

# Chapter 4

## DATA AND MODEL SETUP

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### 1.1 Introduction

The present chapter details the data used for Rainfall Prognostic Model-based Artificial Framework and model setup for discharge prediction at M.H. Halli station. The work uses rainfall dataset in India to find model error and rainfall dataset used at M.H. Halli station for analyzing the rainfall-runoff.

### 1.2 Dataset description

The rainfall in India dataset is used for analysing the rainfall-runoff. It determines the rainfall for the period from 1901 to 2020. Granularity is represented month-wise like January-February, March-May, June-September, October-December and its location is from North-East. The annual rainfall record for each month is also described. The rainfall unit is expressed as millimeters in the dataset.

### 1.3 System Specification

The proposed technique is described in previous section 3 and in this section, the detailed explanation and its performance are analyzed. The proposed method is implemented in the working platform of MATLAB with the following system specification. Table 4.1 shows the detail of system specification which is used for this study.

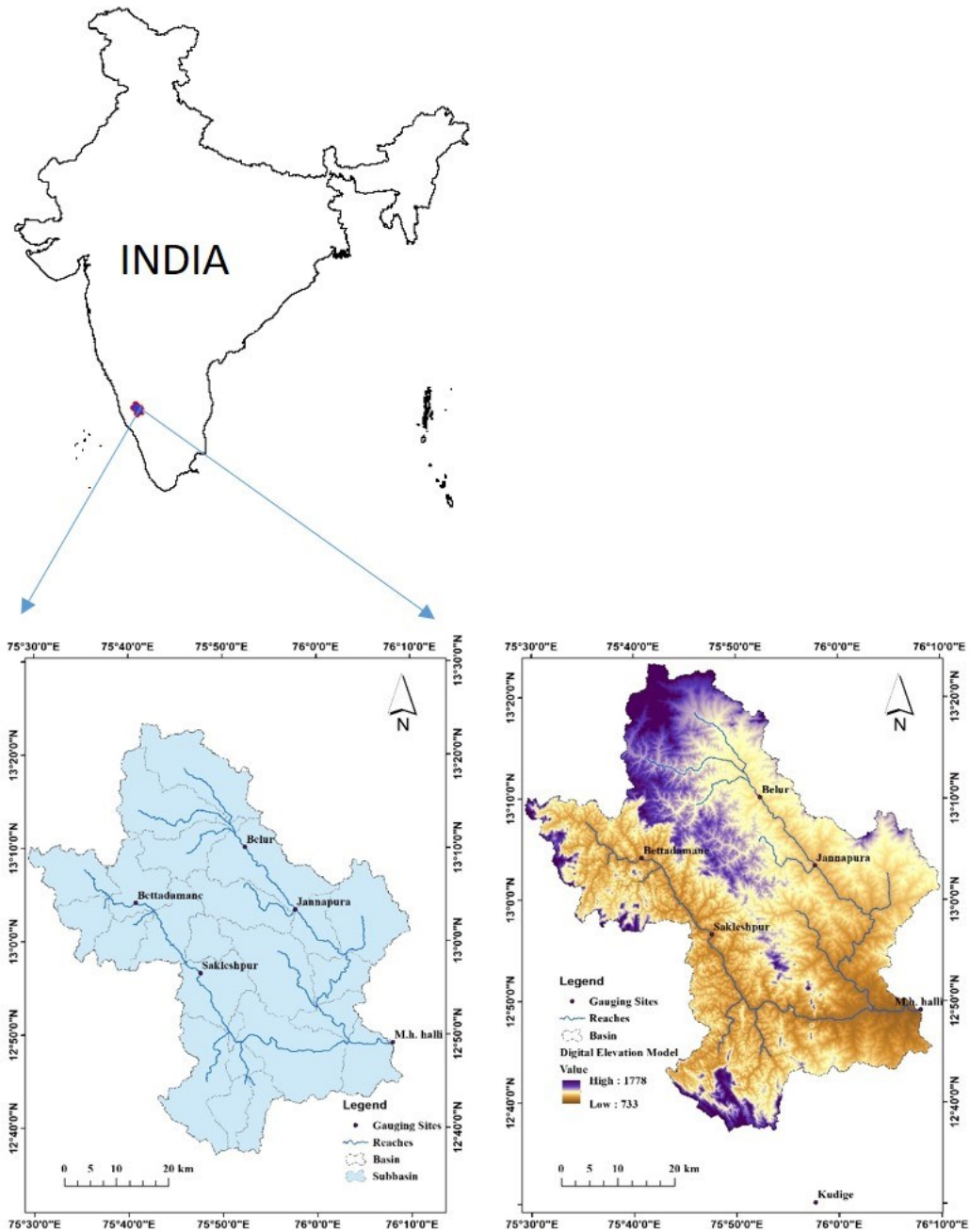
**Table 1.1 System Specification**

Platform	MATLAB 2019a
OS	Windows 8
Processor	Intel core i5
RAM	8 GB RAM

### 1.4 Study area and data set

The Hemavati River which is a major tributary of the Cauvery River, originates from the Western Ghats at an elevation of about 1219 m amsl near the Ballalarayanadurga village in the

Chikmagalur District of the Karnataka state, India. It passes from Hassan District and joins its chief tributary, the Yagachi River at Hemavati dam and then into Mysore district before joining the Cauvery River near Krishnarajasagara. It is approximately 245 km long and has a drainage area of about 5,410 km<sup>2</sup>. In this study the study area for hydrological simulation has been taken upto its gauging site located at M.H Halli. Geographically the study area has the extent of latitude from 12°37'8" N to 13°23'24" N and longitude from 75°29'23" E to 76°10'2" E. The study area falls under humid climatic conditions with an average annual rainfall of 1530 mm (Shekar and Hemalata, 2021) and the average annual maximum temperature of 29.35°C and min temperature of 18.68°C. The soil type is found to be loamy, clay and clay skeletal textures with deep in depth and well drainage class and the elevation profile falls between 733m to 1778m above mean sea level. Figure 4.1 shows the location map and digital elevation model for the study area.

