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Exploring Pressure-Temperature Trends toward Climatic change in Ikogosi

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Abstract. Global warming is sketching the isobars on weather maps in a different way, owing to new patterns and their climatic imprint. Climatological reports have shown that atmospheric pressure fluctuations in the past five decades has strong affiliations with human stimulus. Any infinitesimal change in air pressure could produce a dramatic climatic effect, such as wind, precipitation, diurnal perturbations and storms. Pressure in air is the pointing device for atmosphere's circulation, and consequently, determines how humidity circulates. Progressive studies on air pressure from both experimental and theoretical sources have corroborated with each other. The potential for atmospheric pressure is a function of the individual sum of oxygen, carbondioxide, water vapor, nitrogen, and noble gases in air. Although, it is difficult to predict the life span of these atmospheric gases, we cannot assume that the abundance of either of these gases has remained constant over geologic time. This study focuses on analyzing weather changes in Ikogosi SW Nigerian, in conjunction with pressure for almost four decades, using curve fitting regression analysis and statistical methods relative to direct plots. The result reveals exponential trends of growth in pressure-temperature measurement indicative of weather change. In view of this, recommendations are given based on indices of measurement shown by occurrence and the force of atmospheric pressure.

1. Introduction

Planet Earth is largely getting unhabitable owing to the presence of two core greenhouse gases, CO_2 and water vapor, they act as a blanket for trapping radiated heat emanating from the earth's surface [1]. In effect, these gases are responsible for controlling the mean global temperature context for evolution of life [2]. The atmosphere devoid of its prevalent condition would possess a global mean temperature of about −18 °C, aquatic life would be the dominant sphere [3]. In previous studies, the focus has been on the greenhouse effect on Earth consequent of direct absorption of water vapor and CO_2 by atmospheric species with radiative forcing's of approximately 80 W/m^2 and 30 W/m^2 correspondingly [4]. Nevertheless, atmospheric pressure is acting in a serious capacity by enlarging the infrared lines of absorption of these gases when they collide with other gaseous species, such as O_2 and N_2 present in the atmosphere [5]. By illustration, if the atmospheric pressure was less, greenhouse climate forcing gases would be less, greenhouse effect would be reduced, and global mean temperature would nosedive [6]. Artificial or natural mitigation of Earth's atmosphere would in effect enhance the longevity of the biosphere due to Geochemical and geobiological processes that have altered the course of history of the atmospheric pressure [7]. In the first case, regulation of atmospheric pressure in the atmosphere is by photosynthetic cyanobacteria, green plants and in algae. Secondly, the mixing ratio of N_2 exerts the highest stimulus on enlargement of pressure bands on greenhouse gas absorption [8]. In congruence,

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pressure is directly proportional to physical quantities like density, temperature and volume. Thus, warm surfaces heat up the air above them in the atmosphere, instigating the air to become less dense and rise [9]. A gradual build-up of this process develops into clouds and precipitation in convection current, similar to doldrum of low pressure. Conversely, high pressure accumulation in the atmosphere is the source of air compression resulting in clear weather conditions [10]. The effect of atmosphere disperses swiftly as one travels in the direction of space, and makes air pressure dwindle at the same time. Temperature and moisture exert significant effect on air pressure, this is accountable for cool air being denser than warm air. However, moist air is essentially less dense than dry air, thereby causing it to rise more easily to form clouds [11]. In addition, humidity in air causes a heavier weight as a result of additional water vapor molecules being inhaled, this extra air moistness lessens sweat [12]. The tropopause extends over warm tropical regions than cold polar areas because, air pressure is constant in value but cold air is denser and has smaller volume. In order to attain equilibrium, air transports occur from warmer to cooler areas. This gives rise to a preliminary increase in air pressure in the cold column and subsequent decline in air pressure in the warm column. As soon as the temperatures are equivalent, the volume, pressure and height would equalize, this is the principle that governs air transport in the atmosphere [13]. These Changes in **air pressure** could bring about massive changes in climate, this study seeks to investigate the extent these changes can go, relative to Ikogosi in future.

