Preliminary Assessment of Air Pollution Quality Levels of Lagos, Nigeria

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Abstract

The low-cost sensors and IoT have come to the rescue due to the high cost and operational complexity of equipment and methodologies in environmental monitoring. They are relatively inexpensive and reliable. It is on this assumption that we have decided to use the World Air Quality satellite data supplied by air matters.com. This study is a 40-day preliminary work in which air quality (Air Quality Index (AQI), $PM_{2.5}$, PM_{10}, NO_2, CO, SO_2, and O_3) and meteorological (temperature, humidity, and wind speed) parameters were monitored. The data collected was for five locations in Lagos State, Nigeria (Ojodu, Opebi, Ikeja, Maryland, and Eti-Osa). The data obtained were subjected to basic statistical analyses. The findings showed that the Opebi had the highest mean value of $PM_{2.5}$ (69.28 μg/m^3), PM_{10} (107.38 μg/m^3), and CO (1392 μg/m^3). The mean values of O_3 are as follows: 32.52, 38.7, 36.2, 37.85, and 36.13μg/m^3 for Ikeja, Maryland, Opebi, Ojodu, and Eti-Osa respectively. Opebi had the highest value (3179μg/m^3), followed by Eti-Osa (2978μg/m^3), and the lowest value in Maryland (1943μg/m^3) among the CO reference locations. AQI of all locations presented the levels of contamination as 'Unhealthy for Vulnerable Groups'. The pollutants were much higher than the World Health Organization (WHO) guidelines. There were relationships between the parameters monitored and meteorological influences, and the effects of natural and man-made activities may be the sources of the elevated pollutants throughout the locations.

Introduction

Urban air pollution is typically caused by a wide variety of emission sources, including commercial/residential fuel traffic, manufacturing, and combustion, and consists of a complex mix of gaseous and particulate air pollutants such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$) and ground-level ozone ($PM_{2.5}$) (defined as aerodynamic diameter particulate matter ($PM_{2.5}$) air quality has been a big concern in many countries. According to the World Health Organization (WHO) (2018), more than seven million people die each year because of this disease, and more than 80 percent of the population of urban areas live in places where air quality increases above WHO (2020) guideline limits. As stated by Apte et al. (2018), global and national life expectancy has been lowered due to air pollution. In addition to correlations with decreased life expectancy overall, epidemiological studies suggest potential associations for different cardiovascular and pulmonary disorders, including strokes, between short-and long-term exposure to air pollutant requirements and increased morbidity, mortality, and hospital admissions. The assessment of long-term air monitoring data and atmospheric $PM_{2.5}$ characterization will help to increase understanding of the state of air quality and explain the sources of urban particulate pollution. Mass concentration is the global normative metric for measuring and tracking the exposure of particulate matter (PM). Based on epidemiology and the subsequent guidelines of international organizations, national legislation in many developing countries sets fixed thresholds, limits, and/or target values for PM mass concentrations (WHO, 2000; IARC, 2013).

Growing use is being made of low-cost sensors, satellite modelling and citizen scientists, non-scientists interested in specific issues who collect or analyze data to contribute to scientific research, or advocate for environmental or public health improvements. Several organizations such as New York City Community Air Survey (NYCCAS), AirVisual, and Air Matters, just to name a few have developed into this field of community engagement and community-based participatory research by developing air quality toolkits for 'citizen-science' and AQI modelled using satellite to accessible pollution source data, Using fresh, low-cost air pollution surveys to construct community air pollution surveys. The World EPAs (Environmental Protection Agencies) have made available air quality data showing more than 15,000 stations in 2000 major cities from 132 countries. The world currently operates more than 30,000 recognized air quality monitoring stations, of which more than 12,000 are published in the World Air Quality Index project. The AQI standard for any single published station is based on the US EPA Instant-Cast standard (The World Air Quality Index Project Team, 2020).

According to Iskandaryan et al. (2020) and Giffinger et al. (2020), a smart city is a city in which there are six main components, including smart economy, smart transport, smart environment, smart citizens, smart life, and smart management, or The use of smart computing technologies to render critical infrastructure components and services of a city, including city governance, education, and smart management The availability of data produced by sensors is a significant characteristic of smart cities (Trilles et al., 2017; Granell et al., 2020). In other words, because of the above explanation, there is the aspiration of Lagos becoming a smart town in Nigeria.

In Nigeria and the African continent, Lagos is the most populous city in (Campbell, 2012). The megacity has Africa's fourth highest GDP and houses one of the continent's biggest and busiest seaports (Lees et al., 2015). It is one of the world's fastest growing cities.

