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INVESTIGATING THE ANTHROPOGENIC GLOBAL WARMING IN ILORIN AND SURROUNDINGS

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Abstract

The blanketlike covering of the earth's-near-surface-air by greenhouse gases which has made the planet to be habitable by living things, has been threatened in recent times by technological and other pollutants. British Broadcasting Corporation (BBC) statement of 6th October 2008, that the protective ozone layer is being depleted at the rate of 6% every 10 years by human activity, is a matter for serious concern. The increase of the anthropogenic GHGs has trapped more heat energy in the earth's-near-surface-air, thus causing global warming. Ilorin recorded a highest temperature of 40^{o}C in one day of February 2005 and had an increase of 2^{o}C over the 2003 to 2006 period. The highest pressure at Ilorin was 76mbar in 2003 and the lowest was 60.1mbar in 2004. The average variation between 2003 and 2006 was 4mbar. The windrun was not high but significant for the region, the highest recorded as 53.15m/s in 2005. The average variation in the windrun was 5m/s. By the use of multiple regression technique, equations were developed for predicting the climate change variables of maximum and minimum temperatures, pressure and windrun. The equations were found to be directly dependent on the products of the climate change variables and the coefficients to be estimated from the ANOVA. About 80% of the GHG emission at Ilorin is from automobiles. The minimal level of atmospheric carbon pollution puts Ilorin at an advantage in the Carbon – Trade. Joining the carbon market will cause the industrial world to invest by bringing environmental friendly technology and funds to Ilorin.

Keywords: Air, greenhouse, carbondioxide, ozone, carbon-trade, cap-and-trade, multiple regression, variance, hypothesis, offsets, blanket

1.Introduction

If there is anything that constitutes a direct threat to the existence of human life on the planet earth, it is global warming. It is only second to direct destruction through atomic nuclear energy discharge. It is a phenomenon that is so serious that the United Nations Environment Programme and the World Metrological Organisation constituted the Intergovernmental Panel on Climate change (IPCC) in 1988 to address the matter. Global warming (GW), which is also known as the Greenhouse effect (GE), is the increase in the average temperature of the earth's near-surface-air and oceans in recent decades and its projected continuation, Hegeri, [1]. GE is a process by which absorption and emission of infrared radiation by atmospheric gases warms the earth's atmosphere and surface. It was discovered by Joseph Fourier in 1824 but was first investigated quantitatively by Svanto Arrhennius in 1896. The global average temperature near the earth's surface rose 0.74± 0.18^{o}C during the last 100 years. By the IPCC record, the year 1998 was the global warmest year on record. The average temperature of the earth's near-surface air increased by 0.5^{o}C since 1950 and will continue to rise at an increasing rate.

The IPCC consist of a panel of more than 2500 Scientists from 60 countries all over the world. The scientists of the IPCC consist of Climatologists, Ecologists, Ocenographists, Medical personnel and Technologists. It is a climate model proposed by this group that the global surface temperature may rise from 1.4^{o}C to 5.8^{o}C by end of 21st century, assuming 1990 as base temperature rise 0^{o}C, that had gingered the governments all over the world into action to save our planet. Increase in surface air temperature has caused glaciers to melt at the Arctic and Antarctic poles, a process which has increased the sea water level. The rising sea levels has led to coastal flooding in some regions. Surface air temperature increase has caused draught and water shortages in other regions. It has also fueled intense hurricanes and cyclones in the Atlantic and pacific coastlines. The surface air temperature increase as a result of GW has caused forest fires that has increased the atmospheric CO_2 content which has further raised GW. It is a vicious circle seeing that increased damage is being done to man, his natural environment and the ecosystem.

Global warming (GW) or greenhouse effect (GE) is analogous to the greenhouse structural cubicles built by agriculturists with glass or plastic sheets which trap heat energy and allows the inside of the structure to maintain a regular temperature. Similarly, greenhouse gases in the atmosphere like carbon dioxide (CO_2), water vapour (H_2O), methane (CH_4), nitrous oxide (N_2O) and few others, reflect heat energy back to the earth's surface, forming a blanketlike cover for the earth' surface. The earth is 33^{o}C warmer than it would have been as a result of the atmospheric blanket of the greenhouse gases. These gases have their molecules composed of component atoms that are bound loosely enough together to be able to vibrate with the absorption of heat. The vibrating molecules then emit the radiant energy to another greenhouse gas molecule. This heat energy transfer process of absorption-emission-absorption serves to retain most of the heat near the earth's surface. The earth's surface is thus effectively insulated from the cold of space.

