Assessment of climate change impact on streamflow prediction using SWAT a case study of Cauvery river basin, Peninsular India

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INTRODUCTION

- Climate change impacts on hydrological regimes over the past few decades turned our focus on assessing the reliability of modelling water resources in past and future projections.
- Evaluating the information on climate change over a global scale is made possible through General Circulation Models (GCMs).
- Regional-scale climate change impacts on hydrological structures can be performed by downscaling GCMs from various climate institutes.
- The GCMs are ranked based on their performance in representing the daily historical climate parameters such as precipitation, minimum and maximum temperature.
- The ensemble of historical and future projected data will help in a better projection of climatic conditions over different possible future scenarios.
- Soil and Water Assessment Tool (SWAT) is adopted to model the hydrological system in the selected basin with the help of observed climatic and topographical data.

STUDY REGION

- Cauvery River basin falls in peninsular India and lies between 75°27'E to 79°54'E and 10°9'N to 13°30'N.
- It has a spread over states of Tamil Nadu, Karnataka, Kerala and Union Territory of Puducherry, draining an area of around 85,000 Sq.km.
- It is confined by the Western Ghats on the west, by the Eastern Ghats on the east and south.
- The key regions of the basin are covered with agricultural land up to 67% of the total area and 20 % of the basin is covered by forest area (CWC and NRSC, 2014).
- The Cauvery river basin has four seasons namely Winter (December to February), Summer (March to June), South-West Monsoon (July to September) and North-East Monsoon (October to November).

DATA DESCRIPTION

A) GCM Data

- The CMIP5 GCM was used in this study considering the daily ensemble realization run r1i1p1.
- Sixteen models from various institutions were selected namely ACCESS-1.0, BCC-CSM1-1-M, BNU-ESM, CanESM2, CCSM4, CNRM-CM5, CSIRO-Mk3-6-0, EC-EARTH, GFDL-CM3, HadGEM2-CC, INMCM4, IPSL-CM5A-MR, MIROC5, MPI-ESM-LR, MRI-CGCM, and NorESM1-M.
- The weather parameters considered in the present study are precipitation (pr) and near-surface air temperature (tas).

B) Observed Data

- The daily observed station data are obtained from the Indian Metrological Department (IMD) for the 35 stations located in the Cauvery river basin for the period of 1976-2005.
- The river basin is further classified into upper, middle and lower Cauvery river basin based on its weather pattern and discharge statistics.
- Historical GCM datasets are regridded to the station scale and trimmed to the observed data specifications..

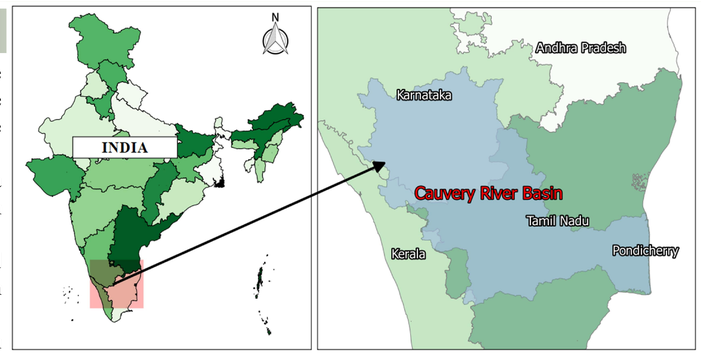

FIG 1. Cauvery River Basin extent and boundary

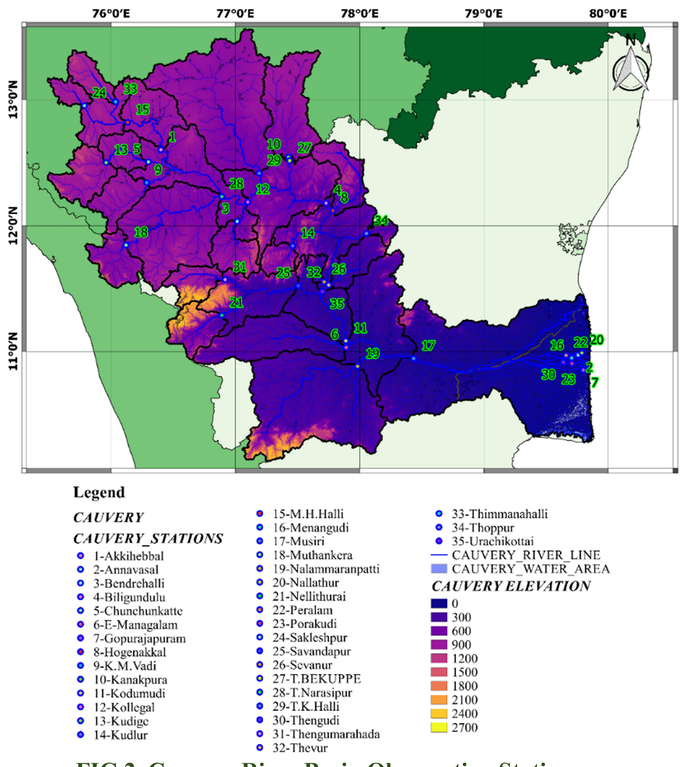

FIG 2. Cauvery River Basin Observation Stations

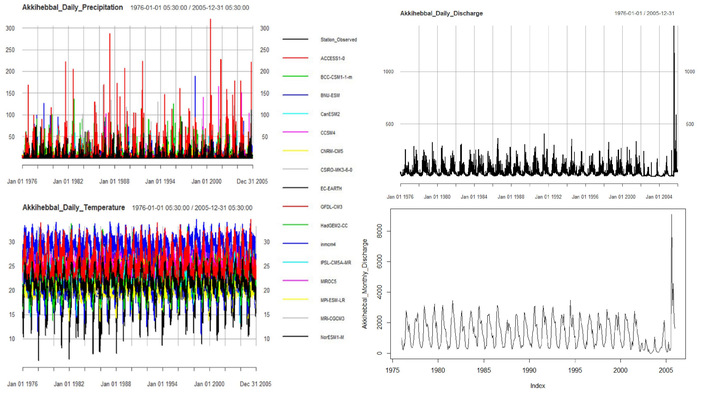

FIG 3. Sample Station Observed and GCM Data (Precipitation, Temperature and Discharge)

