Esxon Publishers

International Journal of Applied Research and Technology
ISSN 2277-0585

Publication details, including instructions for authors and subscription information:
http://www.esxpublishers.com

Analysis of 2005 Rainfall Patterns with Long-Term Averages and their Implications on Climate Change in South-East Agro-ecological Zone of Nigeria

Audu, H. O.[1], Ekanem, E. M.[2], Chukwu, G. U.[3], Felix I.[4] and Audu, E. B.[5]

[1]National Root Crops Research Institute, Umudike, Nigeria
[2]University of Uyo, Uyo, Nigeria
[3]Michael Okpara University of Agriculture, Umudike-Umuahia, Nigeria
[4]Abia State University, Uturu
[5]Government Secondary School Lugbe, Abuja

Available online: August 30, 2012

To cite this article:

Audu, H. O., Ekanem, E. M., Chukwu, G. U., Felix I. and Audu, E. B. (2012). Analysis of 2005 Rainfall Patterns with Long-Term Averages and their Implications on Climate Change in South-East Agro-ecological Zone of Nigeria. *International Journal of Applied Research and Technology*. 1(4): 170 – 176.

PLEASE SCROLL DOWN FOR ARTICLE

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan, sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contexts will be complete or accurate or up to date. The accuracy of any instruction, formulae and analysis should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

International Journal of Applied Research and Technology
Vol. 1, No. 4, August 2012. 170 – 176.

Esxon Publishers

Analysis of 2005 Rainfall Patterns with Long-Term Averages and their Implications on Climate Change in South-East Agro-ecological Zone of Nigeria

Audu, H. O.[1], Ekanem, E. M.[2], Chukwu, G. U.[3], Felix I.[4] and Audu, E. B.[5]

[1]National Root Crops Research Institute, Umudike, Nigeria
[2]University of Uyo, Uyo, Nigeria
[3]Michael Okpara University of Agriculture, Umudike-Umuahia, Nigeria
[4]Abia State University, Uturu
[5]Government Secondary School, Lugbe, Abuja

(Received: 30 July 2012 / Accepted: 14 August 2012 / Published: 30 August 2012)

Abstract

The 2005 Rainfall and rainy days of Umudike and Uyo in southeast agro-ecological zone of Nigeria were compared with their long-term averages (32 years). Simple descriptive statistics and Kendall Tau correlation coefficients were used to analyze the data. Rainfall amount showed significant positive correlation (r = 0.93, 0.85). Amount of long-term rainfall and rainy days in the study area showed significant positive correlation (r = 0.72, 0.88). Similarly, rainfall amount and rainy days in 2005 in the area showed significant positive correlation (r = 0.71, 0.86) was also observed between the long-term averages, rainy days and those of 2005. In the seasonal pattern the LTA of rainfall showed that 12.5% and 11% falls between November and March in Uyo and Umudike, respectively, whereas the 2005 rainfall and rainy days depicted 16.04% and 18.35% to 14.08%, 14.39% for Uyo and Umudike, respectively.

Keywords: Agro-ecology, Long-term average, South-East, Nigeria, Rainfall and Rainy days

Corresponding author:
E-mail: mongareenho@yahoo.com
ISSN 2277-0585
© 2012 **Esxon Publishers**. All rights reserved.

Introduction

Agro-meteorological information in a developing economy such as Nigeria is indispensable for effective management of environmental resources and sustainable national development. Environmental resources, in this context, define the different uses with which the gases of the atmosphere, the plant cover, the soil minerals and water bodies of the environment can be put to use. Agro-meteorological information on the other hand is the systematic collection; storage and application of meteorological and climatological information for effective planning; development and utilization of environmental resources in an organized economy so as to optimize the utility values, yet ensure environmental safety. Weather and climate impinge heavily on a variety of human activities on the environment such that successful plant and animal selection, introduction, storage and cultural operations in an environment for instance, are functions of the systematic application of agro-meteorological information in the relevant human endeavour (Cunningham and Saigo 2001). Other areas of application include environmental monitoring for Early Warning Systems (EWS) on pest and pathogens invasion, desert encroachment, irrigation scheduling (Amades, 1987).