2. Methodology

The meteorological data for 456 months of Ikogosi SW Nigeria, located in a tropical rainforest characterized by approximately undeviating temperature through the year with the annual mean temperature fluctuating between 21°C and 28°C and high humidity. The source of data was MERRE, it was plotted with ORIGIN software. Graphical plots of Temperature -Atmospheric pressure for approximately four decades are as illustrated in Figure 1. Regression curves were fitted for each of the months and further analysis was done with analysis of variance - ANOVA.

3. Results and Discussion

3.1. Temperature-Pressure Graphs

All the plots in Figure 1 depict a sinusoidal characteristic, it is notable that this occurs for a temperature mean drop of $13^{o}C$ and $17^{o}C$ and yet, there are several points of confluence in the temperature and pressure. In general Physics, boiling occurs at a temperature when saturated vapor pressure equals external atmospheric pressure. In this case, vapor pressure of the atmospheric gases grows sufficiently to allow bubbles of vapor to form inside the bulk of the atmosphere. This boiling point temperature of the atmospheric fluid comprising of gases and water vapor, varies with the ambient environmental pressure. Consequently, regions in Ikogosi experiencing a partial vacuum record a lower boiling point than that liquid at atmospheric pressure. In addition, when atmospheric fluids are at high pressure, the molecules have a higher boiling point than when that liquid is at atmospheric pressure. The differences in pressure, causes different regions in Ikogosi to attain atmospheric saturation at different temperatures.

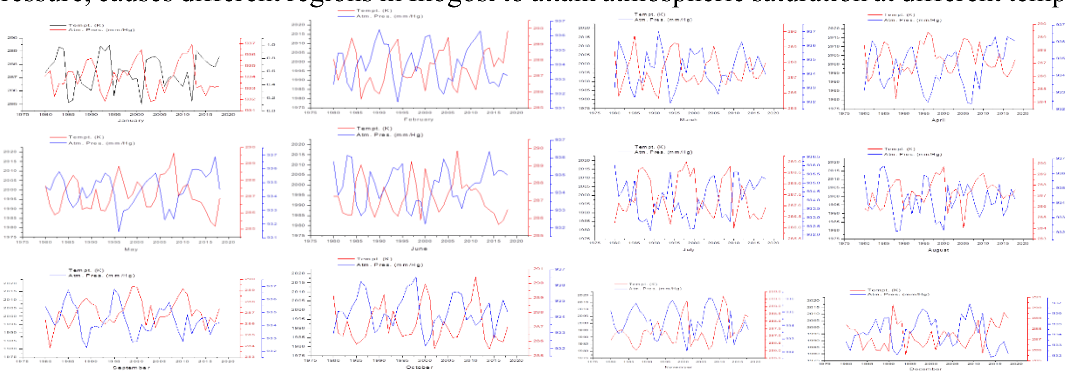

Figure 1: Temperature-Pressure graphs of Ikogosi SW Nigeria

3.2. Curve Fitting

The outcome of a polynomial fit on Temperature-Pressure graphs of Ikogosi produced Figure 2. The curves portend a dominant trend of exponential temperature versus logarithmic decay or vice versa, with the exclusion of a linear pattern in April. This indicates a departure from the erstwhile tranquil weather in Ikogosi. The line of best fit also shows a congruence with all the dots perfectly fitting on it. This confirms the validity of the MERRE data used.

