HYDROLOGICAL MODELLING OF A SEMI BASIN UNDER CLIMATE CHANGE SCENARIOS

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CLIMATE CHANGE

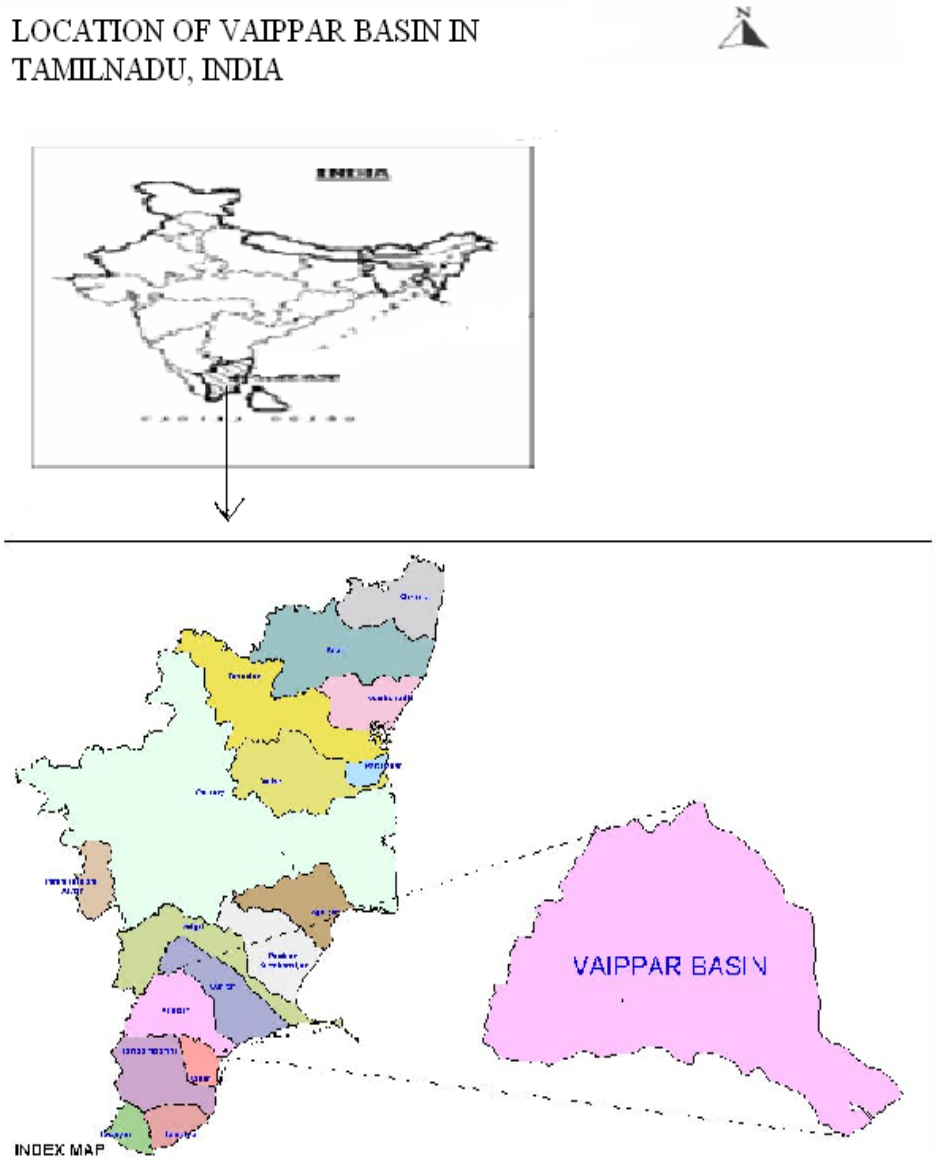
- Climate change refers to variations in mean state of climate or variability of its properties in its rate, range and magnitude that extends for a long period usually a decades or longer (IPCC 2007).

- Developing countries are more vulnerable to climate change damages than developed countries (IPCC 2007)

IMPACTS ON HYDROLOGICAL SYSTEM

- Different **precipitation trends** in different parts of the world
- Changes in seasonal patterns of rainfall may affect the regional distribution of **surface water resources**
- Changes in **recharge and groundwater potential**
- Change the magnitude and timing of run-off and the intensity of **floods and droughts**
- Increases in surface **temperature** and rates of **evaporation**
- Vegetation cover, type, and characteristics play a important role in **evaporation**
- Global warming will **exacerbate the water stress** caused by pollution and by growing populations and economies

VAIPPAR BASIN



- Basin Area - 5423km^2
- Maximum rainfall – northeast monsoon
- Climate stations - (kavalur, kovilpati, Vembakottai)
- Max & min temp 37^{o}C and 21^o C
- Watrap rainfall 957 mm

Climate change in Vaippar Basin

- Climate plays an important role in the basin as most of its area are rainfed.
- Changes in the rainfall Characteristics (occurance, duration ,Frequency)
- No of rainy days in the basin is decreasing.
- Spatial and temporal variations of rainfall are quite high.
- The basin gets most of its rainfall during northeast monsoon (oct-dec) but erratic in nature (late onset of monsoon).

- so in other season there is serious decline in the total water availability and the basin is water starved.

- The normal annual rainfall of the basin is 770.5mm with below average rainfall.(2003-2004) -977mm for Tamil nadu

- This basin suffers frequent drought occurence in the recent decades.

- This import serious water stress in all the reservoirs of the basin

GCM DATA

- Selection of GCM and scenario relevant to the study area is a crucial step in climate modelling studies. The data is extracted from HADCM3 (GCM) which is a coupled atmosphere-ocean GCM.

- Hydrological modelling studies & vulnerability assessment requires much finer and spatial scale resolutions.

