Sediment yield Modeling with Parameters Sensitivity Analysis of a River basin using SWAT Model.

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Presentation includes

■ **Introduction**

■ **Objectives**

■ **Methodology**

■ **Case Study on Kadalundi River basin**

■ **Results and discussion**

■ **Conclusions**

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SWAT Soil & Water Assessment Tool

Introduction (why this study ?)

❑ Generally due to sparse data, and uncertainty in climate (e.g. rainfall and temperature), accurate prediction of hydrologic parameters in a mountainous river basin, highly depends on how well spatial input data describe real and relevant characteristics.

❑ With significant development in hydrologic modeling, such as Soil and Water Assessment Tool (SWAT) model, the over-parameterization is usually a critical issue in the calibration process.

❑ To deal with this problem, global sensitivity analysis methods are developed which can reduce the number of parameters to be adjusted during calibration and simplify the use of the model.

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Research Questions

How can we make sure which and how much parameters are more sensitive for simulation of particular hydrological process (in this case sediment yield)

How can we make sure the range of particular parameters which either sensitive or non-sensitive during calibration of hydrological process.

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Model Calibration

To estimate the sensitive parameters for sediment yield

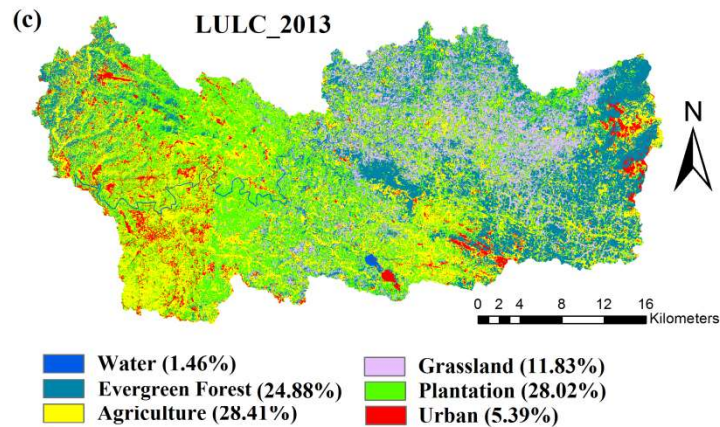**A large number of parameters in SWAT
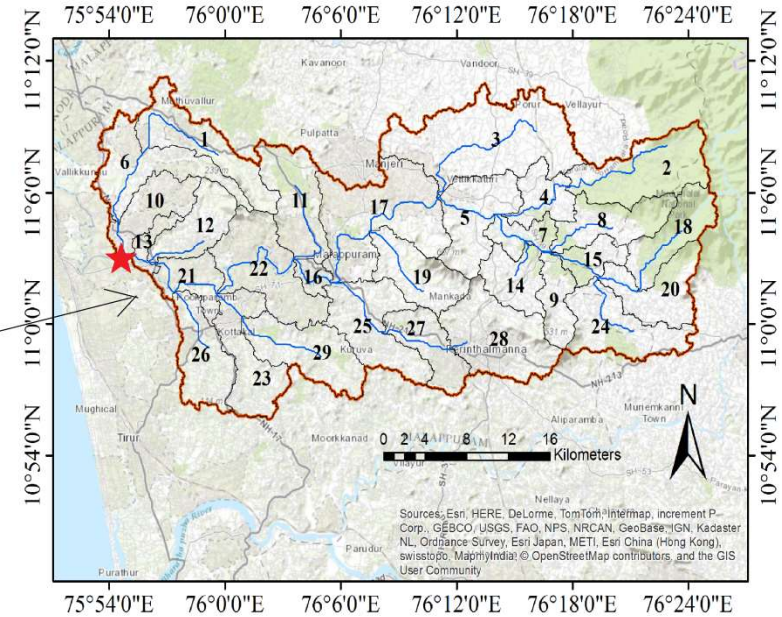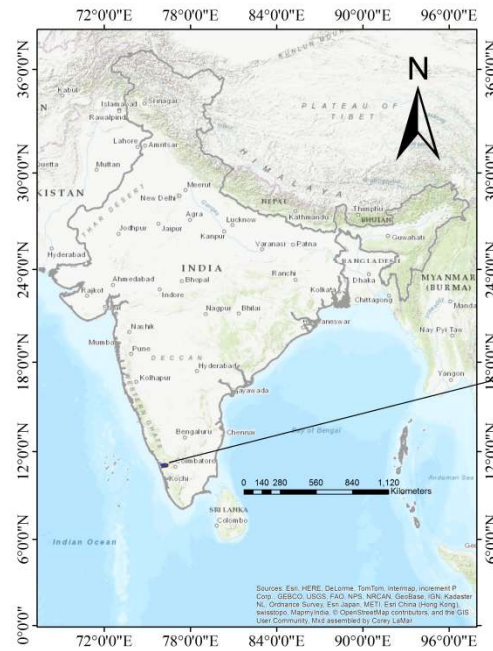model
+
Lack of data**