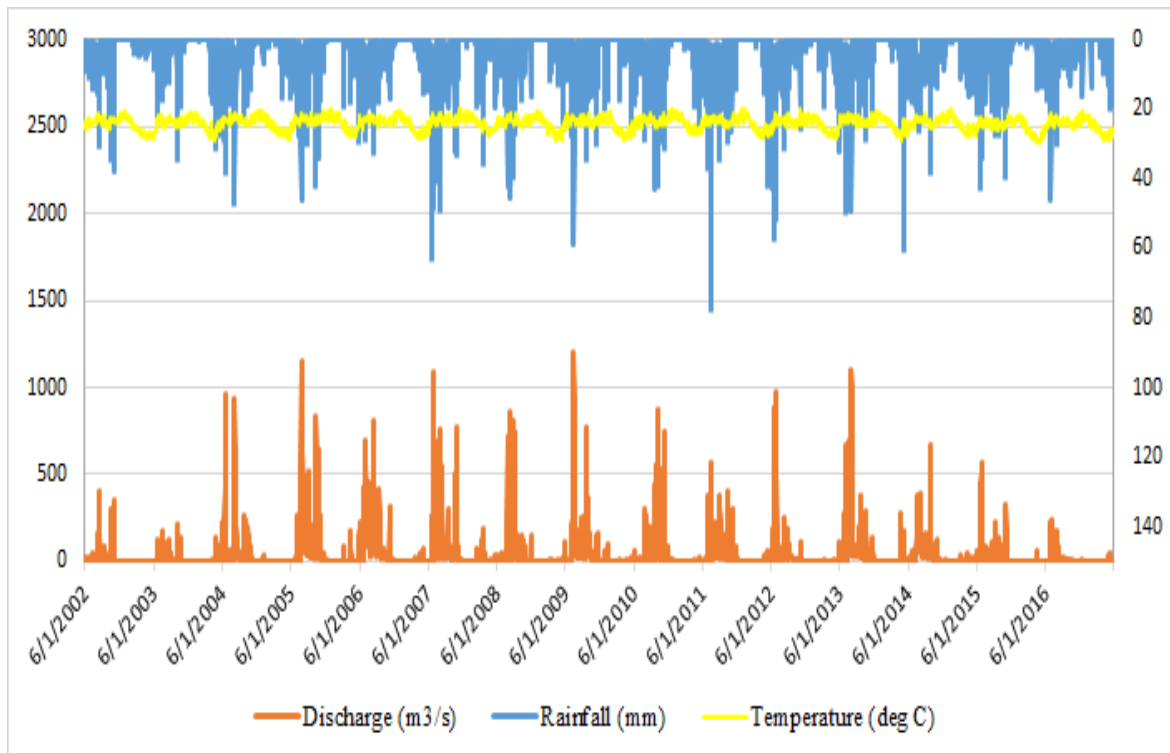


**Figure 1.1: Location map and Digital Elevation Model of the Study area**

For the period 2003 to 2017, discharge ( $\text{m}^3/\text{s}$ ), rainfall (mm) and temperature ( $^{\circ}\text{C}$ ) data in daily scale from the M.H. Halli station were used. First eight years of the data for discharge, rainfall and temperature were used for model development/calibration, while the remaining seven year was used to test and evaluate the model's performance. The time series of the whole data that was applied for M.H. Halli station is shown in Figure 4.2. The statistical parameters for the results are listed in Table 4.2.

**Table 1.2 Statistics of the data**

Dataset	Datatype	Data no.	Mean	STD	CV	Max	Min
Calibration (2003-2010)	Rainfall (mm)	1346	6.12	8.34	1.36	62.415	0.000
	Discharge (Cumec)		95.13	167.47	1.76	1203.000	0.023
	Temperature (°C)		23.23	1.01	0.05	27.733	19.920
Validation (2010-2017)	Rainfall (mm)	1198	6.33	8.67	1.37	76.940	0.000
	Discharge (Cumec)		68.53	123.19	1.80	1102.000	0.040
	Temperature (°C)		23.47	1.14	0.09	29.135	19.804



