Climate Model Uncertainty and its Influence on Coastal flood risk assessment

The impact of climate change on the regional hydrological cycle has become a significant global scientific concern in recent decades, primarily due to its profound effects on droughts and floods. Therefore, it is crucial to study the changes in regional hydrological characteristics in the context of global warming to develop strategies for mitigating floods and optimizing water use in the future. Selecting an appropriate Global Climate Model (GCM) is an essential component of this process. This study aims to conduct a comprehensive analysis of future runoff and flooding in the Mithi river watershed in Mumbai by integrating future climate scenarios and a hydrodynamic model. To understand and quantify this, we assessed the performance of bias-corrected daily precipitation data from 13 Global Climate Models (GCMs) in the Coupled Model Intercomparison Project Phase 6 (CMIP6). This assessment was conducted under Shared Socioeconomic Pathways (SSP245 and SSP585) during the monsoon season (June to September, JJAS) for the near future (2030). The hydrodynamic model was used to estimate the flood depth and extent for each individual model, and a risk map was subsequently created. The findings show that in both scenarios, all Global Climate Models (GCMs) demonstrated distinct performances in terms of precipitation and peak discharge. Under SSP245, models such as INM-CM5-0, MPI-ESM1-2-LR, and MRI-ESM2-0 are underpredicting, while under SSP585, except these models (ACCESS-CM2, EC-Earth3, EC-Earth-Veg, MPI-ESM1-2-LR, and MRI-ESM2-0) all others showed underprediction. Under SSP245 scenario, the ACCESS-ESM1 model predicts the highest rainfall of 313 mm/day on July 27, 2030, with a peak discharge of 277.4 m^3/s. In comparison, under SSP585, the ACCESS-CM2 model predicts a maximum rainfall of 303 mm/day on July 12, 2030, with a peak discharge of 259.7 m^3/s. Results also indicates that population exposure to flooding is higher under both of these climate models compared to other models.

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