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The Circular Trend of Temperature in Anambra State of Nigeria for 30 Years (1977-2006) and its Implication for Climate Variability

V. C. Nnodu and J. O. Duluora

ABSTRACT

This work examined the temperature of Anambra State for a 30 year period (1977-2006).The problem that prompted this study is the continued complaint of hotter temperatures, increased installation of air conditioners and fans in houses and the increase in the height of rooms as a way to reduce the temperature of such rooms. Trend analysis and graphs were used to determine the fluctuations, variations and trend of temperature over the area. The trend analysis shows that there have been fluctuations in the temperature while a best fit line showed a steady increase in the temperature of Anambra State in the past 30 years. Planting of trees, reduction in the use of synthetic surfaces, re-afforestation and reduction in the rate of use of fire woods are some of the ways of reducing temperature increase.

Key words: temperature, synthetic surfaces, trend analysis, temperature fluctuations, temperature variations, re-afforestation.

BACKGROUND

The atmosphere is not a static environmental system. It is in constant state of dynamics. Atmospheric characteristics change from place to place and over time at any given place on time scales ranging from micro seconds to hundreds of years. The United Nations Framework Convention on Climate Change (UNFCCC) defined climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over a comparable time period (IPCC, 2001). According to Adejuwon (2004) in Nwajuba and Onyeneke (2010) climate change describes changes in the variability or average state of the atmosphere over time scales ranging from a decade to millions of years. Researches have

shown that for the past few decades anthropogenic factors like urbanization, deforestation, population explosion, industrialization have contributed to increases in the release of greenhouse gases and are major contributing factors to the depletion of Ozone layer and its associated global warming and climate change (Odjugo and Atedhor, 2007).

Certain gases such as carbondioxide, methane, nitrous oxide (NO_x), chlorofluorocarbons (CFCs) along with water vapour in the atmosphere form a blanket of gases that does not allow solar radiation to re-radiate into space. Broad scientific agreement according to Nwajuba and Onyeneke (2010) now exists, that continued accumulation of heat- trapping greenhouse gases in the atmosphere is contributing to changes in the global climate, and in the climate of regions around the world.An analysis of temperature records shows that the earth has warmed to an average of 0.6^0C over the past 100 years. Concerned with the implications of global climate change, several governments came together in 1988 and formed the Intergovernmental Panel on Climate Change (IPCC).

In 1992, the Earth Summit was held in Rio de Janeiro, Brazil and the United Nations Framework Convention on Climate Change (UNFCCC) was adopted. This framework was aimed at reducing the concentration of greenhouse gases emitted into the atmosphere. There are other agreements which have been reached or signed by the United Nations in order to combat or reduce the incidence of global warming and climate change and they include the Berlin Mandate of 1995, the Kyoto Protocol of 1997, the Copenhagen Accord of 2009 and the Conference of Parties (CoP) held in Cancun, Mexico in 2010.

The increase in global average temperature and the associated climate change effect has resulted to many changes in the normal workings of the earth. There is the problem of global warming which according to Aguado and Burt (2007) is the rising of average temperature of the earth's atmosphere due to greenhouse gases, and the consequential melting of the polar ice. The melting of the polar ice has resulted in increase in ocean level (sea level rising). In some quarters there is an increase in precipitation as a result of high evapotranspiration and the resultant flooding in such areas that receive more precipitation than normal. This is evident in recent flooding events in places like the Philippines, China, Colombia, Australia, Brazil, Sokoto in Nigeria, etc.

According to Gbogbo (2009) there is evidence of climate change in Nigeria. This is evident in increase in the frequency and intensity of extreme events like drought and floods. Currently temperature increase of 0.2 to 0.3 % per decade have been observed in the various ecological zones of the country, particularly since 1960. This work was carried out in Anambra State of Nigeria. The State is located within latitudes 6^0 15^1N and 7^0 10^1N and longitudes 6^0 35^1E and 7^0 20^1E and is located in the South Eastern geopolitical zone of Nigeria as shown in figure 1.

