Global Warming: A Case Study of Southeast Nigeria.

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ABSTRACT

The greenhouse effect is the process by which the radiative properties of the atmosphere raise the surface temperature of the earth above that which would occur in the absence of any radiation-absorbing atmosphere. This situation is accentuated by anthropogenerated gases especially carbon dioxide (CO_2). We present in this work an analysis of temperature data (1901 – 2000) obtained from the archives of the International Water Management Institute (IWMI). The results show a strong signature of elevated temperature which may be an indication of climate change as seen in the first climatological period of 33 years, that Awka warmed additionally to 0.45^{o}C, while in the second climatological period of 33 years it warmed an addition 1.77^{o}C, and during the third climatological period of 34 years, it warmed a further 0.66^{o}C. During this epoch of warming in the global temperatures, it has been noticed that the amount of solar radiation has increased as well as the amount of monsoon rainfall.

(Keywords: temperature, global warming, anomaly, southeast Nigeria)

INTRODUCTION

The Earth is warming up (getting hotter) with potentially disastrous consequences. Computer models based on the principles of physics are the best tool of predicting and managing climate change (Adam et al., 2000). Global warming is the increase in the measured average temperature of the Earth's near surface air mass and oceans, and its projected continuation (Weart, 2000).

The global surface temperature increased by 0.74±0.18^o C (1.33±0.32^o F) in the last 100 years ending in 2005. These changes have raised concerns about adaption to the climate future with respect to accelerated climate change, as reflected in the United Nations Framework Convention on Climate Change (UNFCCC) drafted at the Earth Summit in Rio, June 1992 (IPCC, 2007). These issues have also driven the subsequent process of moving towards a protocol aimed at controlling greenhouse gas (GHG) emission - the Kyoto protocol (IPCC, 1997). The major problem in Nigeria is the non-availability of historical observed data to ascertain the level of changes within the country.

DATA AND METHODOLOGY

Temperature data were obtained from the archives of the International Water Management Institute, (IWMI), Climate Research Unit, (CRU) of University of East Anglia (IMWI, 2008). The temperature data span for a period of 100 years ranging from 1901–2000 and was split into climatological periods of first 33 years, second 33 years, and third 34 years (Dugam et al., 1990). The southeast of Nigeria comprises five states' data which have capital cities in the study sites. The coordinates and elevations of the data sites of this study are summarized on Table 1.

Table 1: Location of Study Sites.

Site	Lat (^{o}N)	Long (^{o}E)	Elevation (m)
Abakaliki	6.33	8.1	
Awka	6.2	7.73	72
Enugu	6.5	7.5	231
Owerri	5.48	7.02	74
Umuahia	5.53	7.48	121

(Chineke et al., 2000)

The data were analyzed for variations using the method of variance and fitted regression trend, given as:

$$T=\sum(Y_i - \overline{Y}) \quad \textbf{(1)}$$

Where T is the period in years, $\overline{Y}_i$ is the temperature and Y is the assumed 25.5^{0}C temperature benchmark for this study.

RESULTS AND ANALYSIS

Figure 1 shows the analyzed temperature anomaly for the first climatological period from 1901-1933 using the equations for the time series variance. This result shows a greater frequency of warming than cooling during the warm and cold epochs of the mean surface temperature anomalies, which could be attributed to a process that induces further warming referred to as positive feedback (Soden and Held, 2005). From the analysis, it is observed that the temperature anomaly was 2.5^{o}C for the entire location of study in 1909, while Abakiliki and Enugu had an increase of 3.5^{o}C in the same year respectively and Umuahia increased additionally to 3.6^{o}C within the same year 1909. Abakiliki and Umuahia warmed additionally to 3.5^{o}C in 1912.

It is shown that from 1902 – 1924, there was a stable temperature at -1.5^{0}C while Enugu in 1924 and Owerri in early 1928 and late 1929, respectively, dropped further to -2.5^{o}C A situation that triggers off further cooling, giving rise to a negative feedback (Soden and Held, 2005). In 1923, the temperature anomaly of Abakiliki and Umuahia had an increase of 4.5^{o}C, respectively, while Awka was observed to have a value of 3.5^{o}C in 1925, 1928, and 1929, respectively. The warmest period occurred at Awka in 1931 at a surface temperature anomaly of 5.5^{o}C.

