GEOSTATISTICAL MODELLING OF SPATIAL-TEMPORAL PATTERNS OF WET AND DRY CONDITIONS AT A LOCAL SCALE IN UGANDA

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Abstract

The uncertainties surrounding climate change have made it imperative for economies such as Uganda's that depend on agriculture to model wet and dry conditions at the local scale. Wet and dry conditions have profound effects at the local scale, including irregular crop yields, intense flooding, landslides, water scarcity, and extended droughts. Information on local patterns of wet and dry conditions decentralizes decision and policymaking to adapt and minimize the resulting negative outcomes at a local scale while facilitating the development of emerging concepts such as precision agriculture, climate insurance, and climate proofing. However, information on local patterns has often been done using globally scaled models. The globally scaled models introduce geographic ambiguity, resulting in a net underestimation of wet and dry conditions at a local scale. This study created a geostatistical-oriented approach with the hypothesis that geostatistics will improve the modelling of wet and dry conditions at a local scale using satellite-gridded datasets to minimize geographic ambiguity. The gridded datasets were converted to SPI for wet and dry condition representation, integrated into a space-time cube, and geostatistical modelling was performed using the Get-Ord Gi* statistic, Mann Kendal rank correlation, PELT algorithm, nugget sill ratio, and the forecast and validation root mean square errors. Results from the study reveal that satellite-gridded datasets are an alternative estimate of in situ precipitation data. They also reveal that geostatistical modelling enables local scale modelling with input from satellite-gridded datasets. The results further show that within an area of multiple localities, different geostatistical algorithms are required to forecast wet and dry conditions depending on the degree of precipitation variability at a locality. The research results also revealed an optimal scale of $0.02^0*0.02^0$ at district coverage.

In terms of contribution, this research validates alternative precipitation data, provides a geostatistical approach for modelling local wet and dry conditions, and spatially allocates forecast algorithms optimal for forecasting wet and dry conditions at different localities aiding in the development of local policy initiatives. Further research on localizing space-time cube analysis should explore multi-sensor, multi-scale modelling of meteorological conditions, and also focus on household scales.

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