Arrangement of watershed from overflowing lookout applying the SWAT prototypical and SUFI-2 (case study: Kasiliyan watershed, Mazandaran Province, Iran)

Kaveh Ostad-Ali-Askari[1] ●

Abstract

Overflows are an ordinary singularity that origins substantial fatalities of lifecycle and possessions and anthropological civilizations each time and persons have recognized it as a predictable occurrence. In this investigation, to forecast the overflowing in Kasiliyan SWAT hydrological prototypical was applied. Evidence wanted to be this investigation, with topographical maps, terrestrial usage, soil information, and climatological information, information about steady precipitation, temperature, and current degree were organized earlier. SUFI-2 database was applied for prototypical standardization. Subsequently the standardization and optimization of the prototypical, justification of the prototypical in the study zone was completed. The standardization of the prototypical was done from 2004 to 2010 and corroboration was completed from 2011 to 2014. To examine the consequences of arithmetical gauges R^2, bR^2, and Nash Sutcliffe constant were applied. Afterward prototypical standardization the particular constants were 0.79, 0.66, and 0.79 and the individual corroboration constants were 0.79, 0.76, and 0.71. The sensitivity consequences of 25 components that are important on overflow aquatic displayed that static components of groundwater improper current, its period, and the smallest quantity of aquatic essential for groundwater improper current are more complex than other components. Quantity Kasiliyan component curvatures were applied for overflow washbasin. Kasiliyan washbasin was separated into 24 zones to investigate the overflowing design. Lastly applying the overhead professed Mockups, it was decided that sub basin number 7 had the primary-rank with runoff 128.06, sub basin number 12 had the next rank with overflow in relations of overflowing and sub basin number 2 with a 12.62 has the minimum quantity of overflow.

Keywords Topographical maps · Overflowing · Flood managing · SWAT prototypical · Kasiliyan basin · Hydrological · Groundwater · Runoff

Introduction

As well as destructive anthropological existences, flood damage outbreaks the district's agronomic domains and productive earth in numerous conducts (Fatahi Nafchi et al. 2021, 2022; Abdollahi et al. 2021; Ostad-Ali-Askari 2022; Ostad-Ali-Askari and Shayan 2021; Ostad-Ali-Askari et al. 2017a, b; Ostad-Ali-Askari and Shayannejad 2021; Ostad-Ali-Askari 2022a, b). Destruction of seaside walls, overflowing of grounds by residues and filling of pools of barriers are other reimbursements triggered by overflows. In what way superficial flows are dispersed in most portions of Iran does not encounter the period requirements of water. There is an essential to control superficial flows in nearly all belongings. Consciousness of the quantity of current (runoff capacity) owing to precipitation and its measurable and qualitative variations in dissimilar periods and districts is one of the significant depends of water possessions development. The requirement of water possessions and precipitation in diverse watersheds to instrument water developments to be attentive of the position and on the one hand the absence of a satisfactory system of positions for gauging climatological and hydrological components instead of the position of applying secondary approaches for example It discloses hydrological models for simulating current and calculating runoff capacity in watersheds. Iran is one of the nations that

