INVESTIGATION OF CARBON (II) OXIDE POLLUTION IN SEVEN STATIONS OF NIGERIA THROUGH REMOTE SENSING

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Abstract: A growing concern in our world today is air pollution. Carbon (II) Oxide, an air pollutant has been reported to contribute to a large number of poisoning deaths. The magnitude of the health hazard due to carbon (II) Oxide, both fatal and non-fatal, is huge and poisonings are probably more prevalent than is generally recognised. The aim of this study was to determine the level of human exposure to Carbon (II) Oxide and also to identify the major source of Carbon (II) Oxide emission within the study areas, using MOPITT (measurement of pollution in the troposphere) satellite. Carbon (II) Oxide was measured at seven environmentally different sites viz; Lagos, Port-Harcourt, Ibadan, Akwa-Ibom, Sokoto, Kano, and Abuja. From these measurements, the effect of varying levels of Carbon (II) Oxide at different environments was analyzed. Ambient Carbon (II) oxide at these sites, their monthly variation, average annual variation, seasonal variation was outlined respectively. This study revealed that Lagos has the highest ambient Carbon (II) Oxide (3.00842 ppm), followed by Port-Harcourt (3.00175 ppm), Uyo (2.85 ppm), Ibadan (2.83 ppm), Abuja (2.68 ppm), Kano (2.31 ppm), and Sokoto (2.28 ppm) in descending order. The results shows the characteristic Carbon (II) Oxide levels encountered at different environmental locations, their response to traffic and the anthropogenic activity that affects Carbon (II) Oxide levels.

Keywords: MOPITT, Air Pollutant, Health Hazard, Carbon (II) Oxide

Introduction

Vehicular emission remains a threat to environmental health issues which is expected to increase moderately as vehicle ownership increases in the world. Over 600 million people globally are exposed to hazardous level of traffic – generated pollutants such as Carbon (II) Oxide, Nitrogen oxide (NO_2), Volatile Organic Compounds (VOCs), and Polycyclic aromatic hydrocarbon UN, (1998). Human exposure to these air pollutants due to traffic is believed to have constituted severe health problems especially in urban areas where pollution levels are very high. A vehicular emission during transportation is the major source of air pollution summing for over 80% of the total air pollution in the urban areas. This must be controlled if acceptable air quality is to be assured in urban areas. In addition, from review (WHO, 1998), there are numerous health problems associated with high concentration of the pollutant (Carbon (II) Oxide) as shown below.

Table 1: Showing the Health Problems Associated with Air Pollutant (WHO, 1998)

Symptoms	Adult	Child	Infant
General	Dizziness, fatigue, weakness	_	Not feeling well
Neurological	Headache, drowsiness, disorientation, fits	Headache, drowsiness, fits, uncoordinated movement	_
Stomach/ Intestine	Nausea, vomiting, stomach pains	Vomiting, stomach pains, diarrhea, anorexia	Loss of appetite
Heart	Chest pain, wheeziness, palpitation, hypertension	Hyperventilation	_

Carbon (II) Oxide is a colourless, odourless, tasteless and toxic gas which is chemically stable, but relatively inactive gas that has molecular weight close to that of air, according to ideal gas law.

Carbon (II) Oxide is slightly less dense than air. Carbon (II) Oxide consists of molecule of carbon atom and oxygen atom, linked firmly together by a triple bond that consists of two covalent bonds as well as one dative bond (Blumenthal, I., 2001). Carbon (II) Oxide is formed from the incomplete oxidation of a carbon-containing compounds; it is produced when there is not enough oxygen to form Carbon (IV) Oxide (CO_2), such as when operating a stove or an internal combustion engine in an enclosed space.

