IMPACT OF CALIBRATION DATA LENGTH ON THE PERFORMANCE OF SWAT MODEL

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Introduction

- Hydrological models are tools commonly used for simulating the water cycle at basin scale for predicting water yield due
  - Land use / land cover changes
  - Infrastructural development
- Identifying the model parameters has been a task
  - Using the stream flow measurements
  - Field measurements

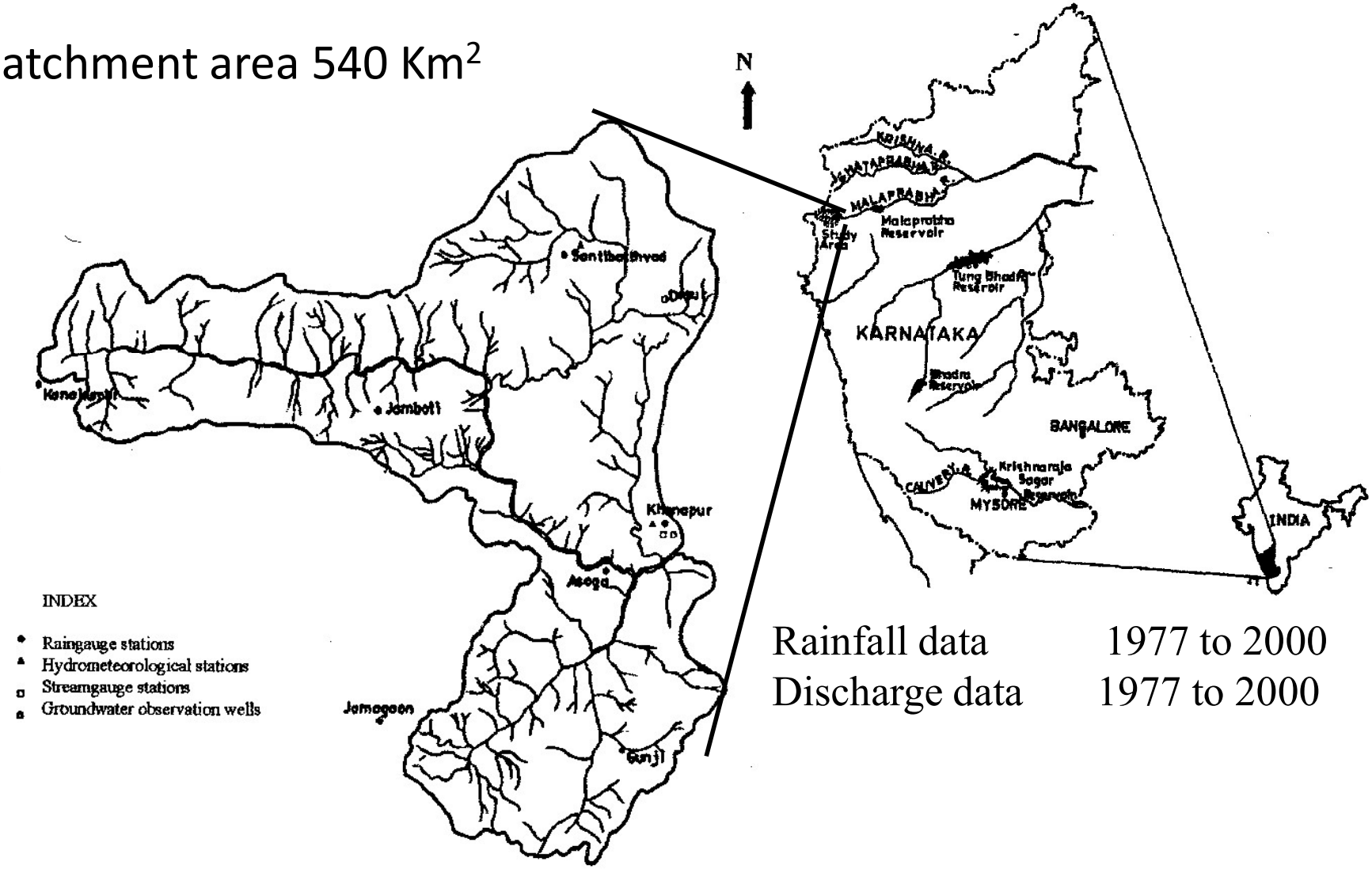
- Several researcher have concluded that, the model performance can be significantly improved when only the data length representing the wettest or dry period are used for calibration. Then the following question raises
  - (i) How the model perform, when the entire length of data available is used for calibration;
  - (ii) what will be the effect of using Wet period data for calibration and it effect on validation under the drier condition; and
  - (iii) How different are the model parameters when Dry period data used for calibration and its effect on validation under the wetter condition

Objectives of the Study

- The objectives of the study
  - Gain insights into hydro-climatic behaviour of the model in dry and wet years which are the climatic extremes; and
  - to understand the uncertainty of the model prediction.

