HYDROLOGICAL MODELLING OF GOI RIVER WATERSHED OF NARMADA BASIN USING SOIL & WATER ASSESSMENT TOOL (SWAT)

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Contents

Introduction

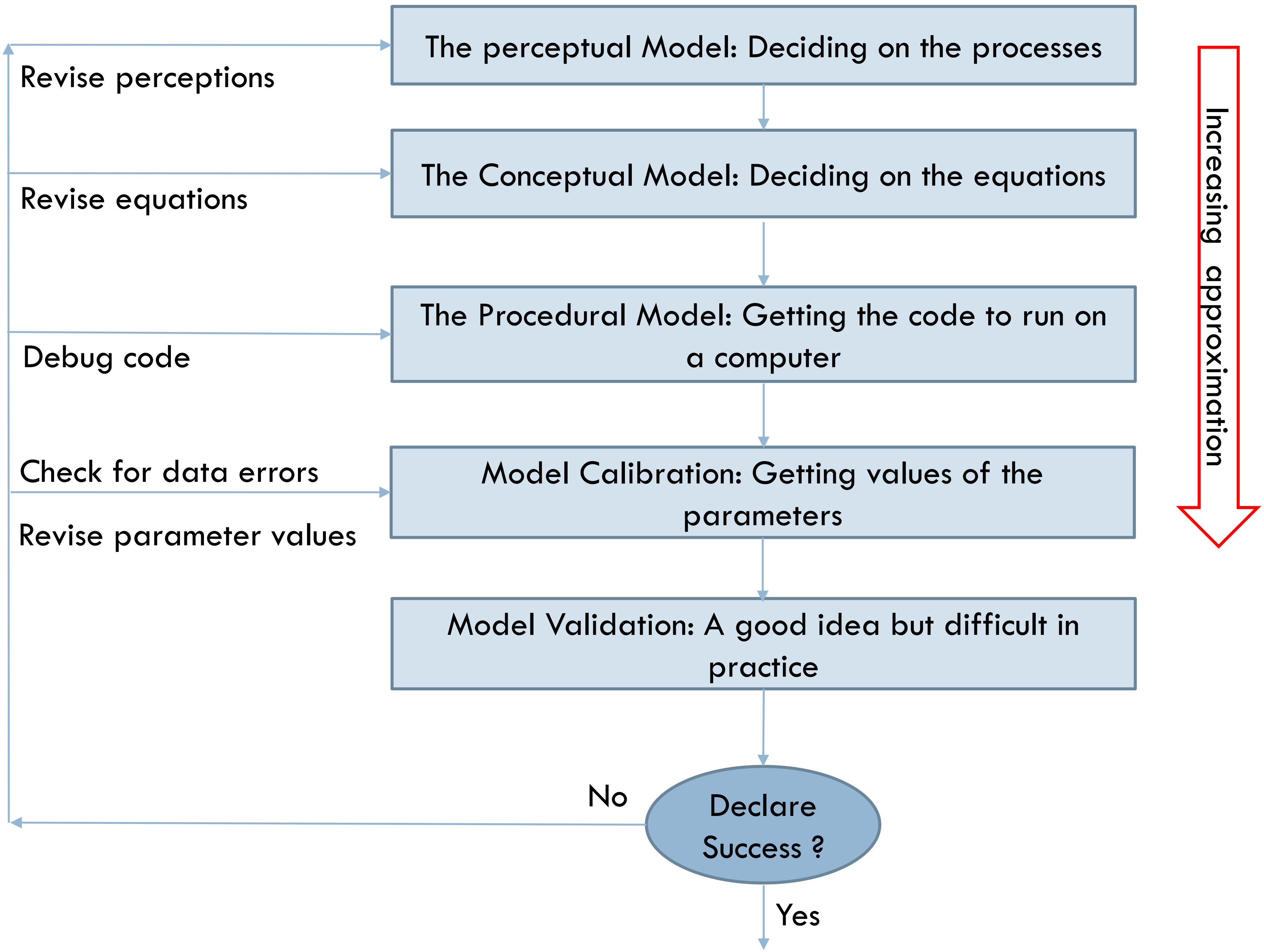
- The Watershed complexity at all levels that pushes us to move towards the advancement in modelling & its components.
- The occurrence of climate change scenarios and uncertainties arising from different aspects needs to be inculcated and many such parameters associated are to be easily handled by modelling techniques only.
- The watershed management activities that are planned for the regional to local administration level needs a good scale difference model respectively.
- Apart from above, the changing landuse/land cover, industrialization activities that are dynamic in pattern has remarkable impact on the watershed and it needs to be addressed very precisely.

Importance of Watershed Modelling

- It meant for formalizing knowledge about hydrological systems.
- The ultimate aim is to improve decision making process about a hydrological problem e.g. drinking water, agricultural needs, water resources planning, flood protection, mitigation of contamination, etc., by keeping sustainability as a goal.
- The models are the useful tools and default choice for predicting future from the current & past scenarios.

Future Management activities such as Water & other resources management, Ecological restoration, etc., in the Watershed at different scale with different Data resolutions that directly or indirectly related with Socio-economic and political processes associated with it.

A Schematic outline of the steps in the modelling process



Problem Statement

- Geographically, the problems identified at local scale level and their solutions, provides really an optimal sustainable development, maintenance of quality and efficient use of water resources to match with growing demands.
- By keeping this in mind, the area covered by Goi Watershed of Narmadha Basin in West Central India which has problems of flooding, irrigation and drought in different years with evident is taken into consideration.

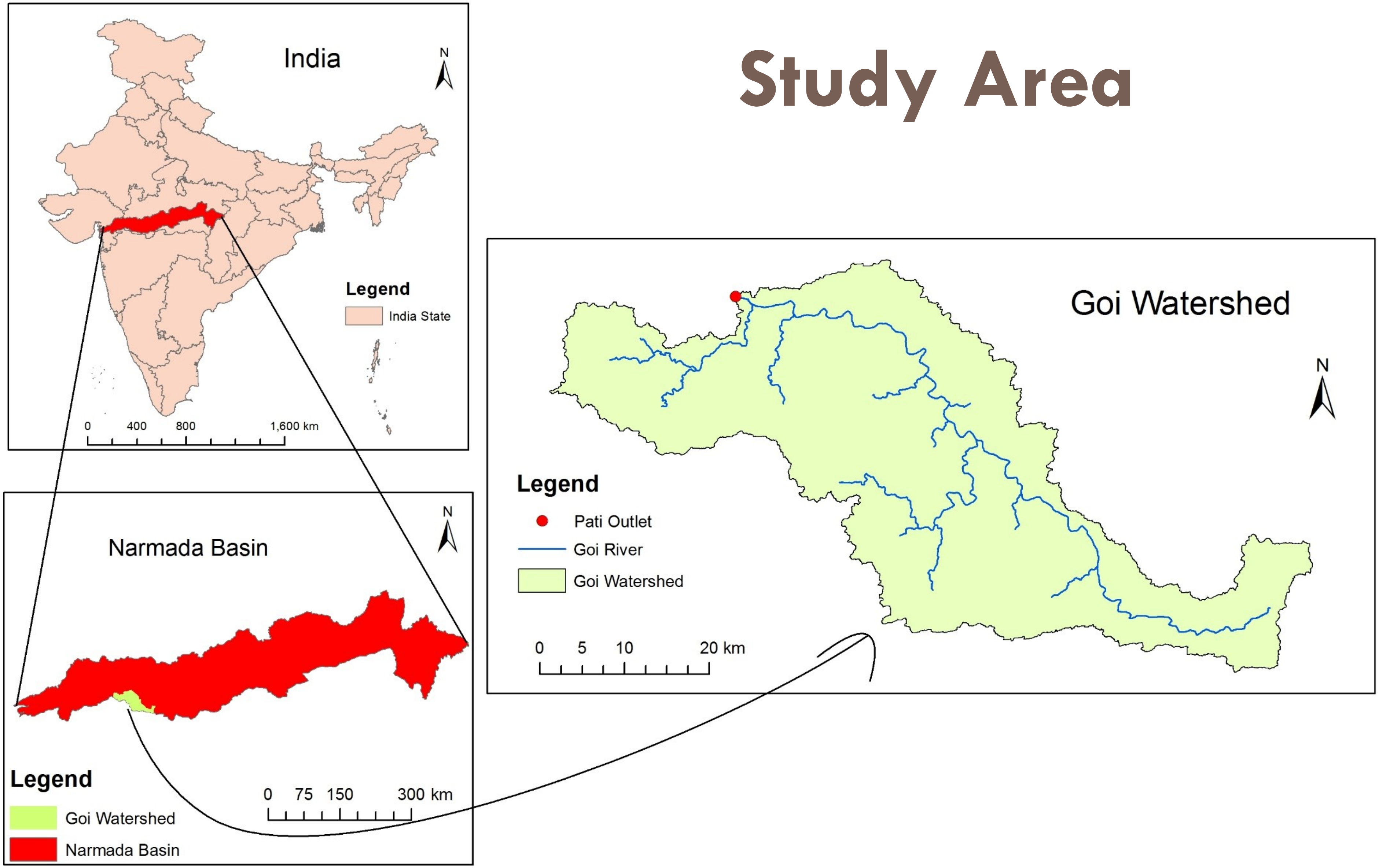
Objectives

- Development of Hydrological model using SWAT
- Model Calibration, Uncertainty Prediction, Parameter Sensitivity Analysis and Validation of model.

