical Documentation Version 2009):

$$t_{ov} = \frac{L_{slp}}{3600.v_{ov}} \tag{5}$$

where L_{slp} is the length of sub-basin slope, v_{ov} is the velocity of land current [m s^{-1}] and 3600 is the unit conversion factor. The velocity of the land current was estimated based Eq.6 or Manning equation (SWAT Theoretical Documentation Version 2009):

$$v_{ov} = \frac{q^{0.4}{}_{ov}.slp^{0.3}}{n^{0.6}} \tag{6}$$

where q_{ov} is the average of the land current (cubic meter per second), slp is the mean slope of sub-basin and n is the Manning roughness coefficient for the sub-basin. The rate of current is assumed as 6.35 [mm h^{-1}] and unit conversion was done through Eq. 7 and Eq. 8 (SWAT

Theoretical Documentation Version 2009).

$$v_{ov} = \frac{0.005.L_{slp}^{0.4}.slp^{0.3}}{n^{0.6}} \quad (7)$$

$$t_{ov} = \frac{L_{slp}^{0.6}.n^{0.6}}{18.slp^{0.3}} \quad (8)$$

A modest method to compute solar declination is:

$$\delta = \sin^{-1}\left\{0.4 \sin\left[\frac{2\pi}{365}(d_n - 82)\right]\right\} \quad (9)$$

Where δ is the solar declination testified in radians, and d_n is the day number of the year.

$$I_{SC} = 1367\, Wm^{-2} = 4.921 MJm^{-2}h^{-1} \quad (10)$$

On any given day, the extraterrestrial irradiance (rate of energy) on a surface normal to the rays of the sun, I_{0n}, is:

$$I_{0n} = I_{SC}E_0 \quad (11)$$

where E_0 is the eccentricity correction factor of the earth's orbit, and I_{0n} has the same unit as the solar constant, I_{SC}.
The extraterrestrial radiation falling on a horizontal surface during one hour is given by the equation:

$$I_0 = I_{SC}E_0(\sin\delta\sin\emptyset + \cos\delta\cos\emptyset\cos\omega t) \quad (12)$$

where I_0 is the extraterrestrial radiation for 1 hour centered around the hour angle ωt.
The temperature for the hour is then calculated with the equation:

$$T_{hr} = \bar{T}_{av} + \frac{(T_{mx}-T_{mn})}{2}.\cos\big(0.2618.(hr-15)\big) \quad (13)$$

where T_{hr} is the air temperature during hour hr of the day [ºC], $\bar{T}_{av}$ is the average temperature on the day[ºC], T_{mx} is the daily maximum temperature [ºC], and T_{mn} is the daily minimum temperature [ºC].
In SWAT, a minimum difference of 1 meter is specified for canopy height and wind speed measurements. When the canopy height exceeds 1 meter, the original wind measurement is adjusted to (Rallison and Miller, 1981):

$$z_w = h_c + 100 \quad (14)$$

where z_w is the height of the wind speed measurement [cm], and h_c is the canopy height [cm].
The variation of wind speed with elevation near the ground surface is estimated with the equation (Haltiner and Martin, 1957):

$$u_{z2} = u_{z1}.\left[\frac{z_2}{z_1}\right]^{aa} \quad (15)$$

Where u_{z1} is the wind speed [m s^{-1}] at height Z_1 [cm], u_{z2} is the wind speed [m s^{-1}] at height Z_2 [cm], and *aa* is an exponent between 0 and 1 that varies with atmospheric stability and surface roughness. Jensen (1974) recommended a value of 0.2 for aa and this is the value used in SWAT.