The sun produces radiant energy in the visible and near-visible spectrum. The visible narrow bend of light is between 450 and 700nm and represent 43% of total radiant energy emitted to the earth. It is in the short wavelength but of extreme importance because of its high energy per photon. The shorter the wavelength the more energy it contains. A wavelength shorter than the visible wavelength accounts for 7 to 8%. This spectrum of the ultraviolet is the one that causes sun burn and skin cancers. The remaining 49 to 50% of the radiant energy is spread over the long wavelength in the near infrared range of 700 to 1000nm, the thermal infrared (between 5 and 120 microns), and the far infrared regions Amman, C. 2007. The atmosphere is quite transparent to visible light. The ultraviolet and infrared radiation from the sun are either absorbed by earth surface, or by the clouds, while some are reflected by the earth, cloud or atmosphere. About 51% of the ultraviolet and infrared solar radiation is absorbed by the earth, and 19% is absorbed by the clouds. About 20% is scattered and reflected by the clouds, while 6% is scattered by the atmosphere, and 4% is reflected by the earth. This means that about 70% of the sunlight that strikes the earth is absorbed by our planet and its atmosphere, while the other 30% is immediately reflected Amman, C. 2007. Therefore, if the earth did not re-radiate most of the newly absorbed energy back into space, the world will get warmer and will eventually become too hot for human life to survive. Clouds and greenhouse gases keep the earth warm and the temperature increases as these gases increase.

The greenhouse gases that have effect of increase the earth's temperature are water vapour, carbondioxide, methane, nitrous oxide, CFC, HFC, HCFC, and ozone. Some of these gases exist naturally, others are due to human activities, while others are as a result of natural as well as human activities. There are 3 factors which determine the contribution of each of these gases to GW. They are firstly, the atmospheric lifetime the gas will remain in the air. For instance, CO_2 has an atmospheric lifetime of 100years. Secondly, how effectively has the gas prevented the passage of infrared radiation, or what is the global warming potential (GWP) of the gas. For example the GWP of CO_2 is 1, that of methane is 11, while that of HFC is a closed 1500. Thirdly, the volume of these gases in the air, that is the atmospheric concentration measured in parts per million (ppm), determines their GW effect, Vinton, N. 2006. The burning of fossil fuel, oil, gas and coal from our refineries and power plants are the major source of CO_2 in the atmosphere. Bush fires and volcanoes are also sources of CO_2 supply into the atmosphere. The gas nitrous oxide N_2O occurs naturally and is also as a result of fertilizer usage.

As a result of the attack on ozone layer, CFCs and HCFCs are being phased out of use. They are to be replaced by HFC which though powerful with GWP 1500 is however short lived in the atmosphere. Ozone layer is found in the stratosphere between 10Km – 50Km above sea level, and at ground level also. Life on the earth's surface will be impossible without the protection of life from the damaging ultra-violet sun radiation. Ozone layer filters out the UV-B radiation and allows only the useful rays for living things to pass through. The origin of the ozone layer took place million of years ago when oxygen, from the photosynthesis of micro-organism living underwater on earth, was released into the atmosphere where it reacted with the incoming UV radiation to form ozone. Filtration of the UV-B radiation by the ozone layer permitted the evolution of living species on land which were no longer limited to underwater protection. The ozone layer had been known to break and reform naturally in the past. But in recent times, human activities had generated ozone depletion gases which attack and cause the layer to have holes. The manufacture and use of synthetic chemical compounds known as CFCs and HCFCs, that are used in refrigeration, aerosols, solvents and foam insulation, have caused these gases to escape into the stratosphere. A small amount of these compounds have formed a chain-reaction which has destroyed a large quantity of the ozone, such that it is breaking down more quickly than it is forming. There is the danger that unless humans curb the generation of GH and ozone depletion gases, our earth will become impossible to live on. As UV-B \radiation will pass through holes in the ozone layer and GH gases will increase the earth's air temperature.

