IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 9, Issue 4 Ver. II (Apr. 2015), PP 17-22
www.iosrjournals.org

The Effect of Thunderstorm Activity Over Port Harcourt

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Abstract:*The study examines thunderstorm activities in all ramifications over Port Harcourt, South-South Nigeria. It includes diurnal, seasonal and annual occurrences of thunderstorm. Data on both hourly and monthly thunderstorm occurrence were collected from Nigerian Meteorological Agency, Oshodi Lagos from 1970 - 1999 for analysis. The results among other things show a late evening diurnal peak occurrence of thunderstorm activity. More thunderstorms tend to occur during wet season than during dry season. Thunderstorm within Port Harcourt has double maxima (double peak during the month of May and October. It was observed that thunderstorm decreases over the year. Finally the study discovered that there is statistical difference in diurnal, seasonal and annual variation of thunderstorm at 95% level of confidence in the study area. This explains the high rain fall occurrence in the study area.*

Key words:*Annual variation, Diurnal variation, seasonal occurrence, Port Harcourt, Thunderstorm.*

I. Introduction

Thunderstorm is a convective storm accompanied by lightening, thunder, and variety of weather such as local heavy rain shower, hails, high wind, sudden temperature change and occasionally tornadoes. Thunderstorm develops when dense air overlays moist air that is less dense. A trigger such as solar heat, frontal weather, or rising terrain, causes the warm moist air to begin to rise through cold air. Air current develops, and heat energy stored in the air and water vapour is then converted into wind and electrical energy.

The roaring and rumbling of the cloud and lightening associated with it, had over the year invoke fear on millions. Many associated it to gods, others to eventuality (Alexander, 2005). The challenge thunderstorm posed on aviation industry, air force and naval personal during the Second World War cannot be underestimated. This spurred scholars to study all aspect of thunderstorm.

In the tropical regions, climate and its variables dictate the people ways of life. Thunderstorm is one of the micro variables that exert great influence on tropical activities.

Adelekan (1998) pointed out the importance of thunderstorm in terms of its significant contribution to flowing episodes and soil erosion processes due to high intensity and torrential characteristics. Others who had carried out research on thunderstorm activity in Nigeria include, Mulero (1973) on seasonal distribution of thunderstorm days in Nigeria for the period (1962 — 1971); Balogun (1981) on season and spatial variation of thunderstorm activity in Nigeria; Oladipo and Mornu(1984) discussed the characteristics of thunderstorm in Zaria, Nigeria; Omotosho (1984) was concerned with the individual contribution of thunderstorm line squall and Monsoon, to the total rainfall in Nigeria over five years. Salau (1986) discussed the influence of Jos Plateau on the occurrence of thunderstorm activity in Jos, Zaria, and Kaduna in her work on temporal and comparative analysis of thunderstorms and related phenomena (hail, squall and Lightening). Ologunorisa, 1991; Ologunirisa and Alexander, 2004; 2007 were other notable contributions from Nigeria.

Outside Nigeria, scholars have also worked on thunderstorm activity (Sivaramkrishnam, 1990; Moid, 1995; Kolendowicz, 1998; Singh and Sontakke, 1999; Monohar et al, 1999; Moid, 2001; Bielec, 2001; Kandalgaonkar et al, 2005).

Despite the contributions no real attempt has been made to study thunderstorm in all its aspect — diurnal, seasonal, annual, and trend in a single study. Besides, thunderstorm is of local importance, it is imperative therefore, that a smaller unit like Port Harcourt be study for a long period of 30years (1970 - 1999). This study seeks to carry out a detailed analysis of thunderstorm over Port Harcourt because of its importance in Nigeria.

Study Area

Port Harcourt is the capital of Rivers State in Nigeria; it is also a Local Government Area. Itlies along Bonny River, located on Latitude 04°47'21"N and longitude07°59'54"E. It occupies about 109sqkm. Port Harcourt lay on 16.0m altitude. It is generally a plane area.

