Abstract

In this dissertation the behaviour of rainfall over the several past years was investigated in a long term analysis for some key urban agglomerations of India as well as for every Indian river basin. The long term changes in the annual and seasonal rainfall along with the extreme events are investigated in detail. The findings chiefly pointed towards the rising extremes and altering annual/seasonal rainfall for majority of the regions. Such trends if continue in future, would have serious implications on drought and flood related disasters. To study these hydro-climatic phenomenon, climate projections from Global Climate Models (GCMs) were utilized. First the drought across mainland India was studied employing a multi-scalar drought index, i.e., Standardized Precipitation Evapotranspiration Index (SPEI) at 3 month scale into three time frame of near-future (2010-2039), mid-future (2040-2069), and far-future (2070-2099). The multi-model ensemble of 9 GCMs was developed post bias-correction of rainfall and temperature time series to analyse the droughts in projected climate scenarios. The analysis infers towards the likelihood of increase in drought severity and duration in warming scenarios wherein more area will be affected due to 'above moderate drought'. After characterizing the drought across India, the focus of study was shifted to examine the streamflow regime of a large river basin under the influence of climate change in future time frames. For this purpose, Mahanadi river basin, one of the Major basins of India, was selected to study the river response employing the integrated MIKE 11 NAM-HD model. Owing to the fact that river response, especially the high flows, are sensitive towards extreme rainfall events additional efforts were put to devise a novel bias-correction approach for GCM rainfall. The suggested rainfall approach, i.e., monthly hybrid approach, captures rainfall extreme better than other commonly used approaches while resolving the rainfall seasonality with reasonable accuracy. The mean monthly simulated streamflow using all the nine GCMs were used to develop the multi-model ensemble streamflow to study the mean monthly discharge and high & low flows for Mahanadi river basin. One of the key findings of modeling exercise indicates the rise in high flows in the Mahanadi basins in projected climate that may bring flood risk to the downstream regions.

Keywords: Climate change, India, River basins, Mahanadi, Hydrological modeling, Global Climate Models, Drought, Streamflow, Bias correction