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Data Article

Exploration of environmental noise in Saharan oases on the basis of urban configurations: City of Biskra datasets

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A R T I C L E   I N F O

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A B S T R A C T

The scope of this dataset is to explore the acoustic environment on the basis of spatial configurations. To fulfill this objective, two ranges of data were involved. Firstly, urban acoustic data was obtained by setting up 240 stations of measurements based on equivalent continuous A-weighted sound pressure level, across 16 urban zones in Biskra City, Algeria, during working hours. The data was analyzed using geostatistical and interpolation models on a Geographic Information System platform in order to enhance the observations and examine their distribution within the urban area. Secondly, spatial configuration data is based on two indicators: Normalized Angular Integration and Normalized Angular choice. Integration refers to the degree of accessibility “to-movement”, whereas Choice values depict the urban route hierarchy, or the “through-movement” potential. The data includes different values of the global and local scale of the urban structure using several metric radii of 400m.

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800m, 1200m, 1600m, 2000m, 2400m and 3200m. A correlation scheme is required in order to validate the effectiveness of this methodological approach. The dataset serves as an insightful reference for further inquiry and policymakers in dealing with sustainable concerns related to soundscape, noise pollution, and urban planning.

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### Specifications Table

| Subject               | Environmental Science                  |
|-----------------------|----------------------------------------|
|                       | Environmental Engineering              |
| Specific subject area | Urban Acoustics, Spatial analysis      |
| Type of data          | Table, Graph, Figure                   |
| How the data were acquired | In-site measurements using a portable sound level meter (Model SL-586P of Merit-mi Brand). QGIS software was used to interpolate the measured data and depthMapX generated the urban morphology indicators. |
| Data format           | Raw, Analyzed                          |
| Description of data collection | Collected data represent 240 values of equivalent continuous A-weighted sound pressure level (LeqA) for a duration of 5 minutes. These measures were carried out during the daytime of working days in November 2020 and January 2021. A geostatistical process was carried out using interpolation models on QGIS. The city map was exported firstly from open street map, and the spatial data were obtained by depthMapX software by establishing an angular segment analysis at various metric radii. |
| Data source location  | Biskra, Algeria.                       |
| Data accessibility    | Geographic coordinate: 34° 51’ 1.37” N, 5° 43’ 40.98” E. |
|                       | The dataset has been deposited in an open repository and is permanently accessible under the following specification: |
|                       | Repository name: Mendeley               |
|                       | Data identification number (DOI): https://dx.doi.org/10.17632/yg7mwk8j5x.2 |
|                       | Direct URL to data: https://data.mendeley.com/datasets yg7mwk8j5x/2 |

### Value of the Data

- The systematic review of these data yields a broad sense assessment of the relationship between the acoustic environment and the functional state of the urban system.
- A starting point for synchronized or diachronic research in the same Saharan urban area, as well as for comparisons with other contexts.
- These data may be used by researchers in a range of domains, including soundscape, noise pollution, urban planning, computational and applied sciences, social and psychological sciences, inhabitants’ health and well-being, and sustainability challenges.
- Due to the lack of data in such regions, this article assists policymakers throughout the urban planning process and acts as a diagnostic aid for soundscape management.

### 1. Data Description

The urban soundscape is a complex and multifaceted topic that has been widely addressed across a broad array of disciplines using different methods and multidimensional data [1,2]. However, only a few studies were based on urban structure components related to people's
movement and activities. This article provides in-site measurements of the acoustic environment and spatial configuration analysis data series.

The meteorological conditions during data collection are illustrated in Table 1 which highlights different indicators such as temperature, wind speed, precipitation, humidity and cloud cover ratio. Table 2 summarizes the contextual and physical characteristics of the case study region’s urban sectors, including zone identifiers and names for 16 urban zones, land use, building typologies, and area. The raw data shared in the repository (in particular in File: A. Level Sound Measured Data.csv) contains for each measurement the following information: sector ID, sector name, stations ID, values of equivalent continuous A-weighted sound pressure level (LeqA), date, time and the geographic coordinates (Longitude and Latitude) of each measurement station. Fig. 1 depicts the propagation of measured data according to geospatial interpolation methods such as Inverse Distance Weighted Gaussian, IDW Exponential, IDW k2, Ordinary Kriging and Universal Kriging. A statistical description and validation of the preceding interpolation models are highlighted in Table 3. Fig. 2 represents zonal statistics for the validated model IDW k2 raster, as well as some useful statistics to describe each zone, based on the clustered data spread.