Rivers State has a population of about 5.2 million and population density of 190 persons/sqkm.The population of Port Harcourt is estimated at 1,620,214 (NPC, 2007).

Port Harcourt has a humid semi hot equatorial climate (Iwenai, 2010; Salau, 1985). The temperature is high like every other tropical city. The mean relative humidity (R.H) is about 90%, but in July and September it is over 95% and about 75% in January.

The two dominant soil types in Port Harcourt include alluvial soil and ferrasol. Port Harcourt is the only significant city in Rivers State. It is host to many multinational companies. It has two refineries, two Sea Ports, Petrol Chemical Company, three Universities and other higher institutions including three polytechnics and standard hospitals.

The road network has been improved by the State Government; however traffic is stock in the morning and, late evening hours. Raining days triggers traffic jam known locally as go slow or hold up. Figure 1 show the study area not just Port Harcourt Township.

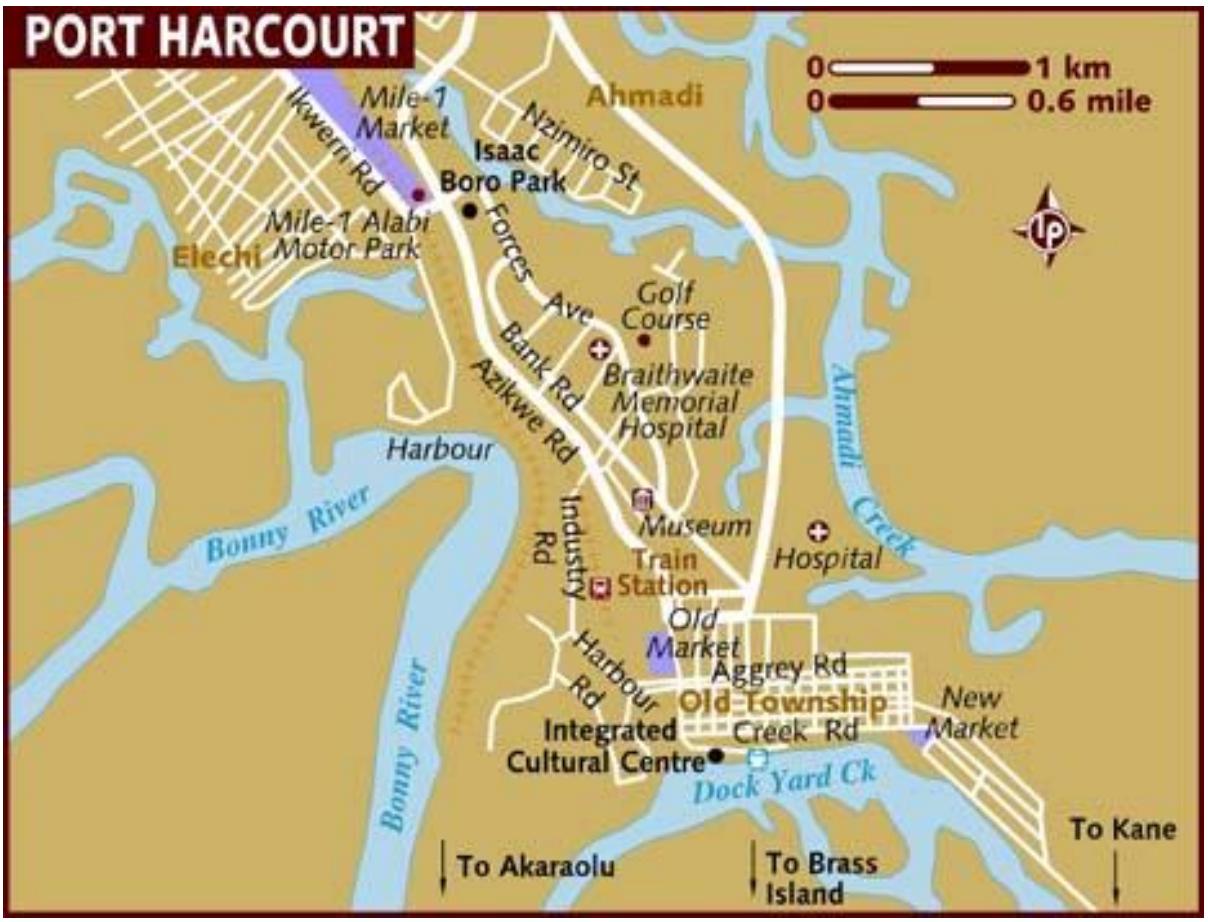

Figure 1: Map of Port Harcourt.

II. Methodology

The data used in this work were extracted from form 100/5 of daily weather register of Nigerian methodological Agency, Oshodi,Lagos. The study covered 30 years (1970 — 1990).

The method of data analysis includes descriptive and inferential statistics. Descriptive statistics such as means, percentage and co-efficient of variation (C.V) were used. The C.V was used in determining the variation in diurnal and seasonal occurrence of thunderstorm. Ologunorisa (1999) and Oslon (1983) used it in their work.

CV = STD/ б *100 …… (1)

Inferential statistics used include Pearson Product moment correlation (PPMC) and regression analysis. The PPMC was use for annual distribution and regression analysis for trend in thunderstorm activity in Port Harcourt PPMC r is given as

r = (x- б) (y- e)/σx *σy …….. (2)

y = a +bx …… (3)

To test for the significance of the seasonal and animal occurrence of the thunderstorm, student t" test was used.