Study Area

Catchment area 540 Km^2



Rainfall data 1977 to 2000

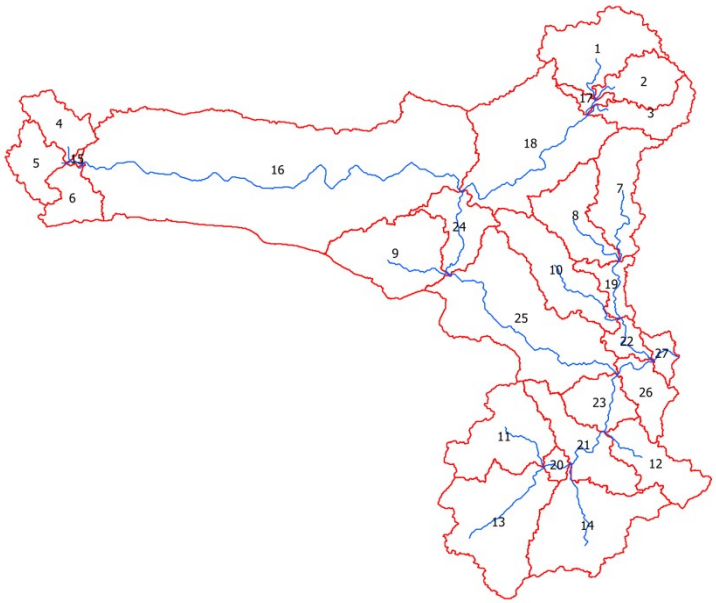
Discharge data 1977 to 2000

Methodology

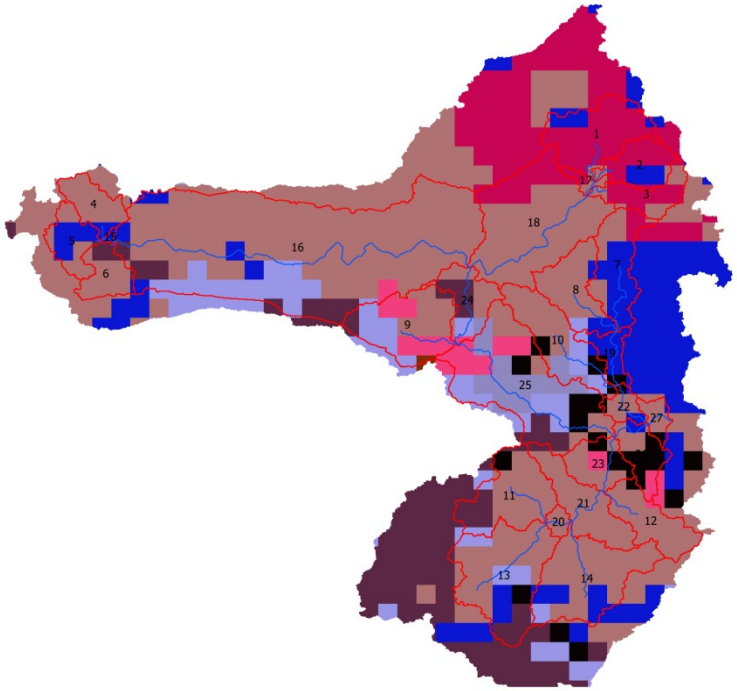
- The methodology used in the study is as follows
  - Setting up of SWAT Model
  - Calibration and Validation of model for entire period (1980-1994)
  - Calibration of model for dry period and validation wet period
  - Calibration of model for wet period and validation for Dry period

SWAT Model Set-up

Sub-basin : 27
HRU : 27



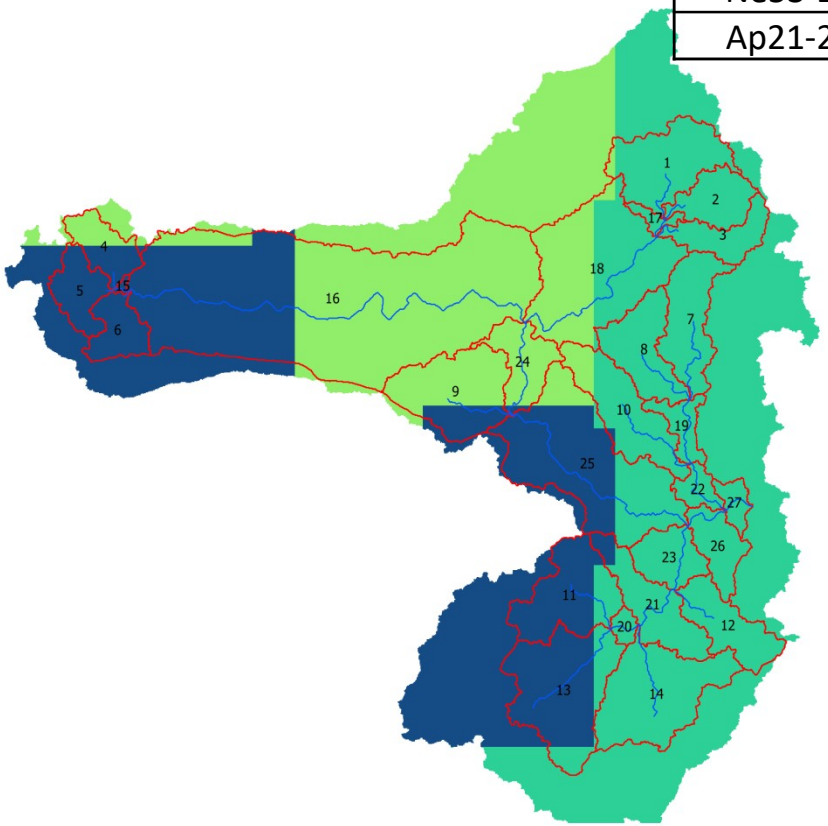
Land-use



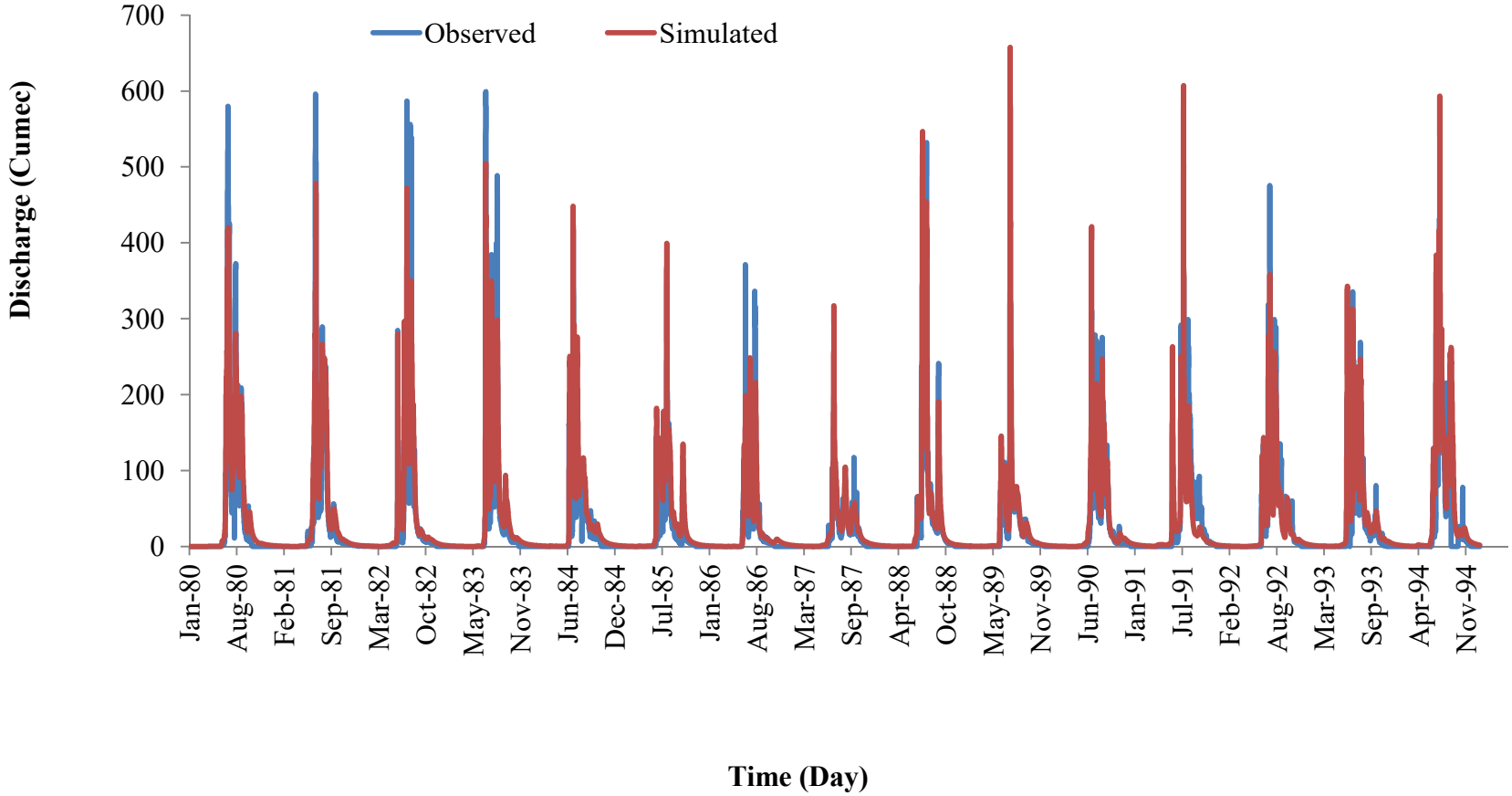
Type	Land-use	Aea (Ha)	% of total area
CRDY	Dryland Cropland and Pasture	3160.15	8.32
CRIR	Irrigated Agriculture	1485.99	3.91
CRGR	Cropland/grass land mosaic	3046.01	8.02
CRWO	Cropland/woodland mosaic	3229.4	8.5
SHRB	Shrubs	1350.33	3.56
SAVA	Savana	22386.76	58.94
FODB	Deciduous broad leaf forest	1169.7	3.08
FOEB	Evergreen Broad leaf forest	2122.06	5.59
FOMI	Mixed forest	30.9	0.08

