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Climate Change Related Alterations in Precipitation Regime and Futureproofing Infrastructure in Ankara Province-Turkey

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As the alteration of the precipitation regime due to climate change is a reality, extreme precipitation events causing floods with the negative impacts on urban water infrastructure are becoming increasingly important. In the present study, rainfall analysis for past, present and future conditions, which enables us to incorporate climate change and variability into infrastructure design and management, is performed and discussed. Stationary and nonstationary models developed and applied for the precipitation data for observation (1950-2015 period) and projection periods (2015-2099 period) for Ankara province which is the capital of Turkey having a population of 5.3 million people (2016) mostly (88%) living in the city center. The analysis are conducted for the 5 minute and 1 hour extreme observed precipitation data and Mann-Kendall (MK) Trend Test results for these two durations clearly indicated that there is significantly a downward monotonic trend in precipitation quantities between 1950-2015 period. Daily projected data from HadGem model (scenario 4.5) is disaggregated to 10 minutes, 1 hour, and 6 hours using Bartlett-Lewis rectangular pulse model to use in the analysis. Model results for observation period data showed that nonstationary return levels of 2, 20 and 100 year return periods decrease for five minute data. On the contrary nonstationary return levels for one hour data decrease for 2 and 20 years and increase significantly for 100 years return periods. There is a decrease from 5% to 14% for five minute data. For the one hour data, 2 and 20 years return level estimates decrease but there is a 6% increase for 100 years return period. For the future projections, nonstationary mean values and stationary return level estimates are compared. Especially ten minute data showed significant difference; the return level values decreased with the increasing return period; 22% decrease for 100 year and 27% decrease for 200 year return levels were calculated. On the other hand, for one hour data, there is only 2%-3% decrease in return level values for 100 and 200 years. Considering six hours data the difference increases with increasing return period. It is not as significant and large when compared with ten minutes but reaches 4% for 50 years and 5%-6% for 100 years and 200 years return levels respectively. The short duration precipitation extremes in future seem to be more influenced by the non-stationarity in Ankara. Ankara city urbanization has concentrated after 1960s, causing the transformation of the pervious surfaces to impervious surfaces which influenced the increasing rate and the volume of stormwater runoff. The results of the present study will be the background data for the rehabilitation and/or the redesign of the stormwater infrastructure and management for Ankara province in the future.