Geophysical Research Abstracts
Vol. 14, EGU2012-172, 2012
EGU General Assembly 2012

Changes in the synoptic drivers of extreme rainfall in South Africa

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South Africa consists of several rainfall regimes that are determined by seasonal synoptic circulations. During boreal summer the interior of the country experiences a sub-tropical convective rainfall regime whereas during boreal winter the south-western regions of the country experience a mid-latitude driven frontal rainfall regime. Extreme rainfall is therefore regionally seasonal and associated with particular types of synoptic circulation.

Eight rainfall regimes were selected and for each regime station data were used to identify extreme rainfall days during 1979-2010. For each extreme rainfall day the corresponding daily values of mean sea level pressure (mslp) and the 500hPa geopotential height (z500) were extracted from the Climate Forecast System Reanalysis (CFSR). These data were then used to develop a self organizing map which produced characteristic synoptic states that could be associated with the regionally specific extreme rainfall. Temporal trends in the occurrence of extreme rainfall in the station record were matched against the frequency of occurrence of the synoptic drivers.

Summer extreme rainfall was associated with a sub-tropical low pressure system, tropical temperate troughs and tropical cyclones. During winter extreme rainfall was related to cut-off lows and mid-latitude cyclones. Autumn extreme rainfall (MAM) was associated with winter-like synoptic states while spring (SON) extreme rainfall displayed more heterogenous circulations. Increasing and decreasing trends of extreme rainfall were found in the station record for each regime corresponded to trends in synoptic circulations being most apparent in the shoulder seasons.

This paper presents the regionally and seasonally specific synoptic drivers of extreme rainfall in South Africa as well as changes in the characteristics of these.