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Rainfall And Relative Humidity Occurrence Patterns In Uyo Metropolis, Akwa Ibom State, South- South Nigeria.

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Abstract: - Study of rainfall and relative humidity occurrence patterns between 2003 and 2012 in Uyo metropolis, Akwa Ibom State has been carried out using data collected from the meteorology data station of the University of Uyo. A correlation coefficient of 0.9021 was obtained between rainfall and percentage of relative humidity. The relationship between rainfall and relative humidity was obtained as RH = 0.0337R + 73.7 being a regression equation for relative humidity on rainfall and R = 22.3180RH - 1552.19 for rainfall on relative humidity. There were heavy down pour of rainfall at certain periods of the year while there were low occurrences in others. In the same vein there were high percentage of relative humidity at certain period but low occurrence at other periods.

Key Words: - *Rainfall, Relative Humidity, weather, Precipitation*

I. INTRODUCTION

To determine the relationship between and among the atmospheric parameters has become a major concern of many meteorologist, climatologist, and physicists. This has achieved acceptance over the years as means of determining causes and effects in the atmosphere, thereby providing a hint on how to deal successfully with our environment.

Precipitation occurs most often in cyclones or tropical disturbances. In weather forecasting, several synoptic (weather maps) types of precipitation are warm front, warm moist air rising over a wedge of cold air undercutting and lifting, warmer air, convection caused by local updraft of moist air (Glossary of Meteorology, June 2000).The amount of moisture in air is also commonly reported as relative humidity, which is the percentage of the total water vapour air can hold at a particular air temperature. How much water vapour a parcel of air can contain before it becomes saturated (100% relative humidity) and forms into a cloud (a group of visible and tiny water and ice particles suspended above the earth's surface) depends on its temperature.

The overall state of the atmosphere on a time scale of minutes to months, with particular emphasis on those atmospheric phenomena that affect human activity is what is termed as the weather (Glossary of Meteorology, June 2000). Mark (2005) stated that weather is the state of the atmosphere and measured on a scale of hot or cold, wet or dry, calm or storm, clear or cloudy. Most weather phenomena occur in the troposphere just below the stratosphere. Weather refers, generally, to day-to-day temperature and precipitation activity, whereas climate is the term for the average atmospheric conditions over longer period of time. When used without qualification, "weather" is understood to be the weather of the Earth. Weather occurs due to density (temperature and moisture) differences between one place and another. Weather forecasting is the application of science and technology to predict the state of the atmosphere for a future time and a given location. The atmosphere is a chaotic system, so small changes to one part of the system can grow to have large effects on the system as a whole. Human attempts to control the weather have occurred throughout human history, and there is evidence that human activities such as agriculture and industry have inadvertently modified weather patterns (Mark, 2005).

On Earth, common weather phenomena include wind, cloud, rain, snow, fog and dust storms. Less common events include natural disasters such as tornadoes, hurricanes, typhoons and ice storms. Almost all familiar weather phenomena occur in the troposphere (the lower part of the atmosphere). Weather occurs primarily due to density (temperature and moisture) differences between one place and another. These differences can occur due to the sun angle at any particular spot, which varies by latitude from the tropics. In other words, the farther from the tropics you lie, the lower the sun angle is, which causes those locations to be cooler due to the indirect sunlight (Ahrens, 1982). Uneven solar heating (the formation of zones of temperature and moisture gradients, or frontogenesis) can also be due to the weather itself in the form of cloudiness and precipitation. Higher altitudes are cooler than lower attitudes, which is explained by the lapse rate. On locals scales, temperature differences can occur because different surfaces (such as oceans, forests, ice sheets, or man-made objects) have different physical characteristics such as reflectivity, roughness, or moisture content. It is difficult to accurately predict weather more than a few days in advance, though weather forecasters are continually working to extend this limit through the scientific study of weather, meteorology. Because of the sensitivity to small changes, it will never be possible to make perfect forecasts. Chaos theory says that the slightest variation in the motion of the ground can grow with time. Weather is one of the fundamental processes that shape the earth. The process of weathering breaks down rocks and soils into smaller fragments and then into their constituent substances (Ahrens, 1982).

