SIMULATION OF SUB-DAILY RUNOFF FOR AN INDIAN WATERSHED USING ArcSWAT MODEL

2012 INTERNATIONAL SWAT CONFERENCE
NEW DELHI, INDIA
JULY 16-20, 2012

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Introduction

- SWAT model is a hydro-dynamic and physically-based hydrologic model.
- Geographic Information System (GIS) provides the framework within which spatially-distributed data are collected and used to prepare model input files and to evaluate model results.

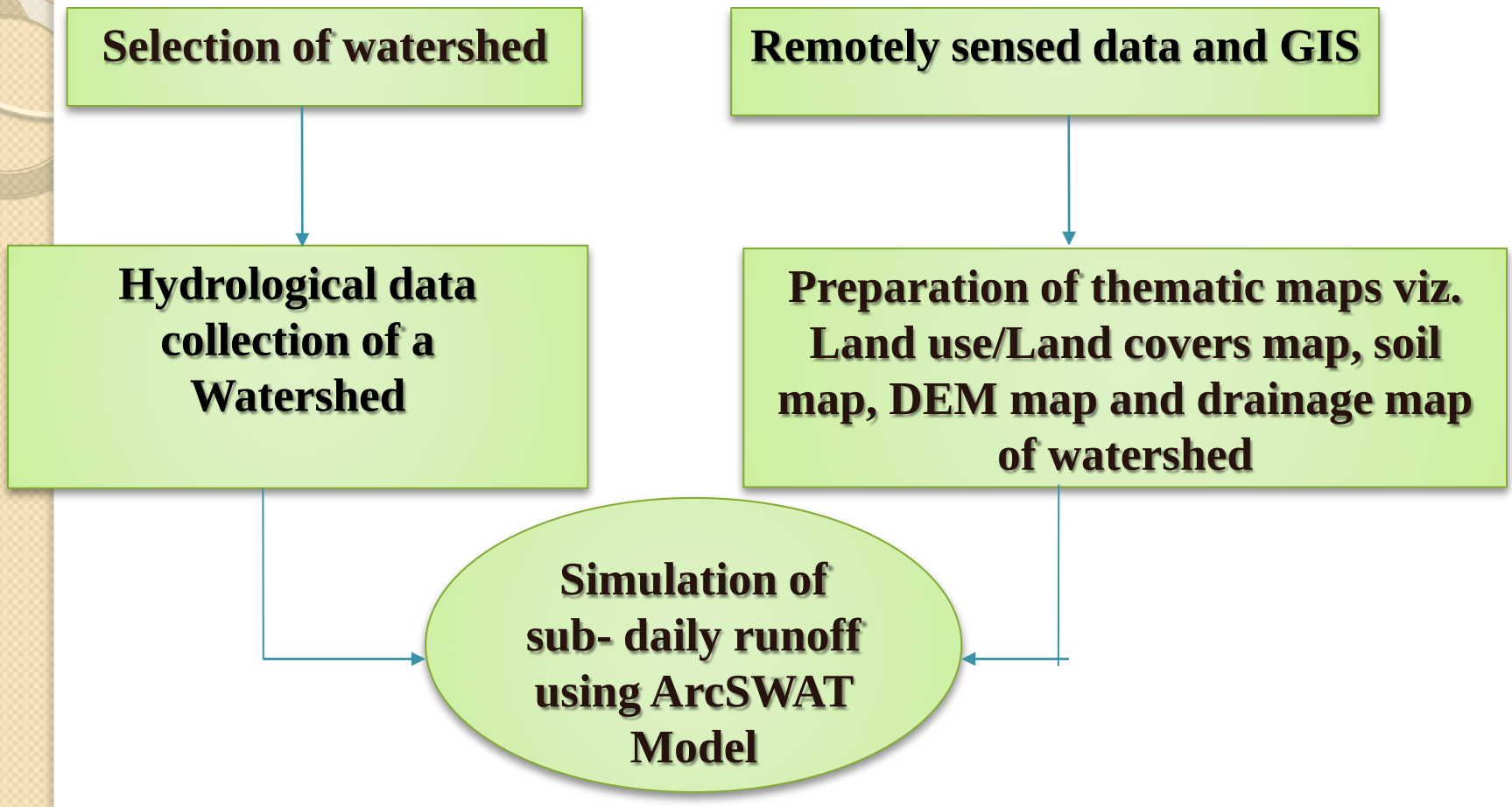
Literature Review

- Arnold et al. (1999) presented two methods of simulating excess rainfall on a large basin with multiple rain gages and compared the simulations.
- Simic et al. (2009) studied the application of SWAT in modeling of the rainfall runoff Process.
- Arnold et al. (2010) presented the development and testing of a sub-hourly rainfall–runoff model in SWAT.

Objectives

- The objective of the study is to simulate the sub-daily runoff using ArcSWAT model.
- Harsul watershed has been selected and relevant hydrological data has been collected.
- Remotely sensed data and GIS have been used to prepare the thematic maps of the watershed.

