Climate Change and Variability in the Guinea Region of Africa

Introduction

Africa is one of the most vulnerable continents to climate variability and change. Agriculture is the major source of livelihood for the majority of West Africa and many of these farmers are only able to produce close to subsistence levels, facing numerous constraints from the environment. Climate variability and change poses a great threat to farmers in this region of study, with possible impacts such as reduced yields, lower farm incomes, and reduced welfare. The purpose of this research is to understand climate variability and assess climate change in Africa's Guinea region by analyzing rainfall as well as temperature. The hypothesis posed is that *climate has changed over Africa's Guinea region in the last 60 years: temperature has increased and rainfall has decreased.* This study has the following objectives: 1) identify what the normal climate is, 2) assess if there is any change in the normal climate, and 3) clarify the relative role of known large-scale phenomena over the Guinea region. The present study could further the understandings of not only researchers but ultimately farmers and policymakers and to help them anticipate the potential impact it will have on the region.

CSS Building 224(Internship Site), UMD

Methodology

A Macintosh machine linked to a Linux-based cluster for general use by all users in the Atmospheric and Oceanic Science Department. The cluster includes 32 cpus, 256 GB of memory and 4TB of storage. The open access software named GrADS. This software was used to make calculations and display the processed information. A HP color printer, model: LaserJet 4700dn.

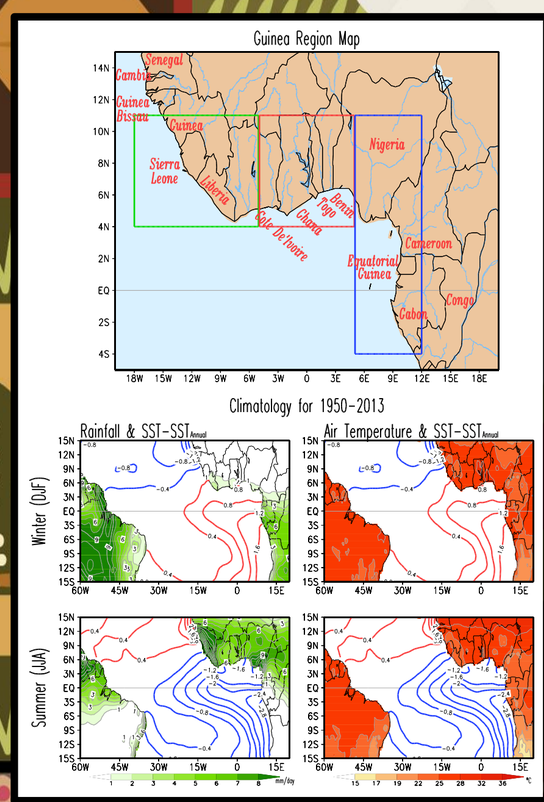
Characterization of the mean or "normal" climate. For this the long-term means or climatology were calculated for the period 1950-2013.

Identification of the impact that global scale phenomena, such as AMO, ENSO, and the Atlantic Niño have over the climate of the region is explored via the least-squares method.

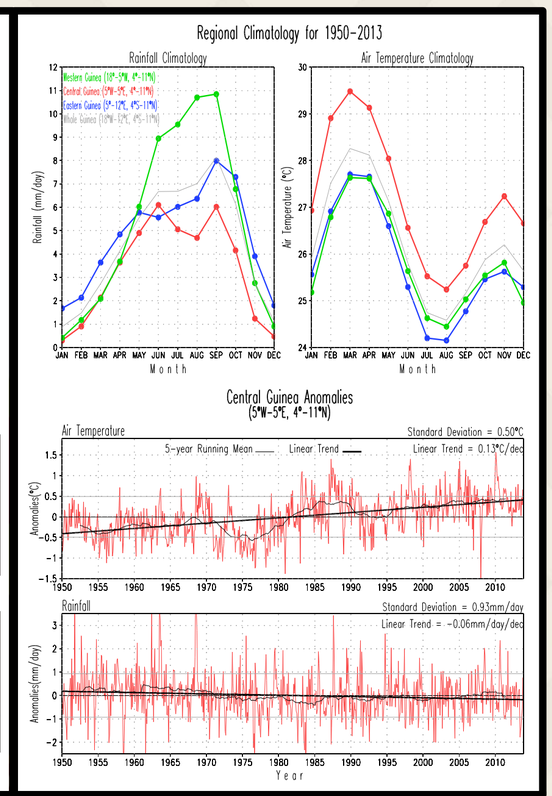
Identification of the regions with the largest year-to-year (i.e. interannual) variability via standard deviations.

Identification of changes in the mean climate and long-term linear trends via the least-squares method.

