A Review Paper on Hydrological Modelling and Climate Change in India

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Abstract— *the term Climate change refers to long-term changes in temperature, humidity, clouds and rainfall and not to day-to-day variations (IPCC, 2007). Climate change has become a very established fact and its impacts have to be taken care off. Strategies to mitigate the impacts of climate change have been evolving over last couple of decades. Climate change has its implications on water resources. Proper analysis of various parameters of hydrology by taking into consideration the present and futuristic climatic changes would help mitigate the stressed water resources scenario of the country. Research based coping strategies and framework using advanced modeling techniques may prove boon to the already highly variable water availability in the country.*

***Keywords*— Climate change, IPCC, SWAT**

I. INTRODUCTION

India is the second most populous and seventh largest country in the world. India's terrain leads to a number of different regions with a wide variety of diverse climatic conditions, all of which would face significant but different impacts from climate change. With its large and growing population, and an economy that is closely tied to its natural resource base, India's population is vulnerable to the impacts of climate change such as changes in forest and water resources and sea level rise. Growing population, rapid industrialization and urbanization coupled with Climate Change will create additional pressures on India's overall ecology and socio-economic system.

The IPCC (Intergovernmental Panel on Climate Change) was created by UN to enable scientists from all part of the world to provide an authentic summary of our present understanding of the climate change or adapt to it. Important points are summarized as –

- The Intergovernmental Panel on Climate Change, in its 2007 report, predicts that temperatures will rise by 2.7- 4.3°C over India by the 2080s.
- The panel also predicated an increase in rainfall over the Indian sub-continent by 6-8 percent and that the sea level would rise by 88 cm by 2100.
- An annual mean surface temperature rise by the end of this century, ranging from 3°C to 5°C *(under A2 IPCC scenario)* and 2.5°C to 4°C *(under B2 IPCC scenario)*, with the warming more pronounced in the northern parts of India.
- A 20 percent rise in all India summer monsoon rainfall and a further rise in rainfall is projected over all except Punjab, Rajasthan, and Tamil Nadu, which show a slight decrease.
- Observations over India show that the mean annual surface air temperature has increased by 0.4-0.6°C in the last 100 years *(Hingane et al., 1985. Rupa Kumar et al., 2002).*

II. LITERATURE REVIEW

The all-India annual-mean surface air temperature was the highest in *2010 (IMD, 2010)*. The all India annual mean surface air temperature has increased by 0.51^0c in the past 106 years. Most of the increase was seen during the past 30 years during pre-monsoon season *(Rupa Kumar et al., 2002).* During the past 50 years the heavy rainfall events (rainfall greater than 100mm/day) has increased by 50 percent in central India *(Goswami et al., 2006)*. This rapid increase in heavy rainfall events may be on account of global warming or increase in aerosols. To predict climate change in India in the 21st century we need to use climate models. Many works has been done in this area of which some extractions are shown below;

1. Mapping vulnerability to multiple stressors : Climate change and globalization in India *(Karen O'Brein et al., Global environment change, volume 14, issue 4 Dec2004, pg303-313)*
2. Impact of climate change in terms of rainfall and temperature on water balance and response of catchments in extreme flood and drought condition

was studied using NAM model *(RPS Consulting engineers, Belfast 2006)*

3. Climate change challenges water managers and researchers to find sustainable management solutions, in order to avoid undesirable impacts on water resources, environment and water dependent sectors *(Fred Fokko Hatteerman)*
4. All India summer monsoon rainfall is free from any long-term trend although on subdivisional scale there are regions of increasing/decreasing trends *(K. K. Kumar 2010)*
5. Impact of climate change on water resources was carried out as a case study for mulunguzi and namadzi catchment areain southern Malawi by D. Mbano 2, 3, J. Chinseu.
6. High-resolution climate change scenarios for India for the 21st century *(K. Rupa Kumar et al., IITM)*
7. Do CMIP 5 simulations of Indian summer monsoon rainfall differ from those of CMIP 3?, Royal Meteorological Society(K. Shashikanth, , Kaustubh Salvi, Subimal Ghosh, and K. Rajendran 2013)
8. Impact of climate change on rainfall over Mumbai using distribution-based scaling global climate model projections, Journal of hydrology: Regional studies (Arun Rana, Kean Foster, Thomas Bosshard, Jonas Olssan, Lars Bengtsson 2014)

III. CONCLUSION

The present paper may be summarized through the following conclusions: The climate change is an inevitable process which leads the earth to evolve from ice age to present scenario. Its long term impact can be modeled through SWAT or many other available models. The Soil and Water Assessment Tool has a wide range of applications which can be applied to any region to estimate any hydrological parameters or for future prediction provided necessary modification is ensured by Calibrating and Validating the model for any particular region and their local parameters. There are various sources available for data collection which can be used for comparative study.

IV. SCOPE

There is a clear evidence of global warming in India in the 20^{th} century and this will accelerate in the 21^{st} century. The climate models used to predict the climate change in the 21^{st} century are not agreed on the nature of regional climate change. This is caused by both by poor spatial resolution of the climate models and our incomplete understanding of the impact of aerosols and clouds on climate. This uncertain future has made it difficult to plan strategies for adaptation and mitigation.

In the Indian context, if we adopt strategies to adapt to climate variability then we will be able to tackle long term climate change more confidently. One can expect more heavy rainfall events, higher sea level and more severe heat waves in the future. Thus climate change will add one more dimension to the problems created by uncontrolled population growth and inappropriate human activities.

By using simulation models long term predictions, early warning systems and evaluation processes can be produced in near future.

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