SPATIO-TEMPORAL ANALYSIS OF HEAT INDEX IN THE OUTDOOR ENVIRONMENT IN UYO, AKWA IBOM STATE, NIGERIA

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https://doi.org/10.35410/IJAEB.2023.5826

ABSTRACT

The study analysed spatio-temporal analysis of heat index in the outdoor environment in Uyo, Akwa Ibom State, Nigeria. The study made use of meteorological data including minimum and maximum temperature, relative humidity, wind speed and solar radiation from 1985 to 2021 obtained from NiMet. Both descriptive and inferential statistics were used for the data analysis. Results showed that both minimum and maximum temperatures in Uyo increased with increasing time while the monthly mean minimum and maximum temperature decreased from January to December. The mean total heat index continued to rise at the rate of 0.13381 in Uyo. The mean total heat index increased at the rate of 0.1998 in the dry season and 0.0968 in the rainy season in Uyo. The study concluded that the air temperature and relative humidity in Uyo are increasing from 1985 to 2021 while solar radiation and wind speed are slightly decreasing. However, the heat index in Uyo was increasing from 1985 to 2021 and as a result the human comfort in the outdoor environment becomes a challenge. The study thus recommended that the menace of increasing heat index in Uyo should be critically looked at so that the human comfort can be improved. Also, afforestation programme should be encouraged to decrease the heat in the outdoor environment.

Keywords: Heat Index, Outdoor, Environment, Temperature, Relative Humidity, Afforestation.

1. INTRODUCTION

Temperature Humidity Index (THI) is a measure developed by Earl (1959), which has been in use since then. The index accounts for the combined effects of environmental temperature and relative humidity and is a useful and easy way to assess the risk of heat stress. It, however, has some limitations. It does not indicate the effect of other environmental conditions on thermal comfort. However, Epstein and Moran (2006) conducted a study on thermal comfort and heat stress indices. They reported that the level of risks corresponding to given heat stress were classified according to the THI values as follows (safe) 27°C (heat fatigue is possible with prolonged exposure to activity) 32°C (sunshine and heat exhaustion are possible with prolonged activity. Gawith, Doening and Karacostas, (1999) using the temperature humidity index (THI) and a THI threshold of 84, above which the majority of a mid-latitude population would feel discomfort, found for Thessaloniki that the frequency of hours of discomfort will increase markedly by 2050. Only a few years exceed 50 hours at present but over 100 years will exceed the THI 84 threshold by 2050. Eludoyin and Adelekan (2013) studied the spatial and temporal variations in thermal climate of Nigeria, using the values of the indices Effective Temperature (ET), Relative Strain Index (RSI) and Temperature–Humidity Index (THI). They estimated the values of these indices from the respective records of Temperature and relative humidity for each station, and for different period. However, the value of indices of thermal climate (THI) that is above or below threshold for comfortable was 15 – 24ºC. Therefore, heat was said to occur when THI is greater than 24ºC. Cold stress occurs with THI less than 15ºC.

The developing countries have been reported to be characterized by increasing population but relatively poor social infrastructural facilities to cope with extreme climate effects. While many studies have been carried out in temperate region and in developed countries, only a few studies have been done in many developing countries, including Nigeria (Abuloye, Nevo, Eludoyin, Popoola, and Awotoye, 2017). Molders, (2019) in his study, used data from 456 surface meteorological sites in Alaska, eastern Russia and northwest Canada for 1979-2017 (38years) to model hourly universal thermal comfort indices (UTCIs) under consideration of Alaska-appropriate clothing. The results served to determine a high-resolution climatology of thermal comfort levels for Alaska at various temporal and spatial scales as well as the frequency of thermal stress levels.

Few thermal comfort field studies were found in Nigeria and most of them were conducted in residential buildings and few in offices and in university hostel. The subjects used for the experiments were all adults and no young child was included in the experiments. From available records, the pioneers of thermal comfort studies in Nigeria are Ambler, H.R and Peel, M.C. Ambler, (1955) recorded information on the climate of Nigeria and observed the thermal comfort of male Europeans based in the country. Effective temperature was used as index to assess their thermal conditions. Result from the study showed that appreciable discomfort to the Europeans occurred when effective temperature was above 80ºF (22.6ºC). Peel investigated the physiological reactions of nursing students to their thermal environment in Kano, a hot climate. Result from the investigation conducted by Ambler indicated that a maximum comfort was achieved at the air temperature of 23.9ºC with 37% as the relative humidity.

Following the footsteps of these earlier researchers is Ojosu et al who conducted various thermal comfort research in the 80’s (Ojosu et al., 1988). Later researchers such as Odim (2008) conducted experimental studies of comfort levels of East-West and North-South solar orientation buildings in a warm and humid climate of Nigeria. The primary data obtained were the indoor air temperature and indoor relative humidity while the secondary data were the outdoor air temperature, outdoor relative humidity and, air velocity. Results showed that the comfort levels of the buildings did not confirm to comfort standards, despite their orientation. Ogbonna & Harris (2008) conducted a thermal comfort survey in a total of 29 naturally ventilated residential buildings as well as in three university classrooms, in the city of Jos, during the rainy season in July and August. The approach of the study was based on the theory of adaptive comfort which posits that physiological factors play equally-central roles in the perception and interpretation of thermal comfort. Results reported 26.27ºC as the neutral temperature of the subjects which closely tracked the average outdoor temperature of 26.3ºC. Jimoh & Demshakwa (2020) aimed to understand the concept of thermal sensation in order to establish neutral temperature for office users in Jos, Nigeria. The study was carried out in the month of May where the CO2 levels, wind velocity, operative temperature and humidity were recorded while the subjective data was collected from questionnaire administered to the participants. The study established a neutral temperature of 29.4ºC which is by 4.34ºC higher than that established by Ogbonna & Harris (2008) in similar locality (Jos). The author posited that the difference in the neutrality between these two surveys is likely as a result of the different buildings adopted in the surveys. Ojo & Lawal (2011) assessed the thermal performance of residential buildings that have different design characteristics in Ibadan, Nigeria a warm humid climate. The paper recommended that achieving the desired internal comfort for the occupants, requires adequate consideration to effective building architecture, with emphasis on window openings. Abiodun (2014) investigated thermal comfort and occupant behavior in a naturally ventilated hostel block in Ile-Ife, Nigeria, a warm humid climate zone. Results indicate that all the measured environmental parameters fell below the comfort range recommended by ASHRAE 55 and ISO 7730 standards. However, respondents were comfortable and preferred cooler environment and more air movement. Uzuegbunam (2011) concerned with the need to reduce the high consumption of fossil fuel energy did evaluate the effectiveness of passive ventilation of student's hostels in the hot-humid tropical environment of Eastern Nigeria. The study found significant correlation between design strategies and passive ventilation in the student's hostels of the study area.

Wodu, Nwagbara and Weli, (2020) examined the relationships between outdoor and indoor temperature characteristics in Yenagoa, Bayelsa State, Nigeria. It adopted the quasi experimental research design; as such data on meteorological parameters, such as, outdoor and indoor temperature were collected using thermometer and hygrometer, by the researcher in the study area and at designated locations in the metropolis, baring land-use in mind. The effective temperature equation was thereafter used to determine the effectiveness of the indoor temperatures, while the Pearson's product moment correlation coefficient was used to determine the relationships between the outdoor and indoor temperature characteristics. Results indicate that the relationships between indoor and outdoor temperatures were not positive all year round. At the dry periods, outdoor temperatures showed strong correlation with that of indoor at $p>0.05$, but at rainy season temperatures outdoor showed weak association with indoor temperature at $p>0.05$. This implies that the relationships between indoor and outdoor temperatures are, to a good extent, dependent on seasons. The heat index studies in the outdoor environment in the Niger Delta cities are few in the literature and therefore the present study is focusing at analyzing the spatial and temporal heat index in Uyo, Akwa Ibom State, Nigeria.

