



Characterization of drought over Botswana: Towards a multivariate approach of drought prediction

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Recently there has been an increased water scarcity around the world due to high water demand, which is worsened by the recurrent drought characterized by long duration and high severity. However, these characteristics are important in drought monitoring and decision-making for reliable disaster early warning system, water resources planning and management. Semi-arid environments, of which Botswana is known for, exhibit high variability in climate leading to recurring droughts. Hence there is a need to conduct a study to understand the spatio-temporal variability of droughts over Botswana. The Standardized Precipitation Index (SPI) and the Standardized Evapotranspiration Index (SPEI) were used for analysing drought based on gridded rain gauge and evapotranspiration data referred to as Climatic Research Unit (CRU) covering a period of 1901-2018 at a time scale of 12 months. Both SPI and SPEI were able to detect the spatial and temporal variation of drought events. But SPEI was able to identify more droughts in the severe to moderate categories over a wider areas in the country than SPI does. The temporal trends of droughts mostly showed a significant drying trends. The conditional return period of drought of different categories was also determined in a multivariate context by coupling duration, severity, inter-arrival time of drought based on copula distribution and cumulative density functions. Drought events with high intensities had a low probability of occurrence while lower intensities had a high chance of occurrence within 5 to 10 years. Such information on the drought conditional probabilities can be useful in evaluating the water-supply capability and the needed supplementary water resources during severe droughts for a specific water-supply system. In particular, it is generally suitable for the long term planning and management of water resources systems over the country.