$$R_{day} = \mu_{mon} + 2.\sigma_{mon}.\left(\frac{\left[\left(SND_{day}-\frac{g_{mon}}{6}\right).\left(\frac{g_{mon}}{6}\right)+1\right]^3-1}{g_{mon}}\right) \quad (16)$$

where R_{day} is the amount of rainfall on a given day [mm H_2O], μ_{mon} is the mean daily rainfall [mm H_2O] for the month, σ_{mon} is the standard deviation of daily rainfall [mm H_2O] for the month, SND_{day} is the standard normal deviate calculated for the day, and g_{mon} is the skew coefficient for daily precipitation in the month.
The standard normal deviate for the day is calculated:

$$SND_{day} = \cos(6.283.rnd2).\sqrt{-2\ln(rnd1)} \quad (17)$$

where $rnd1$ and $rnd2$ are random numbers between 0.0 and 1.0.
Relative humidity is defined as the ratio of the actual vapour pressure to the saturation vapour pressure at a given temperature:

$$R_{hmon} = \frac{e_{mon}}{e_{mon}^0} \quad (18)$$

where R_{hmon} is the average relative humidity for the month, e_{mon} is the actual vapour pressure at the mean monthly temperature [KPa], e_{mon}^0 is the saturation vapour pressure at the mean monthly temperature [KPa].
The saturation vapour pressure, e_{mon}^0, is related to the mean monthly air temperature with the equation:

$$e_{mon}^0 = \exp\left[\frac{16.78.\mu ump_{mon}-116.9}{\mu ump_{mon}+237.3}\right] \quad (19)$$

where e_{mon}^0 is the saturation vapour pressure at the mean monthly temperature [KPa], and μump_{mon} is the mean air temperature for the month [ºC] (Neitsch at al., 2005).

Soil Type

In this investigation, we consider the optimal curve number and Overland Roughness factor of watershed. The precipitation data was chosen from the different meteorological parameters to obtain the optimum curve number and the Overland Roughness coefficient of the watershed. SWAT was initially run with the curve number, CN_2=69 and the Overland Roughness coefficient 0.12. The consequences are offered in (Fig. 2). To optimize parameters different values for the curve number and roughness coefficient were utilized and the correlation of the Discharge variations with each one of parameters introduced in Table 1 and Table 2. In comparison with runoff amounts registered in hydrometer station and the calculated amount of current, the most optimum curve number was 69 and the Roughness coefficient of watershed was 0.12 (Frizzle et al., 2021; Neitsch et al., 2005). Subsequently, based on the obtained values, variations in SWAT input parameters were used to simulate the river runoff. The properties of difference in separately of climatological components on overflow was computed and contrasted with the experiential overflow. It should be stated that in this phase of computations individual rainfall information were fed into the prototypical. Fig. 3 shows difference CN2 Simulated Discharge. Fig. 4 shows difference Manning Overland Roughness coefficient with Simulated Discharge.

Sympathy Investigation of Climatological Components in Stream Overflow

In this phase of investigation, other essential climatological component with temperature, relative humidity, wind speed and solar radiation in addition to

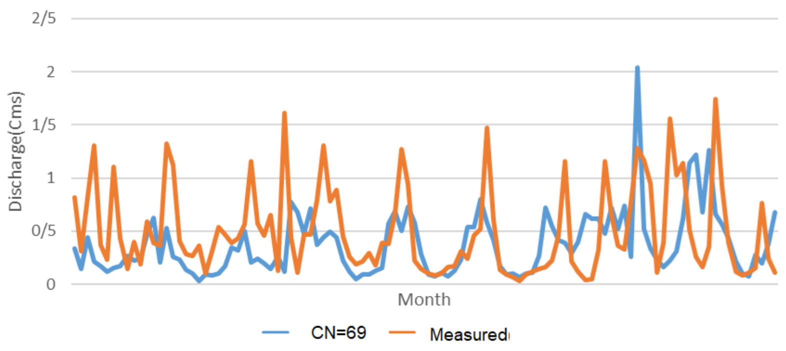

Fig. 2. Comparation Monthly Simulated Release of the SWAT with Quantified overflow.

