RAINFALL VARIABILITY AND THE RECENT CLIMATE EXTREMES IN NIGERIA

By

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INTRODUCTION

- **Devastating climate and weather related events recorded in recent years have captured the interest of the general public, governments, and media, among others.**

- **Although difficult to attribute to climate change and variability the devastating impacts of recent natural disasters, such as Lagos flood of July 10, 2011, Ibadan flood of August 26, 2011, Sokoto, Kebbi, Katsina and Jigawa floods of September 2010, Ogun flood of October 2010 and recently wide spread of flooding in the country in 2012 have demonstrated that many urban areas are highly vulnerable to climate change and variability.**

INTRODUCTION CONT…

- **It was reported that floods in these cities swept away homes, vehicles, persons, roads, buildings and farmlands. The September 2012 overflow of the River Niger and Benue in Nigeria, was a monumental disaster as virtually all states were affected in the aftermath of the flooding that resulted. There were unestimated loss of lives and properties, as communities, towns and villages were submerged in floods.**

- **The recent disaster in the country, in particular, exposed the urgent need to reverse the planlessness of our cities and the lack of efficient official pre-emptive and ameliorative mechanisms against natural disasters. The consequences of these extreme events have no doubt demonstrated the fragility of our socio-economic systems and the extent to which these systems depend on weather and climate.**

OBJECTIVEOFTHESTUDY

The main objective of this paper is to identify the spatial and temporal variations which include areas with long-term rainfall trends and inter-annual persistence.

The paper will in addition examine the rainfall anomalies and maximum temperature departures from their long-term values in the last five years, which indeed have given clues to the spate of recent and wide spread of flooding across the country.

DATA AND METHODOLOGY

Data

- **The monthly rainfall and maximum temperature data used in the present study were collected from the Nigerian Meteorological Agency, Oshodi, Lagos. For detailed studies of the inter-annual to seasonal variations in rainfall in Nigeria, fifty meteorological synoptic stations were used. In each climatic zone, at least ten stations have been used to examine the variation and variability of rainfall.**

METHODOLOGY

. For the present analysis, emphasis was placed on climate extremes as related to rainfall variation which can be taken to mean their variations in space and time (see for example, Oguntoyinbo and Odingo, 1979).

. Also, the data analysis was based on only four climatic zones, which were taken as fairly and climatologically representative of the country. It provides variations, trends and changes in maximum temperatures, rainfall amounts and distributions. The magnitudes of these weather indicators in the past five years were compared with their long term values and those of the previous years. Climate variability indices were also computed to determine the extent of flooding across the country.

- **METHODOLOGY CONT…**

The index used for defining the two major climate extremes, viz - floods and droughts, thus emphasized rainfall variability, and is the time series of the normalized annual departure of rainfall in the region. For individual stations, the index can be quantitatively expressed in the form,

$$Y_{ij} = \frac{P_{ij} - \overline{P}_i}{\delta} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where P_{ij} is the rainfall for station i in year j and

$\overline{P}_I$ IS the mean annual rainfall for station i and

δ is standard deviation

METHODOLOGY CONT…

Regionally averaged, the standardized rainfall departure can be expressed in the form

$$P_{ij} = \frac{1}{N} \sum_{j=1}^{Ni} Y_{ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2$$

- **Where N is the number of years**
- **Y_{ij} is the normalized departure for stations in the country**
- **For the purpose of defining categories of floods and droughts, the groupings in table 1 were used according to (Oguntoyinbo and Odingo, 1979).**

Table 1: Categorization of Intensities of Climate Extremes

FLOODS		DROUGHTS	
Departure range	**Flood Intensity**	**Departure range**	**Drought Intensity**
0 to +½δ	Moderate	0 to -½δ	Moderate
+½δ to +δ	Large	-½δ to -δ	Large
+δ to 2δ	Severe	-δ to -2δ	Severe
More than + 2δ	Disastrous	Less than -2δ	Disastrous

RESULTS AND DISCUSSIONS

Rainfall Variations

Fig. 1 shows the pattern of mean annual distribution of rainfall in Nigeria. The mean values decrease as one moves from the coast to inland. The on-going climate variability is already altering the boundaries of the major climatic zones as evidenced in the animal and plant composition, salt water intrusion along the coast, erosion and flooding in the south, drought and desertification in the marginal arid zones of the country.