Ozone depletion allows UV-B radiation through which causes health problems to human beings. It causes skin cancer and eye disease. It attacks marine environment where it reduces the number of phytoplankton, photosynthesizing organism in the sea which absorb CO_2 from the atmosphere helping to reduce global warming and also form the base of the marine food supply. The UV-B radiation also destroys young fish, shrimp, crab larvae and small animals. Agriculture and plant life is affected by UV-B radiation. Crops and plants experience stunted growth and are open to pest attack and diseases. When exposed to UV-B radiation, plastic materials undergo photochemical reaction which causes their properties to change and degrade, Vinton [2]. Gases like suphur dioxide, SO_2, and nitrogen oxide NO_x are known as acid gases. This is because they react with the cloud and water vapour in the atmosphere to form dilute sulphuric acid and nitric acid. SO_2 and NO_x originate from chimneys of coal and oil fired power stations, road transport vehicles and other machines. When they are airborne they are converted to dilute sulphuric acid and nitric acids. They then fall to the ground as “acid rain” which attack building structures, human beings, crops and the earth’s surface. Global warming, acid rain, ozone layer depletion, and ground level ozone pollution which are of serious threat to human life on earth, are all of technological origin. Majorly the principal offending gas CO_2 is an end product of the technological processes. Flared gases at refineries and power plants, road transport vehicles and farming machine exhaust fumes are the main producers of CO_2 to the atmosphere. Refrigerators, aerosol, solvents, foam insulations and fertilizers are main CFCs and HCFCs sources which attack and destroy the ozone layer, Jaffe [3]. The concern of this work is to study how technological processes have affected climate change in Ilorin and its surroundings. The technological processes in industries, power plants, refineries, road and air transport machines, have produced greenhouse gases which had brought some climate change over the period of year considered.

2. History Of Global Warming and Contribution Made

Svante Arrhenius who lived in 1859 – 1927 was the first to discover that the concentration of CO_2 in the atmosphere affect the earth’s surface – air temperature. He found the surface – air temperature of the earth around where he lived to be 15^{o}C because of water vapour and CO_2, which became known as the greenhouse effect, Maslin [4]. Arrhenius realized that increasing the CO_2 also increased the surface – air temperature. He and Thomas Chamberlin recognized that human being could endanger the earth by adding CO_2 to the atmosphere. This discovery was verified in 1987. Development in infrared spectroscopy revealed that increased CO_2 in the earth’s surface –air increased the absorption of infrared radiation. Gilbert Plass concluded in 1955 that increased CO_2 in the earth’s surface – air, trapped infrared radiation and caused the earth to be warmer. Modern techniques that use concentration curves for CO_2 in the atmosphere in the regions of Mauna Loa and Antarctica were introduced in the late 1950’s and early 1960’s. The curves became a symbol of global warming, a projection of which showed a reduction in temperature from 1940 – 1970. In 1976, Stephen Schneld was the first scientist to predict global warming. The temperature rise that brought concern started in the 1980’s. Environmental NGOs began to show concern and advocate the prevention of global warming in the late 1980’s. Since then, the IPCC was formed, consisting of 2500 scientists and technical experts from over 60 countries. The IPCC had put forward theories, data and models for global warming which is contested by other scientists. But the effect of global warming is felt by everyone, and because it is a universal problem, most of the nations negotiated the Kyoto Protocol of 1998. They were required to reduce their anthropogenic greenhouse gas emissions (CO_2, N_2O, HFC, PFCs and SF_6) by at least 5% below the 1990 levels. The Kyoto Protocol was eventually signed by 186 countries in Bonn in the year 2001. It is of interest that the world’s greatest GHG producer, the United State, refused to sign the agreement to cut its emission. Australia only signed up in March 2008.

2.1 Carbon Trade

An important development in AGW was the introduction of the Carbon Trade by the IPCC. The Kyoto Protocol agreed on “caps” or quotas on the maximum amount of GHG for developed and developing countries (about 170 countries). These quotas are on the emission of machines installed by businesses. National registries are set up in each country which are monitored and validated for compliance by the UNFCCC. The Carbon Trade are done in monetary terms where each unit of credit gives the owner the right to emit one metric tone of CO_2 or equivalent GHG for the agreed period, Starvins [5]. This is known as “cap”. When operator did not use up their caps, they can sell them while companies that are about to exceed their allocation can buy the extra as credits. The buying is done openly in the market or privately. The total emissions are compulsorily kept within the cap, hence the term “cap – and – trade”. Emitting below the cap means such a company can sell the credit, while emitting above the permitted GHG makes it mandatory for the business to buy carbon credit worth its extra GHG emission.

