



An assessment of the Long-term Trends in Annual Mean Temperature using three Nonparametric Methods and a Linear Trend Analysis in some selected Nigerian cities

Nnodu Ifeanyi Daniel^{1*} and Magaji Joshua Ibrahim²

¹Department of Geography, Nasarawa State University, Keffi, Nigeria

²Associate Professor, Department of Geography, Nasarawa State University, Keffi, Nigeria

Abstract

The impact of climate change on annual mean air temperature has received significant attention from scholars worldwide. Many studies have been conducted to demonstrate that changes in annual mean temperature are becoming evident globally. This study focused on detecting trends in annual mean temperature in six stations in Nigeria: Calabar, Lagos, Enugu, Abuja, Kano, and Maiduguri. Three different widely used nonparametric methods of Mann-Kendall, Innovative Trend Analysis, Sen's Slope Estimation, and a Linear Trend Analysis method were used on time series data for each of the stations for 50 years (1971 to 2020) to detect trends and estimate the trend magnitude at a 5% significance level. This study analysed yearly mean temperature trend values and found that the Innovative Trend Analysis (ITA) is more effective in detecting trends than the Mann-Kendall (MK) method. The results obtained from ITA, Sen's Slope Estimation (SSE), and Linear Trend Analysis (LTA) showed good agreement. All stations, except Enugu, indicated statistically significant increasing trends. The Linear trend line plot also indicated increasing temperature trends ranging from 0.007 to 0.03 °C/year (0.07 to 0.3 °C/decade) range compared to the global annual mean temperature which has increased at an average rate of 0.08°C per decade since 1880 and more than twice that rate (0.18°C) since 1981 as reported by NOAA. Similarly, Sen's results indicated that the magnitude of the temperature trend ranged from 0.005 to 0.035 °C per year, or 0.05 to 0.35 °C per decade. Climate models predict that increasing trends will continue in the 21st century and slow down if greenhouse gas emissions are drastically reduced. Analyses of trends in West Africa averaged over all available land stations in the region over the past 50 years, revealed statistically significant increases in annual mean temperature indices. Specifically, the mean annual maximum temperature increased by 0.16°C per decade, and the mean annual minimum temperature increased by 0.28°C per decade (Barry, A.A. et al, 2018). The MK, ITA and linear trend line indicated a decreasing trend of 0.01°C for Enugu.

Keywords: Temperature trend, Mann-Kendall, Innovative Trend Analysis, Sen's Slope Estimation, Linear Trend Analysis, Autocorrelation, Climate Change.