Rainfall Variations Con

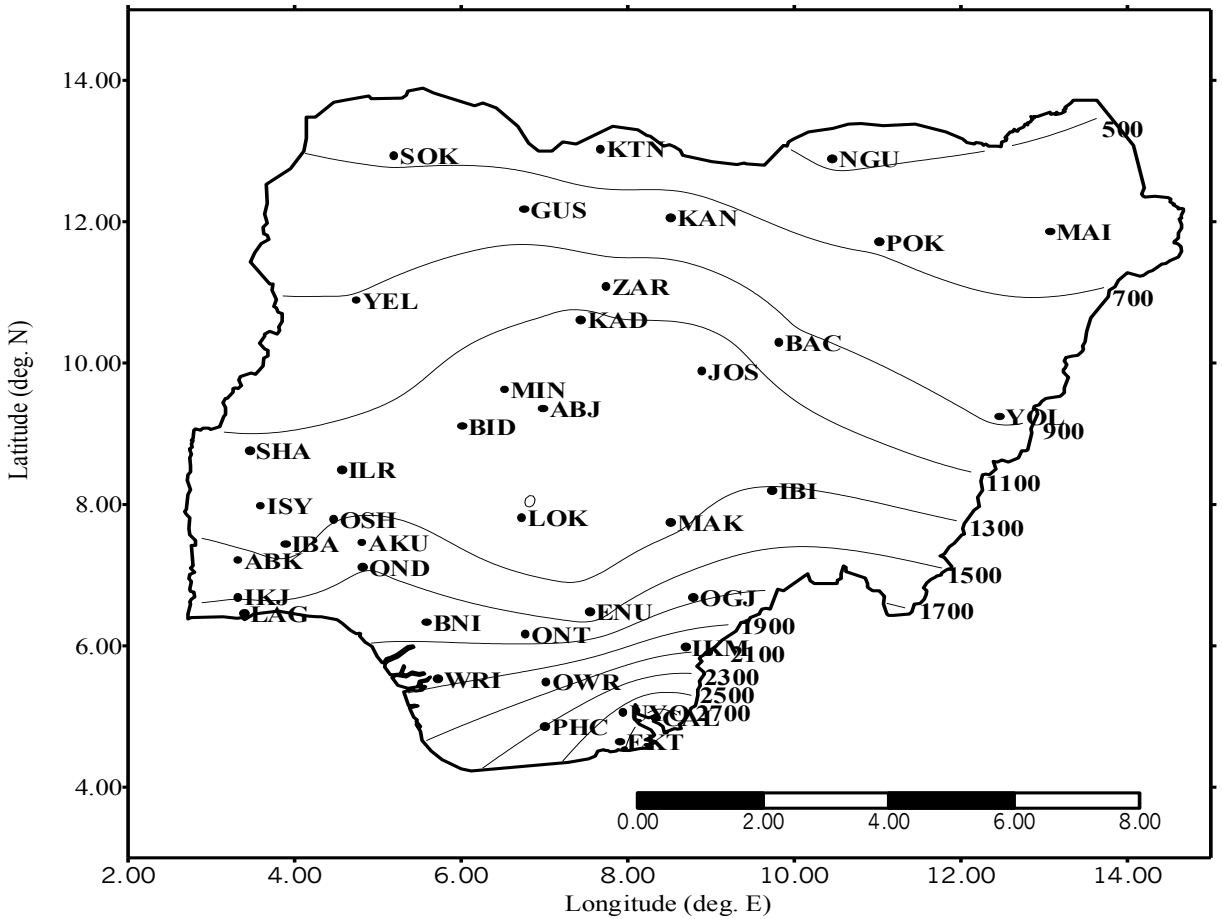


Fig. 1 Mean Annual Distribution of Rainfall (mm) in Nigeria

Rainfall variation Cont…

Fig.2 Standardized Mean Annual Rainfall Anomaly at Sahel Zone of the Country

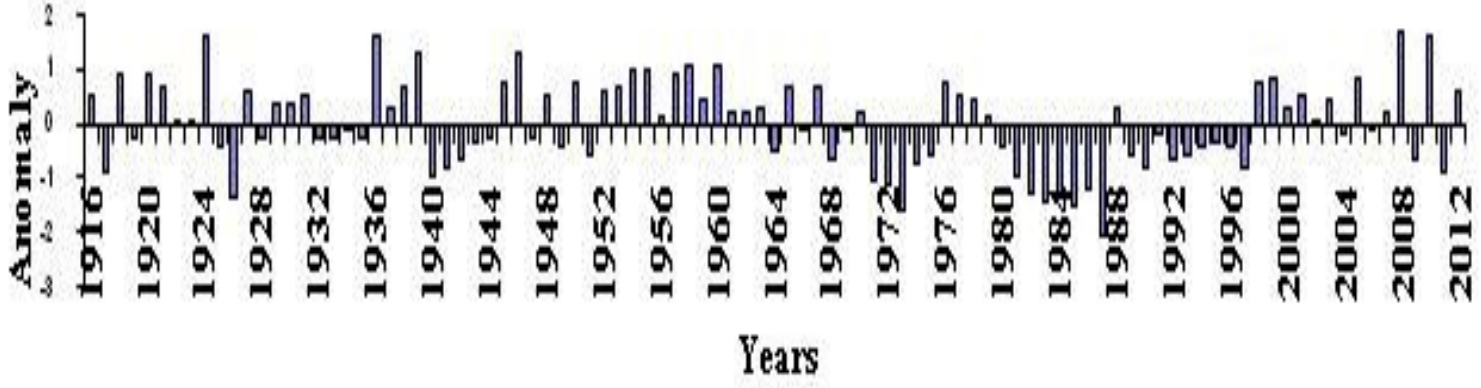


Fig.3 Standardized Mean Annual Rainfall Anomaly at Rainforest / Coastal Zone of the Country