In Nigeria, Nigerian scientists and their international collaborators have taken a variety of air quality measurements (Osimobi et al., 2019 Daful et al., 2020; Croitoru et al., 2020). These are, however, limited-point measurements around the city (background, commercial, roadways, and informal settlement households) and limited numbers of contaminants, primarily $PM_{2.5}$ and PM_{10}. In certain cases, PM levels appear far above the World Health Organization (WHO) 24-h average guideline.

The prospect of building low-cost PM sensors and the use of IoT has attracted the attention of many researchers around the world in recent years (Obayan et al., 2018; Johnston et al., 2019; Chojer et al., 2020). Much of the study centered on the followings: i assessment and calibration of various PM sensor systems (Bulot et al., 2019; Suriano, 2002; Suriano et al., 2020; Markowicz and Chili'ski, 2020); (ii) local air pollution sources detection (Morawska et al., 2018; Rogulski, 2018); (iii) effects on air pollution of meteorological and topographical parameters (Rogulski, 2017; Rogulski, 2018), and (iv) studies to determine the risk of athletic activities linked to exposure to air pollution (Nieckarz and Zoladz, 2020). The present paper is the first attempt, to the best of our knowledge, to draw the attention of researchers to the use of satellite model (IoT).

This does not, however, take away the fact that Lagos State does not have an active monitoring method for air quality. The current monitoring scheme employs relatively large, heavy and expensive air pollutant analyzers, with device prices ranging from EUR 5000 to EUR 30,000. The results of air quality monitoring are collected for enhanced decision-making in a database. It takes time to process the laboratory results and, even then, the results could be unreliable as certain parameters differ on site and in-lab. This research, therefore, is a development in this part of the nation in the field of air quality monitoring. The main objective of the study is to use satellite data (Internet of Things, IoT) systems in order to track Lagos' air quality. The satellite data will concentrate only on the most important parameters because of financial constraints.

It is expected that the study will last for 24 months. Consequently, the purpose of the study was to carry out a 40-day preliminary air quality assessment ($PM_{2.5}$, PM_{10}, CO, NO_2, SO_2, and O_3) at five separate locations (Opebi, Ojudu, Ikeja, Maryland, and Eti-Osa) in Lagos State, Nigeria, and to assess the effect of meteorological parameters (wind speed, temperature, and humidity) on air quality.

Materials And Methods

For the year in Lagos, the average temperature is 27.2°C. On average, the warmest month is February, with an average temperature of 28.9°C. On average, the coolest month is August, with an average temperature of 25°C. For the year in Lagos, the total amount of precipitation is 1506.2 mm. On average, the month with the most rainfall is June, with 315 mm of precipitation. On average, the month with the least rainfall is January, with an average of 12.7 mm. There is an average of 53.0 days of precipitation, with 9.0 days being the most precipitation in September and 1.0 days being the least precipitation in January. There is an average of 53.0 days of rain in terms of liquid precipitation, with the most rain occurring in September with 9.0 days of rain, and the least rain occurring in January with 1.0 days of rain (CantyMedia, 2020). The temperature average for the year in Lagos is 27.2 ° C. The warmest month, on average, is February, with an average temperature of 28.9°C. The coolest month, on average, is August, with an average temperature of 25°C. The overall amount of precipitation is 1506.2 mm for the year in Lagos. The month with the most precipitation, on average, is June, with 315 mm of precipitation. The month with the least precipitation, on average, is January, with an average of 12.7 mm. There is an average of 53.0 days of precipitation, with 9.0 days in September being the most precipitation, and 1.0 days in January is the least precipitation. In terms of liquid precipitation, there is an average of 53.0 days of rain, with the most rain occurring in September with 9.0 days of rain, and the least rain occurring in January with 1.0 days of rain (CantyMedia, 2020).

Due to lack of monitoring stations, the air quality was assessed in this study using regular AQI satellite data obtained from Air Matters (Air Quality.com, 2020) at five locations in Lagos State, Nigeria (elevation: 38 meters, latitude: 06 35N, longitude: 003 20E). From the 1st of October and 9 November 2020. The stations are Ojodu (6.625, 3.354); Ikeja (6.601, 3.351); Eti-Osa (6.458, 3.601); Maryland (6.571, 3.372); and Opebi (6.589, 3.361). A tropical savanna climate with dry and wet sessions (Cfa following Köppen climate classification) characterises the study cycles in Lagos.