Table 1. Examine effective curve number in the Average Simulated Discharge

Curve Number	68	70	73	77
Average Simulated Discharge [m^3 s^{-1}]	0.375793	0.377234	0.38093	0.388232
Average Measured Discharge [m^3 s^{-1}]	0.498963	0.498963	0.498963	0.498963
Error [m^3 s^{-1}]	0.123169	0.121736	0.118126	0.11085
Percent change or variable	0	0.4025%	1.3614%	3.4361%

Table 2. Inspect operative Over land Roughness factor in the Average Discharge design

Manning Overland Roughness coefficient	0.07	0.12	0.17	0.22
Average Simulated Discharge [m^3 s^{-1}]	0.375793	0.375793	0.375793	0.375793
Average Measured Discharge [m^3 s^{-1}]	0.498966	0.498966	0.498966	0.498966
Difference Average Measured Discharge and Simulated Discharge [m^3 s^{-1}]	0.123179	0.123179	0.123181	0.123183
Percent change or variable	0	0	-0.0009%	-0.0037%

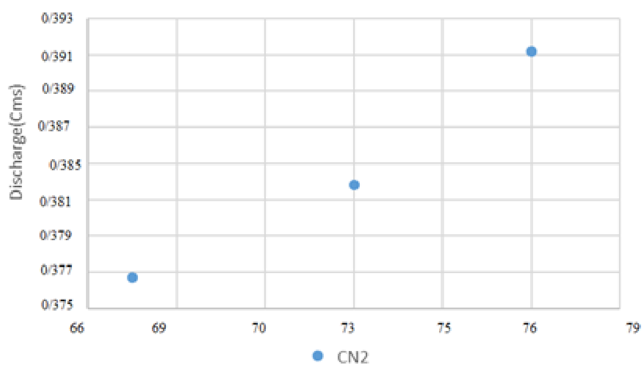

Fig. 3. Difference CN_2 with Simulated Discharge.

precipitation were due to SWAT and the medium runoff, as is shown in the third row if the Table 3, was calculated as 0.5715 cubic meters per second (Novak, 2023).
Fig. 5 shows simulated Discharge river with variable curve number to compare Measured Discharge. Fig. 6 shows Simulated Discharge river with variable Manning Overland Roughness coefficient to compare Measured Discharge.

Precipitation Effect

In order to study the sensitivity of the runoff estimated by the model to precipitation, initially, all precipitation values were multiplied to 1.52 and the runoff was

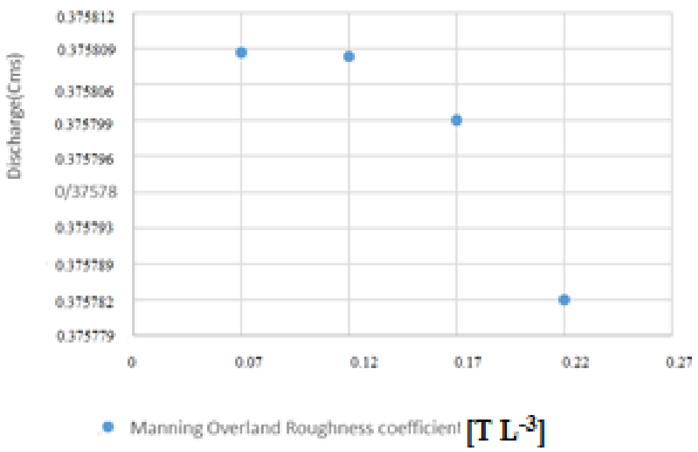

Fig. 4. Difference Manning Overland Roughness coefficient with Simulated Discharge.

