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Global Warming and Air Temperature Anomalies in the Niger Delta Region of Nigeria

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Abstract: ***The study examines the trends of temperature parameters from five synoptic stations in the Niger Delta region of Nigeria. The annual mean temperature from five synoptic stations between 1951 and 2012 were collected from the archives of the Nigeria Meteorological Agency, Oshodi, Lagos. The data was analyzed using correlation coefficient and standardized anomaly. The results show that, air temperature demonstrated steady increasing trend from 1980s, it reveals that global temperature for the past 100 years is 0.74^{0}C that of the Niger Delta region under the period investigated is o.66^{0}C while the trend showed an increase of temperature anomaly of 0.3^{0}C. The current trend shows that global warming is evident in the region but is covered by the variation in some local and regional temperature. Based on the findings of the work, it is therefore; recommended that sustainable ecological measures should be practiced.***

Keywords: Temperature; Standardized Anomalies; Global Warming; Niger Delta, Nigeria

1. Introduction

Climate change, specifically global warming is a major environmental challenge that has captured the attention of scientist and public worldwide (Teme, 2005). Global warming is caused by excessive quantities of greenhouse gases emitted into Earth's near-surface atmosphere, however, increasing levels of these gases is the cause of rising surface air temperatures, resulting in the most severe ecological crisis that the Niger Delta region has witnessed. The Intergovernmental Panel on Climate Change (IPCC) (2007) concludes that greenhouse gases are responsible for most of the observed temperature increase since the middle of the twentieth century, and that natural phenomenon such as solar variation probably had a small warming effect from pre-industrial times to 1950 and a small cooling effect afterward. . Also Ekpoh and Nsa (2011) observed that there is sufficient evidence of rising global temperatures due to increased emission of greenhouse gases into the atmosphere which have the capacity to trigger large scale climatic changes thereby having significant effect on the temperature. Studies have shown that global average air temperature has significantly been on the increase mainly as a result of anthropogenic activities (IPPC, 2007). Anthropogenic activity such as population growth, deforestation, unsustainable agriculture, and the widespread use of fossil fuels are contributing to global warming (Cicerone, 2005). The strongest evidence of global warming can be seen in the rising air temperatures in nearly all parts of the world. According to O'Hare (2002), increase in temperature will cause higher frequency and intensity of extreme weather events such as severe heat and drought, intense rainfall and serious flooding, excessive wind and violet storm. It is observed that global temperatures have increased by 0.4^{0}C-0.8^{0}C with a mean of 0.74^{0}C since record started in 1860 according to 2007 Intergovernmental Panel on Climate Change (IPCC). Without a new treaty to halt carbon dioxide emissions, world temperatures could rise an additional 7.2^o C by 2100, raising fears of widespread crop failures, climate "refugees," rising seas and desertification for regions such as Sub Sahara and Kalahari Desert areas of Africa etc. In addition to rising air temperature, the region is faced with gas flaring and massive deforestation due to oil exploration and exploitation activities in the area. Nzeadibe and Egbule et. al (2011) stated that the concentration of biodiversity in the Niger Delta region may experienced a loss of about 40% of its inhabitable terrain in the next thirty years due to natural gas flaring, oil spillage, concentration of greenhouse gas in the atmosphere and over exploitation of natural resources in the region. These environmental problems have contributed enormously to carbon levels in the atmosphere. If the current rate of atmospheric warming continues, it will intensify the listed environmental issues and may led to loss of fragile ecosystem in the Niger Delta region. In this background this study finds relevance in examining climatic trends in the Niger Delta region of Nigeria using Temperature parameter.

2. Material and Method

Mean monthly temperature (minimum and maximum) data for Warri, Ondo, Port Harcourt, Benin City and Calabar (1951 to 2012) were collected from the archives of the Nigeria Meteorological Agency (NIMET), Lagos. The climatic data used covered a period of sixty two (62) years and was divided into two climatic periods of thirty-one (31) years each except for one station i.e Portharcourt due to inadequate data. The standardize anomalies of temperature were computed using the 1951-2012 mean to examine the annual deviations of these climatic parameters from their respective normal (mean) and the data were subjected to testing for significance using the correlation coefficient given as;

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2) - (\sum x^2)(N\sum y^2 - (\sum y)^2)}}$$

This is to ascertain if the climatic trends during the period under consideration are statistically significant.