Study Area

- The Study area is Goi River Watershed of Narmada basin in India. This Goi river is considered to be one of the friends river of Narmada River. The delineated watershed area is about 1690.52 km^2 .
- It lies in the Lat, Lon range of 21° 30'N to 22° 0'N and 74° 30'E to 75° 25'E respectively.
- The discharge measuring station is at Pati established by CWC, India.
- The minimum and maximum elevation range is from 131m to 950m.

Study Area


India
N
Legend
India State
0 400 800 1,600 km
Narmada Basin
N
Legend
Goi Watershed
Narmada Basin
0 75 150 300 km
Goi Watershed
N
Legend
Pati Outlet
Goi River
Goi Watershed
0 5 10 20 km

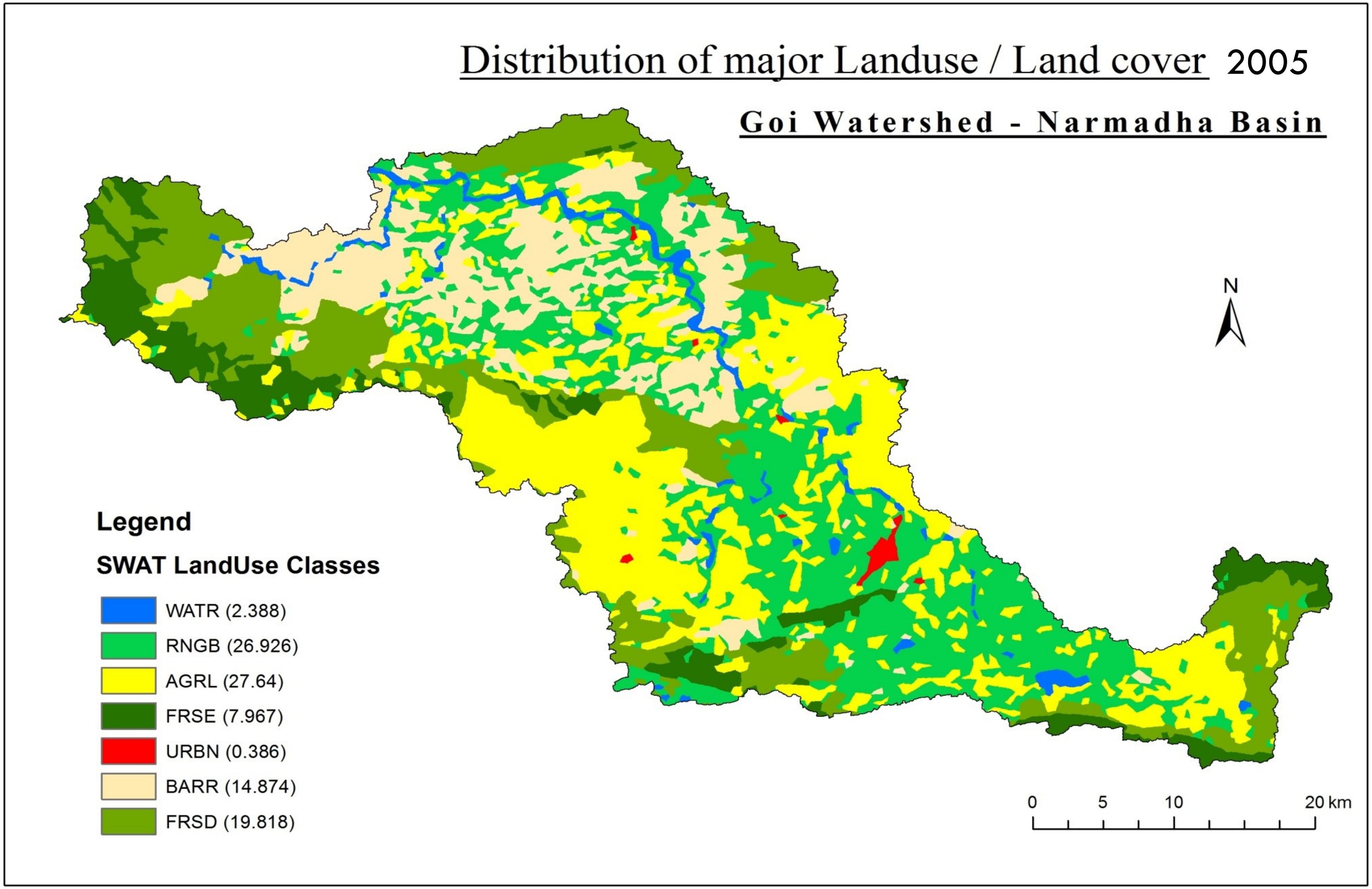
Data Used

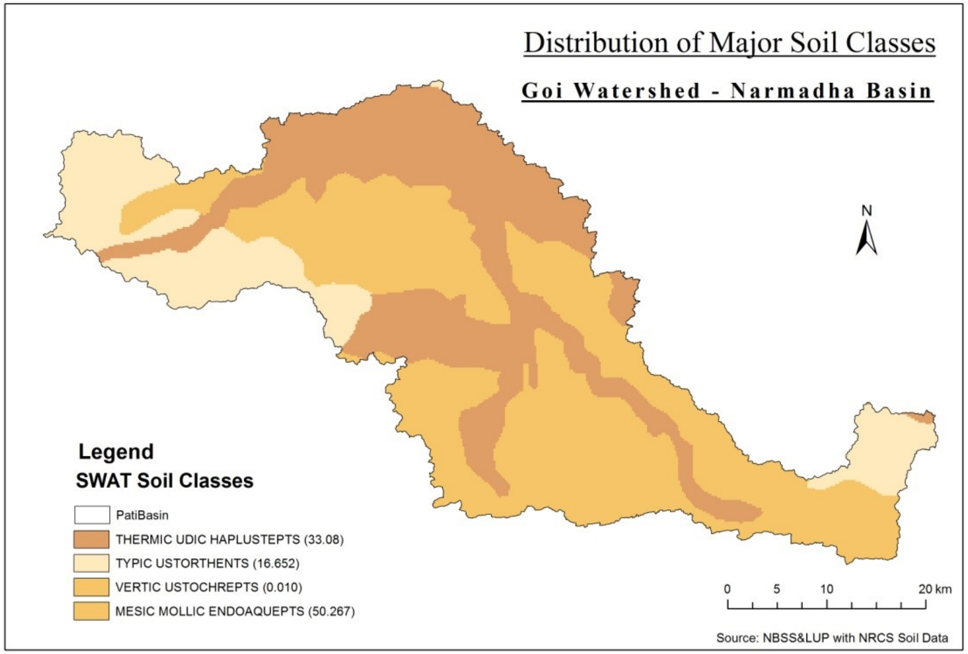
- LandUse/Land Cover
  - The landuse/land cover is obtained from NRSC/ISRO (2005)
- Soil
  - NBSS&LUP Soil Information
- Slope
  - Cartosat-DEM Version-3DR
- Weather Data
  - IMD(PCP) & NASA(other)

Weather Data

- Precipitation
  - IMD 0.25° X 0.25° Gridded Rainfall(2003-2010)
- Temperature
  - NASA Merra 0.5° X 0.5° Gridded Temperature(2003-2010)
- Relative Humidity
  - NASA Merra 0.5° X 0.5° Gridded RH(2003-2010)
- Solar Radiation
  - NASA Merra 0.5° X 0.5° Gridded SR(2003-2010)
- Wind Speed
  - NASA Merra 0.5° X 0.5° Gridded Wind Speed(2003-2010)

