Assessment of Climate Change on Water Availability in Central Himalayas, Nepal

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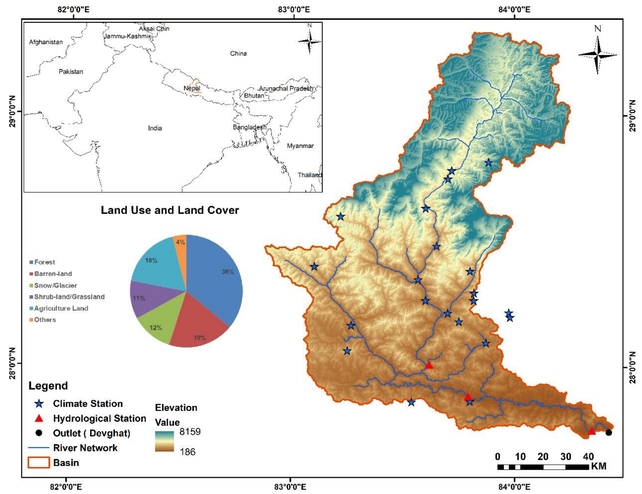
Introduction

This research focuses on examining the potential effects of climate change on the hydrological dynamics of the Kaligandaki River Basin (KRB) in Nepal's Himalayan region. By employing downscaled CMIP6 data, future climate projections are analyzed to understand the anticipated shifts in hydrological patterns. Utilizing the Soil and Water Assessment Tool (SWAT), a hydrological model, simulations were conducted to project future hydrological processes. The model's accuracy was confirmed through calibration and validation against historical data spanning from 1996 to 2015, both on monthly and daily time scales. It is predicted that a combination of increased precipitation and accelerated snowmelt, driven by rising temperatures, will likely result in heightened discharge levels in the Kaligandaki River. This study evaluates the implications of climate change on river hydrology, particularly its impact on the expected design discharge for run-of-the-river hydroelectric plants situated in the mountainous basins of Nepal.

Study Area (Kaligandaki River Basin)



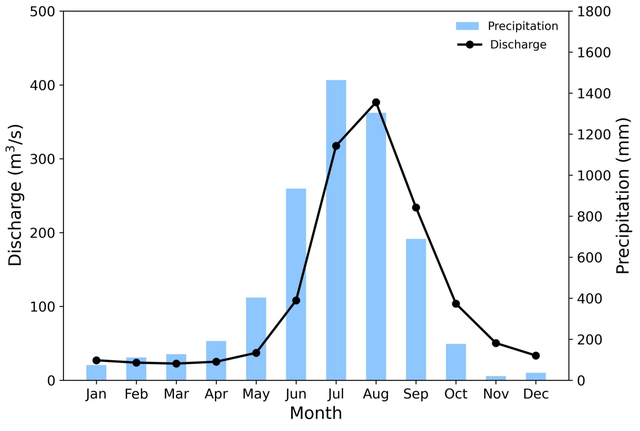
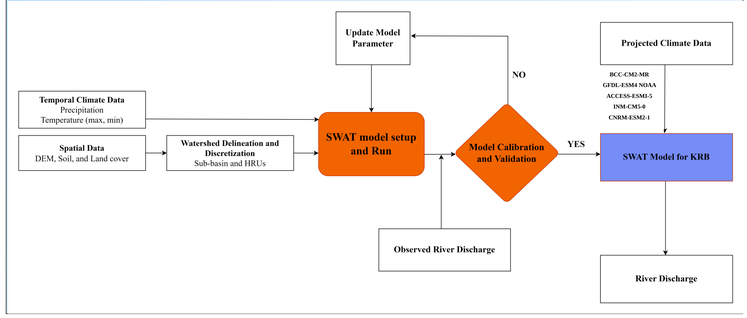


