

Variability of Climatic Parameters in Port Harcourt, Nigeria

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Abstract

Meteorological data collected in Port Harcourt, Nigeria covering a period of ten years, 2001 – 2010 is here presented. The purpose of the work is to correlate the monthly variation of weather conditions of rainfall, humidity, temperature, solar radiation, and evaporation with each and to deduce climatic changes over the ten-year period. The analysis of the observations shows that the mean maximum monthly temperature is 31.29°C. The mean minimum monthly temperature is 21.80°C. Generally, the mean annual maximum temperature is 31.03°, while mean annual minimum temperature is 22.54°C. The mean monthly solar radiation is observed to be 10.55mJm⁻²/day, while mean annual solar radiation is 9.25mJm⁻²/day. The mean maximum monthly humidity is 112.47%, while mean annual minimum humidity is 69.08%. For evaporation, the mean annual evaporation is 97.27mm, while mean monthly evaporation is 111.31mm. Monthly rainfall is 203.03mm while annual rainfall is 200.45mm. Port Harcourt in Nigeria being part of the global community, the analysis of this work shows variability and uncertainty of the regions' climatic parameters over the ten-year period. The results of this work could be integrated into local and national data bank for further research work. Moreover, the results could also provide input for climate risk information, local and national planning and decision-making for sustainable development in the areas of agriculture, aviation, health, weather forecasting.

Keywords: Evaporation, temperature, rainfall, humidity, solar radiation, Port Harcourt, Niger Delta, Nigeria

INTRODUCTION

The most abundant meteorological information on air temperature, rainfall, wind direction, and humidity collected are from thermometers, rain gauge, wind vane and hydrometer in meteorological gardens. These data are randomly taken thrice a day at 6am, 2pm, and 10pm. Geoscientists can also use the average air temperature in studying the subsurface geothermal gradients and heat flow (Akpabio *et al.*, 2003). Weather and climate data play very significant role in weather forecasting, and in socio-economic

activities throughout Nigeria (Wikipedia, 2010; Olofintoye and Sule, 2010).

Port Harcourt is a coastal city located in the Niger Delta region of Nigeria within latitudes 6°58' – 7°60'E and longitudes 4°40' – 4°55'N (Fig. 1). Niger Delta is one of the largest wetlands of the world. Its total land area is approximately over 2900 km² (NDES, 1997).

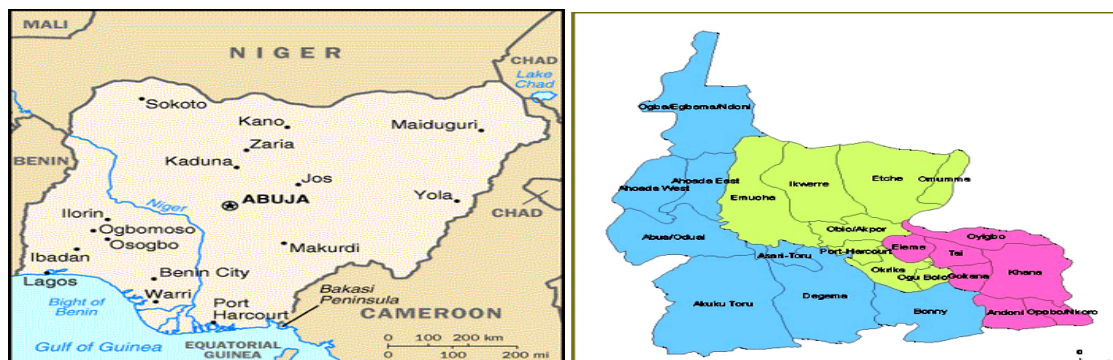


Fig.1. Map of Nigeria showing Port Harcourt City
(From <http://nigeriamasterweb.com/Masterweb/sites/default/files/RiversStateMap.gif>, 2013)

The weather variables of rainfall, humidity, temperature, solar radiation in the Niger Delta, specifically in Port Harcourt are primarily as a result

of the interplay between two major pressure and wind systems. The moist South-West wind transports its moisture to Port Harcourt (Nigeria) along the coast line. This air stream blows over the area between

February and October. This is the *wet season* in which the region receives its rains (Ayoade *et al.*, 1991). Conversely, the North-East trade winds bring dry conditions, having passed over the hot dry Sahara desert to reach Port Harcourt from the North. This air blows over Port Harcourt between November and February during which the area experiences its *dry season* (Sheriff, 1991; Ayoade *et al.*, 1991). In this work, we look at weather as basically the way Port Harcourt atmosphere is behaving monthly in terms of temperature, humidity, precipitation, solar radiation. The climate of Port Harcourt is then the description of the patterns of the ten-year averages of these weather conditions.

