GPH-International Journal of Applied Science
(Online ISSN 3050-9653)
Volume 09 | Issue 10 | 2026
Published by: Global Publication House
DOI: https://doi.org/10.5281/zenodo.23686028
Available online at: www.gphjournal.org
Journal homepage: https://gphjournal.org/index.php/as/index

Wet-Season Co-Occurrence of Ambient Air Pollutants and Environmental Noise in Ughelli, Nigeria: A Spatial Screening Study

***Omoko Ejiro Newton*[1]**
[1]Department of Geology, Faculty of Science, University of Delta,
Agbor, P.M.B. 2090, Agbor, Delta State, Nigeria.
Corresponding author email: ejiro.omoko@unidel.edu.ng

Abstract

Urban residents may experience air pollution and environmental noise together, but co-occurrence does not establish a statistical interaction or a health effect. This study screens wet-season air quality and sound levels at 17 activity-centred sites and one background reference point in Ughelli, Delta State, Nigeria. The source project reports single-site readings for carbon monoxide (CO), carbon dioxide (CO_2), formaldehyde (HCHO), total volatile organic compounds (TVOCs), $PM_{2.5}$, PM_{10}, A-weighted sound level, temperature, relative humidity, wind and elevation. We reconstructed descriptive statistics from the tabulated observations and recalculated Pearson correlations for the 17 urban sites, retaining the control point as a contextual reference. Urban-site means were 93.99 dBA for sound, 154.0 µg m^{-3} for $PM_{2.5}$ and 204.35 µg m^{-3} for PM_{10}; the corresponding ranges were 85.3–104.2 dBA, 26–602 µg m^{-3} and 30–797 µg m^{-3}. Correlations between sound and the measured pollutants were weak and statistically non-significant ($|r| \leq 0.33$; $p \geq .198$). The results identify locations for follow-up monitoring but do not support causal attribution, seasonal comparison, formal health-risk estimates or claims of a demonstrated air–noise interaction. A key contribution is a transparent reanalysis that separates the background point, corrects inconsistencies in the source narrative and specifies the evidence needed for a defensible long-term exposure assessment.

Keywords:

Ambient air quality; environmental noise; particulate matter; wet season; Ughelli.

1. Introduction

Air pollution and environmental noise are two widespread environmental exposures generated in part by shared urban activities, including road traffic, construction, power generation and commercial activity. They are often recorded in the same place and period, but their sources, transport, averaging times, measurement scales and health pathways differ. Concurrent measurement is therefore useful for describing exposure environments, while statistical association, interaction and joint health effect require distinct analyses and cannot be inferred from simple co-location (Stansfeld, 2015; Münzel et al., 2024; Mayntz et al., 2024). The distinction matters in fast-growing cities where monitoring networks are sparse and short field campaigns are sometimes used to guide local action (Obanya et al., 2018; Forehead & Huynh, 2018; Ambrose et al., 2025).

© 2026 Author(s). Published by Global Publication House (GPH).
This is an Open Access article distributed under the terms of the CC BY 4.0 License.

Ambient particulate matter has been associated with respiratory and cardiovascular morbidity and mortality across diverse populations. Fine particles can reach the lower respiratory tract, while the composition, size distribution and source mixture modify toxicity. Population-level evidence supports reducing long-term exposure, but a short series of point readings cannot be translated directly into an individual dose, disease probability or attributable burden (Cohen et al., 2017; Burnett et al., 2018; Thurston et al., 2017; Landrigan et al., 2018; Basner et al., 2014). This limitation is especially important where portable sensors are used without collocation against reference instruments, because humidity, aerosol composition and device response can bias estimates (Hagan et al., 2018; Rai et al., 2017; Hua et al., 2021).

Environmental noise also affects well-being through annoyance, sleep disturbance and physiological stress responses. Epidemiological research has associated long-term transportation noise with cardiovascular outcomes, although effect estimates depend on exposure metrics, population context, confounding control and study design. The evidence base is much stronger for chronic exposure and time-averaged indicators than for single instantaneous readings (Basner et al., 2014; Stansfeld, 2015; van Kempen et al., 2018; Münzel et al., 2024). Thus, a measured A-weighted level at a roadside location is a spatial screening observation; unless measurement duration and temporal sampling are documented, it should not be equated with Lden, Lnight or an eight-hour occupational dose.

Air and noise may be correlated because they arise from common sources, particularly motor vehicles. Yet their spatial gradients are not identical: particles and gases disperse and transform in the atmosphere, while sound propagation changes with distance, barriers, surface properties, wind and source directivity. Recent reviews report that studies of joint air pollution and noise exposure remain uneven, with mixed evidence on interaction and limited representation of lower-income settings (Eminson et al., 2023; Mayntz et al., 2024; Stansfeld, 2015). Joint monitoring should consequently test measured associations while retaining the possibility that pollutants and sound vary independently across sites.

The Niger Delta presents a relevant setting for local exposure screening. Urban settlements in the region experience traffic, construction, fuel handling, generator use, waste burning and industrial activity against a background of hydrocarbon extraction and uneven environmental monitoring. Evidence from Lagos and other Nigerian cities documents traffic-related spatial gradients and elevated pollutant measurements, while Niger Delta studies have described air quality concerns near industrial and artisanal refining activities (Obanya et al., 2018; Abulude et al., 2021; Yorkor et al., 2021; Ambrose et al., 2025). More recent regional analyses also show strong temporal variation and heterogeneous particulate exposure, underscoring the need to report season, duration, instrument and averaging period precisely (Lala et al., 2023).

Ughelli is an expanding urban centre in Delta State with commercial corridors, junctions, markets and road construction that may concentrate sound and combustion-related emissions. Wet-season weather can alter pollutant removal, atmospheric mixing, surface moisture and sound propagation; rainfall may scavenge particles, while humidity can also affect particle growth and optical sensor response. Temperature and wind influence emissions, dispersion and measurement conditions, but their net effects depend on time, source strength and local morphology (Roldán-Henao et al., 2020; Wu et al., 2022; Plocoste et al., 2021; Hua et al., 2021; Yorkor et al., 2021; Lala et al., 2023). A single wet-season campaign can describe conditions observed during the campaign but cannot establish that rainfall caused a measured concentration or that the wet season is more polluted than another season.

The motivating project reports observations from 18 named points in Ughelli, including one control location, and includes maps of the site layout and measured parameters. The accompanying narrative, however, contains internal inconsistencies: the calculated sound mean

differs from the project's stated value; the tabulated control point has substantially lower sound than urban sites; elevation summary values do not align with the table; and the original abstract reports pollutant–noise correlations that are not reproduced when computed from the listed observations. The concentration units and measurement-duration metadata for several sensors are also incomplete. Transparent reanalysis is therefore essential before interpreting the patterns or submitting the work as a journal article.

The purpose of this study is to describe the spatial screening pattern of selected wet-season air-quality indicators, meteorological variables and environmental sound at 17 urban activity-centred sites in Ughelli, using the project's control point as contextual background. Specifically, the study (a) reconstructs site-level descriptive statistics, (b) recalculates pairwise associations between noise and measured air-quality or meteorological variables, (c) identifies observations that warrant quality assurance and repeated monitoring, and (d) interprets results in light of exposure science and Nigerian urban evidence. Its novelty lies in an explicit, reproducible distinction between urban observations and the background point, a corrected statistical reading of the source table, and a conservative integration of spatial co-occurrence with measurement uncertainty. This study does not estimate personal exposure, diagnose health effects or establish causality.

2. Methodology

2.1 Study setting and sampling locations

The study is based on the field project conducted in Ughelli, Delta State, Nigeria. Seventeen urban observation points were selected at junctions, market areas, commercial routes and other locations with regular human activity; an eighteenth point at Good Tiding Drive by Marvel International School was designated as a control or background location. The named urban locations in the source include Ekiugbo Junction, Ekiugbo First and Second Roundabouts, Egor Junction, Ughelli Market, Okorodafe Roundabout, Oharisi Street, Uloho Avenue Junction, Oharisi Roundabout, Miller Uloho Avenue Junction, Makolomi Junction, Otowodo Roundabout, Agbarha Junction, a panel-beater workshop, the spare-parts market, Afiesere Junction and Amekpa Junction. Figure 1 presents the project's location map and Figure 2 retains the available regional geology illustration for geographic context. The geology figure is not used as an explanatory variable because the monitoring points are not georeferenced in the tabular dataset with sufficient precision for site-specific geological inference.

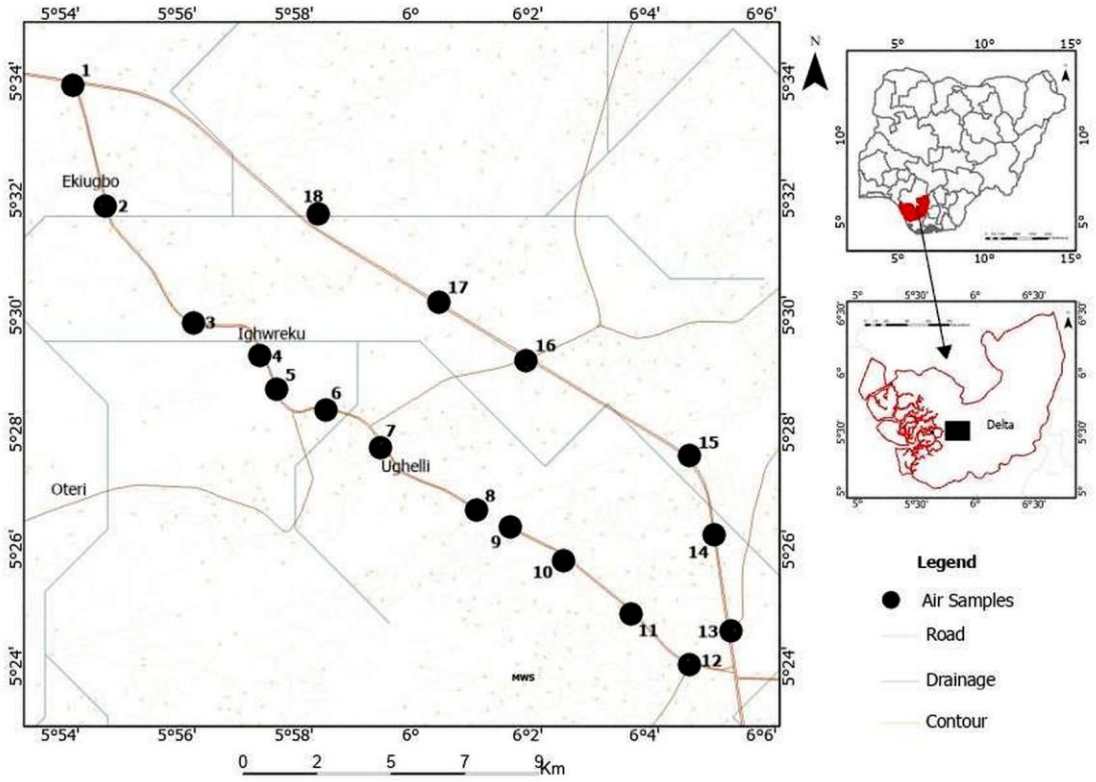


Figure 1. Ughelli study-location map and sample-point layout reproduced from the source project. The location descriptions are in Table 1; source coordinates and mapping metadata should be supplied for reproducibility.