Air-quality.com (powered by Air Affairs) is a low-cost real-time, citizen-based PM sensor network deployed in more than 180 countries and regions (https:/air-quality.com). Air-quality.com provides measurements via satellite images of contaminants ($PM_{2.5}$, PM_{10}, CO, NO_2, SO_2, O_3) and meteorological parameters (humidity, wind speed, and temperature). In this analysis, measurements of hourly pollutants and meteorological parameters were used. In this research, the available data on AQI, pollutants, and meteorological parameters in Ikeja, Ojodu, Opebi, Eti-Osa, and Maryland were computed and statistically analysed using Minitab software version 16 (Descriptive, Pearson correlation, Box plot, and Times series).

Results And Discussion

The mean values for AQI are as follows: Ikeja (127.88), Opebi (141.82), Ojodu (109.88), Eti-Osa (101.4), and Maryland (127.88). To determine the health hazards to which the public is exposed due to air pollution, the AQI of the contaminants was collected. Table 1 displays the outcomes of AQI data for the five sites. In other regions, the health details for the locations ranged from good in Eti-Osa to very unhealthy. Eti-Osa experienced fewer unhealthy air-quality days than other urban areas, likely because of fewer air pollution sources in Eti-Osa. All categories of location had a mean annual average AQI and $PM_{2.5}$ concentration higher than the EPA standard. The air-quality measure suggests that air quality worsens as locations become more urban, in regards to all contaminants combined.

This study is at odds with the Akinfolarin et al. (2017) studies that confirmed Port Harcourt, Nigeria's very unhealthy and dangerous situations. The high AQI values documented were due to the high traffic incidences, industrial fumes, recent national protests that were used in major cities in Nigeria during these periods firearms and banger and high dust incidence were produced. The health consequence is that people who spent long hours were at greatest risk of severe health complications and other vulnerable groups such as asthmatics, children and elderly, people with heart or lung diseases (Nwaogazie and Zagha, 2015). Airborne particulate matter has a harmful health impact (Beelen et al., 2013) and is estimated to cause between 3 and 7 million deaths per year, mostly due to the creation or worsening of cardio-respiratory diseases (Hoek et al., 2013).

The mean concentration of $PM_{2.5}$ and PM_{10} over Ikeja was between 20 - 123 μg/m^3 and 30 - 176 (μg/m^3); Maryland was between 22 - 120 μg/m^3 and 33 - 173 μg/m^3; Ojodu was between 17μg/m^3 - 81μg/m^3 and 27 - 121μg/m^3, and Eti-Osa was between 5μg/m^3 - 212μg/m^3 and 9μg/m^3 - 298μg/m^3. In Opebi, however, $PM_{2.5}$ and PM_{10} were located in the 26 - 163 (μg/m^3) and 40 - 241 (μg/m^3) ranges, respectively. It was observed that during the daytime, high values were reported. During the day, the level of tasks varies. For example, the traffic activities at the various locations are considered the highest at the early morning hours, which are the busiest periods, relative to the other day times due to the beginning time of all works and schooling at this time. Table 1 displays the mean concentrations (±standard deviations) of $PM_{2.5}$ and PM_{10} for all air quality stations at all places. The findings (mean) on the two types of PM from Ojodu area were similar to the mean values 37.65 and 43.45μg/m^3 for $PM_{2.5}$ and PM_{10}, respectively obtained by Liang et al. (2019) in Beijing, China (Table 2). The mean values obtained in this study are lower than that (121 μg/m^3) in Beijing, but higher than those reported for Tokyo (23 μg/m^3), Seoul (54 μg/m^3), and Luzhou (72 μg/m^3), and Nkolfoulou (28.84 – 97.69 μg/m^3). The reasons could be due to time of monitoring, prevailing meteorological parameters, probably the methodology of monitoring. In all places, the mean values of O_3 are as follows: 32.52, 38.7, 36.2, 37.85, and 36.13μg/m^3 for Ikeja, Maryland, Opebi, Ojodu, and Eti-Osa. Opebi had the highest value (3179μg/m^3), followed by Eti-Osa (2978μg/m^3), and the lowest value in Maryland (1943μg/m^3) among the CO reference locations. While the coefficient of NO_2 and SO_2 variations varies from 61.63 percent to 77.06 percent and 26.86 percent to 37.36 percent respectively in all locations, except Eti-Osa with variations of 120.97 percent and 64.84 percent. Comparing the results of gas pollutants in this study with other locations (China, South Korea, and Japan), it is noted that they are not in agreement. The developed countries have the higher levels due to vehicular exhaust, higher industrialization, dust, pollen, mold spores, volcanoes and wildfires. Table 1 also indicates the variations in temperature, wind speed, and relative humidity with concentrations of $PM_{2.5}$ and PM_{10} in all locations on average.