→ **Low calibration efficiency**

The probable solutions to improve the calibration efficiency

✓ Reduction the number of parameters
✓ Identification the most sensitive parameters for sediment yield
✓ Identification the less sensitive parameters for sediment yield

} **Sensitivity
analysis**

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Study area

(c) LULC_2013

Water (1.46%)
Evergreen Forest (24.88%)
Agriculture (28.41%)

Grassland (11.83%)
Plantation (28.02%)
Urban (5.39%)

Reach   Outlet
Sub-basin   Basin

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❑ The Kadalundi River originates from east of Karuvarakkundu village in the district of Kozhikode in Kerala state.

❑ **Latitudes :** 10.54^0 to 11.12^0
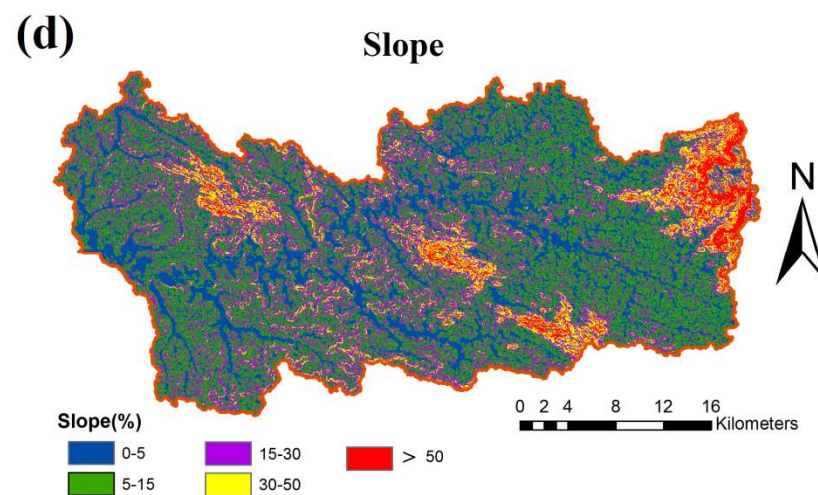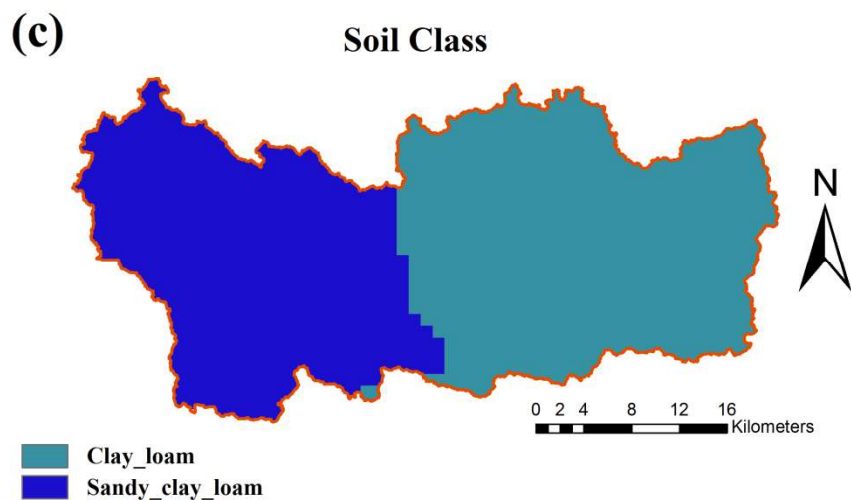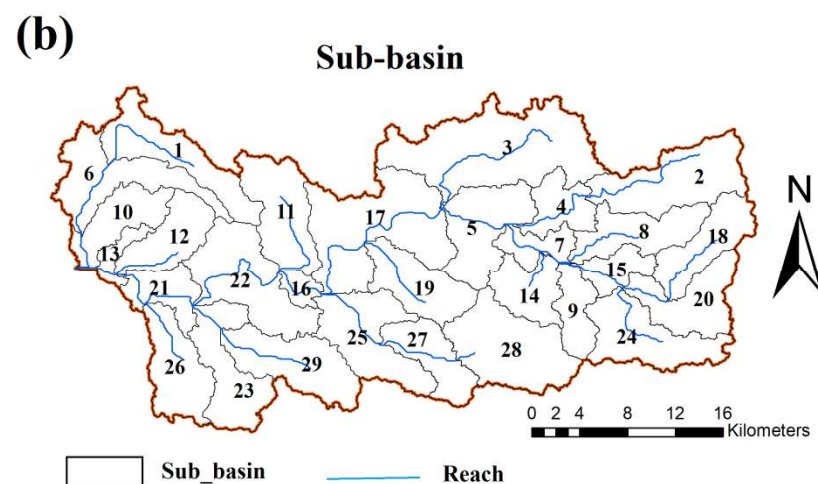 **Longitudes:** 75.50^0 to 76.24^0