Rain is liquid precipitation, as opposed to non liquid kinds of precipitation such as snow, hail and sleet. Rain requires the presence of a thick layer of the atmosphere to have temperature above the melting point of water near and above the Earth's surface. On Earth, it is the condensation of atmospheric water vapour into drops of water nearly enough to fall, often making it to the surface (Mark, 2005). Two processes, possibly acting together, can lead to air becoming saturated leading to rainfall. Cooling the air or adding water vapour to the air. Virga is precipitation that begins falling to the earth but evaporates before reaching the surface, it is one of the ways air can become saturated. Precipitation forms via collision with other rain drops or ice crystals within a cloud. Rain drops range in size from oblate, pancake – like shapes for larger drops, to small spheres for smaller drops. Moisture moving along three – dimensional zones of temperature and moisture contrasts known as weather fronts is the major method of rain production (Mark, 2005). Rain is the primary source of fresh water for most areas of the world, providing suitable conditions for diverse ecosystems, as well as water for hydroelectric power plants and crop irrigation. Rainfall is measured through the use of rain gauges. Rainfall amounts are estimated actively by weather radar and passively by weather satellites (Fulk, 1997).

Air contains water vapour and the amount of water in a given mass of dry air, known as the Mixing ratio, is measured in grams of water per kilogram of dry air (g/kg). The amount of moisture in air is also commonly reported as relative humidity. The shape of rain drops depend upon their size. Rain formation can occur when the freezing level is more than one or too hundred meters above the ground, where snow flakes formed will have time to melt into rain. This is common in the middle latitude (Beers, 1945). For convective precipitation, convective rain or shower precipitation occurs from convective clouds, e.g. cumulonimbus or cumulus congestus. It falls as showers with rapidly changing intensity. Convective precipitation falls over a certain area for a relatively short time, as convective clouds have limited horizontal event. Increasing temperature tend to increase evaporation which can lead to more precipitation. Precipitation generally increased over land north of 30^{o}N from 1900 through 2005 but has declined over the tropics since the 1970s. Globally there has been no statistically significant overall trend in precipitation over the past century, although trends have varied widely by region and over time. Precipitation especially rain, has a dramatic effect on agriculture. All plants need at least some water to survive, therefore rain (being the most effective means of weathering) is important to agriculture. Its effect on Global climatology, deserts, and also the westerlies is impactful.

Warmer air can contain more water vapour then cooler air before becoming saturated. Therefore, one way to saturate a parcel of air is to cool it. The dew point is the temperature to which a parcel must be cooled in order to become saturated (Glossary of Meteorology, 2000). There are four main mechanisms for cooling the air to its dew point namely adiabatic cooling, conductive cooling, radiation cooling, and evaporative cooling. Adiabatic cooling occurs when air rises and expands. The air can rise due to convection, large-scale atmospheric motions, or a physical barrier such as a mountain (orographic lift). Conductive cooling occurs when the air comes into contact with a cooler surface, usually by being blown from one surface to another, for example, from a liquid water surface to colder land. Radiational cooling occurs due to emission of infrared radiation, either by the air or by the surface underneath. Evaporative cooling occurs when moisture is added to the air through evaporation, which forces the air temperature to cool to its wet - bulb temperature, or until it reaches saturation (Mark, 2005). The main ways water vapour is added to the air are wind convergence into areas of upward motion, precipitation or virga falling from above, daytime heating evaporation water from the surface of oceans, water bodies or wet land, transpiration from plants, cool or dry air moving over warmer water, and lifting over mountains. Water vapour normally begins to condense, on condensation such nuclei adjust to ice and salt in order to form clouds. Relative humidity has its significance in climate control, that is, the control of temperature and relative humidity for human comfort, health and safety and for technical requirements of machines and processes, in buildings, vehicles and other enclosed spaces. Also, in comfort, humans are sensitive to humid air because the human body uses evaporative cooling as the primary mechanism to regulate temperature. Humans perceive the rate of heat transfer from the body rather than temperature itself, we feel warmer when the relative humidity is high than when it is low. When the temperature is high and the relative humidity is low, evaporation of water is rapid; soil dries, wet cloths hung on a line or rack dry quickly, and perspiration readily evaporates from the skin. Wooden furniture can shrink causing the paint that covers these surfaces to fracture. When the temperature is high and the relative humidity is high evaporation of water is slow. When relative humidity approaches 100 percent, condensation can occur on surfaces, leading to problems with mold, corrosion, decay and other moisture related deterioration. Certain production and technical processes and treatments in factories, laboratories, hospitals and other facilities require specific relative humidity levels to be maintained using humidifiers, dehumidifiers and associated control systems (Glossary of

