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Spatio-temporal temperature variability and agricultural vulnerability: District scale analysis for Maharashtra, India

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Food prices, food security and land use decisions are highly impacted because of the global changes in production of major crops, which is further determined by climate variability. Among the climate variability factors, growing season temperature and precipitation are the major factors responsible for the fluctuations in annual and seasonal crop yield at regional and global scale. From last several decades, extremes in temperature and their variability has been gaining significant attention due to their impacts on agriculture, water resources, plants, animals and other socio-economic impacts. Increase in temperature since 1981 led to decline in yields of wheat, maize and barley which is approximately 40 million tons of loss per year (Lobell and Field, 2007).
So far, numbers of studies have been carried over United States, Australia, China, Central and Northern Europe but only a limited number of studies have assessed the regional temperature variability in India. The spatio-temporal variability of these temperature variables at the regional scale is not addressed in policy formulation related to climate change for Indian states. Therefore, by analyzing the problems at the district level for one of the most-agriculturally vulnerable state Maharashtra, we provided a framework to analyze temperature variability, agriculture vulnerability and suitable adaptation measures at district-scale for Maharashtra.
Present study investigates the diurnal temperature variability (intra-seasonal fluctuations) for Pre-Monsoon (MAM), and Monsoon (JJAS) seasons at regional scale i.e. over districts of Maharashtra state in India. In the present study, temperature variability is reflected in terms of number of hot days, cold nights (Extremes), and temperature during extremes. The choice of the factors was on the basis of their effect on agriculture and farmers' vulnerability. Fluctuations in trend were observed for all the districts from 1979 to 2015. The trend for temperature variability was found to show spatio-temporal heterogeneity across districts. Number of hot days and temperature during hot days was found to decrease over Maharashtra, implying reduction in day time temperature during monsoon season. On the other hand, number of cold nights were increasing and temperature during cold nights were found to decrease at the rate of (-0.058 0C) each year, which is equivalent to -0.2 0C in the past 36 years. Inter and intraregional
spatio-temporal heterogeneity in monsoon variability parameters was found across districts of Maharashtra. Clustering of different regions was done according to their temperature variability pattern using Factor analysis (FA) (Anderson and Gerbing, 1988). An empirical model of temperature variability is also proposed at district level for the state of Maharashtra that can contribute to the currently operating 'State Action Plan on Climate Change (SAPCC)' or can be used to formulate a new action plan at district level i.e. 'District Action Plan on Climate Change (DAPCC)'. The current study differs from other studies in terms of its application, levels of spatial aggregation and areas of coverage. The findings can be utilized by farmers and policy makers while formulating agricultural policies, risk reduction measures, and adaptation mechanisms to address the adverse impacts of climate change.