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Influences of Weather Variables on Solar Radiation Intensity in Port Harcourt, Nigeria: A Quantitative Approach.

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Abstract

This study investigates how some weather variables influence solar radiation intensity in Port Harcourt. The data were collected in three months (November 2016 to January, 2017) on daily basis at 5 minutes interval using Cambell Scientific weather instrumentations in Rivers State University meteorological station. These data were analyzed using SPSS software, version 20.0 with respect to daily and weekly averages. Multiple regressions tools at significance level of 0.05 having 92 sample points (n) were inputted .The independent weather variables are air temperature(X_1), relative humidity(X_2), Ambient temperature(X_3), wind speed(X_4), air pressure (X_5) and rainfall(X_6) while the dependent weather variable is solar radiation intensity(Y). The solar radiation intensity ranges from 40.8W/m^2 to 155.0W/m^2 with a mean average of 106.2W/m^2. It was observed that variation in the six independent weather variables do have significant influence on the solar radiation intensity. For a 1% increase in each of air temperature, relative humidity, Ambient temperature, wind speed, air pressure and rainfall; the solar radiation intensity increases by 1,104.90%; decreases by 179.80%; increases by 22.80%; increases by 5,132.40%; decreases by 86.90%, decreases by 448.80% respectively. The solar radiation intensity correlated very strongly with the six independent variables with Pearson Moment correlation coefficient of 0.74 and linear coefficient of determination R^2= 0.547. This means that 54.7% of the variance or changes in the solar radiation intensity are due to the combined influence of the six independent weather variables. The essentials of this research can be applied in meteorology, agricultural, industrial, etc.

Key Words: *Solar radiation intensity, pyranometer, Rainfall, Relative Humidity, Air temperature.*

Introduction

Majority of human activities depends on the power of the sun as a source of renewable energy.This energy is green and comes in two forms, namely, heat and light. The quantity of solar energy reaching a given surface area in a given time is called solar radiation intensity. This is measured in watts per metre square (w/m^2) using a pyranometer or a pyheliometer. Solar radiation is an electromagnetic radiation with wavelength ranging from 0.25 to 4.5µm [7]. It includes the visible light, ultraviolet and near infrared (IR) radiation. It is one of the most essential weather variables which determines the temperature of a place. It under goes reflection, absorption and transmission when it falls on a transparent medium or object [9].

When solar radiations strikes a surface, thirty percent (30%) of its energy is either absorbed or reflected by clouds, ocean and land masses [8]. The intensity of solar radiationis commonly dependent on geographical location, Daily earth rotation, yearly earths revolution, weather variables and time of the day [7, 8].The weather variables includes rainfall, relative humidity, air temperature, air pressure, wind speed, Ambient temperature, cloud cover etc. [1].

Solar energy can be captured by electrical or heat energy systems. The installations of these systems require an accurate knowledge on the availability of global solar radiation. This research investigates the influences of the weather variables such as rainfall, relative humidity, air temperature, air pressure, Ambient temperature, wind speed on solar radiation intensity in Port Harcourt, Nigeria.

Study Area

Port Harcourt city is located in the coastal part of Nigeria within the Latitude of 6^o.58' to 8^o.00'E and a longitude of 4^o.4 to 4^o.55 as shown in Figure1a and Figure 1b. It is the capital and largest city of Rivers State with a population size of about 1,382,592 in the Niger Delta region [4].The monthly rainfall in Port Harcourt, increases from March to October, it decreases in the dry season which last from November to February. It features a tropical wet climate with lengthy and heavy rainy seasons and very short dry seasons. The amount of rainfall in Port

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Harcourt experience two weeks of no rain or little rain within the month of July and August. This is sometimes regarded as "August brake" and this varies from time to time depending on the weather condition of the area. It is observed that Port Harcourt has low temperature at night and a high temperature during the day; this is due to heat generated and supplied by the sun.Temperatures throughout the year in the city are fairly constant, showing little changes throughout the year. The average temperature of Port Harcourt ranges between 23.272^{O}C and 29.174 ^{O}C [10].