❑ The drainage area is 1106. 63 Km^2. The maximum elevation is 1303 m

❑ The average annual precipitation in the study area is 2525 mm.

❑ The River basin divided into 29 sub-basin for these study.

❑ The main **LULC** classes include agriculture, grassland, forest, plantation, water, and urbanized area.
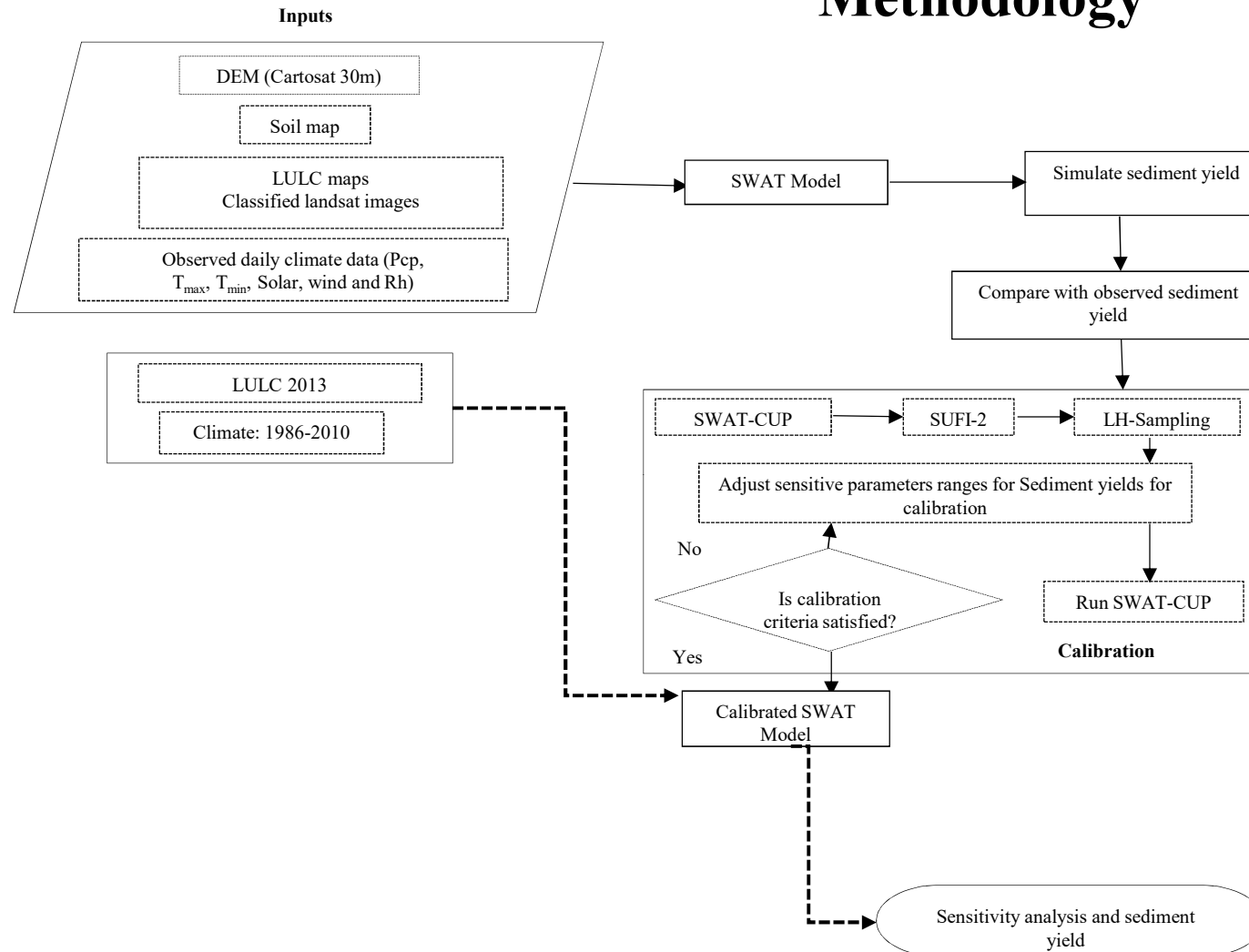
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SWAT Soil & Water Assessment Tool

(a) DEM

(b) Sub-basin

(c) Soil Class

(d) Slope

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SWAT Soil & Water Assessment Tool
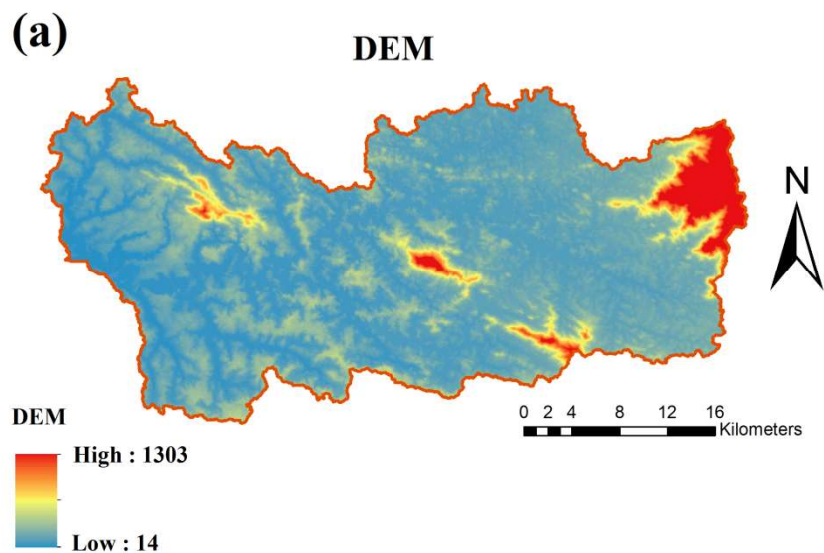
Source of data

Input data for the SWAT model for the Kadalundi River Basin.