Methodology



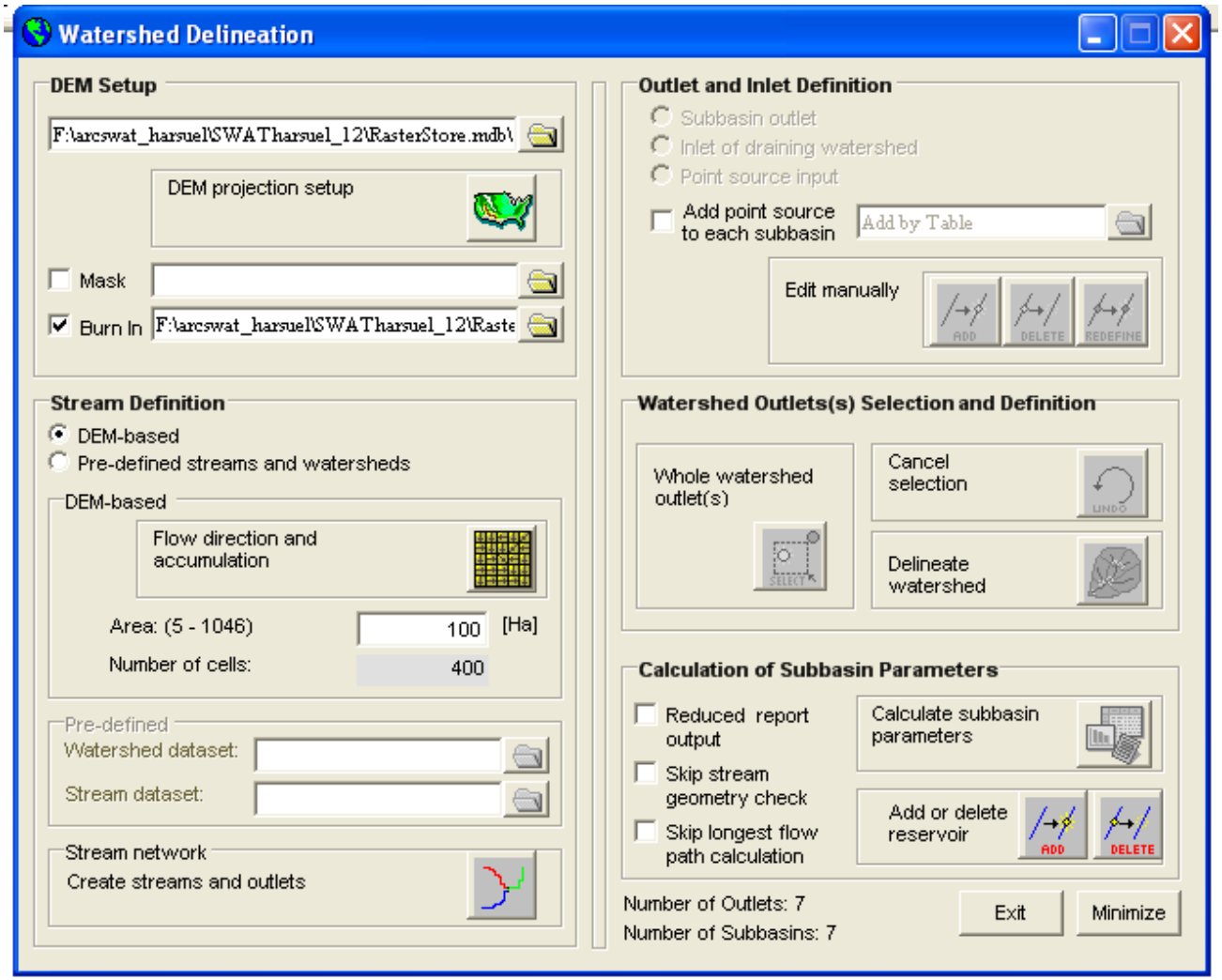
Methodology Flowchart

Location map and Study area of the Harsul Watershed

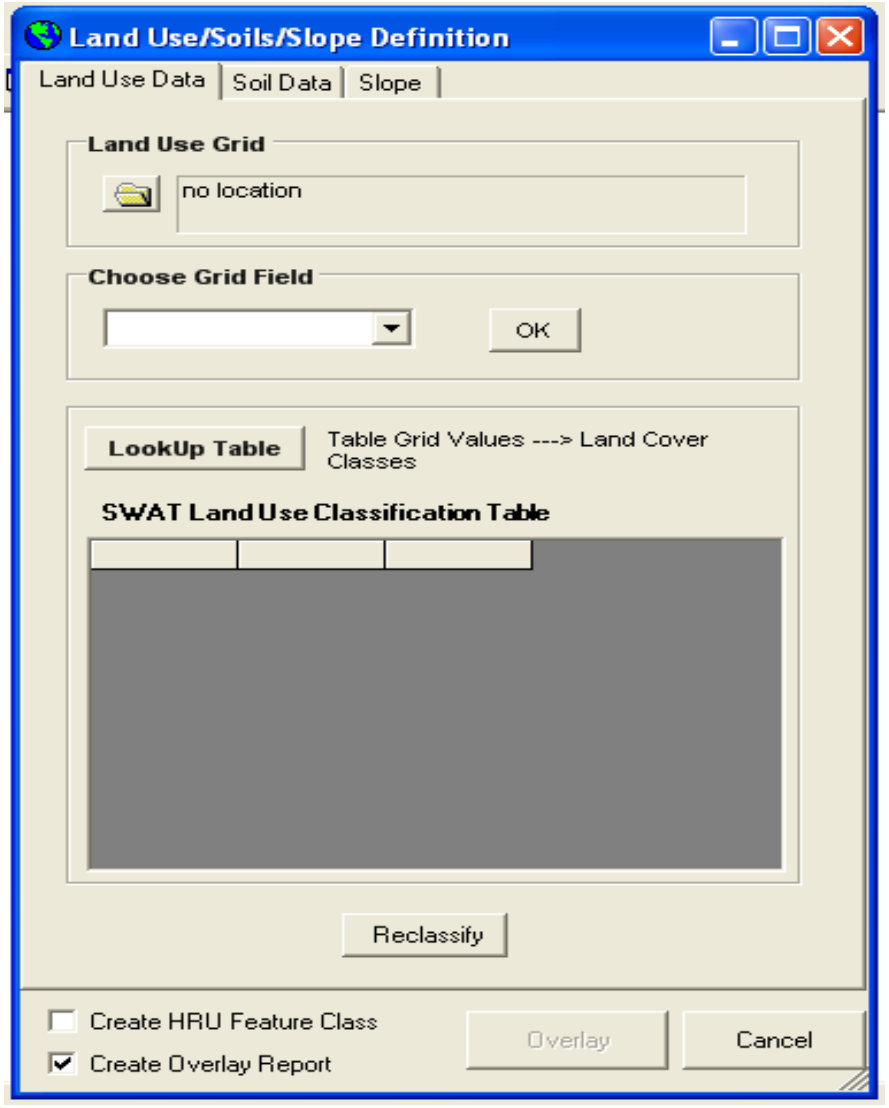
- Harsul watershed is located in Nashik district, Maharashtra, India.
- The watershed has an area of 10.929 sq. km.
