Impact of Climate Change on Hydrology of Moyar-Bhavani Basin

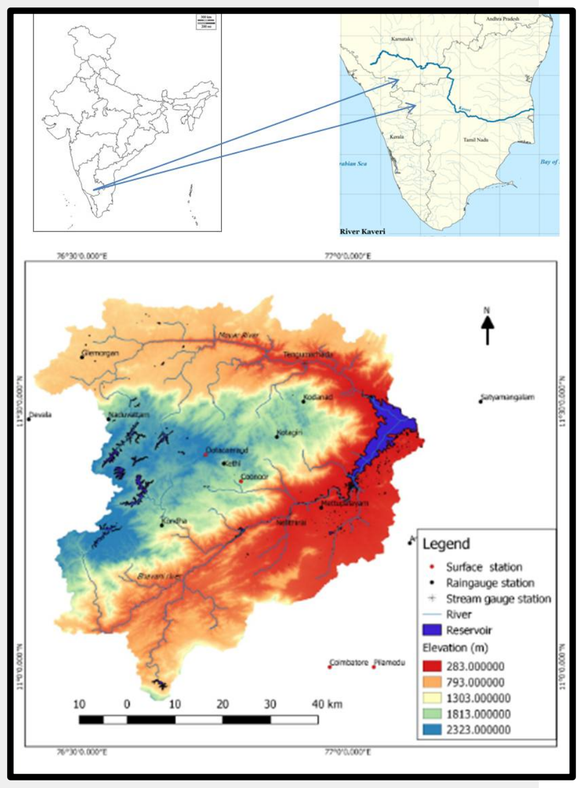
Background

❖ Moyar- Bhavani catchment which is located in Tamil Nadu, India with agricultural and forest dependent socio-ecological systems have two distinct climate zones - subtropical to temperate climate at upstream and semi-arid at downstream.

❖ High spatial variability in topography and land use that results in spatio-temporal variability of precipitation and temperature make the area vulnerable to climate. Annual average precipitation over the basin varies from 1500mm in the upstream to 650mm in the downstream. Maximum and minimum temperature is 41.2°C and -2.1°C.

❖ Since the primary occupation is farming, fluctuation in availability of water in time and space can significantly influence human well being. Therefore, better understanding and assessment of water balance under changing climate are of great importance for development and management of the catchment.

Fig 1: Moyar-Bhavani Catchment



Data

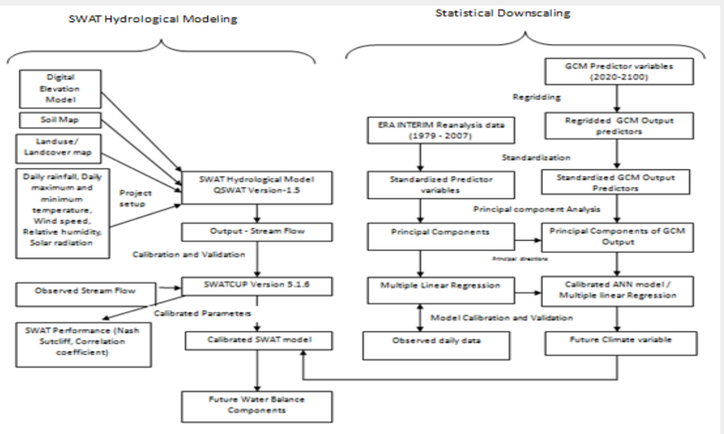
SWAT Data	Source	Original resolution
Digital Elevation Model	USGS website	30m x 30m SRTM
Soil map	National Bureau of Soil Survey & Land Use Planning (NBSSLUP)	Jpg format
Soil hydraulic properties, Soil texture and soil depth	Mehta et al. 2008 (soil analysis from Bandipur which is adjacent to our study area) and J.Schaake 2000 (Average hydraulic properties of ARS soil texture classes) , NBSSLUP publication 46b	
Land use map	NASA Earth Data (Distributed Active Archive center for biochemical dynamics)	100 x 100 m
Meteorological data	India Meteorological Department (Daily data from 1981-2009)	Station data
Stream Flow data		Station data

Table : 1 Data used for SWAT (Soil Water Assessment Tool) Modeling

Statistical Downscaling data	Source	Original resolution
Observed Precipitation and Temperature	India Meteorological Department (Daily data from 1979-2007)	Station data
ERA INTERIM Reanalysis data	European Centre for Medium-Range Weather Forecasts (ECMWF) website	1.125 x 1.125 degree, 1.5 x 1.5 degree, 2.5 x 2.5 degree
CMIP5 Global Climate Model Outputs	World Climate Research Programme Website Models – MRI- CGCM3, CNRM-CM5, GFDL–CM3, MIROC5, MPI-ESM-LR (Scenarios – RCP 2.5, RCP 4.5, RCP 8.5)	1.125 x 1.125 degree, 1.5 x 1.5 degree, 2.5 x 2.5 degree