Geologically, Anambra state is underlain by sedimentary formations of varying ages: Nanka sandstone, Ogwashi-Asaba formation and Ameki

formations (Onyeagocha 1980). The natural flow patterns of the rivers and their tributaries are of dendritic pattern (Igbokwe et al, (2008) in Onwuka, 2010). Two major climatic seasons exist in Anambra State namely the rainy season (from March to October) and the dry season (from November to March). The dry season begins when the dry continental north-eastern wind blows from the Mediterranean sea across the Sahara Desert down to Southern Nigeria and is characterized by extensive aridity and a lot of particulate generation. The temperature is generally between 26^0C and 30^0C, while the wet months with high relative humidity have lower temperatures of between 22^0C and 26^0C (Egboka and Okpoko 1984).

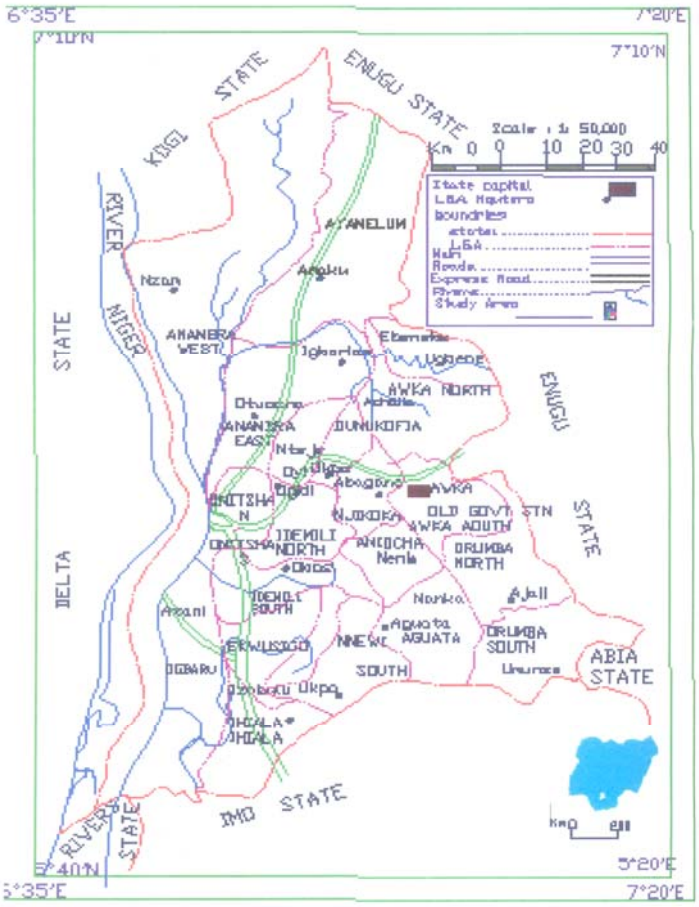

Fig. 1: Map of Anambra State with Nigeria in set.
Source: Survey Department, Awka.

Statement of the Problem

In terms of the problems associated with climate change, Anambra State is not left out. There has been an increase in the insolation and a resultant increase in temperature. High temperature records are recorded on daily and monthly basis. People install gadgets such as fans and air conditioners in their houses and cars to control temperature increases. Architects design rooms to be higher to make rooms cooler than usual. The government has equally been campaigning for planting of trees to reduce the problem of urban heat.