- It is situated between East Longitude of 73º 25´ and 73º 29´ and the North Latitudes of 20º 04´ and 20º 08´.

SWAT Model Description

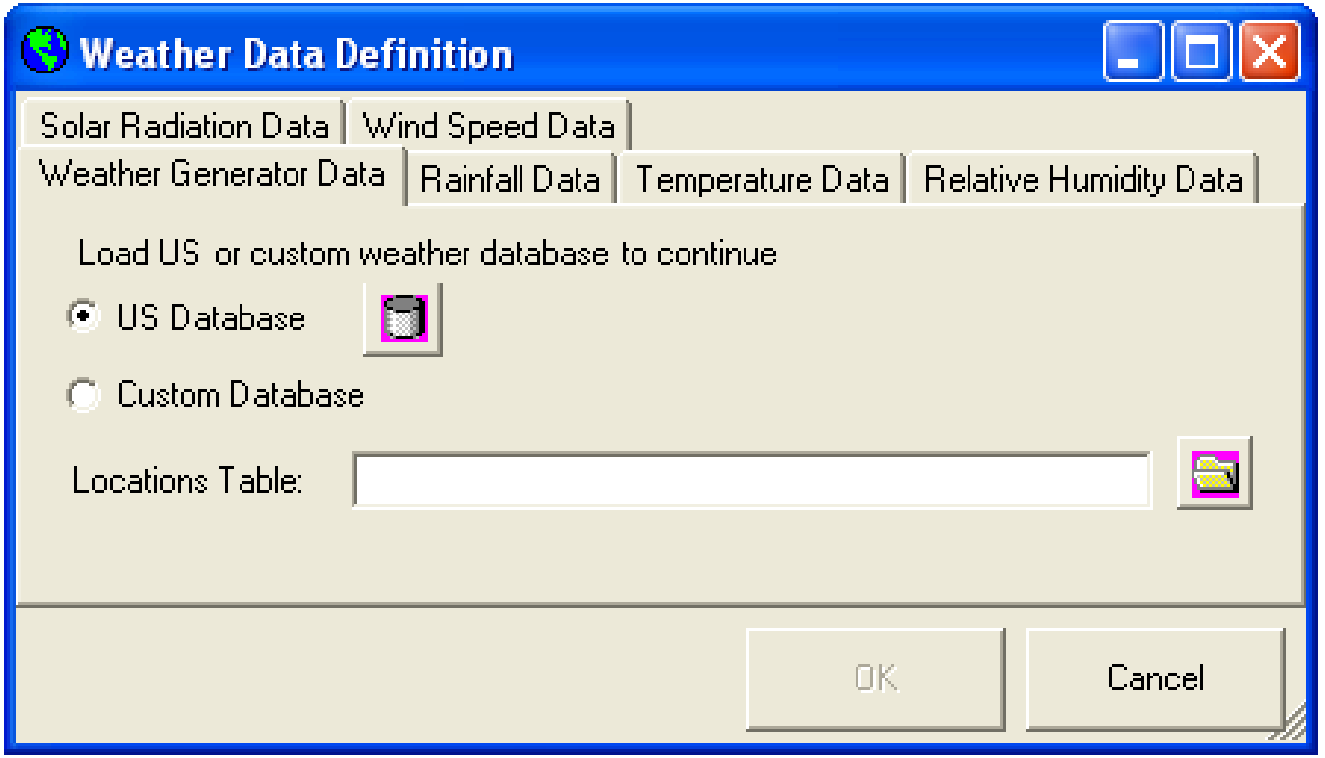
- The model setup involves the following five steps:
  - Watershed delineation
  - HRU definition
  - Weather data definition
  - Edit SWAT input
  - Run SWAT.