The Kyoto Protocol sets 3 operating factors for acquiring GHG reduction credits in developed countries

1. Through Joint Implementation (JI) a developed country which has relatively high costs of domestic greenhouse reduction will set up a project in another developed country.
2. Through the Clean Developed Mechanism (CDM), a developed country can pay for the GHG reduction project in a developing country with lower cost GHG reduction project as long as the atmospheric effect is globally equivalent. The developing country receives the capital investment, clean technology or beneficial change in land use.
3. Through the International Emission Trading (IET) countries with surplus international carbon credits can sell them to countries with capped emission commitments. Most of the transactions in carbon trade are not carried out by national governments, but by operators who have quotas or caps set for them by their countries. It is observed that capped countries take themselves to be disadvantaged against those in uncapped countries (like USA, China and India) as they are paying for the carbon costs of the uncapped countries, Jaffe [3].

2.2 GHG Offsets

Offsets are an effective way of reducing GHG emissions outside a cap – and – trade system. In a cap – trade – system, emissions are covered and capped by regulations. But there are other emissions which remain outside the practical or economic reach of regulations because of their location, size or other reasons. These uncovered emissions may sometimes be greater than covered emissions. Hence, “compliance offsets” represent the reduction, removal or avoidance of uncovered GHGs emissions so as to offset emission in covered regions, Starvins [5].

The global market in carbon trade is known to be increasing at an alarming rate. It increased from $10 billion in 2005 to over $30 billion in 2006. In the year 2007, it doubled to $64 billion US dollars. The EU- emission rights is trading today at US $50 billion. The Carbon Trade attracted 2419 visitors and 222 exhibitors to Colonge in 2007. In 9 May, 2008, under the caption CARBON EXPO, the Carbon Trade organized a trade fair and conference which attracted 300 visitors to Colonge from more than 115 countries. About 258 exhibitors from 60 countries participated. The organizers were Koelnmesse, the World Bank, and the IETA. The purpose was to share experiences and gain knowledge of current topics and trend, technologies, projects and services. 150 leading carbon market practitioners, developers, market movers and experts attended the Carbon Expo. New technologies like carbon capture and storage, green investment schemes (GIS), auctioning and allocation, trading action, pricing trends and future developments now and post 2012 were discussed, Jaffe [3].

3. Identification of Problem

This work investigated the effect of climate change as a result of global warming because of GHG emission in Ilorin and its surroundings. Since this effect is translated to changes in temperature, pressure and earth's – near – surface air movement (wind run), an investigation of these elements for the year 2003, 2004, 2005 and 2006 was found to have given sufficient insight into climate change in this region.

4. Theoretical Analysis

4.1 Maximum Temperature Model

The model for multiple regression was used for maximum temperature as a dependent variable. It was linked to the other variables of month, year, pressure, wind run and minimum temperature such that;

$$\begin{aligned} \textit{Multiple Regression for Maximum Temperature} &= b_o + b_1\,month + b_2\,year + b_3 \max temperature \\ &\quad + b_3 \max temperature + b_4 \min.temperature + b_5\,windrun \end{aligned}$$

where β_1, β_2, β_3, β_4,and β_5 are coefficients to be estimated from the analysis of variance (ANOVA). From Table **11.3a(2)**, F = 150.31 with P – value = 0.000 at $\alpha = 0.05$. The P- value showed that the model was significant. From table **10 1(a)**2, the column p –value with variable less than 0.05 was found to be significant. It was observed that the month, year, minimum temperature, pressure and constant term were found to be significant. The value of maximum temperature for the model is state as;

$$\begin{aligned} \textit{Maximum temperature being } & 72.31157 - 0.21128\,month - 0.29780\,year + 0.130337 \min.temperature \\ & - 0.56468\,pressure + 0.014286\,wind\ run \end{aligned}$$

This model is the appropriate model for predicting maximum temperature in Ilorin and environment.

