

Relation between some metrological parameters in Ilorin, North Central Nigeria

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ABSTRACT

Relative humidity, temperature and atmospheric pressure measurements at Ilorin in North central Nigeria (Latitude 08.29°N and Longitude 04.32°E) for year 2004 were carried out and analyzed in terms of their diurnal variability with respect to the highest mean and lowest values of the parameters. The data were collected at a minute interval each day throughout the year under study. The result obtained showed the highest temperature, relative humidity and pressure of the year to be 39.28°C day 137, 108.7% day 300, and 979mm Hg day 155 respectively while the lowest values are 12.41°C day 22, 6.73% day 283 and 963mm Hg day 87 for temperature, relative humidity and pressure respectively. The diurnal plots showed a significant fluctuation from the beginning of the year to the 55th day of the year and an obvious pattern to the end of the year for the three parameters under study. The highest temperature occurs on may 17th, which marks the dry season while the highest relative humidity and pressure occurs on October 27th and June 4th respectively which are days within the rainy months. The lowest temperature was noticed on January 22nd this falls within the harmattan months while the lowest relative humidity and pressure were noticed on October 10th and March 28th which are months in the rainy and dry season respectively.

Keywords: Relative humidity, variability, temperature and pressure

INTRODUCTION

The study of some metrological parameters such as temperature, pressure and relative humidity play an important role in understanding the earth, its atmosphere, weather and climatic variation and the solar energy available on the earth surface. Relative humidity is the ratio of the actual vapour pressure of water in the air to that in air saturated with water vapour. Humidity is the amount of water vapour in air (Perry and Green 1997). Atmospheric water vapour is an important factor in weather forecast because it regulates air

temperature by absorbing thermal radiation from the sun and the earth. In addition, water vapour is the ultimate source of all form of condensation and precipitation. Water vapour enters the atmosphere primarily by evaporation of water from the earth's surface, both land and sea surface. The water vapour content of the atmosphere varies from place to place and from time to time because the humidity capacity of air is determined by temperature. The water vapour density or absolute humidity is given as

$$\rho_w = 216.7e/T \quad (1)$$

where T is absolute temperature in Kelvin and e is water vapour pressure in hpa. The relationship between water vapour pressure in equation (1) and relative humidity H is given as

$$e = He_s/100 \quad (2)$$

where

$$e_s = a \exp[bt/t+c] \quad (3)$$

e_s is saturation vapour pressure in hpa at temperature in centigrade and the coefficients $a = 6.1121$, $b = 17.502$ and $c = 240.97$ (valid between 20 to 50°C, with an accuracy of 0.2%) (CCIR, now ITU-R, 1992) Low temperatures, high relative humidity and increased water vapour pressure account for high values of water vapour density and water vapour content, (Willoughby et al; 2008).

The present study investigate some metrological parameters (relative humidity, temperature and pressure) at Ilorin north central Nigeria for the year 2004 with a view to obtaining information on their relationship and compare the value of these parameter to those ones obtained at Jimeta-yola by Zemba (2006) in northeastern part of the country and that obtained at Uturu by Chiemeka (2008) in the eastern part of the country.

MATERIALS AND MEASUREMENT PROCEDURE

Measurements of relative humidity, temperature and atmospheric pressure were carried out at University of Ilorin in the Department of Physics, North central Nigeria for the year, 2004. These data were obtained by a combined temperature, relative humidity and pressure sensor. The sensor contains a beta therm 100KA61 thermistor and a vaisala capacitive relative humidity sensor. The output signals from the sensor are converted from millivolts to their respective units. The instruments are connected to a data logger that record data for eleven days after which the data is downloaded to the computer for analysis. The instrument produces 1440 records daily. The measured data are subjected to quality control check for incorrect measurements.

RESULTS AND DISCUSSION

Figures 1, 2 and 3 show the diurnal plots of pressure, relative humidity and temperature respectively. The plots show a significant fluctuation from the beginning of the year to the 55th day of the year for the three parameters under study. This may be attributed to different seasons (dry and harmatan season) we

experience between January and February of each year in the country.

