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THE MONITORING OF EXPOSURE TO ENVIRONMENTAL NOISE

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Abstract

Environmental noise is a pervasive pollutant that adversely affects the health and well-being of European citizens and wildlife. Although noise is a product of many human activities, the most widespread sources of environmental noise are those related to transport. As a result, noise caused by transport is considered the second most significant environmental cause of ill health in Europe, behind fine particulate matter pollution (WHO and JRC, 2011; Hänninen et al., 2014). According to the World Health Organization (WHO), prolonged exposure to environmental noise is associated with an increased risk of negative physiological and psychological health outcomes (WHO, 2018). These include cardiovascular and metabolic effects, cognitive impairment in children, as well as severe annoyance and sleep disturbance. With projections of rapid urban growth and an increased demand for transport, a simultaneous increase in noise exposure and the associated adverse effects can be anticipated (Jarosińska et al., 2018).
The transposition of Directive 2002/49/EC of European Parliament and of the Council relating to the assessment and the management of environmental noise in Romania was achieved by Law no.121/2019 regarding the assessment and management of ambient noise. This law addresses the avoidance, prevention or reduction of harmful effects, including discomfort, caused by the population's exposure to ambient noise, through the progressive implementation of the following measures: the determination of exposure to environmental noise, through noise mapping, ensuring that information on environmental noise and its effects is made available to the public, adopting, based on the results of noise mapping, action plans to prevent and reduce ambient noise, where appropriate, in particular where exposure levels may cause harmful effects on human health, and to maintain ambient noise levels below defined limit values according to art. 4 point 19, if they are not exceeded. In order to evaluate noise pollution, common methods have been established at the level of the countries of the European Union. These methods evaluate environmental noise and define limit values, based on harmonized indicators to determine the noise level.
The purpose of this work is to present the importance of quiet green recreation areas for people's health. In order to achieve this objective, in this paper we present the method of obtaining comparative geospatial noise maps in crowded intersections (Arcul de Triumf and Casa Presei) and green areas (King Mihai I Park and Herăstrau Agronomy Campus) located in the northern part of Bucharest. To obtain the acoustic pressure values, we used the Sound Meter Coolexp application and a digital sound intensity measuring device - Uni-t UT353 sound meter. We used the obtained data to create geospatial noise maps with the QGIS application.

Key words*: comparative geospatial noise maps, crowded intersections, green area, QGIS, Sound Meter Coolexp application, Uni-t UT353 sound meter.*

INTRODUCTION

The transposition of Directive 2002/49/EC of European Parliament and of the Council relating to the assessment and the management of environmental noise in Romania was achieved by Law no.121/2019 regarding the assessment and management of ambient noise.
This law addresses the avoidance, prevention or reduction of harmful effects, including discomfort, caused by the population's exposure to ambient noise, through the progressive implementation of the following measures:

- the determination of exposure to environmental noise, through noise mapping,
- ensuring that information on environmental noise and its effects is made available to the public,
- adopting, based on the results of noise mapping, action plans to prevent and reduce ambient noise, where appropriate, in particular where

exposure levels may cause harmful effects on human health,

- and to maintain ambient noise levels below defined limit values according to art. 4 point 19, if they are not exceeded.

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MATERIAL AND METHODS

Table 1. dB values measured in intersections, parks, campus)

No.	Decibels (dB)	GPS Coordinates	Time of determinations
1	avg/70dB	44°28'44.1"N/ 26°04'21.4"E	14:48
2	avg/44,6dB	44°46'80.101"N/ 26°07'43.299"E	14:30
3	avg/69 dB	44°27′58″N /26°05′11″E	14:20
4	avg/56 dB	44°47'28.32"N/26°06'10.92"E	14:10
5	Avg/ 73 dB	44°46'74.28"N/26°07'75.19"E	14:00

Figure 1. Sound Meter Coolexp application interface

Figure 2. Sound Meter Coolexp application interface

Realization of the noise map

The noise map in intersections and green areas was made with the help of the QGIS application. This is a free professional GIS application that is also free and open source software (FOSS).