The spatial database extracted from depthMapX via angular segment analysis of the entire region is stored in a second file (File: B. Extracted DATA from depthMapX.csv), that further includes global measures of Normalized Angular CHoice (NACH) and Normalized Angular INtegration (NAIN), along with local measures at various metric radii of 400m, 800m, 1200m, 1600m,
Fig. 1. Interpolation models (A. IDW Gaussian, B. IDW Exponential, C. IDW Power 2, D. Ordinary Kriging, E. Universal Kriging) with extracted contours.

Table 3
Statistic description of the interpolation model and Validation (SEM: standard deviation error of mean, MAE: Mean Absolute Error, RMSE: Root Mean Square Error).

| Statistic     | IDW GAUSSIAN | IDW EXPONENTIAL | IDW k2 | Ordinary Kriging | Universal Kriging |
|---------------|--------------|-----------------|--------|------------------|-------------------|
| MIN - MAX     | 0 - 77.1     | 58.1 - 73.0     | 48.1 - 79.1 | 58.4 - 71.7     | 50.7 - 76.7       |
| Mean          | 63.8         | 64.0            | 66.2   | 63.2             | 62.9              |
| St.D          | 4.717        | 3.363           | 1.007  | 3.295            | 5.308             |
| SEM           | 0.1804843    | 0.3820647       | 0.2057886 | 0.1831411   | 0.1836344         |
| MAE           | 3.2499       | 3.2401          | 0.0029 | 3.3425          | 3.3415            |
| RMSE          | 4.1175       | 4.0661          | 0.0047 | 4.1607          | 4.1589            |

2000m, 2400m, 3200m. Figs. 5 and 6 are visual representations of the retrieved table. Table 4 includes a validation test between the observed sound-level data and the spatial database at global and local scales. Detailed associated observations are shared in the third file (File: C. Measurements associated to ASA.csv) using the ID and geolocation fields. Figs. 7 and 8 provide visual representations of modeled data explored by NACH and NAIN, respectively, with the same color legend display for both datasets.
Fig. 2. (Sector’s ID from 1 to 6): LeqA distribution for IDW Power 2 raster divided by zones with descriptive statistics.
Fig. 3. (Sector’s ID from 7 to 12): LeqA distribution for IDW Power 2 raster divided by zones with descriptive statistics.
Fig. 4. (Sector’s ID from 13 to 16): LeqA distribution for IDW Power 2 raster divided by zones with descriptive statistics.

Fig. 5. Normalized Angular CChoice (NACH) metric radii values.
Fig. 6. Normalized Angular INtegration (NAIN) metric radii values.

Fig. 7. Visualization of the NACH radius n values with the IDW Power 2.
Table 4
Correlations of the equivalent continuous A-weighted sound pressure level with the Angular Segment Analysis global and local values.

| ID | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH | NACH |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|    | R400 | R800 | R1200 | R1600 | R2000 | R2400 | R3200 | NAIN | R400 | NAIN | R800 | NAIN | R1200 | NAIN | R1600 | NAIN | R2000 | NAIN | R2400 | NAIN |
| 1  | 0.628 | 0.376 | 0.183 | 0.122 | 0.133 | 0.202 | 0.312 | 0.446 | -0.447 | -0.312 | -0.388 | -0.483 | -0.605 | -0.704 | -0.741 | -0.881 |
| 2  | .724** | .560* | .720* | .739** | .752** | .756** | .748** | .738** | .749** | .689** | .722** | .722** | .760** | .756** | .733** | .700** |
| 3  | .680* | 0.500 | .649* | .642* | .687* | .729* | .726* | .723* | .671* | .562 | 0.557 | .617* | .689* | .750** | .752** | .691* |
| 4  | .537 | 0.364 | 0.487 | 0.496 | 0.500 | 0.485 | 0.503 | 0.541 | .875* | .815* | .810 | .873* | .852* | .857* | .853* | .872* |
| 5  | .522* | 0.395 | .461* | .497* | .496 | .524* | .523* | .553** | .646** | .420 | .544** | .674** | .637** | .718** | .632** | .675** |
| 6  | .470* | .454* | .348 | .368 | 0.398 | 0.408 | 0.411 | 0.429 | .606** | .528 | .491* | .639* | .623** | .596* | .555* | .602** |
| 7  | 0.328 | -0.072 | 0.355 | 0.400 | 0.424 | 0.425 | 0.446 | 0.406 | .649* | 0.263 | 0.586* | 0.527 | 0.548* | 0.656* | .717** | .602* |
| 8  | 0.490 | -0.223 | 0.151 | 0.193 | 0.263 | 0.323 | 0.346 | 0.373 | .561* | -0.318 | 0.135 | 0.508 | 0.756* | 0.808* | .714** | 0.506 |
| 9  | .487* | .507 | .456* | .504* | .532 | .557** | .561** | .556** | .596* | .472 | .602* | .593* | .623** | .623** | .614** | .604** |
| 10 | .759* | 0.446 | .680* | .751** | .776* | .799* | .794* | .782* | .510 | .666* | .757* | .742* | .776* | .745* | .704* | .644** |
| 11 | .565* | -0.075 | 0.403 | 0.547 | .566 | .581* | .595* | .587* | .385 | -0.314 | 0.375 | .427 | 0.046 | -0.095 | 0.110 | 0.293 |
| 12 | .461* | -0.322 | -0.366 | -0.231 | 0.050 | 0.203 | 0.285 | 0.317 | 0.382 | -0.343 | -0.394 | -0.419 | -0.182 | 0.123 | 0.361 | 0.614 |
| 13 | .663** | -0.179 | 0.061 | 0.231 | .417* | .536** | .593** | .629** | .370* | 0.222 | -0.062 | 0.044 | 0.049 | 0.151 | 0.281 | 0.295 |
| 14 | 0.117* | 0.146 | -0.007 | -0.004 | 0.069 | -0.039 | -0.170 | -0.095 | 0.180 | 0.032 | -0.713 | -0.658 | -0.257 | -0.006 | -0.234 | -0.151 |
| 15 | .719** | -0.514 | 0.376 | .659* | .694** | .742** | .752** | .705** | 0.476 | 0.550 | 0.476 | .642* | .686** | .724** | .653* | .548* |
| 16 | .889** | 0.303 | .523* | .690* | .777** | .809* | .818* | .843** | .755* | 0.204 | 0.326 | .550* | .607* | .559* | .622* | .616* |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
2. Experimental Design, Materials and Methods