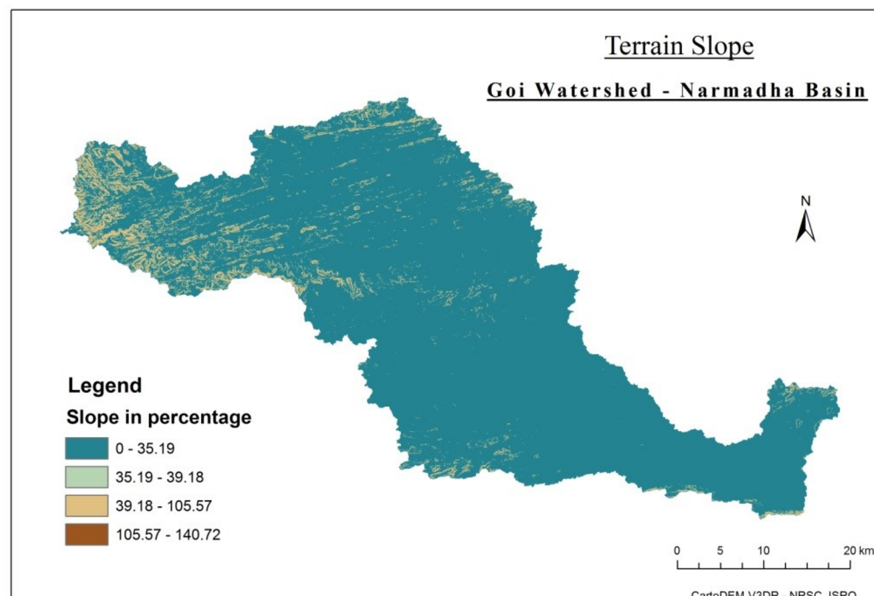
Landuse/Land cover

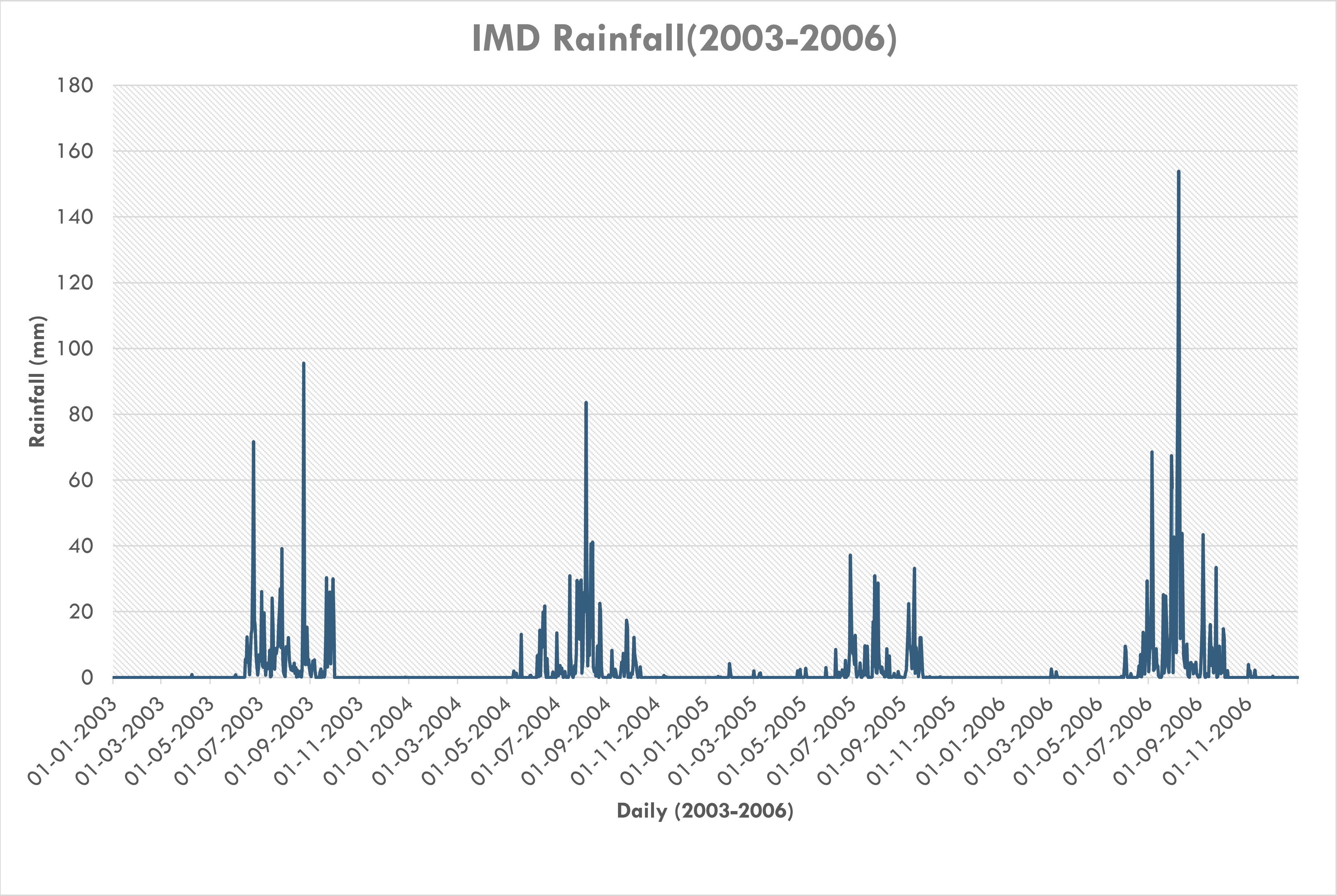




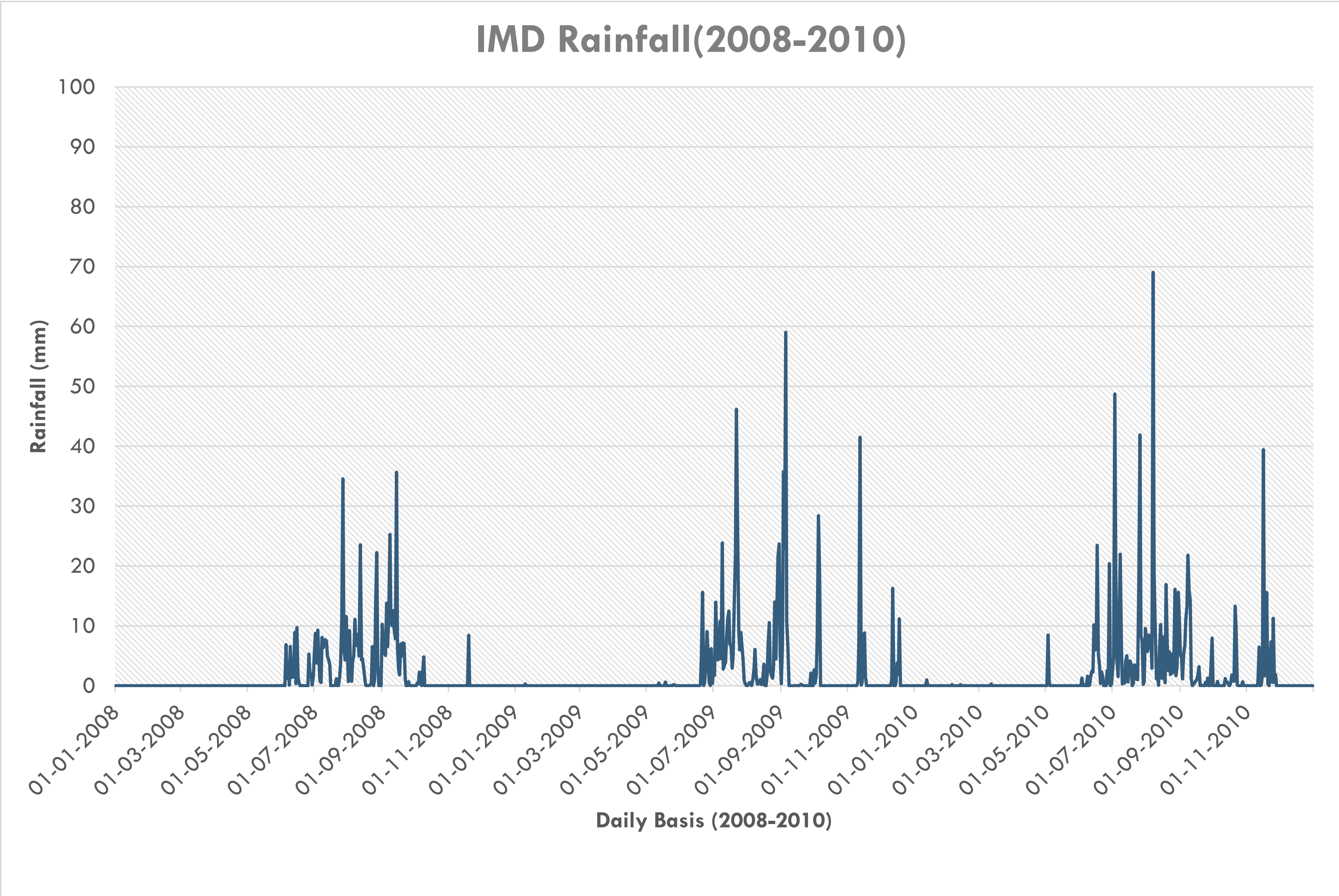
Soil Map

Slope Map



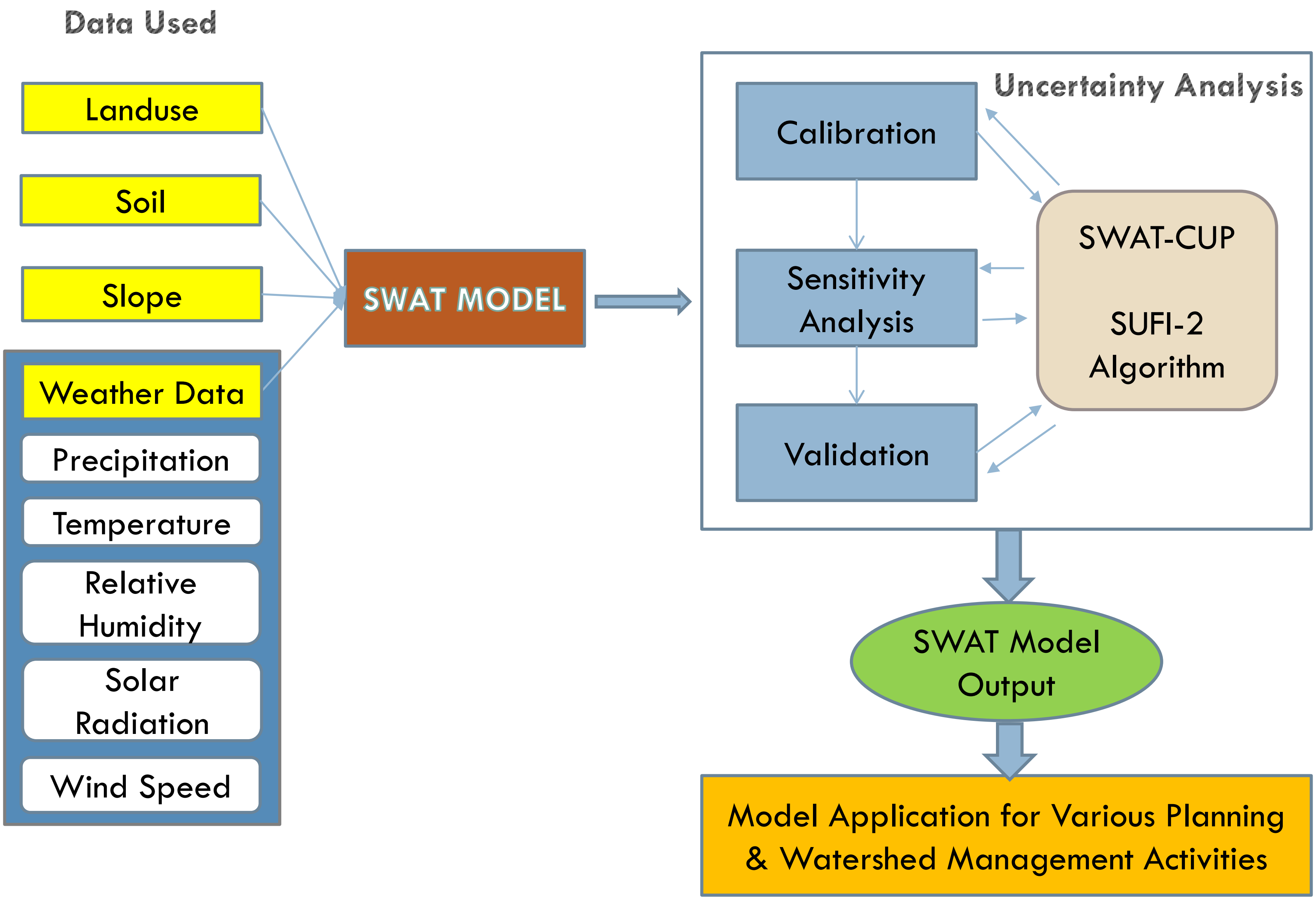


IMD Rainfall(2003-2006)
Rainfall (mm)
180
160
140
120
100
80
60
40
20
0
01-01-2003
01-03-2003
01-05-2003
01-07-2003
01-09-2003
01-11-2003
01-01-2004
01-03-2004
01-05-2004
01-07-2004
01-09-2004
01-11-2004
01-01-2005
01-03-2005
01-05-2005
01-07-2005
01-09-2005
01-11-2005
01-01-2006
01-03-2006
01-05-2006
01-07-2006
01-09-2006