The relevance of moisture from rainfall to agriculture is the most reliable agro-meteorological element in the tropics (Adefolalu, 1982; Amades, 1987 and Nieuwolt, 1977). Weather and climatic investigators, are keen at the unfolding pattern of climatic change occasioned predominantly by anthropogenic causes e.g. deforestation, overgrazing, and industrialization as they increase the volume of green house gases ($CO_{2,}$ $CH_{4\ \mathrm{and}}$ CFC_s) emission in the atmosphere (IPCC., 1995; Cunningham and Cunningham, 2004 and Rao, 2006). Rainfall amount, intensity and distribution are characteristic features affected by climate change. Buan (1988) and Cunningham and Saigo (2001) have noted that climate change due to global warming is causing increasing concentration of rainfall in wet months while dry months register lower rainfall that may necessitate delayed rains during wet season. The impact of these changes especially in Nigeria is note worthy. Undoubtedly, certain human activities such as urbanization and industrialization may be causing increasing precipitation in an environment as studies of urban micro and global climate have shown a 5-10 % more rainfall in urban areas and 1 % more on global scale (Ayoade,1988; Barry and Chorley,1978 and Rao, 2006). These, according to Ayoade (1988), are due to observed large-scale emission of condensation nuclei pollutant in the atmosphere arising from human activities.

The uncertainties surrounding the global warming arguments have reflected in diverse studies on climate change in Nigeria (Rao, 2006 and Adefolalu, 2006b). Hence the need to keep a close watch at the unfolding events of climate change in the southeast ecological zone of Nigeria becomes paramount. This study was based on comparative analysis of the 2005 rainfall pattern with long term Averages (LTA) for two locations (Uyo and Umudike) in south east agro-ecological zone.

Materials and Methods

Monthly rainfall and rainy days totals were collected from agro-meteorological unit of the National Root Crops Research Institute, Umudike Abia State and Geography Department, University of Uyo, Akwa Ibom State. Umudike is located on Latitude 05^0 29 N and Longitude 07^0 50” E and 122 Metres above sea level in the humid tropics. Uyo on the other hand is located on Latitude 05^0 01’ N and Longitude 07 ^{0}56 E and 60 Meters above mean sea level. The data for the study were for 1972 to 2005 for Umudike and 1977-2005 for Uyo. Kendall Tau correlation coefficients were computed to measure the degree of association between the long-term average rainfall and rainy days of Umudike and Uyo respectively using the Statistical Analysis System (SAS Institute, 1999). Similarly the Kendall Tau correlation coefficients for the Long-term average rainfall and the 2005 rainfall pattern for the two locations were also computed.

To analyze and compare the seasonal distribution of the mean state and the 2005 rainfall of the two locations, a November to March and April to October rainfall pattern were computed with their respective percentages to the Mean State and 2005 respectively computed to sea variations between years and seasons.

Results and Discussion

Strong positive correlations exist between Umudike and Uyo Long Term Average rainfall (coefficient r =0.93). Similarly, a strong positive correlation exists between Umudike and Uyo Long Term Average rainy days (coefficient r = 0.85). However, the Long-Term Average (LTA) rainfall and the 2005 rainfall in Umudike show a relatively high positive correlation (coefficient of r =0.787). Conversely a much lower positive correlation (coefficient of r = 0.687) was established between the Long-Term Average rainfall and 2005 rainfall in Uyo. A high positive correlation (coefficient of r = 0.841) exists between Long Term Average rainy days and 2005 rainy days in Umudike. Similarly a high positive correlation (coefficient r = 0897) exists between Long Term Average rainy days and 2005 rainy days. Figures 1 and 2 show the 2005 rainfall and rainy days in Umudike and Uyo.

