MAXIMUM AND MINIMUM TEMPERATURE TREND IN UMUDIKE

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EZERE, U. A, UGWU, J.U, NWOKOMA, E.U
ezere.uchechi@mouau.edu.ng, ugwu.joshuaudoka@mouau.edu.ng,
nwokoma.esomchi@mouau.edu.ng
Department of Physics, Michael Okpara University of Agriculture Umudike.

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Abstract: Temperature variability and trend have been a serious climatic challenge across the globe. Since temperature is one of the fundamental factor of climate change, its study and trend cannot be ignored to ascertain the degrees of climate change. Five years temperature data (2016-2020) of maximum and minimum temperature were collected from the Meteorological unit of the National Root Crop Research Institute (NRCRI) for this study and analysed using standard statistical procedures in minitab software, to elucidate the trend of maximum and minimum temperature. The annual average, monthly average and seasonal categories were deduced. The result obtained from maximum temperature gives a positive trend equation, $Y_t = 31.875 + 0.00629_t$,which suggests that maximum temperature of Umudike tends to increase over time. While negative coefficients were obtained for minimum temperature gives $Y_t = 24.282 - 0.03406_t$. These results imply that global warming is also a challenge in the region of study.

Key words: maximum and minimum temperature, climate variability, trend.

Introduction

The concept of climate change has become of great importance over the past years due to increase in extreme events of flood, drought and erosion. Global warming which is due to climate change has become a well known fact in the globe (Ahrens 2006). Temperature is one of the commonest parameter that indicates climate change (Amadi 2014). Since temperature is one of the fundamental factor of climate change, its study and trend cannot be ignored to ascertain the degrees of climate change. The study of these events is of importance to understand so as to limit its damages. These extreme events will definitely increase in future (Solomon et al., 2007).

Surface temperature of earth has increased by 0.74 ± 0.18℃ during the last 100years (IPCC, 2007) though at varying locations. Nigeria is experiencing a rise in air temperature (Orisakwe 2017). Study on surface temperature over Ibadan was found to be on the increase, maximum temperature was not statistically significant compared to minimum temperature (Ogolo & Adeyemi 2009; Jackson et al.,2012) in other words, minimum temperature is the prime factor for temperature increase for Ibadan and also in Abuja (Orisakwe 2017). On the other hand, Ajiere and Nwaerema (2020) from study noted that Imo is influenced more by maximum temperature with decadal range of years 1987-1996 as 31.74°c, 1997-2006 as 32.45°c and 2007-2016 as 32.47°c and decrease in minimum temperature compared to other southeast.

There have been occurrence of surface warming over land which has been linked with relatively greater increase in daily minimum temperatures than in maximum temperatures over 50 years, (Karl et al., 1993; Easterling et al., 1997; New et al., 2000), though both minimum and maximum temperature show significant increases. This led to decreases in average diurnal temperature range (DTR) in the observed area over land during these years. Since the trend in temperature can be due to either maximum or maximum changes, changes in daily maximum and minimum temperatures are more useful indicators of climate variability than mean surface temperature.

Some studies showed that temperature rise resulted from daily minimum increase at faster rate or decrease at slower rate than daily maximum temperature which leads to decrease in Diurnal Temperature Rise (DTR) for some parts of the world (Karl., 1993).

The current pattern of temperature in Umudike, Abia state has been a source of concern to the inhabitants. Therefore, this study seeks to examine the maximum and minimum trend of temperature in Umudike, Abia state with the view to ascertain the feasibility of government's effort toward improved climate condition and also, agriculture to enhance food security in the state.

Study Area

The study area Umudike is a town in Abia state, Nigeria. It is about 11 kilometers Southeast of Umuahia, the state capital. It is located on the latitude 5°28'19.79"N and longitude 7°32'33.59"E. its humidity is close to 57%. Umudike is characterized by two seasons: The rainy season is from April to October, while the dry season begins from October through February. Although with climate change, there exist variation in values in the months presently Methodology

Method

The temperature data for this study was gotten from the National Root Crop Research Institute (N.R.C.R.I) Umudike. Five years temperature data (2016-2020) of maximum and minimum temperature was collected from the Meteorological unit of the National Root Crop Research Institute (NRCRI) for this study and its annual average, Monthly average and seasonal categories were deduced.