Input data	Resolution	Source
Cartosat Digital Elevation Model (DEM)	30 m	National Remote Sensing Centre (http://www.nrsc.gov.in/)
Land use map	30 m	Landsat imageries (http://earthexplorer.usgs.gov/)
Soil type map	1000 m	Food and Agriculture Organization of the United Nation (FAO)
Meteorological data (rainfall and min-max temperature)	0.25 degree (daily)	Indian Meteorological Department (IMD)
Meteorological data (solar radiation, relative humidity and wind velocity)	0.25 degree (daily)	Climate Forecast System Reanalysis (CFSR)
Observed Hydrological data (sediment yields)	Daily	Central Water Commission (http://www.india-wris.nrsc.gov.in/)

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SWAT Soil & Water Assessment Tool

Methodology

Inputs

- DEM (Cartosat 30m)
- Soil map
- LULC maps
  Classified landsat images
- Observed daily climate data (Pcp, T_{max}, T_{min}, Solar, wind and Rh)

- LULC 2013
- Climate: 1986-2010

SWAT Model → Simulate sediment yield

Compare with observed sediment yield

Calibration

SWAT-CUP → SUFI-2 → LH-Sampling

Adjust sensitive parameters ranges for Sediment yields for calibration

Is calibration criteria satisfied?
- No
- Yes

Run SWAT-CUP

Calibrated SWAT Model

Sensitivity analysis and sediment yield

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Global sensitivity analysis of SWAT model
Analyze the whole parameter space

Using SWAT-CUP

SUFI 2 (Sequential uncertainty Fitting Version 2)