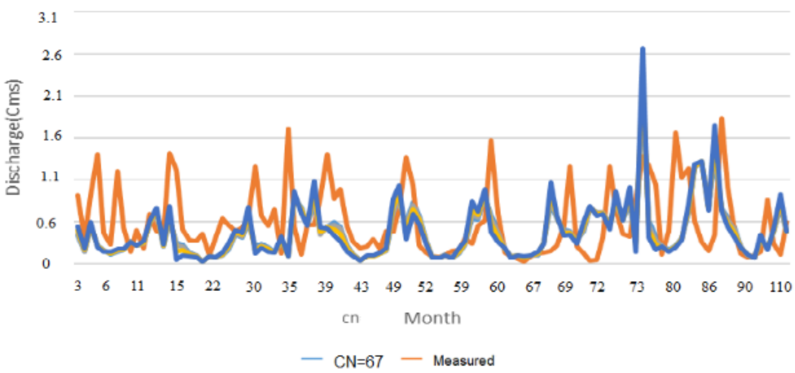

Fig. 5. Simulated Discharge river with variable curve number to compare Measured Discharge.

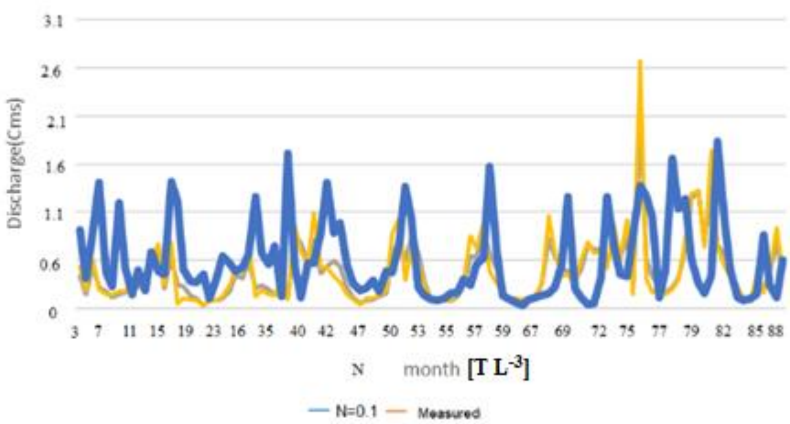

Fig. 6. Simulated Discharge river with variable Manning Overland Roughness coefficient to compare Measured Discharge.

calculated. The real amount of precipitation was used to obtain the average long-term runoff of the river (0.5704232). With a 60% increase in the precipitation, the river runoff was increased to 1.285224121 (a 132% increase). With a 20% decrease in precipitation, the average runoff decreased for 62% (0.203889562 cubic meters per second). Consequently, we face 0.7153 increase and 0.3671 decrease in monthly runoff. As apparent in Fig. 7, the regular runoff tendency is rising depend on the rainfall. With a 60% rise and a 20% decline in input rainfall, the stimulated overflow will be 0.82 and 0.31 which are higher and lower than the mean experiential regular overflow, individually.

Solar Radiation

Effect with a 30% increase and a 40% decrease in the input solar radiation, the simulated runoff varied from 0.61 cubic meters per second to 0.63 and 1.31 cubic meters per second, respectively. The monthly variations are presented in Table 4 and Fig. 8. with a 30% increase and a 50% decrease in the input solar radiation, the simulated runoff would increase 0.16 and 0.86 cubic meters per second respectively.

Humidity Effect

By a 20% rise and a 30% diminution in the input relative humidity, the average monthly runoff would alter from 0.5704 to 0.6947 and 0.3084, correspondingly. These 21.79% increase and 45% decrease are presented in the Table 5 and Fig. 9. By a 20% rise and 30% decrease in input comparative moisture, the simulated runoff was 39.25% advanced, and 38.18% lesser than medium quantified monthly runoff, correspondingly.