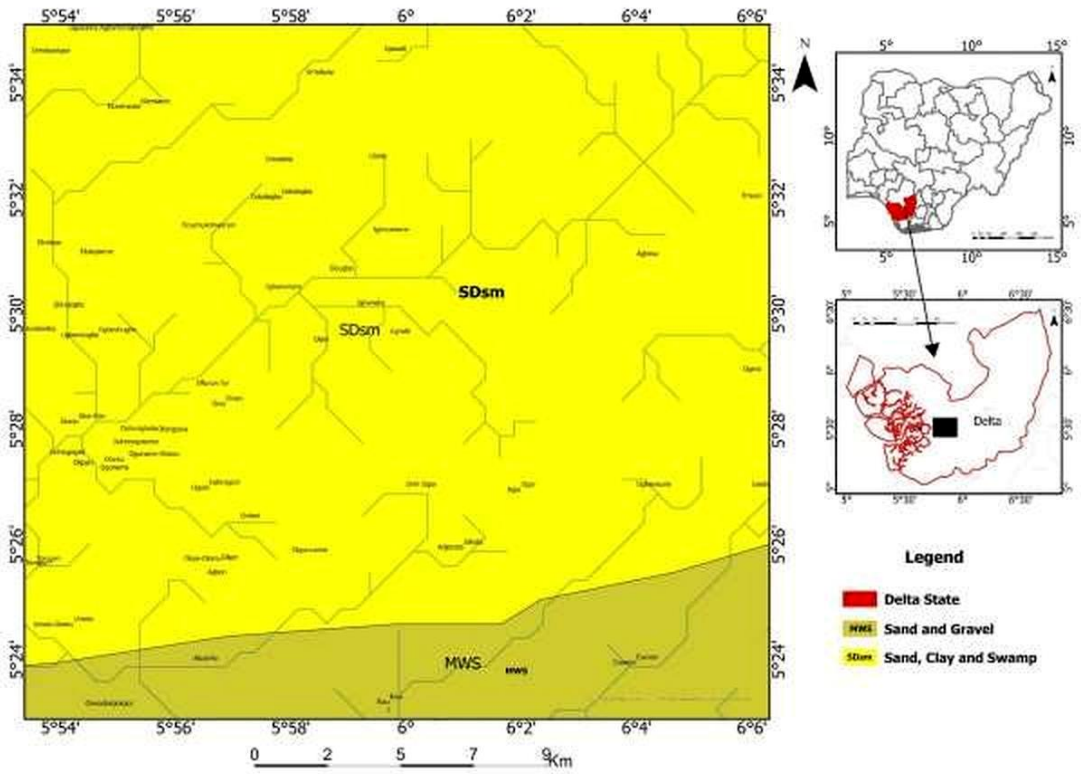


Figure 2. Regional geology illustration supplied with the project. It is shown for geographic context only; no geological inference is made for individual air-monitoring sites.

The project states that field measurements were collected during May, June and July to represent the rainy season. It also refers elsewhere to a six-month wet-season period. Because the primary tabulation contains one value per site and does not include dates, times, repeated observations or rainfall records, this manuscript treats the dataset as a three-month field campaign and does not infer monthly trends or seasonal averages. The observation count is 17 for urban-site inference; the control point is reported separately. This avoids allowing a qualitatively different background site to dominate correlation estimates and keeps the analysis aligned with the stated aim of examining urban exposure co-occurrence.

2.2 Instruments, measurements and data provenance

According to the source project, ambient pollutant readings were obtained with portable DM106 and VT-8 IN1 air-quality monitors, with a portable S318 multiparameter gas detector used for carbon monoxide. A digital sound-level meter identified as version 1351-EN-00 was used to record A-weighted sound in decibels. A Tecman TD8902 anemometer and 5107WIFI weather station were used for temperature, relative humidity, wind speed and wind direction. Coordinates and elevation were obtained with a Garmin GPSMAP 78s receiver. Instrument model names are retained as reported; manufacturer specifications, calibration records, sensor serial numbers, averaging intervals, microphone height, distance from road edge, and time-of-day protocol were not provided in the project file and could not be independently verified.

The source table contains CO in ppm, CO_2 in ppm, HCHO and TVOCs stated in µg m^{-3}, $PM_{2.5}$ and PM_{10} in µg m^{-3}, noise in dBA, temperature in degrees Celsius, relative humidity in percent, wind speed in m s^{-1}, wind direction and elevation in metres. These units are reported without

conversion. The source narrative contains a conflicting HCHO unit (μg cm^{-3}) and inconsistent descriptions of CO ranges; the manuscript therefore follows the tabulated units and values while flagging the need to confirm the original instrument display and calibration before publication. The readings are treated as project-reported field observations rather than reference-grade or regulatory compliance data.

All numerical results were transcribed from the project's data table and independently recomputed using the 17 urban points. The control observation was retained in a separate comparison column and excluded from urban correlation analysis. There was no imputation. The table includes a CO_2 value of 153 ppm at Afiesere Junction, which is well below expected outdoor background and may represent a transcription, sensor or display issue; it remains in the descriptive table but is highlighted as an apparent anomaly requiring source-record checking. PM values at Agbarha Junction are extreme relative to most other observations and likewise retained pending instrument and field-note review. The source-project maps are presented with the corresponding results. Their legends and site labels are preserved to the extent legible; the raster map symbology is not treated as an independent measurement.

2.3 Statistical analysis and screening approach

For each variable, arithmetic mean, sample standard deviation, minimum and maximum were calculated from the 17 urban sites; corresponding values for the control point are shown separately. Equation (1) defines the arithmetic mean, where x_i is a site observation and n is the number of urban sites. Equation (2) defines the sample standard deviation. These descriptive statistics characterize spatial variation in the cross-sectional set of readings; they do not represent the distribution of temporal exposure for residents. The standard deviation uses n − 1 in the denominator because the observations are treated as a sample of possible site conditions rather than an exhaustive census of all urban conditions.

$$\bar{x} = (1/n)\,\Sigma_{i=1}^{n}\, x_i \quad (1)$$

$$s = \sqrt{[\,\Sigma_{i=1}^{n}\,(x_i - \bar{x})^2 / (n-1)\,]} \quad (2)$$

Pairwise linear association between each pollutant or meteorological variable and noise was summarized using Pearson's product-moment correlation coefficient, shown in Equation (3). Two-sided p values were calculated with n = 17 urban observations. Because there are only 17 observations, the analysis is exploratory; p values are reported as descriptive inferential evidence, and no multivariable regression is fitted. A multivariable model with this small sample, correlated predictors and possible sensor anomalies would be unstable and could exaggerate apparent precision. No causal language is used. The control location is not included in urban-site correlations because it differs by land-use context and includes markedly lower sound than the activity-centred sites.

$$r_{xy} = \Sigma_i\,(x_i - \bar{x})(y_i - \bar{y}) / \sqrt{\{\Sigma_i\,(x_i - \bar{x})^2\,\Sigma_i\,(y_i - \bar{y})^2\}} \quad (3)$$

The analysis compares values with published research and commonly used guideline context only where the metric and averaging time are sufficiently comparable. For particulate matter, the World Health Organization's 2021 guideline values are 15 μg m^{-3} for 24-hour $PM_{2.5}$ and 45 μg m^{-3} for 24-hour PM_{10}; these are reference values for a defined daily averaging period, not directly equivalent to single snapshots. WHO's long-term annual values are 5 and 15 μg m^{-3}, respectively, and are not used to classify this dataset. For sound, long-term road-traffic recommendations refer to day-evening-night or night indicators; single instantaneous A-weighted readings are not substituted for those indicators. Accordingly, exceedance language is avoided unless the measurement integration period can be established. The screening ratio in

Equation (4) is presented only as a transparent comparison when an observed concentration and guideline averaging period are comparable; it is not calculated for the current single-site readings.

$$R = C_observed / C_guideline \quad (4)$$

2.4 Quality assurance, uncertainty and ethics

The project did not provide calibration certificates, collocation tests, instrument detection limits, field blanks, replicate readings, uncertainty estimates, time stamps, traffic counts or a complete data dictionary. These omissions limit the use of the numeric outputs for regulatory comparison and make it impossible to distinguish short-lived peaks from stable site contrasts. Portable particulate monitors can respond to humidity and particle properties; gas-sensor outputs may be affected by cross-sensitivity and calibration drift; and sound readings depend on instrument settings, position, integration period and source activity; low-cost sensor performance has been evaluated in several monitoring studies (Hagan et al., 2018; Rai et al., 2017). Such limitations have been documented across low-cost monitoring studies and are particularly consequential in tropical environments with changing humidity (Hagan et al., 2018; Rai et al., 2017; Hua et al., 2021). The manuscript therefore reports source values and identifies quality-control checks required before definitive interpretation.

No human participants, personal identifiers or clinical records are included in the dataset supplied for this analysis. The manuscript does not conduct human-subject health research. All recommendations are framed as monitoring and source-management priorities rather than individual medical advice.

3. Results

3.1 Descriptive profile of urban observations

Table 1 lists the monitoring locations and their classification. Table 2 presents the recomputed descriptive profile of the 17 urban measurements and the separate control observation. Urban-site sound ranged from 85.3 to 104.2 dBA, with a mean of 93.99 dBA (SD = 6.08). The control reading was 52.4 dBA. The separation between the urban range and the control value is substantial and consistent with the different activity setting, although a single control reading cannot establish a true background distribution. The recalculated mean for all 18 points, if the control is inappropriately pooled with urban sites, is 91.68 dBA; this differs from the 88.90 dBA mean stated in the project narrative. The urban-only mean is used in the results because it corresponds to the urban exposure question.