- **Types of downscaling:**

  i. Statistical downscaling

  ii. Dynamic downscaling (regional climate modelling)

SDSM (Statistical Downscaling Model)

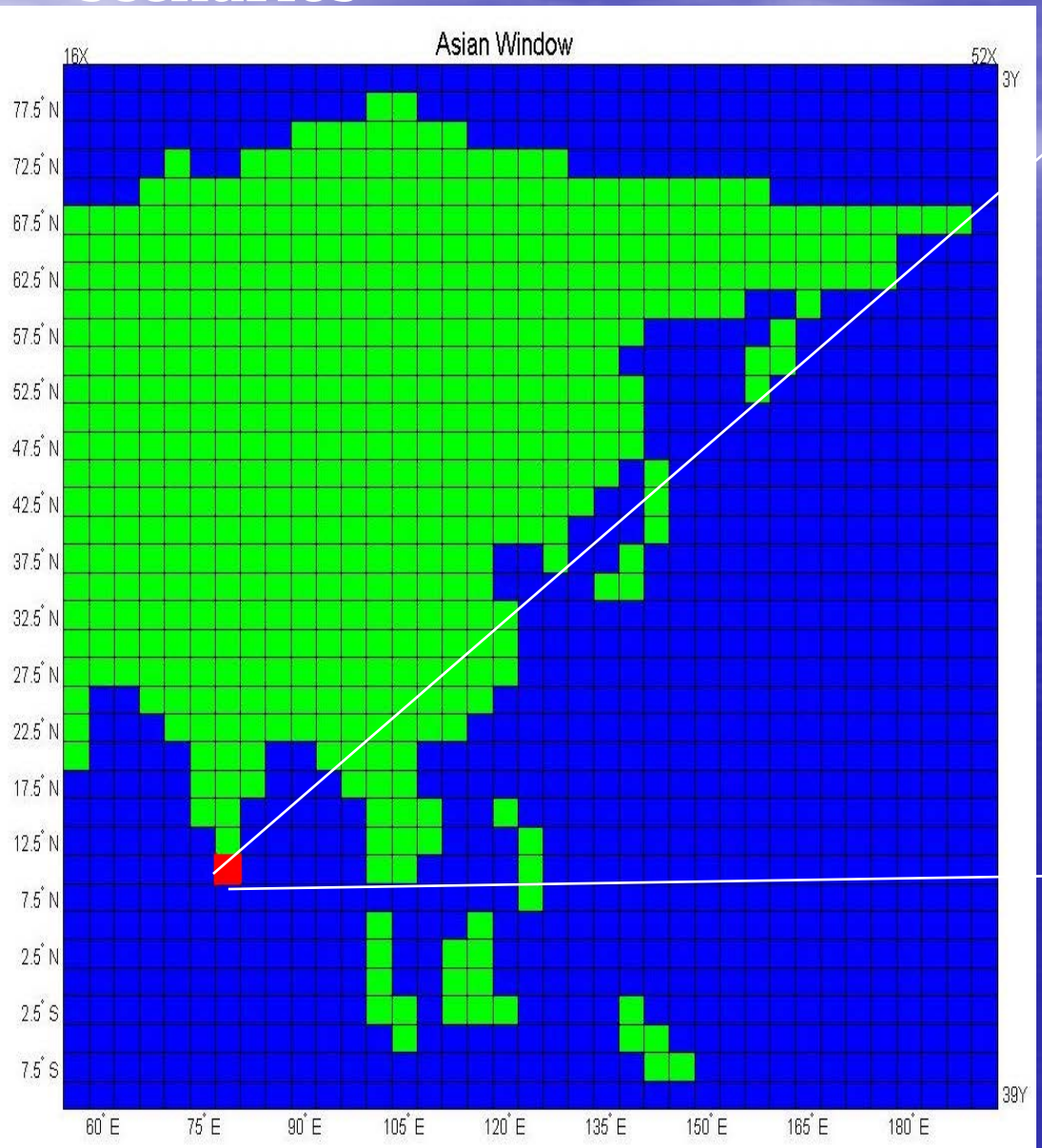
- SDSM is a user-friendly software package designed to implement statistical downscaling methods to produce high-resolution climate information from coarse-resolution climate model (GCM) simulations.

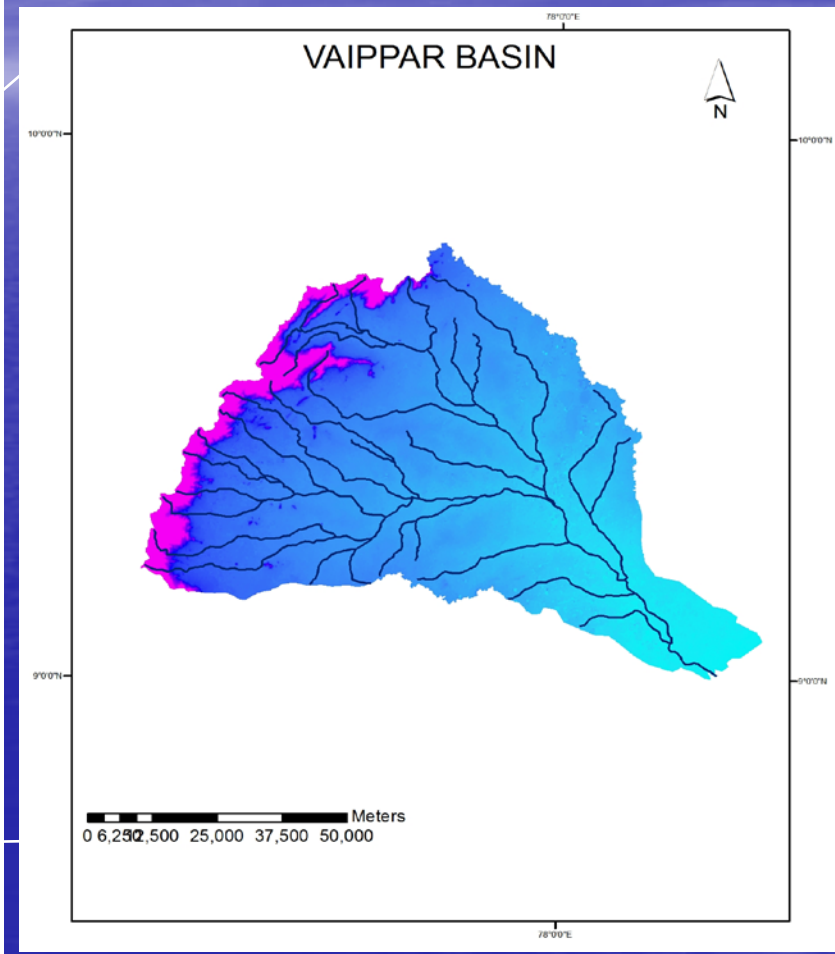
- It require small-scale climate scenarios, provided quality observational data and daily GCM outputs for large-scale climate variables.