01-11-2006
Daily (2003-2006)



IMD Rainfall(2008-2010)
Rainfall (mm)
100
90
80
70
60
50
40
30
20
10
0
01-01-2008
01-03-2008
01-05-2008
01-07-2008
01-09-2008
01-11-2008
01-01-2009
01-03-2009
01-05-2009
01-07-2009
01-09-2009
01-11-2009
01-01-2010
01-03-2010
01-05-2010
01-07-2010
01-09-2010
01-11-2010
Daily Basis (2008-2010)

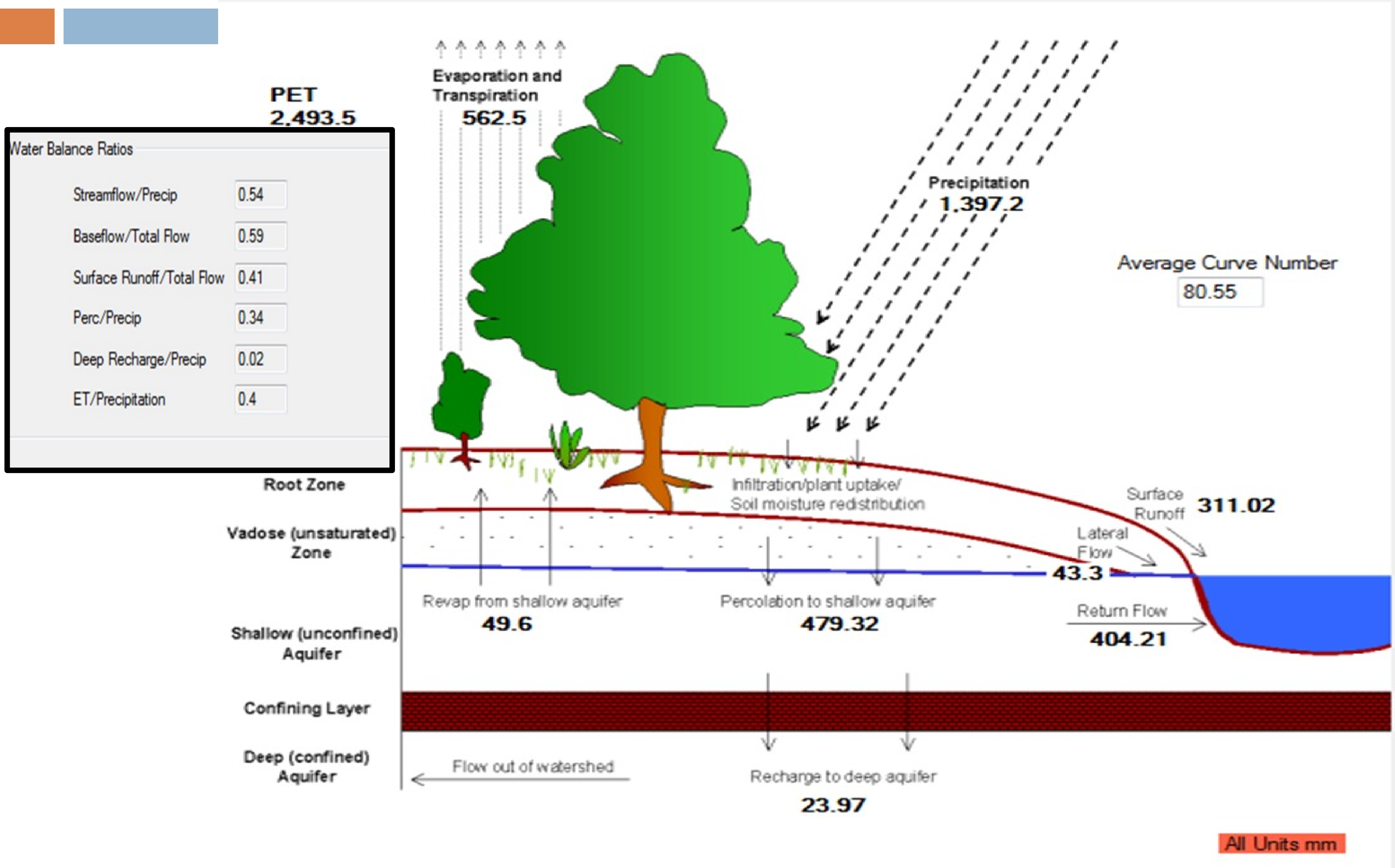
Methodology



SWAT Modelling Process

- Watershed Delineation
- Physical land data input
  - HRU Generation
- Weather data & other SWAT input's
- SWAT simulation run