Latin Hypercube sampling methods

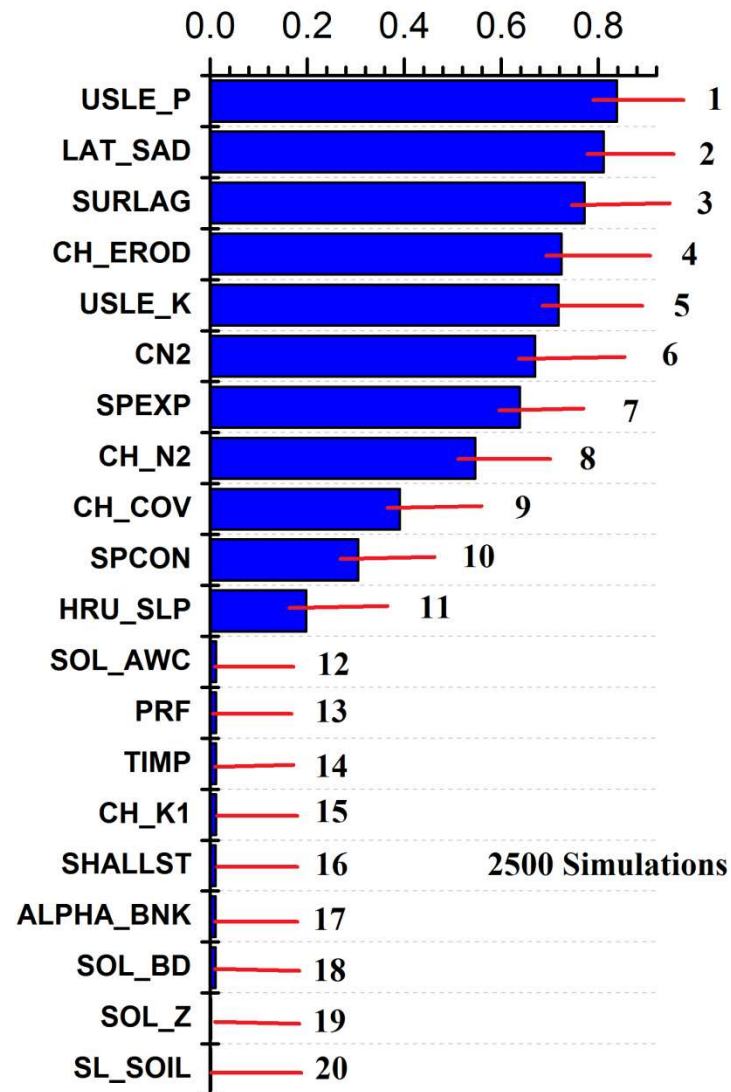## Applications

✓**Conceptually simple**
✓**Easy to implement**