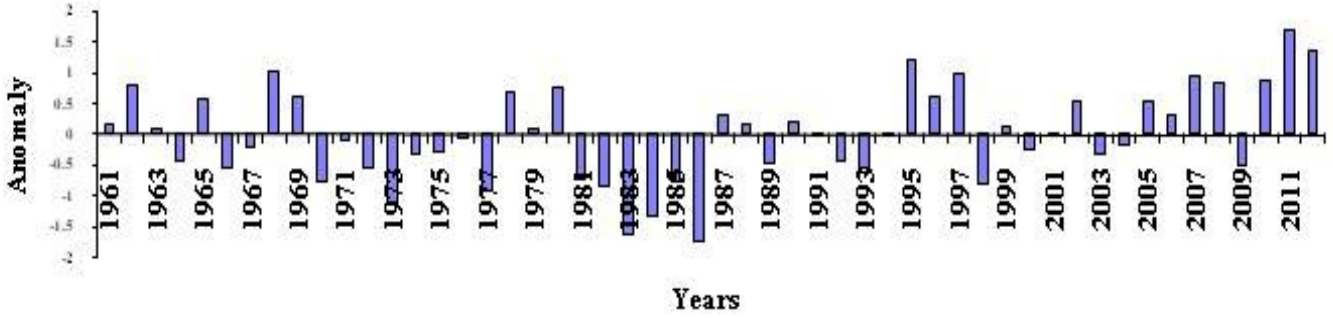
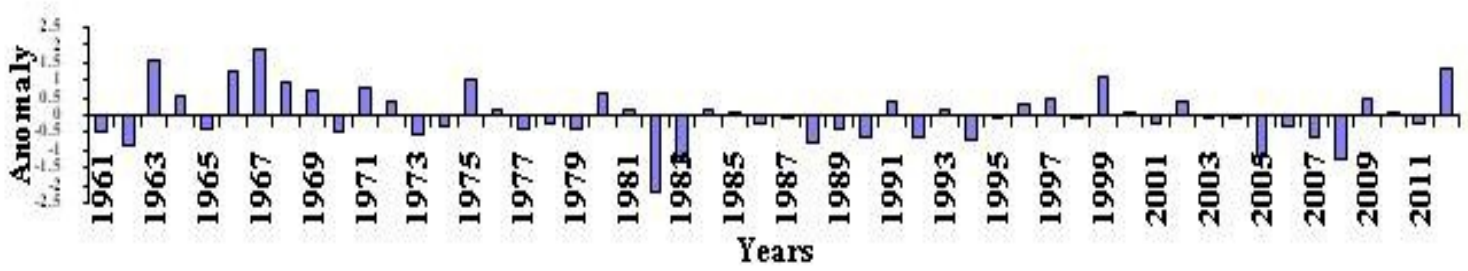
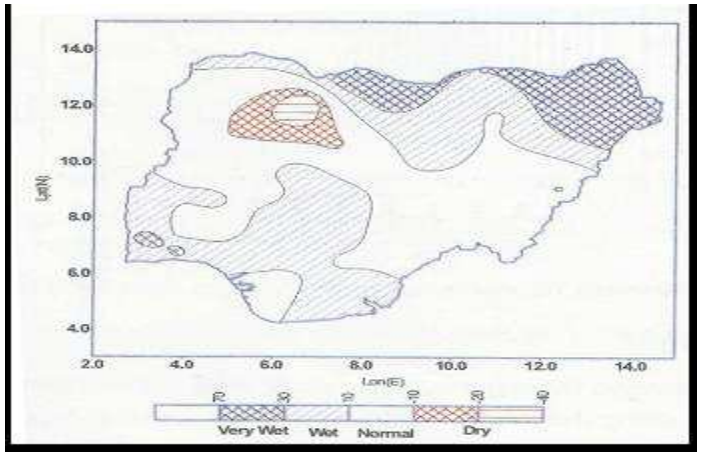
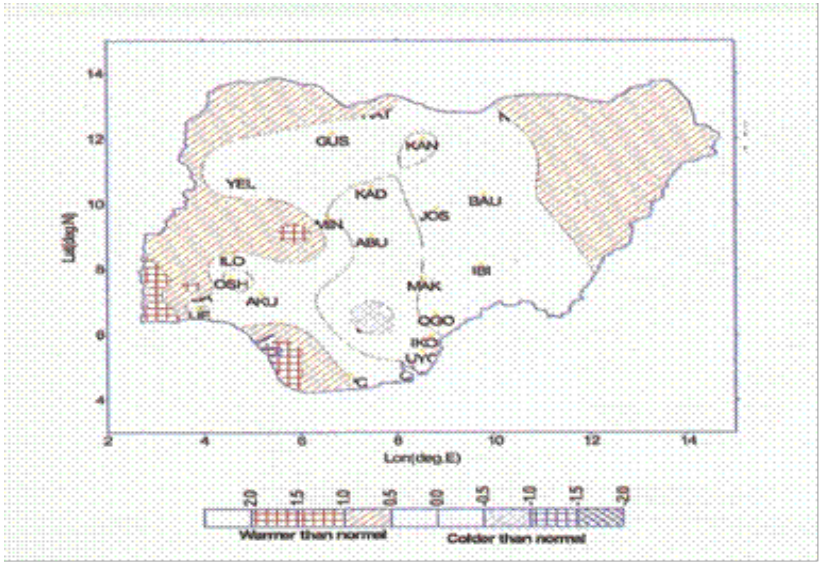


Fig 4 Standardized Mean Annual Rainfall Anomaly at Sudan Savanna Zone of the Country