The annual mean rainfall difference of rainfall for Uyo and Umudike is 299mm surprisingly; the 2005 rainfall pattern on the other hand shows much more contrast in terms of values for the two stations. Uyo recorded 3030.5mm while Umudike had 2192mm giving an annual rainfall difference of 838.5mm between the two stations (. This figure represents a striking percentage increase of 279.43 % over the long-term average difference. Similarly, the LTA rainy days for Uyo and Umudike are 128 and 144 while 2005 recorded 137 and 147 rainy days for Uyo and Umudike. These scenarios have a lot of implications for the evolution of floods, erosion, agriculture and climate change. Umudike LTA and 2005 rainy days are more than those for Uyo in spite of the fact that Uyo receives more rainfall and closer to sea board influence of the cross river basin. One may attribute this to the concave shape of the Niger Delta and the uniformity between the Niger Delta physical features and the ocean surfaces. This prompt the region of maximum convergence of air stream to located further inland within a radius that also incorporate Umudike Uyo as shown in Figure 3 after Adefolalu (1982). With this it is expected that the Umudike LTA and even the 2005 rainfall should be much more than that of Uyo. This is not the case. Thus the 2005 annual rainfall of Uyo by far exceeded the Umudike annual rainfall in spite of the fact that the rainy days are more for Umudike.

Similarly, the rainfall difference between Umudike and Uyo exceeded 635 mm, the rainfall days were by far short of the LTA. In the 2005 rainfall pattern, the number of rainy days for Uyo and Umudike were 137 and 147 while the annual rainfall figures were 3030.5 and 2192 mm respectively giving rise to an annual difference of 10 days of rainfall and 838.5 mm of rainfall amount as against 16 days of rainy days and 299 mm Table 1. The rains were therefore not only heavies and much more concentrated in Uyo but may not have been spread for effectiveness to agriculture, but rather aggravate the menace of flooding in Uyo. Large scale flooding and erosion are quite inevitable just as the pattern depicted a poor agriculture yields year because of the higher rainfall amount and the relatively lower rainy days, may have generated much more suitable runoff to impair even the roads as surface runoff flows on the pavements. This tend agrees with Buan (1988) observation that under conditions of climate change induced by human activities, amount of rainfall receipt during wet months increases significantly.

A critical look at the seasonal pattern no doubt is inevitable. Table 2 and 3 shows the percentage rainfall and rainy days for the dry and wet seasons respectively (November to March and April to October) for Uyo and Umudike.
From Table 2, 12.57% and 11.0% of the rains in Uyo and Umudike fall between November to March while 14% and 11% of the mean rainy days for Uyo and Umudike respectively occur between November to March, whereas the 2005 rainfall and rainy days depicted 16.04% and 18.35% for Uyo and Umudike respectively and 13.87 and 14.29% of the rainy days for Uyo and Umudike occur between November and March. Although the pattern of the wet season rainfall for both Umudike and Uyo depict the percentage that have been observed with seaboard locations such as Warri 86%, Port-Harcourt 84% as reported by Adefolalu (1982), table 3 shows the respective percentage of LTA and 2005 rainfall and rainy days for Uyo and Umudike. From Table 2, while the percentage of the LTA rainfall and rainy days during the dry season of Uyo are 12.57% and 14.66%, those of Umudike are 11.0% and 11.8% respectively. This implies that the rains and rainy days for November-March more equitably distributed in Umudike than for Uyo since a higher percentage of rainfall during the dry season will undoubtedly cause flooding and erosion in especially unconsolidated soil of the farmlands of the region. Besides higher rainfall especially during the onset phase is inimical to optimal germination development of young crops.

The 2005 rainfall pattern seems to have presented a much more disastrous condition. Uyo recorded 16.04% and 13.87% for annual rainfall and rainy days while Umudike registered 18.35% and 14.29% for rainfall and rainy days. Similar pattern is shown by the wet season rainfall and rainy days where 80-86% of the rains and rainy days were concentrated between April and October for the two stations. The distributions for 2005 seem to be worse for Umudike than for Uyo. On the whole, there seems to be an increasing annual rainfall amount and rainy days for Uyo than it is for Umudike Table 3.

Conclusion

There is an observed increase in the rainy days of Uyo and a proportionate increase in the amount of rainfall receipt annually. The case is more pronounced with Uyo than Umudike. Bearing in mind that a 5-10% more rainfall has been observed in urban areas as a result of human activities, the increasing rainy days and rainfall amount of Uyo may be attributed to the impact of human activities which for now are the principal causes of climate change.

The strong positive correlations between Umudike and Uyo rainfall and rainfall days for the long term averages and 2005 further emphasize that the discrepancies observed in increased rainfall amount and rainy days of Uyo may not be unconnected with the impact of human activities.