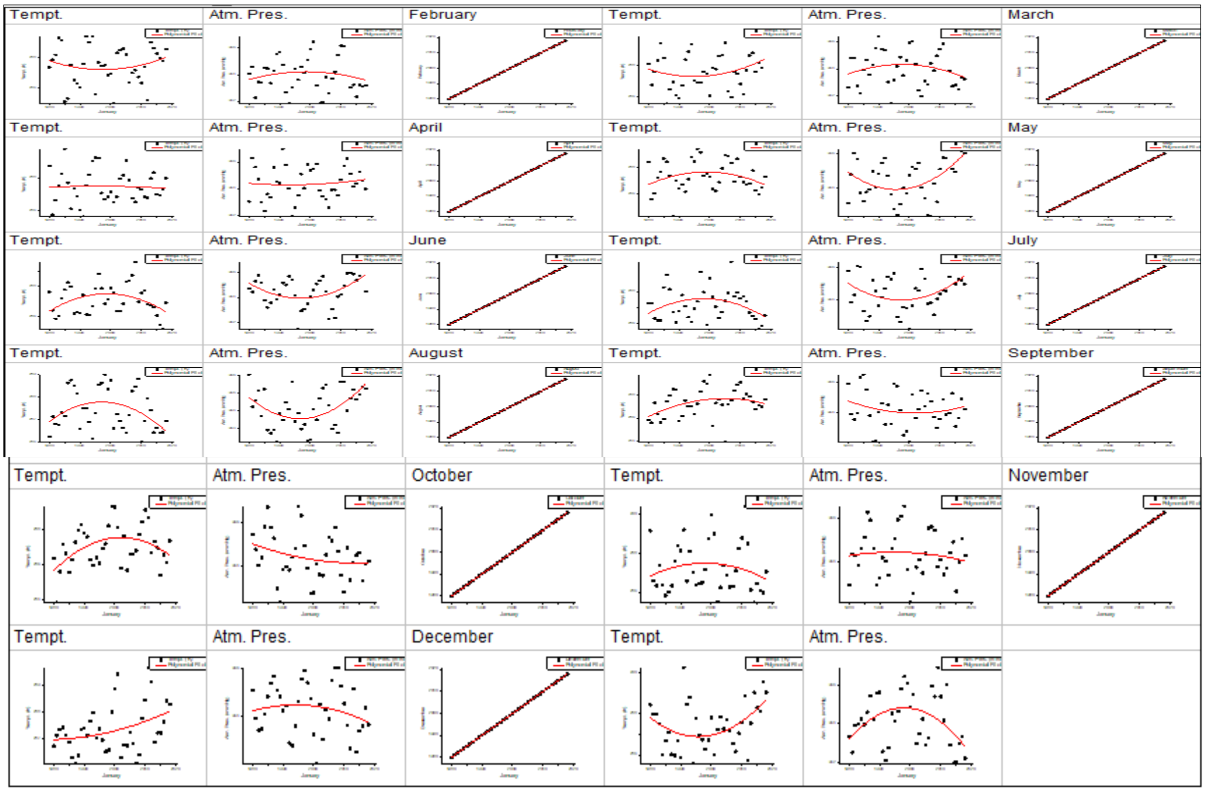

Figure 2: Trend of Curves elicited from Ikogosi Weather Pattern

3.3. Multiple Regression Analysis

Adjusted R squared was used as a statistic tool in the context of Ikogosi climate in order to predict future outcomes on its climate change indices. It offered the measure of how well the data used is reliable based on the number of outcomes, R^2=1 fits the normal range as illustrated by Table 1. The standard error values for temperature was generally observed to be lower than that of pressure. Also, values on column intercept B2 are even less than that of B1 i.e. B1> B2. The standard error of intercept B2 < B1, the implication of this that, there are sufficient data points involved in the determination of the mean, the smaller the standard error tends to be. It is thus an inverse relationship, the less the value, the higher the accuracy and validity of the data used. The data set is representative of the true mean value. R is the coefficient of multiple determination for multiple regression, the value of unity (1) signifies that this model describes all the variability of the response data surrounding its mean. Here all the data values fall on the regression line plot, a further verification of the authenticity of the data set.