Table 1: The basic descriptions of Locations (I - V)

I. Ikeja

Parameter	Mean	Std. Dev.	CoefVar	Minimum	Maximum	Skewness	Kurtosis
AQI	127.88	42.58	33.3	70	188	-0.66	-0.2
$PM_{2.5}$	57.4	28.29	49.28	20	123	0.55	-0.55
PM_{10}	84.97	40.03	47.11	30	176	0.54	-0.63
O_3	35.52	26.34	74.16	16	98	1.49	0.76
CO	1110.2	58.5	52.74	302	2576	0.7	0.05
NO_2	17.77	11.07	62.29	2	45	0.53	-0.35
SO_2	3.95	1.06	26.86	3	7	1.73	3.24
Temperature	27.38	1.51	5.53	23	30	-1.15	2.09
Humidity	84.63	7.92	9.36	66	100	-0.36	0.19
Wind Speed	12.43	5.58	44.94	2	24	0.2	-0.57

II. Opebi

Parameter	Mean	Std. Dev.	CoefVar	Minimum	Maximum	Skewness	Kurtosis
AQI	141.82	39.62	27.93	80	211	-0.25	-1.17
$PM_{2.5}$	69.28	38.18	55.11	26	162	0.81	-0.11
PM_{10}	107.38	52.35	48.75	40	241	0.91	0.2
O_3	38.7	31.93	82.51	11	113	1.36	0.48
CO	1392	708	50.89	332	3179	0.6	0.01
NO_2	23.98	15.08	62.9	4.25	55	0.22	-1.02
SO_2	6.08	2.272	37.35	2	15	1.76	5.41
Temperature	26.7	0.85	3.2	25	28	-0.15	-0.52
Humidity	92.7	2.42	2.61	84	94	-0.85	3.01
Wind Speed	6.55	1.95	9.73	2	11	-0.48	1.27

III. Ojodu

Parameter	Mean	Std. Dev.	CoefVar	Minimum	Maximum	Skewness	Kurtosis
AQI	109.28	38.41	35.15	61	163	0.1	-1.8
$PM_{2.5}$	40.38	19.68	48.74	17	81	0.54	-0.8
PM_{10}	63	27.4	43.49	27	121	0.43	0.82
O_3	37.85	24.13	63.76	12	88	0.96	-0.53
CO	69.6	433.7	56.35	273	1968	1.18	1.11
NO_2	8.82	6.8	77.06	2	28	1.2	1
SO_2	2.83	0.78	27.64	2	4	0.32	-1.27
Temperature	27	2.18	8.09	23	30	0.44	-0.73
Humidity	85.05	7.86	9.24	70	94	-0.24	-1.23
Wind Speed	12.73	6.21	48.77	4	20	-0.09	-1.76

IV. Maryland

Parameter	Mean	Std. Dev.	CoefVar	Minimum	Maximum	Skewness	Kurtosis
AQI	127.88	40.79	31.9	69	192	-0.18	-1.7
$PM_{2.5}$	57.05	28.91	50.67	22	120	0.57	-0.68
PM_{10}	84.97	41.85	49.26	33	173	0.54	-0.74
O_3	36.2	22.5	62.16	13	90	1.41	0.64
CO	964	473	49.05	115	1943	0.31	-0.54
NO_2	15.12	9.31	61.63	2	33	0.34	0.9
SO_2	3.4	1.01	29.64	2	6	1	0.77
Temperature	28.33	0.57	2.02	28	30	1.61	1.75
Humidity	82.75	2.7	3.26	72	84	-2.81	8.04
Wind Speed	9.95	4.24	42.24	6	24	1.33	2.35

V. Eti-Osa

Parameter	Mean	Std. Dev.	CoefVar	Minimum	Maximum	Skewness	Kurtosis
AQI	101.4	77.3	76.2	21	256	0.49	-1.28
$PM_{2.5}$	58.3	63.1	108.17	5	212	0.99	-0.25
PM_{10}	84.5	89.2	105.51	9	298	0.97	-0.3
O_3	36.13	25.32	70.08	10	111	1.45	2.44
CO	1013	1007	99.39	124	2978	0.79	-0.88
NO_2	17.58	21.26	120.97	1	66	1.04	-0.4
SO_2	5.03	3.26	64.84	1	11	0.2	-1.51
Temperature	23.5	0.56	2.37	23	25	0.49	-0.83
Humidity	93.37	1.32	1.42	90	94	-1.84	1.8
Wind Speed	3.79	1.91	50.2	2	6	0.24	-1.94

