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Trends of Variability of Temperature in Awka, Anambra State Nigeria

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Abstract
The trend of variability of temperature in Awka, Anambra State was studied using ten years monthly minimum and maximum temperature(^{0}C) readings from 2011 to 2020 obtained from NIMET Amawbia, Awka Anambra State. The result of the analysis revealed that the highest and lowest mean monthly temperatures of 29.92^{0}C and 26.38^{0}C were obtained in March and August respectively. The result of the variability of annual mean temperature for the ten-years period showed that Awka is getting hotter with highest and lowest annual mean temperature of 28.13^{0}C and 27.40^{0}C obtained in the year 2020 and 2018, respectively. This showed that the year 2020 with an increase in temperature of about 0.73^{0}C from 2018 to 2020 is the hottest year among the ten-years period studied.

Keyword: *Variability, Temperature, Awka, Annual, Mean*

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I. Introduction

The Earth is warming up (getting hotter) with potentially disastrous consequences. In developing nation such as Nigeria, many people are still in doubt of the existence of global warming by characterizing the signs to nature. Global warming is the observed century-scale rise in the average temperature of the Earth's climate system. It is most commonly attributed to higher levels of greenhouse gases caused by increased levels of carbon dioxide, chlorofluorocarbons (CFCs), and other pollutants. The natural variability and climate change fluctuations of the climate system have been part of the Earth's history however, there have been changes in concentrations of greenhouse gases (GHGs) in the atmosphere growing at an unprecedented rate and magnitudes in recent years (Crowley, 2000; Paehler, 2009). Greenhouse gases are chemical compounds, which absorb the sun's infrared radiation reflected back off the earth's surface and trap it in the atmosphere. With higher levels of greenhouse gases, more of the sun's heat stays close to the earth's surface which causes global warming. Earth's mean surface temperature has increased by about 0.80^0 C (1.40^0 F) since the early 20th century, with about two-thirds of the increase occurring since 1980 (America's Climate Choices, 2011).

In its 2007 report the IPCC projected temperature increases for several different scenarios, depending on the magnitude of future greenhouse gas emissions. For a "moderate" scenario-in which emissions grow slowly, peak around the year 2050, and then fall-the IPCC report projected further warming of 1.10^{0}C to 2.90^{0}C by the year 2100 (IPCC, 2007). For a "high-emissions" scenario-in which emissions continue to increase significantly and finally level off at the end of the century-the IPCC report projected further warming of 2.40^{0}C to 6.40^{0}C by the year 2100. The IPCC cautioned that even if greenhouse gas concentrations in the atmosphere ceased growing, the climate would continue to warm for an extended period as a result of past emissions, and with more dramatic effects than were observed during the 20th century. If greenhouse gas emissions continue to increase, climate scientists project severe climate changes. However, current predictions by the IPCC (2013) for the 21st century estimate that mean temperature will increase up to 3.00^{0}C and be accompanied by an increase of extreme climatic events (Schär et al., 2004, Diffenbaugh and Ashfaq. 2010)and the scale of such alterations becomes global in scope. Moreover, the rate of these recent changes is enormously high compared with the historical record. Today, on the threshold of a new millennium, it is clear that humans are inducing environmental changes in the planet as a whole. In fact, the human fingerprint is abundantly seen on the global atmosphere, the world oceans, and the land of all continents. This insight has brought about profound changes in the goals, priorities, and processes of both science and government.

Awka is the capital of Anambra state. It is a town situated in the South Eastern part of Nigeria under Awka South local government area in Anambra state. The area is bounded by latitudes 6.24°N and 6.28°N and longitudes 7.00°E and 7.06°E (Fig 1).The study area covers 144.5 ha with a 2006 contested population of 116, 208 persons (NPC, 2006). The climate is the tropical wet and dry type according to the Koppen's classification system with a clear cycle of season. The mean daily maximum temperature is usually 27.00°C all over the year

although it could reach 34.00°C in March and lowest during the harmattan months of December and January. The aim of this work is to study the trend of variability of temperature in Awka from 2011 through 2020.