Soils

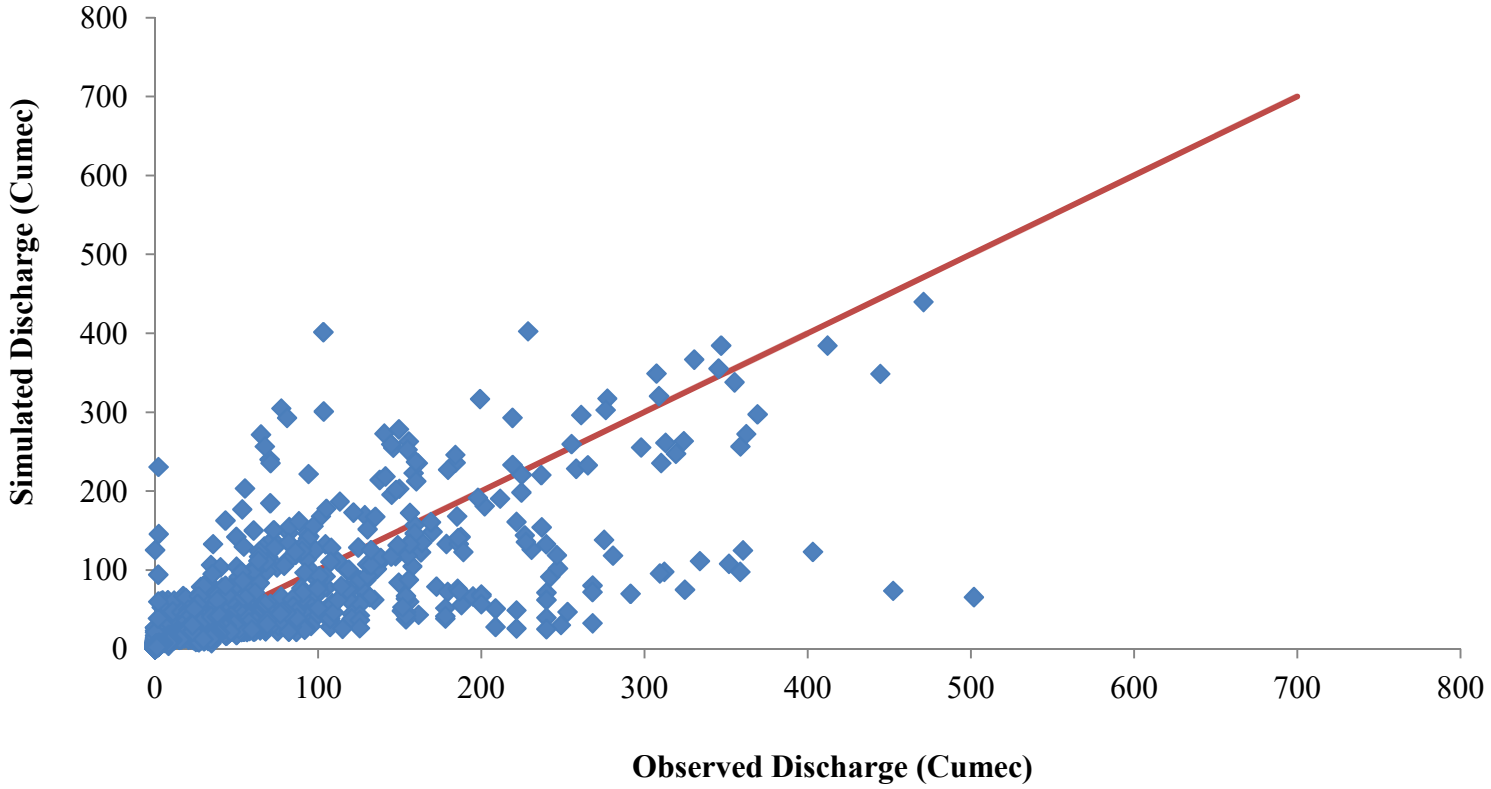
Type	Soil type	Aea (Ha)	% of total area
Bv-3b-3696	Clay-Loam	10702	28.2
Ne53-2b-3825	Sandy-loam-clay	16375	43
Ap21-2b-3656	Sandy-clay-loam	10903	28.8