Water Balance - Simulation Monthly

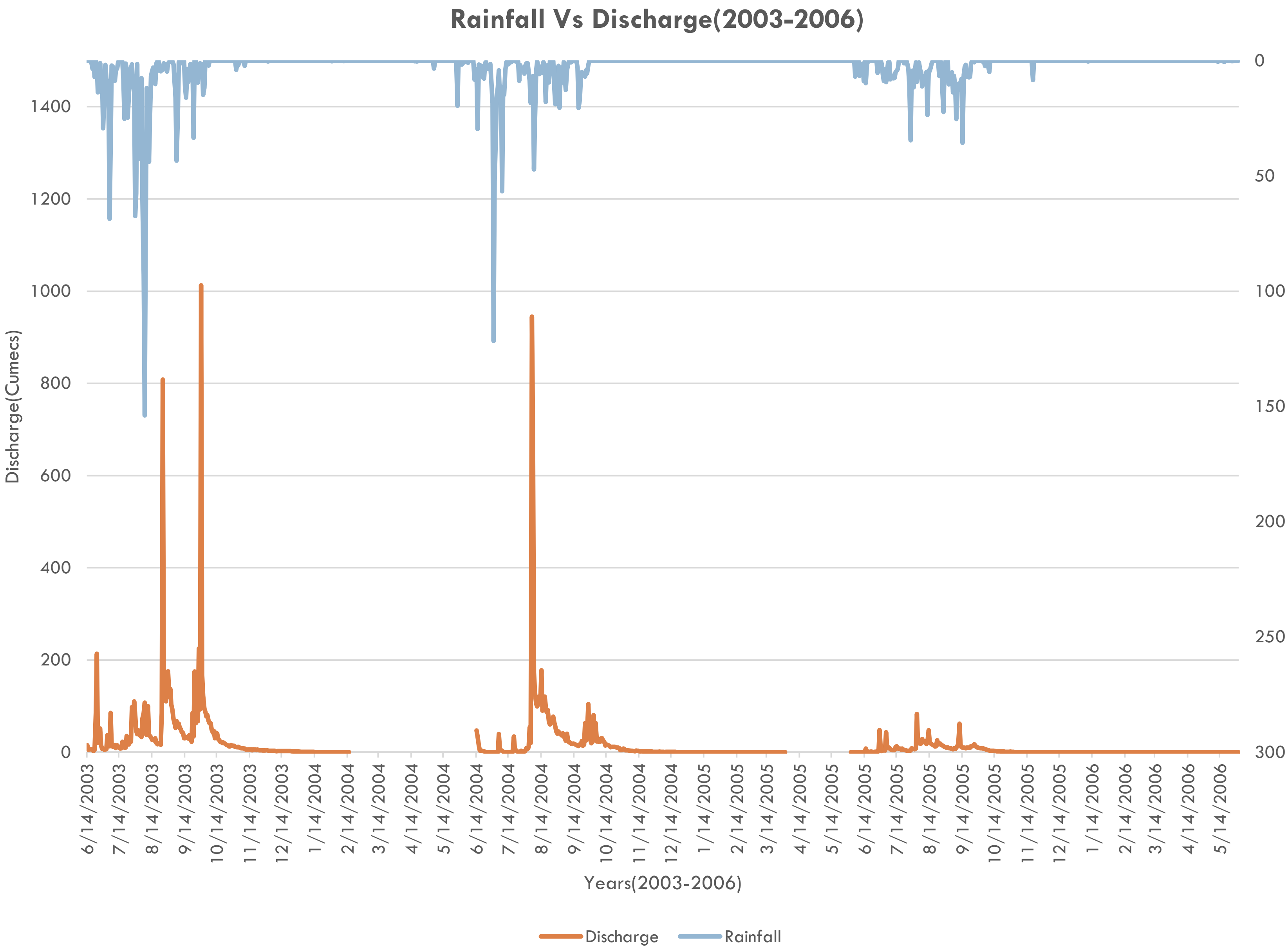


Uncertainty Analysis

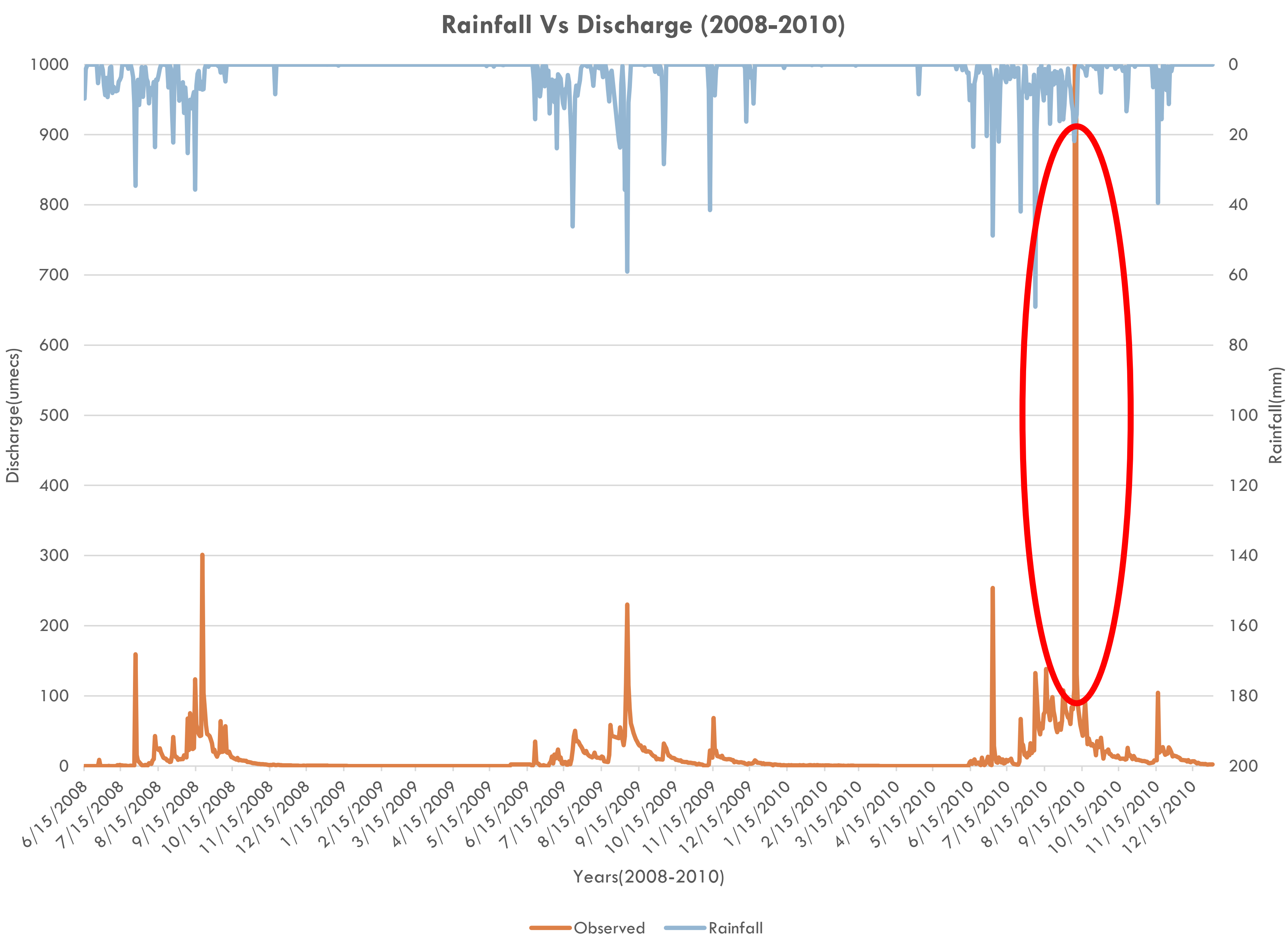
- The Uncertainty in any part of modelling process and calibration process should be addressed and the error propagation in the model should be minimized. Hence, it will be implemented for solving the real world problems.
- The SWAT Automatic Calibration & Uncertainty Prediction program (SWAT-CUP) is used here.
- This uses the widely practiced SUFI-2 Algorithms for optimization of the values.

Calibration using Discharge Data

- The Model is calibrated using the Discharge data available for a period of 2003-2006 and validated for a period of 2008 - 2010.
- Probably, the Discharge data collected are not completely reliable since there might be an error in data recording (Unclassified data, CWC).
- This calibration datasets are checked twice before input in analysis. The doubtful or erroneous data of particular date can be skipped from the analysis.