$$t = r\sqrt{(n-2)}/\sqrt{(1-r^2)} \quad \text{(4)}$$

The results are presented in table and graphs

III. Discussion And Result

1. Diurnal Distribution of Thunderstorm

The diurnal distribution of thunderstorm over Port Harcourt is shown in table 1 and figure 2. The least occurrence was recorded between 0000 - 0300GMT hours with 532 peals, while the highest occurred in the late afternoon hours of 1500- 18000MT with 2544 peals.

The explanation of afternoon - evening types of diurnal thunderstorm over Port Harcourt is complex. Different researchers have proposed various mechanisms (Balogun, 1981; Oladipo and Mornu 1984). (1) Those based on thermo-dynamic process e.g. solar radiation that affects the static stability. (2) Those based on dynamic processes that influence the mass convergence within planetary boundary layers (3) Those based on semi-diurnal pressure wave (Wallace, 1975), and (4) those based on the role of radiation difference between organized Meso-Scale Cloud regions (Gray and Jacobson, 1975). So there is no single hypothesis that can be used to explain the afternoon - evening regime in Port Harcourt. Therefore, the afternoon-evening regime is as a result of multi-dynamic and circumstantial processes.

Table 1: Diurnal Thunderstorm Activity

Time	0000-0300	0300-0600	0600-0900	0900-1200	1200-1500	1500-1800	1800 2100	2100 000
TS	532	630	574	656	1990	2544	1613	695
%	5.8	6.8	6.2	7.1	21.6	27.6	17.5	7.5
Mean	17.7	21	19.1	21.9	66.3	84.8	53.8	23.2

The diurnal co-efficient of variation of thunderstorm (C.V), percentage and true mean were calculated. The result show that thunderstorm occurrence varies within hours. The highest variation occurred during 000-0300GMT hours. The least C.V was recorded during the 1500-1800GMT hours. This implies that thunderstorm is more likely to occur during the 1500- 1800GMT hours than 0000-0300GMT hour.Generally, the C.V of thunderstorm in Port Harcourt is low about 29.3%. This implies that thunderstorm will likely occur during the period, or hours of thunderstorm occurrence and the season (i.e. months).

