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Temporal and spatial characteristics of annual and seasonal rainfall in Malawi

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An understanding of the temporal and spatial characteristics of rainfall is central to water resources planning and management. However, such information is often limited in many developing countries like Malawi. In an effort to bridge the information gap, this study examined the temporal and spatial charecteristics of rainfall in Malawi. Rainfall readings from 42 stations across Malawi from 1960 to 2006 were analysed at monthly, annual and seasonal scales. The Malawian rainfall season lasts from November to April. The data were firstly subjected to quality checks through the cumulative deviations test and the Standard Normal Homogeinity Test (SNHT). Monthly distribution in a typical year, called heterogeneity, was investigated using the Precipitation Concentration Index (PCI). Further, normalized precipitation anomaly series of annual rainfall series (AR) and the PCI (APCI) were used to test for interannual rainfall variability. Spatial variability was characterised by fitting the Spatial Correlation function (SCF). The nonparametric Mann-Kendall statistic was used to investigate the temporal trends of the various rainfall variables.

The results showed that 40 of the stations passed both data quality tests. For the two stations that failed, the data were adjusted using nearby stations. Annual and seasonal rainfall were found to be characterised by high spatial variation. The country mean annual rainfall was 1095 mm with mean interannual variability of 26%. The highland areas to the north and southeast of the country exhibited the highest rainfall and lowest interannual variability. Lowest rainfall coupled with high interannual variability was found in the Lower Shire basin, in the southern part of Malawi. This simillarity is the pattern of annual and seasonal rainfall should be expected because all stations had over 90% of their observed annual rainfall in the six month period between November and April.

Monthly rainfall was found to be highly variable both temporally and spatially. None of the stations have stable monthly rainfall regimes (mean PCI of less than 10). Stations with the highest mean rainfall were found to have a lower interannual variability.

The rainfall stations showed low spatial correlations for annual, monthly as well as seasonal timescales indicating that the data may not be suitable for spatial interpolation. However, some structure (i.e. lower correlation with distance) could be observed when aggregating the data at 50 mile intervals. The annual and seasonal rainfall series were dominated by negative trends. The spatial distribution of the trends can be described as heterogeneous, although most of the stations in the southern region have negative trends. At the monthly timescale, 37 of the stations show a negative trend with four of the stations, all in the south, showing significant negative trends. On the other hand, only 5 stations show positive trends with only one significant trend in the south.

Keywords: Malawi, rainfall trends, spatial variation