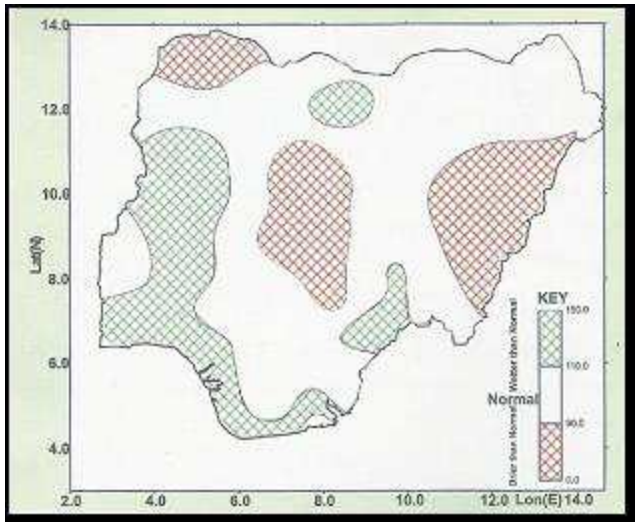


2007 Rainfall Anomaly

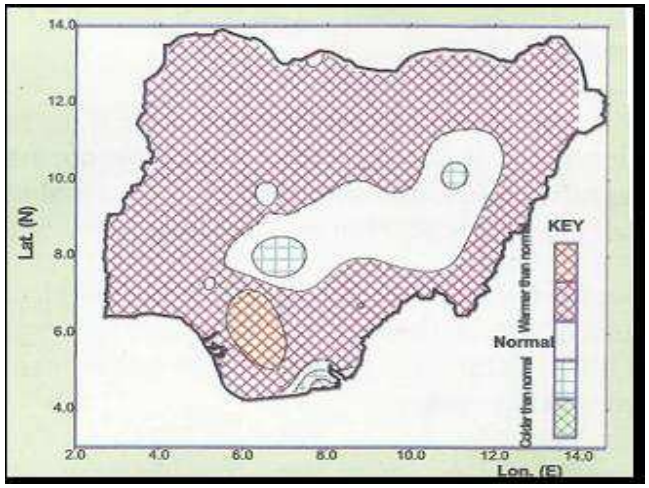




2007 Maximum Temperature Departure from (1971-2000) Normal



2008 Rainfall Anomaly



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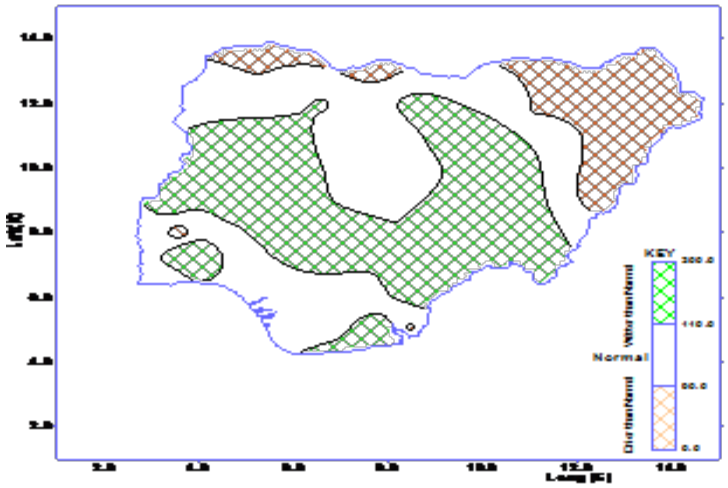

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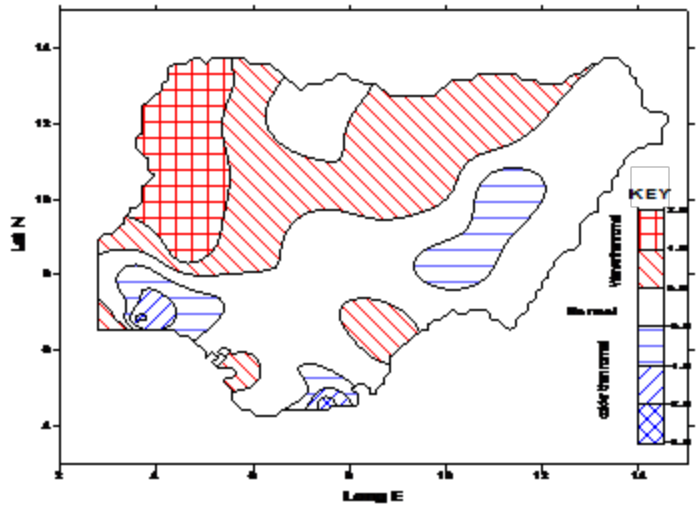

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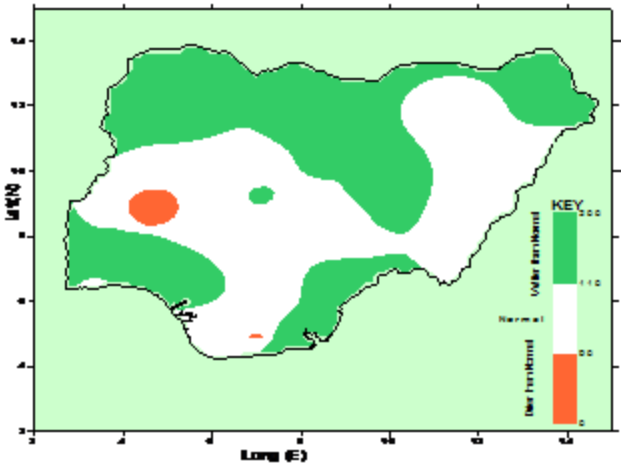
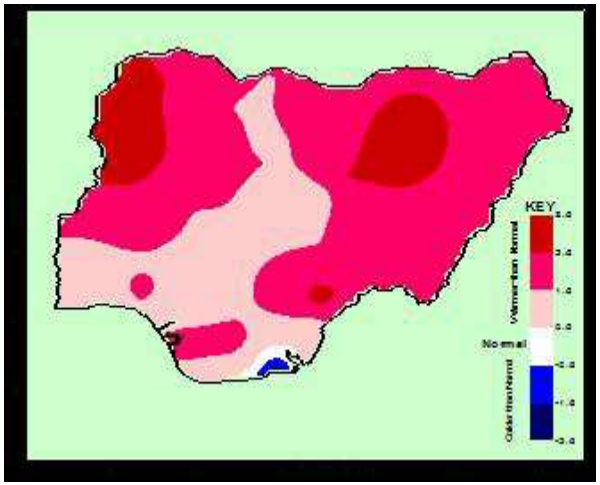
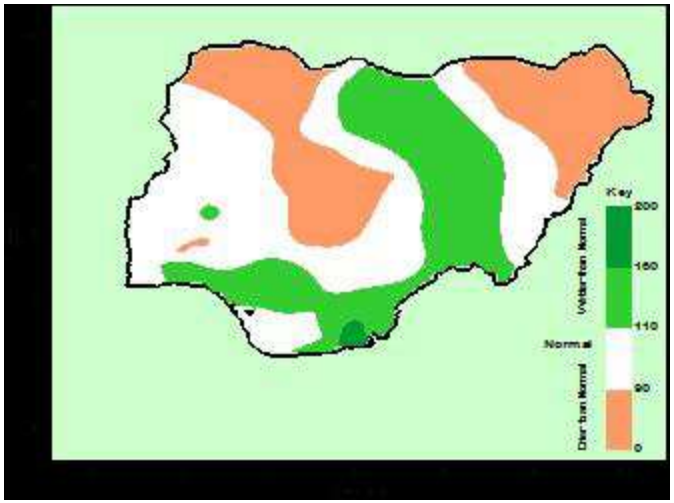