Wind Speed

With a 55% increase and a 20% decrease in input wind speed, the obtained average monthly runoff would be

Table 3. Result variable Simulated Discharge that change precipitation

Precipitation [mm]	Average Simulated Discharge [$m^3\ s^{-1}$]	Average Measured Discharge [$m^3\ s^{-1}$]	Difference Average Measured Discharge and Simulated Discharge [$m^3\ s^{-1}$]	Percent variable Simulated Discharge
PCP×1.6=3.11196	1.28522412	0.49895316	0.7878	131.26%
PCP×0.8=1.452191	0.203889561	0.49895402	0.2963	-66.32%
PCP= 2.07467	0.5704235	0.49895316	0.0725	0

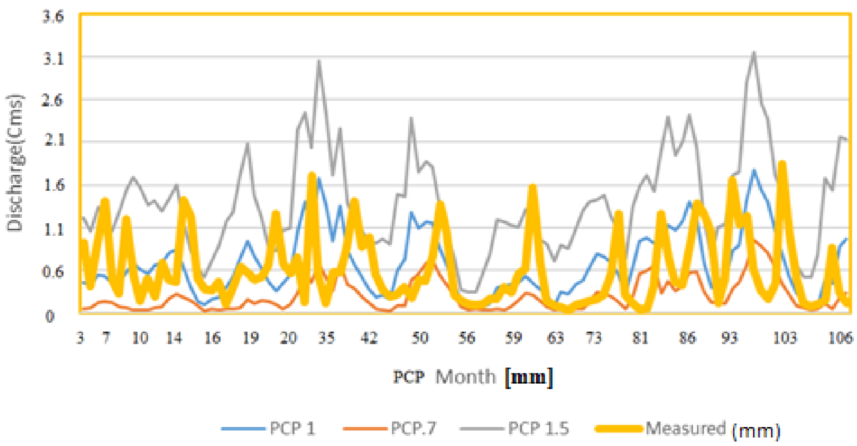

Fig. 7. Result Simulated Discharge with change precipitation.

Table 4. Alteration Simulated Release of the prototypical SWAT with Change data input solar radiation

Average Solar Radiation [MJ/[m^2/Day]]	Average Simulated Discharge [$m^3\ s^{-1}$]	Average Measured Discharge [$m^3\ s^{-1}$]	Difference Average Measured Discharge and Simulated Discharge [$m^3\ s^{-1}$]	Percent variable Simulated Discharge
solar ×1.3=23.19	0.59279362	0.498653806	0.0942	3.9156%
solar ×0.8=14.15	1.224632	0.498653806	0.7263	117.78%
solar=18.63	0.5704362	0.498653806	0.0722	0

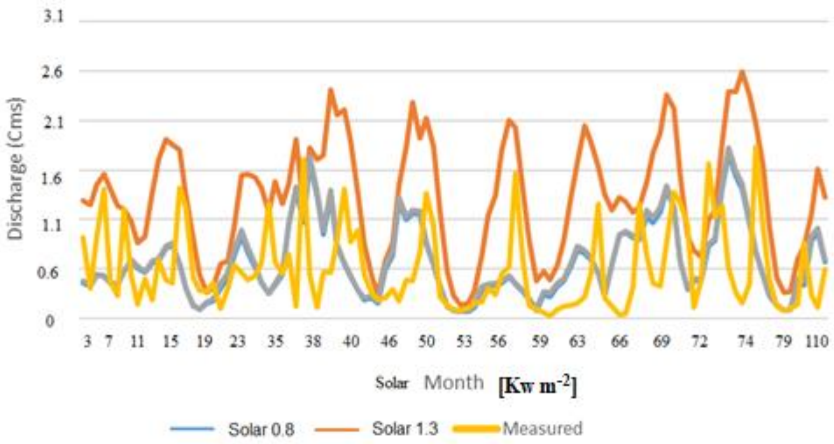

Fig. 8. Result Simulated Discharge with Difference information input Solar Radiation.