4.2 Minimum Temperature Model

When applied to minimum temperature the model is;

$$\begin{aligned} \textit{Multiple Regression for Minimum Temperature} &= b_o + b_6\,month + b_7\,year + b_8 \max.temperature \\ &\quad + b_9 \min.temperature + b_{10}\,wind\ run \end{aligned}$$

where β_0, β_6, β_7, β_8, β_9, β_{10} are coefficients that are estimated from the analysis of variance (ANOVA) using values from Table 2 to 5. From Table **11:3 b**(2), F = 63.89 with P – values = 0.000 at $\alpha = 0.05$.

The month, year, maximum temperature, wind run and the constant term have their P-values less than 0.05. The value of minimum temperature for the model is given as;

$$MinimumTemperature = 19.70363 - 0.24302\,month - 0.43839\,year + 0.092992\,\max imum\,temperature + 0.03353\,swind\ run + 0.018462\,pressure$$

4.3 Pressure Model

The multiple regression model for pressure was also used on the variables of month, year, maximum temperature, minimum temperature and wind run, so that;

$$\Pr essure = b_0 + b_{11}\,month + b_{12}\,year + b_{13}\max.temeperature + b_{14}\min.temperature + b_{15}\,wind\ run$$

where β_0, β_{11}, β_{12}, β_{13}, β_{14},and β_{15} are coefficients that were estimated from the analysis of variance as shown on Table **11.1** (b). The values of F = 103.35 with P – value = 0.000 at $\alpha = 0.05$ showed that the model is significant. The final value of pressure is given in the model equation;

$$\Pr essure = 85.85419 - 0.03708\,month - 0.17506\,year - 0.43197\max.temperature + 0.01979\min.temperature + 0.01153\,wind\ run$$

4.4 Wind Run Model

The model for multiple regression for the wing run is also given in;

$$Wind\ run = b_0 + b_{16}\,month + b_{17}\,year + b_{18}\max.temeperature + b_{19}\min.temperature + b_{20}\,pressure$$

From ANOVA on Table **11:2** (b), F = 508.91, P-value is 0.000at $\alpha = 0.05$, so model is significant and wind run equation is;

$$Wind\ run = -42.04159 - 0.03498\,month + 10.61868\,year + 0.180045\max.temperature + 0.59237\min.temperature + 0.18999\,pressure$$

5. Methodology

Data for temperature, pressure and wind run for the years 2003, 2004, 2005 and 2006 were collect from the Meteorological Department for weather at the Ilorin Airport. Analyses of these data were carried out. The results of the analysis were graphically presented in Figs 1 – 4 below. They are the graphs of the mean temperature, pressure and wind run for the years 2003 to 2006.

6. Discussion of Results

The analysis of variance (ANOVA) was used to explain the four climate factors (variables). These factors were maximum and minimum temperatures, pressure and wind run which varied between the months and years being considered. The ANOVA indicated that the climate factors were significantly different as the months went by. The four climatic factors were not the same in the period considered (2003 to 2006).Two hypotheses were used for maximum temperature ($\acute{T}$). These were H_o and H_1, where Ho assumed $\acute{T}$ not to change from January to December and H_1 stated that $\acute{T}$ varied from month to month. From the analysis, F = 275.629 and p – value = 0.000 at α = 0.05. Therefore, the null hypothesis H_o was rejected. For the next stage, a check was carried out to find which of the months $\acute{T}$ was similar and those that were different from one another. The months of August, July, September, June, October and May had their $\acute{T}$ distinctly different from one another. The months of November, December, January and April have their $\acute{T}$ not different from each other and so were February and March. When ANOVA test was used for the 3 variables over the 4 years period, the hypothesis H_o was again rejected, the $\acute{T}$ differed from 2003 to 2006. 2006, 2005 and 2003 had the same $\acute{T}$ while the year 2004 was different from the rest. A temperature increase of 2°C on average was observed for 2003 to 2006, Fig. 1. For the minimum temperature $\grave{T}$ within the groups, F = 76.989 with P – value = 0.00 and α = 0.05, the null hypothesis varied. The minimum temperature was significantly different from month to month. August, September, July, October and June had the same $\grave{T}$.

