

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

Mangodo, C.<sup>1</sup>, Mangodo, B. O<sup>2</sup>, Ogboru, R. O<sup>1</sup>

<sup>1</sup>Forestry Research Institute of Nigeria, Moist Forest Research Station, Benin City, Edo State, Nigeria

<sup>2</sup>Semena Resources Limited, Warri, Delta State, Nigeria



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serious flooding, excessive wind and violet storm. It is observed that global temperatures have increased by 0.4<sup>o</sup>C-0.8<sup>o</sup>C with a mean of 0.74<sup>o</sup>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<sup>o</sup> C by 2100, raising fears of widespread crop failures, climate "refugees," rising seas and desertification for regions such as Sub Sahara and Kalahari

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

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

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### 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).

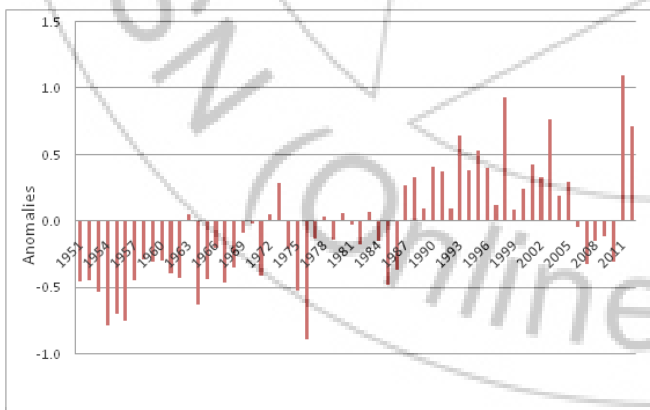


Figure 1a: Standardized anomalies of annual mean temperatures in Warri (1951-2012)

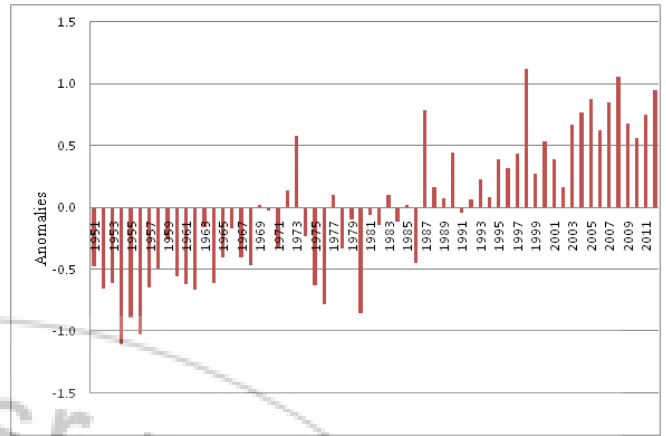


Figure 1b: Standardized anomalies of annual mean temperatures in Ondo (1951-2012)

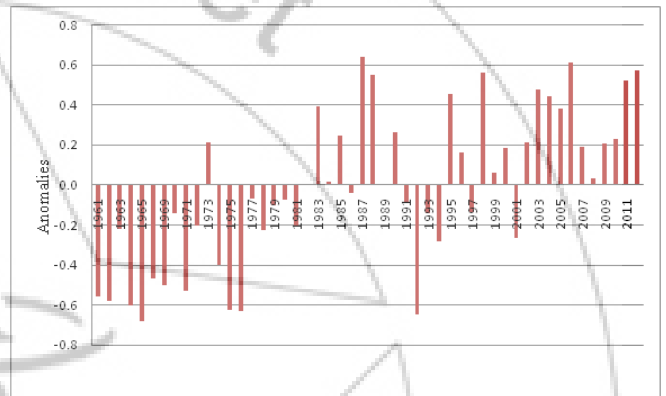


Figure 1c: Standardized anomalies of annual mean temperatures in Port Harcourt (1961-2012)

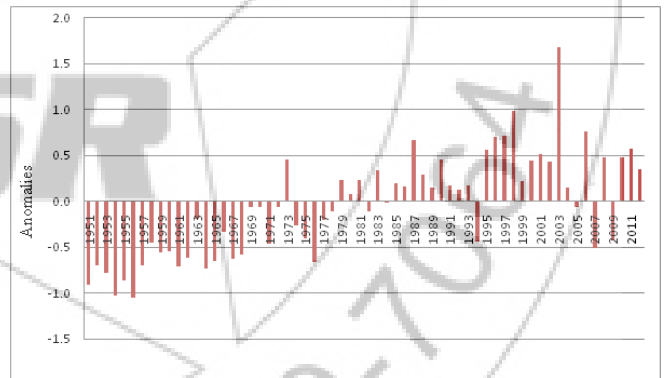


Figure 1d: Standardized anomalies of annual mean temperatures in Benin City (1951-2012)

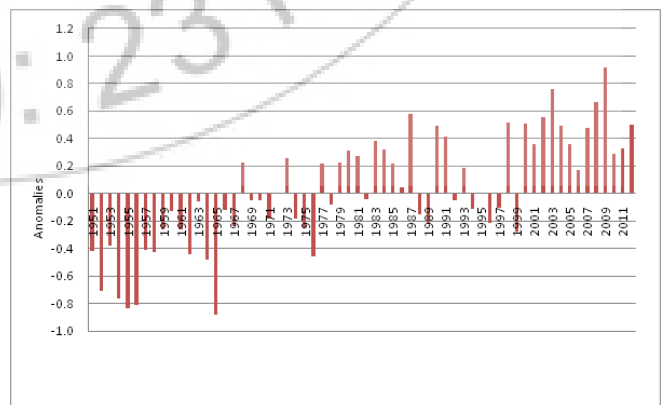


Figure 1e: Standardized anomalies of annual mean temperatures in Calabar (1951-2012)

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<sup>o</sup>C while the mean between 1982 and 2012 was 27.14<sup>o</sup>C. This indicates a mean increase of 0.66<sup>o</sup>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 cloudiness 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.

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