3. Results and Discussion

Figure 1a-1b indicates that years with drought incidence coincide with years with high positive deviation from the 1951-2012 normal at the stations. The anomalies of annual mean temperature in Warri as presented in Figure 1a reveals that annual mean temperature was above the 1951-2012 normal for 27 years. The temperature anomalies point to the fact that climate change signal is stronger as from the 1980s in Warri. This finding agrees with the work of Gobo et al (2014) that reveals a rising temperature in Warri. Figure 1b shows the anomalies of annual mean temperature in Ondo, it reveals an increasing temperature trend, which was more in the second time slice. Also annual mean temperature was below normal in the first time slice and above normal in the second time slice. The temperature anomaly confirms that climate change is more as from the 1980s. Figure 1c shows the standardized anomalies of annual mean temperature in Port Harcourt. It reveals that below long term average persisted during the first time slice with only one year of above average temperature (1973). There is also prevalence of warm years in the second time slice with six years recording below average temperature. This also supports Odjugo (2005) and Ministry of Environment of the Federal Republic of Nigeria (2003) that observed a general increase in temperature throughout Nigeria in the last few decades. The standardized anomalies of annual mean temperature in Benin City in figure 1d shows that below long-term average persisted during the 1951-1981 period with three years of above average temperature while the 1982-2012 periods is marked with above long term average temperature with four years of below average temperature (cooling). The standardized anomalies of annual mean temperature in Calabar in figure 1e shows that below long-term average persisted during the 1951-1981 period with six years of above average temperature(warming) while the 1982-2012 periods is marked with above long term average temperature with six years of below average temperature (cooling).

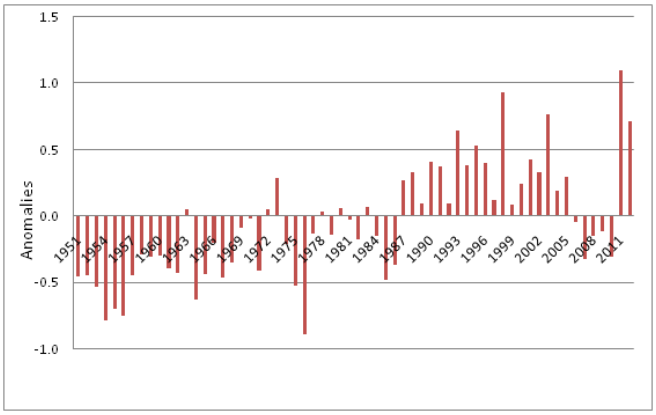

Figure 1a: Standardized anomalies of annual mean temperatures in Warri (1951-2012)

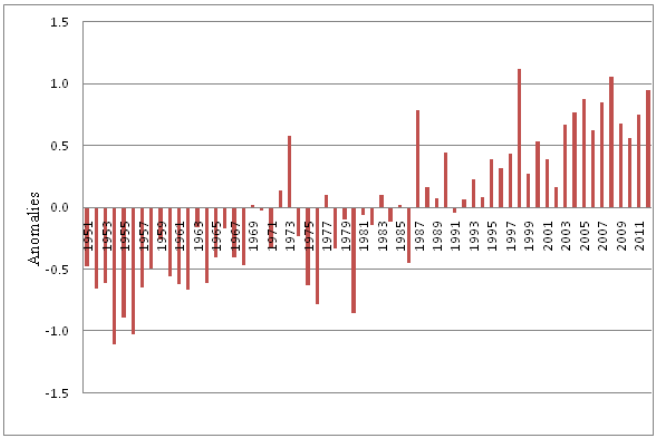

Figure 1b: Standardized anomalies of annual mean temperatures in Ondo (1951-2012)