Table 1: Regression Analysis of Ikogosi Temperature -Pressure Measurement

	Intercept		B1		B2		Statistics
	Value	Standard Error	Value	Standard Error	Value	Standard Error	Adj. R-Square
Tempt.	7834.10981	7207.9645	-7.55681	7.21173	0.00189	0.0018	-0.02108
Atm. Pres.	-5758.76782	7675.15317	6.69764	7.67916	-0.00168	0.00192	-0.03358
February	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	8598.43184	6190.0212	-8.33225	6.19326	0.00209	0.00155	0.02576
Atm. Pres.	-8233.73335	7448.93988	9.17909	7.45283	-0.0023	0.00186	-0.00964
March	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-702.57586	5752.85354	0.99223	5.75586	-2.486E-4	0.00144	-0.05429
Atm. Pres.	3516.64624	7073.50543	-2.59155	7.0772	6.50195E-4	0.00177	-0.04587
April	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-10481.65131	6230.40273	10.77552	6.23366	-0.0027	0.00156	0.02543
Atm. Pres.	17715.02285	5993.12198	-16.81814	5.99625	0.00421	0.0015	0.20022
May	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-12747.57135	5352.71152	13.04326	5.35551	-0.00326	0.00134	0.09412
Atm. Pres.	17936.32254	6114.81155	-17.02946	6.11801	0.00426	0.00153	0.15978
June	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-11021.91031	5444.3158	11.32144	5.44716	-0.00283	0.00136	0.06258
Atm. Pres.	14734.68492	5735.702	-13.81983	5.7387	0.00346	0.00144	0.10652
July	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-11489.30851	4762.4498	11.79474	4.76494	-0.00295	0.00119	0.11842
Atm. Pres.	18043.19369	5390.76741	-17.13903	5.39358	0.00429	0.00135	0.21628
August	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-9735.81745	6532.63699	9.99942	6.53605	-0.00249	0.00163	0.08304
Atm. Pres.	7601.88358	6592.3093	-6.66147	6.59575	0.00166	0.00165	-0.01707
September	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-15584.49201	6144.0802	15.85662	6.14729	-0.00396	0.00154	0.15392
Atm. Pres.	4019.98621	6137.98694	-3.06395	6.14119	7.6055E-4	0.00154	0.01335
October	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	-7841.73649	7275.22082	8.13795	7.27902	-0.00204	0.00182	-0.01833
Atm. Pres.	-1942.59153	6104.99166	2.88487	6.10818	-7.2318E-4	0.00153	-0.04402
November	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	2848.18918	4878.93849	-2.59042	4.88149	6.54986E-4	0.00122	0.08581
Atm. Pres.	-4081.69093	5970.00825	5.03115	5.97313	-0.00126	0.00149	-0.01594
December	-2.91271E-12	5.00398E-12	1	5.0066E-15	-7.85654E-19	1.25227E-18	1
Tempt.	14985.80877	5987.00027	-14.73007	5.99013	0.00369	0.0015	0.1474
Atm. Pres.	-19348.03414	7249.8234	20.30345	7.25361	-0.00508	0.00181	0.13969

3.4. Analysis of Variance (ANOVA) of Temperature-Pressure in Ikogosi

ANOVA was used to further analyze the data on Ikogosi Temperature-Pressure into two distinct groups, Pr > 0.01 and Pr < 0.98. Two months fall within the probability of 0.01, April and September, the majority lie within the probability of 0.98. Since there is a difference between temperature and pressure, the null hypothesis is false, the experiment is consistent with the truth and valid. The model shows the standard from where the deviation or variance is considered, it is assigned a value of zero as the reference, as shown on Table 2.

