STUDY OF CLIMATE CHANGE OVER TROPICAL AFRICA

By

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Abstract

In this thesis we studied the trend line of some climatic parameters (temperature and precipitation) for the tropical Africa (23.5° S, and 23.5° N, 20° W and 50° E) for the period (1960-2002) which is the available grid data .We divided the target area to three regions west region from (23.5° S, and 23.5° N, 20° W and 4° E), middle region from (23.5° S, and 23.5° N, 4° E and 27° E) and east region from (23.5°S, and 23.5° N, 27° E and 50° E).

Results revealed that trends for the three regions of mean annual temperature were positive during 1960-2002. The trends for mean seasonal temperature for west and middle regions (spring, summer and autumn) were positive while it was negative for winter season. On the other hand the east region trends were positive.

It was found that negative trend for annual and seasonal precipitation for the west and middle regions. On the other hand east region has positive trend for annual and winter precipitation, while for spring, summer and autumn precipitations found to be negative trend.

Correlations analysis were established among Carbon dioxide concentration (Co_2), and annual and seasonal temperature and Correlations analysis between El-Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO) and annual and seasonal precipitation have been done to study the main factors cause of climate change in tropical Africa.

For the western region there is a positive correlation between the west region temperature and Co_2 concentration. While for precipitation the significant correlation appear between precipitation and NAO (-0.498**) and ENSO (Nino 1.2) (-0.395**), from this we show that the strong relationship between precipitation and NAO in the West Africa and when the NAO in negative phase lead to decrease rainfall over West Africa and significant correlation between precipitation and ENSO (Nino 4) (-0.335*).

In the middle region we found a significant correlation appears annually between temperature and CO_2 (0.374*), on the other hand there are strong significant positive correlations appear between temperature and CO_2 (0.603**) and with sunspots annual (0.311*) and spring (0.333*) in the east region.

We found for precipitation of east Africa the negative correlation between precipitation and annual NAO (-0.346*), ENSO (Nino 3.4) in spring (-0.323*), summer (-0.387*) and ENSO (Nino 4 and Niño 3) in summer (-0.395**, -0.385*) respectively.

We studied the future climate of the tropical Africa by comparison the output from five models from 1979 to 2000 to compare with the available

National centers for environmental prediction (NCEP) reanalysis data of the ten stations which started from 1979. The Climate Systems Analysis Group (CSAG) at the University of Cape Town provides services in support of climate change data analyses as well as the assessment of impacts and adaptation strategies. Outputs from five different AOGCMs are represented, all of which are available for downloading from the CSAG Data Dissemination Centre (DDC).

The five GCM models are: Geophysical and Fluid Dynamical Laboratory (GFDL) model, NASA Goddard Institute for Space Studies (GISS) model, Max Planck Institute for Meteorology, Germany (ECHAM5) model, Commonwealth Scientific and Industrial Research Organization (CSIRO-MK3_5) model and Canadian Center for Climate Modeling and Analysis (CCCMA) model.

We choose ten stations in the tropical Africa as a case study for the comparison between observed and output results for five GCM models are:

Dakar- Tambacounda- Abidjan- Odienne- Ndjamena- Kinshasa- Jimma- Mandera- Zanzibar- Musoma.

From the previous comparisons we constructed that the CCCMA and ECHAM5 models have the least root mean square error (RMSE) and mean bias (MB) compare with the other models. So the CCCMA model is the highest performance model using for predicting the maximum temperature and precipitation and ECHAM5 model for predicting minimum temperature in the future.

For this we used CCCMA and ECHAM5 models to show the future climate of the selected stations during the period 2046-2065, we found that the trends of maximum temperature are positive for Dakar and Musoma stations and stations (Tambacounda, Abidjan, Odienne, and Zanzibar) have negative trends. While for minimum temperature we found positive trends in Dakar, Ndjamina, Jimma, and Mandera, and the stations that have the negative trends are Tambacounda, Abidjan, Odienne, Kinshasa, Zanzibar and Musoma. Most of stations give a positive trend of precipitation except for two stations gave us a negative trend. The stations that have positive trend are Dakar, Tambacounda, Abidjan, Odienne, Ndjamina, Jimma, Mandera and Zanzibar. The stations that have the negative trends are Kinshasa, and Musoma.

Keywords: climate change, tropical Africa, ENSO, GCMs models, CSAG, Dakar, Abidjan, Ndjamena, Kinshasa