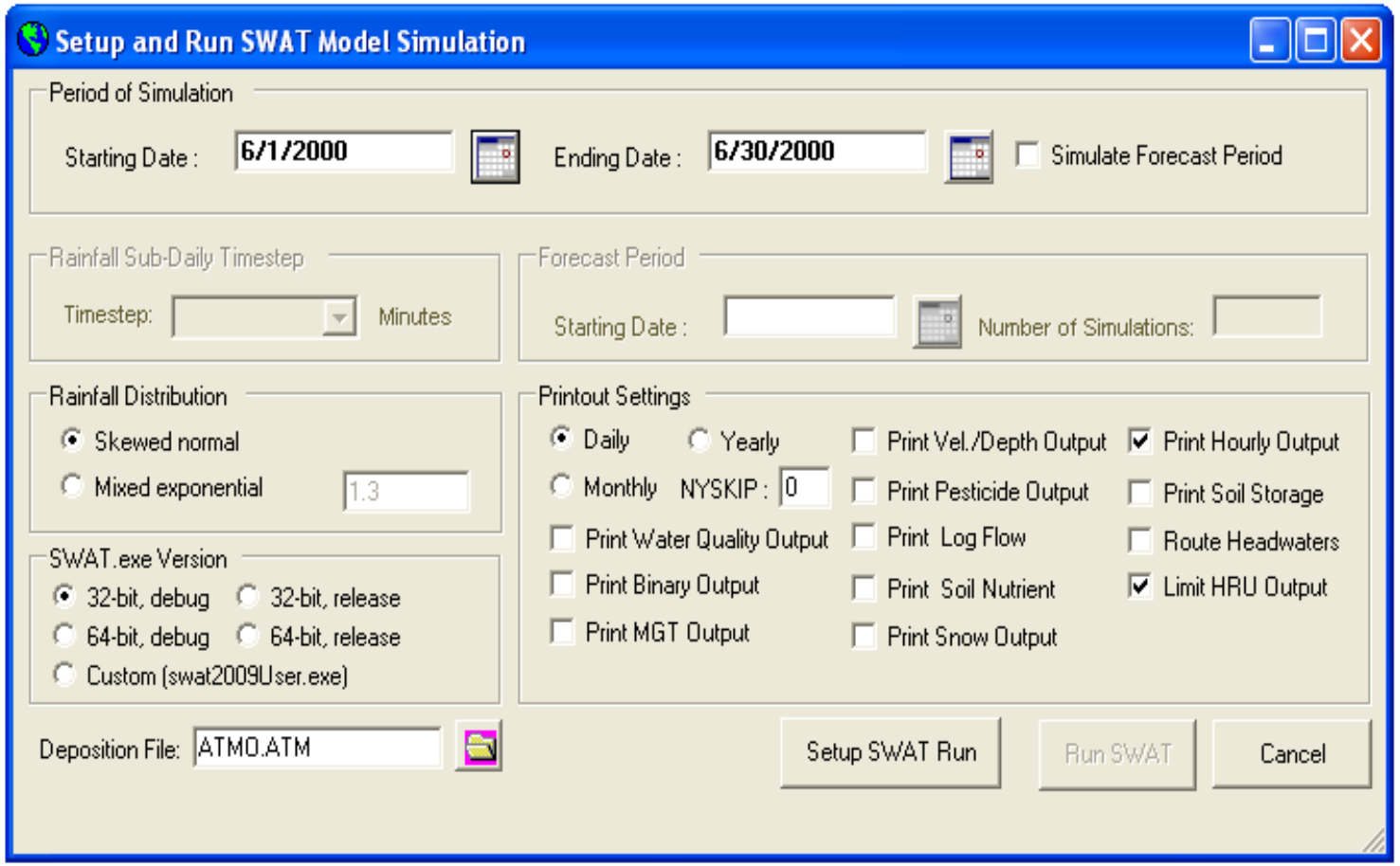
Menu for Automatic Delineation of Watershed in ArcSWAT model