- f: large (predictor) ⟶ local (preditand)

Mean Sea level pressure (MSLP)	Precipitation
Geo potential height (GPH)	Temperature
Wind field (U,V)	Wind
Specific humidity (Sh)	
Moisture flux (Sh.U)	

Downscaling GCM projection data for local climate scenarios





- General strength: Easy to implement, generate site specific information.

- General weakness: Assume that statistical relationships are time invariant under different future climate ,misinterpretation of increased resolution.

- Downscaling experiment is done with the predictand (observed data) from the following station.

  Kavalur

- **Model calibration and validation:**

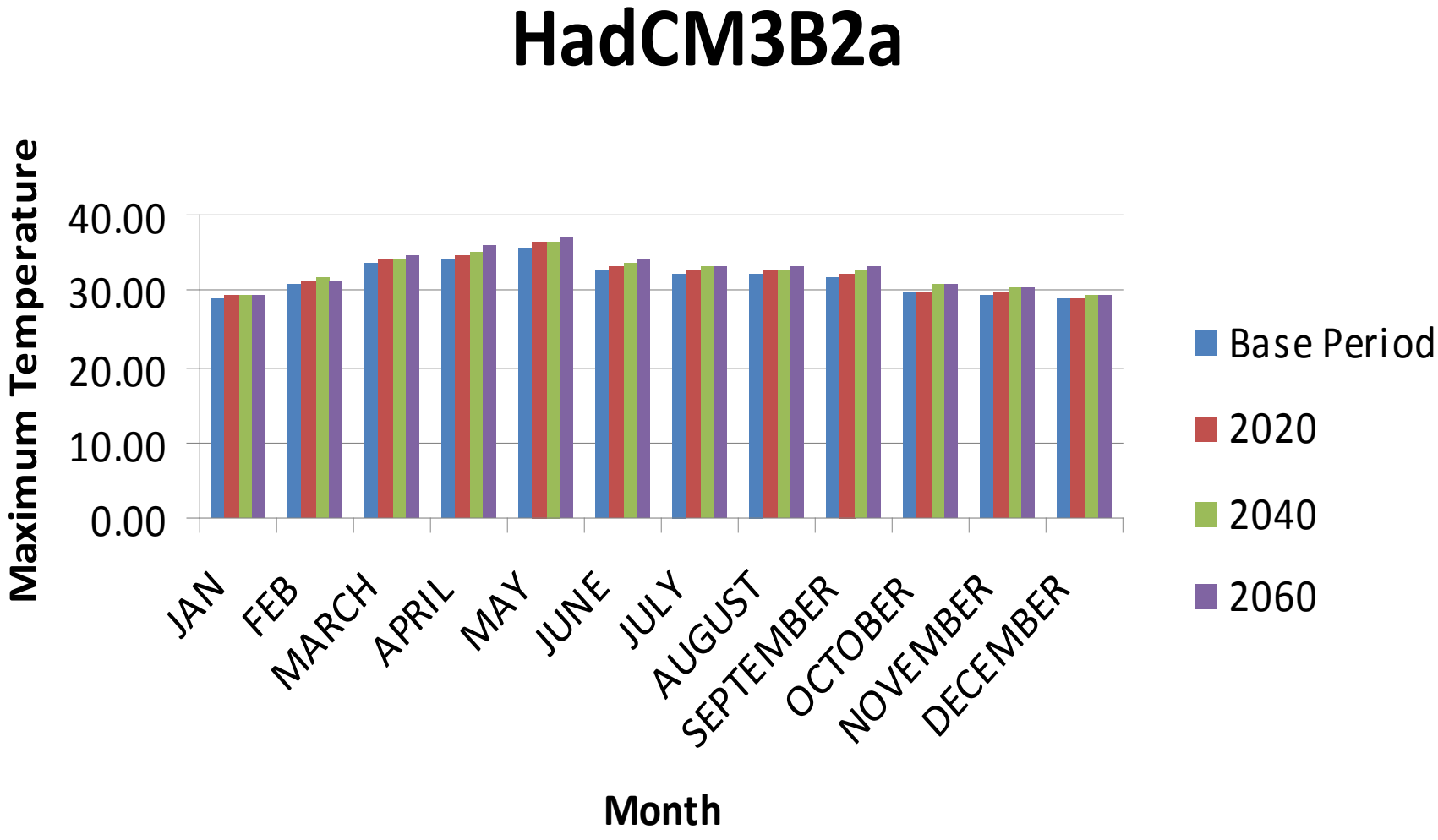
  30 years (1961-1990) are to be used for calibration

  10 years (1991-2001) are to be used for validation.