From the 55th day there is a rise in temperature and the relative humidity but a drop in atmospheric pressure to the 85th day of the year. This is the period when the rain has just started, the amount of rain obtained in this period is not enough to drop atmospheric temperature but it increases the amount of water vapour in the atmosphere and so the relative humidity. A gradual decrease in temperature is noticed from the 85th to the 200th day but during this period the relative humidity maintain a value close to saturation (100%) while the pressure increased steadily. This is attributed to the rainy season which increases the amount of water in the atmosphere to a saturation point and in addition increases the atmospheric pressure. An increase in temperature is noticed from the 200th day to 320th day while the relative humidity still maintain high value close to saturation but the pressure drops steadily. This is the period when the rain is at its peak, the increase in temperature despite the rain is due to the high atmospheric vapour that traps the temperature. From 320th day there is a gradual decrease of temperature and relative humidity but a rise in pressure to the rest of the year. This is the harmattan season when the dry intercontinental wind from the savanna blow to decrease the temperature and also reduce the water vapour of the atmosphere.

The mean monthly variations in relative humidity, temperature and atmospheric pressure for the months of February, March and July are as shown in Table 1

Table 1 shows that temperature relates inversely, to relative humidity and the atmospheric pressure in the months of February and July, while in March when the temperature is relatively high an average relative humidity and pressure is noticed. The month of July have the highest mean relative humidity of 90.4% this may be as a result of intense precipitation that blankets the atmosphere with excess and constant supply of water vapour. An average relative humidity of 55.0% is observed despite the relative high temperature in March this may be due to the dryness of the season that is known for its pronounced reduction in rainfall rates and low relative humidity. The month of February have the lowest relative humidity this may be as a result of dry harmattan that is characterized by a dust-laden northeasterly trade wind that traverses in a southwest direction from the Sahara into the west of Africa. This work was further related to similar work done in Adamawa State of Nigeria by zemba (2006) and that carried out in Abia State of Nigeria by Chiemeka (2008). A comparison of the relative humidity obtained by Chiemeka (2008), Zemba (2006) in Doubeli, Jimeta- Yola and that of table 1 show that there is a gradual increase of relative humidity in the harmattan season from the North (Adamawa) with mean relative humidity of 33 through the North Central (Ilorin) with 46.6 to the South (East) with 52. This could be attributed to the dust-laden Northesterly trade wind that traverses in a Southwest direction from the Sahara into the West African sub region which is dryer in the Northern part than in the southern part of the country. The dry months also reveal a gradual increase of relative humidity from the North to the South. The wet months show a general increase of relative humidity in the three regions with the highest at Ilorin. The high relative humidity at Ilorin during the wet season may be attributed to fact that the town may be at the peak of its rainy season than the rest two locations. Kiehl and Kelvin (1997) and oyediran et al (2001) in their work show the same pattern of relationship existing among different seasons. The relative humidity are low in harmattan season but increases in dry season, while in wet seasons they are close to saturation.



CONCLUSION

Measurements and analysis of relative humidity, temperature and atmospheric pressure were carried out at University of Ilorin in the Department of Physics, North Central Nigeria for the year, 2004. The readings were taken at a minute interval daily for the year. One important deduction is that daily average temperature varies inversely to that of the relative humidity (Figure 2 and 3). This is why during the rainy season when low temperature was recorded a high relative humidity was noticed while the pressure is proportional to the temperature (Figure 1 and 3). This was demonstrated during the dry season when one observed a rise in temperature and pressure concurrently. But during the rainy season the temperature drops and the pressure increases.

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Table 1: Mean monthly variations in relative humidity, temperature and atmospheric pressure.