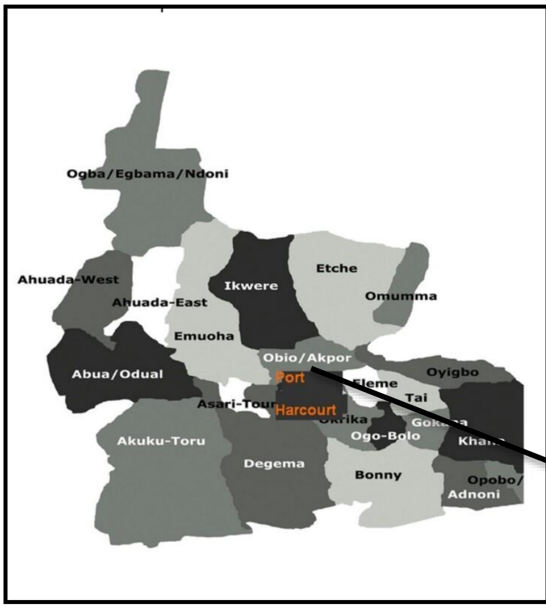

Figure 1a: Map of Rivers State showing Port Harcourt.

Figure 1b: Map of Nigeria

Instrumentation and Methods

The data used in this work, was gathered from the Rivers State University metrological weather station shown in Figure 2.The station is fortified with high standard meteorological and climatological weather monitoring instrumentation in form of hardwares and softwares that include sensors, measurements and control systems, solar power systems for charging of the rechargeable 12V battery and data logging system. The station is computerized having systems whose measurements are precise and accurate taken at 5 minutes intervals.

The weather variable measuring instruments in the station are pyranometer (Figure 3a)

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for solar radiation intensity, rain gauge (3c) for rainfall, solar panel(3d) for solar energy capturing, hygrometer for relative humidity measurement, wind vane/speedometer for direction /speed of wind , maximum and minimum thermometer for air and ambient temperatures and barometer for air pressure. Inclusive is an electronic box (3b) which encloses some of these weather station electronics components such as pressure sensors, the measurement control devices, power back up device, charge controllers, the data logging units and the wireless telemetry device. The wireless telemetry device enables data from this weather station to be downloaded with a computer that is connected to the internet from any part of Nigeria with ease.

The weather station was designed and built by Cambell Scientific Inc., and it is an automatic weather station (AWS) with CR 1000 data logger. Every component of the weather station is interconnected to a programmable data-logger with type number CR1000 that measures with the aid of the sensors attached to it via enough input channels. It stores, process and transmit the data to any computer programmed to it. The operating temperature of the data logger is very wide with programmable execution interval. The data logger is the central processing unit of the weather station. It has low power consumption capability and can be powered by a 12VDC rechargeable battery. The battery is often charged with a solar panel (rated 20W) attached to the body frame of the instrument.

The data were collected using Logger net software (Logger net 4.0), at every 5 minutes intervals within a day.A USB to serial (DB-9) adapter data cord is connected from port RS-232 of the programmable data logger to a laptop that is specifically programmed to the weather station. Figure 4 shows the connection between the laptop and the data logger.The collected data were statistically categorized into daily, weekly and monthly bases, three months for dry season (November, 2016 to January, 2017).The collected data were analyzed using SPSS version 20.0 statistical software. The daily and weekly average for dry season were also computed and analyzed. Tables and combine plot of Daily and weekly averages of weather variables encompassing solar radiation intensity(W/m^2), air temperature (^{0}C), relative humidity (%), Ambient temperature (^{o}C), air

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pressure(Pascal), wind speed(m/s) and rainfall (mm) are discussed for dry season (November,2016–January,2017).

Descriptive Statistics were used to determine the central tendencies and distributions of the collected data as computed and presented.Finally, a multiple regression test with its Anova analysis on F-distribution was carried out to obtain the relationship between the dependent variable (solar radiation intensity) and other independent variables (other weather variables) and generate the solar radiation intensity model.

