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Assessing the Uncertainty in Downscaling Approaches using Hydrological Model

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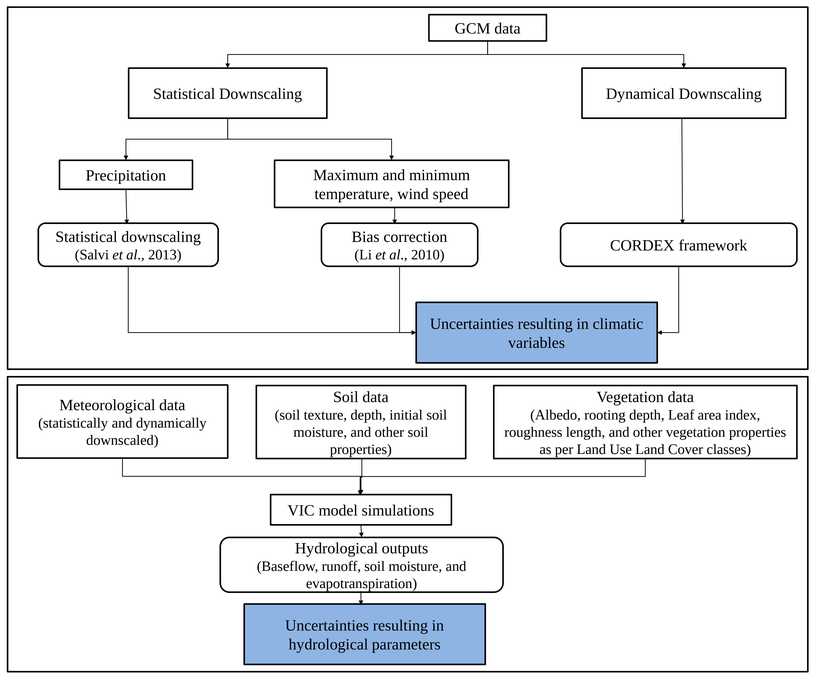
INTRODUCTION

- Global warming affects the hydrological cycle components by spatial as well as temporal variations in water availability.
- Climate variability plays an important role in determining the productivity of the crops, especially under rainfed condition.
- Need of using climate variables at finer resolution, in order to improve regional hydrological projections which may reduce the uncertainties lying in the impacts of climate change on water resources as well as agriculture.
- Need for assessing the uncertainty lying in climatic variables through different downscaling approaches which will further increase the uncertainties involved with hydrological parameters.
- Hydrological response is considered to be an integration of the regional climatic variables (Wilby *et al*., 2000).