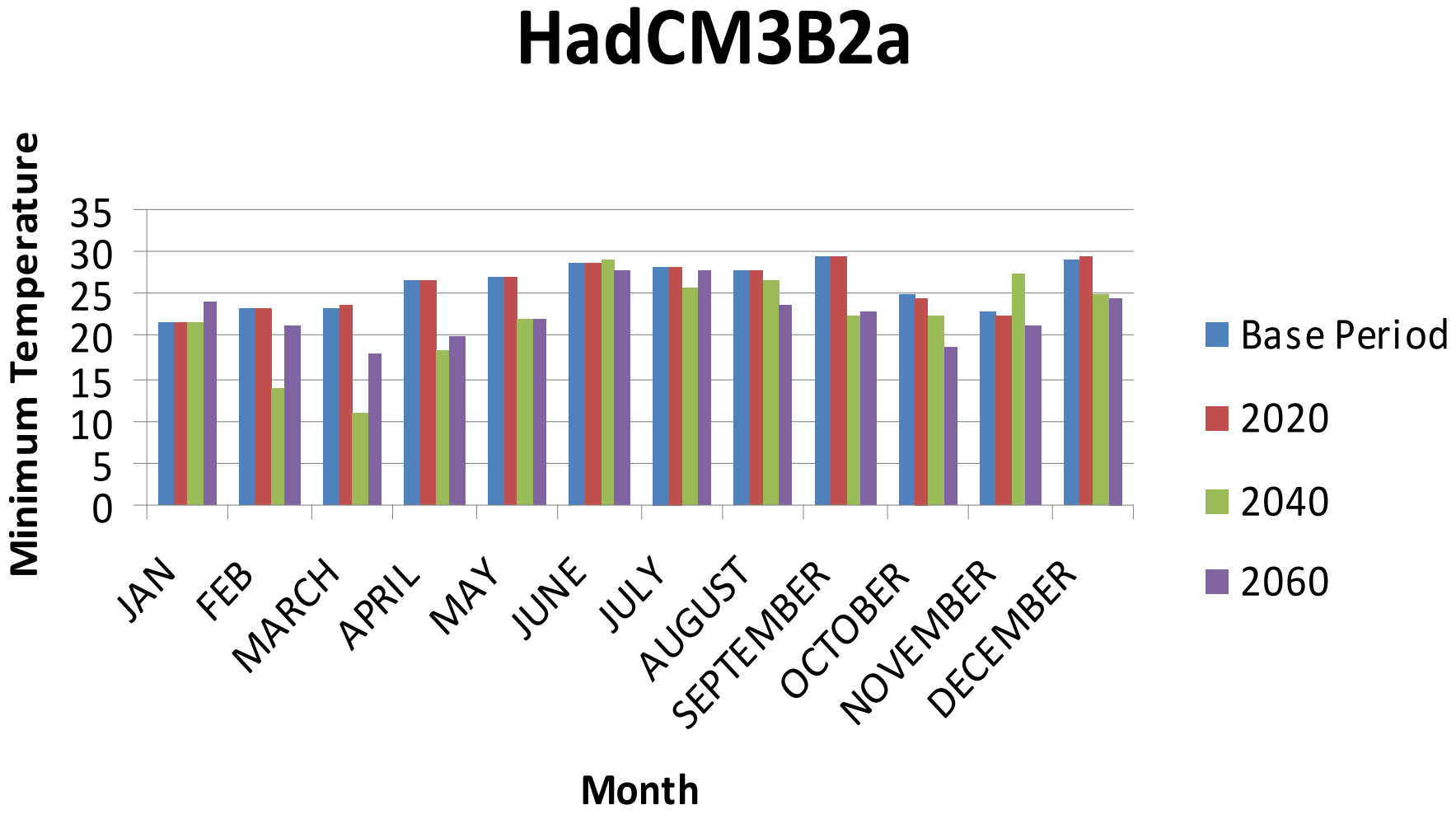
Application: Vaippar Basin

- Vaippar Basin: 5423km^2
- Variables to be downscaled (predictands):
  - daily precipitation &
  - daily Max and Min temperature
- The period between 1970 to 2000 is identified to represent the current climate condition. (Baseline)
- The future climate change simulations (HADCM3) at the coordinate 7.5^o N to12.5^o N latitude and 75^o E to 90^o E longitude are extracted for three distinct periods:
  - the 2020s (2020 and 2040),
  - the 2040s (2040-2050) and
  - the 2060s (2050-2060)