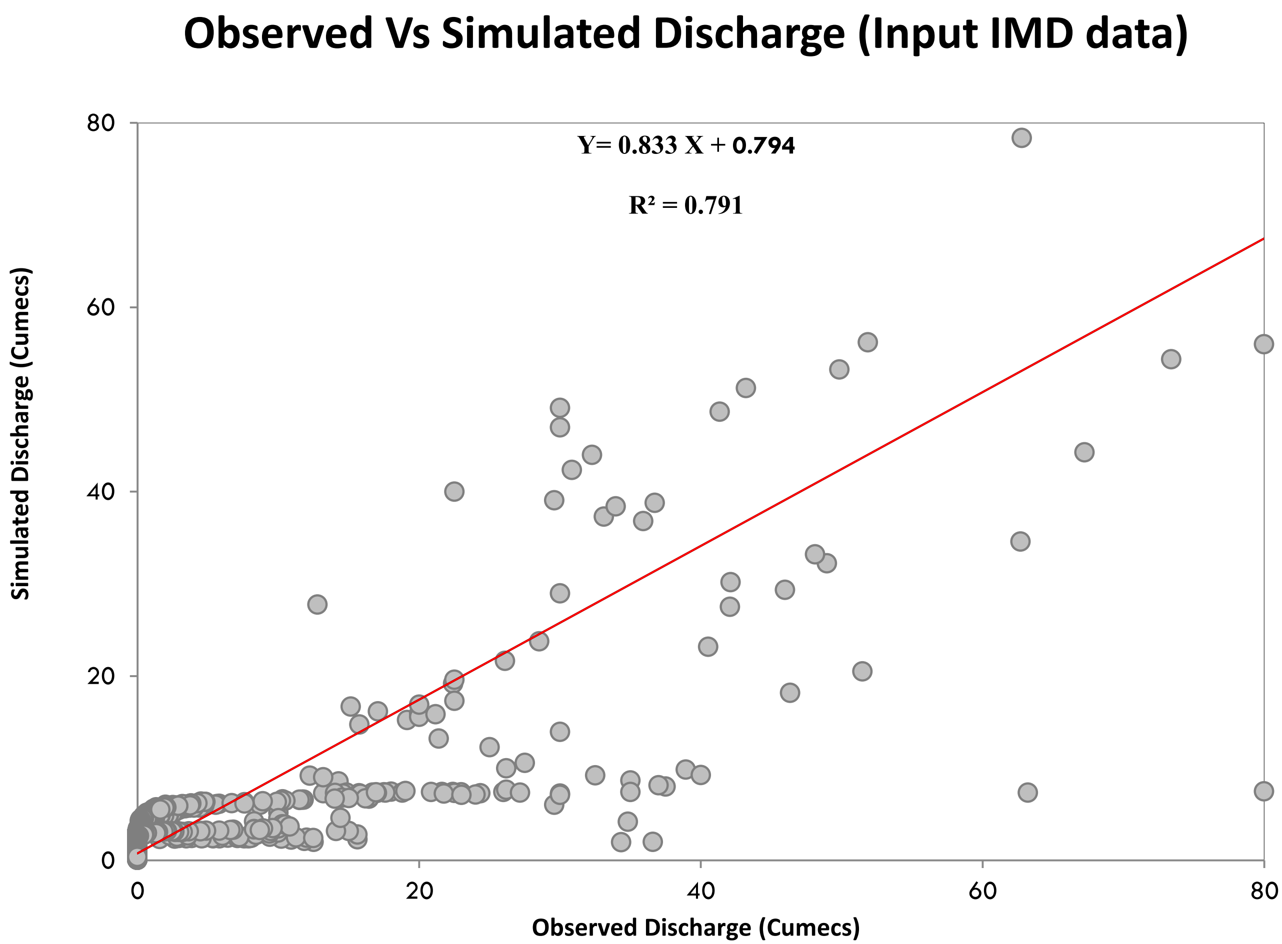


Rainfall Vs Discharge(2003-2006)
Discharge(Cumecs)
Rainfall(mm)
0
200
400
600
800
1000
1200
1400
0
50
100
150
200
250
300
6/14/2003
7/14/2003
8/14/2003
9/14/2003
10/14/2003
11/14/2003
12/14/2003
1/14/2004
2/14/2004
3/14/2004
4/14/2004
5/14/2004
6/14/2004
7/14/2004
8/14/2004
9/14/2004
10/14/2004
11/14/2004
12/14/2004
1/14/2005
2/14/2005
3/14/2005
4/14/2005
5/14/2005
6/14/2005
7/14/2005
8/14/2005
9/14/2005
10/14/2005
11/14/2005
12/14/2005
1/14/2006
2/14/2006
3/14/2006
4/14/2006
5/14/2006
Years(2003-2006)
Discharge
Rainfall

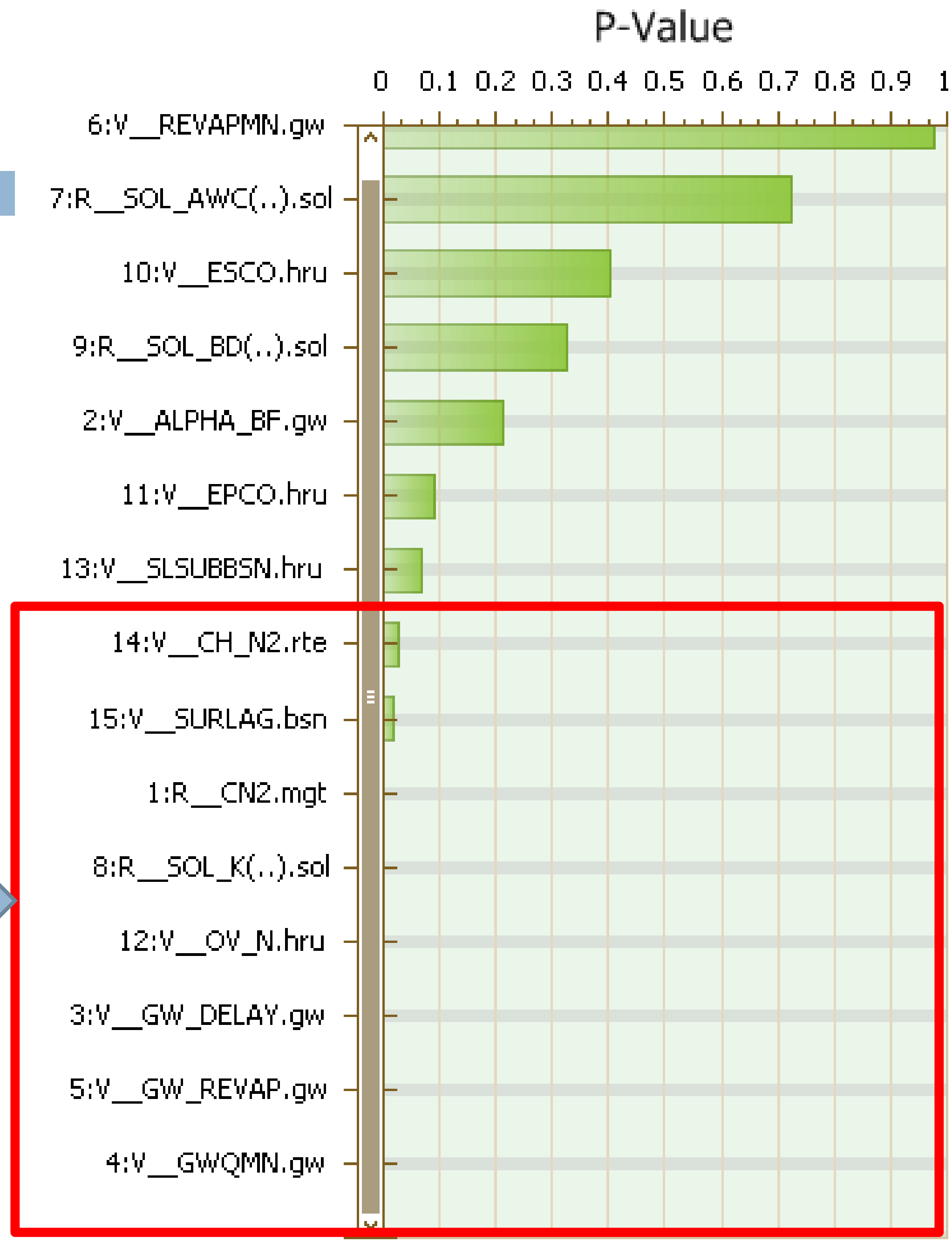


Rainfall Vs Discharge (2008-2010)
Discharge(umecs)
Rainfall(mm)
Years(2008-2010)
1000
900
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
160
180
200
6/15/2008
7/15/2008
8/15/2008
9/15/2008
10/15/2008
11/15/2008
12/15/2008
1/15/2009
2/15/2009
3/15/2009
4/15/2009
5/15/2009
6/15/2009
7/15/2009
8/15/2009
9/15/2009
10/15/2009
11/15/2009
12/15/2009
1/15/2010
2/15/2010
3/15/2010
4/15/2010
5/15/2010
6/15/2010
7/15/2010
8/15/2010
9/15/2010
10/15/2010
11/15/2010
12/15/2010
Observed
Rainfall

Calibration Years (2003-2006)