2.MATERIALS AND METHODS

The study was carried out in Uyo, Akwa Ibom State, Nigeria. The climate of the region is an equatorial type of climate. There are two distinct seasons in the region in a year, they are called rainy and dry seasons. The rainy season begins from the month of February and gradually rises to its peak in the month of July. The major vegetation in the study area comprises of mangrove and freshwater swamp. The region is located within the lower Delta Plain believed to have been formed during the Holocene of the quaternary period by the accumulation of sedimentary deposits. Generally, region is lowland with mean elevation of between 3m and 7m above mean sea level and characterized by flood plains. Umeuduji and Aisebeogun (1999) identified that the area is within the belt of beach ridge barrier complexes generally trending in an east-west direction with height which vary between 10-25m above sea level. The flood plain is a homo-

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ISSN: 2456-8643

climate geomorphic structure whose trends west ward and southwards' are broken in many places by small hogback ridges and shallow swamps basic. The soil of the sandy ridges are mostly sandy or sandy barns and supports crops like Coconut, oil palm, raffia palm and cocoyam. The major geological characteristic of the state is sedimentary alluvium. The region lies on the recent coastal plain of the eastern Niger Delta.

The study made use of meteorological data of the Nigerian Meteorological Agency (NiMeT) Port Harcourt International Airport, and the data included of air temperature, relative humidity, wind speed and solar radiation for 1985 to 2021. Also, meteorological data were obtained from Community Climate System Model which is available from https://gisclimatechange.ucar.edu/gis-data. They are in form of point grid pattern of meteorological data to validate the air temperature, relative humidity, wind speed and radiation of the unsampled points within the study area. Data were examined for spurious values and evidence of non-climatic heterogeneity and instrumental errors as advised by the World Meteorological Organization (1989). The formulae used for computation of THI have been found to be valid and generally accepted for use in Nigeria and the tropics (Eludoyin et al, 2014).

The THI was calculated with the empirical Equation:

$$THI = 0.8*T + RH*(T-14.4) + 46.4 \quad \text{.......................... Equ. 1}$$

Where T = ambient or dry-bulb temperature in °C.

RH=relative humidity expressed as a proportion i.e. 75% humidity is expressed as 0.75

An average monthly (THI) single value was derived by multiplying 0.8 with temperature value plus the total sum of relative humidity and temperature value divided by 100%. And for the average annual (THI), the monthly averages for (THI) values across twelve months were added and the total was divided by twelve months. **Mild** (68 to71 THI) **Moderate** (72 to 79 THI) **Severe** (80 to 89 THI). Descriptive and inferential statistics were used for the data analysis.

3.RESULTS AND DISCUSSIONS

Monthly and annual trends of air temperature, relative humidity, wind speed and radiation in Uyo

The analysis of monthly and annual average of maximum temperature in Uyo from 1985 to 2021 in Uyo is presented in Table 1 and this is 31.458 °C, and the analysis of variance on Table 2 showed that there was no significant variation in the monthly temperature in Uyo. Meanwhile in Table 3, the yearly variation of maximum temperature demonstrated a significant variation at $p<0.05$. It is observed in Table 4 that the monthly maximum temperature in Uyo was highest in February (34.36 °C) and lowest in July (29.02°C). The trend surface analysis of the monthly maximum temperature decreased at rate of 0.2616 °C from January to December with the 27.77% contribution to the variation across the months (Figure 1). The average yearly annual maximum temperature which is displayed in Figure 2 reveals that the temperature continued to increase from 1985 to 2021 which was the period considered for the study at the rate of 0.0151 °C. The percentage of contribution of the annual rate was 12.99% suggesting a low contribution to the variation in the annual maximum temperature over the years. In a different opinion, it is discovered that the trend of the annual minimum temperature for Uyo from 1985 to 2021 reveals

ISSN: 2456-8643

that a growing trend at the rate of 0.0222 °C and the percentage contribution to the variation of the change was 22.74%. The monthly minimum temperature for Uyo within the period considered for this study reveals that March had the highest and January had the lowest. The trend decreased at the rate of 0.0575 from January to December. The percentage contribution of the trend was 13.96%. The monthly and yearly minimum temperature had a mean value of 23.08°C.The monthly minimum temperature of Uyo was highest in March was 23.95 °C and the least was found in August with a mean value of 22.79 °C. The yearly minimum temperature as shown in Table 5 was significantly varied (F=20.996, p=0.000) while the monthly minimum temperature was not significantly varied (Table 5). The general monthly analysis of temperature in Uyo is displayed in Figure 2 whereby the trend was found to be decreasing from January to December at the rate of 0.1595 °C and the percentage of contribution to the variation across the month was 31.44%. The general yearly trend of temperature in Uyo was observed to be increasing at the rate of 0.0187 °C and the percentage of contribution is 27.88% (Figure 3). The descriptive statistics displayed in Table 6 shows that the total mean value of monthly and yearly temperature was 27.27 °C.

Table 1: Monthly and Annual Average of Maximum Temperature in Uyo from 1985 to 2021

	N	Minimum	Maximum	Mean	Std. Deviation
Monthly Average Temperature (°C)	12	28.82	34.36	31.4583	1.78990
Annual Average Temperature (°C)	37	30.57	32.61	31.4583	.45327

Table 2: Analysis of Variance for Monthly Maximum Temperature in Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.481	11	1.135	.304	.985
Within Groups	1610.228	432	3.727		
Total	1622.708	443			

Table 3: Yearly variation of Maximum Temperature

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1305.547	11	118.686	161.660	.000
Within Groups	317.161	432	.734		
Total	1622.708	443			

Table 4: Descriptive Statistics of Monthly Maximum Temperature in Uyo

Months	N	Minimum	Maximum	Mean	Std. Deviation
January	37	31.00	35.30	33.0351	1.04435
Feb	37	32.50	36.40	34.3622	.99732
March	37	31.80	36.80	33.3946	1.12248

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April	37	31.00	34.10	32.5865	.66255
May	37	30.00	33.30	31.6351	.70286
June	37	28.90	32.00	30.3189	.67034
July	37	27.40	30.30	29.0162	.69343
August	37	27.20	30.50	28.8243	.81697
September	37	28.50	32.00	29.5784	.68805
October	37	29.20	32.00	30.6135	.76673
November	37	30.40	34.40	31.8486	.90818
December	37	30.30	34.40	32.3027	1.02374