✓**And Low computational cost**
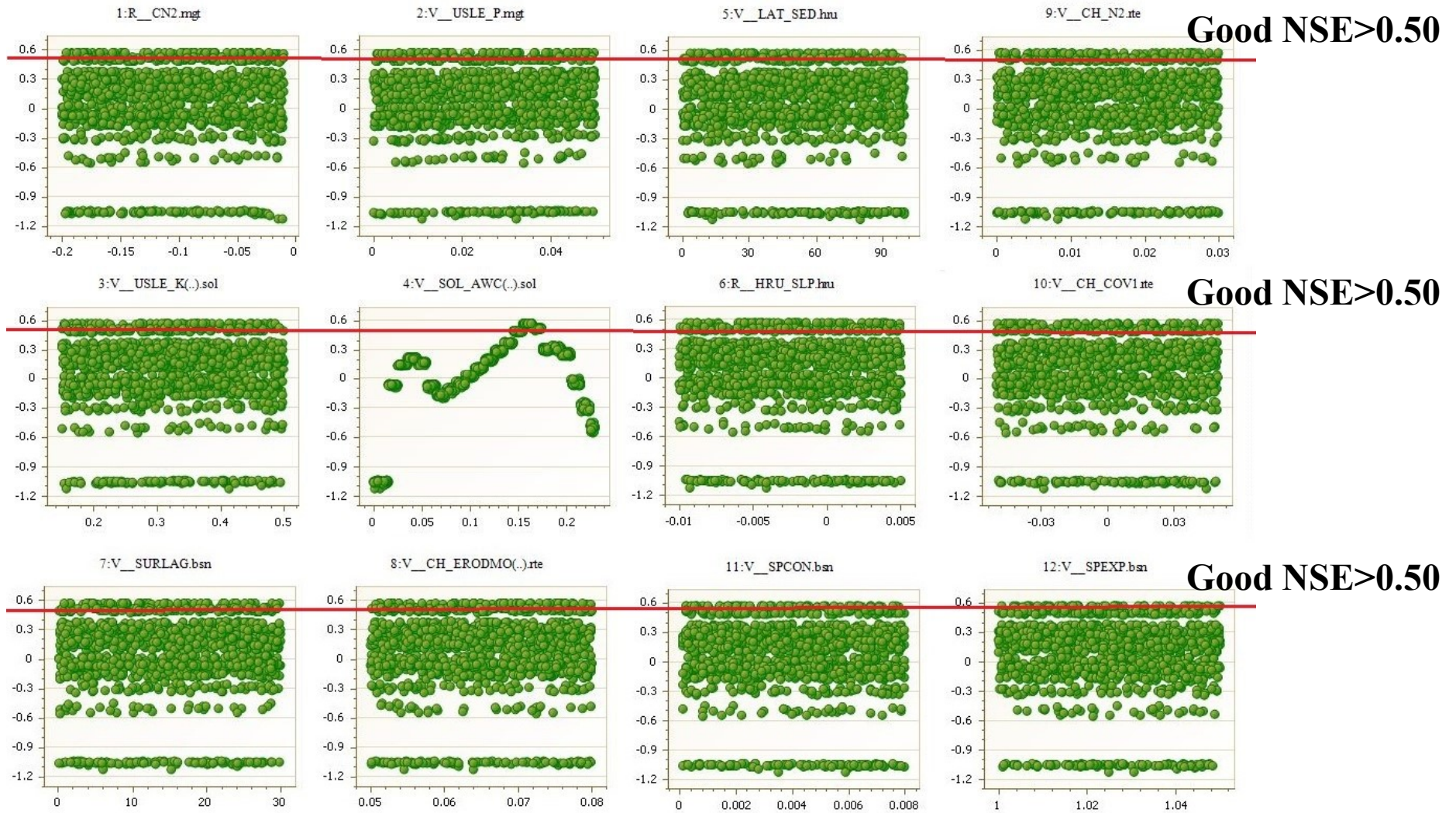
✓**But not reliable for highly non-linear system**