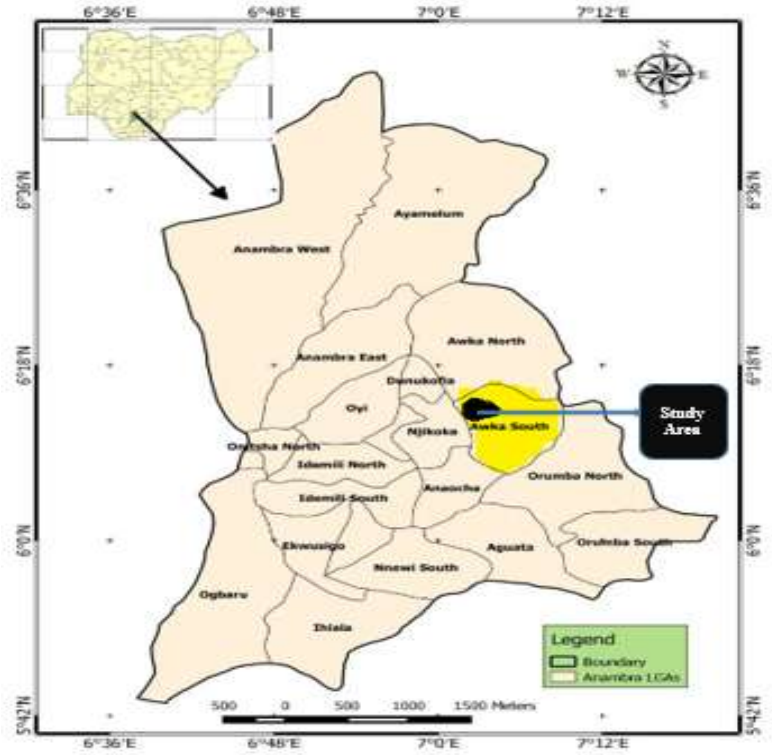

Fig. 1 Map of Anambra State showing Awka (Modified from Ezenwaji *et al*, 2018)

II. Materials and Methods

Data set

The data set consisting of monthly minimum and maximum temperature for Awka from 2011 to 2020 was obtained as secondary data from Nigerian Meteorological Agency (NIMET) Synoptic Station at Amawbia, Awka, Anambra State. The variation in temperature characteristics of Awka were evaluated using the data.

III. Methodology

The mean temperature for each month from 2011 to 2020 was computed from the monthly minimum and maximum temperature using

$$T_{mean} = \frac{T_{min} + T_{max}}{2} \quad 1$$

The monthly mean temperature for each month was calculated to find out the trend of monthly variation of temperature from 2011 to 2020 using

$$T_{mean\ (m1)}\ from\ 2011 - 2020 = \frac{T_{mean\ (m1)\ 2011} + T_{mean\ (m1)\ 2012} + \cdots T_{mean\ (m1)\ 2020}}{10} \quad 2$$

The annual mean temperature was calculated as the sum of the monthly mean divided by twelve (12) months in a year using

$$T_{anual} = \frac{T_{mean\ (m1)} + T_{mean\ (m2)} + \cdots + T_{mean\ (m12)}}{12} \quad 3$$

The result obtained using Equations 1,2 and 3 are shown in Table 1

Table 1: Mean of Monthly and Annual Temperature(^{0}C) in Awka from 2011 to 2020

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2011	26.25	29.80	30.55	29.25	28.20	27.35	26.35	26.10	26.75	27.30	28.80	26.25	27.746
2012	27.10	28.95	30.55	29.15	27.60	27.05	26.45	26.05	26.95	27.50	28.80	27.15	27.775
2013	29.10	29.05	30.55	29.10	28.05	27.10	26.45	26.00	26.65	27.35	28.20	27.95	27.963
2014	28.55	29.50	29.85	29.35	28.30	27.80	26.90	26.45	26.55	27.95	28.30	27.70	28.100
2015	27.00	29.90	29.55	29.15	28.20	27.10	26.60	26.40	26.65	27.55	28.60	25.65	27.696
2016	27.40	30.25	29.20	29.15	28.15	26.90	26.20	26.20	26.55	27.30	28.80	28.00	27.842
2017	28.40	29.80	29.85	28.40	27.75	27.10	26.15	25.70	25.85	26.65	27.75	27.75	27.596
2018	26.35	29.55	29.80	28.40	27.50	27.25	26.20	26.15	26.15	26.95	27.95	26.60	27.404
2019	27.85	29.25	29.90	29.45	28.55	27.20	26.55	26.50	26.95	27.05	28.35	27.85	27.954
2020	27.40	29.95	29.60	29.20	28.15	27.40	26.60	28.20	26.90	27.05	28.50	28.65	28.133
2011-2020	27.54	29.60	29.92	29.06	28.05	27.23	26.45	26.38	26.60	27.27	28.41	27.36	27.820

IV. Results and Discussion

The picture of how temperature varied from January to December from 2011 to 2020 are shown in Figs. 2 through 6. All the years except 2015,2016 and 2020 had their highest mean monthly temperature of approximately 30.00^{0}C in March with the lowest mean monthly temperature occurring in August with the exception of 2015 and 2020 with their lowest temperatures in December and July, respectively. From Table 1, it could be seen that Awka is indeed warming up because almost all the lowest mean monthly temperature obtained in each year is greater than the mean temperature of Awka reported to be about 26.80^{0}C (https://en.climate-data.org). The trend of Variability of Mean Monthly Temperature for Awka from 2011 to 2020 (Fig. 7) showed that March and August are indeed the month with the highest and lowest mean monthly temperature with a temperature of 29.92^{0}C and 26.38^{0}C, respectively.