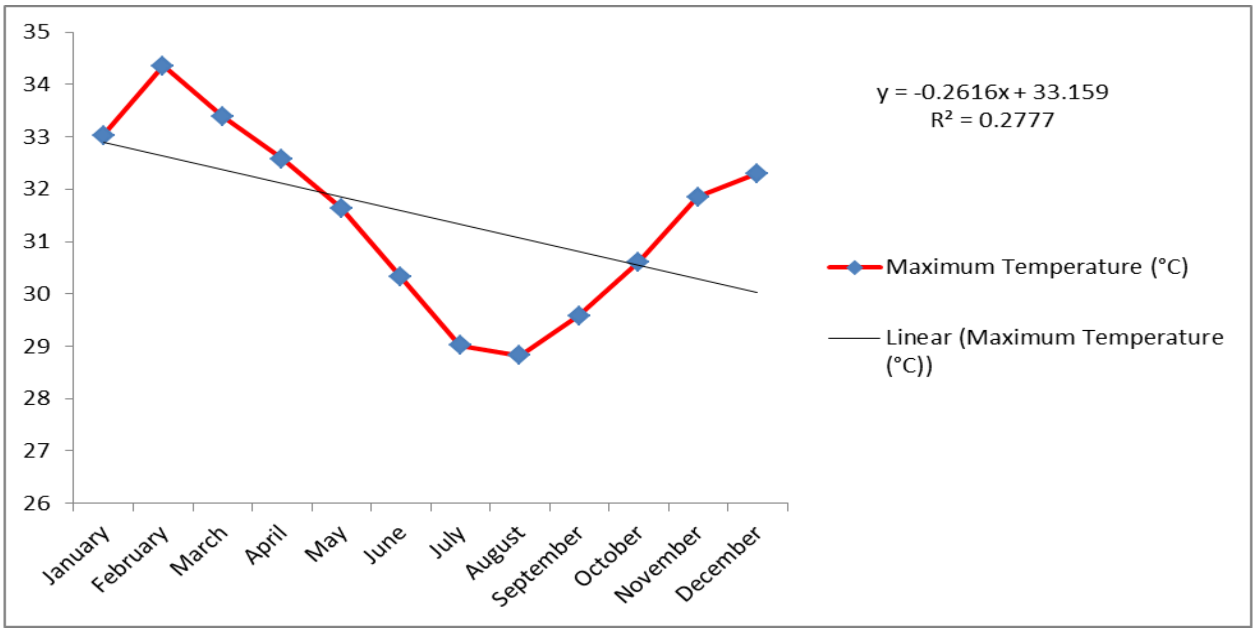

Figure 1: Average Monthly Maximum Temperature in Uyo

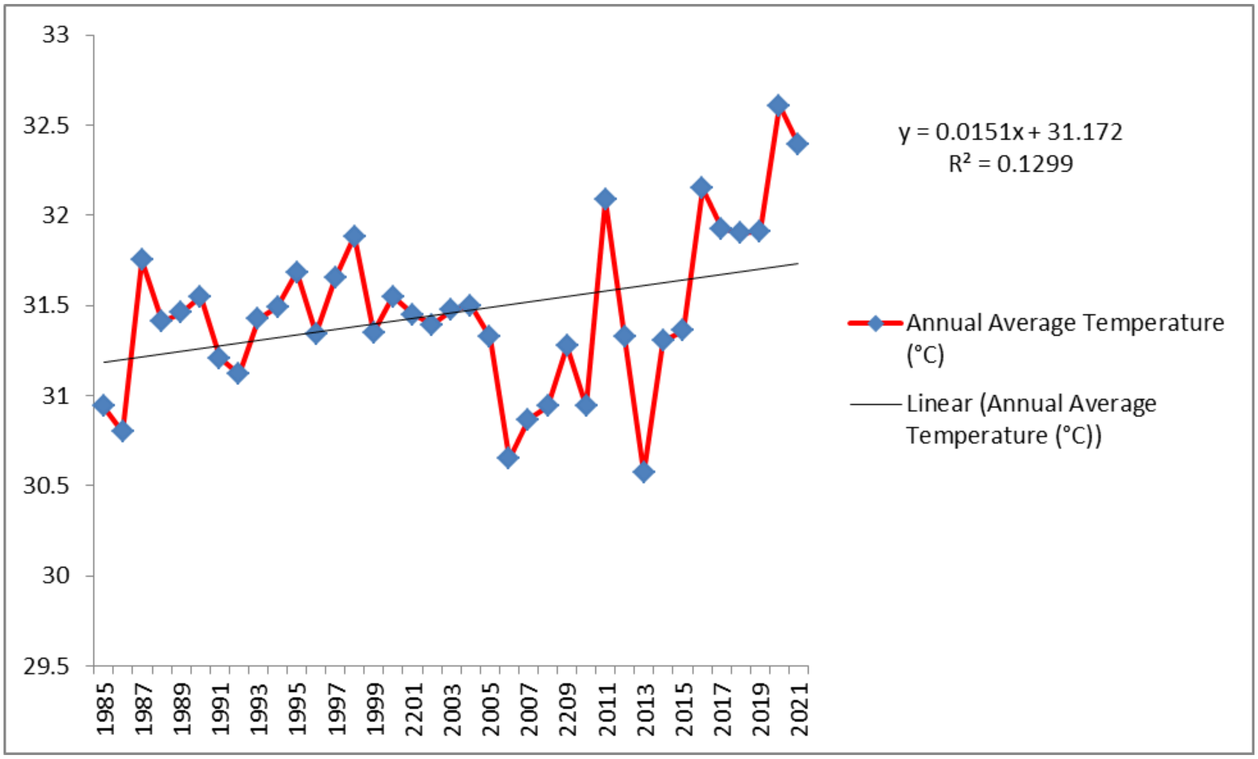

Figure 2: Average Annual Maximum Temperature in Uyo

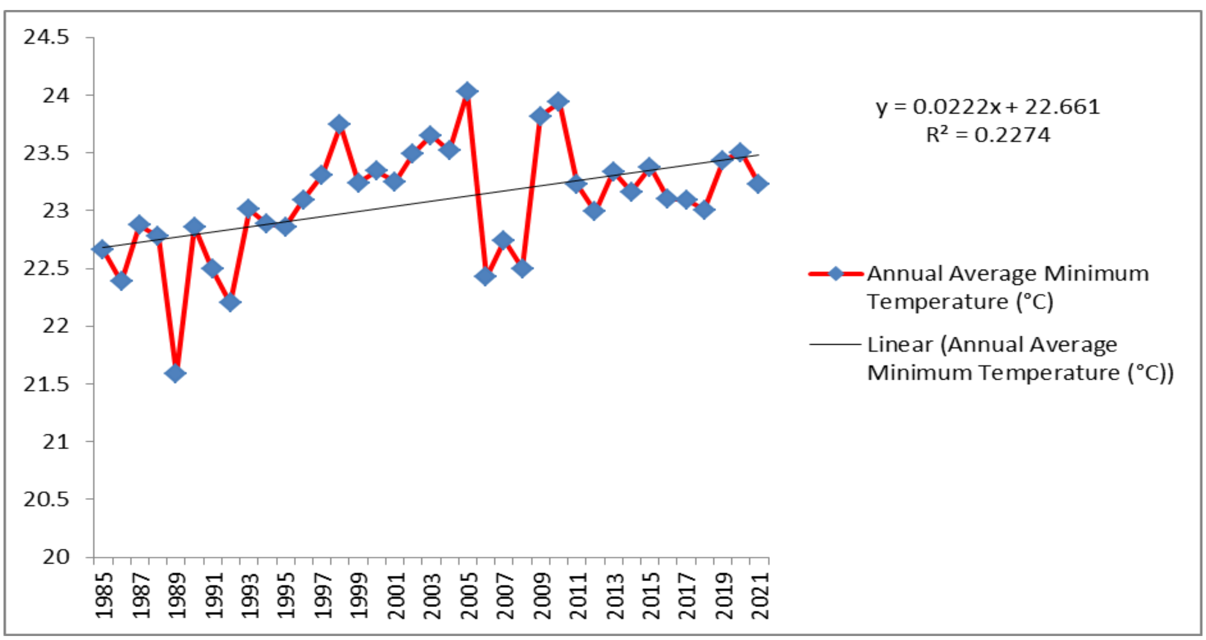

Figure 3: Annual Minimum Temperature for Uyo from 1985 to 2021

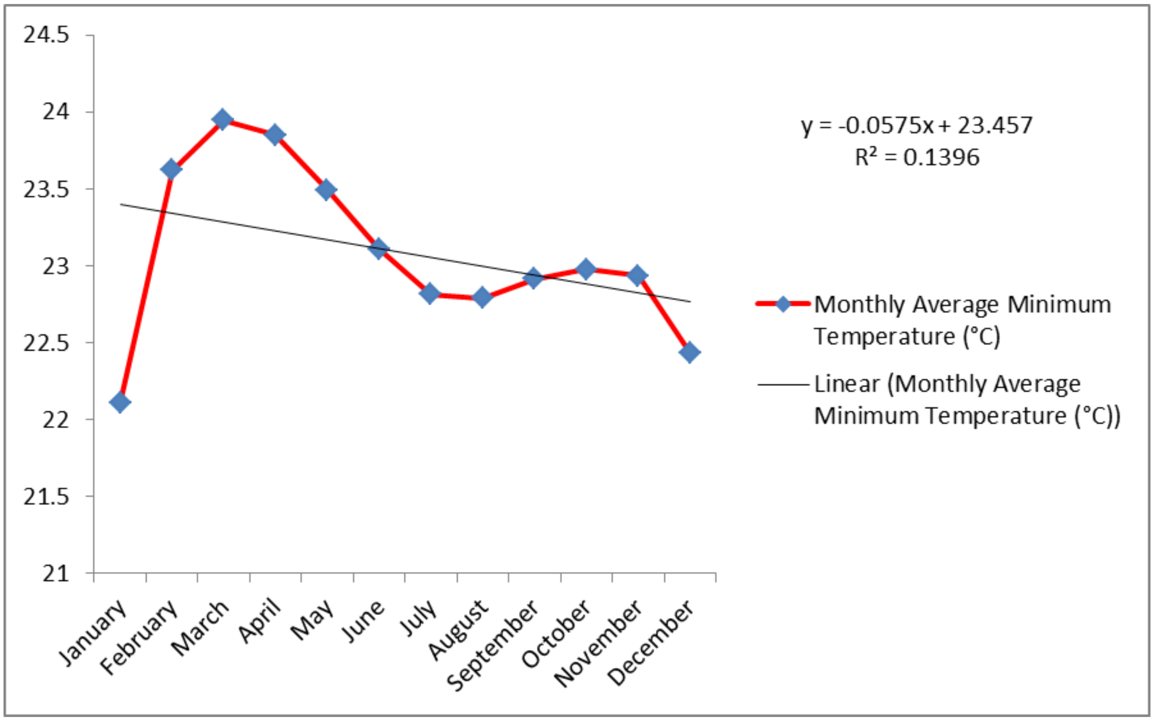

Figure 4: Monthly Minimum Temperature for Uyo from 1985 to 2021

Table 5: Descriptive Statistics of Monthly and Yearly Minimum Temperature in Uyo

	N	Minimum	Maximum	Mean	Std. Deviation
Monthly Average Minimum Temperature (°C)	12	22.11	23.95	23.0837	.55439
Annual Average Minimum Temperature (°C)	37	21.58	24.03	23.0837	.50457

Table 6: Descriptive Statistical Minimum Monthly Temperature of Uyo

Months	N	Minimum	Maximum	Mean	Std. Deviation
January	37	18.60	24.50	22.1108	1.36784
Feb	37	21.50	25.30	23.6243	.85680
March	37	22.50	25.40	23.9459	.61671
April	37	22.80	25.30	23.8541	.52631
May	37	22.20	24.70	23.4946	.55325
June	37	21.80	24.00	23.1081	.47222

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July	37	21.50	23.50	22.8216	.47676
August	37	21.50	23.20	22.7892	.39846
September	37	21.40	24.00	22.9135	.51810
October	37	21.70	27.00	22.9730	.87326
November	37	21.70	24.00	22.9324	.58073
December	37	20.30	24.20	22.4351	.98099

Table 7: Analysis of Variance of the Minimum Yearly Temperature in Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	125.256	11	11.387	20.996	.000
Within Groups	234.294	432	.542		
Total	359.550	443			

Table 8: Analysis of Variance of the Minimum Monthly Temperature in Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.351	11	.668	.820	.620
Within Groups	352.199	432	.815		
Total	359.550	443			