Figure 2: Meteorological Weather Station of Rivers State University Port Harcourt

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Figure 3a: Pyranometer

Figure 3b: Electronics Box

Figure 3c: Rain gauge

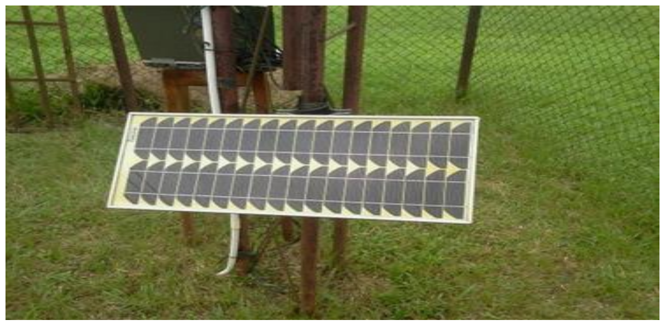

Figure 3d: solar panel (PV cell)

Figure 4: A view showing the connection between a laptop and the weather station

Results

Table 1: Daily Averages for Dry Season (November, 2016-January, 2017)

S/n	Date	Solar radiation (W/m^2)	Air temp. (°C)	Relative humidity (%)	Ambient temp. (°C)	Wind speed (m/s)	Air pressure (Pascal)	Rain fall (mm)
1	Tue 01 Nov 2016	70.266	25.115	73.761	38.084	0.558	815.617	0.060
2	Wed 02 Nov 2016	113.879	26.546	70.268	36.505	0.677	817.866	0.229
3	Thu 03 Nov 2016	75.962	26.313	72.412	38.009	0.839	820.175	0.040
4	Fri 04 Nov 2016	122.316	26.800	71.620	38.136	1.031	817.640	0.108
5	Sat 05 Nov 2016	57.398	26.262	75.790	41.869	0.514	817.415	0.000
6	Sun 06 Nov 2016	115.133	27.148	72.309	41.193	0.645	816.317	0.000
7	Mon 07 Nov 2016	59.870	26.239	74.061	37.748	0.534	817.293	0.043
8	Tue 08 Nov 2016	83.235	26.468	74.930	36.883	0.627	817.685	0.019
9	Wed 09 Nov 2016	140.509	27.673	70.041	40.563	0.683	815.921	0.132
10	Thu 10 Nov 2016	144.049	27.737	65.499	41.075	0.843	819.989	0.157
11	Fri 11 Nov 2016	75.377	25.333	73.362	50.368	0.889	817.099	0.090
12	Sat 12 Nov 2016	94.571	26.200	71.182	41.556	0.814	816.072	0.058
13	Sun 13 Nov 2016	117.602	27.567	69.093	52.638	0.684	816.428	0.000
14	Mon 14 Nov 2016	141.810	27.947	70.297	56.128	0.923	815.240	0.000
15	Tue 15 Nov 2016	111.586	26.466	75.338	44.816	0.696	814.616	0.056