Table 1. Monitoring locations and analytical classification. Source: location descriptions in the supplied field project.

Site	Reported location	Classification
1	Ekiugbo Junction	Urban activity site
2	Ekiugbo First Roundabout	Urban activity site
3	Ekiugbo Second Roundabout	Urban activity site
4	Egor Junction	Urban activity site
5	Ughelli Market	Commercial site
6	Okorodafe Roundabout	Urban activity site
7	Oharisi Street	Urban activity site
8	Uloho Avenue Junction	Urban activity site

9	Oharisi Roundabout	Urban activity site
10	Miller Uloho Avenue Junction	Urban activity site
11	Makolomi Junction	Urban activity site
12	Otowodo Roundabout	Urban activity site
13	Agbarha Junction	Urban activity site
14	Panel-beater Workshop, Ughelli–Patani Express	Workshop/roadside site
15	Spare-parts Market, Ughelli–Patani Express	Commercial site
16	Afiesere Junction	Urban activity site
17	Amekpa Junction	Urban activity site
18	Good Tiding Drive by Marvel International School	Control/background

Table 2. Recomputed descriptive statistics for 17 urban locations and separate control value. Values are mean ± sample SD; range includes minimum–maximum. Source: project table, independently recalculated.

Variable	Urban mean ± SD	Urban range	Control
CO (ppm)	2.12 ± 0.49	1–3	1
CO_2 (ppm)	735.12 ± 332.65	153–1,572	407
HCHO (µg m^{-3})*	0.043 ± 0.023	0.007–0.074	0.007
TVOCs (µg m^{-3})*	0.246 ± 0.141	0.055–0.469	0.033
$PM_{2.5}$ (µg m^{-3})	154.00 ± 127.94	26–602	155
PM_{10} (µg m^{-3})	204.35 ± 171.13	30–797	210
Noise (dBA)	93.99 ± 6.08	85.3–104.2	52.4
Temperature (°C)	36.15 ± 1.23	34.5–39.0	32.7
Relative humidity (%)	58.41 ± 7.02	37–70	76
Wind speed (m s^{-1})	2.940 ± 0.649	1.929–4.224	2.915
Elevation (m)	11.12 ± 1.93	8–14	10

* HCHO and TVOC units reproduce the table's stated units and require confirmation against the original instrument record.

$PM_{2.5}$ ranged from 26 to 602 µg m^{-3} across the urban points (mean 154.00; SD 127.94), and PM_{10} ranged from 30 to 797 µg m^{-3} (mean 204.35; SD 171.13). Figures 3 and 4 display the corresponding $PM_{2.5}$ and PM_{10} spatial patterns, respectively. The values show pronounced site heterogeneity. The maximum for both particle fractions occurred at Agbarha Junction (site 13), while the minimum PM readings were at the spare-parts market and Afiesere Junction, depending on fraction. PM_{10} was greater than $PM_{2.5}$ at every urban site, as expected for size fractions when reported consistently, but the coarse-to-fine fraction ratio varies markedly. The consistency of the paired site measurements should be verified against instrument logs, particularly for the site 13 peak and low observations at sites 14–16.

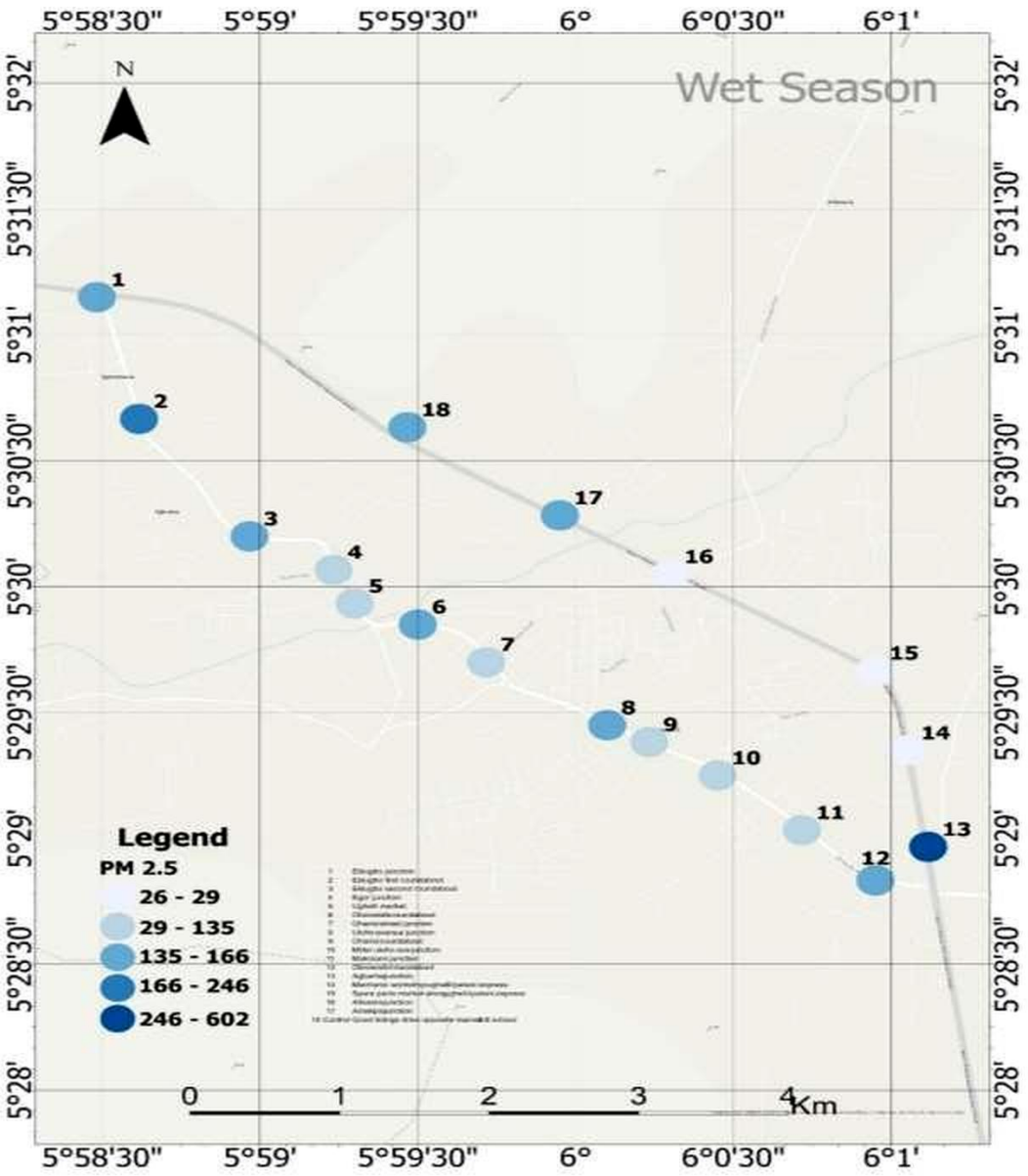


Figure 3. Project map of $PM_{2.5}$ observations during the wet-season campaign. Point symbols and mapped values are source-project outputs; the interpolation method and uncertainty are not documented.

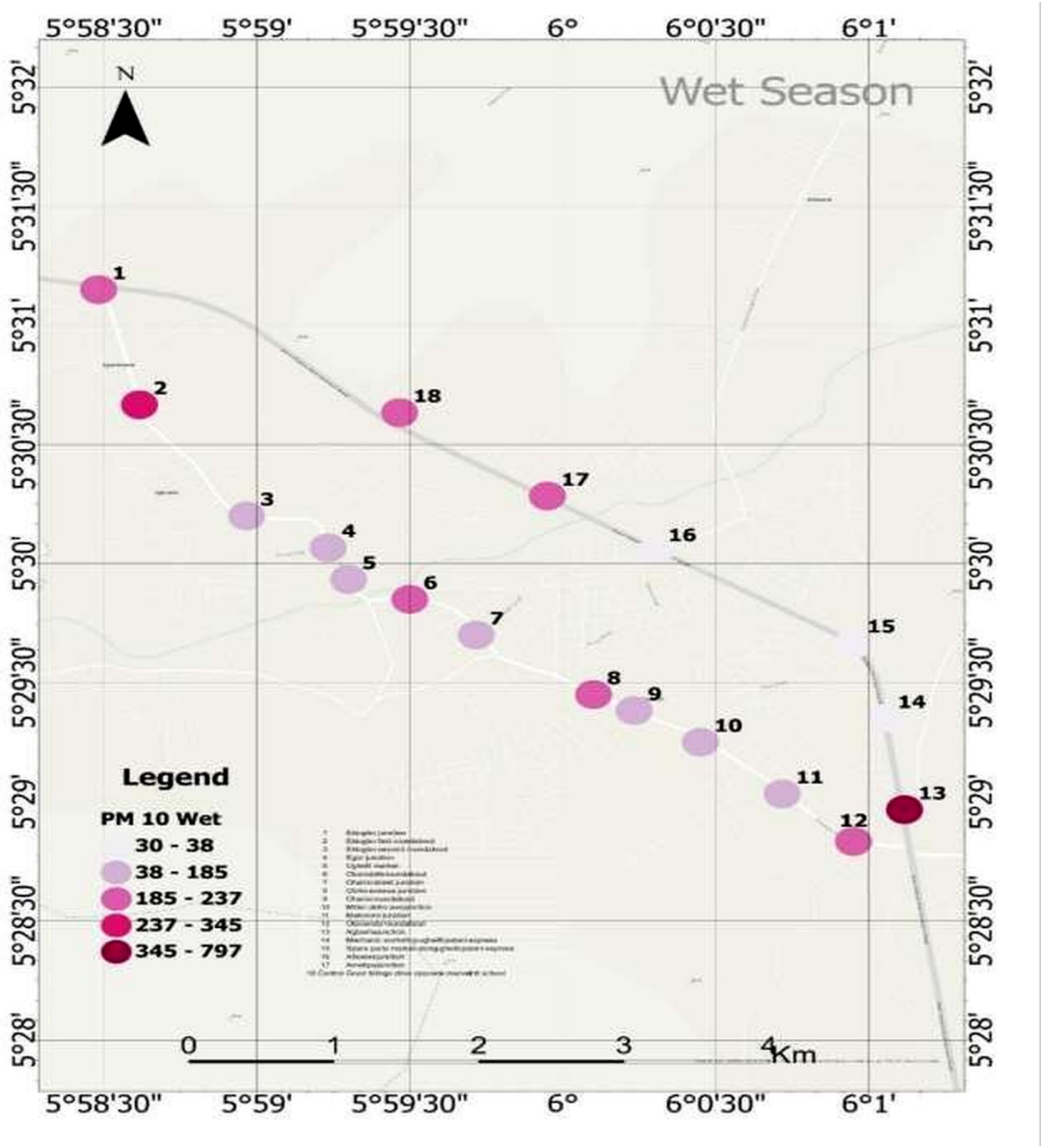


Figure 4. Project map of PM_{10} observations during the wet-season campaign. Interpret as a visualization of sparse sample points, not a validated continuous exposure surface.

CO concentrations were reported between 1 and 3 ppm (mean 2.12; SD 0.49). Figure 5 presents the source-project CO map. These values should be interpreted as screening readings because no calibration record or detection limits were supplied.

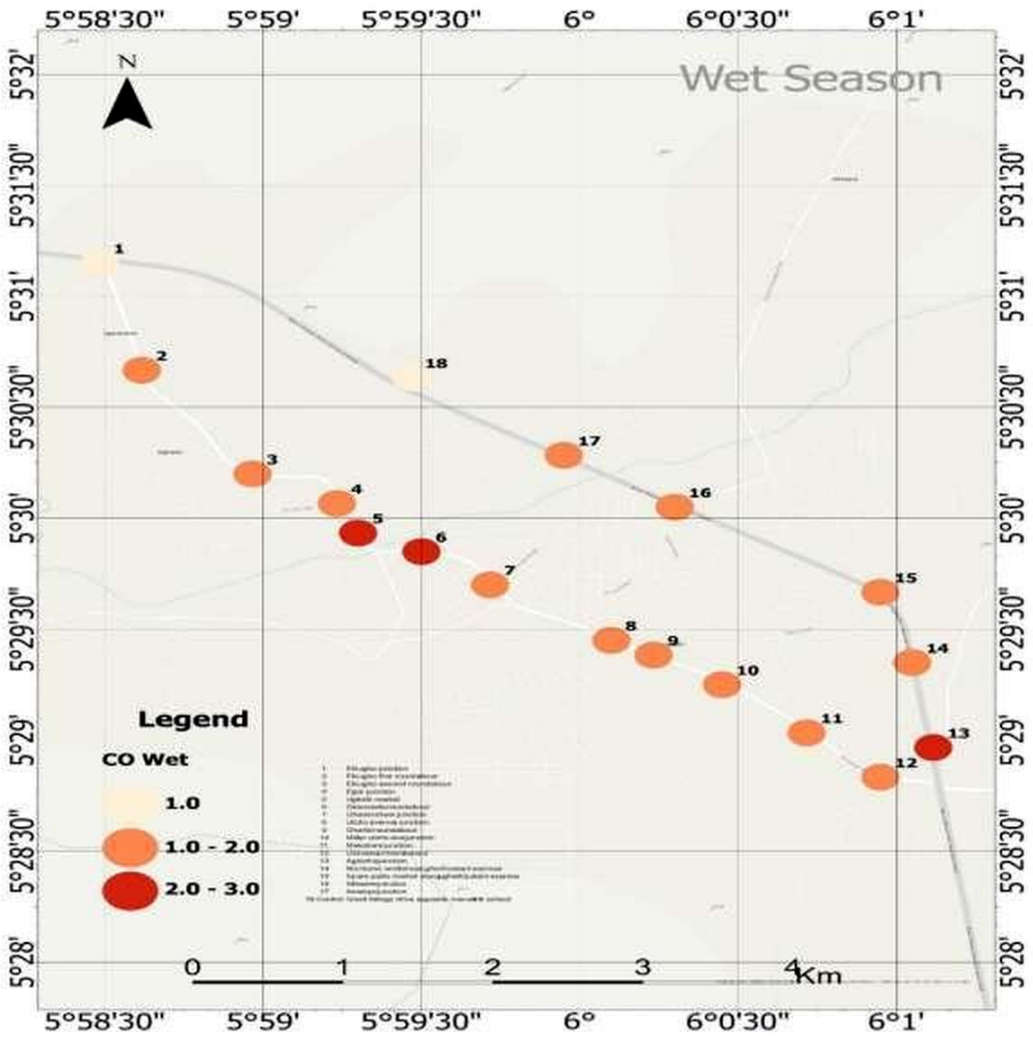


Figure 5. Project map of carbon monoxide readings during the wet-season campaign. Values are reported as supplied; instrument calibration and map-processing metadata are unavailable. CO_2 ranged from 153 to 1,572 ppm (mean 735.12; SD 332.65), with the low Afiesere value flagged as anomalous and the highest at Ughelli Market. Figure 6 shows the source-project CO_2 map, including the reading that requires verification.

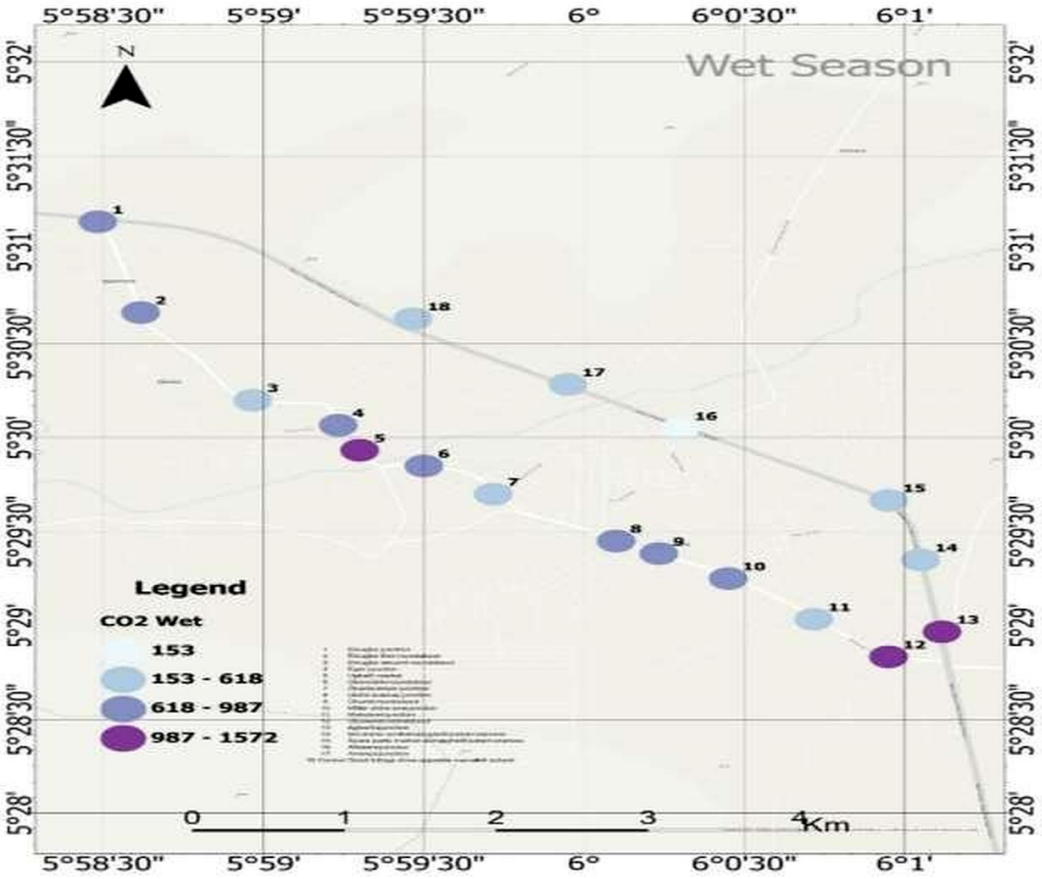


Figure 6. Project map of carbon dioxide readings during the wet-season campaign. The anomalous 153-ppm site reading is retained in the source map and flagged in Table 4 for verification.

HCHO ranged from 0.007 to 0.074 µg m^{-3} (mean 0.043; SD 0.023), while TVOCs ranged from 0.055 to 0.469 µg m^{-3} (mean 0.246; SD 0.141). Figure 7 displays the source-project TVOC map. These figures follow the table's stated units; confirmatory documentation is necessary because the narrative conflicts with units and some stated minima or maxima. No instrument detection or quantification limits were provided.

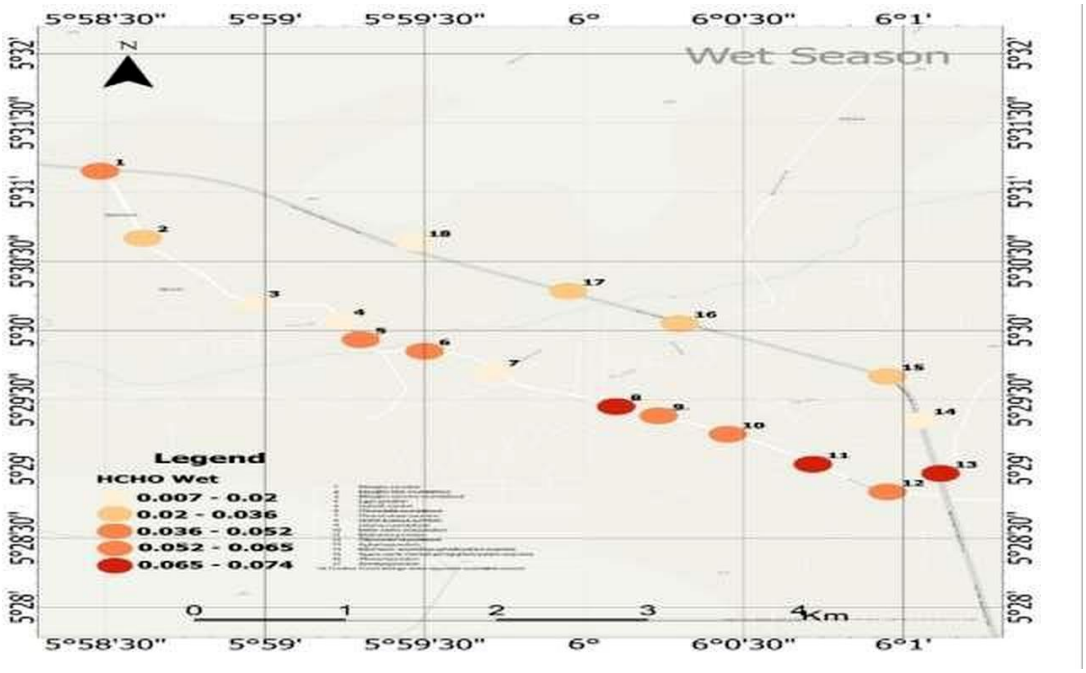


Figure 7. Project map of total volatile organic compound readings during the wet-season campaign. Values are shown as mapped in the source project; sensor calibration and interpolation details are unavailable.

Temperatures ranged from 34.5 to 39.0 °C (mean 36.15; SD 1.23), and relative humidity ranged from 37 to 70% (mean 58.41; SD 7.02) at the urban sites. Wind speed ranged from 1.929 to 4.224 m s^{-1} (mean 2.94; SD 0.65), with southwest wind direction reported at all locations. Elevations ranged from 8 to 14 m, with a recalculated urban mean of 11.12 m (SD 1.93). The stated source mean of approximately 18 m is not reproduced from the site table. The low spatial elevation range cannot, by itself, establish topographic trapping or pollutant accumulation.

3.2 Spatial distribution and site contrasts

Figures 1 and 2 show the available site location and regional geology illustrations from the source project. The points follow an urban transport and commercial corridor, according to the project map and location descriptions. Site 13 has the highest reported $PM_{2.5}$ and PM_{10}, and it also has one of the highest sound readings (100.6 dBA). However, other sites demonstrate that high sound does not necessarily coincide with particle maxima: Miller Uloho Avenue Junction (site 10) has the highest urban noise value (104.0 dBA in the tabulated record), while its $PM_{2.5}$ and PM_{10} values are 120 and 158 µg m^{-3}. Afiesere Junction (site 16) has a high noise reading of 104.2 dBA with low PM values (29 and 38 µg m^{-3}). These contrasts weaken the assumption that one pollutant can serve as a proxy for the other.

Figures 3–7 reproduce the source project's symbolized pollutant maps. The figures help identify where the project mapped high and low readings, but they should be interpreted as a visualization of sparse point data rather than a validated continuous exposure surface. The project file does not specify an interpolation method, cell size, cross-validation, variogram model or uncertainty surface. Spatial extrapolation beyond sampled points is therefore not justified. In particular, localized high values at a single junction should prompt repeat measurement and source inspection rather than an assumption of a persistent neighborhood-wide hotspot. Spatial mapping can support prioritization when sampling density, coordinate

quality and map-production methods are disclosed (Forehead & Huynh, 2018; Abulude et al., 2021; Ambrose et al., 2025).

The study's event-centred sites plausibly represent mixed land-use settings where road traffic, retail activity, idling, generators or construction may contribute simultaneously to sound and emissions. These sources were not quantified through traffic counts, generator inventories, activity logs or source apportionment. The proposed sources in this paper are therefore contextual hypotheses based on location type, not measured source contributions. Similar field studies in Nigeria have found heterogeneous pollutant and sound patterns near roads, transport hubs and industrial activities, but comparisons require compatible instruments, averaging time and meteorological context (Obanya et al., 2018; Oguntunde et al., 2019; Yorkor et al., 2021; Ambrose et al., 2025).

3.3 Air pollutant and noise associations

Table 3 reports the recalculated Pearson correlations between each monitored variable and noise across the 17 urban sites. None of the six pollutant associations reached the conventional two-sided .05 threshold. Correlations were r = .170 for CO (p = .515), r = .197 for CO_2 (p = .448), r = .328 for HCHO (p = .198), r = .281 for TVOCs (p = .274), r = .166 for $PM_{2.5}$ (p = .525) and r = .166 for PM_{10} (p = .524). These estimates are imprecise because the sample is small; the results do not demonstrate that the true associations are exactly zero. They also do not support the prior project abstract's claim of moderate positive noise correlations for CO_2, $PM_{2.5}$ and PM_{10}: those values cannot be recovered from the tabulated urban observations.

Table 3. Pearson correlations between noise and each variable across the 17 urban sites. Two-sided p values; no correlation reaches p < .05. The single control site is excluded.

Variable	r with noise	p
CO	0.170	0.515
CO_2	0.197	0.448
HCHO	0.328	0.198
TVOCs	0.281	0.274
$PM_{2.5}$	0.166	0.525
PM_{10}	0.166	0.524
Temperature	−0.078	0.765
Relative humidity	−0.026	0.921
Wind speed	−0.283	0.270
Elevation	−0.195	0.439

The particulate fractions were nearly collinear by construction and highly correlated with one another across the site table (r approximately .99), which is expected when coarse and fine mass fractions rise together but does not mean their health relevance is interchangeable. The pairwise pattern also depends strongly on site 13, which has extreme PM values. Removing site 13 as a sensitivity check materially reduces the particle–noise correlations, confirming that the full-sample coefficients are sensitive to one spatial observation. Since no pre-specified outlier rule or field verification was available, the primary analysis retains site 13 and reports the sensitivity as a caution rather than deleting a potentially real peak. A validated multi-pollutant model would need more sites and repeated observations.

Noise was weakly and positively correlated with HCHO ($r = .328$) and TVOCs ($r = .281$), but neither estimate was statistically significant. Correlations with temperature and wind speed were $r = -.078$ ($p = .765$) and $r = -.283$ ($p = .270$), respectively; relative humidity was $r = -.026$ ($p = .921$). The source narrative's claims of stronger pollutant–noise relationships appear to reflect calculations on an unspecified dataset or an incorrect inclusion/exclusion convention. Because the project contains no date/time values, the analysis cannot test whether contemporaneous meteorology modified pollutant or sound observations, nor can it estimate within-site temporal covariation.

The absence of statistically significant correlation in this small cross-sectional set does not imply that air and noise are unrelated in all Ughelli settings. Traffic can generate both exposures, but source mix, distance, barriers, wind, pavement, building form and time of day can produce different spatial patterns. Evidence from other studies includes weak-to-moderate concurrent associations as well as independent associations of noise and air pollution with health outcomes, illustrating that empirical correlation depends on context and study design (Stansfeld, 2015; Eminson et al., 2023; Mayntz et al., 2024; Adza et al., 2022; Shah et al., 2024; Münzel et al., 2024).

3.4 Screening interpretation and data checks

The source-project noise plot is presented as Figure 8 for visual context only; its dry-season values are not analysed because the corresponding numeric data and protocol were not supplied. The urban sound observations are high in absolute terms relative to quiet residential expectations and resemble levels recorded at other busy Nigerian junctions, but the source protocol does not establish whether readings are instantaneous, maximum, equivalent continuous levels or averages over a defined duration. Consequently, this study reports measured dBA values without assigning regulatory exceedance status. Such status would require a defined descriptor and time window, calibrated sound-level meter, measurement position and applicable Nigerian limit (Oguntunde et al., 2019; Itaa et al., 2023; Ambrose et al., 2025). The control point is lower than the urban observations but is only one measurement and cannot substitute for a replicated reference network.

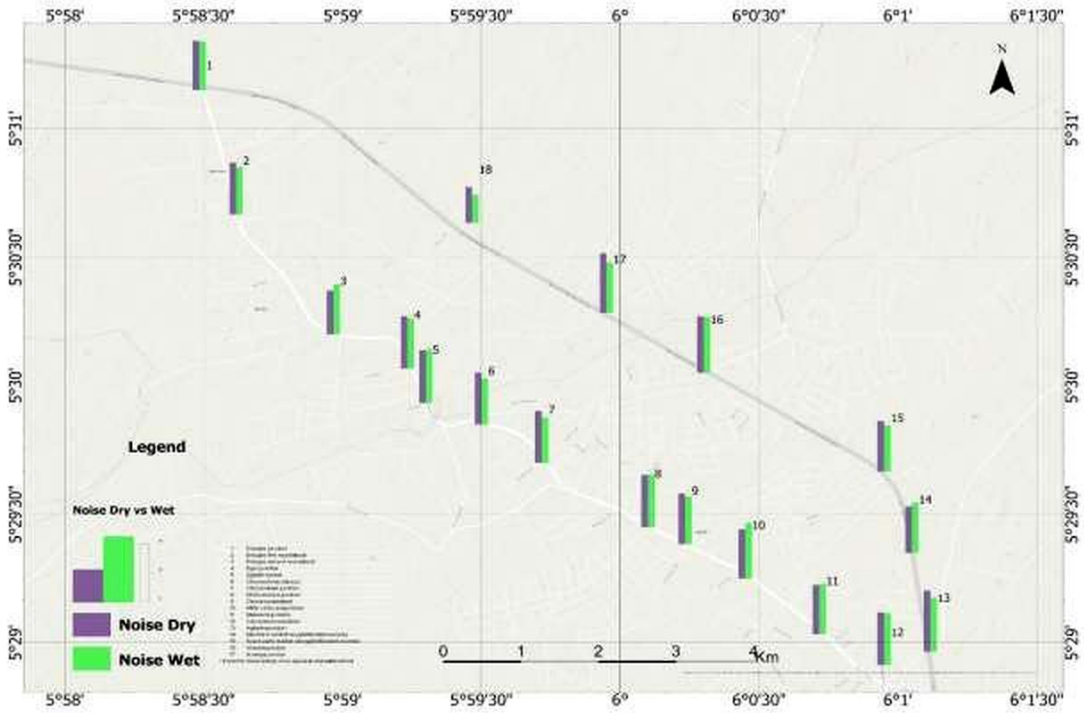


Figure 8. Noise plot supplied in the project. The figure labels dry- and wet-season noise, but the corresponding dry-season numeric dataset and measurement protocol were not provided; the plot is retained as source material and is not used for a seasonal comparison.