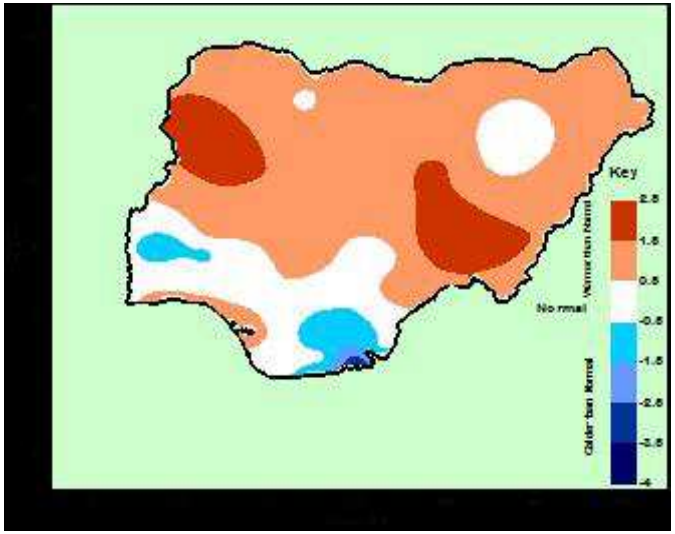
2010 Rainfall Anomaly



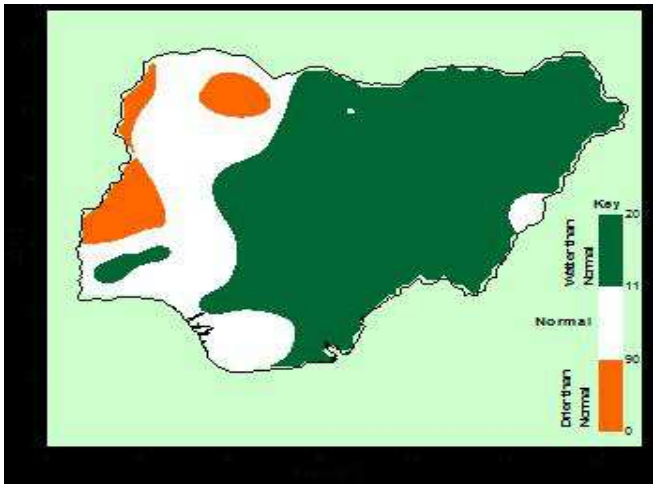
2010 Maximum Temperature Departure from (1971-2000)