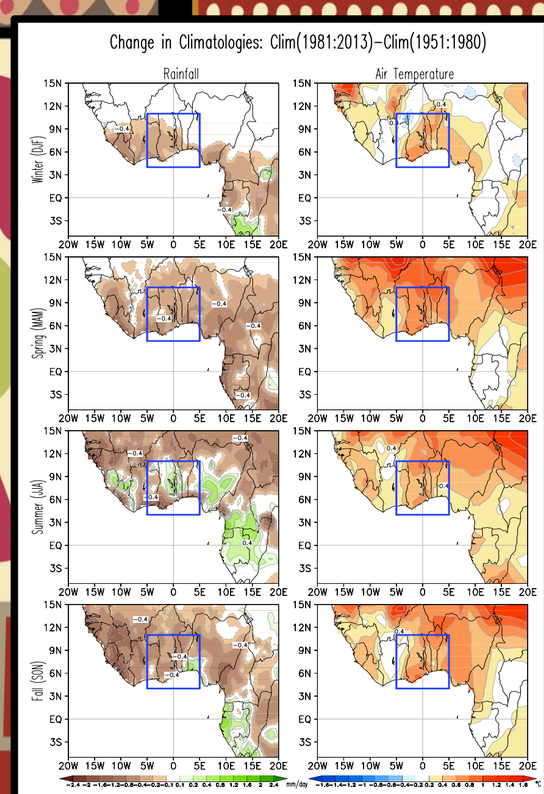
Findings



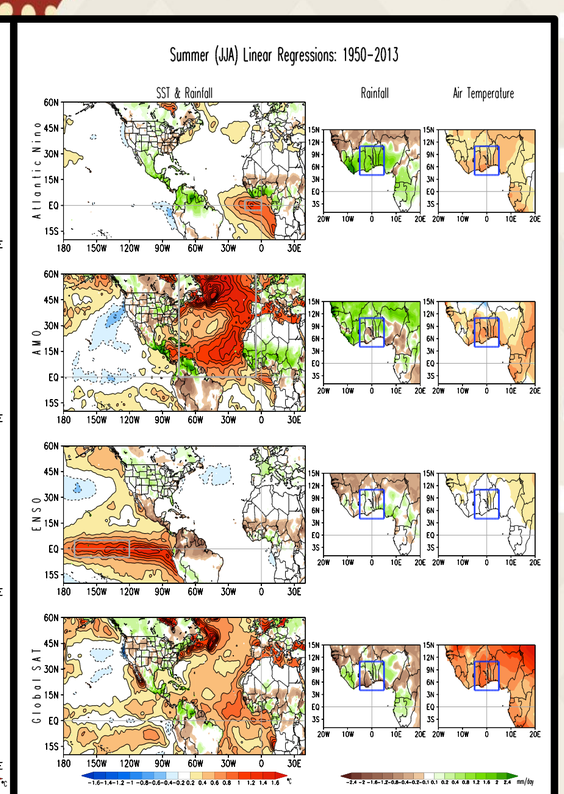
The Guinea region of study is adjacent to the Atlantic Ocean just to the north of the equator where the normal climate is largely driven by what is happening in these waters. The Intertropical Convergence Zone (ITCZ), a region of heavy rainfall, follows the warmer waters of the Atlantic Ocean through the year, and as such, rainfall is to the south of the Guinea region in winter and all over the region in summer. Temperatures, interestingly, are warmer in winter than they are in summer as consequence of increased cloudiness, the cooling effect of evaporation of rainfall and the relatively cooler waters to its south



While this behavior of the seasonal changes in SSTs and rainfall is reminiscent of the monsoon, the partitioning of the region into Western, Central, and Eastern parts reveal that this in not the case for the entire region as the Central sub-region has two rainfall seasons separated by the so called midsummer drought. The Guinea region experiences year-to-year variability that makes that not two consecutive years are the same. In particular the Central sub-region has standard deviation of 0.5°C in temperature and 0.93mm/day in rainfall, although these numbers change by month and season. This Central sub-region has a warming linear trend of 0.13°C per decade, and a drier trend of -0.06 mm/day per decade through the 63-year period of analysis, although these numbers are seasonal dependent.



Analysis of the regional normal climate for the two ~30-year halves confirms that rainfall and temperature are changing and the extent and magnitude of the changes depend on the season. In general the normal climate is drier and warmer than it used to be. Further analysis is needed to assess the robustness of the changes and their statistical significance.



While the normal climate is changing, it is not possible to say if the change is due to human activities or natural causes. Assessment of the natural climate variability phenomena show that those in the Atlantic Ocean have the largest impact on the region, with the Atlantic Niño having the most coherent impact over the region.

Conclusion

The hypothesis posed prior to experimentation that stated that *climate has changed over Africa's Guinea region in the last 60 years: temperature has increased and rainfall has decreased*, holds true. This project is a study of climate variability and change in a region of Africa that is not highly explored and researched but very sensitive to climatic phenomena. There are opportunities to use the findings of this particular study and apply them to the real world, such as, through agricultural practices and environmental conservation. Policymakers can utilize the findings to regulate laws that can spread awareness of the changing climate and how to adapt their lifestyles accordingly in order to prosper in this ever changing world. Another region in the world could be researched through the same processes utilized by this particular study.

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