The particle observations are substantially higher than typical daily guideline benchmarks at several locations if the reported numbers represent correctly calibrated 24-hour averages; however, the file describes campaign field sampling rather than a continuous 24-hour protocol. The data therefore cannot be classified as 24-hour guideline exceedances. The key result is the spatial contrast and the concentration of extreme observations at site 13, not a definitive regulatory finding. Portable sensor readings require collocation and humidity correction before quantitative compliance or health-risk interpretation, particularly where high readings coexist with incomplete instrument metadata (Rai et al., 2017; Hagan et al., 2018; Hua et al., 2021).

Table 4 consolidates the principal data-quality flags. First, the narrative and the actual table disagree on the mean noise value and some correlations. Second, the CO_2 value of 153 ppm is implausibly low for ambient outdoor air and should be checked against the original reading sheet. Third, the HCHO unit differs between the table and narrative. Fourth, the source says that measurements spanned six months in one section but specifies three months in the methods. Fifth, the site-coordinate data and processing metadata needed to reconstruct the maps are absent from the text table. Sixth, a separate dry-season comparison is visible in some supplied graphics but the corresponding dry-season numeric dataset is not included. These inconsistencies should be resolved or disclosed before submission.

Table 4. Data-validation issues to resolve before journal submission.

Item	Recomputed/source-table evidence	Issue	Required follow-up
Urban noise mean	93.99 dBA from 17 sites; 91.68 dBA if control is pooled	Source narrative states 88.90 dBA	Recheck calculations and define population included
CO_2 at site 16	153 ppm	Below expected ambient background	Check field sheet, instrument display and transcription
HCHO unit	Table: µg m^{-3}	Narrative: µg cm^{-3}	Confirm original instrument units
Campaign period	May–July in methods; elsewhere six months	Timeframe is inconsistent	Confirm field dates
Noise metric	dBA only	Averaging duration and descriptor absent	Confirm instantaneous vs LAeq and duration
PM hotspot at site 13	602 µg m^{-3} $PM_{2.5}$; 797 µg m^{-3} PM_{10}	Extreme relative to other readings	Validate repeated measurements and instrument status
Spatial products	Maps included; coordinate table/interpolation metadata absent	Reproduction is not possible from text table	Supply coordinates, projection and mapping method
Health risk claims	No health outcomes or personal exposure data	Health risk cannot be estimated	Limit to environmental screening

No health outcomes, symptom surveys, residential exposure histories, occupational data, or population denominators are available. The study consequently cannot quantify health risk, describe population exposure or attribute effects to pollution. The appropriate screening interpretation is that several sites warrant repeated, higher-quality monitoring and source characterization. All retained figures and tables are cited in the manuscript body and captioned with the provenance of the material.

4. Discussion

4.1 Meaning of the observed co-occurrence

This study provides a corrected, site-level description of wet-season air-quality indicators and noise in Ughelli. Its strongest empirical message is spatial heterogeneity rather than a uniform pollutant field. Urban sound readings cluster at relatively high levels, while particulate matter varies widely and includes one pronounced peak. Gas readings show additional site differences, although incomplete unit and calibration metadata make their absolute interpretation uncertain. Together, these observations justify integrated monitoring at road and commercial locations, but they do not establish a causal air–noise interaction. This framing is consistent with reviews that identify shared urban sources and overlapping exposures while emphasizing that

correlations and health interactions are not interchangeable concepts (Stansfeld, 2015; Eminson et al., 2023; Mayntz et al., 2024; Münzel et al., 2024).

The urban-site mean sound level of 93.99 dBA is high compared with typical daytime environmental targets, and the recorded range extends above 100 dBA at several sites. However, the metric's averaging interval is undocumented. If values are instantaneous spot measurements, they characterize the acoustic environment at the moment of observation but do not estimate an equivalent continuous level or daily dose. Traffic noise changes with vehicle flow, horns, engine type, road surface, congestion and measurement position. Studies from Nigeria report similarly high short-term and equivalent levels in traffic corridors, but methodological differences make direct ranking inappropriate (Ogunjobi et al., 2000; Oguntunde et al., 2019; Itaa et al., 2023; Ambrose et al., 2025). Future work should record LAeq over specified intervals, Lmax, time of day, traffic counts and microphone geometry, following sound-monitoring procedures suitable for environmental assessment.

The particulate means are also high relative to contemporary health-protective daily values when interpreted as daily averages, but the current field readings do not include averaging time. This caveat is not a minor technical detail: a concentration snapshot and a 24-hour mean measure different exposure quantities. A short transient such as dust disturbance, a passing truck or a combustion plume can drive an instantaneous reading well above a daily mean. In contrast, humidity-induced particle growth may inflate optical readings even when dry particle mass is not elevated. The unusually large site 13 measurements therefore merit repeat visits with reference-equivalent monitoring, local activity notes, meteorological observations and collocation checks rather than immediate extrapolation to the whole urban district (Rai et al., 2017; Hagan et al., 2018; Hua et al., 2021; Lala et al., 2023).

The substantial contrast between sites reinforces why simple co-location should not be taken as evidence that sound is a proxy for air pollution. Site 10 and site 16 combine high noise readings with mid-to-low particle values, while site 13 combines high particle and elevated noise readings. Differences in road geometry, traffic composition, commercial activity, generator operation, construction dust and distance to the measurement point could plausibly produce this pattern. Because these candidate sources were not measured, the study cannot identify which mechanism explains the contrasts. In transport settings elsewhere, short-term traffic events have produced concurrent noise and particle peaks, yet the strength of their association varies by pollutant, site and source event (Adza et al., 2022; Forehead & Huynh, 2018; Ambrose et al., 2025).

The corrected bivariate results are weak and uncertain. HCHO had the largest positive noise correlation among recorded pollutants, but $p = .198$ and $n = 17$; CO_2 and particulate correlations were smaller. Statistical non-significance is not proof of independence, particularly with a small spatial sample and measurement error. At the same time, it is not defensible to retain the source abstract's claim that CO_2 explains around 16% of noise variance or that $PM_{2.5}$ and PM_{10} have moderate associations, because those statistics do not reproduce from the source table. The reassessment demonstrates the importance of preserving auditable source data, specifying inclusion criteria and calculating results directly from the reported observations.

A common source can produce correlated exposures without one exposure causing the other. Noise itself does not generate particulate matter or CO_2 in ambient air; engines, combustion

and human activity can jointly emit pollutants and sound. Conversely, air pollution and noise may affect different bodily systems through distinct pathways. Reviews find that both exposures are associated with cardiovascular outcomes, while evidence for biological interaction or statistical effect modification is less certain and less studied than their independent associations (Stansfeld, 2015; Eminson et al., 2023; Mayntz et al., 2024; Shah et al., 2024; Münzel et al., 2024). Accordingly, the title and interpretation use "co-occurrence" and "spatial screening" rather than assert "interaction" in a causal or mechanistic sense.

The control reading provides a useful contextual contrast but is not a robust background estimate. It is one point, and the site may differ in road access, urban density, source activity or measurement time. The source table also shows the lowest CO and HCHO values at this point but comparatively high PM values, which questions whether it is a truly clean background location. That pattern may reflect regional transport, site characteristics, a local event or instrument variation. A future design should include multiple controls matched on topography, land cover and distance from local emissions, and should monitor them concurrently with urban stations. This would help distinguish local source increments from broader regional conditions. The gas observations need cautious treatment as well. CO values in the table vary little between 1 and 3 ppm, which may conceal meaningful short-term variation if the sensor's resolution is coarse. The CO_2 series includes a 153 ppm observation, an implausible ambient value that suggests a likely error or instrument limitation; it also includes values above 1,000 ppm at some commercial sites. Elevated CO_2 may be a useful indicator of combustion or restricted air mixing in some contexts, but it is not a direct measure of toxic air pollution at the levels shown here and cannot alone diagnose a health hazard. HCHO and TVOC estimates are reported at unusually small numeric scales relative to some field instruments, and the conflicting unit in the source underscores the need for instrument manual and log validation. These values should not be used to infer cancer or chronic exposure risk.

The weather observations are single-location snapshots reported at each site and point to warm conditions and moderate winds during the campaign. They are not a meteorological time series. Rainfall intensity, antecedent rain, boundary-layer height, solar radiation and stability were not provided. Wet deposition can remove suspended particles, but the net wet-season effect depends on rainfall timing, source strength and atmospheric mixing; the simplified claim that humidity or rain "traps" pollutants is not universally supported (Roldán-Henao et al., 2020; Wu et al., 2022; Plocoste et al., 2021). Wind direction was reported as southwest at every station, suggesting either a single prevailing direction input or limited measurement resolution. With no timestamped observations or wind-direction variability, transport pathways cannot be reconstructed.

The existing maps communicate practical spatial differences but do not have sufficient metadata for reproducible geostatistical inference. A symbol map of individual points can validly show observations; a continuous interpolated surface makes additional assumptions. A journal-ready spatial analysis would require precise coordinates, coordinate reference system, interpolation method, variogram or smoothing parameters, cross-validation, and uncertainty reporting. Sparse points arranged along urban corridors can create anisotropic patterns that simple interpolation may distort. The figures are therefore captioned as source maps and treated qualitatively. This preserves their value for site orientation and field planning without giving readers an unsupported impression of continuous validated exposure estimates.

The local patterns are broadly consistent with a growing literature on urban exposure assessment in Nigeria, which documents variation between road, residential, industrial and transport settings, and with regional Niger Delta studies identifying high particulate exposure near combustion-related activities. However, the absolute values across studies differ with sensor type, sampling duration, meteorological conditions and reported units (Obanya et al., 2018; Abulude et al., 2021; Yorkor et al., 2021; Lala et al., 2023). The present dataset adds geographically specific evidence for Ughelli, but it is preliminary in scope and should not be treated as a representative estimate for Delta State or the Niger Delta.

Ambrose et al. (2025), measured air quality and noise around a road-construction corridor in Port Harcourt and reported the value of incorporating background points and multiple locations in a hydrocarbon-polluted urban setting. The present work is complementary in its focus on a different Delta State urban centre and on wet-season site contrasts. It also underscores the importance of transparent instrument metadata and cautious interpretation where portable monitoring is used. The comparison should not imply equivalent methods or directly comparable concentrations unless the original protocols and averaging times are matched.