**c: Time series of observed data (rainfall, temperature and discharge) used for training and testing stages**

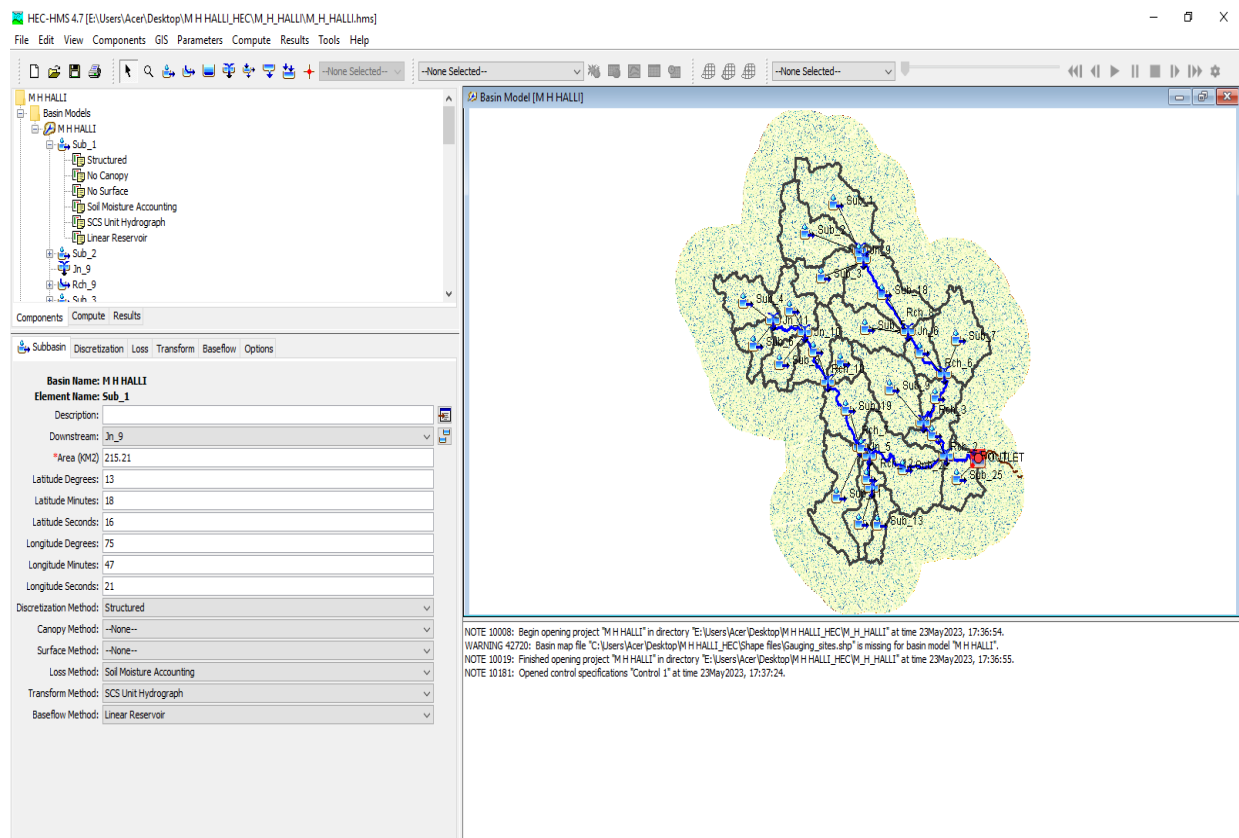
In Figure 4.3, It has been presented with a visual representation of the HEC-HMS model configuration, specifically designed for the estimation of discharge as part of a comprehensive rainfall runoff analysis. This graphical depiction offers a valuable insight into the intricate workings of the model.

One notable aspect highlighted in the figure is the utilization of the SCS (Soil Conservation Service) unit hydrograph method as the Transform method. This choice signifies the

incorporation of a well-established and widely used approach in hydrology. The SCS unit hydrograph method is employed to simulate the temporal distribution of runoff resulting from rainfall events, enabling a detailed analysis of how precipitation is transformed into runoff within the catchment.

Additionally, the figure indicates the adoption of the Linear Reservoir equation as the Base flow method. This component of the model is pivotal in accounting for the continuous, slow release of water into the river system, typically originating from groundwater sources. The Linear Reservoir equation represents an effective approach for modeling this base flow component, further enhancing the model's accuracy in estimating discharge.

Overall, Figure 4.3 serves as a valuable visual aid in comprehending the setup of the HEC-HMS model for rainfall runoff analysis. It showcases the integration of well-established methods and equations that are crucial for accurately estimating discharge within the context of hydrological studies.