Conceptual Framework

The study applies the systems theory to explain the relationship between the concept of radiative heating, human activities and greenhouse gases (GHGs). These greenhouse gases play a crucial role in regulating the temperature of the earth and the earth's atmosphere such that the absence of these gases would have amounted to an average surface temperature of 33^0C colder that is -18^0C instead of the present value of 15^0C (Aina and Adejuwon, 1994). The natural effect is now becoming intensified by the presence of human-induced, synthetic chemicals like chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbon (C_5F) and sulphurehexfluoride (SF_6), which also have the property to absorb terrestrial re-radiated long wave radiation and further heat up the lower tropospheric atmosphere to the extent that the "artificial greenhouse gases" pose great threat to humanity (Nnodu 2010). Human activities have strongly influenced the concentrations of the naturally occurring principal GHGs (Warrick and Riebsan, 1983). These human activities and their resultant outcome can be viewed as a complex system that exhibits interactions among its components and the non-linearity of these interactions.

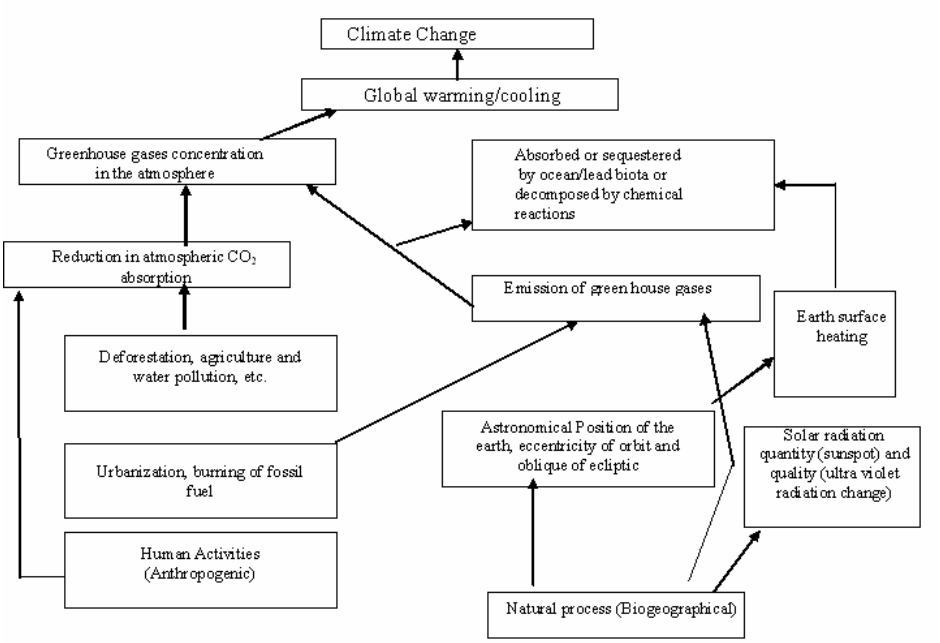

Fig 2: Casual factors of climate change.
Source: Odjugo and Atedhor, 2007).

METHODOLOGY

The research design applied to this study is the survey design. Surveys are oriented towards the determination of the status of a given phenomenon. It does more than merely uncover data. Surveys interpret synthesis and integrate these data and point to implications and interrelationship (Osuala, 2007). In this method, temperature data for thirty years (30 years) was analysed to see their trends, fluctuations and variations. The temperature data were secondary data from NIMET, Oshodi.

RESULTS AND DICUSSION

Table 1: Yearly Temperature Totals and Averages for Anambra State

YEARS	SUM	AVERAGE
1977	319.6	26.63333
1978	320.3	26.69167
1979	319.6	26.63333
1980	320.8	26.73333
1981	321.2	26.76667
1982	326.4	27.2
1983	326.8	27.23333
1984	329	27.41667
1985	323	26.91667
1986	326.9	27.24167
1987	348.2	29.01667
1988	342.4	28.53333
1989	342.1	28.50833
1990	343	28.58333
1991	340.7	28.39167
1992	341.3	28.44167
1993	342.2	28.51667
1994	341.4	28.45
1995	341.4	28.45
1996	343.4	28.61667
1997	342.4	28.53333
1998	352.8	29.4
1999	346.3	28.85833
2000	336.2	28.01667
2001	340.1	28.34167
2002	339.5	28.29167
2003	343.6	28.63333
2004	338.6	28.21667
2005	341.5	28.45833
2006	340.3	28.35833

Source: Author's computation

From table 1, it will be noticed that the yearly total temperature of Anambra State from 1977 – 2006 ranges from 319^0 to 352^0 with 1977 having the

lowest total temperature while 1998 has the highest yearly total temperature. In 1987, the total temperature rose sharply, then maintained an almost steady record before rising sharply again in 1998. This is represented in figures 3 and 4.