This situation is one that calls for an in-depth approach by environmental stakeholders as to the problems of flooding, erosion and uncertainties in agricultural yield.

The above notwithstanding, a much more detailed study of the microclimatology of Uyo is hereby advocated to unveil the latent human or even environmental processes that are responsible for the observed increase in precipitation receipt and rainy days in Uyo. Similar suggestions are made for Umudike.

References

Adefolalu, D. O. (1982): The weather and climate of Calabar. A study of coastal micro- Climatology in the Equatorial tropics. Unpublished senate Research Projects, University of Calabar, Calabar. pp 66-87.

Adefolalu, D. O. (2006a): Isreal-Nigeria Training Workshop on Applied Meteorology lecture [1] on desertification: factors, monitoring, amelioration and management. Oshodi, Lagos.

Adefolalu, D. O. (2006b): Estimating precipitation effectiveness of functional agro-meteorological operations in Nigeria. Lecture [2] delivered at International Human Resources Training in Agro-Meteorology. Oshodi, Lagos.

Amades, G. A. (1987): Hydrometeorology of Sokoto State and Agricultural planning. (Unpubl. Report): Sokoto-Rima River Basin and Rural Development, Sokoto, Nigeria.

Ayoade, J. O. (1988): Introduction to climatology for the tropics. Spectrum books, Ibadan.

Ayoade, J. O. (1973): Annual rainfall trends and periodicities in Nigeria. Geog. J. 16: 167-176

Buan, R. D. (1988): Analysis and interpretation of agronomic data in strengthening Meteorological services for agriculture. PCARRD, Los Banos, Laguna, Pp. 24-23.

Cunningham, W. P. and Cunningham, M. A. (2004): Principles of Environmental Science. Inquiry and Applications (6^{th} Ed.) Mc-Graw Hill Educational, Boston. Pp 205-207.

Cunnigham, P. C. and Saigo, B. W. (2000) Environmental Sciences (6^{th} Ed.): A global concern. Mc-Graw Hill Educational, Boston. Pp 20-22.

Nieuwolt, S. (1977): Tropical Climatology: An Introduction to the Climates of the Low Latitudes. John Wiley and Sons Inc, New York. Pp 182.

Moutgomery, C.W. (2000): Environmental Geology. (5^{th} Ed) Mc-Graw Hill Educational, Boston. Pp 24-25.

Ogolo, E. O. and Falodun, S. E. (2007): Variations and trends in long-term annual mean air temperatures over some selected cities in Nigeria. Journal of Research in Physical sciences, Vol.3, Number2, pp. 40-50

Osodeke, V. E. (1997): Historical trends in rainfall distribution in southeastern Nigeria. Proceedings of the first regional symposium on hydrology of tropical Watersheds held at University of Nigeria, Nsukka.

Rao, C. S. (2006): Environmental Pollution Control Engineering. New age International publishers New Delhi pp 24-25.

Table 1: LTA and 2005 rainfall (RF) and rainy days (RD) for Uyo and Umudike

STATION	UYO				UMUDIKE			
MONTHS	LTA Rainfall	2005 Rainfall	LTA RD	2005 RD	LTA Rainfall	2005 Rainfall	LTA RD	2005 RD
January	16.1	22.4	2	1	13.6	17.3	1	2
February	39.0	97.0	2	2	30.8	267	3	5
March	123.3	156.0	7	9	120.2	64	7	6
April	205.7	284.8	11	10	185.8	141.3	12	11
May	276.7	186.7	13	9	265.2	222.4	16	17
June	277.6	325.6	15	17	283.9	264.4	18	18
July	362.7	637.7	19	25	294.2	277.0	21	24
August	348.6	325.1	19	22	225.5	225.0	22	21
September	350.4	279	18	17	341.6	336.7	21	17
October	256.3	505.5	15	18	252.8	323	17	18
November	102.7	207.1	6	6	54.8	45.4	5	6
December	17.6	3.6	1	1	9.3	8.6	1	2
Total	2376.7	3030.5	128	137	2077.7	2192	144	147

Table 2: Dry Season LTA and 2005 Rainfall (RF) and Rainy days (RD) for Uyo and Umudike