Calibration of model for data 1980-1994

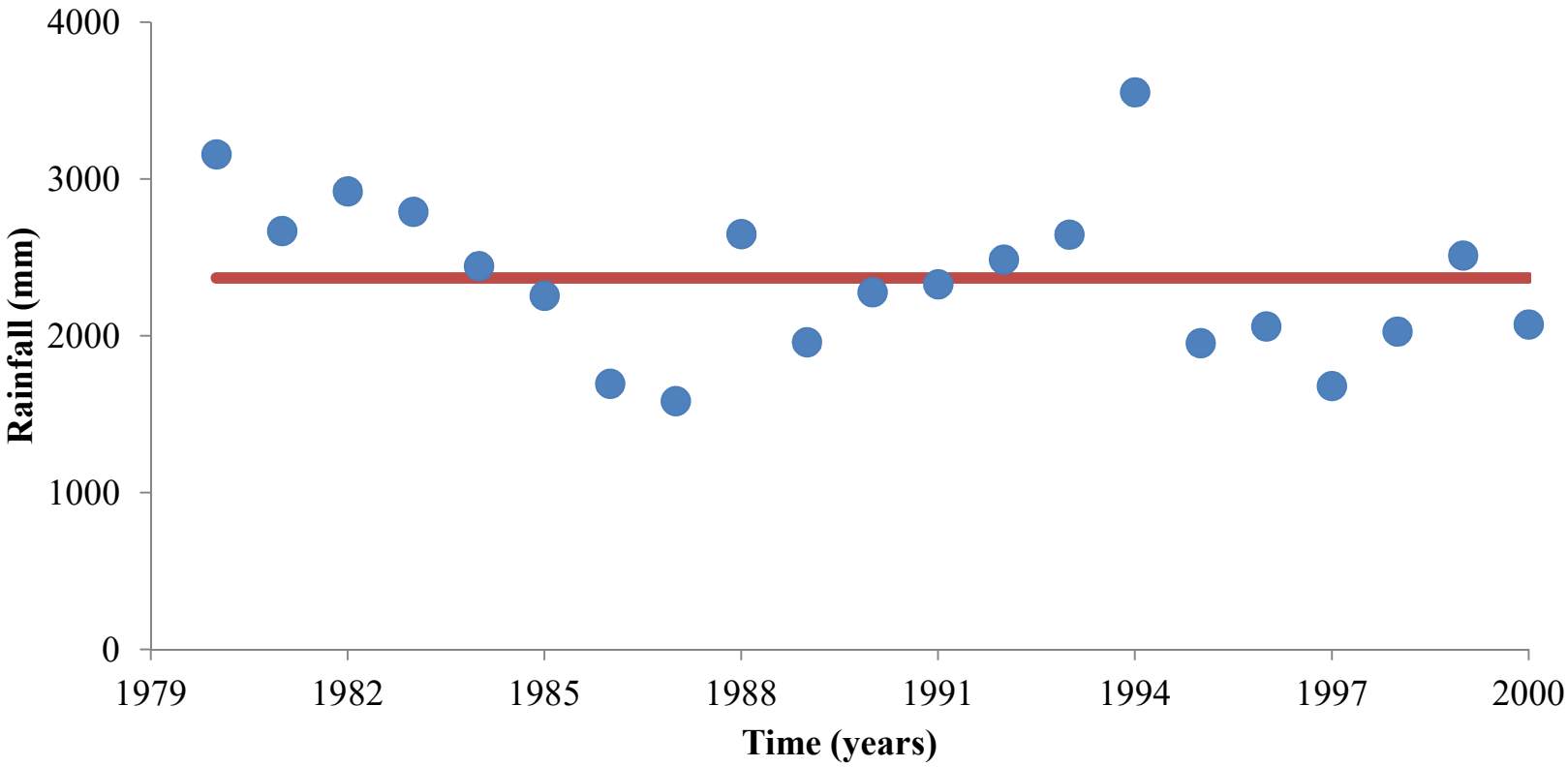


Validation



Performance Index	Values obtained	
	Calibration Period	Validation Period
Root Mean Square Error (RMSE)	27.76	38.39
Correlation coefficient	0.78	0.73
Mean Absolute Error (MAE)	6.93	1.41
Index of agreement (d-Index)	0.70	0.75