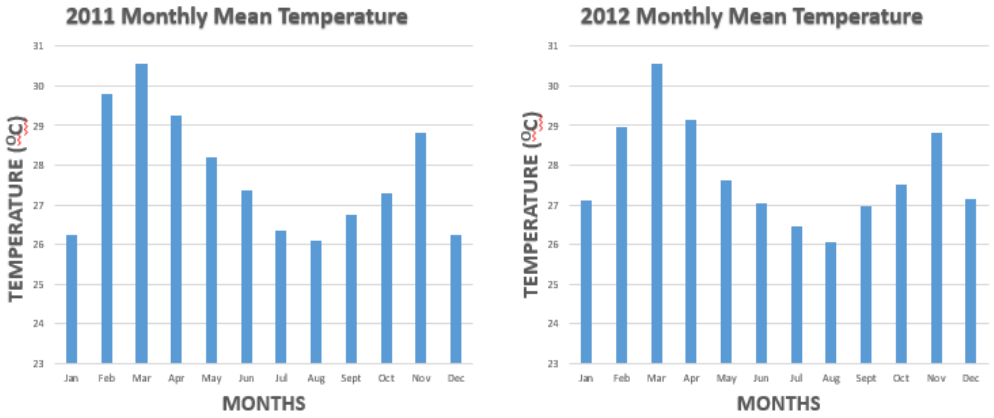

Fig 2: Monthly Mean Temperature for Awka in 2011 and 2012

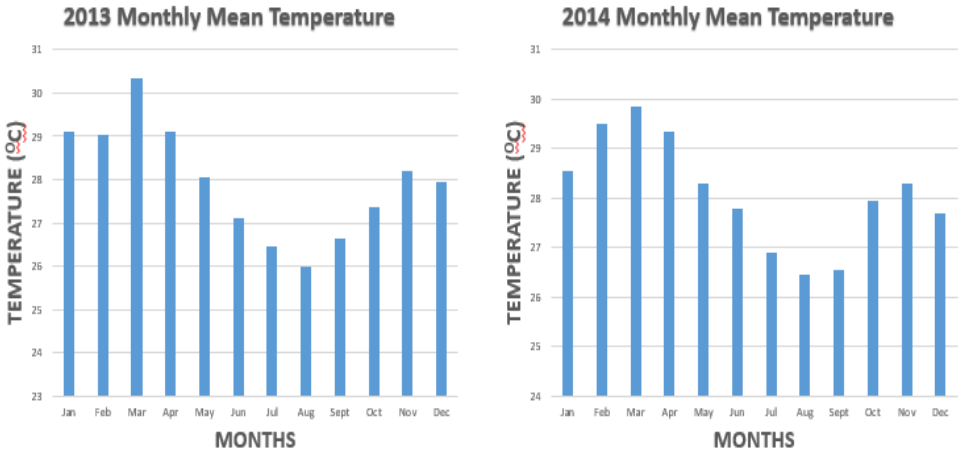

Fig 3: Monthly Mean Temperature for Awka in 2013 and 2014

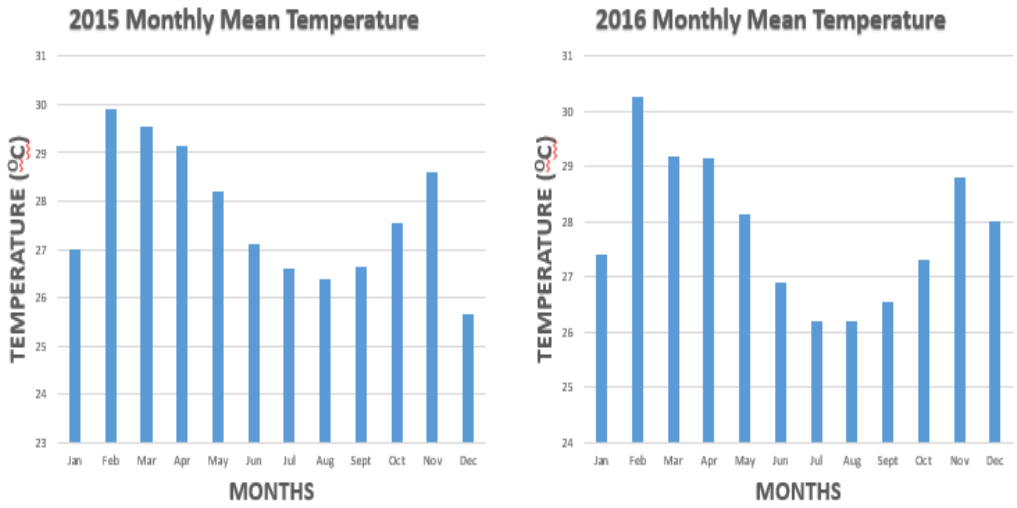

Fig 4: Monthly Mean Temperature for Awka in 2015 and 2016

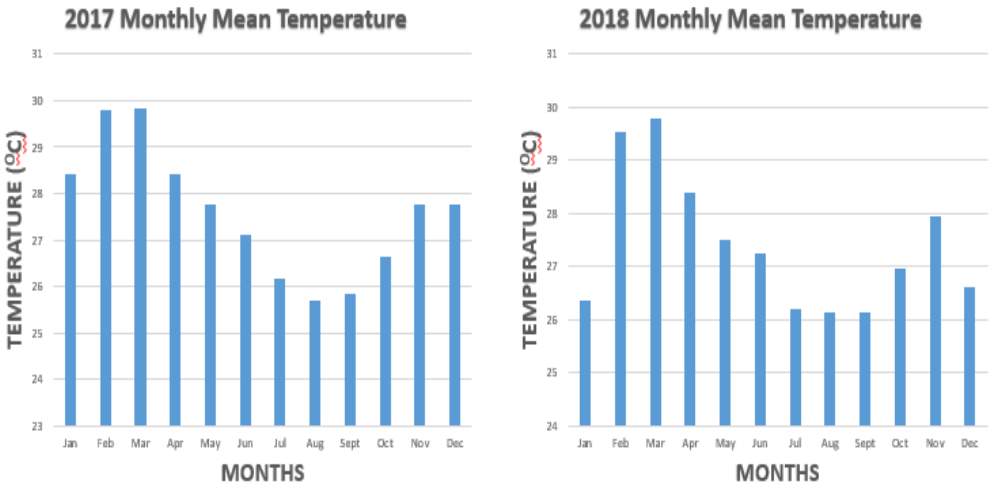

Fig 5: Monthly Mean Temperature for Awka in 2017 and 2018

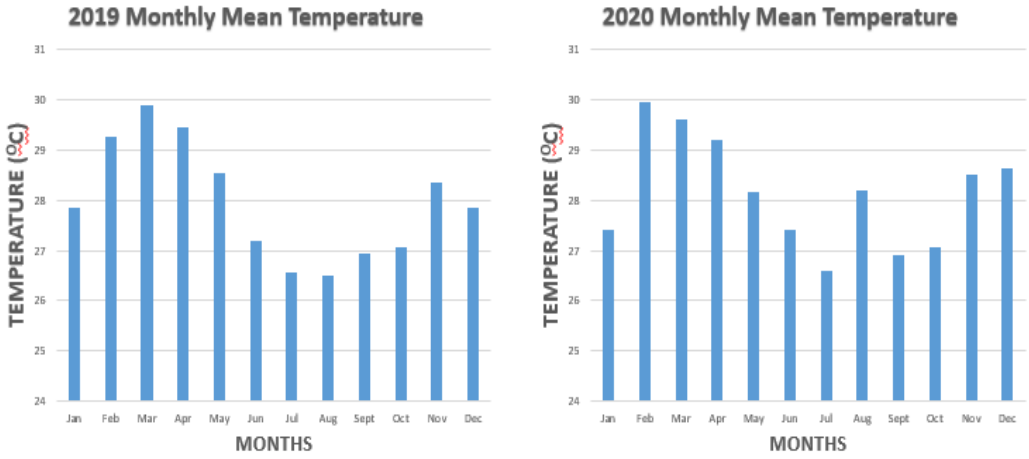

Fig 6: Monthly Mean Temperature for Awka in 2019 and 2020

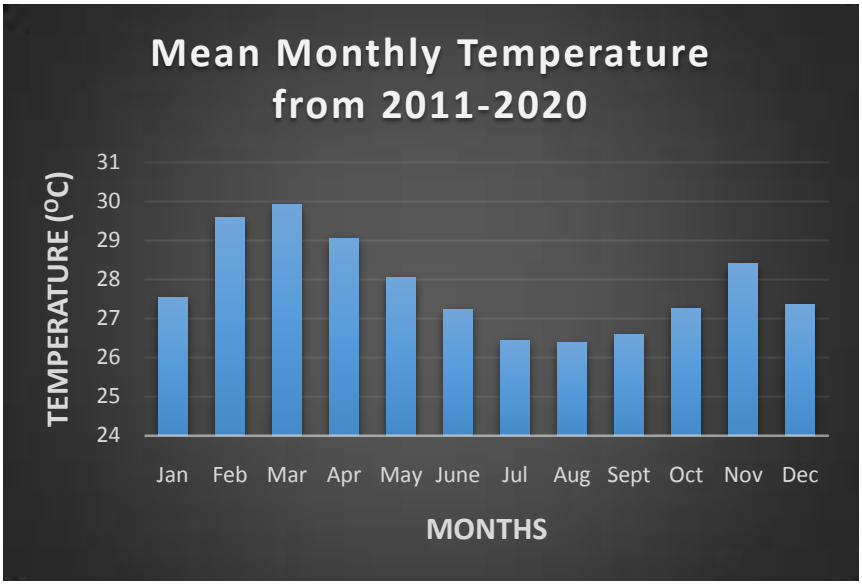

Fig 7: Trend of Mean Monthly Temperature for Awka from 2011 to 2020

The result of variation of annual mean temperature for Awka from 2011 to 2020 (Fig. 8) showed that the annual mean temperature of Awka increased from 27.74^{0}C in 2011 