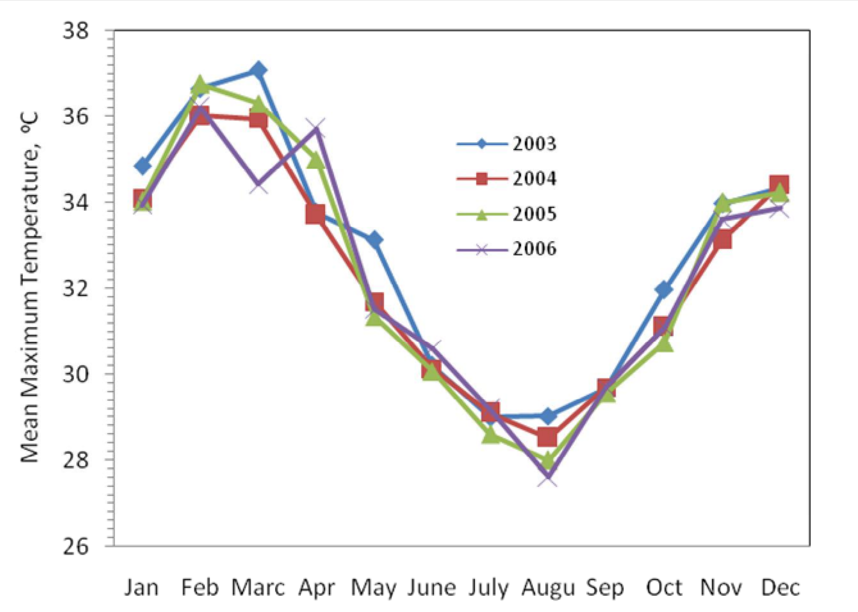

Fig. 1: Graph of Mean Maximum Temperature for the Period 2003 to 2006

Likewise February, April and March had the same $\grave{T}$. The null hypothesis when applied from 2003 to 2006, for minimum temperature $\grave{T}$, F=5.647 with P – value = 0.01 at α = 0.05 was rejected. It was concluded that $\grave{T}$ did differ over the period. The years 2006 and 2004 have different minimum temperature while the years 2003 and 2005 had the same minimum temperature. The hypothesis used for pressure was that pressure was not significantly different from January to December, and that it varied from January to December, i.e F= 44.264 with p – value = 0.000 and since the p – value was < 0.05, the null hypothesis was rejected. The pressure was significantly different from month to month. The month of February had different pressure than other months, while the months of March, April, November, February and December had their pressures similar or the same. The months of October and May had the same pressure. Also the months of June, July, September and August had the same pressure. F = 5.966 with P-value = 0.000 and $\alpha = 0.05$. Since P-value was less than 0.05, H_o was rejected and it was concluded that pressure was significantly differently over the period 2003 to 2006. It was also observed that the year 2004 was distinctly different from the other years. Years 2003, 2005 and 2006 had the same pressure. For the windrun, F= 1.873 with P-value of 0.039 at $\alpha = 0.05$. Hence the null hypothesis was rejected and the conclusion was that the windrun was significantly different from month to month. The months of June and April had distinct windrun that were different to the other months. The other 10 months had almost similar windrun. When the windrun for the period 2003 to 2006 was considered, i.e, F = 2122.850 with p – value = 0.000 and $\alpha = 0.05$. Again with p-value < 0.05, the null hypothesis was rejected and the conclusion was the windrun was significantly different from 2003 to 2006. It was observed that year 2003 and 2004 had almost similar windrun while years 2005 and 2006 are distinctly different from each other and different from the other years as well. The graphs shown on Figs. 1, 2, 3 and 4 represented the 4 climatic factors (variables) over the period of the test. They are graphs of mean values that did not show specific high or low values, but reflected the mean of the monthly readings. They therefore represented true climatic variations over the period of the test. A mean deviation in temperature of 0.5^{o}C over 4 years gave a maximum temperature increase of 2^{o}C.