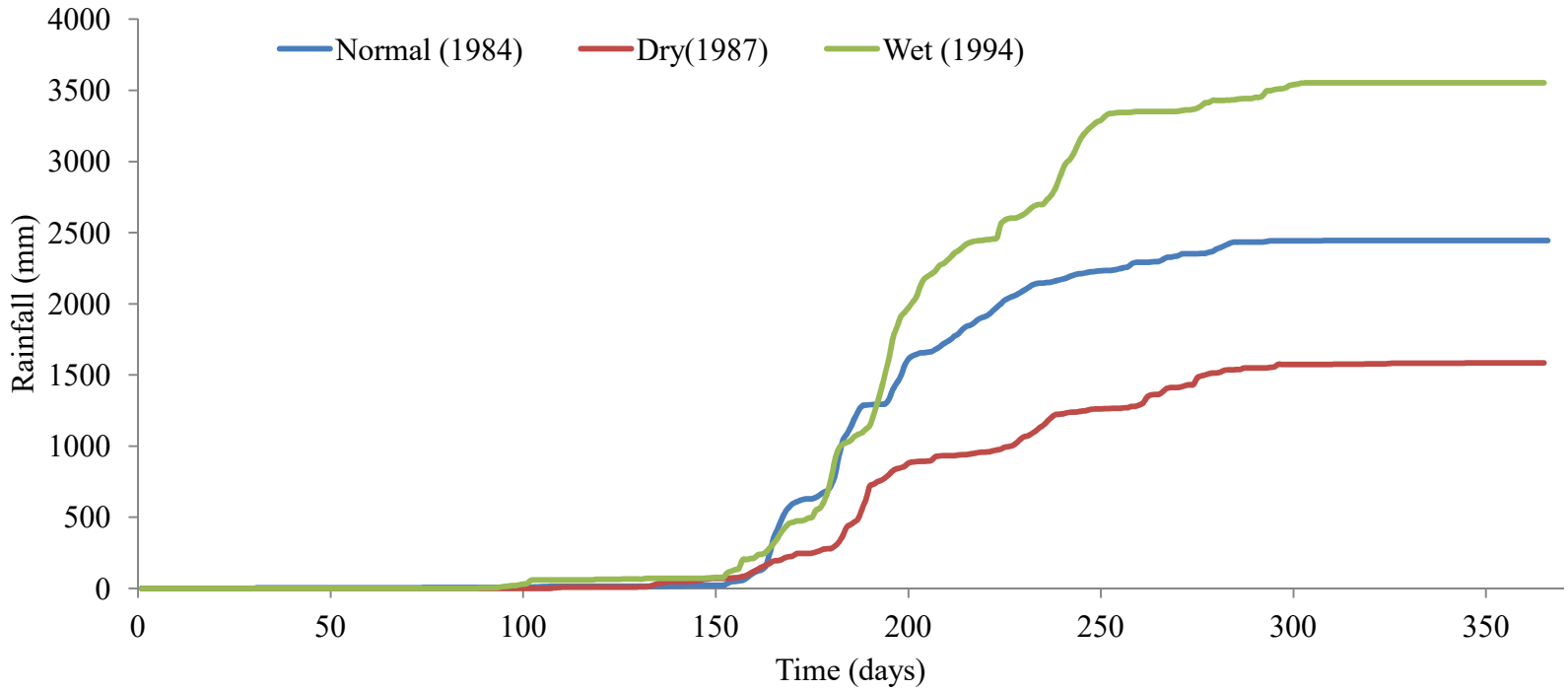
Wet and Dry year



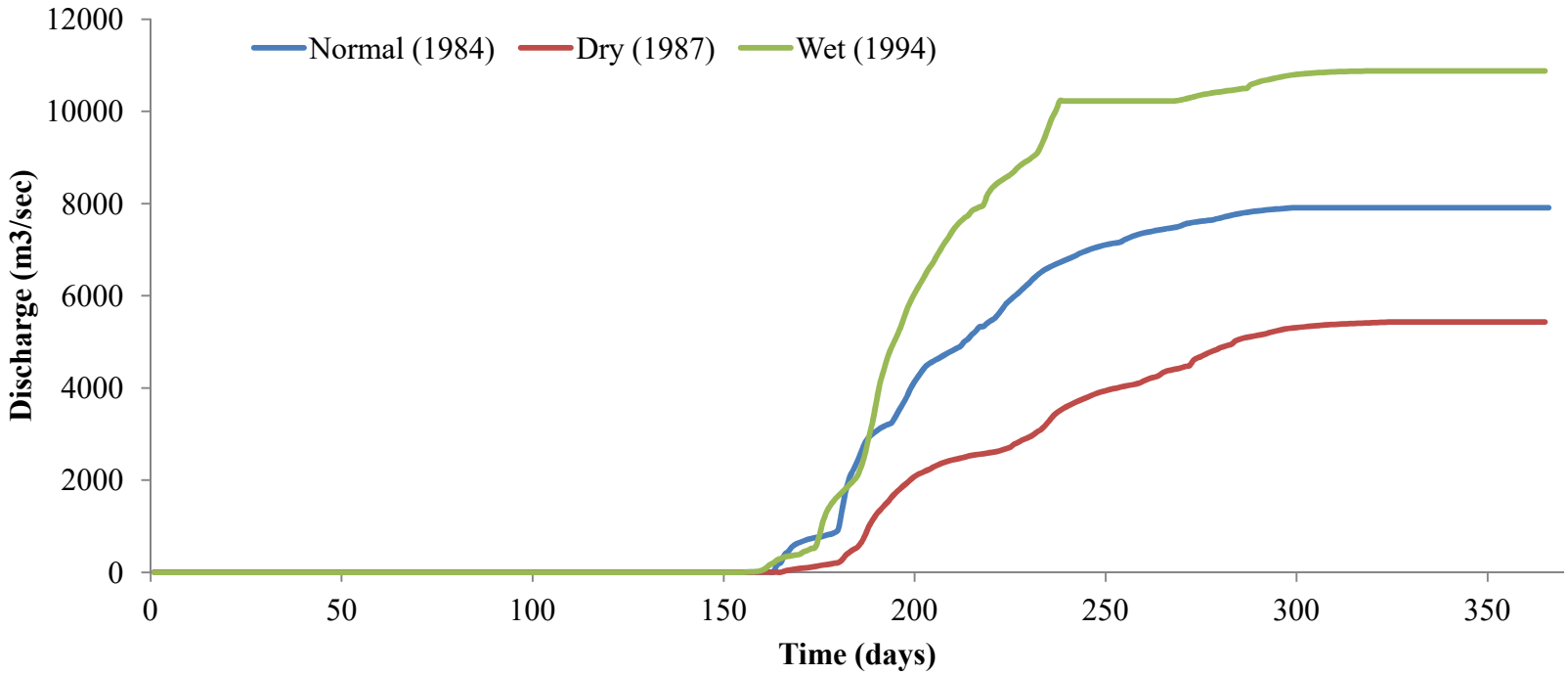
Wet Years : 1980 to 1984

Dry Years : 1985 to 1987

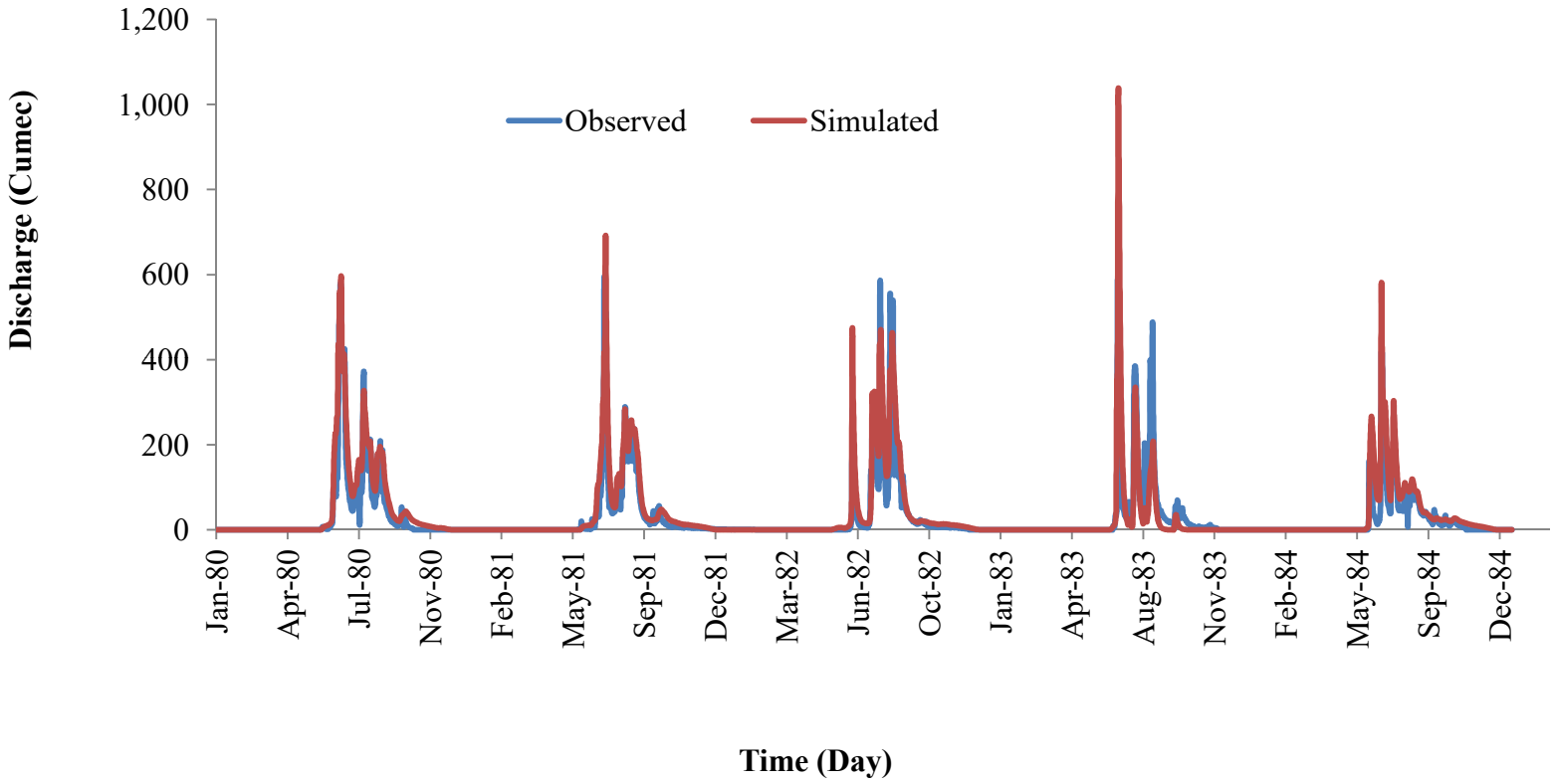
Rainfall


Normal (1984)
Dry(1987)
Wet (1994)
Rainfall (mm)
4000
3500
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
300
350
Time (days)