Meteorology, 2000). The relative humidity of an air – water system is dependent not only on the temperature but also on the absolute pressure of the system of interest.

II. MATERIALS AND METHODS

The data for monthly rainfall and monthly relative humidity were collected from the meteorological data office of the University of Uyo, Akwa Ibom State, Nigeria. Relative humidity at this centre was measured using hygrometer while the amount of rainfall was measured using rain gauge. Regression and correlation analysis were used to determine the relationship between these two parameters. The data which covers the years 2003 – 2012 are shown in table 1 and 2.

III. RESULTS

Table 1: Monthly Rainfall data in Uyo Metropoli , Akwa Ibom State, Nigeria (2003 – 2012)

MONTH/ YEAR	JAN (mm)	FEB (mm)	MAR (mm)	APR (mm)	MAY (mm)	JUN (mm)	JUL (mm)	AUG (mm)	SEP (mm)	OCT (mm)	NOV (mm)	DEC (mm)
2003	17.5	Nil	113.4	120.8	195.2	237.5	345.9	326.6	151.7	314.1	81.2	Nil
2004	Nil	8.6	229.9	219.3	339.7	503.2	219.0	182.6	270.6	225.6	118.3	0.4
2005	Nil	10.8	135.1	261.4	312.4	255.8	205.0	347.0	320.0	414.85	70.1	9.0
2006	20	43.0	104.0	223.5	235.6	181.6	202.4	218.6	340.6	207.8	116.7	1.0
2007	2.1	57.0	24.2	165.8	218.1	368.8	357.1	288.9	362.3	280.9	79.4	22.0
2008	22.4	97.0	156.0	284.8	186.7	325.6	637.7	325.1	279.0	505.5	207.1	3.6
2009	3.7	60.8	277.8	296.7	370.8	592.7	419.3	360.5	566.8	374.9	49.6	Nil
2010	Nil	35.6	178.3	374.3	360.6	466.8	387.9	311.3	393.7	365.4	353.9	80.4
2011	42.0	Nil	134.1	338.8	493.7	418.1	141.3	552.6	201.7	234.1	79.8	61.4
2012	82.2	81.2	59.9	280.2	290.8	380.6	159.9	207.9	225.2	167.1	49.1	Nil
Mean	19.0	39.4	141.3	256.6	300.4	368.6	334.9	312.1	311.2	309.0	120.5	17.8
Min.	2.1	8.6	24.2	120.8	186.7	181.6	159.9	182.6	151.7	167.1	49.1	0.4
Max.	82.2	97.0	277.8	374.3	493.7	592.7	637.7	552.6	566.8	505.5	353.9	80.4

Source: Meteorology Office, University of Uyo, Akwa Ibom State, Nigeria

Table 2: Monthly Relative humidity data in Uyo Metropolis, Akwa Ibom State (2003 – 2012

