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Hydrological Modeling and Climate Change Impact Assessment Using HBV Model, A Case Study of Karnali River Basin of Nepal

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Abstract : The lumped conceptual hydrological model HBV is applied to the Karnali River Basin to estimate runoff at several gauging stations and to analyze the changes in catchment hydrology and future flood magnitude due to climate change. The performance of the model is analyzed to assess its suitability to simulate streamflow in snow fed mountainous catchments. Due to the structural complexity, the model shows difficulties in modeling low and high flows accurately at the same time. It is observed that the low flows were generally underestimated and the peaks were correctly estimated except for some sharp peaks due to isolated precipitation events. In this study, attempt has been made to evaluate the importance of snow melt discharge in the runoff regime of the basin. Quantification of contribution of snowmelt to annual, summer and winter runoff has been done. The contribution is highest at the beginning of the hot months as the accumulated snow begins to melt. Examination of this contribution under conditions of increased temperatures indicate that global warming leading to increase in average basin temperature will significantly lead to higher contributions to runoff from snowmelt. Forcing the model with the output of HadCM3 GCM and the A1B scenario downscaled to the station level show significant changes to catchment hydrology in the 2040s. It is observed that the increase in runoff is most extreme in June - July. A shift in the hydrological regime is also observed.

Keywords : hydrological modeling, HBV light, rainfall runoff modeling, snow melt, climate change
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