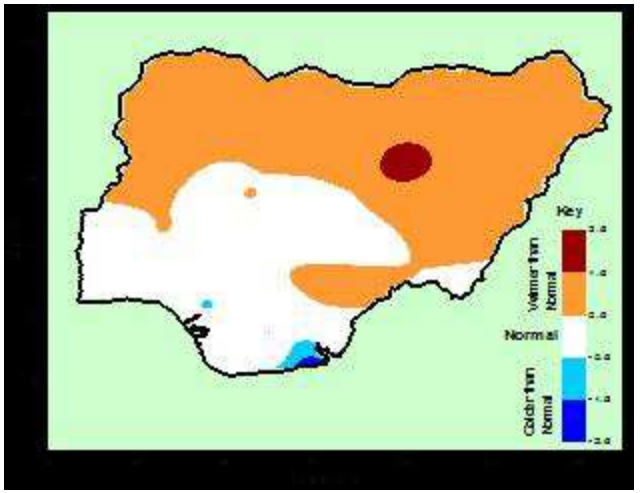
2011 Rainfall Anomaly



2011 Maximum Temperature Departure from (1971-2000)



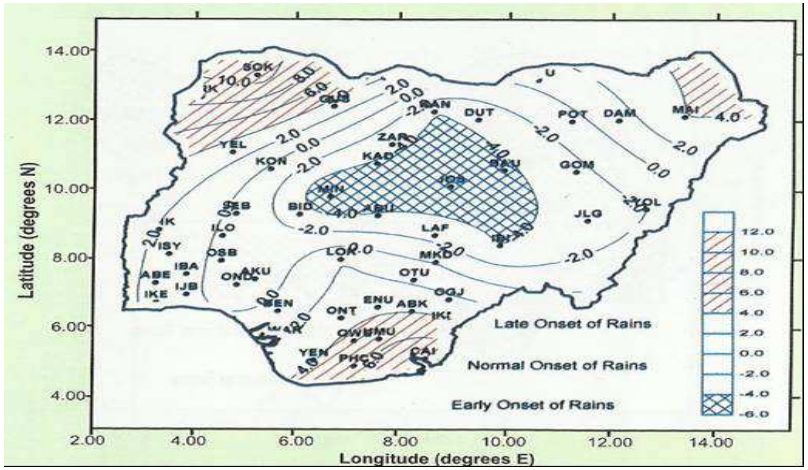
2012 Rainfall Anomaly



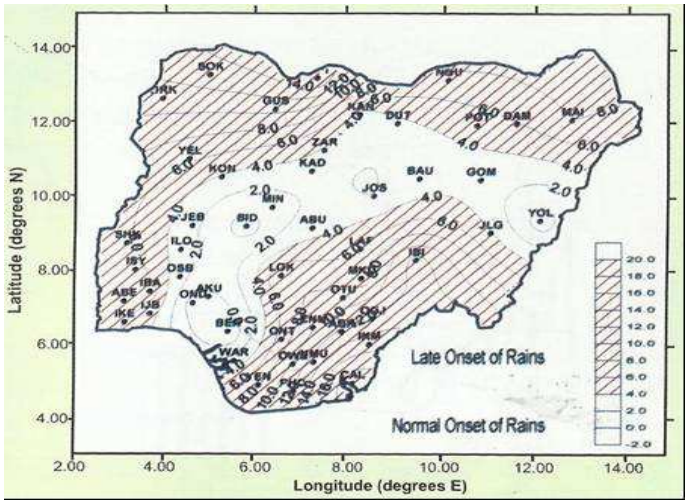
2012 Maximum Temperature Departure from (1971-2000)

Evidence of Climate Variation

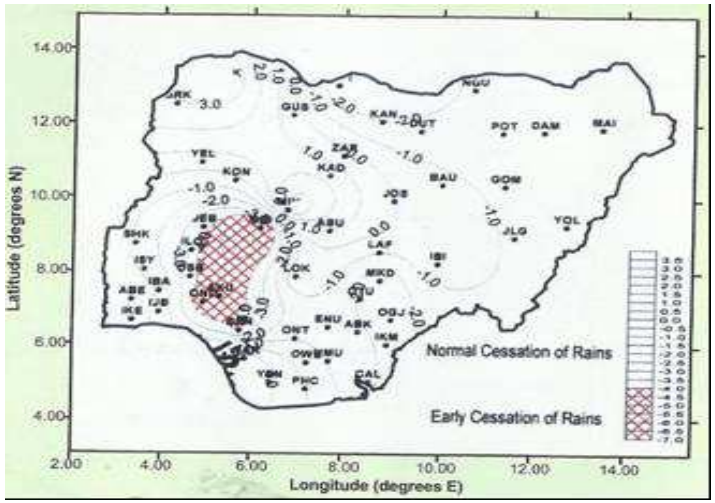
- Shorter rainfall duration due to shifts in periods of onset and cessation
- General increase in mean temperatures,
- High rainfall intensity
- Shift in onset and duration of Little Dry Season
- Increasing storm frequency
- Return of Hail occurrence
- Decreasing rain days
- Increasing dry spells during the rainy season
- Increasing heat waves in the extreme north



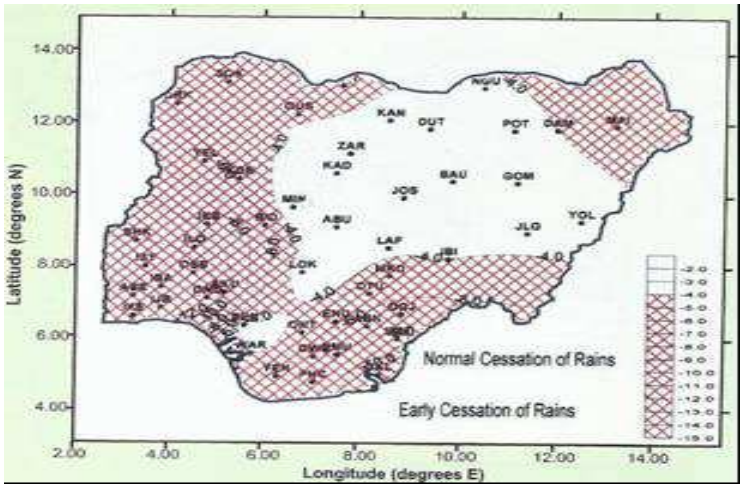
The Distribution of Anomaly of (1941-1970) mean onset date of rainy season from (1911-1940)
Source: (NIMET 2007)



The Distribution of Anomaly of (1971-2000) mean onset date of rainy season from (1911-1940)
Source: (NIMET)



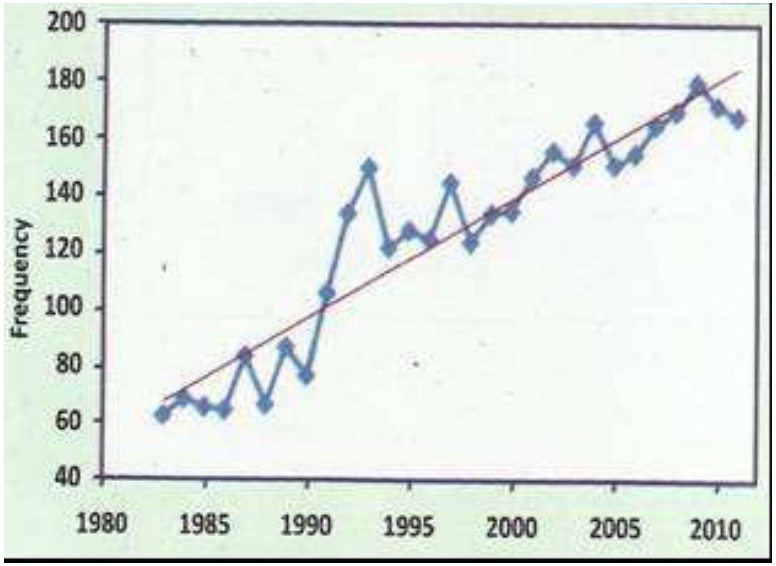
The Distribution of Anomaly of (1941-1970) mean cessation date of rainy season from (1911-1940)
Source: (NIMET 2007)