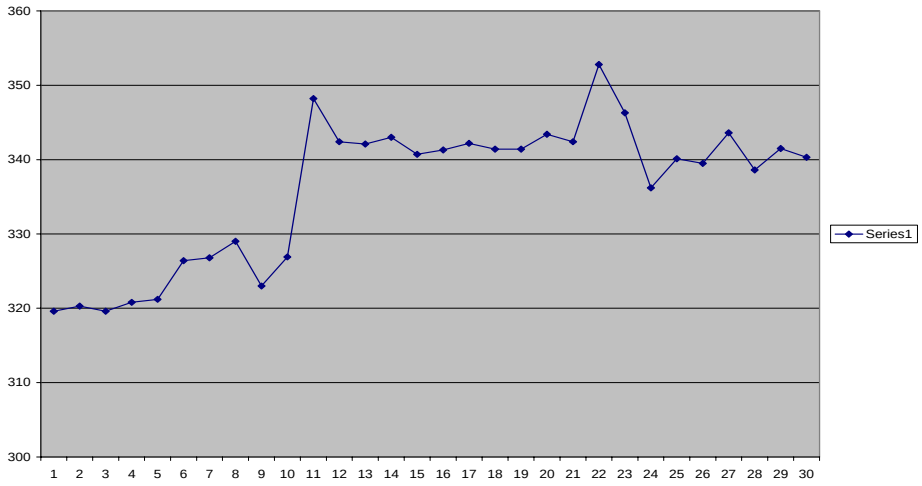

Fig 3: Graph of yearly temperature total for Anambra State (1977-2006).

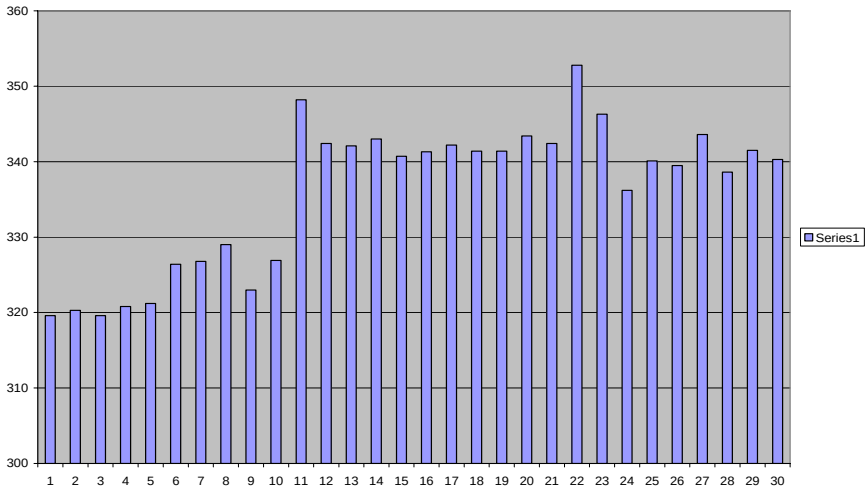

Fig 4: Bar chart of yearly temperature total for Anambra State (1977-2006).

Consequently, a close look at the yearly averages equally shows a range of between 26.63^0 to 29.4^0. There are eighteen years with average temperature ranges of between 28.0^0 to 28.86^0. The average temperature also has the same graphical movement with the yearly totals. This is shown in figure 5.