S/n	Date	Solar radiation (W/m^2)	Air temp. (°C)	Relative humidity (%)	Ambient temp. (°C)	Wind speed (m/s)	Air pressure (Pascal)	Rain fall (mm)
16	Wed 16 Nov 2016	136.340	27.031	70.992	39.336	0.767	815.283	0.006
17	Thu 17 Nov 2016	65.697	25.954	73.130	30.426	0.584	816.379	0.264
18	Fri 18 Nov 2016	108.721	26.621	76.369	50.094	0.636	815.889	0.065
19	Sat 19 Nov 2016	109.520	26.178	72.568	53.913	0.806	814.786	0.108
20	Sun 20 Nov 2016	83.105	26.661	74.884	50.069	0.810	815.634	0.000
21	Mon 21 Nov 2016	40.791	25.117	76.008	48.622	0.633	819.618	0.000
22	Tue 22 Nov 2016	151.639	27.329	68.429	42.447	0.950	818.487	0.000
23	Wed 23 Nov 2016	144.638	28.020	69.680	49.119	1.020	818.754	0.063
24	Thu 24 Nov 2016	104.752	27.286	74.172	41.406	0.693	817.306	0.060
25	Fri 25 Nov 2016	135.111	27.909	73.511	46.601	0.974	817.831	0.229
26	Sat 26 Nov 2016	100.346	27.241	73.657	48.315	0.919	815.386	0.040
27	Sun 27 Nov 2016	95.792	27.111	73.331	50.257	0.656	816.491	0.108
28	Mon 28 Nov 2016	55.663	26.198	75.883	53.186	0.833	818.286	0.000
29	Tue 29 Nov 2016	98.793	26.526	72.661	43.529	0.717	815.781	0.000
30	Wed 30 Nov 2016	124.392	27.880	71.393	43.496	0.947	816.831	0.043
31	Thu 01 Dec 2016	132.577	28.088	72.299	43.712	1.118	819.019	0.019
32	Fri 02 Dec 2016	90.524	27.037	75.075	38.663	0.878	819.146	0.132
33	Sat 03 Dec 2016	63.414	26.956	76.551	46.655	0.683	814.984	0.157
34	Sun 04 Dec 2016	94.430	27.558	69.390	49.486	0.557	817.486	0.090
35	Mon 05 Dec 2016	86.568	27.452	74.052	53.902	0.623	817.587	0.058
36	Tue 06 Dec 2016	114.630	27.841	70.261	43.488	0.801	818.350	0.000
37	Wed 07 Dec 2016	144.289	28.247	68.553	44.479	1.060	817.614	0.000
38	Thu 08 Dec 2016	78.700	26.318	70.903	42.881	0.768	815.615	0.056
39	Fri 09 Dec 2016	99.612	27.417	70.679	42.454	0.769	816.589	0.006
40	Sat 10 Dec 2016	76.997	26.694	72.711	50.257	0.779	817.759	0.264
41	Sun 11 Dec 2016	100.957	25.721	76.807	43.495	0.607	817.432	0.065
42	Mon 12 Dec 2016	104.205	26.481	73.295	42.548	0.658	817.858	0.108
43	Tue 13 Dec 2016	119.117	27.900	69.967	42.223	0.649	818.271	0.000
44	Wed 14 Dec 2016	100.895	28.108	70.549	45.657	0.860	817.995	0.000
45	Thu 15 Dec 2016	71.526	26.864	74.086	40.171	0.621	819.326	0.000
46	Fri 16 Dec 2016	93.781	27.175	72.978	44.615	0.893	816.581	0.063
47	Sat 17 Dec 2016	94.596	28.002	70.009	50.119	0.719	817.979	0.060
48	Sun 18 Dec 2016	120.169	28.386	69.458	53.154	0.854	816.455	0.229
49	Mon 19 Dec 2016	127.033	28.278	72.112	47.854	0.920	816.368	0.040
50	Tue 20 Dec 2016	102.842	28.355	71.410	45.313	0.946	820.156	0.108
51	Wed 21 Dec 2016	78.861	28.262	69.948	44.276	0.767	815.243	0.000
52	Thu 22 Dec 2016	107.994	28.683	68.578	40.720	0.718	816.035	0.000