Menu for Hydrologic Response Unit Analysis in ArcSWAT model

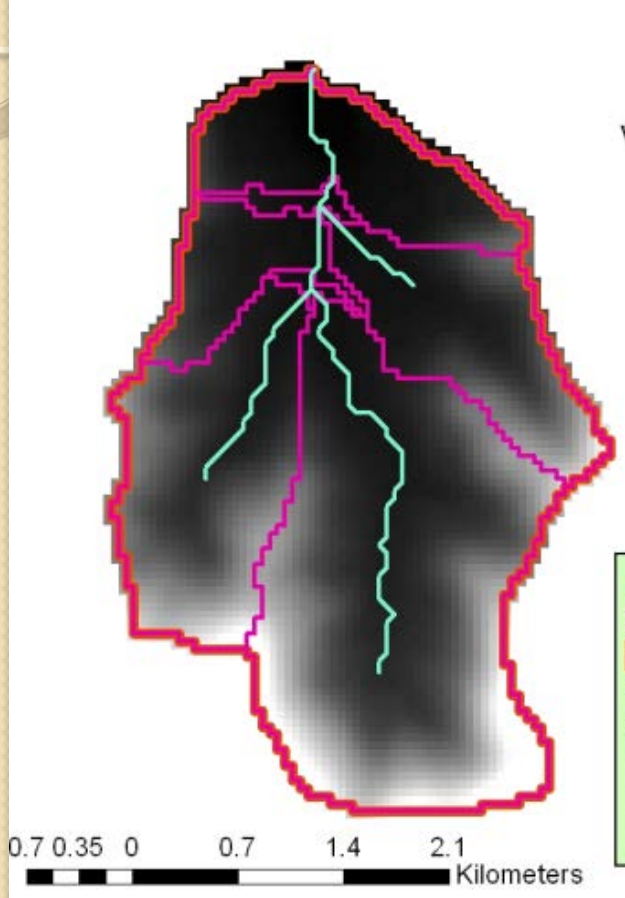


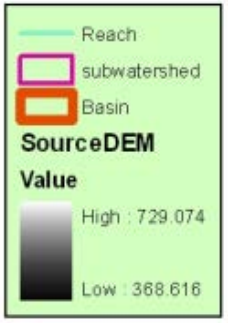
Menu for Weather Data Definition in ArcSWAT model