✉ Kaveh Ostad-Ali-Askari
ostadaliaskari.k@of.iut.ac.ir

1   Department of Irrigation, College of Agriculture, Isfahan University of Technology, Isfahan 8415683111, Iran

encounter the two issues of water deficiency and water overflow. Numerous grounds of agronomy, manufacturing and consumption water make the essential procedures to switch the water and avoid its consumption, in addition to the appropriate packing and usage of water. Flood water and soil evaluation prototypical is one of the greatest extensive perils that mostly impacts persons since people have designated flood-prone zones for lifespan. Flood regulator and inhibition of likely compensations have extensive been measured. Hydraulic mockups are extensively applied by hydrologists and water possessions administrators as an instrument to examine water organization. They examined the impacts of weather variation on water possessions in diverse watersheds in Iran and applied the SWAT prototypical to pretend the hydrological comeback of the watershed to climate variation. Terrestrial usage alteration has the capability to control water possessions and can similarly be applied to restrained and alleviate the damaging properties of climate alteration. Corrosion and deposit were one of the issues intimidating the expansion of water resources in these zones. The soil and water assessment model have been used to model soil erosion. The consequences display that the daily observations noted are very adjacent to the consequences simulated with SWAT software. Significant standardization and uncertainty of the SWAT prototypical were considered on a great measurement. In many revisions, important standardization and uncertainty investigations of important SWAT mockups have been showed. In many investigations, the building and standardization of a combined hydrological prototypical from Iran applying SWAT and numerous features of simulated water possessions and invention presentation and water superiority per unit of superficial hydrological comeback were measured. Depend on the consequences of the prototypical; the components of the channel erodibility curve number and canal exposure were documented as the greatest sensitive components of the prototypical for deposit condensation. The goal of the current study is to arrange sub-basins in terms of flooding applying the SWAT perfect in the Kasiliyan watershed. Assumed the extensive apply of this prototypical on a worldwide gauge, attaining this goal can be the source for ordering sub-watersheds for the operation of connected plans and evade spending a lot of currency in redundant zones. It is essential to control the monthly and annular profits of the stream. A gage station cans quantity the input water. In the default of the quantity position, an automatic model, e.g. SWAT, can be used to assess the stream and the input runoff. The high-tech mockups can achieve exact and complex designs in a short period. So as to compute the watershed runoff, the prototypical needs such powerful climatological information as precipitation, temperature, wind speed, solar radiation and relative humidity, and instead we require the watershed washbasin data as well as the curve number and the roughness constant.

Owing to the restriction in the quantity of weather positions in some watershed basins, the standards recorded in a position do not signify the entire watershed. There is a essential to compute the runoff approximation fault. This investigation is depending on SWAT, goals to examine the compassion of the stream runoff approximation to differences in the most projecting climatological components with precipitation, solar radiation, wind, humidity and temperature.

Materials and Methods

The situation to be considered is restricted to Kasillian watershed (positioned in Northern jungles of Alborz highland in Iran) with Sangdeh, Darzikela, Sootkela, Valikchal and Valikbon towns. The zone of Kasillian watershed is nearly 66.82 square kilometers and the foremost river gives for 16.9 km. The topographical organizes of the streams are as surveys: latitude from 36°-02' to 36°-11' N, and longitude from 53°-10' to 53°-26' E. There is an instrument place on Kasillian River at Valikbon. The position, constructed in 1970, is located at longitude of 53°-17' and the latitude 36°-10' to quantity its Discharge. This model takes the precipitation, temperature, solar radiation, wind speed and relative humidity information accessible into account to stimulate the runoff. The stated numerical components were recovered from Pol-e-sefid cineoptic, Sangdeh and Darzikela climatology, Valikchal precipitation-scale, and Valik hydrometer positions. Principles of runoff modeling assessment gauges in diverse stages of SWAT model application is shown in Table 1. Optimum standards of sensitive components after calibration for the study zone is shown in Table 2.

Water Balance Equation in SWAT Model

$$SW_t = SW_0 + \sum \left(R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw} \right) \qquad (1)$$

where SW_t in Eq. 1 is the final water content in the soil, T time (day), SW_0 is the quantity of main water in the soil, R_{day} is the amount of precipitation per day, Q_{surf} is the amount of surface runoff per day, E_a is the amount of daily evapotranspiration, W_{seep} is the amount of water penetrating into the

Table 1 Principles of runoff modeling assessment gauges in diverse stages of SWAT model application

Validation Stage	Calibration Stage	Assessment gauges and model application phases
0.79	0.79	R^2
0.75	0.79	NS
0.72	0.66	Br^2

Table 2 Optimum standards of sensitive components after calibration for the study zone