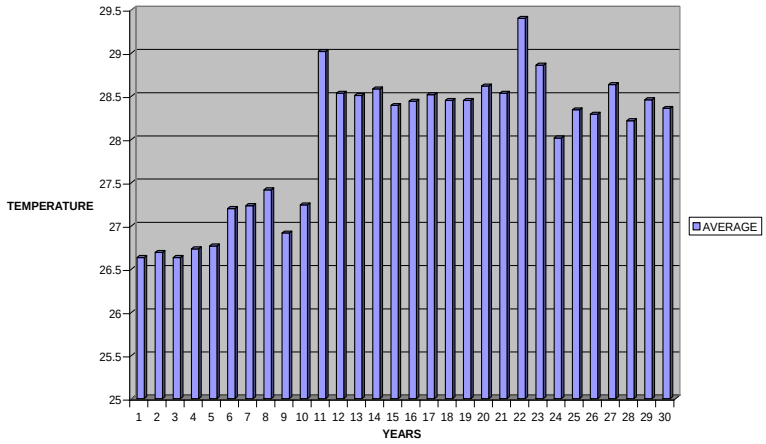

Fig.5: Average yearly temperature total for Anambra State (1977-2006).

Table 2: Total Monthly and Mean Monthly Temperature.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
SUM	858	903.6	899.2	876.3	846.5	811.3	782	774.8	792.4	821.6	858.9	856.4
AVERAGE	28.6	30.12	29.97333	29.21	28.21667	27.04333	26.06667	25.82667	26.41333	27.38667	28.63	28.54667

Source: Researcher's computation .

Table 2 shows both the total monthly temperature and the mean monthly temperature of the study area. The total monthly temperature ranges from 774.8^0 (in August) to 903.6^0 (in February). This implies that the hottest month in Anambra is February while the coldest month in the state is August. It will also be noticed that the temperature of Anambra State decreases from February to August then starts increasing again giving a U/V shape. This is shown in figure 6.

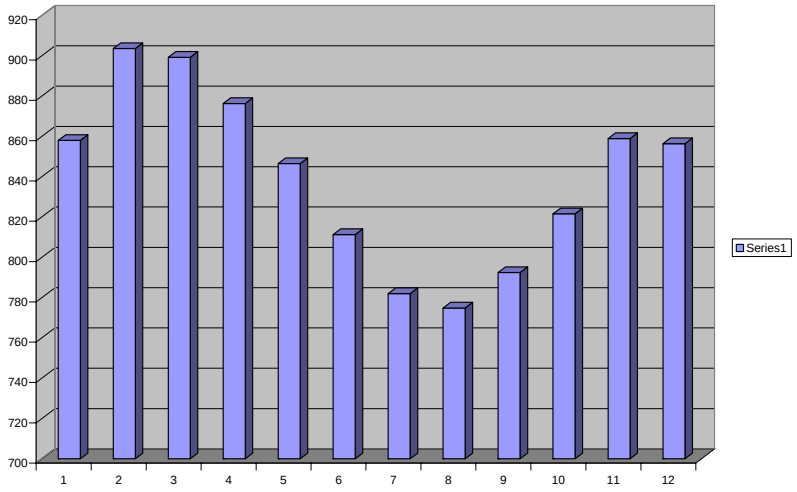

Fig.6: Bar chart of monthly temperature total for Anambra State (1977-2006).

From table 3, it will equally be observed that the average monthly temperature of Anambra State ranges from 25.83^0 in February to 30.12^0 in August. The average temperature pattern also has the same shape with that of the total monthly temperature. This is illustrated in figure 7.

