Theor Appl Climatol
DOI 10.1007/s00704-016-1973-9

ORIGINAL PAPER

Variability of extreme weather events over the equatorial East Africa, a case study of rainfall in Kenya and Uganda

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Received: 13 May 2016 / Accepted: 8 October 2016

Abstract This study investigates the variability of extreme rainfall events over East Africa (EA), using indices from the World Meteorological Organization (WMO) Expert Team on Climate Change Detection and Indices (ETCCDI). The analysis was based on observed daily rainfall from 23 weather stations, with length varying within 1961 and 2010. The indices considered are: wet days ($R \geq 1$ mm), annual total precipitation in wet days (PRCPTOT), simple daily intensity index (SDII), heavy precipitation days ($R \geq 10$ mm), very heavy precipitation days ($R \geq 20$ mm), and severe precipitation ($R \geq 50$ mm). The non-parametric Mann-Kendall statistical analysis was carried out to identify trends in the data. Temporal precipitation distribution was different from station to station. Almost all indices considered are decreasing with time. The analysis shows that the PRCPTOT, very heavy precipitation, and severe precipitation are generally declining insignificantly at 5 % significant level. The PRCPTOT is evidently decreasing over Arid and Semi-Arid Land (ASAL) as compared to other parts of EA. The number of days that recorded heavy rainfall is generally decreasing but starts to rise in the last decade although the changes are insignificant. Both PRCPTOT and heavy precipitation show a recovery in trend starting in the 1990s. The SDII shows a reduction in most areas, especially the in ASAL. The changes give a possible indication of the ongoing climate variability and change which modify the rainfall regime of EA. The results form a basis for further research, utilizing longer datasets over the entire region to reduce the generalizations made herein. Continuous monitoring of extreme events in EA is critical, given that rainfall is projected to increase in the twenty-first century.

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1 Introduction

Climate change is a global phenomenon with varying effects from one region to another depending on various socio-economic factors (IPCC 2007). Recent reports by the Intergovernmental Panel on Climate Change (IPCC) have indicated that the intensity and frequency of extreme events are likely to increase over many areas including East Africa (EA) (IPCC 2007, 2012; Niang et al. 2014). This is mainly attributed to anthropogenic changes in atmospheric forcing (IPCC 2007, 2014; Peterson et al. 2013). Similar observations have been made in different studies over EA using global climate models (GCM) (Anyah and Qiu 2012; Shongwe et al. 2011).

East Africa is very vulnerable to effects of climate variability and climate change as a result of the region's over-reliance on agriculture and other rain-fed sectors to sustain its economy (IPCC 2007). The most frequent and disastrous extreme weather events in the region are droughts and floods. The two extreme events are associated with devastating socio-economic losses (Hastenrath et al. 2007; Lyon and Dewitt 2012; Funk 2012; Lyon 2014). This is happening in the background of the reduction in March-May seasonal rainfall, known as "long rains" (Yang et al. 2014; Maidment et al. 2015). A recent study (Nsubuga et al. 2014) observed mixed seasonal rainfall trends in southwestern Uganda. Today, regardless of the rainfall