S/n	Date	Solar radiation (W/m²)	Air temp. (°C)	Relative humidity (%)	Ambient temp. (°C)	Wind speed (m/s)	Air pressure (Pascal)	Rain fall (mm)
53	Fri 23 Dec 2016	107.535	28.514	66.650	45.224	0.620	816.705	0.043
54	Sat 24 Dec 2016	86.674	28.274	70.453	49.587	0.686	821.311	0.019
55	Sun 25 Dec 2016	155.657	27.822	55.835	53.610	0.637	818.642	0.132
56	Mon 26 Dec 2016	124.823	26.552	32.273	49.406	0.644	816.996	0.157
57	Tue 27 Dec 2016	117.066	26.779	37.140	37.144	0.599	817.229	0.090
58	Wed 28 Dec 2016	130.725	27.202	42.749	35.608	0.525	819.647	0.058
59	Thu 29 Dec 2016	119.538	26.909	45.488	34.818	0.568	817.884	0.000
60	Fri 30 Dec 2016	129.458	27.314	45.966	34.013	0.417	819.222	0.000
61	Sat 31 Dec 2016	126.034	27.322	55.865	33.876	0.498	815.076	0.056
62	Sun 01 Jan 2017	144.603	27.294	48.467	35.008	0.685	817.047	0.006
63	Mon 02 Jan 2017	148.434	27.105	40.708	32.461	0.560	819.128	0.264
64	Tue 03 Jan 2017	142.278	27.092	47.485	31.876	0.461	818.838	0.065
65	Wed 04 Jan 2017	142.021	27.416	45.231	31.916	0.600	816.605	0.108
66	Thu 05 Jan 2017	123.294	27.127	62.581	31.991	0.598	816.117	0.000
67	Fri 06 Jan 2017	116.805	27.604	67.151	33.486	0.598	819.639	0.000
68	Sat 07 Jan 2017	125.632	28.285	67.998	38.548	0.722	821.228	0.000
69	Sun 08 Jan 2017	78.491	28.059	69.280	35.311	0.609	816.444	0.063
70	Mon 09 Jan 2017	155.554	28.242	45.252	33.834	0.634	816.908	0.060
71	Tue 10 Jan 2017	126.539	27.342	68.078	33.704	0.839	816.035	0.229
72	Wed 11 Jan 2017	130.450	28.189	67.108	39.541	1.078	817.819	0.040
73	Thu 12 Jan 2017	55.800	26.532	71.435	34.755	0.826	816.182	0.108
74	Fri 13 Jan 2017	103.979	27.284	70.195	36.411	0.841	814.558	0.000
75	Sat 14 Jan 2017	96.780	27.295	71.954	36.682	1.014	818.736	0.000
76	Sun 15 Jan 2017	63.908	27.272	74.243	33.831	0.495	817.330	0.043
77	Mon 16 Jan 2017	136.430	27.986	68.255	50.110	0.780	816.799	0.019
78	Tue 17 Jan 2017	123.298	28.647	69.120	46.204	0.925	818.695	0.132
79	Wed 18 Jan 2017	62.013	27.843	73.885	39.721	0.758	818.253	0.157
80	Thu 19 Jan 2017	100.768	28.163	71.686	44.260	0.859	818.853	0.090
81	Fri 20 Jan 2017	99.843	28.381	71.865	37.649	0.983	816.033	0.058
82	Sat 21 Jan 2017	103.946	28.772	69.568	38.848	1.035	815.894	0.000
83	Sun 22 Jan 2017	65.341	27.166	73.808	37.699	0.773	815.369	0.000
84	Mon 23 Jan 2017	111.043	26.754	71.801	39.708	0.818	817.019	0.056
85	Tue 24 Jan 2017	114.688	26.778	68.094	37.243	0.933	816.422	0.006
86	Wed 25 Jan 2017	105.424	27.619	70.188	36.379	0.795	817.983	0.264
87	Thu 26 Jan 2017	48.077	27.058	77.055	33.934	0.335	817.574	0.065
88	Fri 27 Jan 2017	125.753	28.141	68.691	34.039	0.783	818.178	0.108
89	Sat 28 Jan 2017	117.497	28.177	70.294	33.554	1.103	815.807	0.000

S/n	Date	Solar radiation (W/m²)	Air temp. (°C)	Relative humidity (%)	Ambient temp. (°C)	Wind speed (m/s)	Air pressure (Pascal)	Rain fall (mm)
90	Sun 29 Jan 2017	143.526	28.220	67.941	35.084	0.828	819.770	0.000
91	Mon 30 Jan 2017	128.883	28.324	69.222	34.443	0.762	816.564	0.000
92	Tue 31 Jan 2017	48.321	26.667	72.930	32.718	0.587	818.926	0.063

Table 2: Weekly Average for Dry Season (November, 2016-January, 2017)

S/N	Week	Solar intensity (W/m²)	Air temp(⁰C)	Relative humidity (%)	Ambient temp. (⁰C)	Wind speed (m/s)	Air pressure (Pascal)	Rainfall (mm)
1	1	87.964	26.207	72.765	38.521	0.724	817.743	0.087
2	2	101.821	26.685	71.616	41.341	0.719	817.197	0.071
3	3	113.039	26.823	72.549	46.764	0.728	815.517	0.071
4	4	108.626	27.080	72.904	46.654	0.857	817.574	0.056
5	5	94.451	27.114	73.850	45.642	0.833	817.220	0.066
6	6	99.318	27.361	70.916	46.707	0.765	817.286	0.068
7	7	97.868	27.179	72.569	44.118	0.715	817.920	0.042
8	8	104.444	28.393	69.822	46.590	0.787	817.468	0.063
9	9	129.043	27.129	44.938	39.782	0.555	817.814	0.070
10	10	134.724	27.417	54.281	33.612	0.603	818.372	0.063
11	11	106.799	27.563	66.281	35.748	0.835	816.669	0.071
12	12	98.601	28.152	71.115	41.518	0.834	817.408	0.071
13	13	98.260	27.385	71.440	36.079	0.792	816.907	0.071
14	14	106.910	27.737	70.884	34.082	0.725	818.420	0.021