Max	Min	Optimal Amount	Parameter	Row
0/083450	-0/231052	-0/031202	R_CN2.mgt	1
0/599746	-0/047065	0/485365	V_ALPHA_ BF.gw	2
336/465985	90/965236	260/705965	V_GW_DELAY. gw	3
1/752695	0/352965	0/965756	V_GWQMN.gw	4
0/185262	0/066252	0/090652	V_GW_REVAP. gw	5
0/856235	0/682635	0/796325	V.ESCO.hru	6
0/301052	0/040895	0/046189	V_CH_N2.rte	7
126/695859	62/526362	87/962563	V_CH_K2.rte	8
0/486359	0/009526	0/381956	V-ALPHA_BNK. rte	9
0/125759	-0/120958	0/019019	R_SOL_AWC(1). sol	10

subcortical region and Q_{gw} is the amount of penetration into the aquifer. The SWAT model needs complete numbers and data from the study zone, for example daily rainfall information, maximum and minimum temperature, average relative humidity, average wind speed and solar radiation energy during the desired period. To run the model, daily rainfall information of rain gauge station and synoptic station situated in the zone were applied. In this investigation, to begin working with the prototypical, original the plans and diagrams of the sub-basins and channel system those were formerly organized. They were named to the model software situation. At this phase, the watershed zone and sub-basins and physical features of the watershed are planned by the prototypical. By using of land use soil maps and Hydrological response units and grade stages were described. The plans were combined in the prototypical software situation and formerly climatological information is applied and the essential stations are presented to the model. Formerly, added essential data was entered physically in the software tables. Subsequently this stage, the model was well-organized and the consequences were examined.

Q_{surf} = Surface Runoff (mm), R_{day} = Daily rainfall depth (mm), S = Humidity retention parameter (mm).

The moisture preservation component alters spatially with variations in soil usage organization domains and gradients and briefly with variations in soil moisture. The moisture preservation component is explained as surveys as Eq. 2:

$$S = 25.4\left(\frac{1000}{CN} - 10\right) \qquad (2)$$

Somewhere CN is the curve number (number zero to 100) is connected to the ground which be contingent on the physical possessions of the ground and S is the humidity preservation component (mm). In this investigation, the curve number component was applied to examine the overflowing of the Kasiliyan watershed. After calibration and validation of the prototypical and gaining the optimum standards of sensitive components applying the optimum standards of the components defined in the model calibration phase, the model was performed once more. Formerly, in the S model catalogue file, the number of curves of each sub-domain was changed with the least probable number of 40, individually, and the curve of other sub-spheres was expected to be persistent, and the model was applied for each sub-realm discretely. Lastly, subsequently the model was applied for all sub-basins and the consequences were verified, the consequence of each sub-basin on the hydrograph curve was contrasted by comparing the output hydrograph and the flood possible of each sub-basin was defined. Then the consequences were assessed. Along with the sensitivity analysis of the model, operative components were recognized and applied in model optimization.

Results and Discussions

After applying the SWAT model, the model is regulated to the SWAT model applying a SUFI-2 program in the procedure of SWAT-CUP software. For calibration, the seven-year measurement statistics (2004–2010) of daily rainfall, temperature and flow were applied. The consequences were assessed. Conferring to the sensitivity analysis of the model, effective components were recognized and applied in model optimization. In overall, the gained consequences are suitable and the efficacy of SWAT model in pretending the monthly runoff discharge of Kasiliyan river basin is suitable. After the model calibration phase, the model was assessed. The model assessment similarly has suitable consequences. At this phase, along with the optimum consequences of the calibrated phase, applying river information from 2011 to 2014, the stream movement was pretend.

Conclusions

Overflows are an ordinary singularity that origins substantial fatalities of lifecycle and possessions and anthropological civilizations each time and persons have recognized it as a predictable occurrence. In this investigation, to forecast the overflowing in Kasiliyan SWAT hydrological prototypical was applied. Evidence wanted to be this investigation, with topographical maps, terrestrial usage, soil information, and climatological information, information about steady precipitation, temperature, and current degree were organized earlier. SUFI-2 database was applied for prototypical standardization. Subsequently the standardization and optimization

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Declarations

Conflicts of interest Author have declared that he have no conflicts of interest.

Ethical approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

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