Table 2: ANOVA of Ikogosi Temperature-Pressure Data

		DF	Sum of Squares	Mean Square	F Value	Prob>F
Tempt.	Model	2	1.97588	0.98794	0.60774	0.55007
	Error	36	58.52136	1.62559		
	Total	38	60.49724			
Atm. Pres.	Model	2	1.41093	0.70547	0.38275	0.68472
	Error	36	66.35341	1.84315		
	Total	38	67.76434			
February	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	3.6021	1.80105	1.50229	0.23625
	Error	36	43.1592	1.19887		
	Total	38	46.7613			
Atm. Pres.	Model	2	2.84204	1.42102	0.81851	0.44913
	Error	36	62.49972	1.7361		
	Total	38	65.34176			
March	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	0.04462	0.02231	0.02155	0.9787
	Error	36	37.27827	1.03551		
	Total	38	37.32289			
Atm. Pres.	Model	2	0.52179	0.2609	0.16665	0.84714
	Error	36	56.35838	1.56551		
	Total	38	56.88017			
April	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	3.63319	1.8166	1.49568	0.23769
	Error	36	43.72415	1.21456		
	Total	38	47.35734			
Atm. Pres.	Model	2	12.93842	6.46921	5.7565	0.00677
	Error	36	40.45716	1.12381		
	Total	38	53.39557			
May	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	5.33226	2.66613	2.97404	0.06377
	Error	36	32.27281	0.89647		
	Total	38	37.60508			
Atm. Pres.	Model	2	10.7942	5.3971	4.61326	0.01646
	Error	36	42.11679	1.16991		
	Total	38	52.91099			
June	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	4.20753	2.10376	2.26842	0.11807
	Error	36	33.38687	0.92741		
	Total	38	37.5944			
Atm. Pres.	Model	2	6.72205	3.36103	3.26522	0.04976
	Error	36	37.05632	1.02934		
	Total	38	43.77837			
July	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	5.04164	2.52082	3.55218	0.03909
	Error	36	25.54759	0.70966		
	Total	38	30.58924			
	Model	2	11.3534	5.6767	6.24321	0.0047
Atm. Pres.	Error	36	32.73334	0.90926		
	Total	38	44.08674			
August	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	7.26574	3.63287	2.72074	0.07936
	Error	36	48.06912	1.33525		
	Total	38	55.33487			
Atm. Pres.	Model	2	1.85245	0.92623	0.68117	0.51243
	Error	36	48.95131	1.35976		
	Total	38	50.80376			
September	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	10.52773	5.26387	4.45661	0.01865
	Error	36	42.52094	1.18114		
	Total	38	53.04868			
Atm. Pres.	Model	2	2.96378	1.48189	1.25712	0.29666
	Error	36	42.43665	1.1788		
	Total	38	45.40043			
October	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	2.17934	1.08967	0.65798	0.52401
	Error	36	59.61856	1.65607		
	Total	38	61.7979			
Atm. Pres.	Model	2	0.46368	0.23184	0.19881	0.8206
	Error	36	41.98163	1.16616		
	Total	38	42.44531			
November	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	4.14631	2.07316	2.78352	0.07516
	Error	36	26.81266	0.7448		
	Total	38	30.95897			
Atm. Pres.	Model	2	1.56548	0.78274	0.70191	0.50229
	Error	36	40.1457	1.11516		
	Total	38	41.71117			
December	Model	2	4940	2470	3.15267E33	0
	Error	36	2.82046E-29	7.83462E-31		
	Total	38	4940			
Tempt.	Model	2	9.61094	4.80547	4.2848	0.02142
	Error	36	40.37455	1.12152		
	Total	38	49.98549			
Atm. Pres.	Model	2	13.43571	6.71785	4.08497	0.02519
	Error	36	59.20304	1.64453		
	Total	38	72.63874			

Conclusion and Recommendation

The Pressure -Temperature study of Ikogosi reveals rapidly changing progressive trends, high indicative of climate change. In view of these finding, the following measures are considered suitable for sustainability of Ikogosi environment; Ikogosi run-off spring is recommended for architectural construction of natural fountains for tourism and to reduce the waste water Gravi-potential electricity be tapped from this Ikogosi spring and waterfall to serve the immediate locality and supply excess to the National grid. The health and quality of air in Ikogosi can be greatly influenced by increased vegetation, thus promoting agriculture (especially planting cash tree crops) to create revenue, boost health and provide jobs related to these occupations.

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Author Credit
Abodunrin T.J –Visualization and writing
Emetere M.E.- Data Curation and Methodology

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