In Figure 2 shows the second climatological period which ranged from 1934 – 1967. The cooling trend remained at -1.5^{o}C on the barest minimum of the temperature anomaly, while the positive departure (elevation) occurred at Abakiliki and Enugu in the years 1935 and 1936 respectively at the temperature of 4.5^{o}C while at Awka a positive departure in the years 1942, 1943, and 1947, respectively at 4.5^{o}C. The trend showed a maximum increase of temperature anomaly of 2.5^{o}C for all the location on the positive feedback while a value of –1.5^{o}C of temperature anomaly was observed on the negative feedback.

In the third climatological period shown in Figure 3 the surface air temperature anomaly attained a minimum level of -1.5^{o}C from 1968 to 1982 except for Umuahia and Enugu in 1969 and 1973, respectively, having a value of 3.5^{o}C. The temperature trend increased from -1.5^{o}C to -0.5^{o}C in 1983 and warmed on the elevated path from 2.5^{o}C to 3.5^{o}C that same year, remaining steady till the year 2000. Although, there were intermittent drops both for the positive feedback and the negative feedback more occurred on the positive trend.

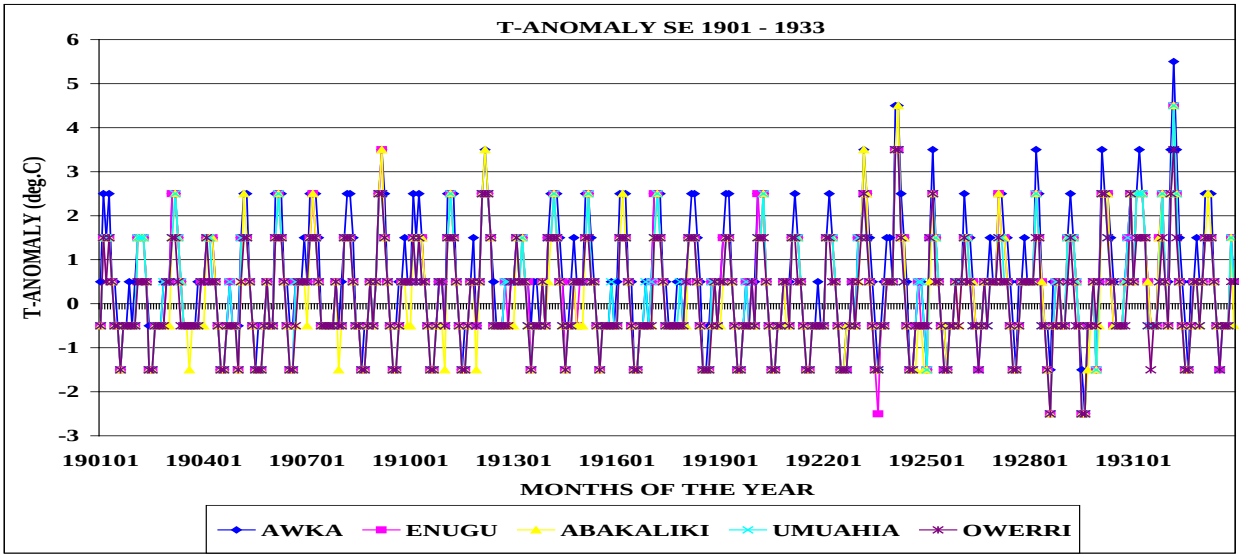

Figure 1: Time Series Anomaly for South – East 1901 – 1933.