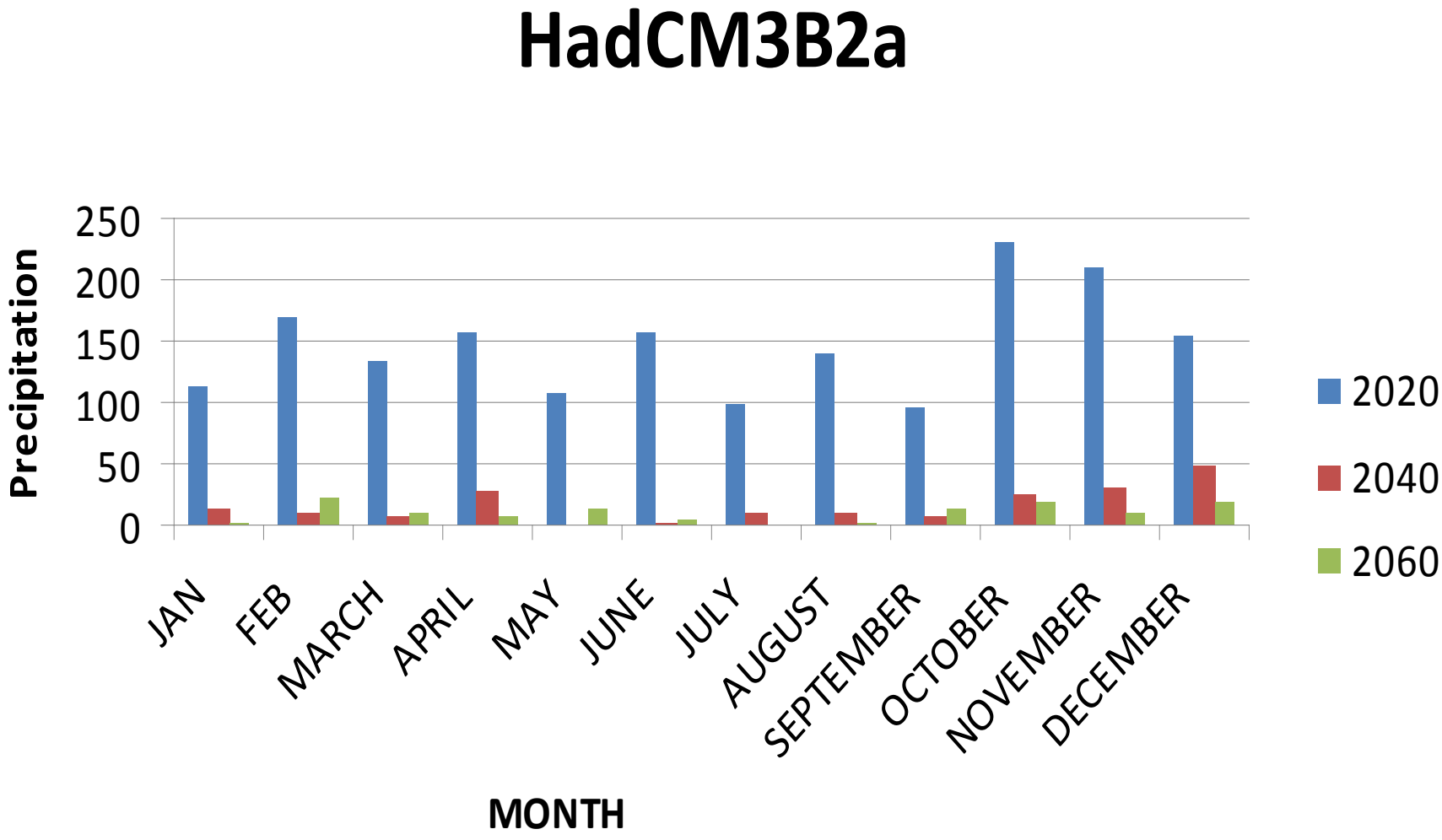
DOWNSCALED MAXIMUM TEMPERATURE



DOWNSCALED MINIMUM TEMPERATURE



DOWNSCALED PRECIPITATION



HYDROLOGICAL MODEL IN CLIMATE CHANGE STUDY

- For assessing water resources management on a regional scale, rainfall-runoff (water balance) models were found useful for identifying hydrologic consequences of changes in temperature, precipitation, and other climatic variables

- One of the more frequently used models is the SWAT for studying the impact of climate change in a basin.

- The climate change impact assessment on water resources in the Vaippar basin is can be best handled through simulation of SWAT under the projected weather conditions.

- The downscaled climate variables for the IPCC emissions scenarios are given as climate input in the weather generator for the year 2020, 2040 and 2060.

- Arc SWAT(2005) provides the tools for delineating the watershed, defining the land use and soil, editing the model data bases, defining the weather stations, parameterzing and editing the inputs, running the model, reading and mapping the results, and calibrating the simulation result

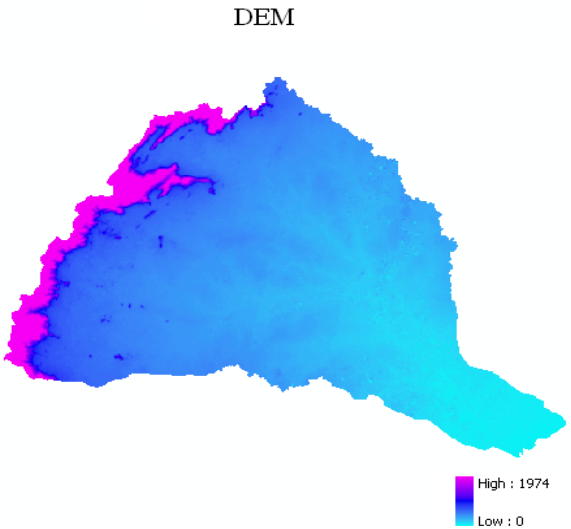
DATA TO BE USED FOR MODELLING

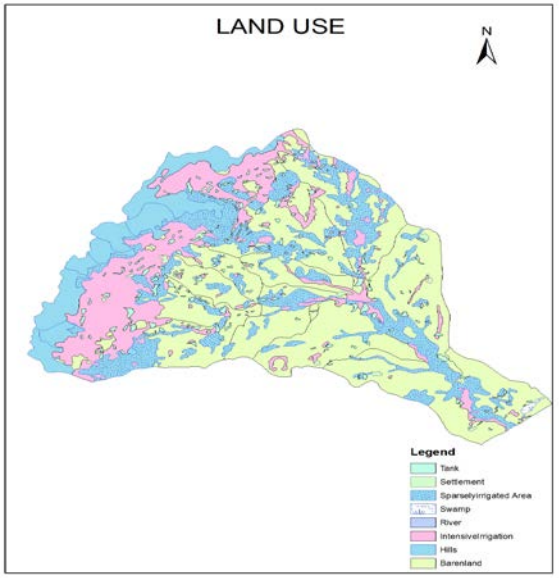
- Digital Elevation Model- From SRTM website
- Landuse –
- Soil –
- Drainage –

Institute for Water Studies, Taramani

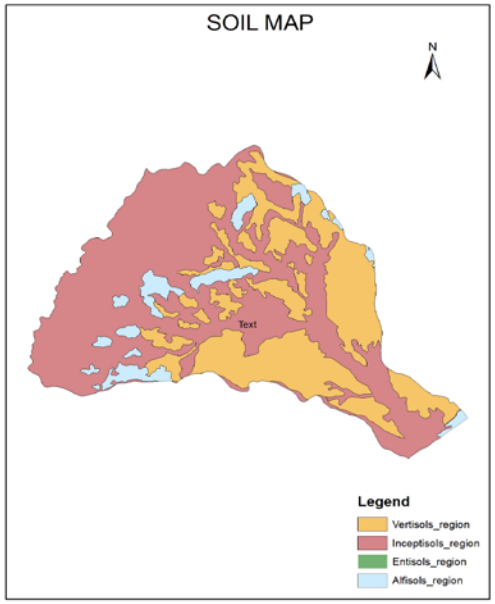
- Weather- Data generated by the Hadley Centre for climate Prediction U.K at a resolution of 2.5° x 3.75° latitude by longitude
  - HADCM3- IPCC scenario
  - 20 years current & projected 2020,2050,2080