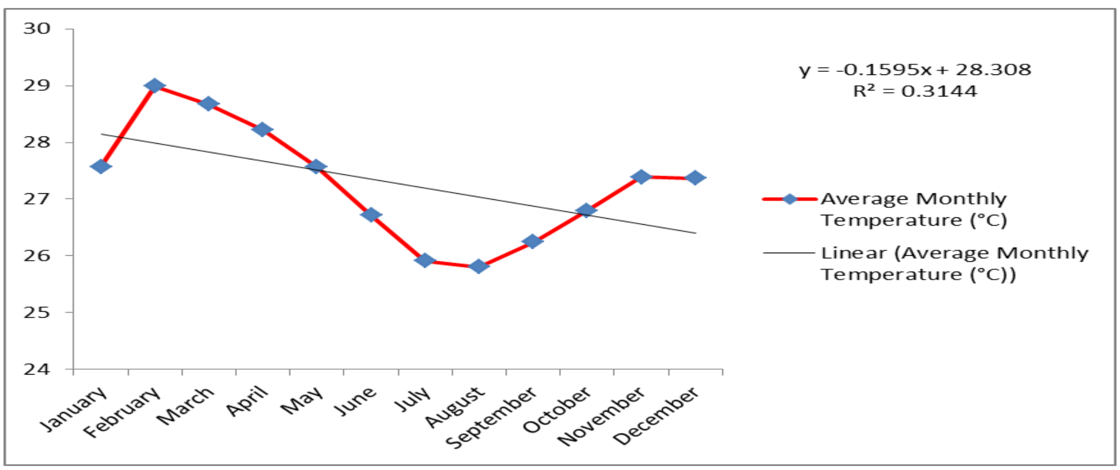

Figure 5: General Monthly Temperature in Uyo from 1985 to 2021

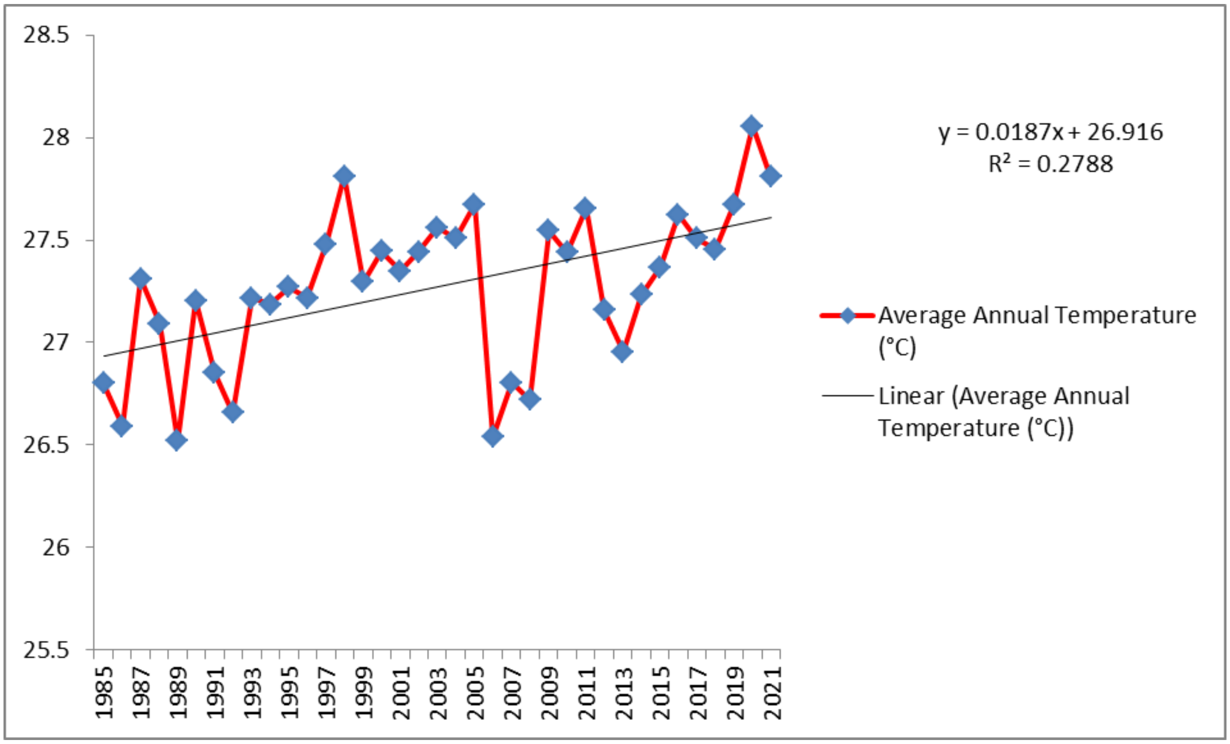

Figure 6: General Yearly Temperature in Uyo from 1985 to 2021

Table 9: General Monthly and Yearly Average Temperature in Uyo from 1985 to 2021

	N	Minimum	Maximum	Mean	Std. Deviation
All Monthly average temperature	12	25.81	28.99	27.2710	1.02576
All Yearly average temperature	37	26.52	28.05	27.2710	.38252

Considering the trend annual average relative humidity of Uyo from 1985 to 2021 in Figure 7, it is observed that the relative humidity has been increasing at the rate of 0.8663% and year has contributed 36.74% to the variation across the years. The trend of the monthly relative humidity was increasing slightly over the months at the rate of 1.05% (Figure 8). It is also observed that the relative humidity was higher in July, August and September as each of them had 80.4%, 85.37% and 86.46% respectively (Table 10) while the total mean relative humidity in Uyo was 74.62% (Table 11). The analysis of variance of yearly relative humidity in Uyo was significant (F=8.235; p=0.000) (Table 12). It is shown in Table 13 that monthly relative humidity of Uyo was not significantly different.

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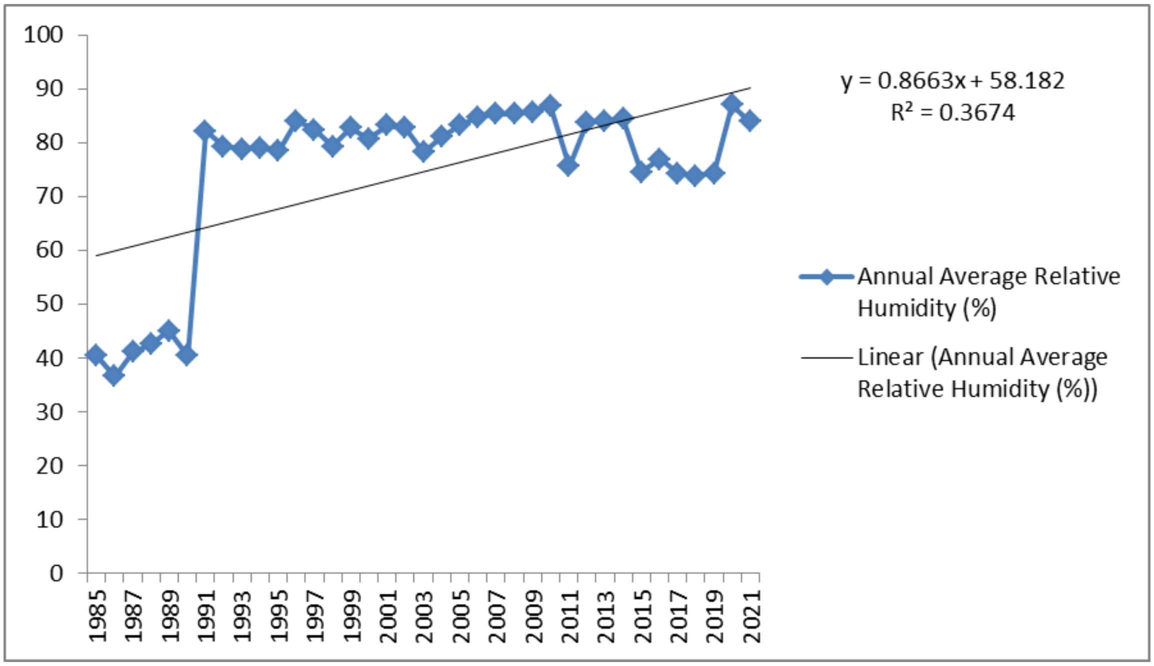

Figure 7: Average Annual Relative Humidity of Uyo from 1985 to 2021

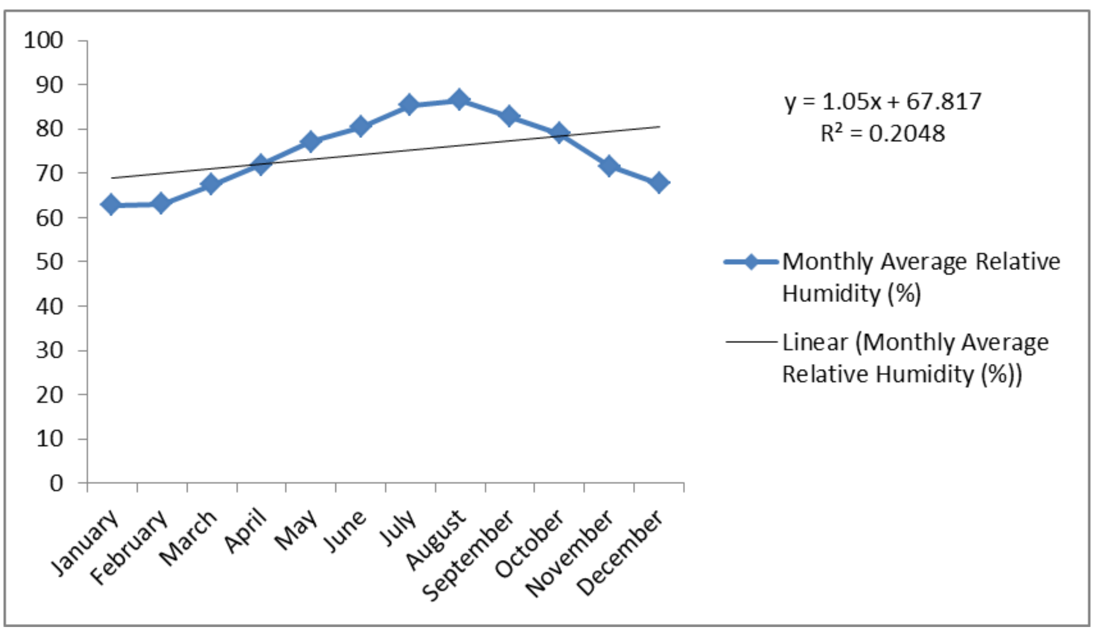

Figure 8: Monthly Average Relative Humidity

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Table 10: Descriptive Statistics of Relative Humidity from 1985 to 2021 in Uyo