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LH sampling method

Global Sensitivity Analysis

Non-Sensitive parameters

2500 Simulations

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Dotty plot of sensitive parameters

Good NSE>0.50

Good NSE>0.50

Good NSE>0.50

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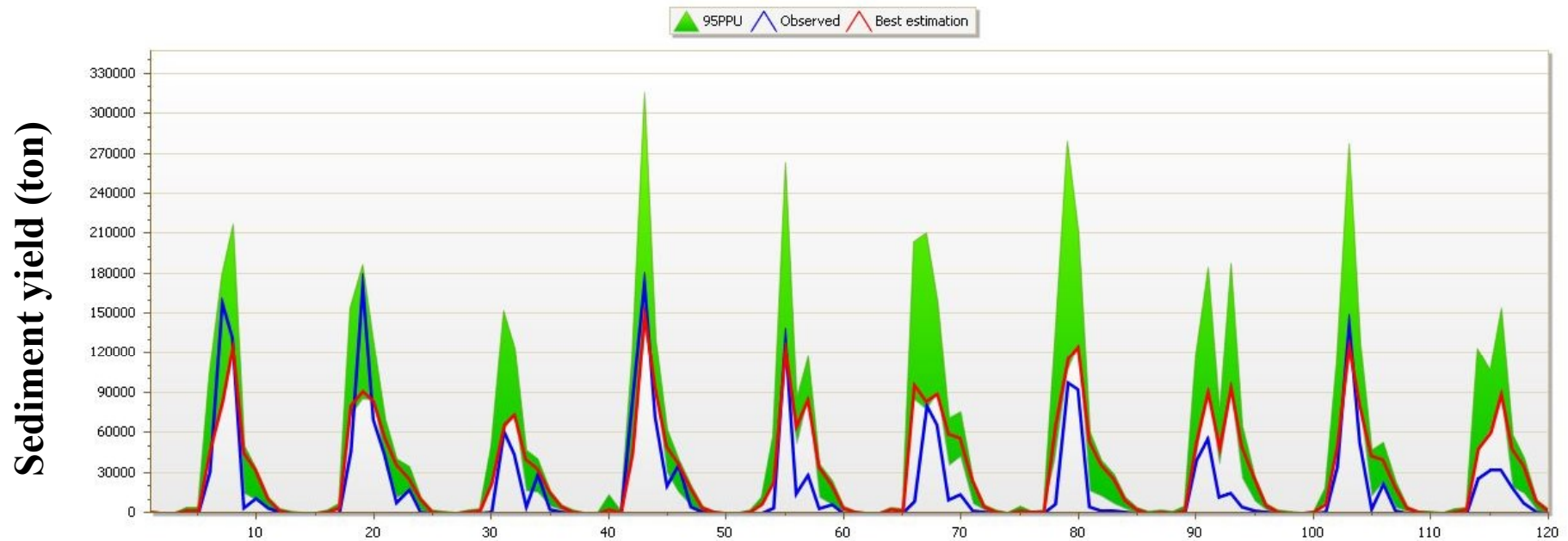
Calibration

R2 = 0.69   NSE = 0.58

5 years warm-up period and 10 years calibration

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Conclusions

➢ **SWAT model successfully simulate the hydrological parameters and SWAT-CUP well performed for evaluating the sensitive parameters for sediment yield.**

➢ **LH sampling method for global sensitivity analysis can be use for calibration of the hydrological parameters.**

➢ **Evaluation of one parameters is not sufficient to ensure the realistic condition of water balance of particular river basin.**

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Thank you for your kind attention

Any Question and Suggestions Please !!!!

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