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Projected changes in extreme precipitation and floods in central India

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Precipitation extremes are expected to rise in a warming climate; however, the corresponding increases in flood magnitudes remain a complex and underexplored issue. This study employs the annual maxima approach to assess the relationship between extreme precipitation and floods, using a process-based hydrological model, the Soil & Water Assessment Tool (SWAT), in four river basins of central India (Brahmani and Baitarni, Subarnarekha, Mahanadi and Narmada) for past (1984-2014) and future (2030-2060 and 2070-2100). First, the SWAT models underwent rigorous data selection (climate and land cover data), calibration and validation to ensure a reliable representation of the hydrologic conditions of these basins at a daily scale, based on observations from 26 hydrometric stations for the 1988–2019 period. Second, climate projections from four CMIP6 GCMs were statistically downscaled using Bias Correction/Constructed Analogues with Quantile mapping reordering (BCCAQ) for the SSP245 and SSP585 scenarios. Finally, the SWAT models were used to project future changes in extreme precipitation and flood characteristics in the selected river basins. Considering both daily model performance (Nash-Sutcliffe Efficiency-NSE > 0.60) and catchment representativeness, we selected 10 from 26 hydrometric stations for the extreme value analysis. The analysis of the ensemble mean of the 95th percentile of four GCMs and the modelled 20-year return levels show a future increase in both precipitation (0.27 to 27.93 % and 6.19 to 50.06 %) and discharge (1.31 to 50.35 % and 5.42 to 100.73 %) at 6 out of 10 selected stations, with a more significant increase under the SSP585 scenario than the SSP245 scenario, highlighting a clear link between increased precipitation and discharge The modelling framework developed in this study will improve understanding of processes involved and the thresholds at which the central Indian catchments correspond to extreme precipitation. The findings will help the projection of future flood risks and could help to shape effective adaptation strategies in the region.