In the trend analysis, the least square method is used for the estimation of the trend equation. The least square equation is defined as follows:

$$Y_t = \hat{a} + \hat{b}_t \quad (1)$$

where

$$\hat{b} = \frac{n\sum ty - \sum t \sum y}{n\sum t^2 - (\sum t)^2} \quad (2)$$

And

$$\hat{a} = \bar{y} - b\bar{t} \quad (3)$$

Thus Y_t is the estimated trend value for a given time period (dependent variable)
a = the intercept that is the trend line when t=0
b = the slope of the trend line, that is, change in Y_t per unit of time (coefficient of independent variable, time)
t = the time unit (independent variable)
Using Minitab Software version 16.0, the trend analysis generating the plot and the equation was done. The fitted trend values as shown in the graph were equally obtained. From the analysis the trend equation was obtained as $Y_t = 31.875 + 0.00629_t$.

Data Analysis

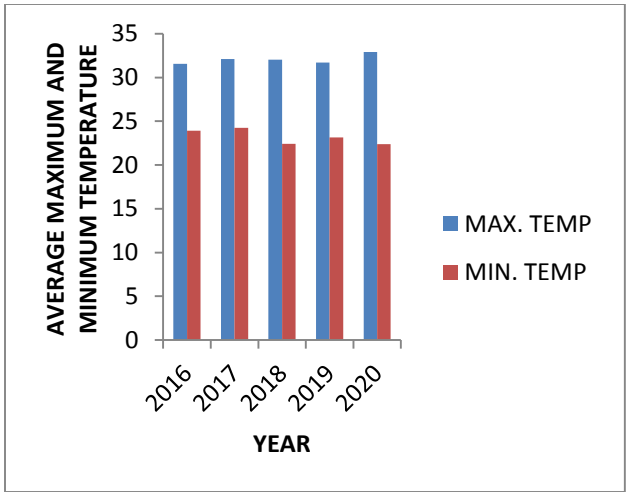

Fig 1. Bar chart representation of Average Annual Maximum and Minimum Temperature From 2016 – 2020

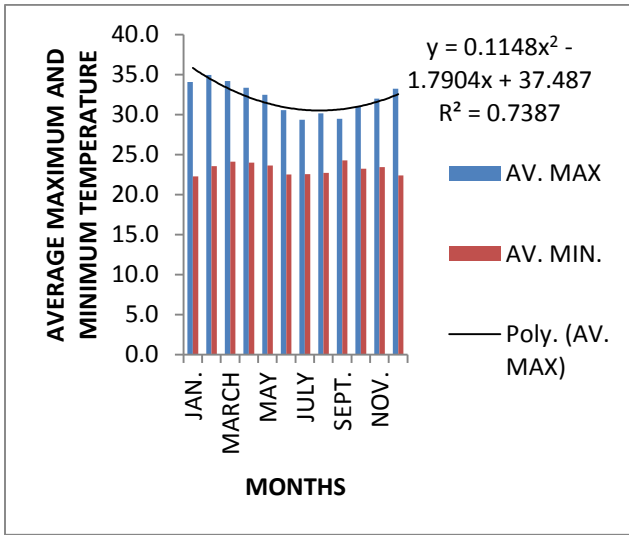

Fig 2. Average monthly maximum and minimum temperature (2016 – 2020)