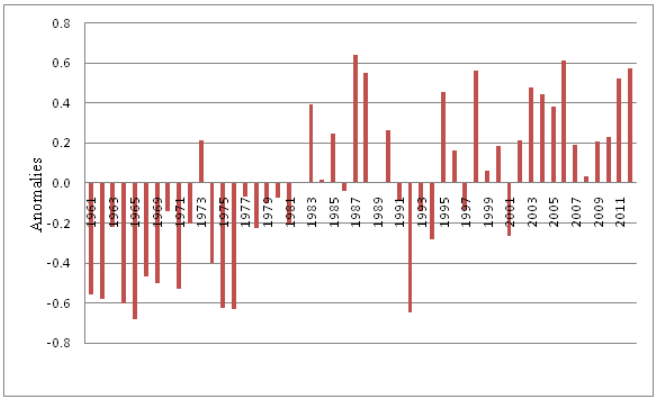

Figure1c: Standardized anomalies of annual mean temperatures in Port Harcourt (1961-2012)

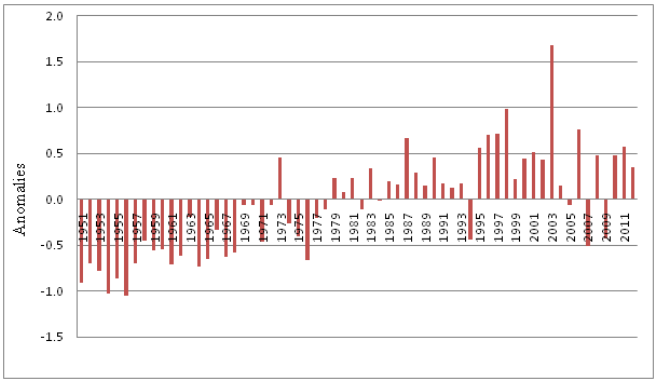

Figure1d: Standardized anomalies of annual mean temperatures in Benin City (1951-2012)

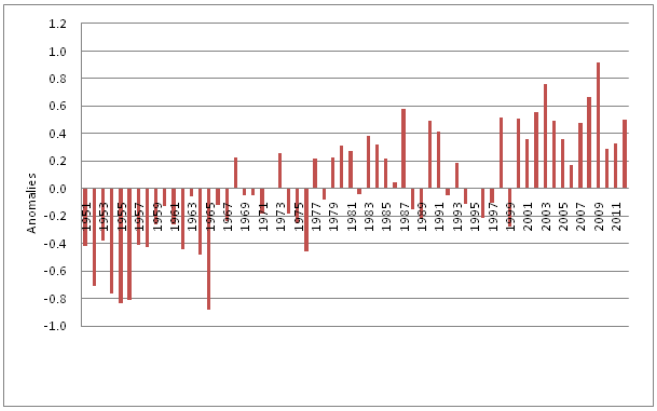

Figure 1e: Standardized anomalies of annual mean temperatures in Calabar (1951-2012)

The anomalies of annual mean temperature was marked with below long term average in the first time slice which indicates cooling while the second time slice was marked with above long term averages which indicates warming. In all the stations, temperature was below the 1951-2012 normal in the 1950s / 1960s with the exception of 1973 drought year in all the stations that were above normal. However, Odjugo (2011) stated, that temperature in Nigeria has no much increase between 1901 and 1938 but rapidly increased in the early 1970s. The mean temperature between 1951 and 1981 was 26.48^0C while the mean between 1982 and 2012 was 27.14^0C. This indicates a mean increase of $o.66^0$C for the two climatological periods. This is slightly lower than the global temperature but if this current rate of atmospheric warming continues, the Niger Delta region may be faced with rapid increase in temperature by the year 2100 in line with IPCC, 2007 projection.

Table 1: Correlation coefficients of annual trends of temperature parameters in the Niger Delta

S/N	*Temperature parameter*	*Warri*	*Ondo*	*Port Harcourt*	*Benin City*	*Calabar*
1	Minimum temperature	0.690**	0.618**	0.456**	0.671**	0.558**
2	Maximum temperature	-.646**	0.823**	0.736**	0.675**	0.692**
3	Mean temperature	0.533**	0.856**	0.696**	0.757**	0.766**