**Figure 1.2 HEC-HMS model setup**

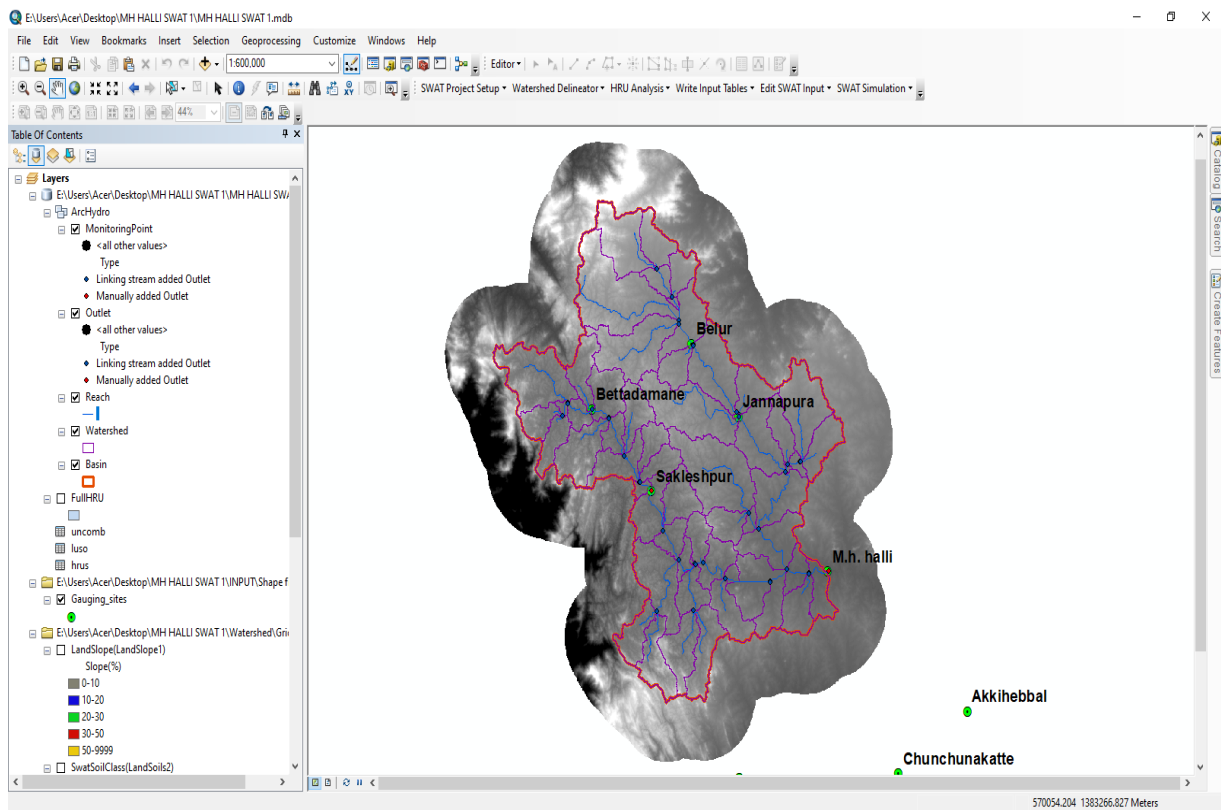
In Figure 4.4, It has been presented with an illustrative representation of the setup for the SWAT (Soil and Water Assessment Tool) model specifically configured for conducting Rainfall-Runoff Analysis within the M.H. Halli Catchment. This visual depiction provides a

comprehensive overview of the key components and characteristics of the model as they pertain to this specific study area.

The figure begins by offering a geographical context, giving us a clear understanding of the M.H. Halli Catchment's boundaries and spatial extent. This is crucial as it defines the area under investigation and sets the stage for the subsequent hydrological analysis.

Within the figure, various elements of the SWAT model setup are delineated, such as land use, soil types, terrain characteristics, and hydrological features. These components are fundamental to the model's functionality, as they represent the physical attributes of the catchment that influence rainfall-runoff processes. Furthermore, Figure 4.4 may also include information regarding the selection and calibration of model parameters specific to the M.H. Halli Catchment. This could encompass details on the selection of hydrological equations, the characterization of land use changes, and the integration of meteorological data.

By visually presenting these details, Figure 4.4 serves as a valuable reference for understanding the specific configuration and nuances of the SWAT model tailored to the unique characteristics of the M.H. Halli Catchment. It facilitates a deeper comprehension of how the model is applied to analyze rainfall-runoff dynamics within this particular geographical area, aiding researchers and stakeholders in their hydrological assessments and decision-making processes.



**Figure 1.3 SWAT model setup**

In this particular study, the calibration of the Soil and Water Assessment Tool (SWAT) model was deemed unnecessary. The decision was based on the observation that the initial simulation results met the predefined criteria of satisfaction, as suggested by Moriasi et al. (2007). The satisfactory performance of the model in reproducing the hydrological behaviors of the study area was attributed to the proper setup of the model, as detailed in the methodology section. Consequently, given the favorable results and the confidence in the initial model configuration, no further calibration of SWAT model parameters was undertaken for this specific study.