Table 5. Difference Simulated Discharge with changing information input humidity

Average Humidity [%]	Average Simulated Discharge [$m^3 s^{-1}$]	Average Measured Discharge [$m^3 s^{-1}$]	Difference Average Measured Discharge and Simulated Discharge [$m^3 s^{-1}$]	Percent Difference Simulated Discharge
0.4581 =Rh	0.5704232	0.498966	0.0723	0
0.56322=Rh×1.3	0.694742122	0.498966	0.1963	21.83%
0.3223=0.8 Rh×	0.308425123	0.498966	0.1915	-46.93%

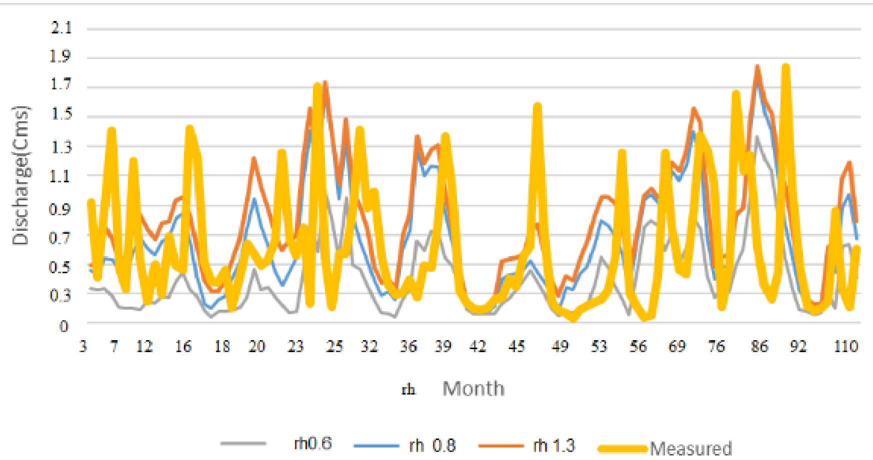

Fig. 9. Consequence Replicated Release Average Monthly with Alteration data input Relative Moisture.

1.32 and 1.42 cubic meters per second. The simulated values are 0.81 and 0.86 higher than the observed average monthly runoff (Fig. 10, Table 6).

Temperature

With a 60% increase and a 20% decrease in the input temperature, the average monthly runoff varied from 0.5704235 to 0.242062696 and 0.79410478, that is, a 58.64% increase and a 40.32% decrease in the monthly runoff. The Simulated results are 52% lower and 62.32% higher than the Measured Average Monthly Runoff (Fig. 11, Table 7).

Results and discussion

1. With 14.56% increase in the curve number, the Simulated Average Monthly Runoff would 2.63% close to the Measured average runoff. With a 1.7% increase in the roughness coefficient of watershed,

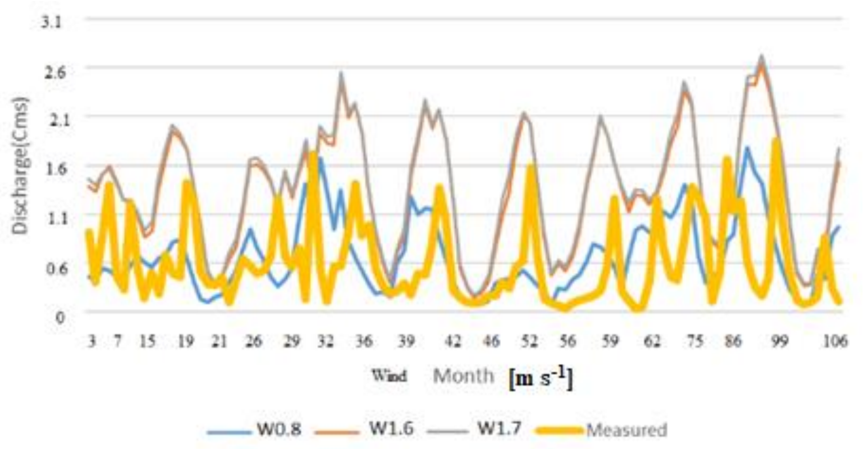

Fig. 10. Simulated Discharge with Difference information input Wind Speed.