The spatial heterogeneity is operationally useful even without causal attribution. Sites with very high reported particles, high sound or discrepant readings can be prioritized for repeat monitoring. For instance, site 13 should be revisited to determine whether the particle peak is reproducible and what activity occurred at the time; sites 10 and 16 merit time-integrated acoustic measurement; the low CO_2 reading at site 16 should be checked against original records. This targeted validation can reduce uncertainty efficiently and help local agencies decide where permanent low-cost sensors or mobile sampling campaigns would provide the greatest information value. Monitoring results should be paired with location-specific source inventories and community observations.

The health literature supports concern about repeated exposure to high particulate and noise levels, but it does not authorize individual risk estimates from this dataset. Ambient air pollution contributes to global disease burden, and fine-particle reductions can yield public-health benefits (Cohen et al., 2017; Burnett et al., 2018; Landrigan et al., 2018). Transportation noise is associated with sleep disturbance and cardiovascular stress, especially under chronic exposure conditions (Basner et al., 2014; Stansfeld, 2015; Münzel et al., 2024). The Ughelli readings are therefore a rationale for better exposure monitoring and source management, not evidence that the sampled residents have suffered illness or that measured site values represent individual doses.

Communication of findings should avoid alarmist terms such as “very high health risk” when the exposure duration, sensor accuracy and population data are missing. It should distinguish an instrument reading, a comparison benchmark, an exposure estimate and a health effect. For particles, a daily guideline comparison is informative only if the instrument output represents a valid 24-hour mean; for sound, annual Lden or Lnight recommendations cannot be tested with a spot dBA value. These distinctions improve scientific credibility and protect the manuscript from overclaiming. They also make the results more actionable because they specify exactly what future data should be collected.

In summary, the analysis supports three conclusions about interpretation: urban sites had higher spot sound readings than the single control point; reported particle mass varied substantially

between sites; and measured pollutant and noise values did not show statistically significant linear associations in the 17-site analysis. The evidence is consistent with co-occurring environmental pressures in an urban setting, but the data are too limited to establish a general relationship, the effect of the wet season, source attribution or combined health impacts. Future campaigns can directly test those questions through better temporal sampling, calibrated instrumentation, improved site metadata and explicit exposure models.

4.2 Implications for monitoring and urban management

The immediate practical implication is to replace one-off screening with a coordinated monitoring design. A minimum follow-up campaign should sample each site repeatedly across morning, midday and evening traffic periods, on wet and rain-free days, and across more than one month. $PM_{2.5}$ and PM_{10} should be monitored continuously or for documented 24-hour intervals with reference collocation at a central station. Portable readings should be corrected against a calibrated reference and accompanied by temperature and humidity. CO and CO_2 should be recorded with instrument response times and calibration gases; HCHO and TVOC methods should be checked against the manufacturer's stated units and detection limits. Such design features would allow separation of persistent spatial contrast from transient events and sensor artifacts (Hagan et al., 2018; Rai et al., 2017; Hua et al., 2021).

The acoustic component should measure LAeq over explicit intervals and log Lmax and L10/L90 where appropriate. Measurements should note microphone height, distance from carriageway, shielding, surface condition, traffic composition, horn events and generator operation. Traffic counts and vehicle classifications can support source interpretation, while sound logging at the same time as air monitoring can characterize event-level covariation. The analysis should account for day of week, time of day and weather, and should distinguish traffic noise from construction and commercial activity. Repeated acoustic monitoring also enables more meaningful comparison with environmental limits than a single reading.

A stronger spatial design would include site coordinates, standardized land-use categories, road hierarchy, traffic volume, distance to major sources, building density and vegetation cover. A balanced design should sample along source gradients and include matched control locations outside the immediate urban corridor. GIS maps should present observed points and sample uncertainty; any interpolated surfaces should document technique, model settings and validation. An explicitly georeferenced database would permit reproducibility and allow integration with population distribution or mobility data without implying that every resident experiences the value measured at a nearby roadside point (Forehead & Huynh, 2018; Abulude et al., 2021; Ambrose et al., 2025).

Local interventions can be selected from source characterization rather than generalized claims. If traffic is confirmed as a dominant contributor, traffic-flow management, vehicle maintenance, anti-idling enforcement and safer walking corridors can reduce combustion and noise exposure. If construction dust drives peaks, worksite dust control, material covering and road cleaning may be appropriate. If generator clusters are important, quiet enclosures, maintenance and cleaner distributed energy can reduce both sound and combustion emissions. These interventions should be evaluated with before-and-after measurements, accounting for changes in activity and weather. The present project identifies candidate locations for such assessment but does not identify a dominant source or prove that a specific measure will achieve a quantified reduction.

Environmental agencies and local authorities can use the field project as a starting baseline if data records are made auditable. The source spreadsheet should retain raw readings, instrument identifiers, timestamps, coordinates, calibration status, and any corrections. A data dictionary should explain units, decimal precision, missing values, and whether each reading is instantaneous, averaged or modeled. Flagged values should be reviewed against original field sheets before analysis. Publishing a de-identified machine-readable data table alongside the article would make the recalculation reproducible and help future researchers compare seasonal measurements. These practices are especially important in regions where independent monitoring is scarce and locally collected datasets may serve as early evidence for policy discussion.

Community engagement can improve monitoring design by identifying activity schedules and sensitive receptors such as schools, clinics, markets and residential clusters. Residents can help locate recurring sources, note generator operating times, report construction events and identify periods when road congestion is highest. Community-reported observations should complement rather than replace calibrated measurements. A participatory monitoring approach can also improve communication of uncertainty and build trust around environmental data, especially if maps distinguish measured values from estimates. The reported field campaign indicates that site-based monitoring can be developed into a repeatable local programme.

Health protection decisions should be based on exposure data appropriate to the decision. If high spot values recur, authorities may use the evidence to prioritize detailed assessment; public-health agencies can then combine validated exposure estimates with population information and clinical or epidemiological data. This staged approach avoids unsupported statements about current disease burden while not dismissing potential exposure concerns. Integrated air and noise strategies are supported by the shared-source character of transportation emissions, though the evidence for interaction and additive risk should be evaluated with suitable statistical designs (Stansfeld, 2015; Eminson et al., 2023; Mayntz et al., 2024; Shah et al., 2024).

The results also have implications for journal reporting. The original work should be submitted with an expanded methods description and a table of all raw observations, rather than only summary statistics and maps. Authors should provide coordinates or a suitably generalized map, instrument manuals or specifications, calibration records, time of day, exact measurement duration, weather conditions and data processing steps. Where an instrument's precision or calibration is unknown, this should be stated clearly. If dry-season figures are retained, their underlying dataset and sampling protocol must be supplied and analysed consistently; otherwise, they should be omitted from this wet-season manuscript. These revisions would strengthen peer review and allow readers to distinguish a field screening study from a compliance assessment.

Ambrose et al., (2025)'s road-construction assessment in Port Harcourt illustrates the value of explicitly considering construction and traffic as coupled air and noise sources in the Niger Delta. For Ughelli, the corresponding next step is to collect source-event information alongside repeated measurements. Roadwork, congestion, fleet composition, generator operation and roadside commerce can be logged with structured field forms. If those data are available, future analyses can test whether co-occurrence is strongest near particular sources and whether

temporal changes are shared across pollutants and sound. Without that evidence, the current findings should remain descriptive.

A practical monitoring sequence is: verify the field values and units; conduct instrument calibration and collocation; repeat measurements at flagged sites and controls; expand temporal coverage; and then estimate exposure or policy impacts. This sequencing follows the uncertainty structure of the current project. It avoids investing in complex spatial or health models before the underlying measurements and metadata have been established. The current paper can thus function as an initial screening synthesis and a technical roadmap for a more robust environmental assessment.

For readers and decision makers, the most defensible interpretation is straightforward: Ughelli's sampled activity sites showed high observed sound and wide variation in reported particulate readings, but the measurements are too sparse and insufficiently documented for definitive threshold or health classification. The control point is informative but not replicated. Air and noise were measured together, but the corrected site-level correlations were weak and statistically uncertain. These are useful findings because they locate the current knowledge boundary and direct follow-up monitoring toward the places and variables most likely to reduce uncertainty.

4.3 Strengths and limitations

A strength of the study is the simultaneous collection of air-quality, sound and meteorological indicators at named urban sites. The spatially distributed measurements provide a local screening perspective for Ughelli, a location with limited published exposure evidence. The use of a background reference point offers context for interpreting the reported urban observations. Recalculation from the source table is an additional strength: it reveals that some statements in the source narrative are unsupported by the table and prevents their repetition as findings. This auditability is a useful contribution for future environmental monitoring in data-sparse urban contexts.

The limitations are substantial. The project does not supply raw repeated readings, exact timestamps, sampling duration, reference calibration, detection limits, coordinate table or site-specific source inventory. The sample size is small, and sites were purposively selected rather than randomly sampled. A single measurement per location cannot estimate temporal variability or population-level exposure. Missing metadata and unit discrepancies limit interpretation of CO_2, HCHO and TVOC results. The maps are raster figures without documented interpolation methods. The control point is singular, and the dry-season plots included in the source file are not supported by a corresponding numeric dataset in the supplied project. Each constraint affects generalizability and should be considered in any future analysis. The correlations are vulnerable to measurement error, influential observations and multiple testing. With 17 urban locations, a moderate association may not reach statistical significance, while a single extreme location can substantially change the coefficient. The reported p values should therefore be read as exploratory, not as a definitive test of independence. There is no correction for multiple comparisons, and there is no multivariable adjustment for site type, traffic volume, temperature or humidity. A larger repeated-measures dataset would be better analysed using mixed-effects models or spatially explicit methods, provided sampling structure and measurement uncertainty are documented.

The study's health framing is indirect. No personal exposure, medical, behavioural or demographic data are available, so this is not a health-outcome study or a quantitative risk assessment. Pollutant readings cannot be translated to disease incidence without valid exposure durations, exposure-response functions, population data and appropriate baseline assumptions. Similarly, high noise readings do not establish hearing loss or cardiovascular harm in residents. The manuscript accordingly discusses health relevance through the literature while limiting its empirical conclusions to measured environmental indicators.

Because the underlying source file contains conflicting summary values, the final author should verify the corrected statistics and all stated units against the original field notebook and device exports. In particular, confirm the CO_2 reading at site 16, the HCHO unit, the sound-level metric and averaging interval, the apparent PM peak at site 13, and the project period. Confirm the map coordinate system and location names, and obtain permission for identifiable photographs. If verification changes any values, tables, figures and correlations should be regenerated before journal submission. These are source-data validation tasks, not editorial preferences.