Fig. 1: Rainfall Runoff relation

Methodology



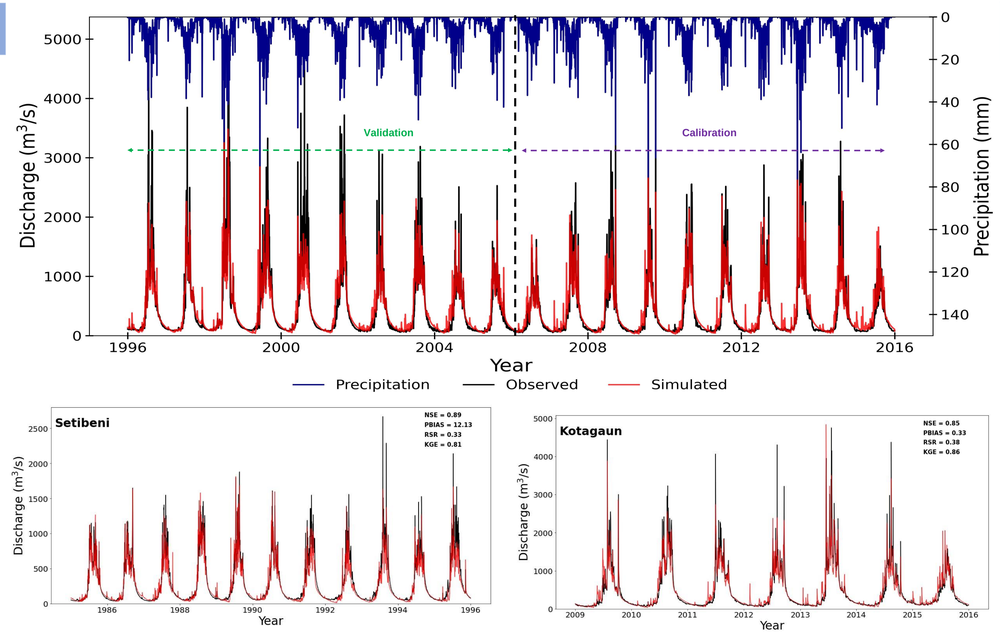


Fig. 2: Multi-site calibration and validation of Kaligandaki River Basin

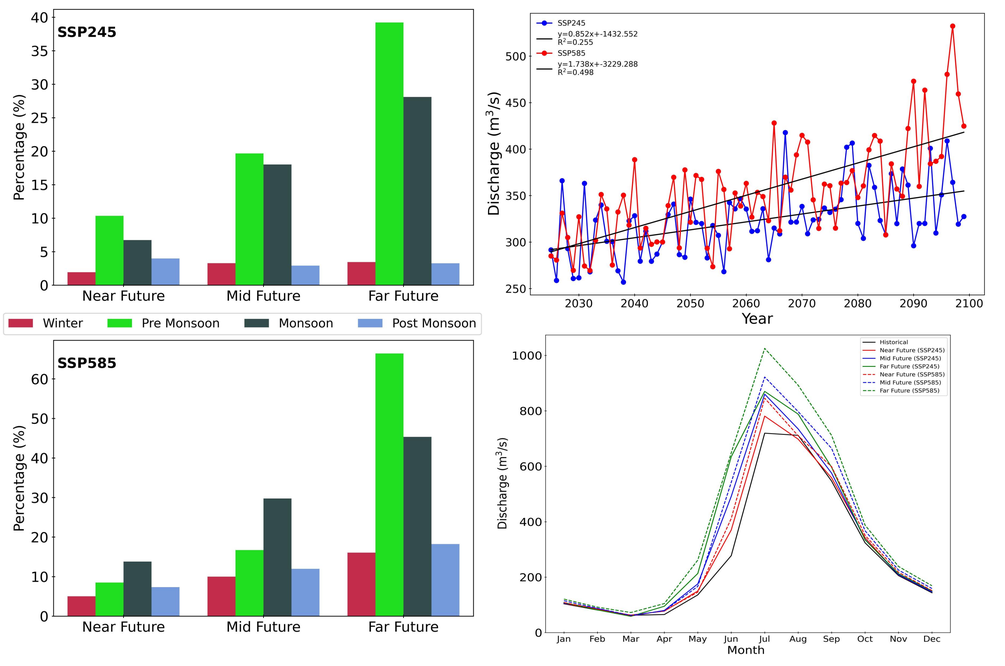


Fig. 3: Impact of climate change on hydrological behavior

Table1: Statistical performance for Angsing (daily)

Performance Statistics	Calibration (2006-2015)	Validation (1996-2005)	Entire Simulation (1996-2015)
NSE	0.86	0.84	0.85
PBAIS	-2.97	3.00	0.27
RSR	0.37	0.40	0.39
KGE	0.85	0.76	0.79
R^2	0.87	0.86	0.86

Results

- The performance of the model was excellent, achieving a consistently very good ranking throughout the study, as evidenced by calibration and validation results.
- In the high emission pathways SSP585 scenario, the average annual temperature is projected to increase by 2.2°C, with a maximum rise of 4.3°C expected during the winter season in the far future.
- Precipitation is anticipated to increase across all future time windows, with higher magnitudes under the SSP585 scenario.
- The combined effect of temperature and precipitation increases is expected to increase the discharge of the river. Specifically, discharge is projected to increase by 6% (under SSP245) and 12% (under SSP585) for 2025-49, 14% (under SSP245) and 24% (under SSP585) for the 2050-74, and 23% (under SSP245) and 40% (under SSP585) for the 2075-99 timeframes.

Conclusion

- Shift in runoff pattern is unfavorable for water users, like planned storage/ peaking hydropower, and irrigation projects.
- This findings are highly beneficial to plan, in advance, the possible adaptation measures to minimize the climate change induced impacts on water users of KRB.