Table 6. Difference Simulated Discharge with changing information input humidity

Average Wind Speed [m s^{-1}]	Average Simulated Discharge [m^3 s^{-1}]	Average Measured Discharge [m^3 s^{-1}]	Difference Average Measured Discharge and Simulated Discharge [m^3 s^{-1}]	Percent variable Simulated Discharge
0.8 wind×=1.764	1.2898432	0.498953716	0.7916	132.12%
wind× 1.6 =3.78	1.23933897	0.498953716	0.7416	121.26%
Wind=2.52	0.5704232	0.498953716	0.0725	0

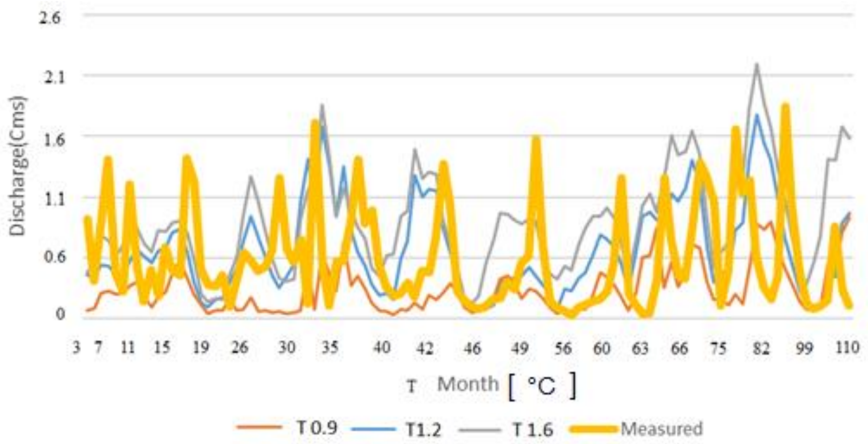

Fig. 11. Simulated Discharge with Difference information Input Temperature.

Table 7. Alteration Simulated Release with Change data Input Temperature

Temperature [°C]	Average Simulated Discharge [m^3 s^{-1}]	Average Measured Discharge [m^3 s^{-1}]	Difference Average Measured Discharge and Simulated Discharge [m^3 s^{-1}]	Percent variable Simulated Discharge
T×0.9 =7.762742	0.79410478	0.498953715	0.2963	39.32 %
T×1.6 =16.635596	0.242062699	0.498953715	0.2572	-57.63 %
T= 11.08987	0.5704246	0.498953715	0.0719	0

the Simulated runoff would come 0.02% closer to the Measured Discharge.