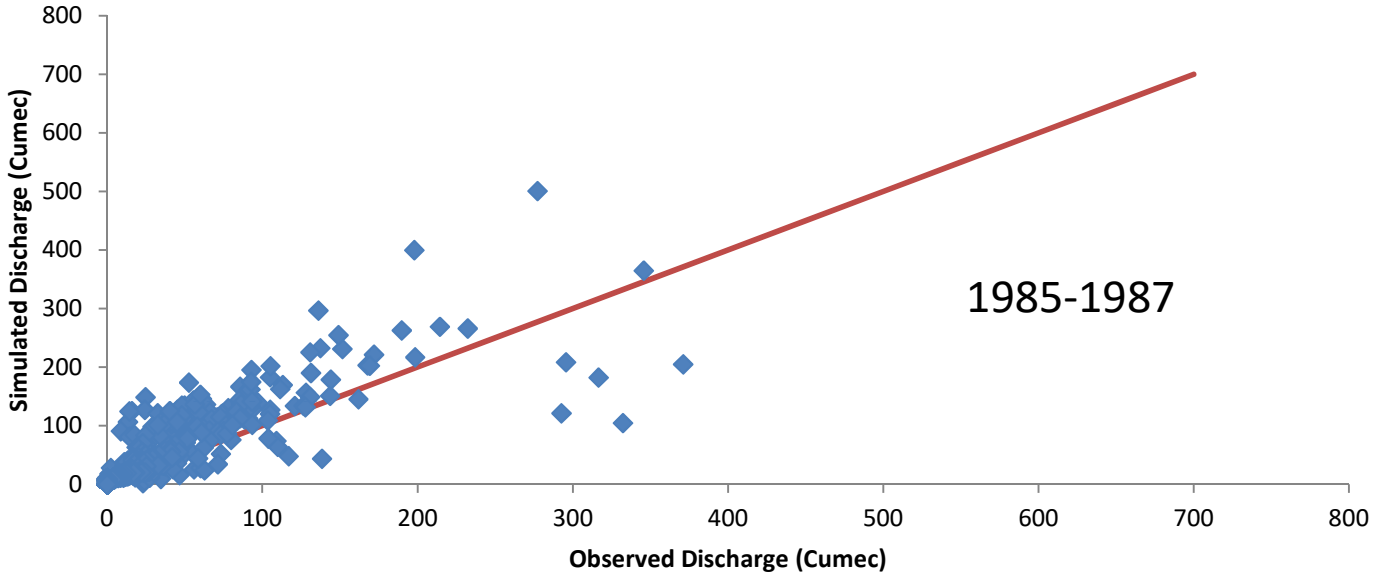
Discharge


Normal (1984)
Dry (1987)
Wet (1994)
12000
10000
8000
6000
4000
2000
0
Discharge (m3/sec)
0
50
100
150
200
250
300
350
Time (days)