**Correlation is significant at the 0.01 level (2-tailed).

The temperature series was further subjected to testing for significance using the correlation coefficient. The result in Table 1 shows that there are significant warming trends for annual maximum, minimum and mean temperature in the period 1951-2012 across the station. The result further confirmed the earlier findings of Adesina and Odekunle (2011) that minimum and maximum temperature generally indicates an upward trend and can be ascribed to global warming. It also reveals that minimum temperature show a higher correlation value than maximum temperature in Warri. The results further support the findings of IPCC (2007) and Brito-Castillo et. al (2008) which observed that minimum temperature is increasing at a rate faster than the maximum temperature. It has also been established that dense cloud and cover affects air temperature by producing lower maximum temperature and larger minimum temperature anomalies, while cloudness skies produce larger maximum temperature with lower minimum temperature anomalies (Brito- Castillo et. al, (2008). Thus the situation there is in line with situations projected by IPCC about Africa in general. According to Christian et al. cited in Speranza (2010), the IPCC Fourth Assessment Report states that "all of Africa is very likely to warm (as a result if increase in temperature) during the century. This is already evident that there is a general increase in temperature over the Niger Delta region as a result of global warming due to increased green house gases, but sometimes disrupted by variation in some other climate related parameters in the regions.

4. Conclusion

Based on the findings in this study the following conclusions are made:

- The anomalies of annual mean temperature show that there is a statistical significant increasing trends of temperature in all the synoptic weather stations investigated which indicates warming in the region
- The trends of these temperature parameters highlighted may have contributed to climate change and its associated global warming in the region. Hence, sustainable ecological measures such as afforestation, reduced use of fossil fuel, sustainable agriculture, forest management etc are therefore recommended, since the concentration of green house gases is the main cause of atmospheric warming in the region.

References

[1] Adesina, F.A and Odekunle, T.O (2011): Climate Change and Adaptation in Nigeria: Some Background to Nigeria's Response –part II. International Conference on Environmental and Agriculture Engineering Vol 15 pg 137-145.

[2] Brito-Castillo,L Sara, C.,Castro,D., Ra'ul,S. and Herrera, U. (2008): Observed Tendencies in Maximum Temperatures in Zacatecas, Mexico and possible Causes. *International Journal of Climatology* (www.interscience.Wiley.com)

[3] Cicerone, R.J (2005) "Current State of Climate Science: Recent Studies from the National Academics," Reports of the President, National Academy of Sciences before the Committee on Energy and Natural Resources, US Senate.

[4] Ekpoh, I.J and Nsa, E (2011): Extreme Climatic Variability in North-western Nigeria: An Analysis of Rainfall Trends and Patterns, *Journal of Geography and Geology* Vol.3, No1

[5] Gobo, A.E and Eze, M. (2004): Temprature and Spatial temperature and Their Implications on Health Conditions in Port Harcourt and Warri in Niger Delta. *Journal of Environment and Earth Science.* Vol 4, No 8

[6] Intergovernmental Panel on Climate Change (IPCC)(2007) "Climate Change: Impacts Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment, Report of the Intergovernmental Panel Climate Change, Cambridge University Press, Cambridge

[7] Ministry of Environment of the Federal Republic of Nigeria. (2003): Nigeria's First National Communication under the United Nations Framework Convention on Climate Change. Landmark Publications, Lagos, Nigeria. 132p.

[8] Nzeadibe,T.C.,Egbule, C.L., Chukwuone,N.A and Agu, V.C(2011):Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria, African Technology Policy Studies Network, Nairobi, Kenya, ISBN:978-9966-1552 6-9.

[9] Odjugo, P.A.O. (2005): An Analysis of Rainfall Pattern in Nigeria. *Global Journal of Environmental Science,* 4(2):139-145

[10] Odjugo P.A.O (2011): Climate Change and Global Warming: The Nigeria Perspective; *Journal of Sustainable Development and Environmental Protection* Vol. 1(1)
[11] O'Hare, G. (2002): Climate Change and the Temple of Sustainable Development. Geography, Vol. 87(3): 234-246.
[12] Teme, S.C (2005): Effect of Domestic and Industrial activities on Climate Change. In Konya, R.S.,Gobo, A.E and Imabo, C. Edited, Minimizing Green House Gas Emission in River State, River State Ministry of Environment and Safe Earth Consult, Port Harcourt, Nigeria, pp 53-55