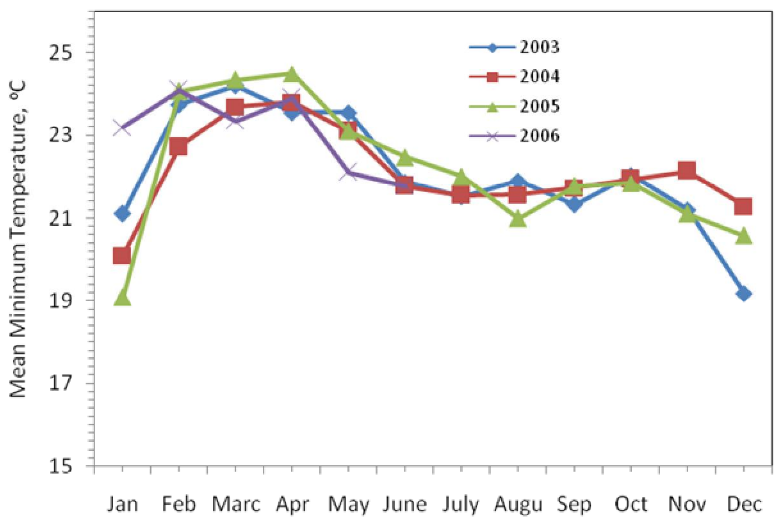

Fig. 2: Graph of Mean Minimum Temperature for the Period 2003 to 2006

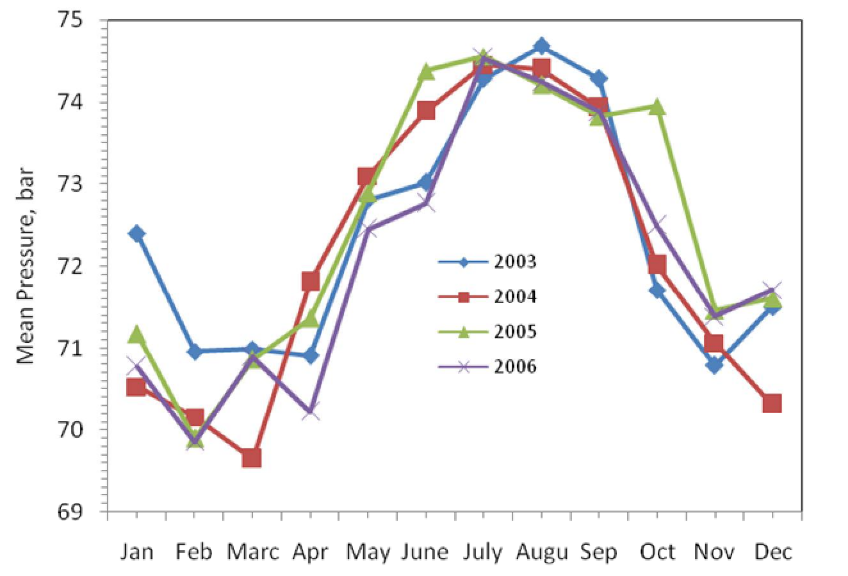

Fig. 3: Graph of Mean Pressure for the Period 2003 to 2006

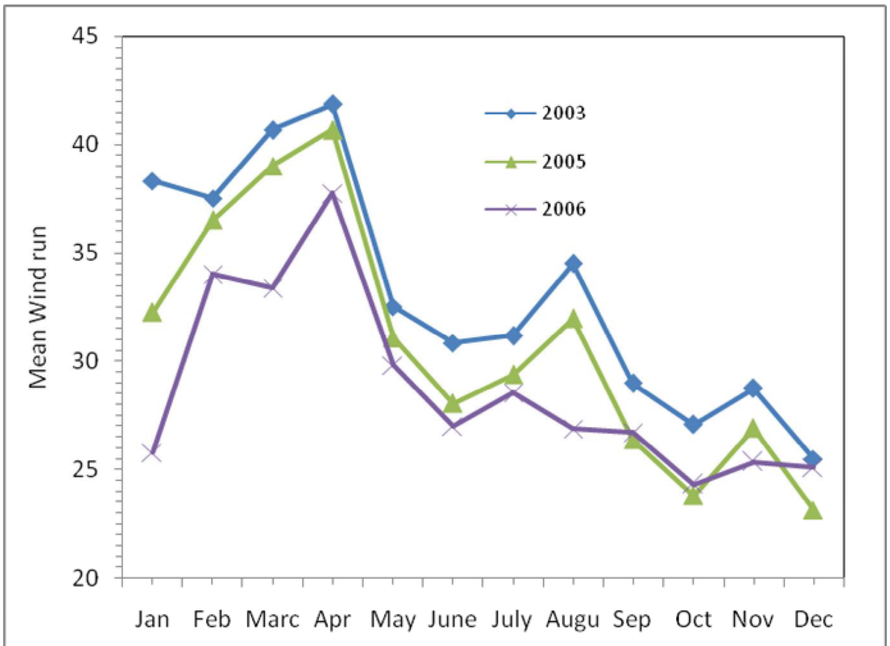

Fig. 4: Graph of Mean Windrun for the Period 2003 to 2006

Fig. 3 showed an average of 1mbar increase over 4 years which gave a maximum increase of pressure of 4mbars for the period considered. Fig. 3 also showed the characteristic curves for pressure to be opposite to that of maximum temperature with the peak between January and early May.

As expected the graphs of mean windrun, Fig. 4 showed the peak and depression in agreement with those of the mean maximum temperature, Figure 1. The peak of the curve was from February to April, and the depression from May to October. High windrun accompanied high temperature, and low windrun followed low temperature. When Figure 3 was compared with Fig. 4, the period of low pressure did attract high windrun and vis- a-vis. An increase of 5m/s was recorded on average over the period of 20034 to 2006.

7. Conclusion

The models for the multiple regression of the four climatic factors of maximum temperature, minimum temperature, pressure and windrun, were determined for Ilorin and its surroundings. The climatic factors or variables were found to be significant and pointed to the fact that GHG emission had affected Ilorin and its surroundings. A temperature increase of 2^oC was recorded between 2003 and 2006. The model for pressure showed that it was significant in the period investigated. The increase of pressure over the 20034 to 2006 period was 4mbar. It was significant to have observed that months of low pressure accompanied months of high temperature. Therefore high winds and storms were experienced in the December to May period, and floods in the June to October period. The wind movement was not high but significant. The average variations in the windrun were 5m/s for the period under test.

