Dryland land crop yield sensitivity to drought in Botswana: Development of statistical tools based on satellite remote sensing, observation and climate models for use in risk assessment

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Abstract
Assessing agricultural drought is of great importance as it is viewed as the most serious problem in most countries in terms of food security, economy, and social stability. Various drought indices have been developed in order to describe the characteristics of drought such as severity, extent, frequency and duration. These indices can be classified into two categories: ground-based and remotely-sensed indices. Ground-based drought indices are more accurate but limited in coverage, while remote sensing drought indices cover large areas but have poor precision. Therefore there is need to apply advanced data fusion methods based on satellite data and ground-based drought indices to fill this gap. However there is a lag time between drought events and the impacts they cause. Due to the semi arid conditions of Botswana, the country is prone to the occurrence of droughts and has a great influence on agriculture and economy of the country at large. In order to monitor droughts in Botswana this paper proposes that it is necessary to link the pre meteorological observations and the consequential vegetation drought. This is needed for effective monitoring of agricultural drought and early warning. In this study, MODIS reflectance data and data from recent satellites such aslandsat OLI, Sentinel will be used to discover relationships between vegetative drought and meteorological drought using vegetation condition index (VCI) derived from NDVI and NDWI, and meteorological drought
derived from SPI and SPEI in Botswana. Dataset derived from Soil Moisture Active Passive (SMAP) will be used to generate %soil moisture content. The %moisture content will be compared with experimental results from the field. Pearson correlation analyses were performed between single remote sensing drought indices and in-situ drought indices, NDVI and SPEI. Preliminary studies show that VCI derived from NDWI (VCI-2) over Southern District of Botswana can be used as an approach to monitor and provide early warnings. However, there is weak correlation SPEI and VCI-1 and VCI-2 ranging from -1 to 0.2.