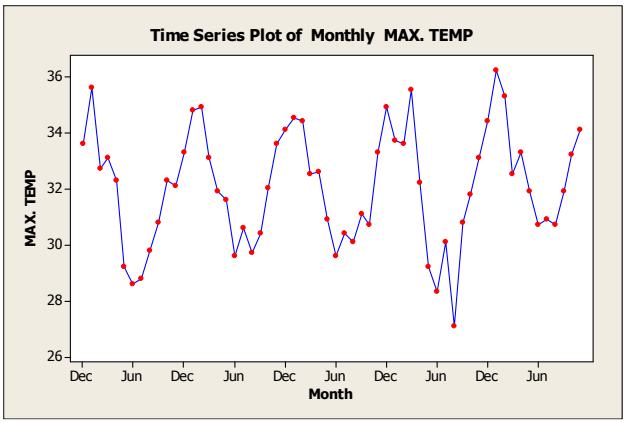

Fig. 3 Time series plot of monthly Maximum Temperature recorded from 2016 - 2020

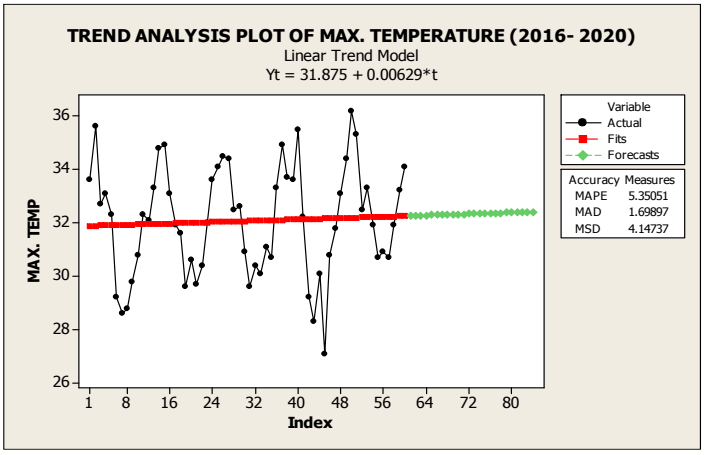

Fig 4: Time series Plot of the Maximum Temperature recorded from 2016 – 2020 with its fitted Trend values

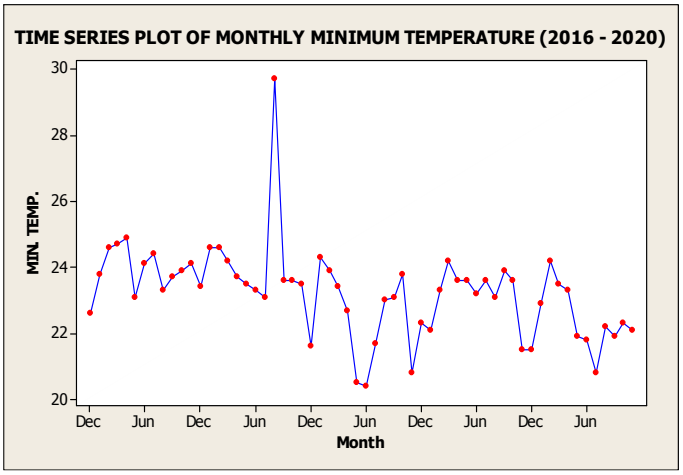

Fig 5a. Time series plot of the Minimum Temperatures recorded from 2016 - 2020

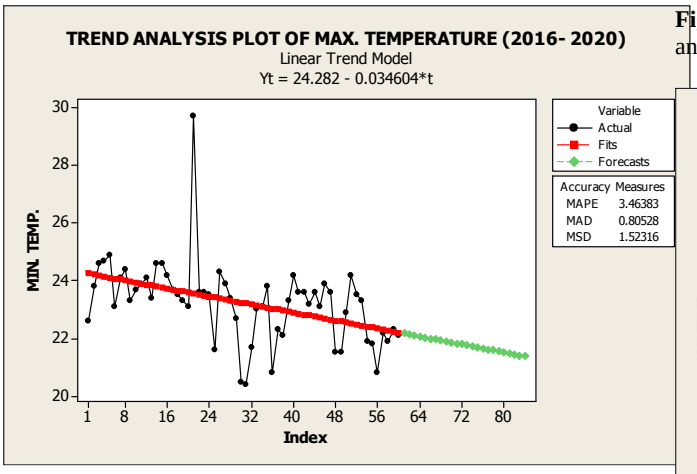

Fig 5b: Time series Plot of the Minimum Temperature recorded from 2016 – 2020 with its fitted Trend values $Y_t = 24.282 - 0.03406_t$ was obtained as the trend equation for minimum temperature.