The Distribution of Anomaly of (1971-2000) mean cessation date of rainy season from (1911-1940)
Source: (NIMET)

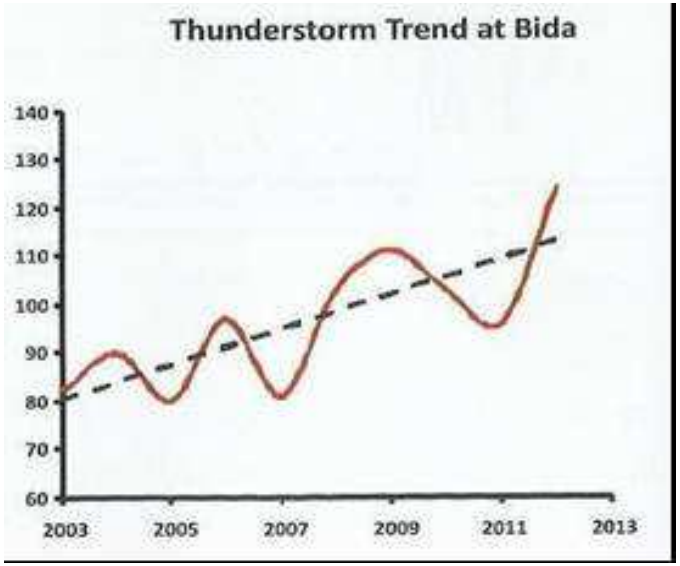
Thunderstorm Frequency

Abuja Thunderstorm Frequency



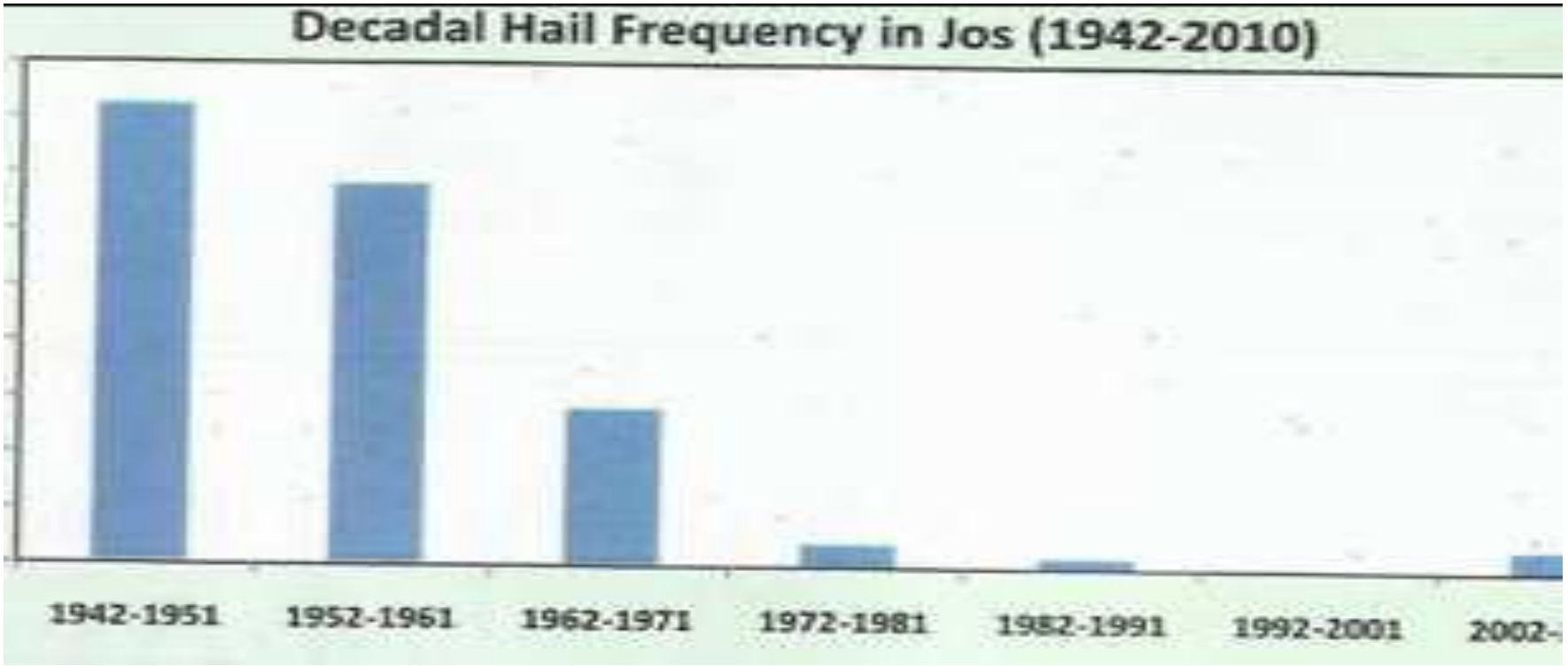
Bida Thunderstorm Frequency

Source: (Anuforom 2013)



Little Dry Season in the Southwest: (Year 2009 – 2012)

	City	Period (2012)	2012 Duration (Days)	2011 Duration (Days)	2010 Duration (Days)	2009 Duration (Days)
	Abeokuta	August 1- 17	17	22	6	36
	Akure	July 17 – August 17	32	12	0	17
	Ikeja	August 1 – Sept 6	37	23	20	46
	Ijebu-Ode	July 24 – August 9	17	8	7	17
	Iseyin	August 9 – 17	8	11	10	16
	Ondo	August 1 – 21	21	7	10	15
	Oshogbo	August 1 – 16	16	11	18	30
	Shaki	August 4 – 16	13	7	9	0
	Ibadan	July 16 – August 3	19	0	10	25