MONTH/ YEAR	JAN (%)	FEB (%)	MAR (%)	APR (%)	MAY (%)	JUN (%)	JUL (%)	AUG (%)	SEP (%)	OCT (%)	NOV (%)	DEC (%)
2003	79.0	60.0	69.0	79.0	80.0	84.0	85.0	87.0	87.0	84.0	85.0	76.0
2004	76.0	74.0	82.0	83.0	81.0	80.0	85.0	87.0	86.0	84.0	82.0	78.0
2005	58.0	68.0	78.0	82.0	81.0	82.0	85.0	88.0	84.0	84.0	80.0	76.0
2006	71.0	78.0	78.0	80.0	84.0	87.0	84.0	85.0	86.0	77.0	75.0	69.0
2007	73.0	65.0	72.0	81.0	80.0	84.0	92.0	85.0	83.0	83.0	81.0	79.0
2008	63.0	80.0	83.0	81.0	87.0	82.0	90.0	88.0	85.0	86.0	83.0	83.0
2009	85.0	78.0	88.0	82.0	84.0	81.0	87.0	84.0	88.0	84.0	82.0	79.0
2010	54.0	79.0	78.0	83.0	81.0	85.0	84.0	86.0	86.0	84.0	85.0	85.0
2011	65.0	63.0	77.0	81.0	83.0	86.0	87.0	86.0	87.0	85.0	81.0	80.0
2012	80.0	80.0	79.0	85.0	78.0	85.0	87.0	89.0	85.0	82.0	79.0	80.0
Mean	70.4	72.5	77.9	81.7	81.9	83.6	86.6	86.5	85.7	83.3	81.3	78.5
Min.	54.0	60.0	69.0	79.0	78.0	80.0	84.0	84.0	83.0	77.0	75.0	69.0
Max.	85.0	80.0	83.0	85.0	87.0	87.0	92.0	89.0	88.0	86.0	85.0	85.0