The diurnal occurrence of thunderstorm over Port Harcourt is also shown in table 1. The afternoon-evening hours of 1200-21000MT accounted for 66.8% of the total thunderstorm during the study period. The mean thunderstorm occurrence is 307.8 peals approximately 308 peals of thunderstorm. However the true means from diurnal occurrence is 38.5 peals 39 peals of thunderstorm. The concept of true mean used in this work shows the true thunderstorm occurrence daily or monthly for season. Note true mean = total thunderstorm occurrence/duration of study * the hourly interval.

The thunderstorm for Port Harcourt for the 30 years understudy is 9,234peals. The hourly interval for diurnal occurrences is 8 (i.e. 24hrs / 3). The true mean = 9234/ (30*8) = 39 peals.

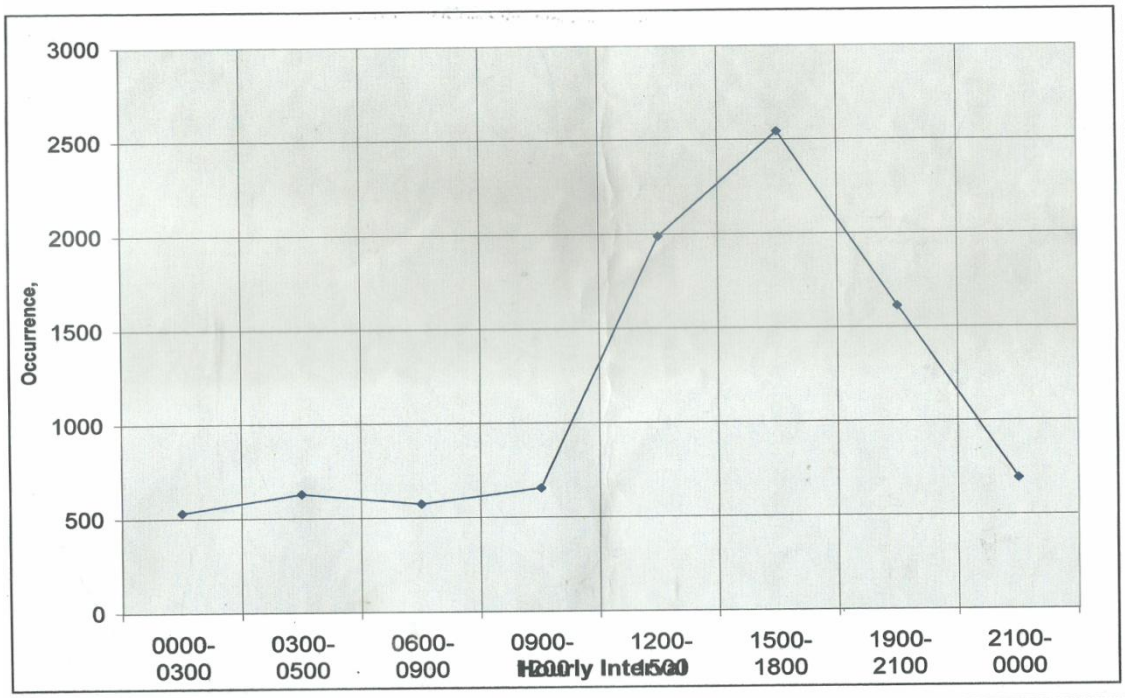

Figure 2: Diurnal Distribution of Thunderstorm over Port Harcourt.

IV. Seasonal Occurrence Of Thunderstorm

Figure 3 explained the seasonal occurrence of thunderstorm over Port Harcourt (1970 — 1999) from the graph it was observed that January had the least thunderstorm occurrence 93 peals. The month of May had the highest occurrence of 1247 peals; April came second with 1154 peals.

The thunderstorm has two regimes, the first March to June these accounted for 4375 peals representing 47.4% of the total thunderstorm in Port Harcourt. The second regime starts from September to November, accounting for 2648 peals representing 28% of thunderstorm occurrence in Port Harcourt. The two high thunderstorms (TS) regime accounted for 7024 peals representing 76.10% of the total TS occurrence.

