Submitted Abstract

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Abstract

Glacier, snow and permafrost play an important role in the Himalayan river basins and change in climatic variability directly affects these cryospheric elements. The large portion of river discharge in Himalayan river basins comes from snow and glacier ice melt, and their contributions to river flow are critical to fully understanding current and future scenarios. The glacier's status and its response to different time-series climatic variability need to understand for the past and future glacier dynamics. This study aims to estimate the cryospheric and hydrological regime of the Marsyangdi River Basin (MRB) of Nepalese Himalaya covering an area of 4026 sq. km. MRB comprises 20 % of the glacierized area, the future glacier change is evaluated using the Open Global Glacier Model (OGGM) with three Shared Socioeconomic Pathways (SSP) scenarios from Coupled Model Intercomparison Project- Phase 6 (CMIP6). The MRB glacier area from 2021 to 2100 is expected to decrease by 32%, 47%, and 66% under SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios. Similarly, the glacier volume is also expected to decrease by 56%, 62%, and 73% till 2100 under those three scenarios. The glacier area and volume change from the glacier dynamics model is integrated with a distributed glacio-hydrological model, Glacio-hydrological Degree-day Model (GDM) to simulate the future hydrological regime of MRB. The GDM model is calibrated with the observed discharge to estimate the contributions of snowmelt, icemelt, rainfall, and baseflow in river flow. The GDM-estimated future changes in river flows reveal that glaciers icemelt from (debris-free, debris-covered) and snowmelt contributions are important for the water supply in MRB. The change in glacier area and volume under the SSP5-8.5 scenarios, remarkably affect the total river flows and tends to decrease slightly by the end of this century, whereas the glacier ice melt contribution increases after mid-century in the MRB. Similarly, the snowmelt contribution to river flow decreased after the mid-century. The future cryospheric and hydrological regime is effectively evaluated by integrating the glacier dynamics and a glacio-hydrological model. This integrated approach could potentially improve understanding of the hydrological system dynamics and potential impacts of climate change in the Himalayan glaciated river basins.