Calibration of Wet year and validation with dry year

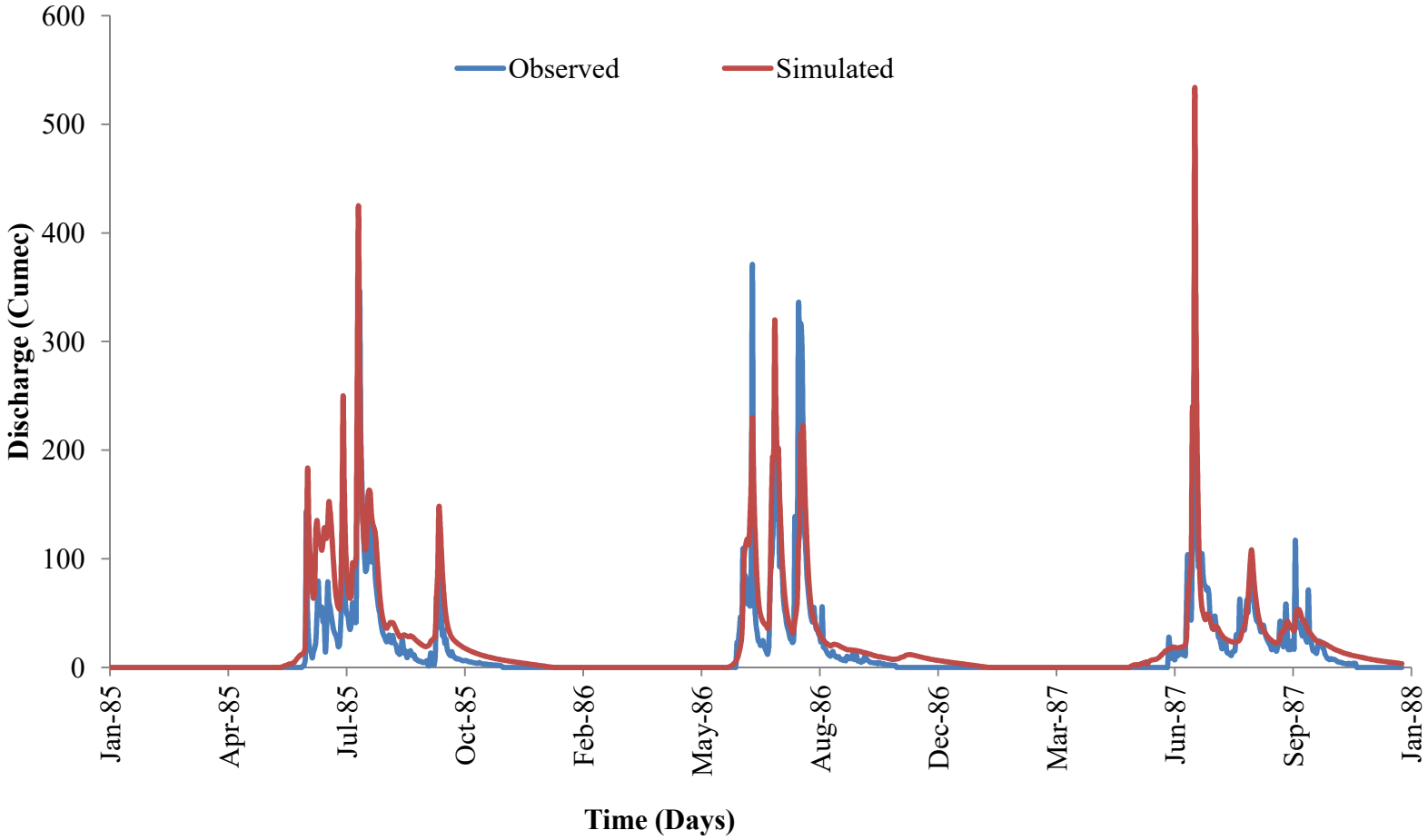


Calibration of Wet year and validation with dry year

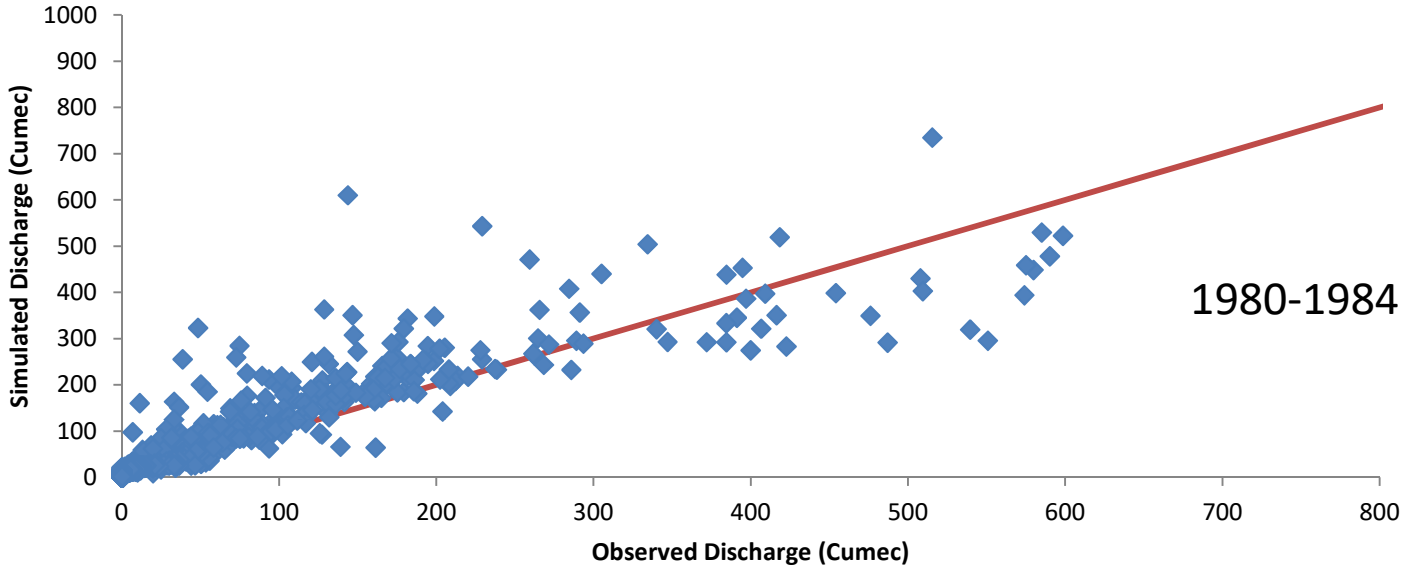


Performance Index	Values obtained	
	Calibration Period	Validation Period
Root Mean Square Error (RMSE)	41.49	26.35
Correlation coefficient	0.80	0.78
Mean Absolute Error (MAE)	9.09	8.25
Index of agreement (d-Index)	0.77	0.75

Calibration of Dry year and validation with Wet year



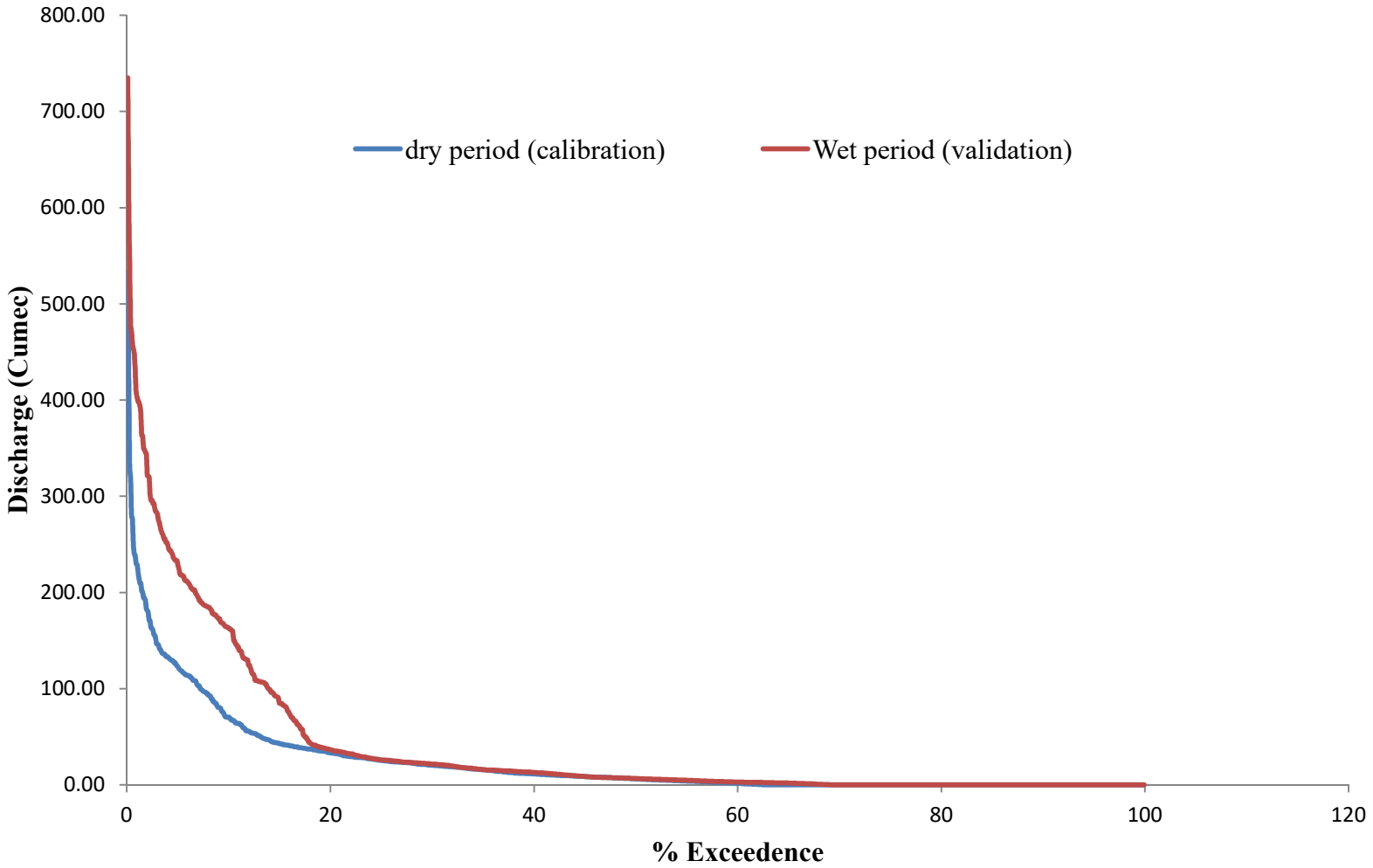
Calibration of Dry year and validation with Wet year