Table 2. Comparison of the Air Pollutant Concentrations in Lagos with Other Cities ($\mu g/m^3$)

Location	$PM_{2.5}$	PM_{10}	O_3	CO	NO_2	SO_2	Reference
Beijing, China	-	121	-	1,600	53	34	Li et al. 2018
Tokyo,	-	23	4	500	43	6	Li et al. 2018
Seoul		54	26	50	72	14	Li et al. 2018
Luzhou City, China	-	72	54	2017	40	59	Li et al. 2018
Ibadan, Nigeria	-	-	31	0.59	63	30	Ipeaiyeda and Adegboyega, 2017
Nkolfoulou, Cameroon	18.59 - 37.57	28.84 - 97.69	5.73 - 26.18	0.04 - 1.48	35.92 - 49.60	1.05 - 4.18	Feuyit et al., 2019
Lagos, Nigeria	40.38 - 69.28	63 - 107.38	35.52 - 38.7	69.6 - 1392	8.82 - 23.98	2.83 - 6.08	Our Study

Temperatures (°C) range from 23 to 30, wind speed (m/s) from 2 to 20 and humidity (percent) from 66 to 100. Compared to other locations, most of the contaminant values obtained for Eti-Osa were low simply because Eti-Osa is located around the lagoon. In this analysis, most of the $PM_{2.5}$ findings were above the NAAQS limit of 35μg/m^3 (Osimobi et al., 2019). In the same way, most of the findings published here are above the limit of 150μg/m^3. Living things (humans, animals, and plants) (Abulude et al., 2017) and non-living things (monuments, vehicular components, and buildings) (Abulude et al., 2018a) are susceptible to the harmful effects of particulate matter in these areas of research.

Table 3: Pearson Correlation Coefficient of the locations

rameter	AQI	$PM_{2.5}$	PM_{10}	O_3	CO	NO_2	SO_2	Temp	Humidity	Wind Speed
AQI	1									
$PM_{2.5}$	0.97	1								
PM_{10}	0.97	0.99	1							
O_3	-0.53	-0.56	-0.57	1						
CO	0.93	0.92	0.92	-0.58	1					
NO_2	0.84	0.84	0.85	-0.59	0.97	1				
SO_2	0.92	0.86	0.86	-0.39	0.92	0.84	1			
Temp	-0.64	-0.58	-0.58	0.14	-0.65	-0.57	-75	1		
umidity	0.07	0.09	0.09	0.05	0.16	0.13	0.18	-0.45	1	
Wind Speed	-0.83	-0.74	-0.74	0.23	-0.97	-0.69	-0.91	0.79	-0.23	1

High levels of other contaminants - gases (CO, NO_2, O_3, and SO_2) reported in this study are reported (Table 1). In this work, the NO_2 values are well above the recommended 1-hour mean (0.5μg/m^3) of the Federal Ministry of Environment (FMEnv) Nigeria maximum, but less than the recommended 24-hour WHO limit (40μg/m^3). In a similar study in India, Jayamurugan et al. (2013) obtained NO_2 (11.7 - 50.3μg/m^3) compared to our findings, but their SO_2 values were lower than our results. The discrepancies may be attributed to the two countries' weather conditions. The SO_2 values obtained were lower than the WHO limit suggested for 24 hours (500μg/m^3). The CO values were also well above the WHO limit of 55μg/m^3 for 8 hours. The effect of the high results is that it can lead to the secondary pollutant(s) polluting water sources and soil if the elevated contaminants are washed down by rainfall. This is the case with HNO_3-forming NO_2, which acidifies surface water, soil water, and soil water. The burning of fossil fuels, vehicular movements, high population rise, rapid economic development, and re-suspended soil dust are the contributing variables of airborne contaminants in different cities of the world (Abulude et al., 2018b). In addition to associations with overall reduced life expectancy, epidemiological studies indicate possible associations between short and long-term exposure to requirements for air pollutants and increased morbidity, mortality, and hospital admissions for various cardiovascular and pulmonary diseases, including strokes (Ilie and Eisl, 2020; DeSouza et al., 2017). Skewness and Kurtosis (below 2 and 6, respectively) were poor. Skewness and kurtosis indices are generally used to verify the symmetry and flatness properties of the density and data distribution function in the time series. The skewness coefficient is very susceptible to extreme and discontinuous fluctuations. The presence of interruptions in the time series is suggested by Kurtosis. Table 1 shows that the highest value of the skewing coefficient in Ikeja and Opebi is SO_2 (but not the same in the other three locations), which corresponds to a sharp increase in the results. The kurtosis coefficient also shows a very high value, corresponding to the current discontinuities in the results, for both NO_2 and O_3.