The methodological approach is based on two main dimensions: the acoustic environment and space syntax analysis. The acoustic data was collected by establishing 240 stations of measurements using a calibrated sound level meter (Model SL-586P of Merit-mi Brand). The instrument was fixed at one-meter level from the ground for a duration of 5 minutes for each station location, and the sound equivalent continuous weighted A levels (LeqA) were acquired. The temporal trends of the LeqA parameter for each station location were acquired with a frequency of 2 data per second, obtaining 600 data for each station location. These measurements were performed in the city of Biskra, Algeria, during the working days in November 2020 and January 2021. The meteorological conditions should be assessed as indicated in Table 1.

The street network map was imported from the open street map database, edited and prepared to explore the urban system that compromises 16 official divisions according to the Municipal Master Plan. Contextual and physical properties are required for a further diagnosis (see Table 2).

Therefore, the mean values of the performed measurements were modeled on open source software QGIS [3] in order to obtain the acoustic profile for the extent region using Inverse Distance Weighted (IDW) and Kriging interpolation which have proven their potential in acoustic environment studies [4–6]. For soundscape profiling, several models are used, including Invert Distance Weighting via different weighted functions (Gaussian, Exponential, and Power 2 functions), as well as Kriging spatial interpolation (Ordinary and Universal) resampling by a B-spline Interpolation (Fig. 1).
A validation process of the modeled observations was required to verify data accuracy, as mentioned in Table 3. The model that accurately represents the acoustic data has been explored by a zonal statistical raster function on QGIS in order to explore data propagation through the city urban system (see Fig. 2).

Space syntax theory and angular segment analysis were used to analyze the georeferenced map of the city. Two key values were the subject of the second data range whereas, Normalized Angular Integration and Normalized Angular Choice, which represent the degree of accessibility “to-movement potential”, whereas Choice values depict the urban route hierarchy, or the “through-movement potential” [7]. This analysis was applied at global and local scales of the urban system applying various metric radii for NACH and NAIN values [8–11]. These values were extracted after a simulation run on depthMapX [12] and visualized on QGIS (see Figs. 5 and 6).

To emphasize the novelty of this methodological approach, which promotes a sense of collecting and pairing the various data presented in this article, a Pearson correlation analysis was established, see Table 4. The correlation analysis can be explained by graph visualizations on QGIS, as shown in Figs. 5 and 6.

CRediT Author Statement

Okba Benameur: Software, Validation, Investigation, Post-Processing, Data Curation, Writing – original draft, Visualization; Noureddine Zemmouri: Supervisor, Conceptualization, Resources; Valerio Cutini: Conceptualization, Methodology, Editing; Francesco Leccese: Conceptualization, Methodology, Writing – review & editing, Funding acquisition; Giacomo Salvadori: Conceptualization, Validation, Writing – reviewing & editing, Visualization, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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