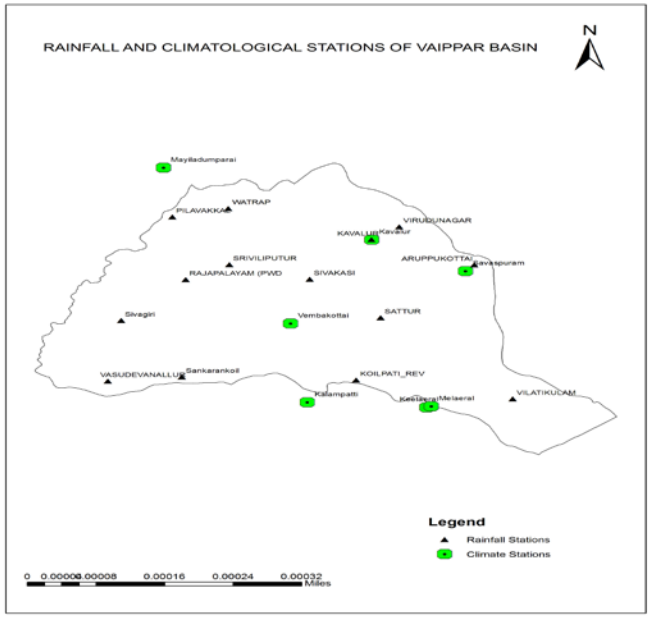
LAYERS

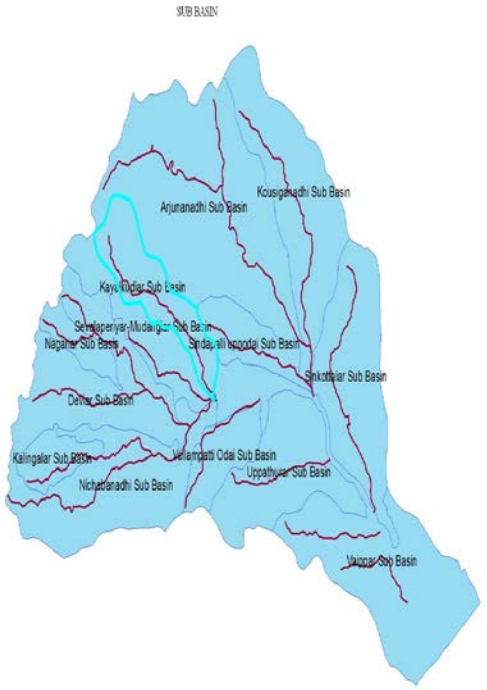




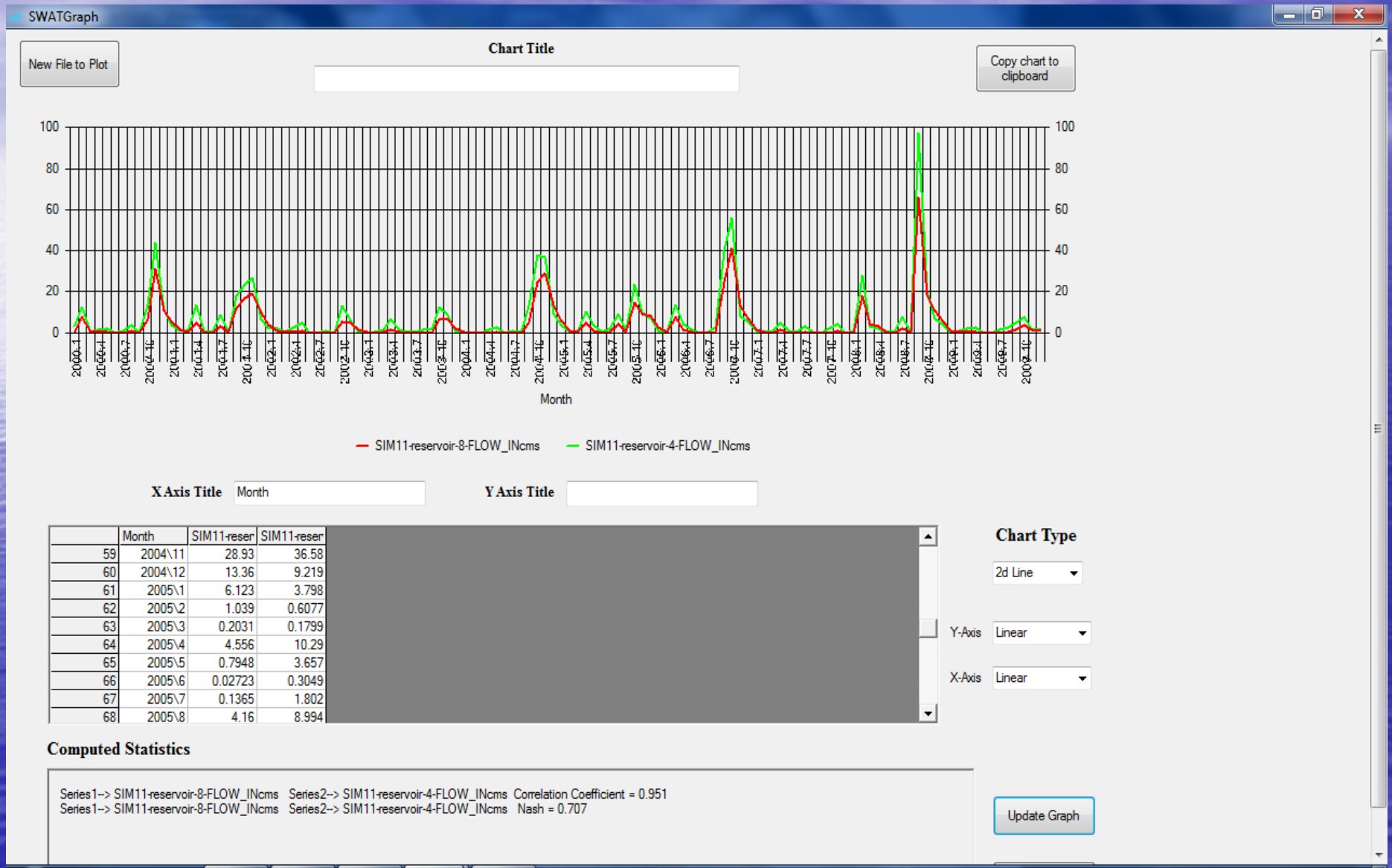
DEM
Delineated Basin
Land use
Soil
Weather