Climate change has affected Ilorin and its surroundings, as observed by the increase in temperature and windrun. Also pressure had been found to have dropped in the months temperatures and windrun had increased. This escalated the heat waves in the city, increase the storms relatively. Rivers overflowed their banks to the level that had not been experienced before.The GHG emission that was responsible for the climate change in Ilorin was due mainly to the proliferation of automobiles between the years 2003 to 2006. Automobiles were known to have increased by over 100% between those periods. Industrial emission from power stations and manufacturing processes were less than 15% of the total emission because Ilorin is not an industrial city. The GHG emissions were mainly from automobile CO_2 discharge, accounting for about 80% of the discharge. Wind transported GHGs from neighbouring towns like Lagos, PortHarcourt, Aba, Nnewi, Ibadan and Ogbomosho to the South, and Kano, Jos, Kaduna, Minna and Abuja to the North, accounted for about 5% of the emission in Ilorin.

7.1. Recommendation

1. GHG emission is a matter to be taken very seriously as man is likely to destroy this planet, if care is not taken. Ozone layer depletion will cause this planet to be too hot to sustain life.
2. Refrigerators, aerosols, foam insulators and fertilizers are main CFCs and HCFCs sources which attack and destroy the ozone layers. They should as a matter of urgency be replaced by the modern appliances that are made from ozone friendly gases like HFC which although with GWP= 1500 do have fairly short life in the atmosphere. It should be government policy that

importation of refrigerated appliances be restricted to those that use HFC gases to protect the ozone layer.

3. Automobile pollutants from CO_2 gases account for about 80% of Ilorin GHG emission. Therefore automobiles that use new technology, which run cleaner and burn less fuel, should be allowed into the country.
4. Modernized power plants and electric generators with minimal or no pollution should be allowed, and the government should promote the efficient use of electricity.
5. The government should increase the people's reliance on renewable energy sources such as wind power, solar energy and geothermal.
6. This nation should join the Carbon Trade of the IETA. That way the nation will benefit from the cap – and – trade scheme of the IETA. Since it emits far less CO_2 to the atmosphere than the industrialized nations, they will pay development levies to Nigeria in cash and in environmental safe technology to compensate for the pollution of its atmosphere

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