There was a break in TS occurrence between July and August. The break in July precedes rainfall break in August. The wet season recorded higher TS occurrence during the study period. The reason for high TS occurrence during the wet season can be explained by the availability of moisture, sporadic wind and temperature changes during the period (i.e. wet season).

The seasonal variations of thunderstorm, mean, true mean and coefficient of variation (C.V) over the period of study were calculated. The C.V during the study period is 25.96% meaning that TS distribution is reliable. The variation is low. The mean TS is 769.5 peals (approximately 770 peals), the true mean is approximately 26 peals. The mean explain the monthly distribution as if it was just for a year. The true mean explains the monthly condition of TS for the 30 years of study.

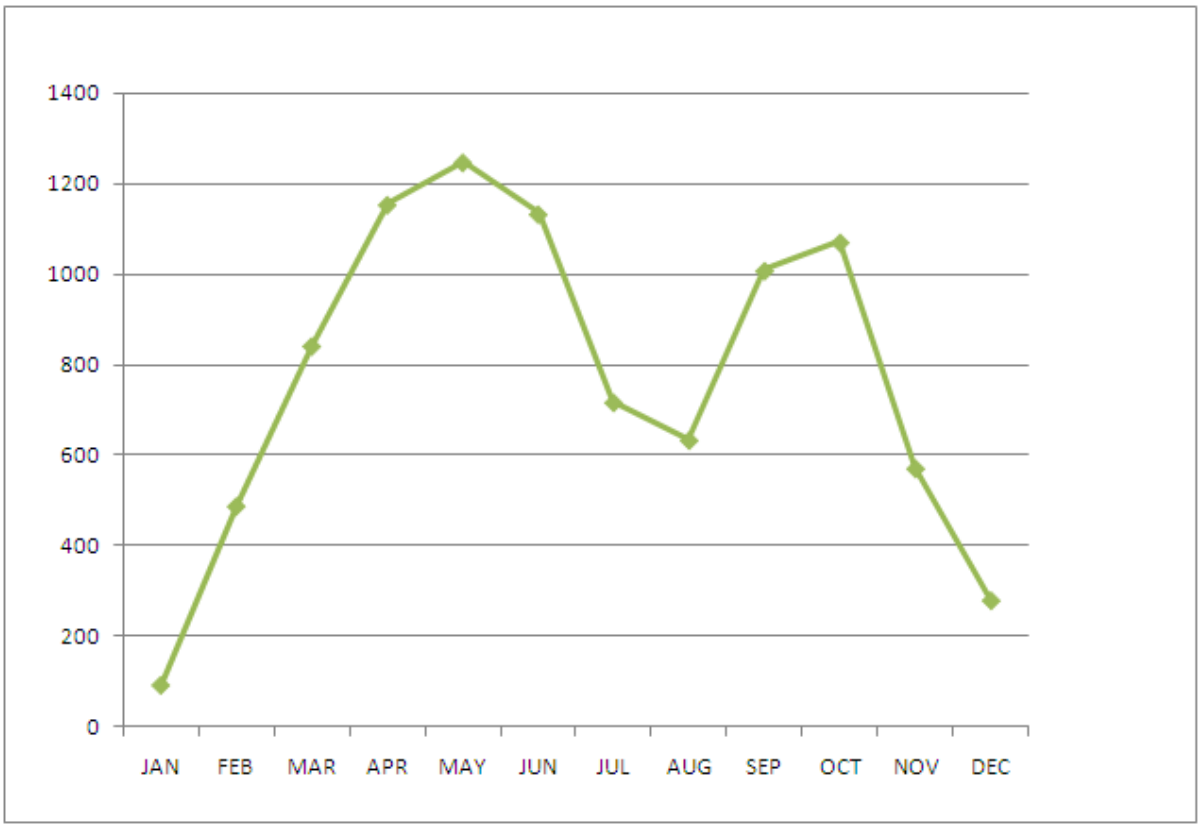

Figure 3: Seasonal Distribution of Thunderstorm over Port Harcourt.