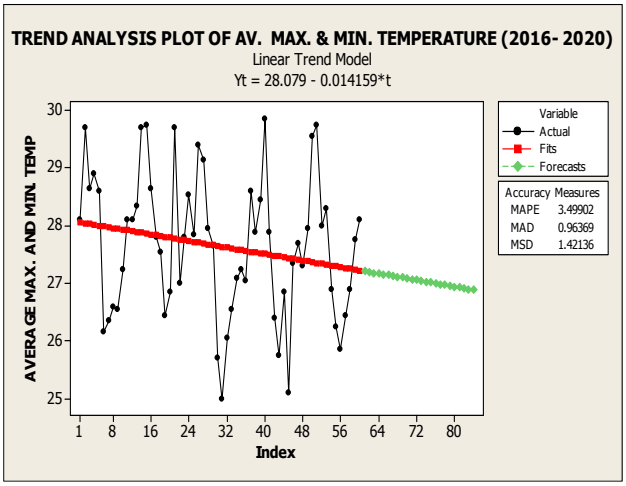

Fig 6: Time series Plot of the Average Maximum & Minimum Temperature with the fittedTrend values $Y_t = 28.079 - 0.014159_t$.

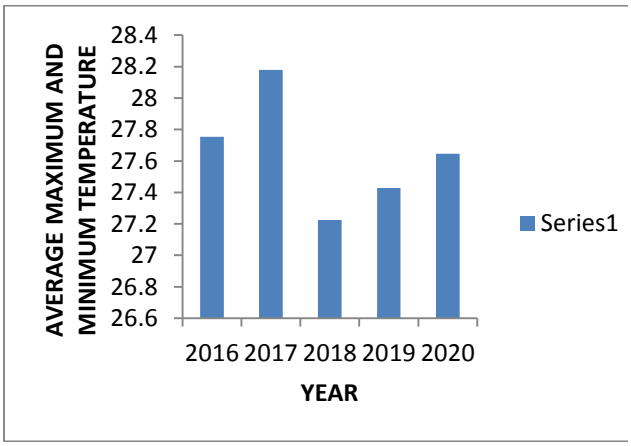

Fig.7: Bar chart showing the Annual average Maximum and Minimum Temperature (2016 – 2020)

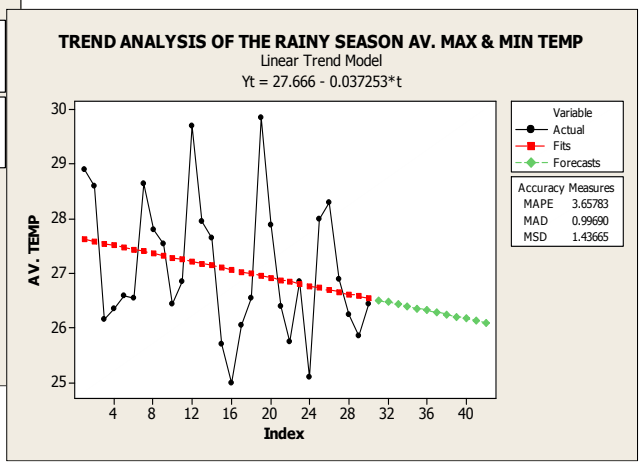

Fig 8: Time series Plot of the Rainy Season Temperature (2016 – 2018)
The trend equation for the rainy season temperature obtained is $Y_t = 27.666 - 0.037253_t$.

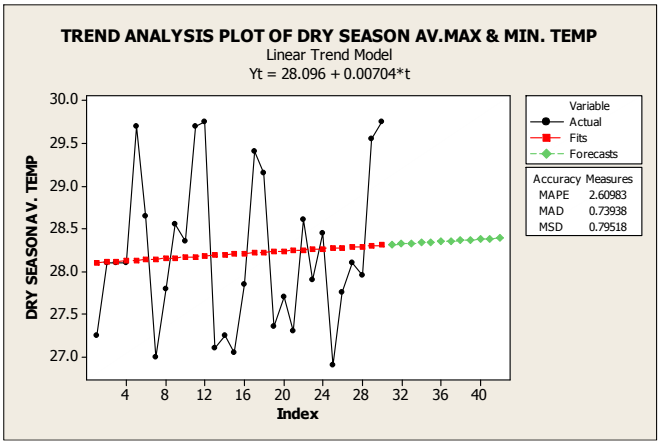

Fig 9: Time series Plot of the Dry Season Temperature (2016 – 2018) with the fitted Trend values. From the above plot displayed, generated trend equation $Y_t = 28.096 + 0.00704_t$