METHODOLOGY

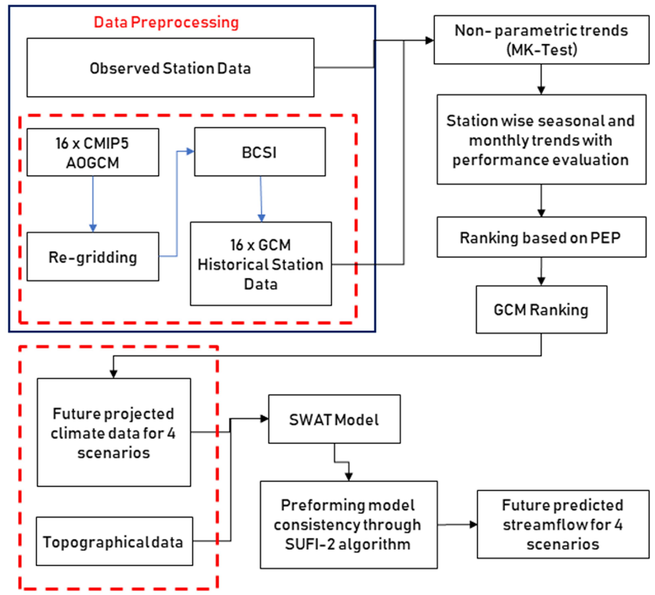

FIG 4. Brief Methodology

RESULTS & DISCUSSION

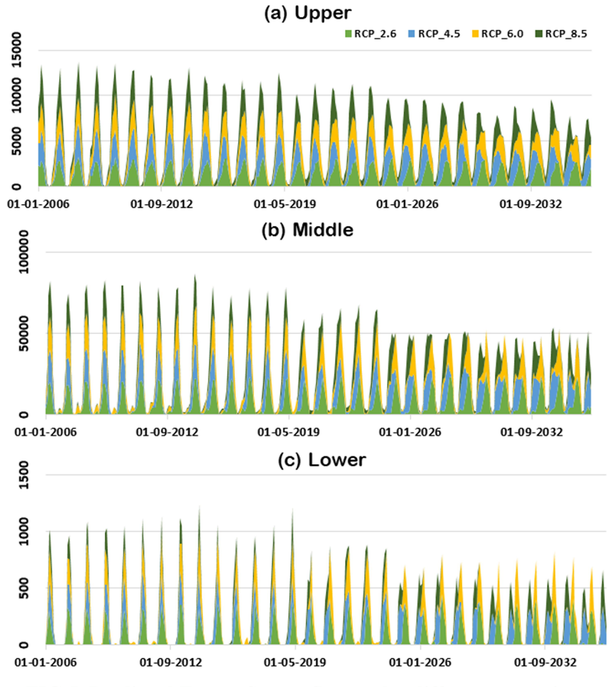

FIG 5. Predicted Future Streamflow under different scenarios

- The daily observation data from gauge station is used to model the monthly discharge , Climatic parameters such as Precipitation (pr), Surface Temperature (Tas), Minimum Temperature (Tmin) and Maximum Temperature (Tmax) were selected for modelling the discharge.
- The Ensemble of future climate model data for all selected scenario (RCP 2.6, RCP4.5, RCP 6.0 and RCP 8.5) are made with the help of ranks obtained from the experiment.
- The SWAT model is used to project future streamflow discharge based on four different Representative Concentration Pathways (RCPs).
- The future streamflow predicted using each RCP is assessed for the variations and impact of climate change on water resources over the Cauvery river basin.
- To improve the SWAT model consistency, it is calibrated with monthly observed data for 1976-2005 (Warmup period (1976-1980), Calibration (1981-1995) and Validation (1996-2005)) from available 35 stream gauge stations using Sequential Uncertainty Fitting Algorithm (SUFI-2).
- To deal with input and model uncertainty the observed and simulated discharge will be evaluated within the 95% confidence interval (95 PPU).

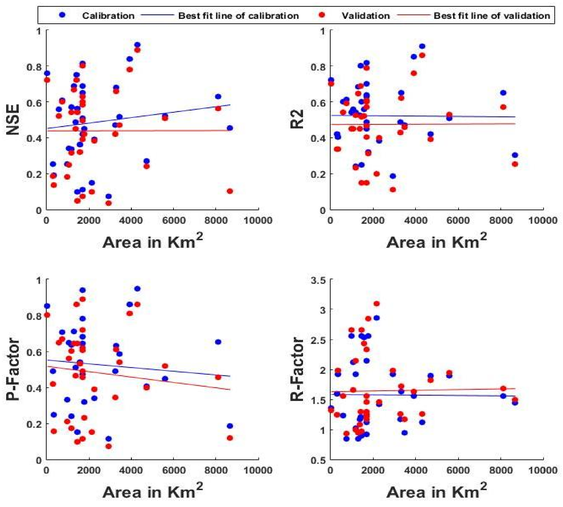

FIG 6. Station wise Performance Evaluation based on extent of area

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