Table : 2 Data used for Statistical Downscaling

Methodology



Results

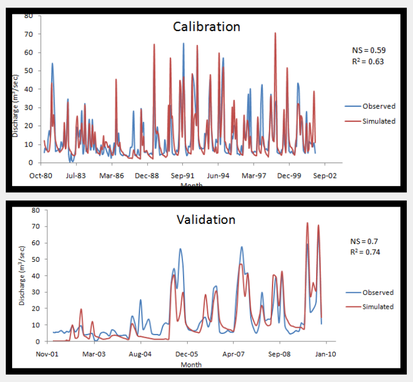


Fig : 2 Calibration and Validation results of SWAT Model

Station	MRI-CGCM3				CNRM-CM5,MPI-ESM-LR,MIROC-5				GFDL- CM3			
	Corelation coefficient		Root Mean Square error		Corelation coefficient		Root Mean Square error		Corelation coefficient		Root Mean Square error	
	Calibration	Validation	Calibration	Validation	Calibration	Validation	Calibration	Validation	Calibration	Validation	Calibration	Validation
Precipitation												
Mettupalyam	0.32	0.3	7.85	8.14	0.31	0.3	7.71	8.1	0.31	0.3	7.99	8.14
Satyamangalam	0.32	0.3	7.67	7.32	0.32	0.31	7.74	7.31	0.33	0.29	7.53	7.41
Maximum Temperature												
Coimbatore	0.84	0.82	1.57	0.82	0.83	0.81	1.61	1.61	0.85	0.83	1.55	1.53
Ooty	0.77	0.71	1.91	0.71	0.77	0.7	1.92	2.34	0.77	0.71	1.92	2.32

Table : 3 Performance of Statistical Downscaling

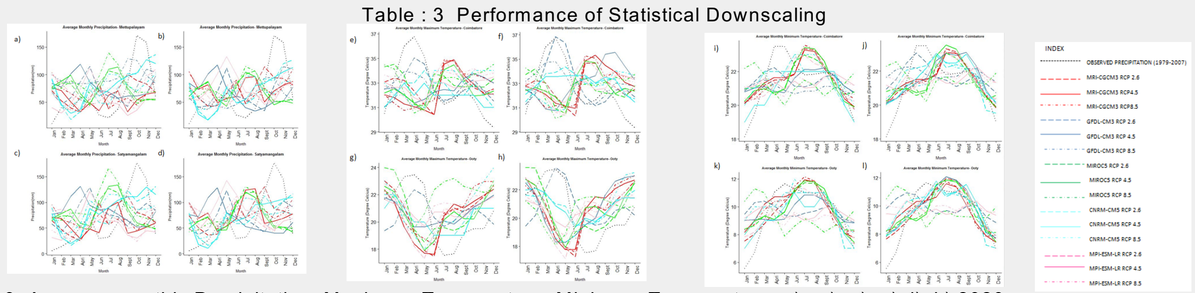


Fig : 3 Average monthly Precipitation, Maximum Temperature, Minimum Temperature a) , c) ,e), g), i), k) 2020-2049, b) ,d) , f), h), j), l) 2050-2079),

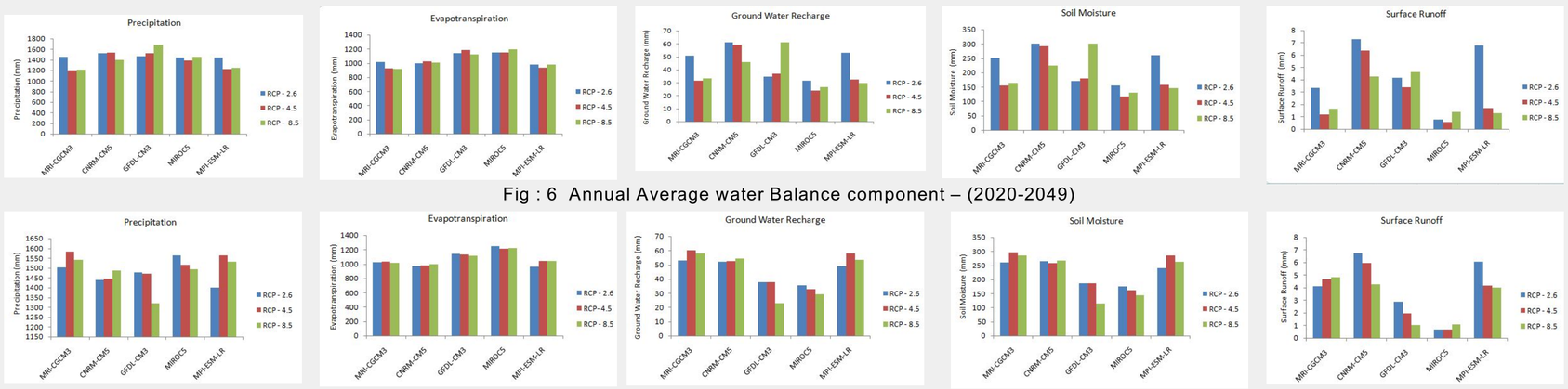


Fig : 6 Annual Average water Balance component – (2020-2049)

Fig : 7 Annual Average water Balance component – (2050-2079)

Conclusion

❖All models exhibit results indicating decrease in rainfall during North East monsoon. Further the results also show rainfall during summer season. There is an increase in annual average precipitation during 2020's and 2050's compared to historical period.

❖Approximately, 1.5^{0}C rise in Maximum Temperature was shown by all the GCMs during winter season.

❖In comparison with pre-industrial period, the future period indicates that Evapotranspiration accounts for major portion of precipitation. Runoff has drastically reduced. With every passing year, Evapotranspiration and Runoff is shown to be decreasing balanced by Soil moisture and Ground water Recharge

www.assar.uct.ac.za

This work was carried out under the Adaptation at Scale in Semi-Arid Regions project (ASSAR). ASSAR is one of five research programmes funded under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), with financial support from the UK Government's Department for International Development (DfID) and the International Development Research Centre (IDRC), Canada. The views expressed in this work are those of the creators and do not necessarily represent those of DfID and IDRC or its Board of Governors.

Prepared by Ashwathi V K and Shrinivas Badiger, ATREE, Bangalore. India

Part of the CARIAA programme: