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Probing In To Health and Enviromental Impact of Harmattan Dust in Offa, A Sub-Saharan Africa

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ABSTRACT
Climate and human perturbations have a significant impact on the global cycle of desert dust aerosols, which in turn affects climate and biogeochemistry. On people or the environment, harmattan dust has a variety of effects. The effects of dangerous dust are inversely correlated with its size, which is always influenced by place or region. The effects of dangerous airborne particle size distributions on human health are the main topics of this research. The Bettersizer 2600E, a cutting-edge instrument, was used to characterize samples of harmattan dust that were collected over the study area. The results showed that both coarse particles (PM10) and tiny dust particles (PM2.5) were present in variable amounts. In addition to the potential health risks associated with the presence of both coarse and fine particulate matter, such as catarrh, cough, asthma, inflammation of the airways, crust, and dryness in the nostrils (which may result in epitasis), both PM10 and PM2.5 can have an impact on the radiative forcing of the study area. The report strongly advises using nasal masks to avoid inhaling particles that can lead to a variety of health issues.

I. INTRODUCTION

According to Betrand et al. (1979), the Bodele depression in the Chad Basin is the primary source of harmattan dust, which is responsible for the dust over the area. The predominant North East winds carry the harmattan dust particles from the source region to the northern section of Nigeria in a plume that takes an average of 24 hours to go there (Aina, 1979). In West African locations, this predominant North-Easterly wind regime known as harmattan often lasts from November through March of the following year (Falaiye et al., 2013). It's hot, dry, and dusty; the heat and aridity can occasionally cause tree trunks to crack. It carries a great deal of desert dust with it, and occasionally a dense cloud forms that makes it difficult to navigate rivers. Crops and fields may suffer significant harm as a result. It is extremely dusty, dry, and generally unhealthy. Catarrh, STDs, and dry skin and lips are among the prevalent illnesses afflicting people during the harmattan era (Sufiyan et al., 2021).

Mineral aerosols, often known as dust particles from the desert, are soil fragments floating in the air in areas with easily erodible dry soils, scant vegetation, and strong winds. In terms of mass and aerosol optical depth, mineral aerosols are among the most significant aerosols (Tegen et al., 1997) and can have a big impact on radiation during intense events or even in the yearly mean (Li et al., 2004). According to Mahowald and Kiehl (2003), desert dust can interact with liquid or ice clouds to change their optical characteristics and lifetimes. This can also have an impact on precipitation processes (Creamean et al., 2013). Once dust particles are deposited on the surface, they supply micronutrients to the ocean or to land ecosystems, and they also change the snow's albedo (Jickells et al., 2005; Okin et al., 2008). (Painter et al., 2007). Additionally harmful to human health is the inhalation of dust aerosol. According to Brunekreef and Holgate (2002), the likelihood that an aerosol will be deposited in the lungs' gas-exchange area increases with its size. The biogeochemistry, meteorology, and human health all depend on mineral aerosols. Numerous epidemiological studies have found a connection between exposure to airborne particulate matter and a higher risk of dying as well as a number of dangerous respiratory, cardiovascular, and neurological conditions (Roberts et al., 2013). Many of these studies typically describe exposure in terms of the measured mass concentration of particles falling within specific size ranges. Inhalable, coarse, and particles having aerodynamic diameters of less than 10 m (PM10), less than 2.5 m (PM2.5), and between 2.5 and 10 m are common examples of these (PM2.5-10). Although helpful, this approach does not take into consideration the chemical composition of the particles, making it unlikely to fully explain how exposure to airborne particles affects human health. Recent literature suggests that chemical components such as metals, elemental carbon, and organic carbon compounds, among others, may play a critical role in particle toxicity (Fanning et al., 2009). Epidemiological

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studies have shown some evidence about the significance of this particle composition, as seen in a recent study showing a connection between autism spectrum disorder and exposure to airborne metals and diesel particles (Roberts et al., 2016). One instance of how epidemiological studies have given some evidence about the significance of this particle composition is a recent study showing a connection between autism spectrum disorder and exposure to airborne metals and diesel particles (Roberts et al., 2013).

Other studies have connected some heavy metals present in harmattan dust to an increase in cardiovascular disease and mortality, either alone or in mixes (Vedal et al., 2013; Flemming et al., 2013; Valdes et al., 2012). Specific particulate matter components and physiological effects have also been linked in clinical and toxicological research (Araujo et al., 2010).

The strongest shortwave (usually cooling) radiative effect per unit mass is produced by particles with diameters of the order of the solar (shortwave) wavelengths (0.2-2 lm) for impacts through direct solar radiation interactions. On the other hand, the largest longwave (warming) radiative effect is produced by particles with diameters of the order of terrestrial (longwave) radiation (> 4 lm) (Miller et al., 2006). The number of particles activated in a cloud is significant for indirect effects with clouds, even while larger particles initially serve as cloud condensation nuclei, hence the crucial quantity is the number of particles over a particular size (Dusek et al., 2006). Large particles might predominate because the mass deposited is crucial for biogeochemical consequences. Size is a major factor in determining the effects of mineral aerosols.

The goal of this study is to determine how the harmattan dust that was collected in the study area affects the environment and people's health. The population's health and the high rate of dust concentration are both negatively impacted. [deLongueville]). Through neutron instrumental activation analysis, Adepetu et al. (1988) determined that the chemical makeup of Harmattan dust consisted of approximately 29 distinct elements.

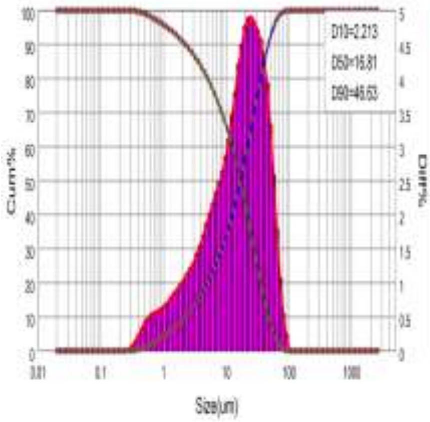
II. METHODOLOGY

Clean petridishes were placed on an elevated platform at designated locations in the study area using the dust collecting technique proposed by Falaiye and Aweda (2018). (Offa). These locations include the federal polytechnic, the mini and major campuses, the college of health technology, and the area behind Total Filling gas stations in Offa. The elevated platform was the highest point of an unfinished construction, providing a secure height with the least amount of local dust interference. To reduce the amount of local dust introduced during the collecting process, additional precautions including keeping the sample containers away from untarred public roads and high ways were made. All of the petri dishes were left out for at least a month. To prevent contamination, the collected samples were kept in desiccators before being analyzed. In order to obtain an adequate sample quantity for the analysis, the samples in each petridish were then merged to create one sample.

Particle size measurements were made at each area due to the significant effect that particles of different sizes played. At the Central Research Laboratory of the University of Technology, Akure (FUTA), Nigeria, a Bettersizer 2600E device was used to measure the different sizes of the harmattan dust particles. For this measurement, half of the samples that were taken from each location were used. The device is capable of measuring particles of a size between 0.1 and 2600 micrometers.

Short-wave (635 nm) laser light strikes the particles during the measurement and is elastically scattered based on the particle size. The unique design of the optical bench, based on the combination of Fourier setup and inverse Fourier setup, enables the permanently placed detectors to determine the angle dependency of the scattering intensity in the forward, sideways, and backward directions. The volume-based particle size distribution of the sample is produced by data editing using either Fraunhofer or Mie theory.