Decadal Hail Frequency in Jos (1942-2010)
Source: (NIMET 2011)

High Rainfall Intensity in 2012

Station	Rainfall (mm/day)	Month
Port Harcourt	100.2	May
Calabar	100.7	June
Abeokuta	134.2	June
Eket	121.8	June
Ijebu- Ode	110.1	June
Ikeja	216.3	June
Ogoja	101.3	June
Oshogbo	117.9	June
Uyo	105.6	June
Uyo	158.4	June
Oshodi	225.8	June
Lagos Island	169.8	June
Lagos Marine	115.3	June
Calabar	132.8	July
Ijebu-Ode	132.5	July
Maiduguri	107.3	July
Owerri	128.8	July
Uyo	111.7	July
Warri	113.6	July
Calabar	123.8	August
Gombe	120.4	August
Kano	143.0	August
Zaria	158.4	August

Daily Rainfall of 100.0mm and higher for some cities in 2012

CONCLUSION

.The type of climate hazards and their spatial variations, the expected frequency and intensity of impacts of climate change on urban areas can no longer be predicted by solely relying on historical data, local experiences and institutional memory.

.The results from the analysis, presented scientific information on the magnitude, departures from long term conditions and trends in maximum temperatures, rainfall amount and distribution. Most places in the country experienced record flooding due to a combination of above normal rainfall and excess water released from Dams.

CONCLUSION CONT…

.For instance, the most recent analysis showed that in 2012, high intensity rainfall exceeding 100mm in 24 hours was recorded in many parts of the country.

.The temperature analyses also revealed that, in most years of flooding, there were corresponding warmer than normal conditions observed across the country.

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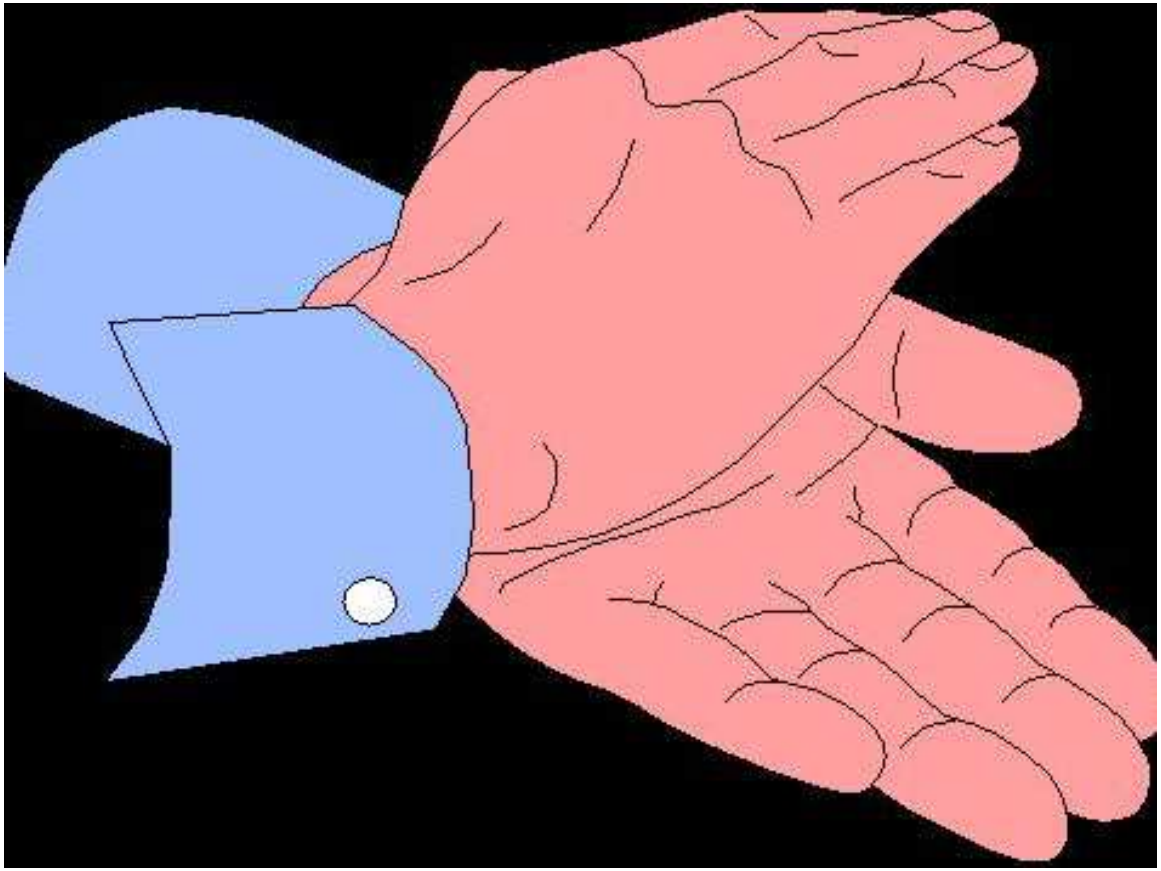
In 2012, the country experienced the worst flooding in more than 80 years as a result of heavy rainfall, coupled with the downstream flow from Fouta Djallon in Guinea and the release of water from some dams within and outside the country in July.

Recovered human bodies from River Benue, Adamawa State flood, 25th August 2012

Aerial view of a submerged school in Bayelsa State in 2012.



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