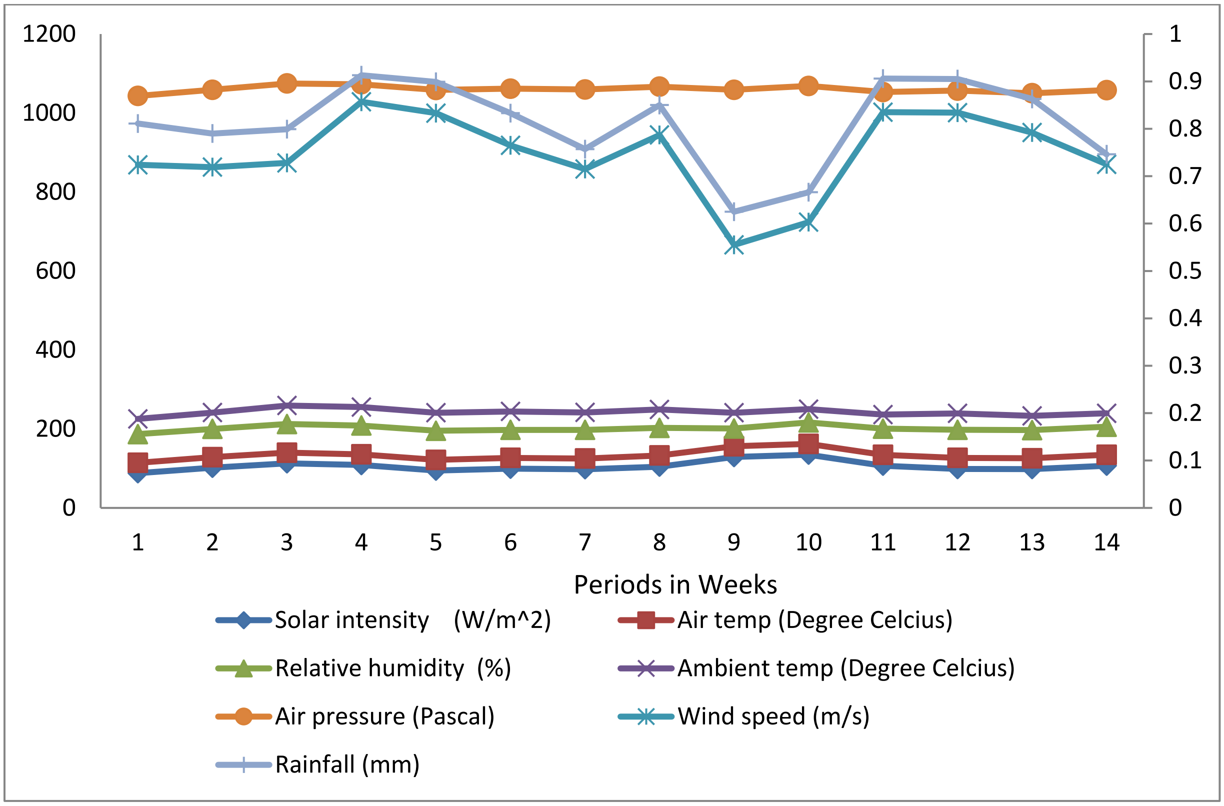

Figure 5: The Cross Plot of the Weekly Averages of the Weather Variables for Dry Season

Table 3: Descriptive Statistics for Dry Season (November, 2016-January, 2017)