For the data collected, Pearson correlation statistics are applied (Table 3). Strong correlations (r) (AQI, $PM_{2.5}$, PM_{10} above 0.90) were observed in Eti-Osa. AQI, $PM_{2.5}$, PM_{10}, CO, and O_3 are closely correlated with CO, NO_2, SO_2, at >0.84. The gases and the values of the PM are also negatively correlated. The implication is that the study area's contaminants are influenced by temperature and wind speed. The correlations were about the same for the other sites, but poor and negative relationships were found. A strong correlation was observed between PM_{10}, $PM_{2.5,}$ and NO_2, and correlations between SO_2, NO_2, PM_{10}, $O_{3,}$ and $PM_{2.5}$ were investigated (Ko et al., 2007; Gocheva-Ilieva et al., 2014). The adverse coefficients of correlation obtained may be due to the washout phase as rain indicates an effect of wet deposition on particulate matter. Rainfall eliminates atmospheric particles and humidity decreases the risk of resuspended soil particles by keeping the soil moist (Jaenice, 1993; Misra et al., 2008), thus decreasing atmospheric particulate mass concentration. Wind speed yielded a negative correlation of 0.05 confidence in PM and other contaminants. The contaminants have good positive temperature associations for most days because the temperature can influence the formation of particles and gases, so the photochemical reaction between precursors can be encouraged by temperature. The impact of temperature on the pollutants could be because hot air conditions were more suitable for atmospheric dispersion than cold air masses (Owoade et al., 2012). The humidity was high (above 40 percent) for most of the days and in each location. Due to hygroscopic growth, when the moisture is low, the concentration of $PM_{2.5}$ and other contaminants increases (Liu et al., 2011). The particles grow too large to remain in the air when the humidity is high enough. Dry deposition, therefore, occurs; particles fall to the earth. As a result, particle numbers are declining and the concentration of $PM_{2.5}$ is decreasing. A negative correlation between $PM_{2.5}$, CO, NO_2, SO_2, $O_{3,}$ and wind velocity below 3 m/s and a positive correlation between $PM_{2.5}$ and wind velocity above 3 m/s are shown in Table 3 (Wang and Ogawa, 2015).

It can blow away contaminants within a certain geographical area when the wind speed is low, but it can carry vast amounts of pollutants from far away when the wind speed is high enough.

Box and Whisker plots are shown in Figure 2 to display the data distribution in terms of the lower quartile, upper quartile, median, minimum, and maximum in each of the five locations. This was carried out to demonstrate the difference in regular concentrations of air pollutants. A brief sketch of the distribution of the underlying data is shown in the Box plot. The plots showed that in Eti-Osa, lower concentrations of $PM_{2.5}$ and PM_{10} were obtained, while in Opebi the highest concentration was recorded. Increased commercial operations, temperature, and wind speed may be due to the disparity. Similarly, the graphs show that the highest observed value was NO_2 in Eti-Osa, followed by Opebi, while the lowest was obtained in Ojodu. The results may be attributable to the lack of photochemical processes in the fields of study, which may further be influenced during the rush hours by increased vehicular traffic (Sun et al., 2008; Ibe et al., 2020). In the parcels, the upper whisker shows that the highest concentration of CO is present in Opebi. This shows that the highest value is given to the venue. The least of these was contained in Ojodu. Due to high vehicle activity, the fluctuations in the upper whisker could be due to elevated CO in the regions, whereas the lowest value observed could be due to reduced vehicle traffic. Finally, at Eti-Osa, the Box and Whisker plot of O_3 showed that greater concentrations were observed in the vicinity. This value contrasts favorably with the values obtained in other places, however. Photochemical reactions that occurred during the reporting period can be attributed to this.