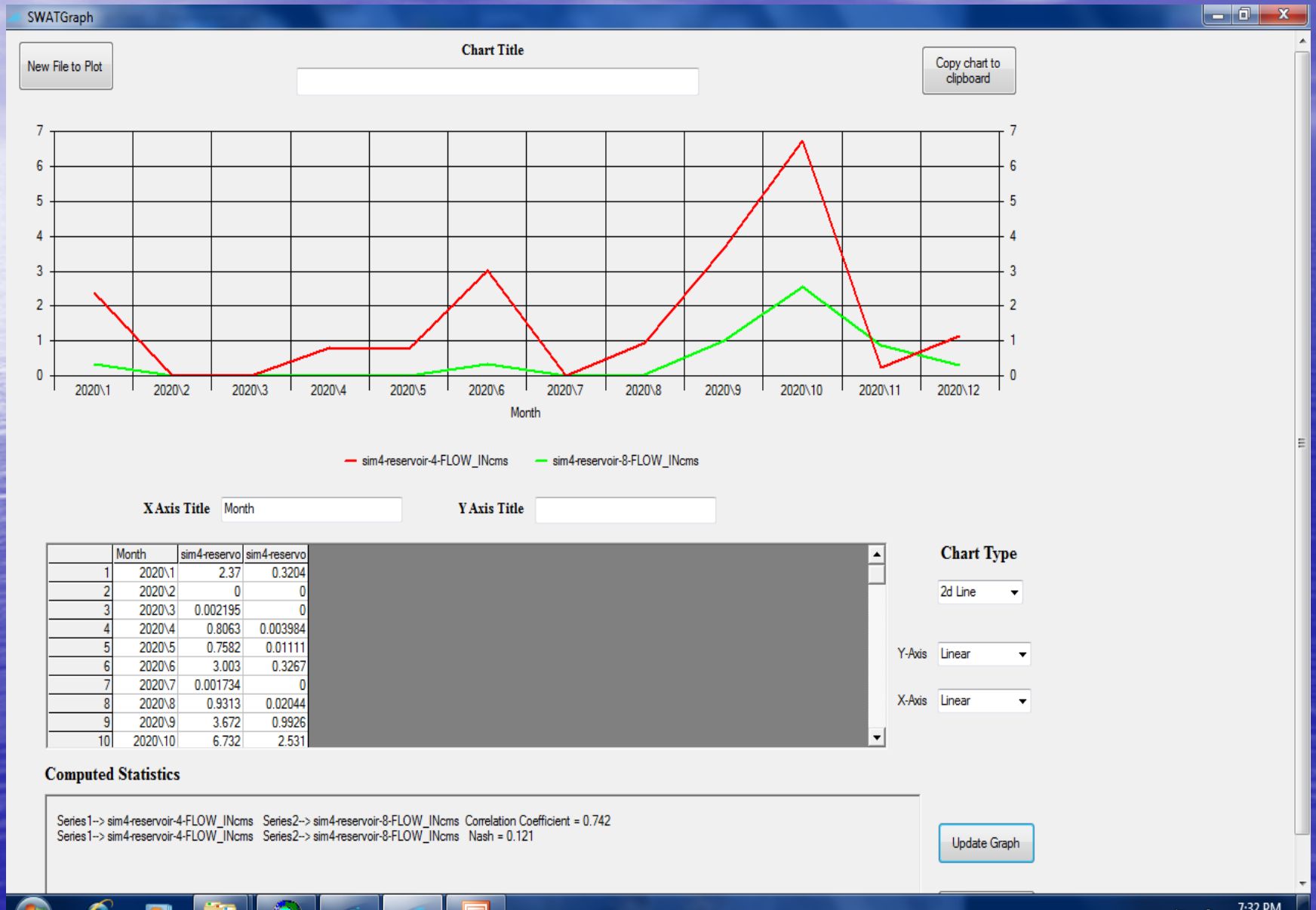




SIMULATED RESERVOIR INFLOW(2000-2010)



SIMULATED RESERVOIR INFLOW(2020)



SIMULATED RESERVOIR INFLOW(2040s)

