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## Twenty First Century Climate Extremes Projection and Climate Vulnerability Risk Assessment in Homogeneous Climatic Zones using high Resolution Climate Data

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Climate change assessment plays a pivotal role in impact assessment studies for better planning and management in different areas. A three-steps-integrated approach is used for climate change assessment. In the first step, homogeneous climatic zones were developed by combining two statistical approaches, cluster analysis and L-moment on the basis of Reconnaissance Drought Index (RDI). A set of GCMs was selected for each climate zone by incorporating Bayesian Model Averaging (BMA), using the outputs of fourteen GCMs for maximum, minimum temperature and precipitation. The seven best GCMs were downscaled to higher resolution using statistical methods and considered for climate extremes assessment for each zone. The performances of GCMs are different for different climate variables, however, in some cases there is coincidence. Climate extremes were analyzed for the baseline and future periods F1 (2011-2040), F2 (2041-2070) and F3 (2071-2100) for the Representative Concentration Pathways (RCPs) 4.5 and 8.5. For precipitation under the RCP4.5, most of climate extremes have decreasing/increasing trends. Further, zone-01, zone-02, and zone-03 show increasing trends while zone-04 and zone-05 have mixed (decreasing/increasing) trends in climate extremes for all periods. For temperature, sixteen climate extreme indices were considered, some important indices are: GSL, SU25, TMAXmean, TMINmean, TN10p, TN90P, TX10p, TX90P, TNN, TNX, TXN, TXX. GSL has mixed trend (increasing/decreasing) depending on cold or hot climate zones. Similarly, TN10P and TN90P also show decreasing and increasing trends, respectively, while TX10P and TX90P have decreasing and increasing trends, respectively, in RCP4.5. TNN, TNX have mixed trends and TXN, TXX have mostly increasing trends except of few time periods in which they have decreasing and insignificant trends. The overall precipitation does not show significant changes, however, the projected intensities and frequencies are changing in future and require special consideration to save infrastructure, prevent casualties and other losses. More importantly, this study will help to address different Sustainable Development Goals of the United Nation Development Program related to climate change, hunger, environment, food security, and energy sectors.