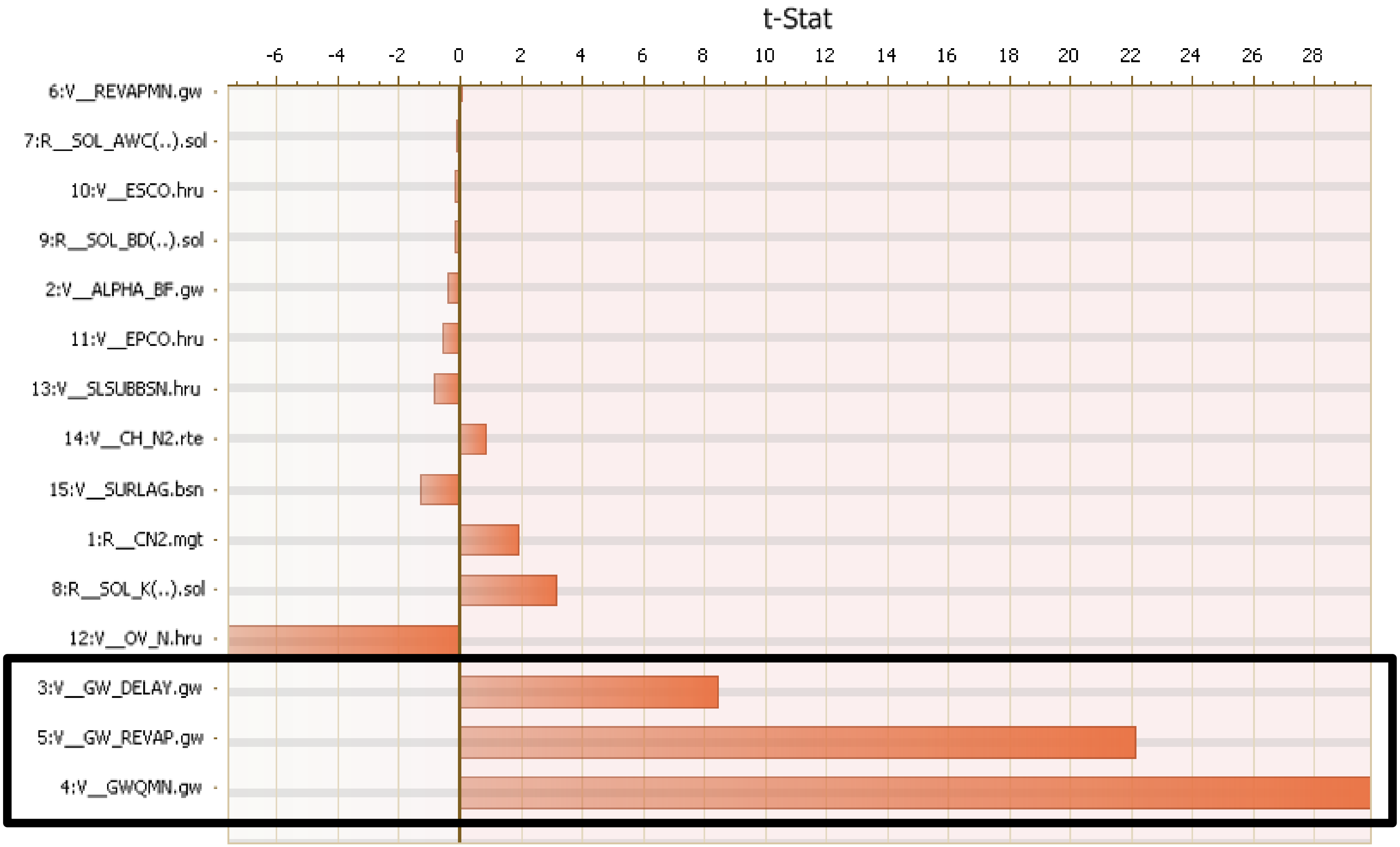


Sensitivity Analysis

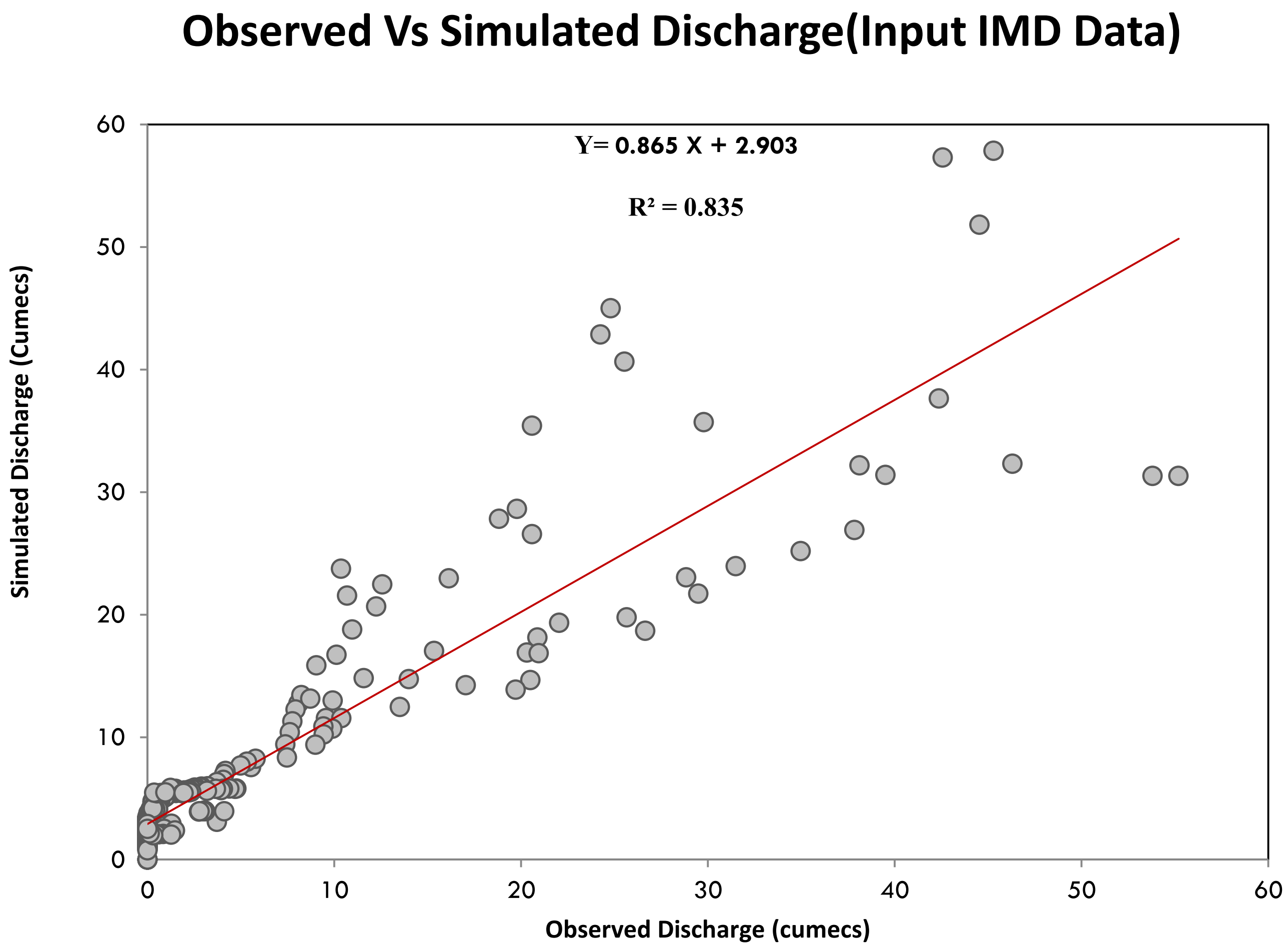


Significant parameters in Model

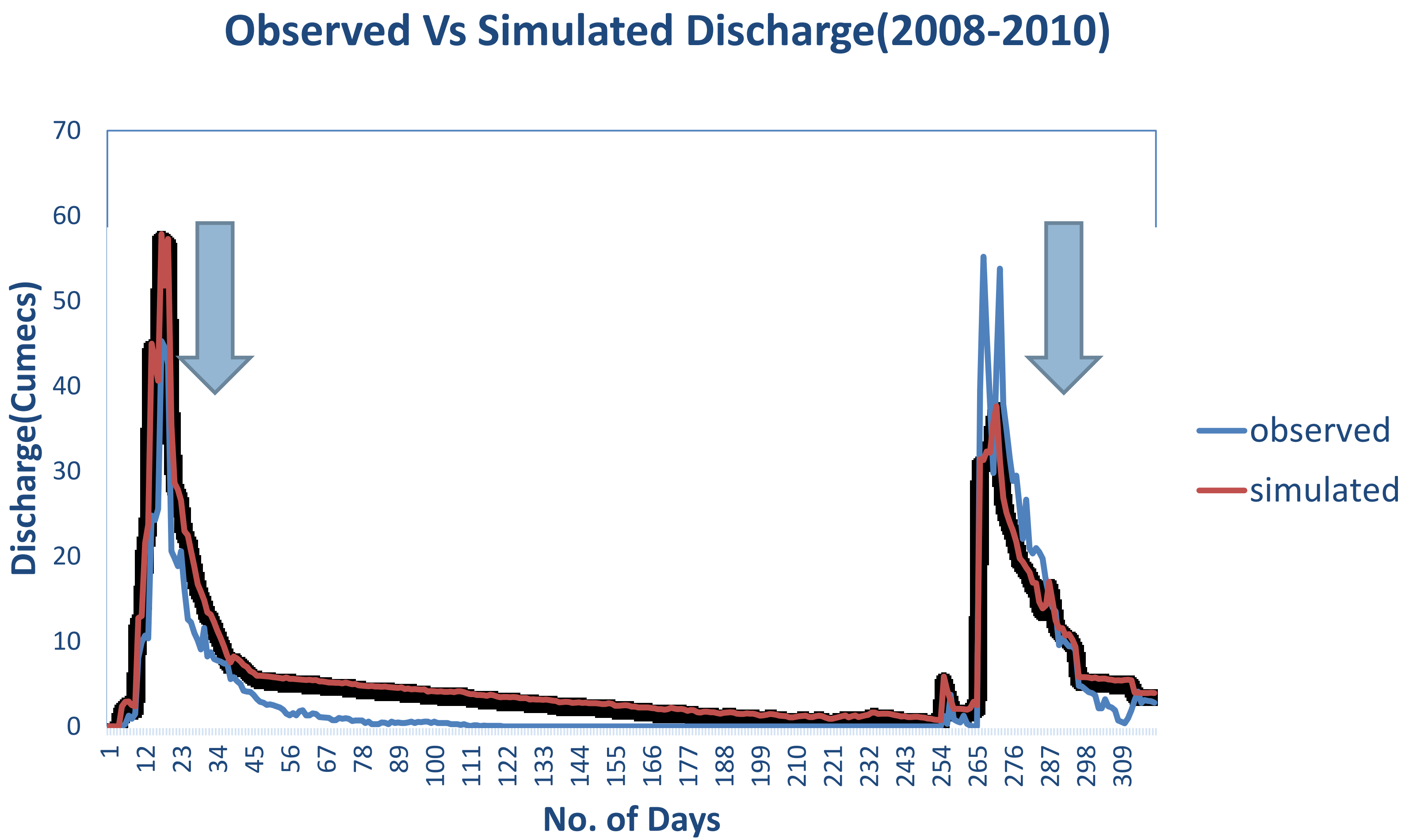
Parameter Sensitivity



Validation Years(2008-2010)



Validation Years(2008-2010)



Calibrations & Validation Statistics

Test	R^2	NSE
Calibration 1 (500 Simulations)	0.68	0.63
Calibration2(500 Simulations)	0.78	0.74
Calibration3(500 Simulations)	0.79	0.79
Validation (500 Simulations)	0.84	0.78

Results and Conclusions

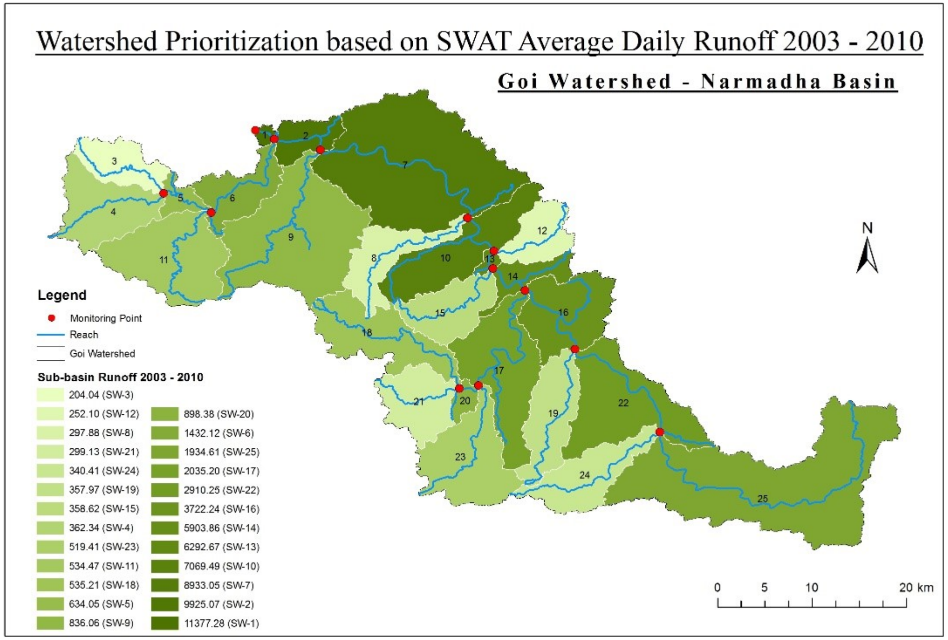
- The Calibration and Validation statistics of the model shows that the model is performing good in predicting the observed discharges.
- This in turn can state that the model can be applied for various watershed management studies, etc.,
- This study briefs about the Development of Hydrological model at a watershed scale with the data limitation at its side and how well the planning and managerial activities an be addressed using it.

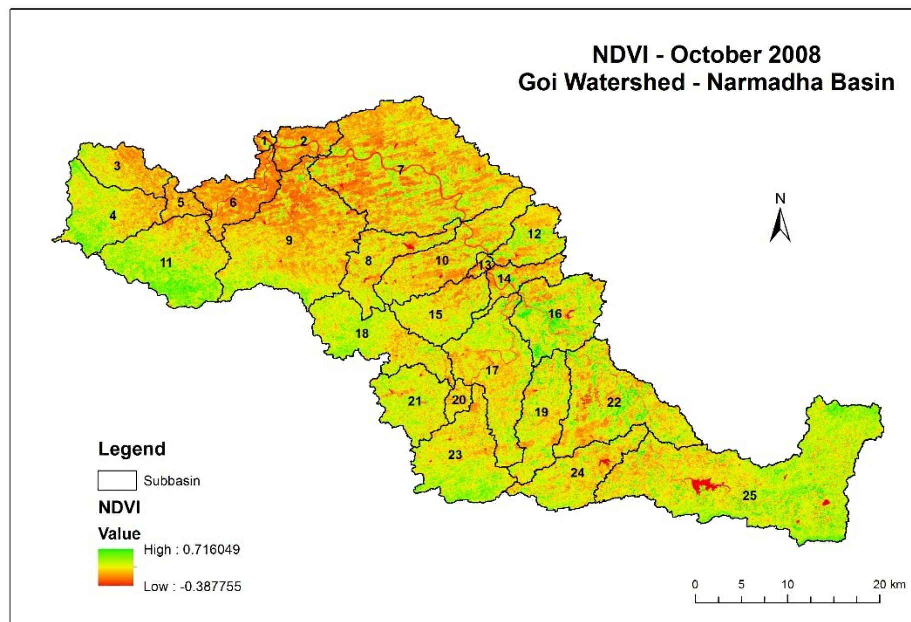
Limitations & Future plans on this study

- As far as this study is concerned the data constrains are major factors.
- The period of data taken can be revised for further improvements in the model and the use of higher resolution of data.