Despite these limitations, a cautious paper remains valuable because it identifies exposure contrasts and defines what can and cannot be concluded. It offers a transparent urban-only reanalysis, makes an explicit distinction between co-occurrence and interaction, and provides practical priorities for validation. The main contribution is methodological and local: converting a student project into a properly bounded screening report without claiming unsupported health effects or regulatory noncompliance. Future studies can build on this base with stronger monitoring design and a complete digital data archive.

5. Conclusion

This wet-season screening study describes air-quality indicators, environmental sound and weather observations at 17 urban activity-centred locations in Ughelli, with one control point reported separately. Recalculation from the source table produced an urban mean sound level of 93.99 dBA, mean $PM_{2.5}$ of 154.0 µg m^{-3} and mean PM_{10} of 204.35 µg m^{-3}. The particle values showed marked site variation, including high readings at Agbarha Junction, while the control sound reading was considerably lower than the urban observations. The site table did not reproduce the source narrative's reported correlations: pollutant–noise correlations were weak and non-significant in the 17-site analysis.

The evidence supports spatial co-occurrence of environmental stressors and identifies locations for repeat monitoring. It does not demonstrate a causal interaction, establish seasonal effects, confirm guideline exceedances for time-integrated exposure, attribute emissions to specific sources or quantify health risk. Instrument calibration, reading duration, units and anomalous values require validation before submission. A follow-up campaign should combine repeated calibrated air measurements, time-integrated acoustic monitoring, traffic and source logs, rainfall and meteorological records, multiple controls, accurate coordinates and reproducible GIS methods. Until then, the appropriate use of these findings is environmental screening and monitoring prioritization.

References

Abulude, F. O., Damodharan, U., Acha, S., Adamu, A., & Arifalo, K. M. (2021). Preliminary assessment of air pollution quality levels of Lagos, Nigeria. Aerosol Science and Engineering, 5, 275–284. https://doi.org/10.1007/s41810-021-00099-1

Adza, W. K., Hursthouse, A. S., Miller, J., & Boakye, D. (2022). Exploring the combined association between road traffic noise and air quality using QGIS. International Journal of Environmental Research and Public Health, 19(24), 17057. https://doi.org/10.3390/ijerph192417057

Ambrose, I. S., Etuk, S. E., Agbasi, O. E., Silas, I. I., Saturday, U. U., & Orok, E. E. (2025). Public health implications of road construction and traffic congestion in a hydrocarbon-polluted environment: An assessment of air and noise pollution. Revue Internationale de Géomatique, 34(1), 335–350. https://doi.org/10.32604/rig.2025.064552

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. The Lancet, 383(9925), 1325–1332. https://doi.org/10.1016/S0140-6736(13)61613-X

Burnett, R., Chen, H., Szyszkowicz, M., Fann, N., Hubbell, B., Pope, C. A., III, Apte, J. S., Brauer, M., Cohen, A., Weichenthal, S., Coggins, J., Di, Q., Brunekreef, B., Frostad, J., Lim, S. S., Kan, H., Walker, K. D., Thurston, G. D., Hayes, R. B., ... Spadaro, J. V. (2018). Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter. Proceedings of the National Academy of Sciences, 115(38), 9592–9597. https://doi.org/10.1073/pnas.1803222115

Cohen, A. J., Brauer, M., Burnett, R., Anderson, H. R., Frostad, J., Estep, K., Balakrishnan, K., Brunekreef, B., Dandona, L., Dandona, R., Feigin, V., Freedman, G., Hubbell, B., Jobling, A., Kan, H., Knibbs, L., Liu, Y., Martin, R., Morawska, L., ... Forouzanfar, M. H. (2017). Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: An analysis of data from the Global Burden of Diseases Study 2015. The Lancet, 389(10082), 1907–1918. https://doi.org/10.1016/S0140-6736(17)30505-6

Eminson, K., Cai, Y. S., Chen, Y., Blackmore, C., Rodgers, G., Jones, N., Gulliver, J., Fenech, B., & Hansell, A. L. (2023). Does air pollution confound associations between environmental noise and cardiovascular outcomes? A systematic review. Environmental Research, 232, 116075. https://doi.org/10.1016/j.envres.2023.116075

Forehead, H., & Huynh, N. (2018). Review of modelling air pollution from traffic at street-level: The state of the science. Environmental Pollution, 241, 775–786. https://doi.org/10.1016/j.envpol.2018.06.019

Hagan, D. H., Kroll, J. H., Sillman, S., & Bae, M.-S. (2018). Calibration and assessment of low-cost particulate matter sensors. Atmospheric Measurement Techniques, 11, 5631–5644. https://doi.org/10.5194/amt-11-5631-2018

Hua, J., Zhang, Y., deSouza, P., & Kinney, P. L. (2021). Improved PM2.5 concentration estimates from low-cost sensors: Model development and validation. Aerosol Science and Technology, 55(10), 1130–1143. https://doi.org/10.1080/02786826.2021.1873911

Itaa, C. M., Ugwoha, E., & Yorkor, B. (2023). Evaluation of daily vehicular traffic flows and noise levels at major junctions in Port Harcourt Metropolis, Nigeria. Journal of Scientific Research and Reports, 29(10), 71–84. https://doi.org/10.9734/jsrr/2023/v29i101799

Lala, M. A., Onwuzo, C. S., Adesina, O. A., & Sonibare, J. A. (2023). Particulate matters pollution in selected areas of Nigeria: Spatial analysis and risk assessment. Case Studies in Chemical and Environmental Engineering, 7, 100288. https://doi.org/10.1016/j.cscee.2022.100288

Landrigan, P. J., Fuller, R., Acosta, N. J. R., Adeyi, O., Arnold, R., Basu, N. N., Baldé, A. B., Bertollini, R., Bose-O'Reilly, S., Boufford, J. I., Breysse, P. N., Chiles, T., Mahidol, C., Coll-Seck, A. M., Cropper, M. L., Fobil, J., Fuster, V., Greenstone, M., Haines, A., ... Zhong, M. (2018). The Lancet Commission on pollution and health. The Lancet, 391(10119), 462–512. https://doi.org/10.1016/S0140-6736(17)32345-0

Mayntz, S. P., Rosenbech, K. E., Mohamed, R. A., Lindholt, J. S., Diederichsen, A. C. P., Frohn, L. M., & Lambrechtsen, J. (2024). Impact of air pollution and noise exposure on cardiovascular disease incidence and mortality: A systematic review. Heliyon, 10(21), e39844. https://doi.org/10.1016/j.heliyon.2024.e39844

Münzel, T., Molitor, M., Kuntic, M., Hahad, O., Röösli, M., Engelmann, N., Basner, M., Daiber, A., & Sørensen, M. (2024). Transportation noise pollution and cardiovascular health. Circulation Research, 134(9), 1113–1135. https://doi.org/10.1161/CIRCRESAHA.123.323584

Obanya, H. E., Amaeze, N. H., Togunde, O., & Otitoloju, A. A. (2018). Air pollution monitoring around residential and transportation sector locations in Lagos Mainland. Journal of Health and Pollution, 8(19), 180903. https://doi.org/10.5696/2156-9614-8.19.180903

Oguntunde, P. E., Okagbue, H. I., Oguntunde, O. A., & Odetunmibi, O. O. (2019). A study of noise pollution measurements and possible effects on public health in Ota Metropolis, Nigeria. Open Access Macedonian Journal of Medical Sciences, 7(8), 1391–1395. https://doi.org/10.3889/oamjms.2019.234

Plocoste, T., Carmona-Cabezas, R., Gutiérrez de Ravé, E., & Jiménez-Hornero, F. J. (2021). Wet scavenging process of particulate matter (PM10): A multivariate complex network approach. Atmospheric Pollution Research, 12(7), 101095. https://doi.org/10.1016/j.apr.2021.101095

Rai, A. C., Kumar, P., Pilla, F., Skouloudis, A. N., Di Sabatino, S., Ratti, C., Yasar, A., & Rickerby, D. (2017). End-user perspective of low-cost sensors for outdoor air pollution

monitoring. Science of the Total Environment, 607–608, 691–705. https://doi.org/10.1016/j.scitotenv.2017.06.266

Roldán-Henao, N., Hoyos, C. D., Herrera-Mejía, L., & Isaza, A. (2020). An investigation of the precipitation net effect on the particulate matter concentration in a narrow valley: Role of lower-troposphere stability. Journal of Applied Meteorology and Climatology, 59(3), 401–426. https://doi.org/10.1175/JAMC-D-18-0313.1

Shah, B. U. D., Raj, R., Kaur, P., Karim, A., Bansari, R. B., Mehmoodi, A., & Malik, J. (2024). Association of transportation noise with cardiovascular diseases. Clinical Cardiology, 47(5), e24275. https://doi.org/10.1002/clc.24275

Stansfeld, S. A. (2015). Noise effects on health in the context of air pollution exposure. International Journal of Environmental Research and Public Health, 12(10), 12735–12760. https://doi.org/10.3390/ijerph121012735

Thurston, G. D., Kipen, H., Annesi-Maesano, I., Balmes, J., Brook, R. D., Cromar, K., De Matteis, S., Forastiere, F., Forsberg, B., Frampton, M. W., Grigg, J., Heederik, D., Kelly, F. J., Kooter, I. M., Krug, N., Liu, S., London, S. J., Peters, A., Rajagopalan, S., ... Brunekreef, B. (2017). A joint ERS/ATS policy statement: What constitutes an adverse health effect of air pollution? An analytical framework. American Journal of Respiratory and Critical Care Medicine, 196(11), 1434–1445. https://doi.org/10.1164/rccm.201704-0591ST

van Kempen, E., Casas, M., Pershagen, G., & Foraster, M. (2018). WHO environmental noise guidelines for the European region: A systematic review on environmental noise and cardiovascular and metabolic effects: A summary. International Journal of Environmental Research and Public Health, 15(2), 379. https://doi.org/10.3390/ijerph15020379

Wu, Y., Wang, Y., Zhou, Y., Liu, X., Tang, Y., Wang, Y., Zhang, R., & Li, Z. (2022). The wet scavenging of air pollutants through artificial precipitation enhancement: A case study in the Yangtze River Delta. Frontiers in Environmental Science, 10, 1027902. https://doi.org/10.3389/fenvs.2022.1027902