At the earth surface, Carbon (II) Oxide is produced in all forms of burning of biotic material at inadequate oxygen levels. In the atmosphere, natural production to the extent of 50% of the total atmospheric Carbon (II) Oxide load is by the interaction of solar radiation with methane. In the urban centers, developing towns and cities, vehicular exhaust is the major human influence source for Carbon (II) Oxide (Environmental Health Criteria 1999). In rural areas, biomass burning in conjunction with agricultural practices is a major contributor. The largest source of Carbon (II) Oxide worldwide is natural in origin (Blumenthal, I., 2001 and Weinstock, B.; Niki, H., 1972.), due to photochemical reactions in the troposphere that generate about (5×10^{12} kilograms per year), other natural sources of Carbon (II) Oxide include volcanoes, forest fires while anthropogenic sources – those sources that are not natural are road vehicles, non-road equipment, fuel combustion, industrial processes etc. They are quite small in comparison with natural sources (WHO, Guidelines 1999).

Outside of Earth, Carbon (II) Oxide is the second-most common molecule in the interstellar medium, after molecular hydrogen. The Carbon (II) Oxide molecule produces far brighter spectral lines than the hydrogen molecule, making Carbon (II) Oxide much easier to detect (Blumenthal, I., 2001 and Mike Thompson). Carbon (II) Oxide observations provide much of our knowledge about the molecular clouds in which most stars form. An important deficient process for Carbon (II) Oxide is through respiration by warm-blooded animals at the surface and at higher heights above sea level till tropopause; Carbon (II) Oxide is mainly controlled by the hydroxyl (OH) radical. Even at low levels (~9 parts per million for 8 hours of respiration) Carbon (II) Oxide is toxic and harmful particularly to human beings and in general, to all life forms that respire (Coburn, R.F, 1979; Ernst, A., Zibrak, J.D., 1998 and Lipman, G.S., 2006). Thus Carbon (II) Oxide levels in the immediate surrounding

environment play a role in determining the air quality of a region. The research focuses on:

1) Exposing the acute health risk of Carbon (II) Oxide to the entire population.
2) Enlightening individuals about the importance of proper maintenance of combustion equipments.
3) Harnessing a great deal of information that is relevant to air quality.

Methodology and Data Collection

Three methods are mostly commonly used for the routine estimation of Carbon (II) Oxide in air. These are the continuous analysis method based upon non-dispersive infrared absorption spectroscopy (NDIR); the semi-continuous analysis method using gas chromatographic techniques and a semi-quantitative method employing detector tubes. Other methods include catalytic oxidation, electrochemical analysis, mercury displacement, and the dual isotope technique (WHO, 1976). The method adopted for this research was non-dispersive infrared absorption spectroscopy (NDIR), using remote sensing process via MOPITT satellite in space. It is nadir sounding instrument which measures upwelling infrared radiation at 4.7μm and 2.2 – 2.4μm. It uses correlation spectroscopy to calculate total column observations and profiles of Carbon (II) Oxide in the lower atmosphere. It is a playload scientific instrument launched into the Earth orbit by NASA to monitor changes in pollution patterns and its effect in the lower atmosphere of the earth (Drummond JR, Mand GS, 1996 and Bowman KP, 2006).

Satellites make measurements indirectly by sensing electromagnetic radiation coming from the surfaces below. Because radiation can transport energy without a medium, it is the only way in which the earth interacts with the rest of the universe. Thus, electromagnetic radiation is the basis for remote sensing technology. Remote sensing instruments in space, on the ground, or in mid-air record different parts of the spectrum absorbed, emitted, or scattered by the gases and particles in our atmosphere. Remote sensing instruments flown on satellites provide ever-increasing insight into our planet Earth. The instruments that measure electromagnetic energy are called radiometers. They are imagers and sounders.

Imagers: contrary to a common conception, there are no cameras on satellites. Two main types of imagers are utilized in satellite meteorology. One measures the amount of visible light from the sun reflected back to space by the Earth's surface or by clouds. The

second measures the amount of radiation emitted by these entities. Data from these radiometers are transmitted to earth where visible and infrared (IR) images are produced by computers. Visible images are the same thing we would see with our naked eye and require daylight. Infrared images depend on the amount of radiation an object emits.

Sounders: this is the second type of radiometer flown on weather satellite and they measure infrared radiation. Sounders provide vertical profiles of temperature, pressure, water vapor and critical trace gases in the earth's atmosphere.