2. SWAT software is a good tool to estimate Average Monthly runoff using the precipitation, temperature and other required data. A 33% decrease in the average monthly precipitation, solar radiation, relative humidity, wind and temperature would cause a 65.33% decrease, 115.78% increase, 47.99% decrease, 129.14% increase and 39.46% increase, respectively. It is evident that the precipitation and the relative humidity face the most decreases. The most increase in runoff was a function of wind, then solar radiation and finally temperature.
3. With a 55% increase in the Average Monthly precipitation, a 30% increase in the radiation and relative humidity and a 55% increase in wind and temperature, the amount of modeled runoff would face a 126.36% increase, 3.9114% increase, 21.89% increase, 117.32% increase and 57.63% decrease, respectively. Precipitation then wind and relative humidity reason the greatest intensifications. The least runoff sensitivity is related to the solar radiation.
4. Discharge is steady flexible measurement which display a foremost part on water accessibility, environmental conservation and ecohydrological effective of a watershed. So as to inspect their spatial-temporal altering features, hydrological models, are evaluation devices. But, to reduce doubts of the prototypical estimations, good quality spread investigational data recognized are important for realist prediction. The aim of this examination is to apply the Soil and Water Assessment Tool (SWAT) in a affectionate watershed of Haraz watershed, and to measure the possessions of using together issue and soil humidity data's on the prototypical doubts and predictions. For streamflow, the values of the Nash–Sutcliffe prototypical efficiency (NS) amongst tool positions varied from 0.75 to 0.91 in the calibration stage for the yearly period stage, and amongst 0.61 and 0.86 in the monthly period stage. In the justification stage, NS standards fluctuated from 0.61 to 0.81 for the yearly period stage and amongst 0.65 and 0.84 for the once-a-month period stage. These significances mean "satisfactory" and "very good" routines for discharge. Whereas there is still some measurement of uncertainty, the preparation of balancing data, for instance soil humidity, to regulate and approve the SWAT model is valuable, predominantly as soon as discharge data is uncommon, as for some watersheds in the humid area. Water scarcity and the absence of water resources expansion and association are foremost tasks for get-together approaching water problems and dipping civilization powerlessness. Hydrological models afford a global contemplation of measurements refinements that occur in the soil–plant atmosphere association, while donating a mark of uncertainty in their significances. Increasingly, such devices have been useful for expansion, group and water resources approach. Reviews associated to the examination of uncertainties of distributed models have been increasing performed. calibration and examination of doubts of semi-dispersed watershed models are subject to a measurement of issues, for instance their parameterization, the non-eccentricity of an established of parameters, the description of what is a "calibrated model", are the proper restrictions of its practice, and the calibration in watersheds somewhere land usages or rivers have been importantly adapted. Furthermore, input data and three-dimensional gauge descriptions are similarly measured as bases of uncertainties.
5. The Haraz watershed is portion of the Haraz River washbasin, which is situated in the central district of northern Iran south of the Caspian Sea. The smallest and supreme advancements in the washbasin are 292 and 3292 m, consistently. The zone's global category is hilly with average grade of 16.6% and, conferring to the Iranian biological organization, this washbasin depends to the central Alborz with its superficial rocks fitting to the primary, another, and 3rd ages. The popular of this washbasin is bounded to different forestry kinds that have earthly uses for example rangeland and agronomy, in addition to forestry terrestrial usage. The soil in this washbasin is chiefly of the podzolic, brown forest, and sedimentary kinds. Iran has a warm, dry weather considered by extensive, warm, dehydrated summers. Rainfall is occasionally focused in local then fierce hurricanes, causation corrosion and local overflowing, particularly in the winter months. A minor region alongside the Caspian coastline has a very diverse climatological form. Now, precipitation is heaviest from late summer to mid-winter, then, in over-all, falls through the year. The instruction region has an average yearly rainfall of 753 mm and the environment is semi-humid and cool. The Haraz watershed is situated in Mazandaran domain, which hosts the greatest data of splits interesting in inner movement, typically due to satisfactory situation circumstances compared to the dry situation in the rest of the country.

Conclusion

SWAT prototypical routine in simulating the hydrogeological management has been assessed for the Haraz watershed, Mazandaran province (Iran) applying different soil shapes. The consequences of the calibration process show a deteriorating of the routine if a collective number of soil units are measured. Discharge presented a respectable routine and was consequently additional utilized in the validation process. The shaped map displays that some sub-basins are constantly considered by a high quantity of runoff. The runoff exposure map, comprehended examining the yearly maps shows the same sub-basins as high disposed to runoff. Exclusive these zones, considered by high development, short runoff periods could happen, rising the peak current downriver and accordingly the flood hazard. This explanation denotes an appreciated instrument for supervision application strategies and deterrent goal schedules for those zones more disposed to runoff efficiency. The overall method here used can be accepted in many other minor watersheds categorized by Haraz (Mazandaraan Province, Iran) environment. This investigation consider the sensitivity of the runoff approximation for streams, applying the SWAT model, depend on differences in such climatological components as precipitation, solar radiation, wind, humidity and temperature. The obtained results indicate that with a 32.07% decrease in the average monthly precipitation, sunshine, relative humidity, wind and temperature, we witness 65.36% decrease, 116.82% increase, 46.78% decrease, 127.16% increase, and 39.52% increase in modeled runoff, respectively.

COI Declarations Statement
Data Availability statement

Some or all data, models, or code generated or used during the study are available from the corresponding author by request.

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