The purpose of the present paper is to correlate the monthly variation of weather conditions of rainfall, humidity, temperature, solar radiation, and evaporation with each and to deduce any possible changes over the ten-year period. The results of this work could be integrated into local and national data bank for further research work. Moreover, the results could also provide input for climate risk information, local and national planning and decision-making for sustainable development in the areas of agriculture, aviation, health, weather forecasting (Ayotamuno and Gobo, 2004; Confalonieri *et al.*, 2007; Ike and Emaziye, 2012).

MATERIALS AND METHODS

The weather data of rainfall, humidity, temperature, solar radiation, and evaporation were obtained from meteorological records of the Port Harcourt International Airport, Nigeria. The suit of the data was recorded daily and monthly. The only limitation of the study is that we did not measure these data ourselves, but we trust the source and the validity of the datasets. Our work involved finding daily averages for each parameter. We used monthly averages to make for yearly patterns. The variables were cross-plotted against months of the year, and against year covering the 10-year period under review.

RESULTS AND DISCUSSION

Maximum Temperature

The monthly and yearly average temperatures are presented in Tables 1 and 2. During the dry season (November – February), the maximum temperature in Port Harcourt ranged between 31.13 – 33.08°C with a mean of 31.97°C (Figs. 2 and 3). In rainy season (March – October), the maximum monthly temperature ranged 25.71 – 32.48°C with a mean of 29.095°C (Figs. 2 and 3).

Minimum Temperature

Monthly minimum temperatures ranged from 18.32 to 23.14°C in rainy season (March – October) with a mean of 21.49°C (Figs. 2 and 3). The minimum temperature in dry season (November – February)

ranged 21.92 – 22.97°C with a mean of 22.40°C (Figs. 2 and 3). Temperature in Port Harcourt is low at night and high in the day as a result of the external heat supply by the sun.

Rainfall

The monthly rainfall in Port Harcourt follows a sequence of increase from March to October before decreasing in the dry season months of November to February. Annual average rainfall amount of 200.45mm was recorded in the region, Figs. 2 and 3.

Rainfall in Port Harcourt exhibits double maxima regime with peaks in July and September. Port Harcourt does experience mostly two weeks window of little or no rain within July and August otherwise described as “August break” though the actual time of occurrence varies from year to year (Ologunorisa and Ogoonaye, 1999).

The higher rainfall months noted contributed to widespread flooding in the region. Little dry season (LDS) can be observed between July ending and early August as shown in Fig. 2. Monthly rainfall distribution in the region suggests higher rainfall than normal from June to September, Fig. 2.

It was observed in the area of study over the years (2001 – 2010) of an increasing daily amount of rainfall and the extension of the rainy season which is usually 8 months (i.e. March to October) to 10 months (February to November). The dry season had been observed shorter and hotter as the year progresses. These phenomena are in conformity with the consequences of global warming resulting from increased anthropogenic activities (Tamunoberetonari *et al.*, 2013).

Humidity and Solar Radiation

The mean monthly maximum temperature (30.25°C) of the area is enough to cause substantial monthly evaporation (92.76mm) of water to saturate (monthly maximum humidity = 93.73%) the atmosphere with water vapour that in turn condenses and precipitates as monthly rain (203.03mm). In dry season, evaporation exceeds precipitation. High humidity is followed by high temperature and lower solar radiation values (Figs. 2 and 3).

CONCLUSION

The following conclusions are reached from the study:

- (i) Mean maximum monthly temperature is 31.29°C while mean annual maximum temperature is 31.03°C.
- (ii) Mean minimum monthly temperature is 21.80°C while mean annual minimum temperature is 22.54°C.

- (iii) Mean monthly solar radiation is 10.55mJm⁻²/day, while mean annual solar radiation is 9.25mJm⁻²/day.
- (iv) Mean maximum monthly humidity is 112.47%, while mean annual minimum humidity is 69.08%.
- (v) Mean annual evaporation is 97.27mm, while mean monthly evaporation is 111.31mm.
- (vi) Mean annual rainfall is 200.45mm, while mean monthly rainfall is 203.03mm
- (vii) Temperature, evaporation, rainfall in Port Harcourt display increasing trend.