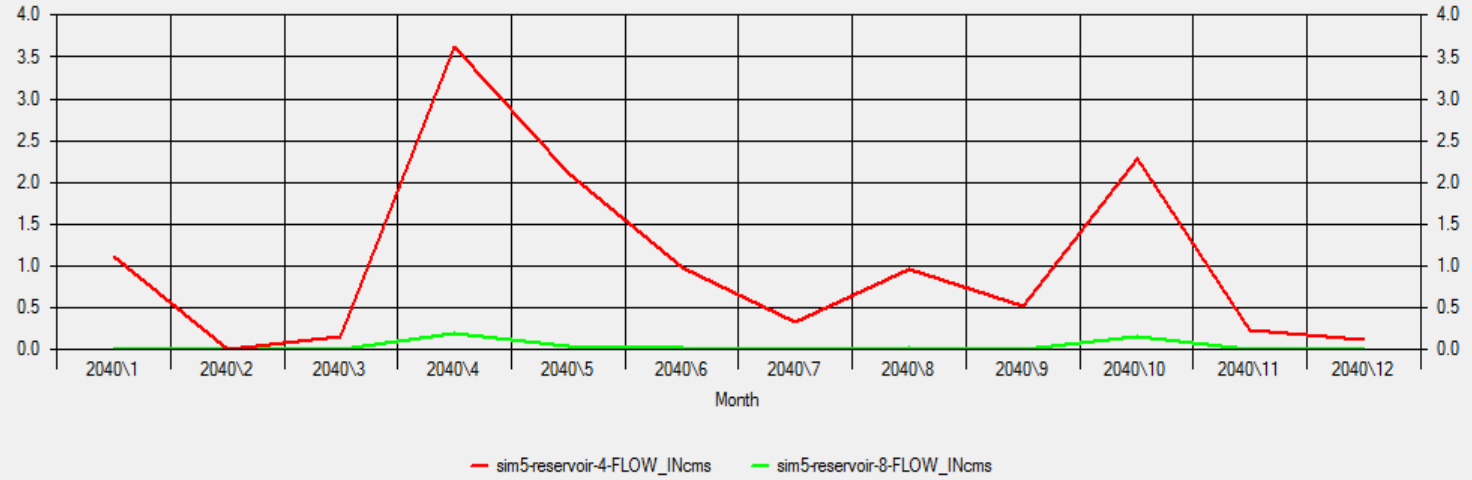
SWATGraph

New File to Plot

Chart Title

RESERVOIR INFLOW IN 2040

Copy chart to clipboard



X Axis Title: Month

Y Axis Title:

	Month	sim5-reservo	sim5-reservo
1	2040\1	1.106	0.01619
2	2040\2	0	0
3	2040\3	0.1416	0.0006453
4	2040\4	3.629	0.1954
5	2040\5	2.099	0.03462
6	2040\6	0.9663	0.007961
7	2040\7	0.3222	0.003177
8	2040\8	0.9517	0.02203
9	2040\9	0.5141	0.005292
10	2040\10	2.282	0.1458

Chart Type

2d Line

Y-Axis: Linear

X-Axis: Linear

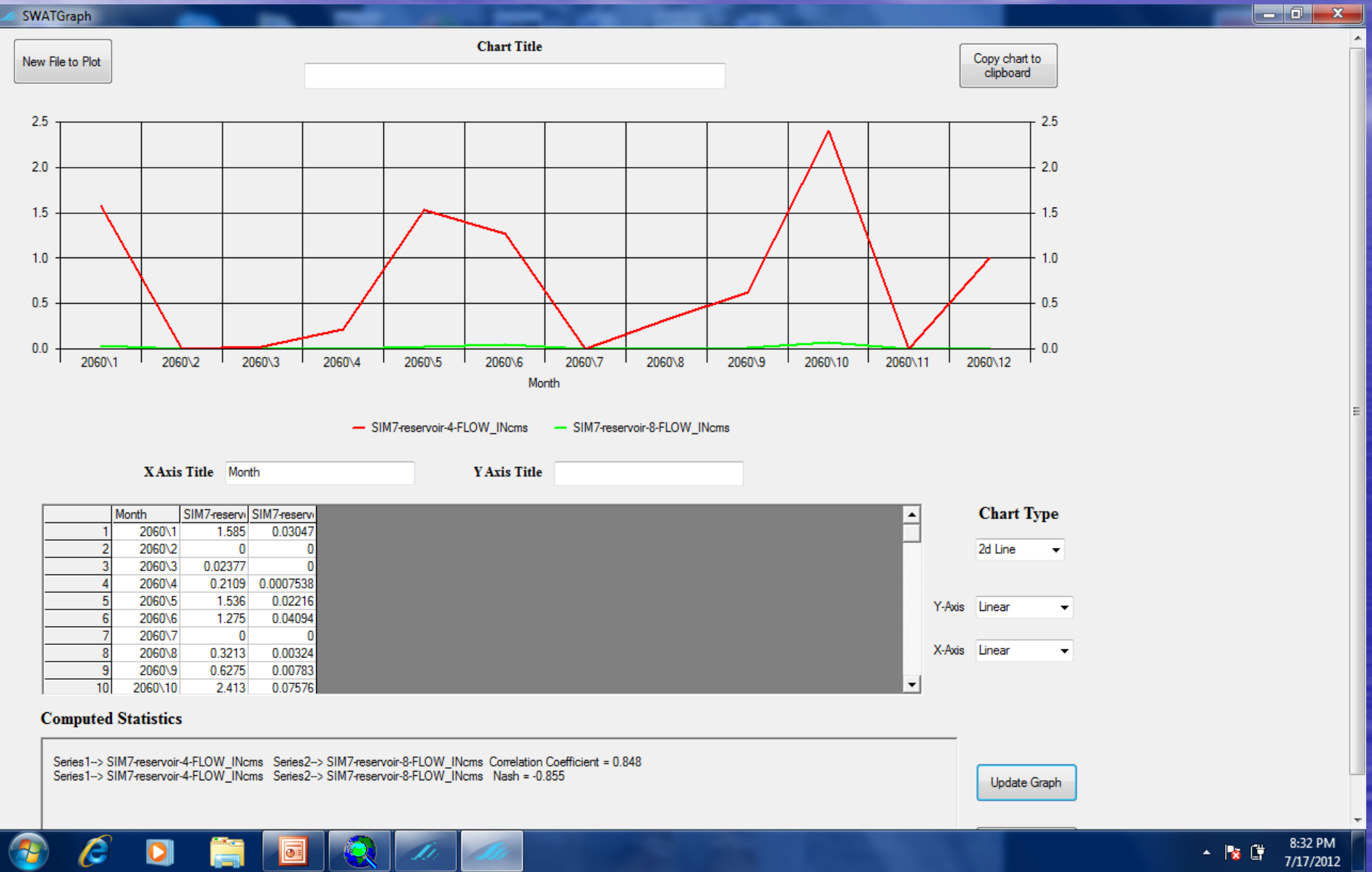
Computed Statistics

Series1--> sim5-reservoir-4-FLOW_INcms Series2--> sim5-reservoir-8-FLOW_INcms Correlation Coefficient = 0.831
Series1--> sim5-reservoir-4-FLOW_INcms Series2--> sim5-reservoir-8-FLOW_INcms Nash = -0.766

Update Graph

8:11 PM

SIMULATED RESERVOIR INFLOW(2060s)



THANK YOU