A very good example of visible and infrared imagers is the POES (Polar orbiting earth satellite) and the GOES (Geostationary operational environmental satellite). Satellites collect data in a swath beneath them as the earth rotates on its axis. In this way, a polar orbiting satellite can "see" the entire planet twice in a 24 hour period. The basic operational mode deploys two polar orbiting satellites continuously, one passing north to south (descending) and the other passing south to north (ascending), circling the earth every 12 hours. The collection of data deals with the different sources such as specification of the equipment used, data collection procedures and possible sources of errors. The data used for this study was obtained using the secondary research methods, which includes:

NASA: The data was gotten from the National Aeronautics and Space Administration (NASA) via their website.

Information from books, research institutes related to Carbon (II) Oxide, journals, and magazines, published and unpublished literatures.

Result and discussion

The results shows that the investigation into relationships between Carbon (II) Oxide levels, human health outcomes and public health warnings of potential harmful Carbon (II) Oxide levels are accurate, precise and representative measurement of Carbon (II) Oxide. Therefore, the results of measuring Carbon (II) Oxide emissions from different sources are presented below.

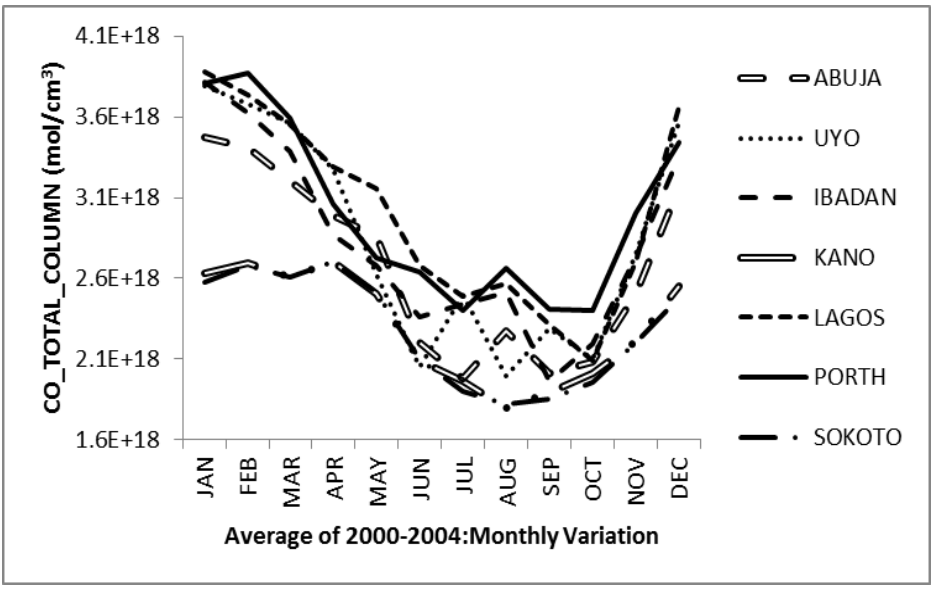
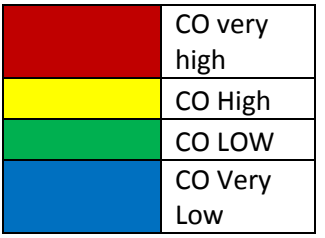


Figure 1: The average monthly variation of Carbon (II) Oxide in several cities of Nigeria.

From the graph (Fig.1), the level of Carbon (II) Oxide was high in all the stations around the month of December, January, and February (DJF) (2000-2004) i.e. during the dry season/ harmattan period and thus outdoor sports or events cannot be carried out during this period. Accordingly, the best time to play outdoor sports or organize any outdoor event is during the month of September, October and November (SON), which is the offset of rainy season while outdoor sports activities cannot be engaged during peak of rainy season i.e. June, July and April (JJA).

Table 2: showing the different stations, population, Carbon (II) Oxide amount, month and seasons.