to 28.10^{0}C in 2014. There was a decrease from 28.10^{0}C in 2014 to 27.69^{0}C in 2015. The temperature increased with about 0.15^{0}C from 2015 to 2016 and decreased with about 0.44^{0}C to 2018. An increase with about 0.73^{0}C was observed from 2018 to 2020. The analysis showed that the lowest and the highest annual mean temperatures of 27.40^{0}C and 28.13^{0}C were observed in 2018 and 2020 marking the year2020 as the hottest year in Awka from 2011 to 2020. This decrease and increase in temperature in Awka over the years is due to variation in other climate parameter and adverse human impact on the ecosystem.

From Fig.8 and Table 1, it could be observed that the highest and the lowest annual mean temperature for Awka is greater than the reported mean temperature of 26.80^{0}C with 1.33^{0}C and 0.60^{0}C, respectively.

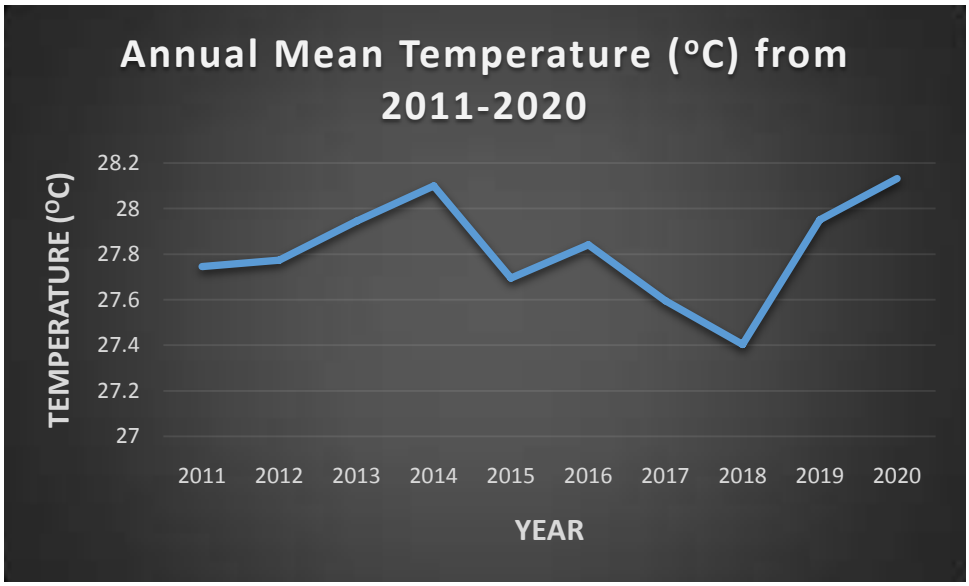

Fig 8: Trend of Annual Mean Temperature for Awka from 2011 to 2020

V. Conclusion

The results of this work reveals that the mean monthly and annual temperature of Awka for all the years has exceeded the reported mean temperature of Awka. It showed that Awka is indeed getting hotter and measures that will minimize the release of the greenhouse gases into the atmosphere should be put in place to avoid further warming up of the environment. The implication of this increase in mean temperature is that Awka will become hotter than it should be and this could lead to other adverse climate effect like flooding.

Acknowledgement

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