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Climate Variability and Trends in Meteorological Time Series in Semi-Arid Botswana

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Studies on climatic variability are of great importance towards water resources planning and management. With detection of change and trends in long time series of meteorological data being a step towards understanding climatic variability. An attempt has been made to make an analysis that facilitates a holistic understanding of the variability in rainfall, maximum and minimum air temperatures at 14 synoptic stations in Botswana for a period of 1960 to 2014. This was accomplished through the coefficient of variation, intervention analysis, step change analysis, homogeneity test, Mann-Kendall (MK) trend test, Sen's slope estimator and analyzing serial correlation effect.The results indicated a generally high coefficient of variation increasing from 26% at Kasane in the Northeast to 43% at Tsabong in the Southwest. Significant interventions were detected in 14%, 43% and 79% for rainfall, maximum and minimum temperatures respectively. The rainfall time series were found to be completely homogenous as compared to the minimum and maximum temperature. Decreasing trend in annual precipitation for 57% of the stations though not significant. Increasing trends in minimum and maximum temperatures were detected in 71% of the stations and most of them significant at 1% and 5% level. The magnitude of the significant positive trends in minimum and maximum temperature varied from 2.44 ^{0}C/year at Tsabong to 2.64 ^{0}C /year at Maun and 3.25mm/yr at Francistown to 2.12 ^{0}C /yr at Mahalapye respectively. The rainfall series are not serially correlated, whereas the 64% and 7% of the stations are serially correlated for the minimum and maximum temperature respectively. The effective sample size method was used to eliminate the effect of serial correlation on the MK statistic. The spatial distribution of the annual trends showed increasing warming trend from North east to Southwest. The results from this study indicate a significantly increasing trend in minimum and maximum temperatures at most of the stations. The high variability in rainfall reported over the study area may become worse with increased warming. The findings of this study may facilitate further investigations in the interaction between water and energy requirements which is a major factor in agricultural water management.

Key words: Climate variability, Intervention, Homogeneity, Trend analysis, spatial analysis