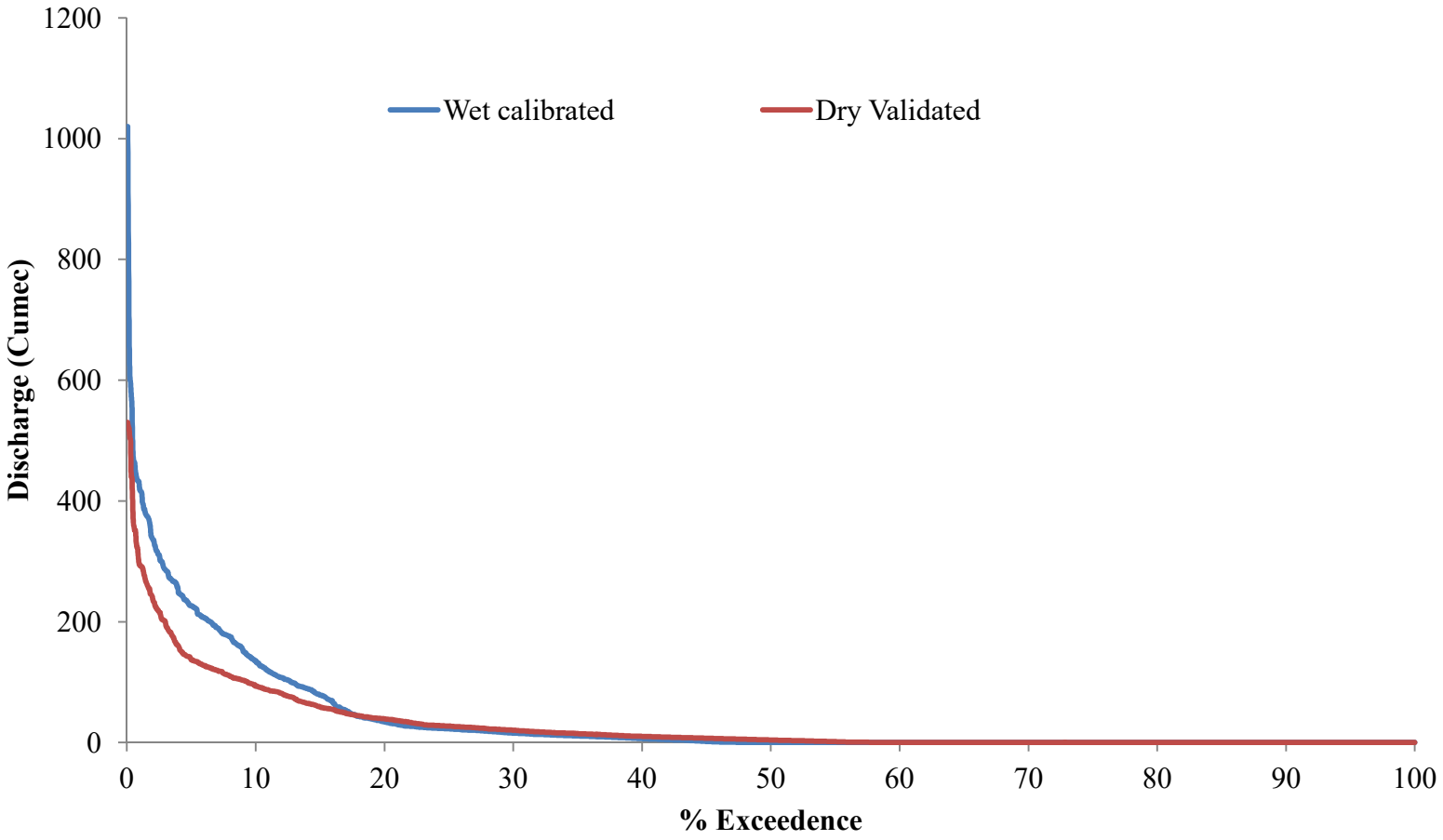


Performance Index	Values obtained	
	Calibration Period	Validation Period
Root Mean Square Error (RMSE)	25.84	33.48
Correlation coefficient	0.76	0.72
Mean Absolute Error (MAE)	7.74	10.04
Index of agreement (d-Index)	0.81	0.79

Optimised model parameters

	Description			
		Full length	Wet period	Dry period
Alpha_BF	Baseflow Recc. Constant	0.048	0.048	0.055
CN2	SCS runoff curve no for AMC-2	80	73	83
ESCO	Soil evaporation compensation factor	0.65	0.65	0.76
EPCO	Plant Uptake compensation factor	0.3	0.27	0.32
Sol_AWC	Available soil Water capacity	0.7	0.8	0.65
SOL_K	Soil saturated hydraulic conductivity	30	30	30
GW_Delay	Groundwater delay time	31	31	38
GWQMN	Threshold water level in the shallow aquifer for return flow	350	320	435
Rcharg_DP	Aquifer percolation coefficient	0.1	0.1	0.15


800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Discharge (Cumec)
dry period (calibration)
Wet period (validation)
0
20
40
60
80
100
120
% Exceedence


1200
1000
800
600
400
200
0
Discharge (Cumec)
Wet calibrated
Dry Validated
0
10
20
30
40
50
60
70
80
90
100
% Exceedence

Observations

- From this study, following points are observed
  - SWAT model was successfully calibrated and validated for different rainfall conditions to simulate the flows
  - The model appears to perform better is both the condition with small variation in the model parameter value
  - The model showed ability to simulate the catchment water balance and flow consistent with the weather parameters

Observation

- From the plot of observed and simulated flows, it is observed that, the model is able to predict the peak and time to peak accurately