	N	Minimum	Maximum	Mean	Std. Deviation
Annual Average Relative Humidity	37	36.58	87.05	74.6419	15.47177
Monthly Average Relative Humidity	12	62.75	86.46	74.6419	8.36518

Table 11: Descriptive Statistics of Monthly Relative Humidity in Uyo

Months	N	Minimum	Maximum	Mean	Std. Deviation
January	37	12.00	89.00	62.7297	22.84081
Feb	37	8.00	86.00	63.1081	23.94413
March	37	12.00	86.00	67.4595	24.38760
April	37	19.00	86.00	71.9189	19.51976
May	37	45.00	87.00	77.0270	12.77255
June	37	52.00	90.00	80.4324	11.03666
July	37	66.00	94.00	85.3784	7.40252
August	37	73.00	92.00	86.4595	4.71166
September	37	30.00	92.00	82.7838	11.00539
October	37	38.00	94.00	79.0270	13.41742
November	37	16.00	90.00	71.6486	23.04008
December	37	16.00	87.00	67.7297	22.60611

Table 12: Analysis of Variance of Yearly Relative Humidity of Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28502.331	11	2591.121	8.235	.000
Within Groups	135927.730	432	314.648		
Total	164430.061	443			

Table 13: Analysis of Variance of Monthly Relative Humidity of Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1737.845	11	157.986	.420	.947
Within Groups	162692.216	432	376.602		
Total	164430.061	443			

The trend analysis of wind speed of Uyo is displayed in Figure 9 whereby the trend line was observed increasing slightly from 1985 to 2021 at the rate of 0.0051 m/s. Similarly, the monthly average of wind speed from January to December can be observed in Figure 10 whereby the trend line was decreasing at the rate of 0.0338 m/s. The total mean of wind speed in Uyo was 2.2511 m/s which is considered slightly low (Table 14). Table 15 reveals that the monthly wind speed in Uyo was highest in February (2.5324 m/s) and lowest in November (2.0838 m/s). The yearly wind speed in Uyo was significantly varied across the years (Table 16) while there was no significant variation in the monthly wind speed (Table 17).

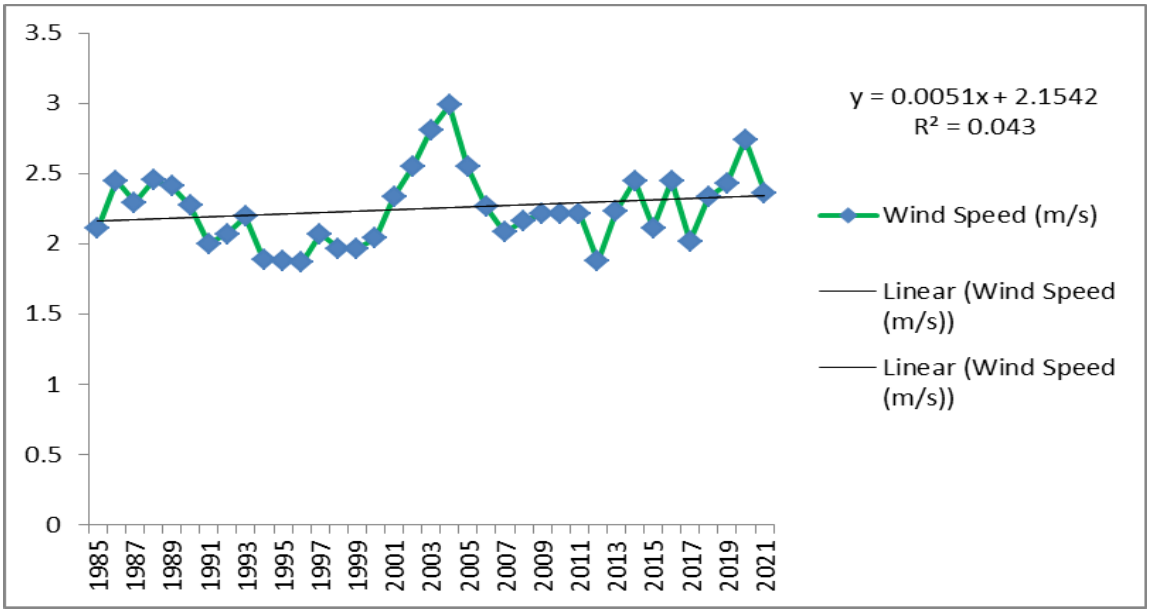

Figure 9: Annual Average Wind speed of Uyo from 1985 to 2021

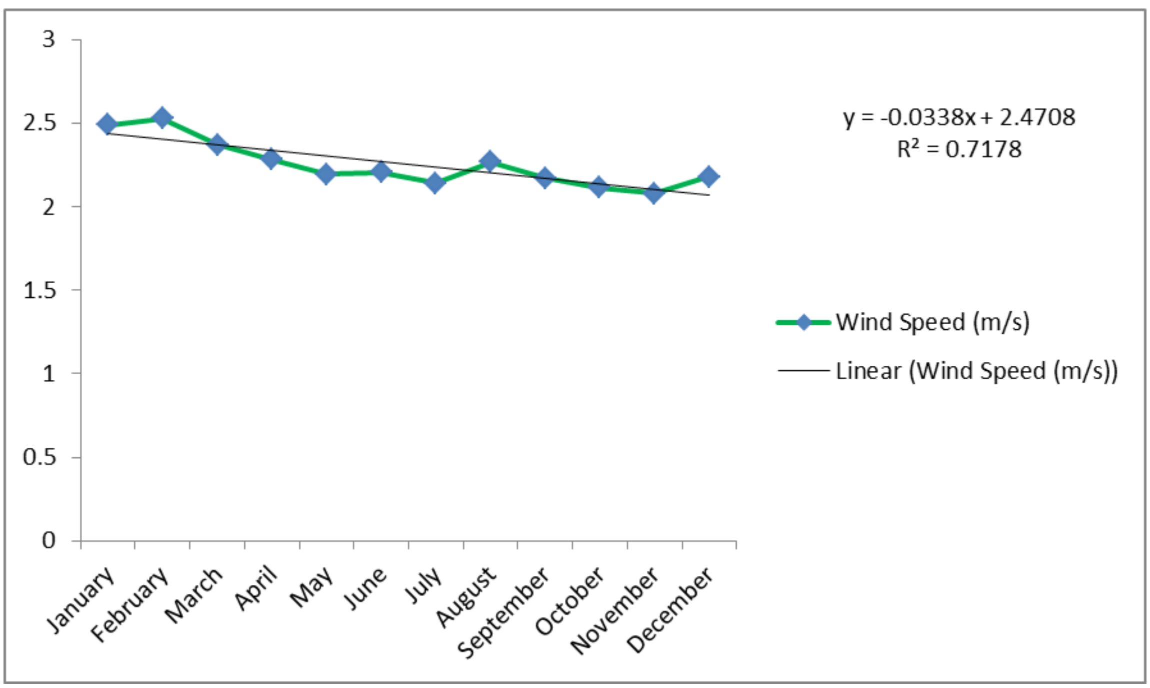

Figure 10: Monthly Average of Wind Speed from 1985 to 2021

Table 14: Descriptive Statistics of Wind Speed in Uyo

	N	Minimum	Maximum	Mean	Std. Deviation
Annual Average Wind Speed	37	1.86	2.99	2.2511	.26611
Monthly Average Wind Speed	12	2.08	2.53	2.2511	.14382