- The Results from the model can be applied & integrated with many of the Remote Sensing Applications in the real scenario and various inferences could be extracted.

Future plans and extensions of the study

- The major focus is on planning and management oriented applications such as
- Watershed Prioritization,
- Land & Water resources management,
- Flood control, Drought & Irrigation management,
- Drinking water facilities,
- Agricultural practices & management activities,
- Integrated watershed management
- Water sharing and water disputes
- Other Socio-economic and political related problems and issues.


Watershed Prioritization based on SWAT Average Daily Runoff 2003 - 2010
Goi Watershed - Narmadha Basin
Legend
Monitoring Point
Reach
Goi Watershed
Sub-basin Runoff 2003 - 2010
204.04 (SW-3)
252.10 (SW-12)
297.88 (SW-8)
299.13 (SW-21)
340.41 (SW-24)
357.97 (SW-19)
358.62 (SW-15)
362.34 (SW-4)
519.41 (SW-23)
534.47 (SW-11)
535.21 (SW-18)
634.05 (SW-5)
836.06 (SW-9)
898.38 (SW-20)
1432.12 (SW-6)
1934.61 (SW-25)
2035.20 (SW-17)
2910.25 (SW-22)
3722.24 (SW-16)
5903.86 (SW-14)
6292.67 (SW-13)
7069.49 (SW-10)
8933.05 (SW-7)
9925.07 (SW-2)
11377.28 (SW-1)
N
0 5 10 20 km


NDVI - October 2008
Goi Watershed - Narmadha Basin
N
Legend
Subbasin
NDVI
Value
High : 0.716049
Low : -0.387755
0 5 10 20 km

Save Water ...

Thank You.....