UNIVERSITY OF NAIROBI

INVESTIGATING LINKAGES BETWEEN THE SUBTROPICAL INDIAN OCEAN DIPOLE MODE AND EAST AFRICA RAINFALL DURING OCTOBER TO DECEMBER

BY

ANTHONY MUSILI MWANTHI

I56/70061/2013

Department of Meteorology

University of Nairobi

P.O. Box 30197-00100

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Declaration

This dissertation is my original work and has not been previously been presented for examination to this or any other University.

Signature …… Date ……

Mwanthi, Anthony Musili (I56/70061/2013)
Department of Meteorology
University of Nairobi

The dissertation has been submitted with our approval as University supervisors:

Signature …… Date ……

Prof. Laban Ogallo
IGAD Climate Prediction and Applications Centre (ICPAC)

Signature …… Date ……

Dr. Gitau Wilson
Department of Meteorology,
University of Nairobi

Dedication

I dedicate this work to my parents, Mr. and Mrs. Nickson Muindi.

Abstract

The linkage of the Subtropical Indian Ocean Dipole (SIOD) with the October-December rainfall season over East Africa was investigated. The data used in the research spanned for the period 1961-2013 and were monthly datasets of rainfall, sea surface temperatures (SSTs) and wind. Climate Research Unit (CRU) rainfall data, Hadley Centre SST from the UK Met Office and NCEP-NCAR wind were used.

Methods applied involved standardization of both rainfall and SST data, a procedure recommended where observations are influenced by diverse factors and need to be compared. The temporal and spatial patterns of rainfall studied were interannual variability and trends and using both smoothed and unsmoothed time series. The trends were computed using the least square regression coefficients and their significance evaluated using the ANOVA method. The relationships between SIOD with both the October-December East Africa rainfall and the Indian Ocean Dipole (IOD) were determined using the Pearson correlation coefficients. The Student t-test was used to test the significance of the correlations. Based on the evolution patterns of SIOD, composited anomalous distribution of rainfall, SSTs and wind were studied during significant SIOD events.

The results show that the variability of rainfall is highest in arid lands on the eastern region of East Africa and lowest on the western sector. The trends also show a regional bias, with the western region (much of Uganda) reporting positive and significant trends based on the smoothed data. The trend in the October-December SIOD index was evidently negative. Further analysis showed that in the recent decades, the eastern pole of SIOD has been reporting higher magnitudes of positive anomalies than the western, hence depicting a sustained non-homogenous oceanic warming.

The instantaneous SIOD-IOD correlations are insignificant over January to September, but significant negative correlations are reported in the October-December period. The correlations were positive at lag four and turned negative in approach to lag zero when peak negative values were reported. Significant correlations were usually reported in lag four and zero. Hence it was observed that there exists substantial changes in the relationship between these periods.

The case studies of SIOD showed that rainfall anomalies tend to be slightly enhanced especially in the equatorial region during all-year persisting positive SIOD events. This may be related the weakening of the Mascarine High hence maintaining the Intertropical Convergence Zone (ITCZ) within the equatorial region over East Africa. The SIOD events involving phase changes of positive to negative during the June-August period also reported enhanced rainfall. The wind patterns at 850mb showed that these events are associated with the intensification and westward displacement of the Mascarine anticyclone, hence promoting the flow of moist equatorial easterlies.

This research has established that SIOD has both oceanic and atmospheric connections that influence the East Africa October - December rainfall season. The oceanic impact is in the SIOD-IOD contrasting interactions especially during the OND season. On the other hand, the atmospheric relations lies on its influence to the intensity and position of the Mascarine High. Hence the monitoring of both of these indices may prove useful for diagnostic studies in over East Africa especially during the short rains season. It is also suggested that further studies may be carried out for the December - February and March - May rainfall seasons, which fall well within the SIOD evolution period.

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