Table 15: Descriptive Statistics of Monthly Wind Speed in Uyo

Months	N	Minimum	Maximum	Mean	Std. Deviation
January	37	1.60	4.00	2.5000	.49329
Feb	37	1.70	3.50	2.5324	.38156
March	37	1.50	3.00	2.3730	.34290
April	37	1.80	3.30	2.2730	.39204
May	37	1.50	3.20	2.1892	.38498
June	37	1.50	3.00	2.1919	.41122
July	37	1.40	3.10	2.1459	.36712
August	37	1.60	3.20	2.2676	.38518
September	37	1.30	3.10	2.1757	.39187
October	37	1.60	2.90	2.1135	.29922
November	37	1.10	3.20	2.0838	.36781
December	37	1.40	3.20	2.1811	.42219

Table 16: Analysis of Variance of Yearly Wind Speed of Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.606	11	.782	5.166	.000
Within Groups	65.422	432	.151		
Total	74.028	443			

Table 17: Analysis of Variance of Monthly Wind Speed of Uyo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.907	11	.082	.487	.911
Within Groups	73.121	432	.169		
Total	74.028	443			

Concerning solar radiation in Uyo, it is observed that the trend analysis in Figure 4.31 that the annual solar radiation was decreasing at the rate of 0.0315 MJ/m2 with the highest being experienced in 1989.and the least around 2011 (Figure 11). Similarly, the monthly trend of solar radiation is observed to slightly decreasing at the rate of 0.246 MJ/m2 from January to December (Figure 12). The descriptive statistics revealed in Table 18 showed that February which was hottest had a mean value of 20.26 MJ/m2 and the least was found in July with a mean value of

15.02 MJ/m2. The analysis of variance of yearly solar radiation in Uyo from 1985 to 2021 was significant (F=103.26, p=0.000) (Table 19).

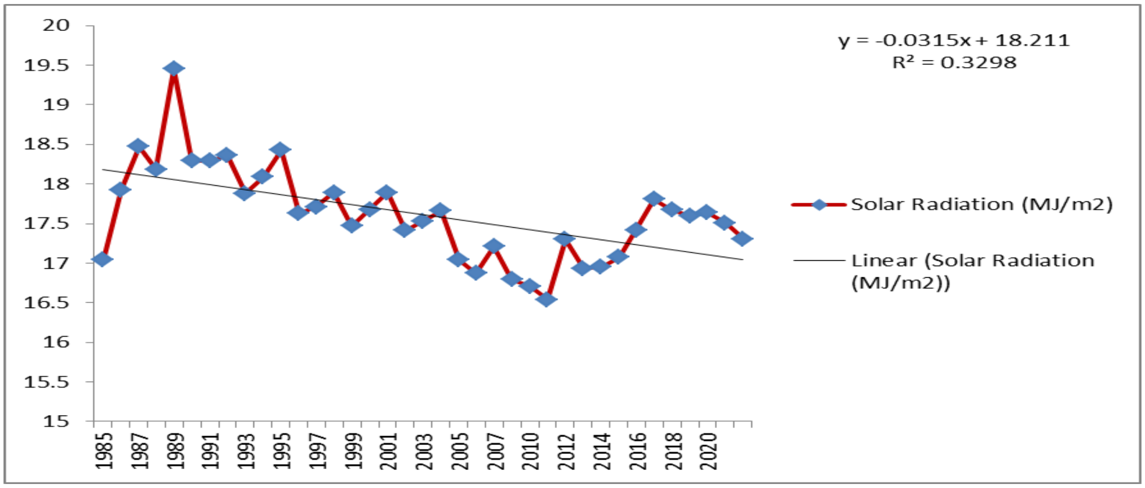

Figure 11: Annual Solar Radiation of Uyo from 1985 to 2021

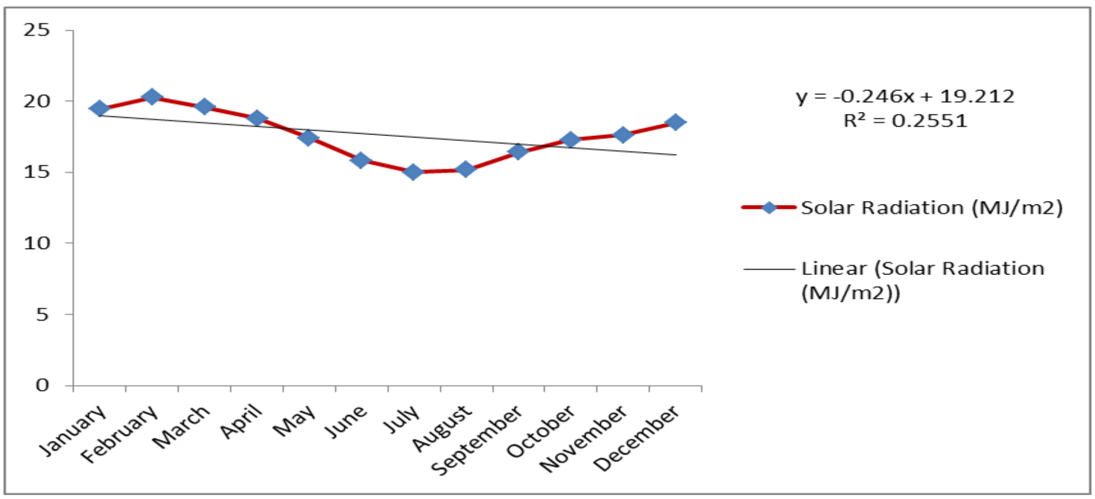

Figure 12: Monthly Solar Radiation of Uyo from 1985 to 2021

Table 18: Descriptive Statistics of Solar Radiation in Uyo

Months	N	Minimum	Maximum	Mean	Std. Deviation
January	37	16.80	22.50	19.4649	1.16027
Feb	37	18.10	23.00	20.2649	1.19541
March	37	17.90	23.10	19.5946	1.12619
April	37	17.40	20.20	18.7919	.78435
May	37	15.70	19.10	17.4027	.96249
June	37	14.00	17.90	15.8432	1.22373
July	37	12.60	17.00	15.0243	1.18566

August	37	13.40	17.10	15.1757	.86904
September	37	14.70	18.10	16.4243	.82610
October	37	16.10	18.30	17.2649	.44735
November	37	15.50	21.30	17.6270	1.12068
December	37	16.40	22.70	18.4622	1.35981

Table 19: Analysis of Variance of Yearly Solar Radiation in Uyo from 1985 to 2021

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1252.515	11	113.865	103.269	.000
Within Groups	476.324	432	1.103		
Total	1728.839	443			

Table 20: Analysis of Variance of Monthly Solar Radiation in Uyo from 1985 to 2021

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.061	11	.551	.138	1.000
Within Groups	1722.778	432	3.988		
Total	1728.839	443			

Heat Index in Uyo from 1985 to 2021

It is also revealed that the trend of total heat index of Uyo from 1985 to 2021 was increasing at the rate of 0.1381°C and the time contributed 44.96% to the variation of heat index in Uyo (Figure 13). The analysis on Table 21 indicated that the THI in Uyo was 78 from 1985 to 2021. In Uyo, the THI was 77.88 during the dry season and 77.75 during the rainy season. With this analysis, it is shown that the THI was higher during the dry season than the rainy season. However, there was a significant variation in the THI between the dry and rainy seasons in Uyo at $p<0.05$ ($t=3.542$, $p=0.001$).

