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Application of SWAT Model to an Agricultural Watershed in Tamil Nadu, India



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Outline

- Introduction
- Study Area
- Preparation of Data Sets
- Model parameterization
- SWAT Run
- SWAT CUP
- Sensitivity Analysis
- Results

Introduction

 Water is the most important natural resource **Current Scenario: Scarcity of fresh water, vulnerability** • of the available resources, shift in the rainfall pattern, climate change, eutrophication etc Need of the hour is to create a strategy and identify tools to model the watershed SWAT – Open source, worldwide usage

Context of the Study

- Application of SWAT model to this study watershed is a first attempt
- Study the possibility and the adaptability of SWAT model to depict the functionality of the watershed
- <u>Preliminary results</u> of the model is presented(needs

further improvement)

Study Area



- Krishnagiri watershed is in the northwest of Tamil Nadu state of India
- Latitudes of 12.275 N -13.125 N
- Longitude of 77.625 E 78.375E
- It has a total area of 3000 km²
- Tropical hot zone
- Maximum temperature 34 C to 37 C and

Minimum temperature 22 C to 24 C

- Average precipitation of 980 mm.
- Elevation varies from 540 m to 1200m
- Major River Ponniyar river Krishnagiri

dam which caters an ayacut of 3642 ha.

Preparation of Datasets

- DEM SRTM 90 m resolution
- Landuse Resourcesat Image
- Soil Agricultural Engineering
 - Department + Soil samplings
- Climate FCS at two locations
- Rainfall Raingauges at eight locations
- Discharge At one location (CWC)
 - Sediment At one location (CWC)

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- Time line
- 1998 2000 (Warmup)
 - 2001 2005 (calibration)
 - 2006 2010 (validation)

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Digital Elevation Model



- SRTM
- 90 m resolution
- Minimum 540 m
- Maximum 1200 m

Land use

ID	LANDUSE	AREA (km²)	Area (%)	SWAT LANDUSE
1	RESIDENTIAL	68.89	2.90	URBN
4	AGRICUOTURAL	779.88	33.25	AGRL
5	FALLOW LAND	500.27	21.33	PAST
7	FOREST	105.07	4.50	FRSD
8	SCRUB LAND	321.94	13.72	WETL
9	RIVER	14.28	0.62	INDN
11	RESERVOIR /WATERBODY	20.87	0.89	WATR
20	BARREN ROCK	534.56	22.79	URLD





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Soil

ID	SOIL SERIES	AREA (km²)	Area (%)	SWAT SOIL CLASSIFICATION (USER SOIL GROUP)
1	KELAMANGALAM SERIES	214	9.49	KELAMANGALAM SERIES
2	ROCKOUTCROP	287	12.60	ROCKOUTCROP
3	VANNAPATTI SERIES	400	17.46	VANNAPATTI SERIES
4	KRISHNAGIRI SERIES	17	0.84	KRISHNAGIRI SERIES
5	HOSUR SERIES	775	29.97	HOSUR SERIES
6	SONEPURAM SERIES	722	29.64	SONEPURAM SERIES





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Rain gauge, Flow gauge and Weather station



- 8 Rain gauges
 - 1 Flow gauge
 - 2 weather station
- Temporal resolution of data: daily measurements
- (used monthly flow data for preliminary analysis)

Preprocessors were used to generate the weather statistics User weather database has been created

Model Setup



- Arc SWAT 2009 interfaced with ArcGIS 9.3
- 26 subbasins (using DEM +Gauges)
- 417 HRUS by using multiple Landuse / Soil
 /Slope (THRESHOLDS : 5 / 5 / 5 [%])
 - 8 years data were used to run the model (NYSKIP = 3)
- 1998 2000 (Warmup)
- 2001 2005 (simulated in ArcSWAT)
- Output in Txtinout folder

Calibration : SWAT- CUP (Calibration and Uncertainity Programs)

Sequential Uncertainity Fitting Version 2 (SUFI2) algorithm was used

Flow Calibration Parameters (initial run)

1.	Curve Number	rCN2.mgt	-0.2	0.2
2.	Base flow alpha factor	vALPHA_BF.gw	0.0	1.0
3.	Groundwater delay	vGW_DELAY.gw	30.0	450.0
4.	Threshold depth of water	vGWQMN.gw	0.0	2.0
5.	Groundwater revap coefficient	vGW_REVAP.gw	0.0	0.2
6.	Soil evaporation compensation factor	vESCO.hru	0.8	1.0
7.	Manning coefficient for channel	vCH_N2.rte	0.0	0.3
8.	Effective hydraulic conductivity	vCH_K2.rte	5.0	130.0
9.	Available water capacity of soil layer	rSOL_AWC(1).sol	-0.2	0.4
10.	Saturated hydraulic conductivity	rSOL_K(1).sol	-0.8	0.8
11.	Soil bulk density	rSOL_BD(1).sol	-0.5	0.6

Initial Run - Results



Variable	p-factor	r-factor	R2	NS	br2	MSE	SSQR
FLOW_OUT_21	0.25	0.07	0.60	0.04	0.0478	397377.8438	383871.8125

S	ensitiv	ity Analy	/sis
	Parameter Name	t-Stat 🔺	P-Value
	vGW_DELAY.gw	-12.685364308	0.000000000
	vCH_K2.rte	-4.546665739	0.000006886
	vGW_REVAP.gw	-2.870006969	0.004283176
	rSOL_AWC(1).sol	-2.036480931	0.042242520
	vCH_N2.rte	-1.508646005	0.132037727
	rSOL_K(1).sol	-0.430540109	0.666993271
*	rSOL_BD(1).sol	-0.412409456	0.680220816
	vGWQMN.gw	0.440800016	0.659553389
	v_ESCO.hru	0.661243046	0.508769164
	vALPHA_BF.gw	2.570685509	0.010445707
	vALPHA_BNK.rte	13.166391077	0.00000000
	r_CN2.mgt	27.060465338	0.000000000







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Second Iteration



- Error in the peaks uncertainity in precipitation
- Limitation of climatic data, soil data

Results - Summary

Description	P-FACTOR	R-FACTOR	R ²	NSE	BR ²	MSE	SSQR
Initial	0.25	0.07	0.60	0.04	0.0478	397377.8438	383871.8125
Calibration	0.08	0.36	0.57	0.15	0.0467	354101.3	340076.3
Validation	0.5	0.59	0.54	0.16	0.0488	348209.5	330425.6

The model under estimates the peak monthly flow It depicts the peaks position

The suspected data for bad prediction could be

- Soil data
- Rainfall data distribution
- Further model parameterization at a local scale should be done as more data and information become available.