RANK	STATIONS	POPULATION	ANNUAL CO AMOUNT (ppm)	HIGH CO MONTH	LOW CO MONTH	HIGH CO SEASON	LOW CO SEASON
1	Kano	9,401,288	2.31E+18	APRIL	AUG	DJF/dry season/harmattan	JJA/peak of rainy season
2	Lagos	9,113,605	3.01E+18	JAN	OCT	DJF/dry season/harmattan	JJA/peak of rainy season
3	Ibadan	5,801,584	2.83E+18	JAN	SEP	DJF/dry season/harmattan	SON off set of rainy season
4	Port - Harcourt	5,198,716	3.00E+18	FEB	JUL	DJF/dry season/harmattan	JJA/peak of rainy season
5	Uyo	3,902,051	2.85E+18	JAN	AUG	DJF/dry season/harmattan	SON off set of rainy season
6	Sokoto	3,702,676	2.28E+18	FEB	AUG	MAM/onset of rain	JJA/peak of rainy season
7	Abuja	1,405,201	2.68E+18	JAN	JUL	DJF/dry season/harmattan	JJA/peak of rainy season



From the research carried out and also with the help of the graph above (Fig. 1), the best time to play an indoor sport or carryout indoor events/parties is between is the months of December January, February, June, July and partially August. This is because any outdoor sports such as athletics performed during the first three months mentioned above, (i.e. the harmattan/ dry season), may have adverse effect on the player due to the fact that when the athlete runs, he/she gasp to breathe in more thereby inhaling more Carbon (II) Oxide and dust/particulate matter. Indoor activities/sports can also be carried out in the last three months mentioned above because that is when rainfall is at its maximum i.e. the peak of the rainy season.

Table 3: Showing the different types of sports that can be played in different seasons of the year.

Season of the year	Types of sport to be played
Dry season i.e. (September, October, November, December, January, February).	Walking, stretching, yoga, arm wrestling, tennis, basketball, marathon, running, hurdles, football, gymnastics, swimming, sprint, car racing etc.
Wet season i.e. (March, April, May, June, July, August)	Boxing, throwing, water sport, swimming, hockey, surfing, canoeing, sword fighting, dance fitness, ballet, calisthenics, power lifting etc.

From the tables above, the safest time to play outdoor sport, in each station is the dry season i.e. between the month of September to November and little should be carried out between the months of December to February, while the best time to play indoor games in each of the stations is between the months of march to August due to the high rate of rainfall. Other factors that might be important to consider in scheduling an outdoor event/ sport includes particulate matter, Sulphur (iv) Oxide, ozone,

carbon dioxide etc. Pollutants such as those mentioned above might lead to the change in the proposed sport schedule. This is because Sulphur (IV) Oxide for example which can lead to the formation of acid rain, when it falls on the body of any individual, can lead to skin irritation and other related skin diseases. The particulate matter which is dust when inhaled, might lead to chest pain and other heart related diseases.

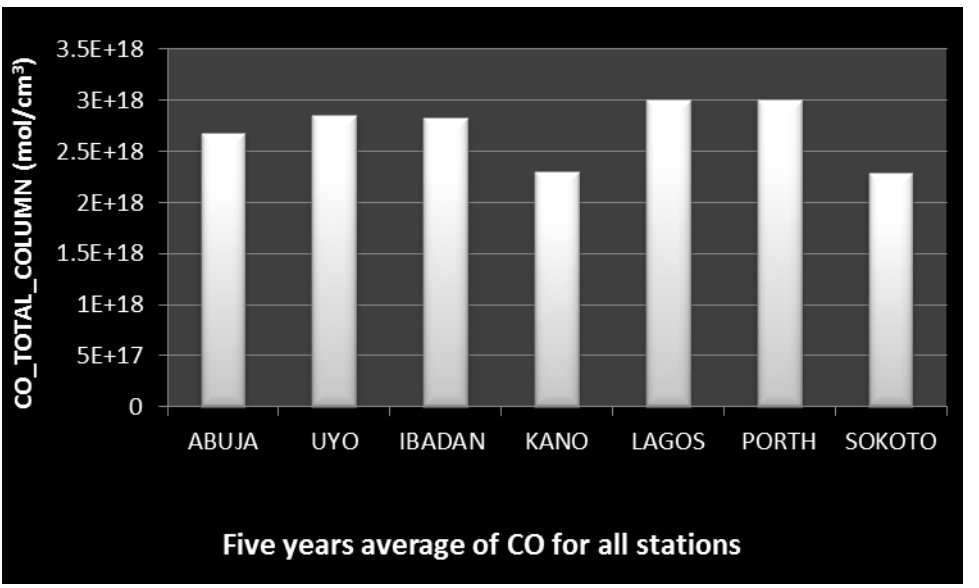


Figure 2: Bar graph showing CO total column against 5 years average of CO for all stations.