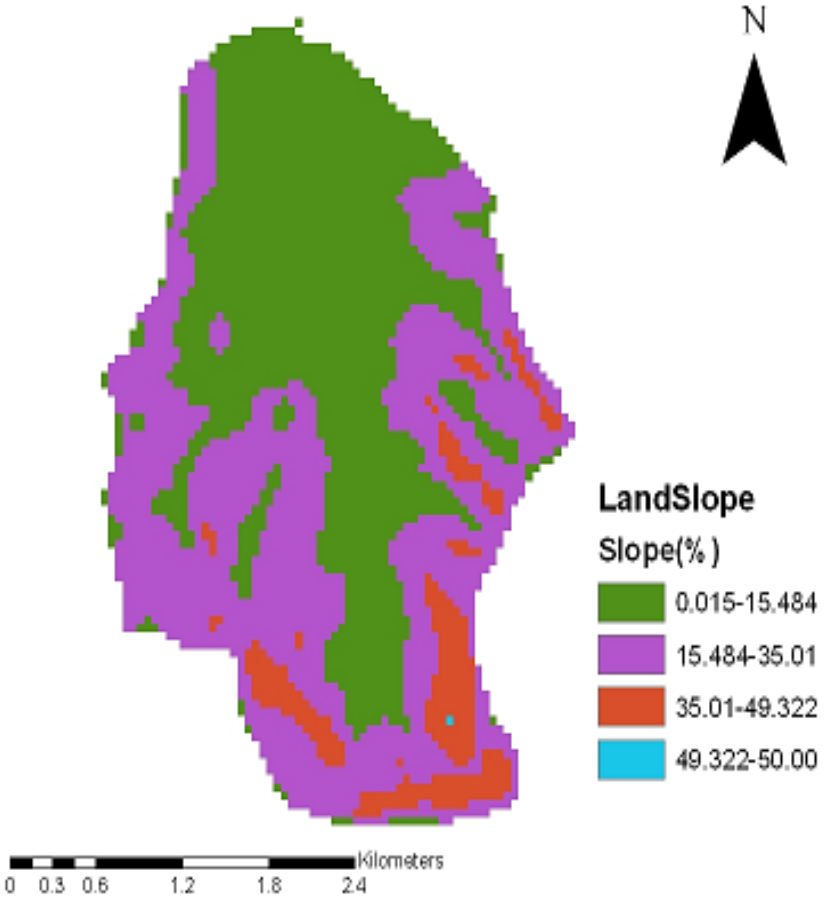


Menu for Setup and Run SWAT model simulation

SWAT Model Application

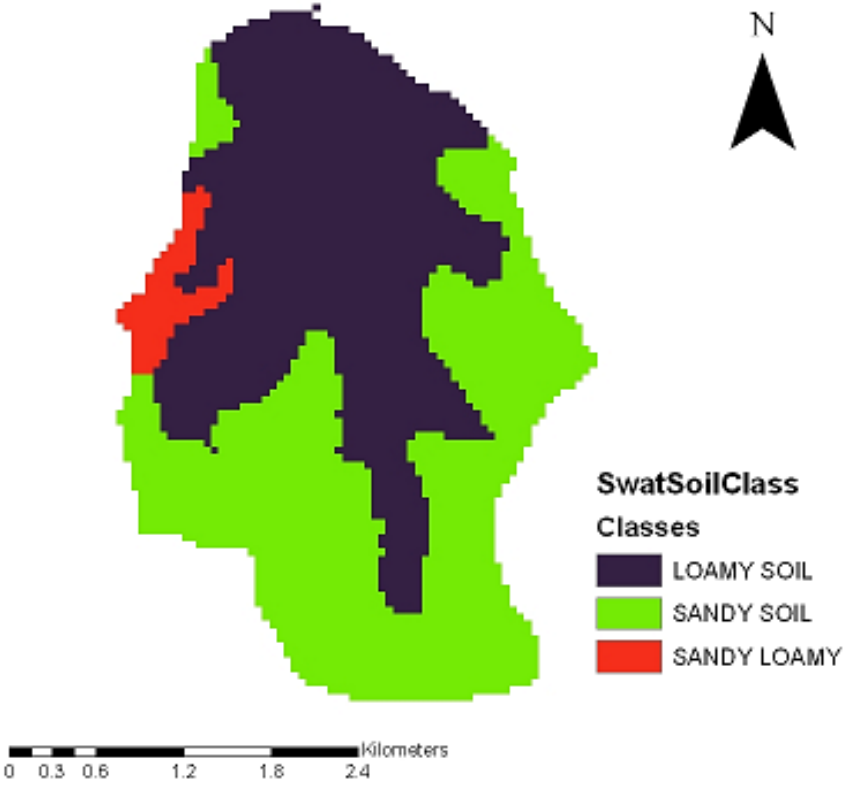




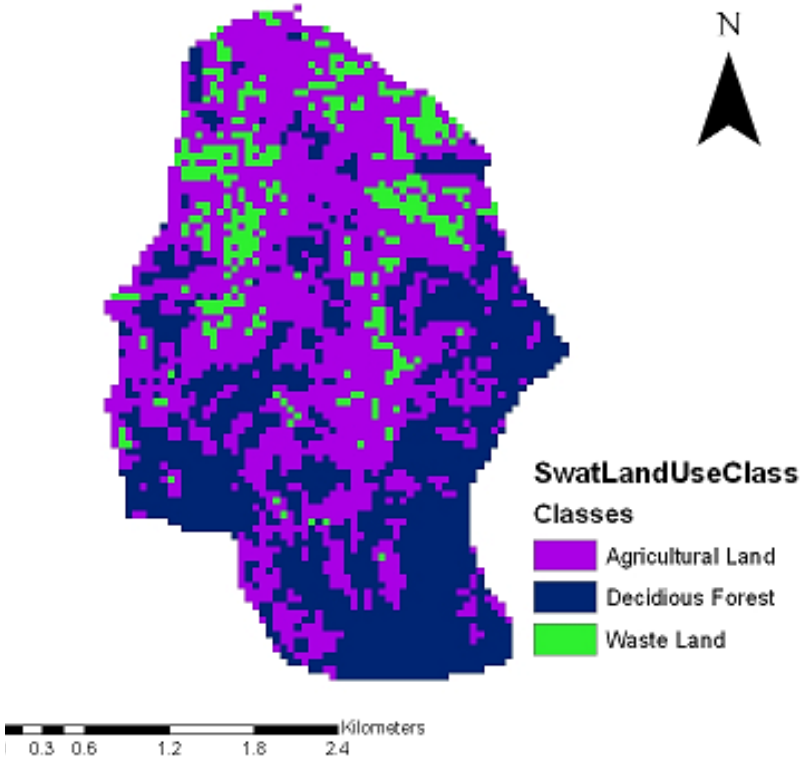


Automatically delineated sub-basins Harsul watershed

Modified Slope map of Harsul watershed

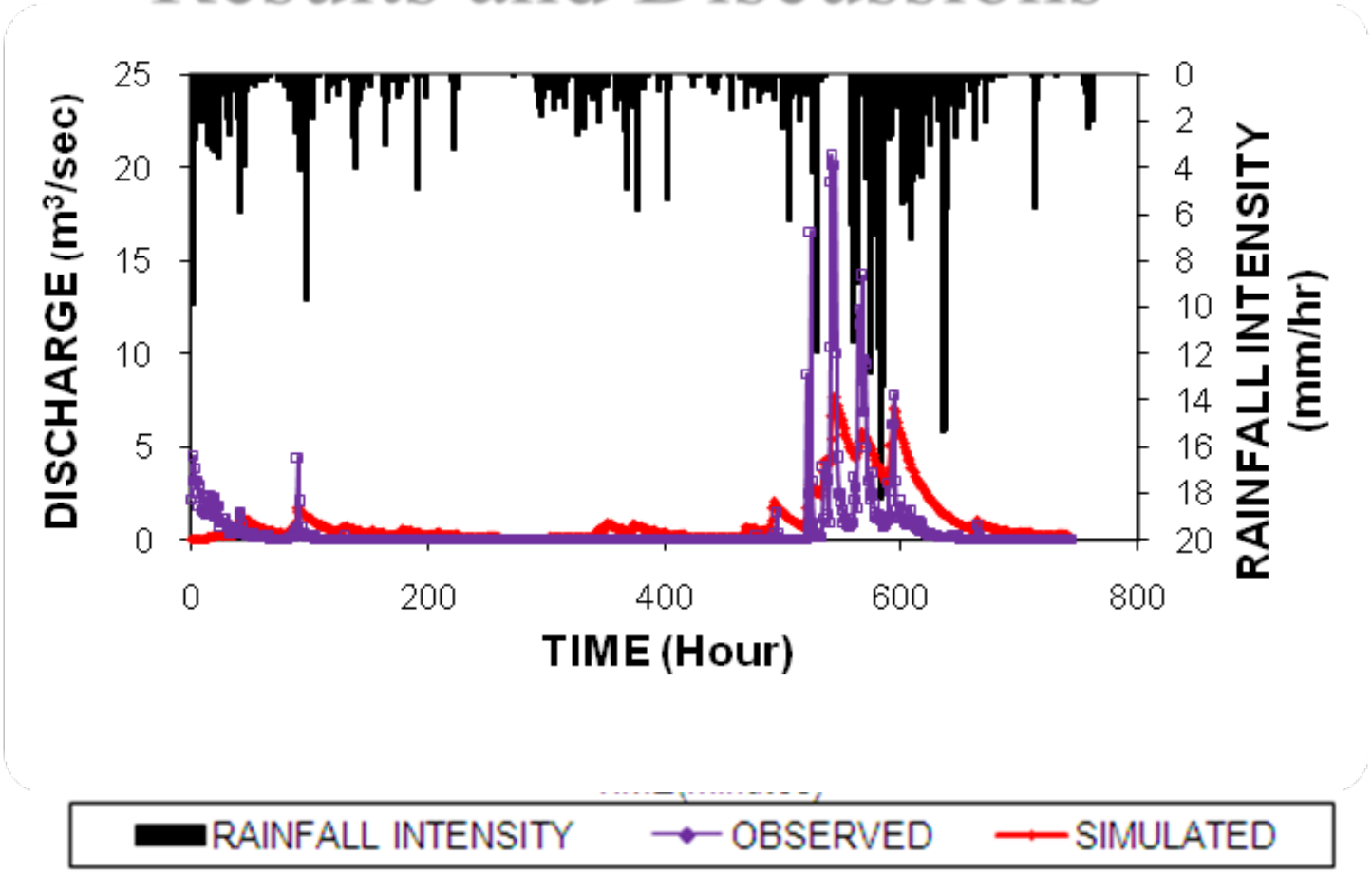


Modified Soil map of Harsul Watershed

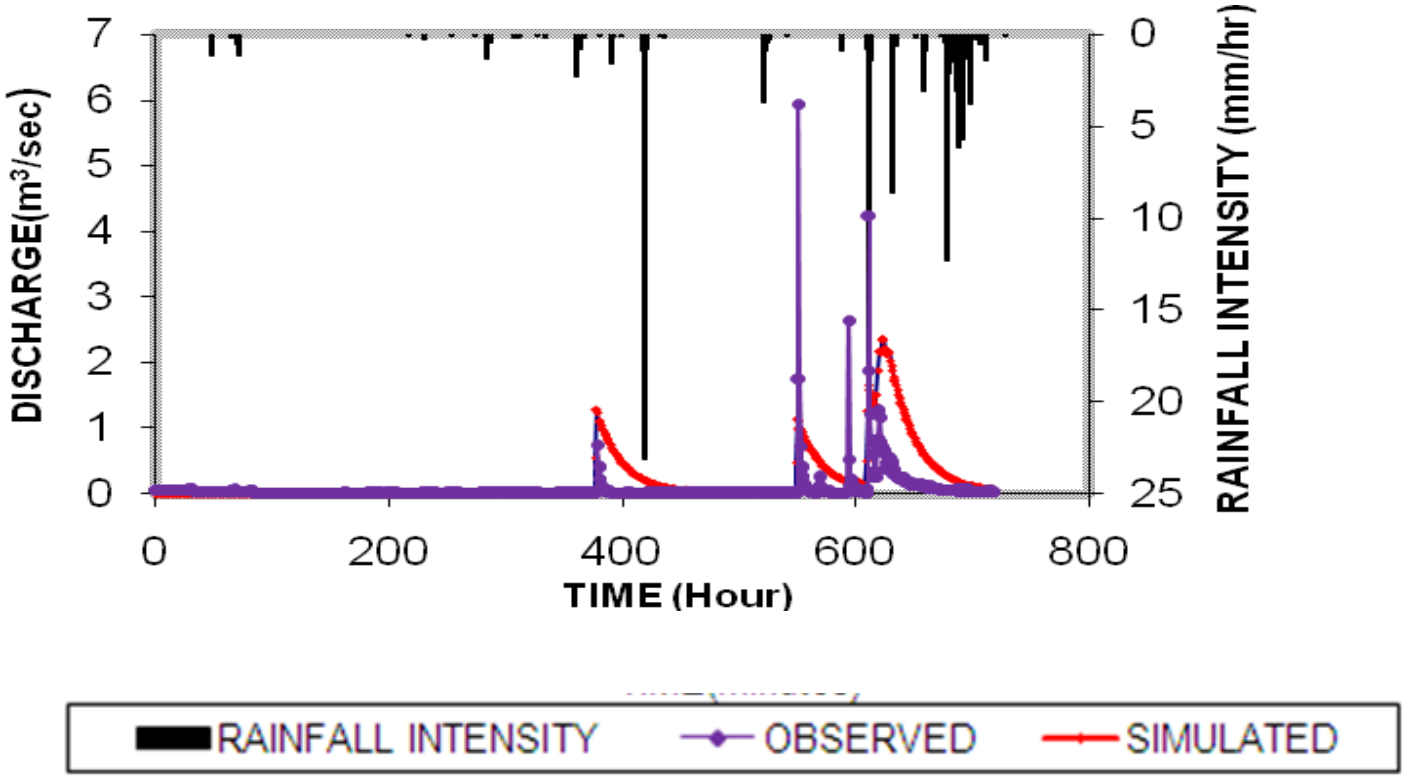


Modified LU/LC map of Harsul Watershed

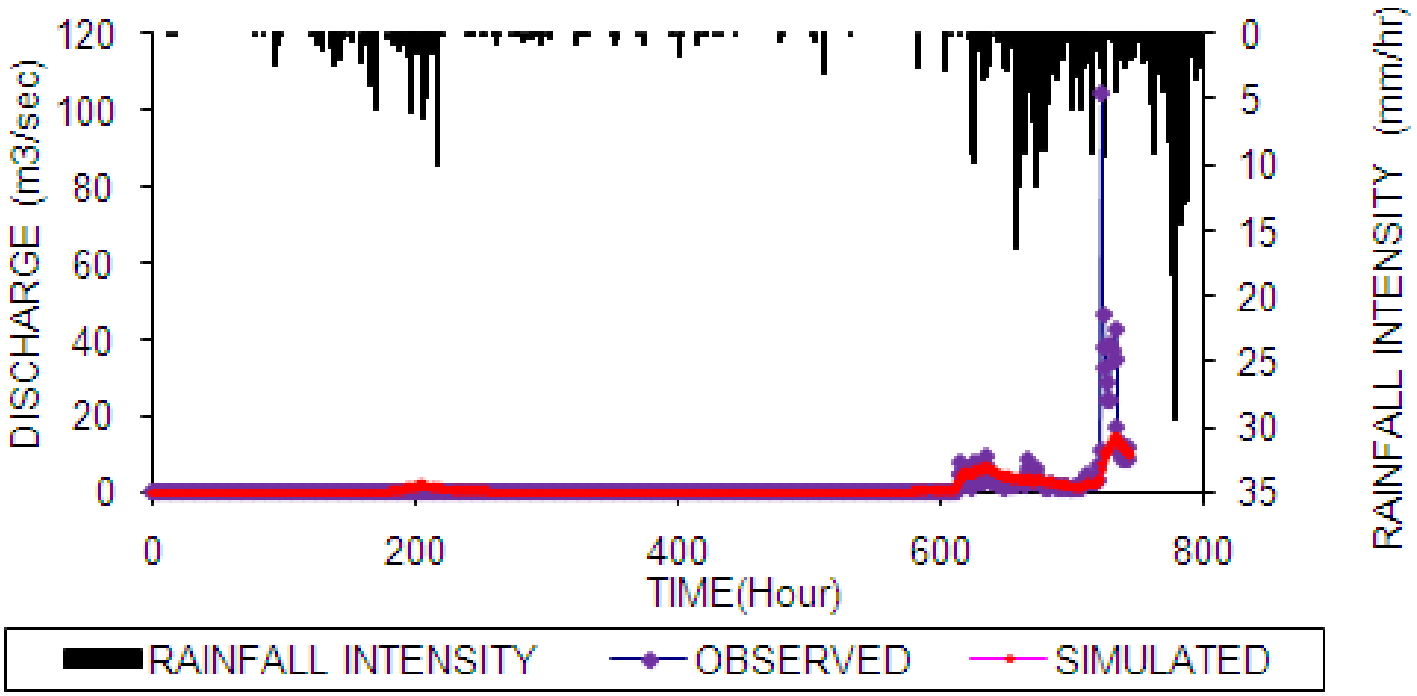
Results and Discussions



Simulated and Observed hydrographs for the Harsul watershed (July 1997)



Simulated and Observed hydrographs for the Harsul watershed
(September 1997)



Simulated and Observed hydrographs for the Harsul watershed (August 1997)

Table 1. Simulation results for Harsul watershed

Rainfall months	Volume of runoff (mm)		Peak runoff (m^3/sec)		Time to peak (Hour)	
	Observed	Simulated	Observed	Simulated	Observed	Simulated
July, 1997	307.76	242.21	104.784	12.9	723	730
August,1997	143.24	247.36	4.437	1.67	91	91
September, 1997	16.71447	47.42	5.935	2.37	551	623

Conclusions

- The model has been applied for the three month's rainfall data.
- From the simulations, it is observed that, the model is able to simulate the volume of runoff and time to peak runoff. But large variations are observed in peak runoff.
- This may be because of inexactness in the values of parameters.
- It is also observed that sensitivity analysis has to be carried out to improve the simulation results.
- The methodology presented in this study is useful to simulate hourly runoff in Indian watersheds using ArcSWAT models.

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