Months	Mean Temperature (°c)	Mean Relative Humidity (%)	Mean Atmospheric Pressure (mmHg)
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January	26.3	49.2	969.5
February	28.2	46.6	970.1
March	28.7	55.0	968.9
April	27.2	77.4	969.1
May	26.1	84.6	971.0
June	24.7	87.9	973.4
July	23.9	90.4	972.4
August	23.7	89.5	973.0
September	24.7	90.6	971.9
October	25.4	87.3	971.1
November	26.1	77.2	970.6
December	26.2	62.4	970.3

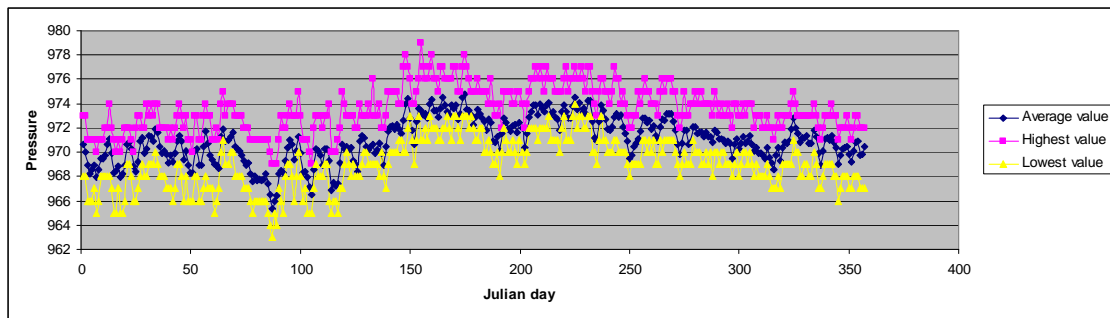


Fig 1: Mean diurnal plot of Pressure

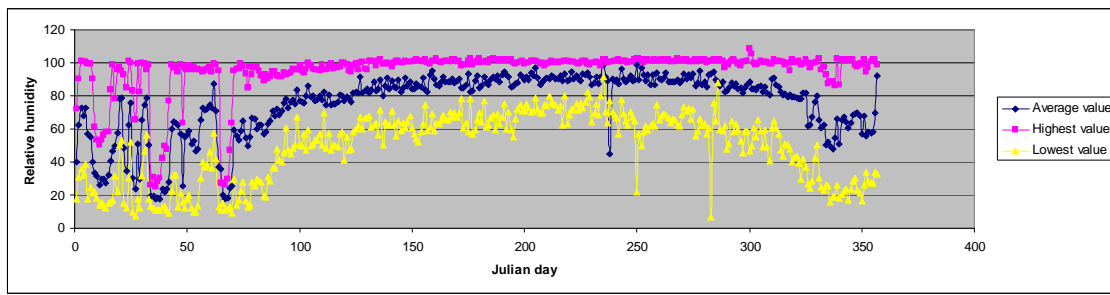


Fig 2: Mean diurnal plot of Relative humidity

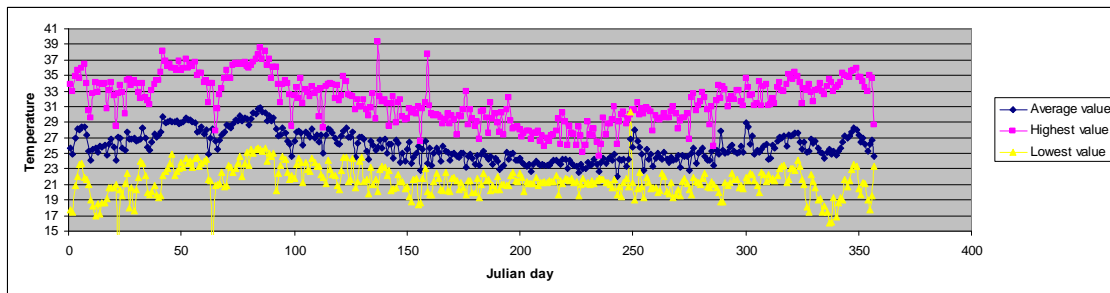


Fig 3: Mean diurnal plot of Temperature

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