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ISSN: 2456-8643

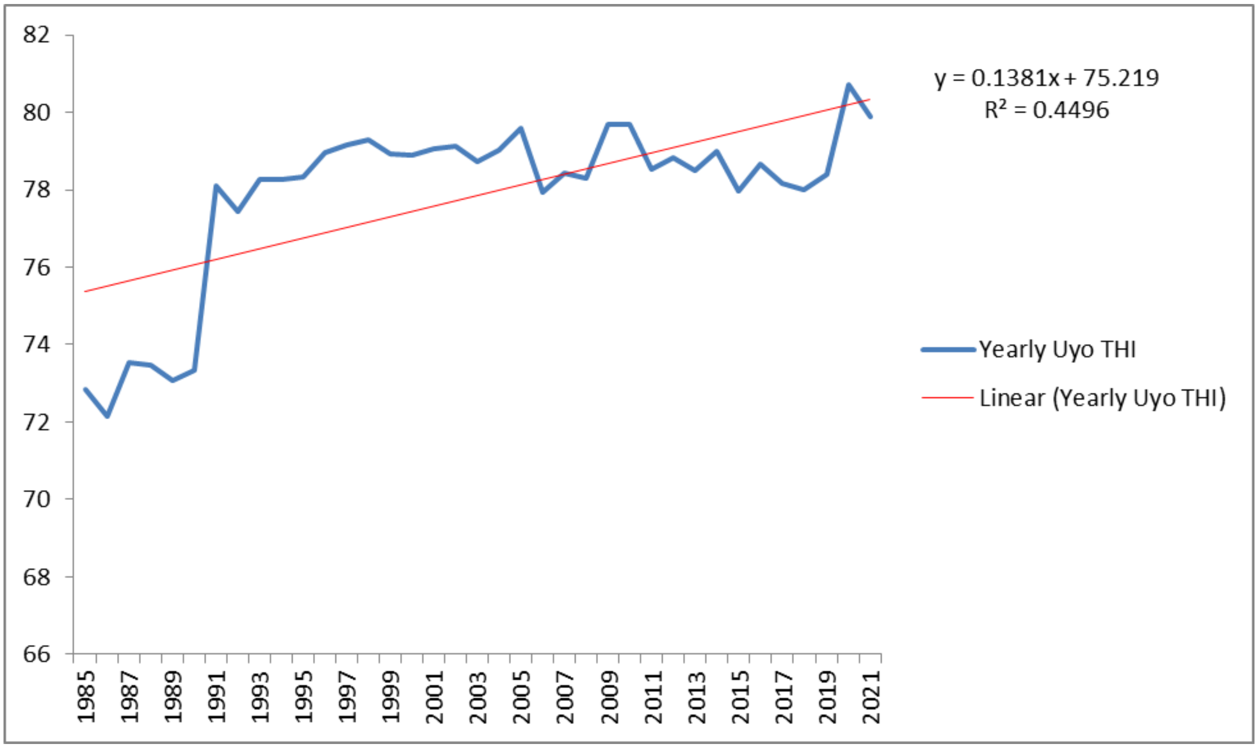

Figure 13: Total Heat Index of Uyo from 1985 to 2021

Table 21: Annual Variation of Heat Index and Descriptive Statistics of THI in Uyo

Location	N	Minimum	Maximum	Mean	Std. Deviation
Annual THI Uyo	37	72.13	80.72	77.8436	2.23021
Dry	37	69.94	81.94	77.8834	3.33590
Rain	37	73.54	79.82	77.7475	1.54062

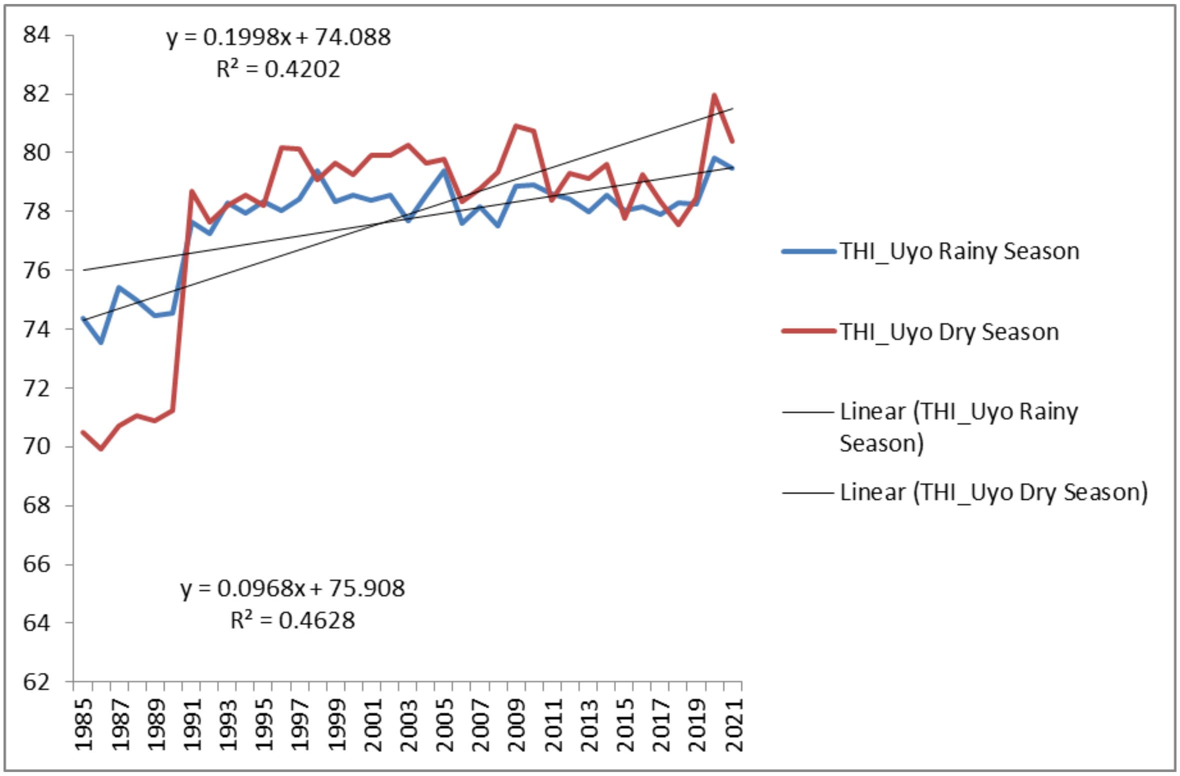

Figure 14: Total Heat Index of Uyo in the dry and rainy seasons from 1985 to 2021

4.CONCLUSION AND RECOMMENDATIONS

The study concluded that the air temperature and relative humidity in Uyo are increasing from 1985 to 2021 while solar radiation and wind speed are slightly decreasing. However, the heat index in Uyo was increasing from 1985 to 2021 and as a result the human comfort in the outdoor environment becomes a challenge. The study thus recommended that the menace of increasing heat index in Uyo should be critically looked at so that the human comfort can be improved. Also, afforestation programme should be encouraged to decrease the heat in the outdoor environment.

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