STATION	**PERIOD:**	**NOV -**	**MAR**					
		NOV	**DEC**	**JAN**	**FEB**	**MAR**	**TOTAL**	**%Total**
	LTA RF	102.7	17.6	16.1	39.0	123.3	298.7	12.57
UYO	2005 RF	207.1	3.6	22.4	97.0	156.0	486.1	16.04
	LTA RD	6	1	2	2	7	18	14.06
	2005 RD	6	1	1	2	9	19	13.87
	LTA RF	54.8	9.3	13.6	30.8	120.2	228.7	11.0
UMUDIKE	2005 RF	45.4	8.6	17.3	26.7	64	402.3	18.35
	LTA RD	5	1	1	3	7	17	11.81
	2005 RD	2	6	2	5	6	21	14.29

Table 3: Wet Season LTA and 2005 RF and RD pattern for Uyo and Umudike

Station									Total	%Total
		APR	MAY	JUN	JUL	AUG	SEP	OCT		
	LTA RF	205.7	276.7	277.6	362.7	348.6	350.4	256.3	2078	87.43
UYO	2005 RF	284.8	186.7	325.6	637.7	325.1	279	505.5	2544.4	83.96
	LTA RD	11	13	15	19	19	18	15	110	85.94
	2005 RD	10	9	17	25	22	17	18	118	86.13
	LTA RF	185.8	265.2	283.9	294.2	225.5	341	252.8	1848.4	88.96
UMUDIKE	2005 RF	141.3	222.4	264.4	277	225	336.7	323	1789.8	81.65
	LTA RD	12	16	18	21	22	21	17	127	88.19
	2005 RD	11	17	18	24	21	17	18	126	85.71

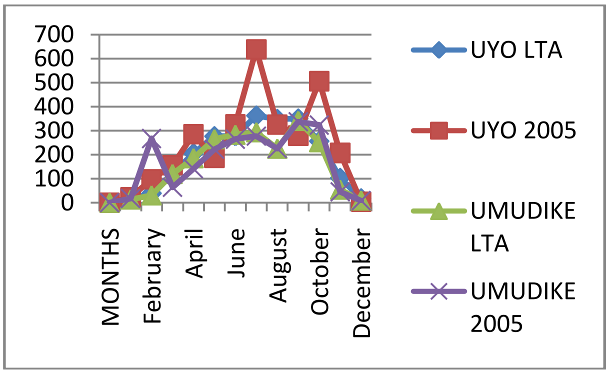

Fig. 1 Long-Term Average Rainfall in Umudike and Uyo for (1972 to 2005)

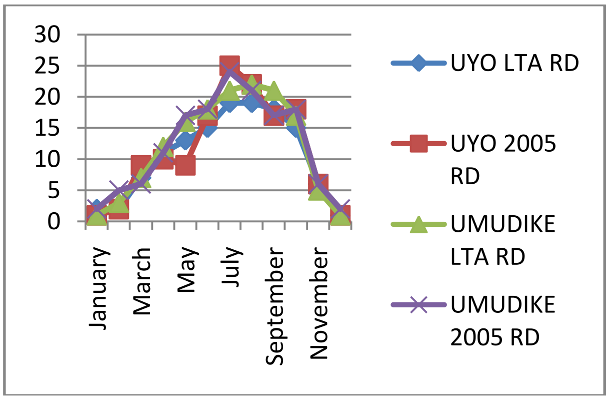

Fig.2: Long-term averages (1972-2004) of rainy days (RD) and 2005 in Umudike and Uyo

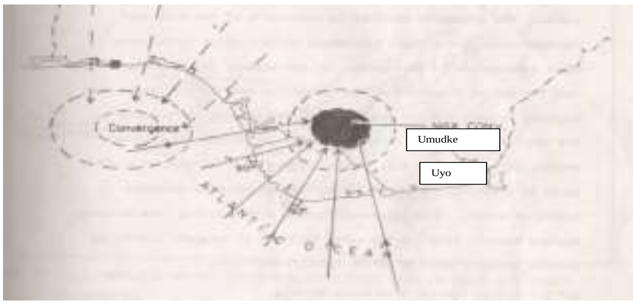

Fig. 3: Sketch region of maximum convergence due to the concave shape of the Niger Delta to reflect Umudike and Uyo locations.