III. RESULT AND DISCUSSION



Diam um	Percent
0.200	0.00
0.500	0.98
1.000	4.22
2.000	9.09
5.000	19.95
10.00	33.95
20.00	56.78
45.00	88.90
75.00	99.17
100.0	100.00

Fig1: an overall graphical and tabular display of result for all particle sizes

Table1: Percentage composition of coarse and fine particle

Diameter(micrometer)	Percent
Fine	14.21
Coarse	53.90

Discussion

According to data from the Bettersizer 2600E instrument used to detect particle size, PM2.5 and PM10 are present in proportions of 14.21% and 53.90%, respectively, as indicated in table 1. The lungs' gas-exchange area is more likely to deposit PM2.5 particles in certain size ranges (Bruneecreef and Holgate, 2002). The region of the country where the study will take place may experience the effects of PM2.5 (fine particles) deposition during the harmattan season, including catarrh, cough, asthma, airway inflammation, crust and dryness in the nostrils (which may result in epitasis), and so forth. This is because the dust deposits become finer the further a location is from the dust's source (the Bodele Depression in the Chad basin). Therefore, even though the central northern region of the country is linked to higher dust concentrations, it might not have as much PM2.5 as the research location. Furthermore, because it receives less of the north-eastern trade wind, the southern region of the country might not suffer particle size range.

The fraction of PM2.5 (fine particles) in the samples is lower than that of PM10 when considering radiative forcing (RF) (coarse particles). When short wave radiation from the sun is reflected, as happens with PM2.5, it has a cooling effect on the environment. When PM10 is present, however, it has a warming effect (Miller et al., 2006). Particles with a diameter of 2.5 to 10 micrometers or smaller are referred to as PM10. Because the PM10, which is the most prevalent, absorbs both incoming radiation from the sun and outgoing radiation from the earth's surface, it is empirically correct to say that the harmful dust particles collected in the study areas have overall warming effects, i.e., they raise the temperature of the environment (www.nsf.gov/discoveries). As a result, harmttan dust may have contributed to the occurrence of meningitis in some diseases that are temperature-sensitive, like meningitis.

REFERENCE

[1]. Adepetu J, Asubiojo O, Iskander F, Bauer T. Elemental composition of Nigerian Harmattan dust. J Radioanal Nucl Chem 1988;121:141-7. 9.

[2]. ina, J.A (1972). Acontribtion to the forecasting of harmattan dust haze. Nig. Quart. Met Mag. 2, 77-90

[3]. Araujo, J.A. 2010. Particulate air pollution, systemic oxidative stress, inflammation, and atherosclerosis. Air Qual. Atmos. Health. 4:79–93. doi:10.1007/s11869-010-0101-8

[4]. Betrand, J., Cerf, A., and DomergueJ.K (1979). Repartition in Space and Time of Dust HazeSouth of Sahara 538, pp 409-415

[5]. Brunekreef, B., Holgate, S.T., 2002. Air pollution and health. Lancet 360, 1233–1242.

[6]. Creamean, J.M., Suski, K.J., Rosenfeld, D., Cazorla, A., DeMott, P.J., Sullivan, R.C., White, A.B., Ralph, F.M., Minnis, P., Comstock, J.M., Tomlinson, J.M., Prather, K.A., (2013). Dust and biological aerosols from the Sahara and Asia influence precipitation in the western US. Science 339, 1572–1578.

[7]. de Longueville F, Ozer P, Doumbia S, Henry S. Desert dust impacts on human health: An alarming worldwide reality and a need for studies in West Africa. Int J Biometeorol 2013;57:1-9.

[8]. Dusek, U., Frank, G., Hildebrandt, L., Curtis, J., et al., (2006). Size matters more than chemistry for cloud-nucleating ability of aerosol particles. Science 312, 1375–1378.

