INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

This study is focused on the climate extremes and glacial lake outburst flood over the Teesta River catchment (up to Chugthang), which is a part of Eastern Himalaya. A Statistical Downscaling Model (SDSM) has been applied for downscaling of precipitation and temperature for present and 21st century scenarios. Significant upward trend was found in annual precipitation and temperature during 2006-2100. The non-monsoon precipitation had significant increasing trend, whereas monsoon precipitation showed falling trend, which indicates shifting in the precipitation pattern. Analysis of precipitation extremes suggested increase in higher precipitation events which may lead to floods in the region. The minimum and maximum temperatures are showing warming trends with the rate of 0.015°C/year and 0.01°C/year in the 21st century, respectively. The minimum temperature indices are more pronounced than maximum temperature indices both in past and future. Copula based assessment of the joint behavior of temperature extremes suggested that cool nights would be colder and warm nights would be hotter. Similarly, joint behavior of precipitation extremes suggested frequent co-occurrence of floods and droughts in same year and higher risk of floods. Hydrological modeling (MIKE11 NAM) and Budyko framework was carried out to assess the hydrological response and relative contribution of climatic variable on annual runoff changes. MIKE11 NAM simulation indicated the increase in streamflow for all projected scenarios, which was consistent with the increase in precipitation. Budyko framework analysis suggested a decrease in the snow-ratio, which indicates lesser likelihood of precipitation to occur as snowfall in future. Landsat satellite images were used to identify the glacial lakes and further, the steep lakefront area (SLA) was utilized to compute the potential flood volumes (PFVs) for the identified lakes. Total 203 glacial lakes having area more than 0.01 km^2 were identified, most of them are situated at the high elevation zone (>4500 m) and some glacial lakes are found increasing their areal extends. Hydrodynamic modeling (MIKE11 HD) simulations for glacial lake outburst flood (GLOF) condition suggested that peak discharge could increase up to 4-6 times, and depth and velocity increased about 100%. The study suggests that the substantial changes in climate and climate extreme could adversely affect the hydrology and snowfall patterns in the region. Increase in high precipitation events along with higher melting of glaciers could result in GLOF events, which may affect the habitat regions and hydro power projects in the downstream areas. This study also suggests the need of adaptation measures viz. early flood warning system and mitigation strategies. In addition, this study recommends the potential use of the high-altitude glacial lakes as a storage mechanism for the controlled utilization of the melt water.