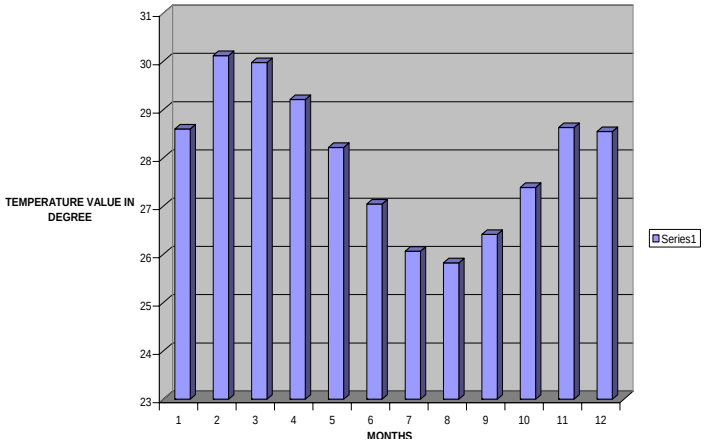

Fig. 7: Bar chart of average monthly temperature total of Anambra State for 30 years.

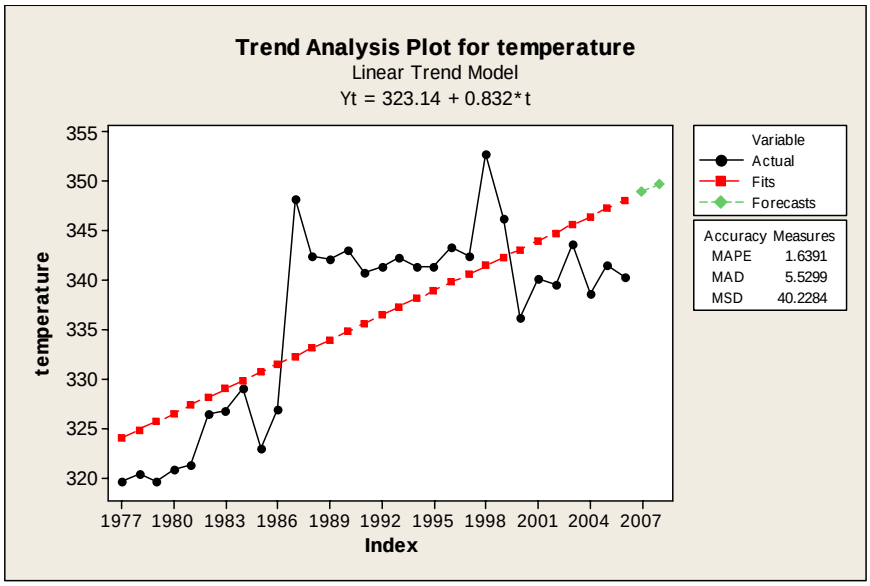

Fig. 8: Trend analysis of temperature.

The trend analysis of temperature shows that Anambra State has had a temperature pattern that fluctuates in the past 30 years. Figure 8 shows the scatter diagram of the trend analysis. A sharp increase will be noticed between the late 70s to early 80s. When a best fit was drawn (red line), it showed that the temperature has been increasing continuously (i.e. steady rise in temperature pattern) in the past 30 years. A forecast of two years (green line) equally showed increases in temperature. This implies that there is a significant variability in the rainfall pattern of Anambra State. From the two forecasts, it will be noticed that these years are likely to be hotter than the previous years.

The trend analysis reveals that there are changes going on in the environment which is seen in the variations in the climatic parameter (temperature). This supports other studies that there is an increase in temperature which causes resultant global warming.

SUMMARY, CONCLUSION AND RECOMMENDATION

The temperature of the state is on the increase from the late seventies (1977) till date. In Anambra State, the month with the highest temperature is February while August is the month with the least temperature and as such is the coldest month. The temperature changes equally affected the water availability in the study area since evapotranspiration increases with increase

in temperature. This implies that for the state to practice dry season agriculture, more reservoirs/ dams must be constructed but in their (dams and reservoirs) absence, dry season agriculture will be affected and equally irrigation farming will suffer since many seasonal rivers (ephemeral) will dry up. Planting of trees, reduction in the use of synthetic surfaces, deforestation and reduction in the rate of use of fire woods are some of the ways of reducing temperature increase.

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