Source: Meteorology Office, University of Uyo, Akwa Ibom State, Nigeria

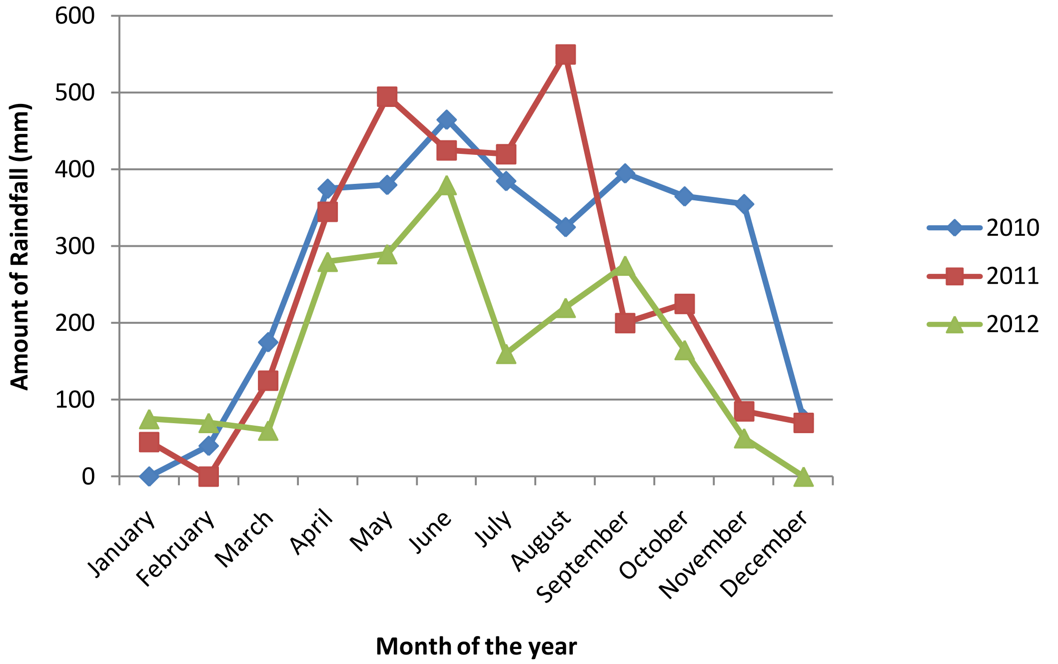

Fig. 1: Variation of rainfall occurence in 2010, 2011, 2012

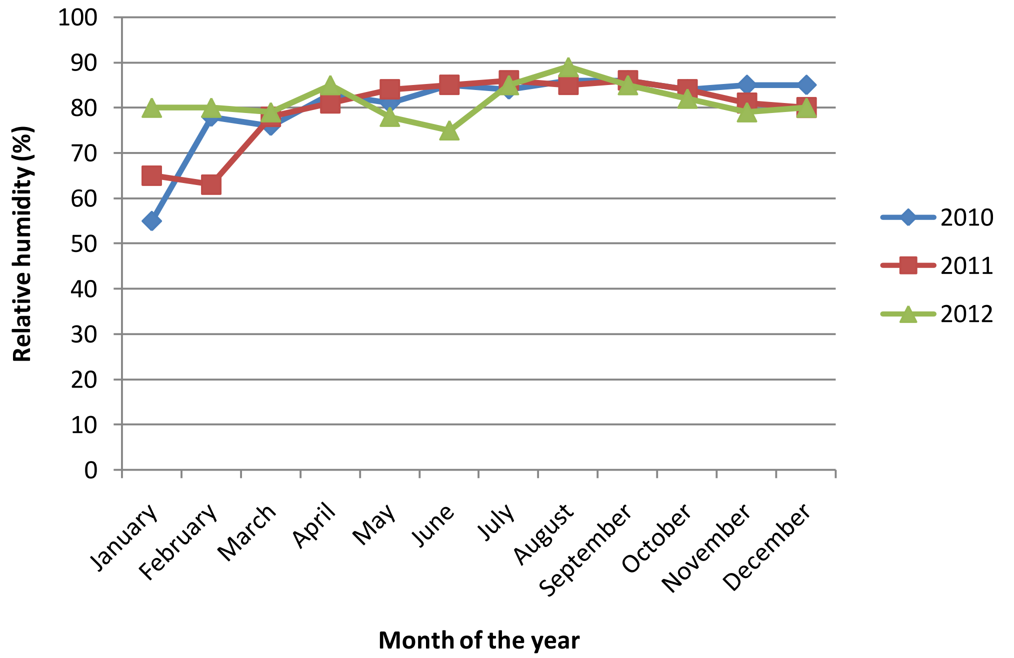

Fig. 2: Variation of relative humidity occurence in 2010, 2011, 2012

IV. DISCUSSION OF RESULTS

The data for the current study covers the period from 2003 to 2012. Composite plots of rainfall occurrence and relative humidity occurrence variation are shown in figures 1 and 2 respectively. The result has shown a high correlation coefficient of 0.9021 between rainfall and relatively humidity occurrence with this period. Furthermore the linear regression equation for relative humidity on rainfall was given as RH = 0.0337R

+ 73.7 and the linear regression equation for rainfall on relative humidity was given as R = 22.3180RH – 152.19, revealing a high direct linear relationship between them, indicating a positive correlation between the two parameter, rainfall and relative humidity in Uyo metropolis. In this study the periods of June solstice (May – July) and September equinox (August – October) recorded the high rainfall and March equinox (February – April) and December solstice (November – January) recorded low rainfall.

The study has further shown that relative humidity is an indicator or precursor to the occurrence of precipitation. Weather forecastings are carried out through having a food knowledge of atmospheric processes, leading to the understanding of the weather.

V. CONCLUSION

Instability in the weather condition of a location can lead to convective precipitation and non-convectional rainfall in that area, hence the need to study the atmospheric parameters, rainfall and relative humidity in the current study. The study has revealed periods of high and low downpours corresponding to positive correlations between the two parameters in Uyo.

Weather forecasts based on temperature and precipitation are important to agriculture, and therefore to commodity traders within the stock market, and hence the impact on the economy of a location.

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