		Solar radiation (w/m^2)	Air temperature (°c)	Relative humidity (%)	Ambient temperature (°c)	Wind speed (m/s)	Air pressure (Pascal)	Rain fall (mm)
N	Valid	92	92	92	92	92	92	
	Missing	0	0	0	0	0	0	
Mean		106.1903	27.3067	68.0466	41.5950	.7496	817.3416	.06513
Std. Error of Mean		2.92458	.08552	.99757	.67688	.01724	.15795	.007579
Median		108.3575	27.2945	70.6140	41.1340	.7600	817.2995	.05600
Std. Deviation		28.05163	.82029	9.56840	6.49236	.16538	1.51504	.072692
Minimum		40.79	25.12	32.27	30.43	.34	814.56	.000
Maximum		155.66	28.77	77.06	56.13	1.12	821.31	.264

*Source: SPSS ver. 20 Output window*a. Multiple modes exist. The smallest value is shown

The Multiple Regression Model (November, 2016-January, 2017)

The equation for the regression model is given as (there are six independent variables):

$$Y = a + b_1(X_1) + b_2(X_2) + b_3(X_3) + b_4(X_4) + b_5(X_5) + b_6(X_6) + \mu, \quad (1)$$

where X_1, X_2, X_3, X_4, X_5, and X_6 are the independent variables

X_1 = Air temperature (°C);
X_2 = Relative humidity (%);
X_3 = Ambient temperature (°C);
X_4 = Wind speed (m/s)
X_5 = Air pressure (Pascal)
X_6 = Rainfall (mm)
Y = independent variable (Solar radiation (W/m^2)
a = is the intercept
b_1, b_2, b_3, b_4, b_5, and b_6 = partial regression coefficients
μ is the error term
N = total number of observations = 92

Table 4: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.740[a]	.547	.515	19.52726

a. Predictors: (Constant), Rain Fall (mm), Ambient Temperature (°C), Air Pressure (Pascal), Air Temperature (°C), Relative Humidity (%), Wind Speed (m/s)

Table 5:ANOVA[a] Analysis of Multiple Regression

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	39195.687	6	6532.614	17.132	.000[b]
1	Residual	32411.664	85	381.314		
	Total	71607.350	91			

a. Dependent variable: solar radiation (W/m^2)

b. Predictors: (constant), rain fall (mm), air pressure (Pascal), Ambient temperature (°C), relative humidity (%), wind speed (m/s), air temperature (°C)

Table 6:The Multiple Regression Coefficients for dry Season

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	588.868	1123.404		.524	.602
Air temperature (°c)	11.049	2.799	.323	3.948	.000
Relative humidity (%)	-1.798	.242	-.613	-7.434	.000
Ambient temperature (°c)	.228	.337	.053	.678	.500
Wind speed (m/s)	51.324	14.540	.303	3.530	.001
Air pressure (Pascal)	-.869	1.382	-.047	-.629	.531
Rain fall (mm)	4.488	28.543	.012	.157	.875

a. Dependent Variable: SOLAR RADIATION (W/m^2)

Discussions

A close examination of the ninety-two (92) solar radiation intensity measurements for dry season depicts that it is at maximum on Sunday 25 December, 2016 with a value of 155.657W/m^2 and minimum on Monday 21 November, 2016 with a value of 40.791 W/m^2. Solar radiation has its peak in the month of December and it decreases gradually in January, 2017. In considering the weekly averages of the study weather variables for dry season as shown in Table 3 and Figure 5, the maximum value of solar radiation intensity of about 134.724

W/m^{2}was recorded during week 10 and theminimum value of about 87.964W/m^2 recorded in week 1.Solar radiation has more peaks in the months of November and December.This finding is satisfactorily in agreement in trend and season with results from previous works in Port Harcourt by Chukwuemeka and Nnabuchi (2009) where monthly solar radiation intensity was used, decreases gradually from January having more of its peak in the month of November and December.

From Table 3 and Figure 5, it was observed that the air temperature ranges from 25.12^{0}C to 28.77^{0}C with a mean average of 27.3061^{0}C and the maximum and minimum values in week 10 and week 1 respectively; rainfall has its minimum and maximum values at 0.00mm and 0.264mm in week 14 and week 1 respectively, its mean average is 0.06513mm; and the relative humidity ranges from 32.27% to 77.06% having its maximum and minimum values in week 1 and week 9 respectively with a mean average of 68.0466% for dry season.