The bar chart above is a statistical graph which shows the total column of Carbon (II) Oxide in mole per centimeter cube against the five year average of carbon monoxide for the seven stations. From this bar graph, the most polluted city in Nigeria is Lagos (Figure 2), with an average Carbon (II) Oxide value of 3.00842 parts per million. This is due to the fact that the population in Lagos is very high, and the amount of Carbon (II) Oxide emitted by vehicles, generators at home, and in most industries is also very high as well. Next to Lagos, the second most polluted city is Port-Harcourt (Table 2), with an average Carbon (II) Oxide value of 3.00175 parts per million. This occurs mostly because of gas flaring which leads to the release of carbon monoxide into the atmosphere. The less polluted city in the course of this study was Sokoto, with an average Carbon (II) Oxide value of 2.28 parts per million. The state was less polluted because of the cloud cover, which leads to the absorption of Carbon (II) Oxide by the atmosphere thereby leaving the

environment with little or lesser amount of Carbon (II) Oxide. Carbon (II) Oxide amount is high in Sokoto within the season of March, April and May (onset of rainy season) due to bush burning by farmers in preparation for the cultivation of their various crops.

Table 4: Showing the mean Carbon (II) Oxide and its standard deviation.

	MEAN CO	STDEV
STATIONS	2000 TO 2004	2000 TO 2004
ABUJA	2.67957E+18	6.07776E+17
UYO	2.89818E+18	6.86736E+17
IBADAN	2.79083E+18	6.11383E+17
KANO	2.27381E+18	3.73145E+17
LAGOS	2.96945E+18	6.3136E+17
PORTH	2.96305E+18	6.41239E+17
SOKOTO	2.25185E+18	3.64934E+17

The table above shows the different stations, the mean Carbon (II) Oxide and the standard deviation from the year 2000-2004. From the study carried out, the station with the highest standard deviation was Uyo, having the value of 0.686736 parts per million. This indicates that Carbon (II) Oxide varies more rapidly in that station. Also, the station with the least standard deviation was Sokoto with Carbon (II) Oxide having the standard deviation of 0.364934 parts per million respectively.

Conclusion

From this study, it has been established that the emission of Carbon (II) Oxide is produced from anthropogenic sources. A great deal of information relevant to the dispersion of Carbon (II) Oxide from anthropogenic processes has also been established. The major sources of Carbon (II) Oxide emission observed in study area were recognized to be from automobiles mainly trucks giving exposures at a minimum of 120 ppm to a maximum of 855 ppm occasionally. It is therefore advisable to be aware and also prevent the health risks caused from Carbon (II) Oxide emissions.

This study revealed that there is still need for further research on Carbon (II) Oxide analysis in the environment. It is recommended that subsequent research data should be more extensive and the investigations should be taken over a long period to determine the emission of carbon monoxide in terms of seasons, temperature and time. Nevertheless, the followings are being recommended for government and individuals

respectively in preventing the effect of Carbon (II) Oxide:

i. Government should ban the use of old engines and generators as these generate a higher level of carbon monoxide.
ii. Individuals should decrease the risk of CO in their homes by ensuring that combustion products are properly installed, operated and maintained.
iii. Government should provide separate transportation routes far from residential areas as well as a time restriction for trucks due to their high level of Carbon (II) Oxide emission.
iv. There should be frequent seminars and conferences on Carbon (II) Oxide for the awareness of the entire populace
v. The government should encourage and sensitize individuals on the need to test their level of CO poisoning
vi. Carbon (II) Oxide detectors should be installed in several areas of the home.

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