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APPENDIX

Table 1. Average monthly temperature anomalies (2001 – 2010)

Month	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)	Minimum humidity (%)	Maximum humidity (%)	Solar radiation (mJm ⁻² day ⁻¹)	Evaporation (mm)
January	19.06	21.92	32.40	42.55	93.56	10.61	114.80
February	45.75	22.49	33.08	46.38	94.32	11.40	119.85
March	141.43	21.38	32.48	56.82	95.41	11.10	120.32
April	154.9	21.26	28.90	59.63	95.02	11.14	95.15
May	209.81	23.14	31.15	59.48	87.84	11.34	100.33
June	222.39	21.78	25.71	64.70	88.31	8.81	81.93
July	460.22	22.54	29.00	68.15	95.40	8.33	80.53
August	361.7	20.84	29.16	69.46	95.50	7.70	65.84
September	361.44	18.32	28.32	59.90	93.25	4.71	72.21
October	293.98	22.62	30.34	63.13	95.78	5.45	82.76
November	142.71	22.97	31.27	52.37	95.28	8.71	87.12
December	22.94	22.23	31.13	48.27	95.04	6.15	92.29
Average	203.03	21.79	30.25	50.82	93.73	8.79	92.76

Table 2. Average yearly temperature, humidity and evaporation (2001 – 2010)

Year	Maximum Temperature (°C)	Minimum Temperature (°C)	Maximum Humidity (%)	Minimum Humidity (%)	Rainfall (mm)	Evaporation (mm)	Solar radiation $mJm^{-2}day^{-1}$
2001	30.97	22.37	93.66	56.44	216.06	102.89	15.3
2002	30.85	22.63	95.43	59.22	185.2	96.16	17.9
2003	32.29	22.66	95.21	56.85	205.28	91.72	15.98
2004	30.94	22.25	95.17	54.54	213.8	98.33	15.35
2005	30.67	22.72	91.11	65.53	209.14	94.75	14.24
2006	30.71	22.51	94.82	63.83	184.49	96.82	13.78
2007	30.74	22.2	94.94	61	197.82	93.64	12.9
2008	30.42	21.44	93.35	59.37	211.68	96.41	5.32
2009	31.24	23.17	96.18	58.35	193.88	99.73	-10.8
2010	31.48	23.48	95.17	54.54	187.18	102.24	5.47
Average	31.03	22.54	94.50	58.97	200.45	97.27	9.25

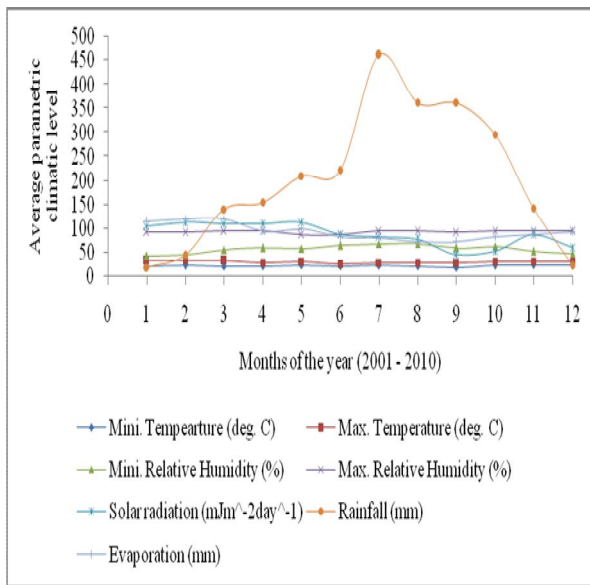


Fig. 2. Average parametric climatic factors-month crossplot for 2001 – 2010 years

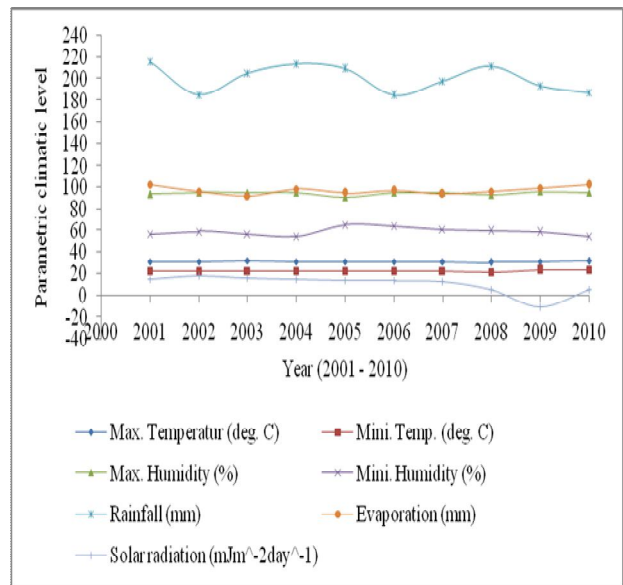


Fig. 3. Average parametric climatic factors-year crossplot for 2001 – 2010 years