Also from Table 3 and Figure 5, the wind speed ranges from 0.34 to 1.12ms^{-1}, the highest value was recorded in week 4 and lowest value in week 9 with a mean average of 0.7496ms^{-1}; air pressure ranges from 814.56Pascal to 821.31 Pascal having maximum in week 14 and minimum in week 3 with a mean average of 817.3416 Pascal for dry season, andthe Ambient temperature from measurement ranges from 30.43^{o}C to 56.13^{o}C having maximum value in week 10 and minimum in week 1 with an average mean of 41.5950^{o}C for dry season.

Multiple Regression Analysis

By considering the results in Table 4, Table 5 and Table 6 and substituting the partial regression coefficients into equation one (1) known as the multiple regression equation for dry season. The Solar Radiation Intensity (SRI) model for the dry season (November, 2016- January, 2017) becomes:

$$Y = 588.868 + 11.049 * X_1 – 1.798 * X_2 + 0.228 * X_3 + 51.324 * X_4 - 0.869 * X_5 + 4.488 * X_6$$

From Table 5, Anova analysis using F-distribution standard, the critical value obtained at 0.05 level of significance (α) using two tail test of degrees of freedom d.f.N. (6), and d.f.D (85) is 2.21 and the

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computed value is 17.132. Since the computed value of F (17.132) is greater than the critical value (2.21), and the p-value (0.000) lessthan the level of significance, α (0.05).The six independent variables does significantly impact on the dependent variable (Solar radiation intensity). Hence, solar radiation intensity can be forecasted for dry season in Port Harcourt using the above model with a p-value of 0.00 and significance level of 0.005 when values are substituted for air temperature, relative humidity, Ambient temperature, wind speed, air pressure, and rainfall for the period under study and within the range of solar radiation data.

It was also observed that for 1% increase for each of air temperature, relative humidity, Ambient temperature, wind speed, air pressure and rainfall, the solar radiation intensityincreases by 1,104.90%; decreases by 179.80%; increases by 22.80%; increases by 5,132.40%; decreases by 86.90%, decreases by 448.80% respectively for the dry season. This means that there exist positive relationships or influences with the solar radiation intensity and the other weather variables such as air temperature, Ambient temperature and wind speed as an increase in each of the variable results a geometric increase in solar radiation intensity. Moreover, a negative relationships or influences exist between the solar radiation intensity and relative humidity, air pressure and rainfall as an increase in each of them result a decrease in solar radiation intensity. It was also observed that the six independent weather variables correlated very strongly with a Pearson Moment Correlation coefficient of 0.74 and linear coefficient of determination of 0.547. This means that 54.7% of the variance or changes in the solar radiation intensity are due to the combined influence of the six independent weather variables.

Conclusion

Base on the findings from the analysis of the measurements on solar radiation intensity known as the dependent variable and the other six independent weather variables namely rainfall, relative humidity, air pressure, wind, speed, Ambient temperature and air temperature. The following conclusions are made:

i. Solar radiation intensity ranges from $40.8W/m^2$ to $155.0W/m^2$ with a mean average of $106.2W/m^2$ for the dry season(November, 2016-January, 2017).

ii. The variations in the six independent weather variables significantly influence the changes in the solar radiation intensity in Port Harcourt for dry seasons.

iii. For a 1% increase in each of air temperature, relative humidity, Ambient temperature, wind speed, air pressure and rainfall, the solar radiation intensity increases by 1,104.90%; decreases by 179.80%; increases by 22.80%; increases by 5,132.40%; decreases by 86.90%, decreases by 448.80% respectively for the dry season.

iv. The solar radiation intensity correlated very strongly with the six independent weather variables with a correlation coefficient of 0.74 and linear coefficient of determination R^2= 0.547 for dry season.

v. The solar radiation models for the dry season is $Y = 588.868 + 11.049 * X_1 – 1.798 * X_2 + 0.228 * X_3 + 51.324 * X_4 - 0.869 * X_5 + 4.488 * X_6$

vi. This model can be used to predict the solar radiation intensities for dry seasons in Port Harcourt.

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