Results and Discussions

Fig 1 shows the bar chart of the average annual maximum and minimum temperature (2016-2020). The highest average annual minimum temperature was recorded in 2017. On the other hand the lowest average annual Maximum temperature was recorded in the year 2016 while the lowest average annual minimum temperature was recorded in 2020.

Fig2 shows the bar chart for the average monthly maximum and minimum temperature revealed that over the years of study (2016-2020). The Month of February, has been recorded as having had the highest average monthly Maximum temperature while the month of July has had the lowest average monthly maximum temperature. For that of minimum temperature, the month of September has had the highest average monthly minimum temperature while the

month of January has had the lowest average monthly minimum temperature.

Fig3 shows the graph of the time series plot of the maximum temperature recorded from 2016 - 2020, confirming the result shown in the bar chart and in the trend analysis of the maximum temperature recorded from 2016 – 2020. Fig 4 showing $Y_t = 31.875 + 0.00629_t$,was obtained as the trend equation. The fitted trend values applying the equation revealed an upward trend (increase) in the Maximum temperature over the years of study. Minimum temperature in fig 5a shows the time series plot, fig5b shows the linear trend model was obtained to be $Y_t = 24.282 - 0.03406_t$. This indicates that there has been a downward trend (decrease) in the Minimum temperature recorded over the years of study (2016 – 2020). The R-square result for the test of significance of the predictive (dependent variable) in that of Maximum temperature showed 0.3% which shows that time (months) predicts or contributes just 0.3% to what the value of the Maximum temperature will be. And with this we can say that time in the Model is not significant. While for that of Minimum temperature R-squared = 19.1% meaning time (Months) just contributes 19.1% what the actual Minimum temperature record will be. This is significant but not too significant as it is still low.

The result of the trend analysis of the Average Maximum and Minimum temperature whose graph plot is shown in fig.6 has a linear trend model of $Y_t = 28.079 - 0.014159_t$ computed. From the fitted trend values, it shows that the average maximum and minimum temperature has been on the decrease over the years under study (2016 – 2020). The R-squared for the model = 4.1% which shows that time (months) contributes just 4.1% of the actual average value of the Maximum and minimum temperature. This of course can be said to be insignificant. Fig 7 clearly shows the bar chart of annual average maximum and minimum temperature over the study period, with 2017 having highest average temperature of 28.17917 and lowest in 2018 at 27.225.

Finally the trend analysis of the average temperature record during the rainy season and dry season was obtained respectively. For that of rainy season in fig 8, the linear trend model $Y_t = 27.666 - 0.037253_t$ was obtained. The fitted trend values show a decrease or decline in values over the years under study. The R-squared for the model = 6.7% which is significant but low. And for the dry season in fig9, the linear trend model obtained is $Y_t = 28.096 + 0.00704_t$. this equally showed an increase in the average temperature outcome over the years of study when the trend values (Y_t) of the model is fitted. The R-squared value = 0.5%. This is significant but as well low.

Conclusion

This study examined the trend in annual maximum and minimum temperature over Umudike in Abia State, Nigeria for the period 2016-2020. Maximum temperature gives a positive trend equation which suggests that maximum temperature of Umudike tends to increase over time. While minimum temperature of Umudike tends to decrease over time. Generally, it has been observed that Abia State is experiencing an increase in surface temperature which implies that it is prone to global warming which has negative effects. Therefore, precautions to reduce these effects should be taken to ensure safety on livelihood that is dependent on temperature. This project therefore recommends that precise and appropriate weather and climate data should be made readily available for proper plans in the agricultural sector and water resources that their activities have significant correlation to temperature.

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