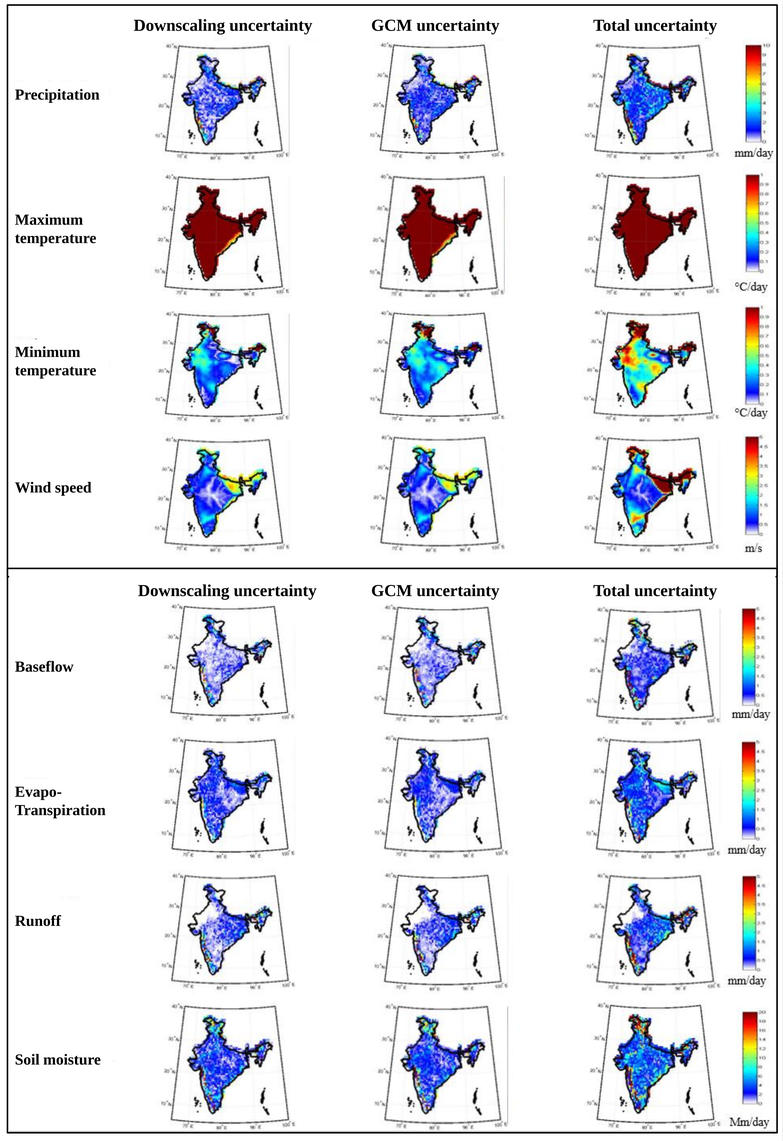
METHODOLOGY



- EC-earth and LMDZ/IPSL General Circulation Model (GCM) data has been used in this study which are a part of CMIP5 framework.
- Statistical downscaling (stat) of precipitation has been done by making use of methodology described in Salvi *et al*. (2013).
- Maximum and minimum temperature as well as wind speed data were bias corrected by making use of methodology described in Li *et al.* (2010).
- Dynamically downscaled data for both the GCM was taken from COordinated Regional climate Downscalling EXperiment (CORDEX) framework derived by Indian Institute of Tropical Meteorology (IITM), India.
- Variable Infiltration Capacity (VIC) model at 0.5° spatial and daily temporal resolution has been used to derive the response of climatic variables on hydrology.

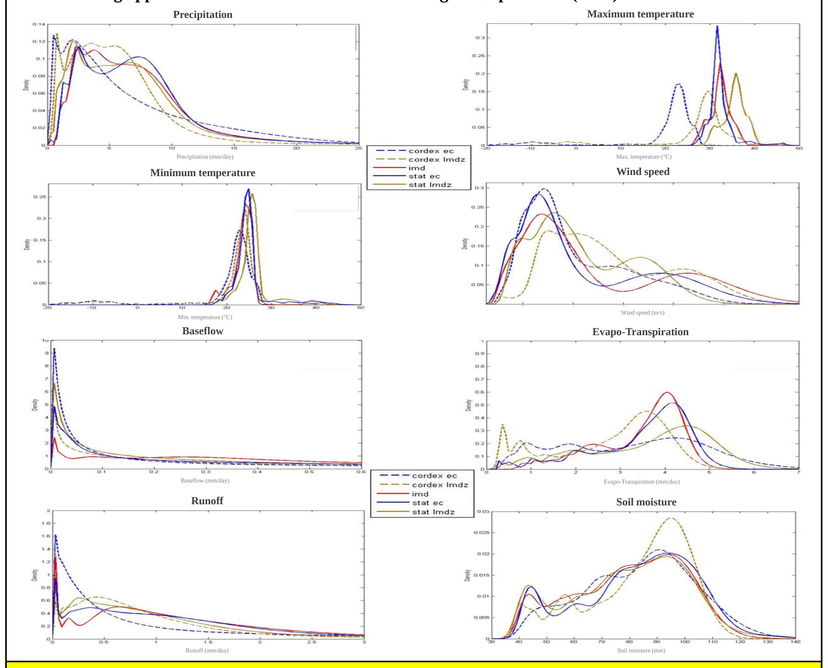
RESULTS AND INFERENCE

- Total uncertainty has been quantified considering both the downscaling and GCM uncertainty.
- Changes in hydrological parameters and climatic variables were derived considering historical period from 1981-2005 and future period from 2016-2040. Here, monsoon season (south-Asian summer monsoon from June to September) has been considered for the analyses.
- It has been found that uncertainties in climatic variables is less as compared to that in hydrological parameters because factors such as soil, Land Use/Land Cover (LULC), etc. play an important role in deriving hydrological parameters.
- Uncertainty in terms of changes within downscaling techniques and within GCM's:



RESULTS AND INFERENCE (Contd..)

- Comparison of daily mean climatic variables and hydrological parameters derived by using both the downscaling approaches and observed India Meteorological Department (IMD) data :



CONCLUSIONS

- Both downscaling as well as GCM uncertainty are contributing to the total uncertainty of all the climatic variables.
- Uncertainty in all the climatic variables has been propagated to uncertainties in hydrological parameters.
- Both statistical and dynamical downscaling were able to capture climatic variability; although when compared with IMD, statistically downscaled precipitation matches better as compared to CORDEX.
- Bias correction proves to be sufficient for projecting maximum and minimum temperature.
- Dynamically downscaled data (CORDEX) for both the GCM's tries to under/over estimate hydro-climatic variables, when compared with IMD data.

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