[9]. Fanning, E.W., J.R. Froines, M.J. Utell, M. Lippmann, G. Oberdorster, M. Frampton, J. Godleski, and T.V. Larson. 2009. Particulate matter (PM) centers (1999–2005) and the role of interdisciplinary center-based research. Environ. Health Perspect. 117:167–74. doi:10.1289/ehp.11543

[10]. Falaiye, O.A, Aro, T.O., Babatunde, E. B. (2003). Inter-annual Variation of Aerosol Optical Depthat Ilorin(8^o 32'N 4^o 34'E)

[11]. Flemming, C.R., M. Heroux, M.E. Gerlofs-Nijland, and F.J. Kelly. 2013. Particulate matter beyond mass: Recent health evidence on the role of fractions, chemical constituents and sources of emission. Inhal. Toxicol. 25:802–12. doi:10.3109/08958378.2013.850127

[12]. Ibrahim Sufiyan , K. D. Mohammed , Innocent E. Bello , I. Zaharadeen(2021). Impact of Harmattan Season on Human Health in Keffi, Nasarawa State, Nigeria. Matrix Science Medica,4(2), 44-50

[13]. Jickells, T., An, Z., Andersen, K., Baker, A., Bergametti, G., Brooks, N., Cao, J., Boyd, P., Duce, R., Hunter, K., Kawahata, H.,

Kubilay, N., laRoche, J., Liss, P., Mahowald, N., Prospero, J., Ridgwell, A., Tegen, I., Torres, R., 2005. Global iron connections between dust, ocean biogeochemistry and climate. Science 308, 67–71.
[14]. Li, F., Vogelman, A., Ramanathan, V., 2004. Saharan dust aerosol radiative forcing measured from space. J. Clim. 17, 2558–2571.
[15]. Mahowald, N., Kiehl, L., (2003). Mineral aerosol and cloud interactiocns. Geophys. Res. Lett. 30, 10.109/2002GL016762.
[16]. Miller, R.L., Cakmur, R.V., Perlwitz, J., Geogdzhayev, I.V., Ginoux, P., Koch, D., Kohfeld, K.E., Prigent, C., Ruedy, R., Schmidt, G.A., Tegen, I., 2006. Mineral dust aerosols in the NASA goddard institute for space sciences ModelE atmospheric general circulation model. J. Geophys. Res. 111, D06208.
[17]. Okin, G.S., Mladenov, N., Wang, L., Cassel, D., Caylor, K.K., Ringros, S., Macko, S.A., 2008. Spatial pattern of soil nutrients in two southern African savannas. J. Geophys. Res. 111 (doi: 10.1029/2007JG000584).
[18]. Painter, T., Barrett, A., Landry, C.C., Neff, J.C., Cassidy, M.P., Lawrence, C.R., McBride, K.E., Farmer, G.L., 2007. Impact of disturbed desert soils on duration of mountain snow cover. Geophys. Res. Lett. 34 (doi: 10.1029/2007GL030284).
[19]. Pope, C.A., and D.W. Dockery. 2006. Health effects of fine particulate air pollution: Lines that connect. J. Air Waste Manage. Assoc. 56:709–42. doi:10.1080/10473289.2006.10464485
[20]. Ruedy, R., Schmidt, G.A., Tegen, I., (2006). Mineral dust aerosols in the NASA goddard institute for space sciences ModelE atmospheric general circulation model. J. Geophys. Res. 111, D06208.
[21]. Roberts, A.L., K. Lyall, J.E. Hart, F. Laden, A.C. Just, J.F. Bobb, K.C. Koenen, A. Ascherio, and M.G. Weisskopf. 2013. Perinatal air pollutant exposures and autism spectrum disorder in the children of Nurses' Health Study II participants. Environ. Health Perspect. 121:978–84. doi:10.1289/ehp.1206187
[22]. Tegen, I., Hollrig, P., Chin, M., Fung, I., Jacob, D., Penner, J., 1997. Contribution of different aerosol species to the global aerosol extinction optical thickness: Estimates from model results. J. Geophys. Res. 102, 23,895–823,915, October 827 1997
[23]. Valdés, A., A. Zanobetti, J.I. Halonen, L. Cifuentes, D. Morata, and J. Schwartz. 2012. Elemental concentrations of ambient particles and cause specific mortality in Santiago, Chile: A time series study. Environ. Health 11:82. doi:10.1186/1476-069X-11-82