The time series plot is depicted in Figure 3. From the graph, it could be deduced that there was variability in this pollutants data with time. The variability is much lower near the valleys than near the peaks. The QAI of the different locations differs, from

Conclusion

The study is preliminary results (40 days) of a year monitoring study of Lagos, Nigeria. The data generated in this study was received via the satellite model provided by Air.Quality.com. The AQI, the pollutants ($PM_{2.5}$, PM_{10}, O_3, CO, SO_2, and NO_2), and the meteorological factors were used for the assessment. It was observed the AQI values were high translating into 'Very Unhealthy' but most of the results in the Eti-Osa area were 'good' due to its location near the lagoon. Most of the results for the pollutants were above the WHO, NAAQS, and FMEnv limits 1-hour mean. Pearson Correlation coefficient revealed great relationships between the pollutants and the meteorological factors. In conclusion, it was depicted that elevated concentrations of the pollutants were caused by man-made activities like vehicular movements, burning of biomass and wastes, industrial, and national demonstration by the youths of the country. No doubt, the locations are in danger in terms of air pollution, efforts to reduce the menace and the aftermath effects should be put in place by all stakeholders (Government, residents, NGOs, environmental scientists, journals, philanthropists, just to mention a few).

Declarations

Conflict of Interest:

None

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None

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Figures

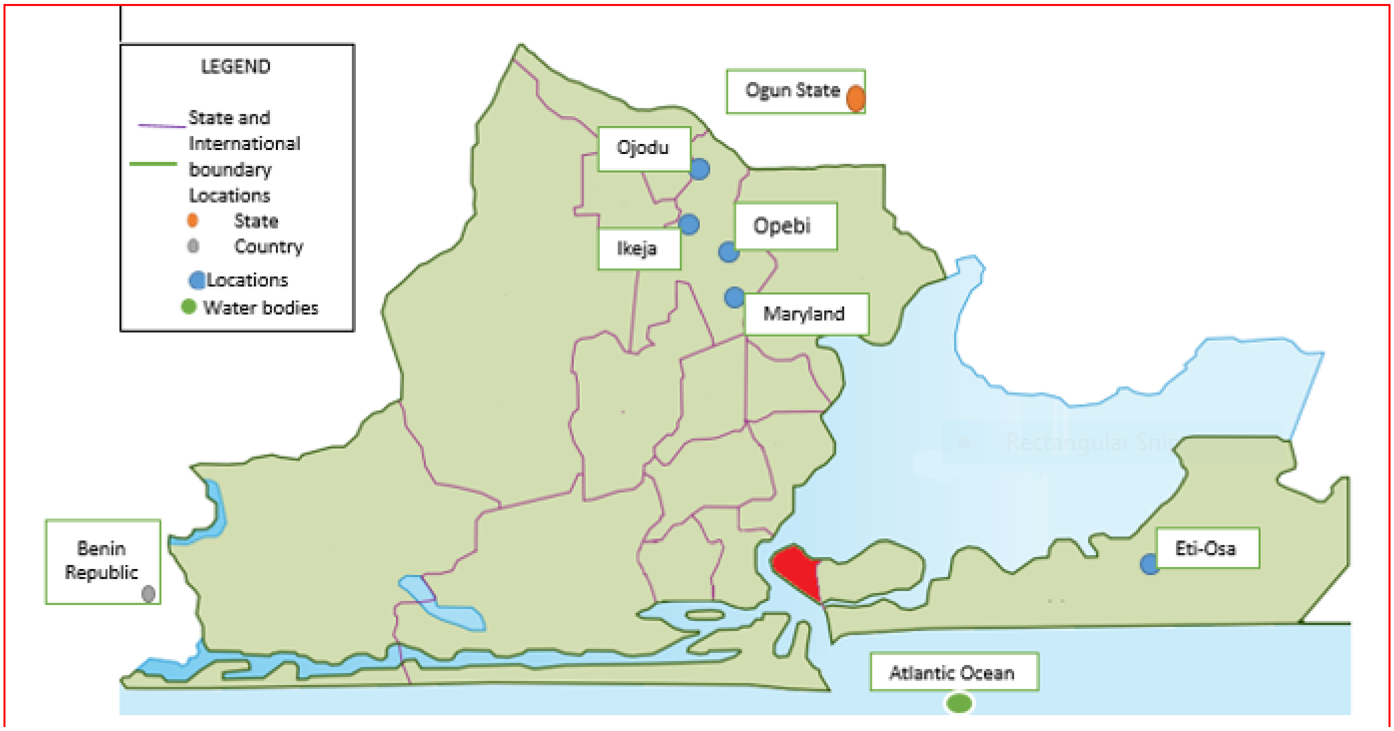

Figure 1

The Sampling Points in the Study Area

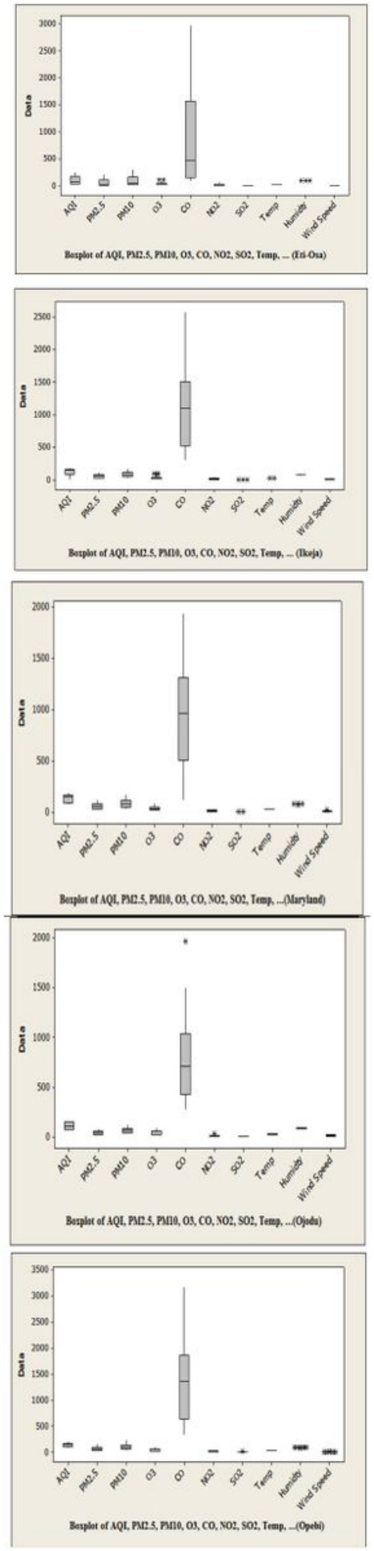

Figure 2

Box and Whisker plots of the Data from the Locations

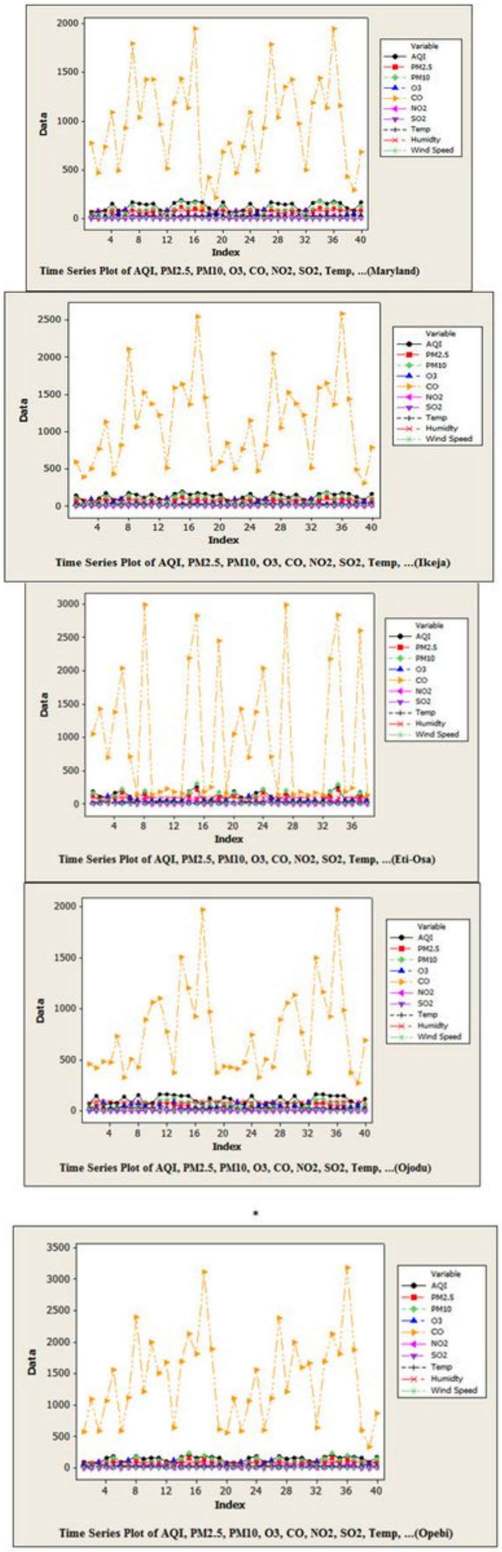

Figure 3

The Time Series Plots of the Data from the different Locations