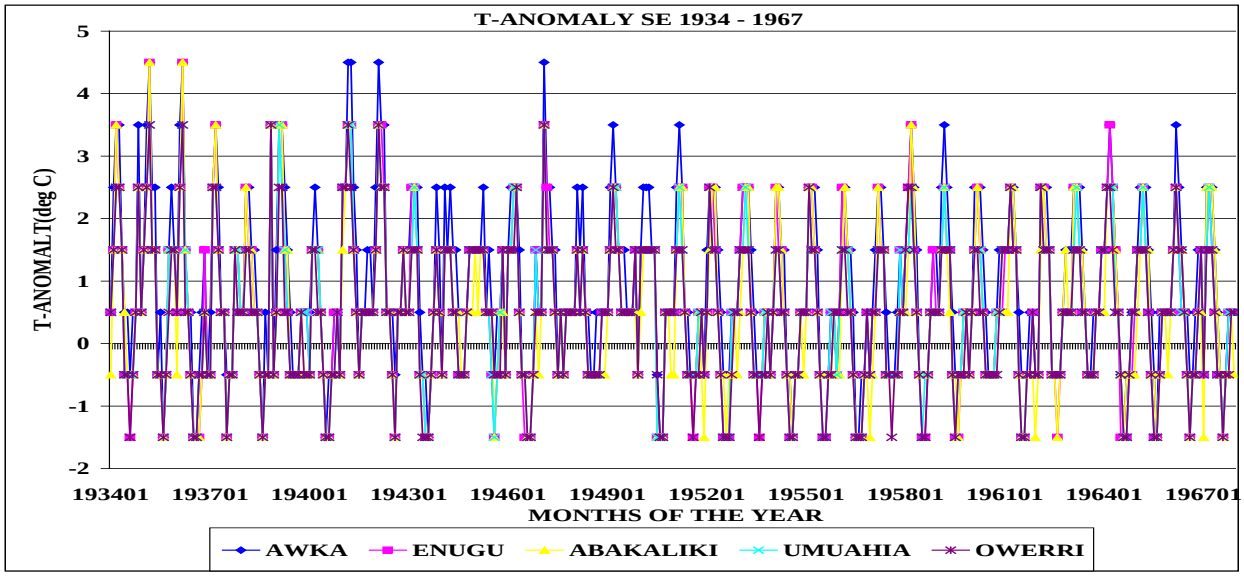

Figure 2: Time Series Anomaly for South – East 1934 – 1967.

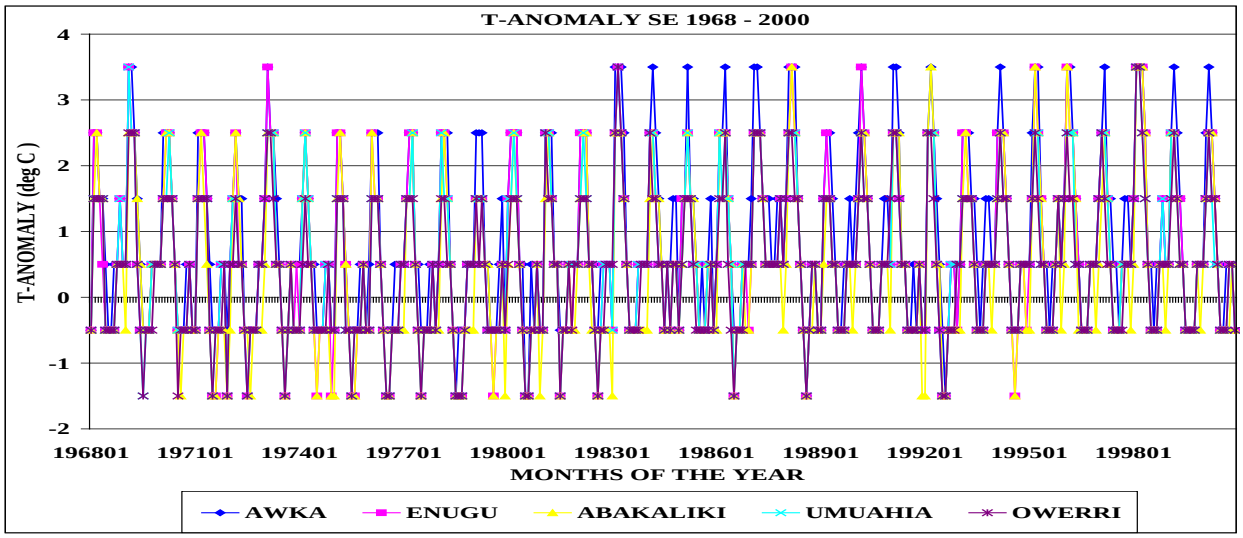

Figure 3: Time Series Anomaly for South – East 1968 – 2000.

CONCLUSION

This work showed that the temperature anomaly within the southeast of Nigeria is attributed to global warming. The elevated surface air temperature anomalies have shown that temperature is rising drastically and that may be an indication of climate change. In 1931, the surface air temperature anomaly departure of 5.5^{o}C gave an indication of the most probable warmest year in the history of the region and would be said to be followed by the record of 4.5^{o}C in 1947.

Hence the spatial variation in the surface air temperature anomaly has influence on the urban microclimate of the southeast and thus hypothesize that urban dwellers may be subjected to some levels of climatological and physiological related disorderliness, which is seen in agriculture yield, precipitation patterns and health risks.

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