V. Annual Distribution Of TS and Trend

The annual TS distribution is explained in table 2 and 3. The highest TS occurred in 1975 and the least occurred in 1999. Generally TS occurrence in Port Harcourt is high. The city proximity to the sea and the effect of the rain bearing south west trade wind is responsible to the high TS occurrence. The trend as shown in table 3 indicates that thunderstorm is decreasing over the years in Port Harcourt. The implication to agricultural activity, water resource management and marine transport is that rainfall tends to reduce over the years, because the amount of thunderstorm rainfall or rainfall generated by TS had decreased.

The result of trend analysis shows a negative or downward scope over the years. This implies that TS occurrence over Port Harcourt (P.H) decreases with time. The negative correlation coefficient shows that the relationship was not by chance. The negative scope is an indication of a linear tendency toward a general decrease in TS occurrence over the study period and thus a downward trend.

The decrease in TS could be as a result of a near static temperature in Port Harcourt. The near static temperature is as a result of "heat island effect."

Table 2: The Annual Variation of Thunderstorm.

Correlation	STD X	STD Y	Critical value	Coefficient determination	Students
Coefficient "r"			Value	r^2 x l00	"t" test
0.79	8.80	90.22	±2.05	62.4 = 62%	- 6.85

The result = -0.79, shows a negative relationship. This agrees with the descriptive statistics above. The "t" critical is > T-calculated (-6.85). This indicates a significant relationship between TS activity and time over Port Harcourt. The (-) points to a negative trend. The regression analysis is shown in table 3 below
The regression analysis points to the fact that TS decreases over years during the period of study 1970 - 1999 in Port Harcourt.

Figure 3: The Annual Trend of Thunderstorm.

Regression Coefficient	Regression equation	t-critical	t-calculated
- 8.4	Y =437.2 -	- 6.85	± 2.05

VI. Recommendation

To plan is to for see. Development depends absolutely on proper planning and management of resources.

This study shows a late-early evening diurnal peak in TS occurrences; it reveals that wet season accounted for more TS occurrence during the study period. The month of May recorded the highest TS, while January had the least TS occurrence. TS tend to decrease over the years. We also observe that TS characteristics show a double maxima one in May and the other September.

Based on the aforementioned information from the study, we suggest that planners and administrators should understand that thunderstorm influences rainfall greatly. Agriculturist, aviation industries, road users, marine transporters and road constructors should learn not to waste resources. Increase in TS point to increase in rainfall, therefore onset of planting should start from late March to late April. Road constructor should try to do more from late October - late March. Marine accident shall be avoided if volume of transports is reduced during TS peak hours and season.

Understanding of TS occurrences will help in harvesting rainfall effectively, since TS precedes rainfall occurrence. Finally Children should be discouraged from playing out door from 1500-1800 GMT hours especially in April, May and September to avoid TS strike.

VII. Conclusion

This study the Effect of TS activity over Port Harcourt for the period of 30 years shows that TS occurs all season, and months of the year. The annual trend shows that TS occurrence decreases over the years. The drop in TS occurrence is an indication thatrainfall in Port Harcourt will soon decrease.

TS shows a lateafternoon / evening diurnal peak occurrence around 1500-1800 hours. TS occur more duringwetseasonthan dry season. It wasobservedthat TS has a doubleseasonalpeak (double maxima)

The study of TS activity in Port Harcourt will help Administrators', Planners, and Policy Makers. Most of the State roads are in state of disrepairbecause of the time of construction. Farmersyield are poorbecause of undermining the onset of rainfall, end and duration of rainfall, whichcanbepredicted by studying TS activity.

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