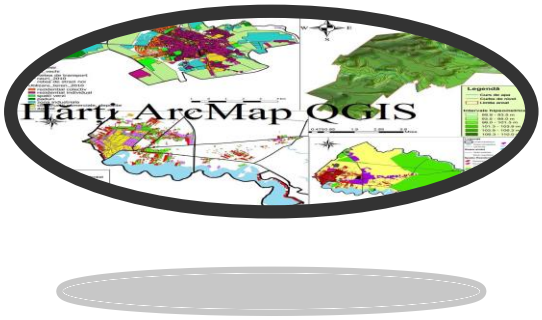


Figure 3. QGIS interface

The steps required to draw a noise map in QGIS are:
1. The data measured with the Cool application and the sound level meter are entered into Excel and saved in "CSV" format, so that they can be used in the QGIS program.

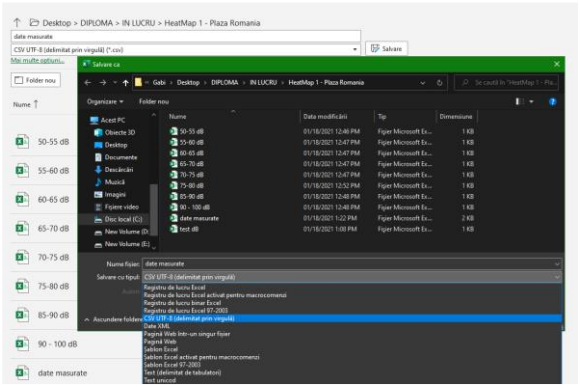


Figure 4. Saving data in CSV format

2. First of all, a "base map" is needed. This requires the use of the "QuickMapServices" or OSM plugin (as it is called in the toolbar).
The plugin may already exist in the program or will need to be installed separately from the program's menu bar. After opening the plugin, the reference area can be searched.

Figure 5. OSM Standard plugin (basemap)

3. After selecting the work area, the data taken in CSV format from Excel is added. To add the Excel table, open the "Open Data Source Manager" menu. Enter the data table and press the "Add" button to place the reference points over the base map. After adding, the points will appear on the map.

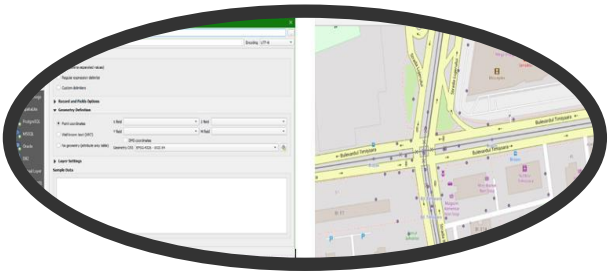


Figure 6. Data Source Manager menu and entering measured points on the map

4. Double-click on the "Layers" tab to open the properties window of the data table. Here the "Heatmap" option is selected to highlight the sound propagation on the map. The radius of the points must be selected, for this there are 2 options: separating the data into intervals, each interval corresponding to a table and a corresponding radius for that decibel interval; or keeping a single table in which the decibel intervals will be approximated by separate colors (example: green for 50-60 dB or red for 80-90 dB).
Points will have a larger radius depending on the decibel level measured at that point and the selected radius. In addition to all this, the column in the table representing the decibel values will be selected from the "Weight points by" option.

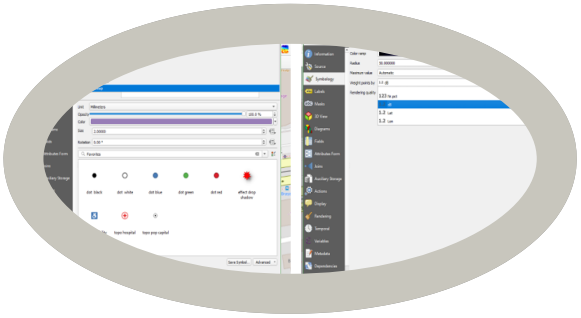


Figure 7. Heatmap menu and related settings

5. Finally, after adjusting the transparency of the points so that the base map can also be seen, adjusting the reference scale and selecting the desired colors.

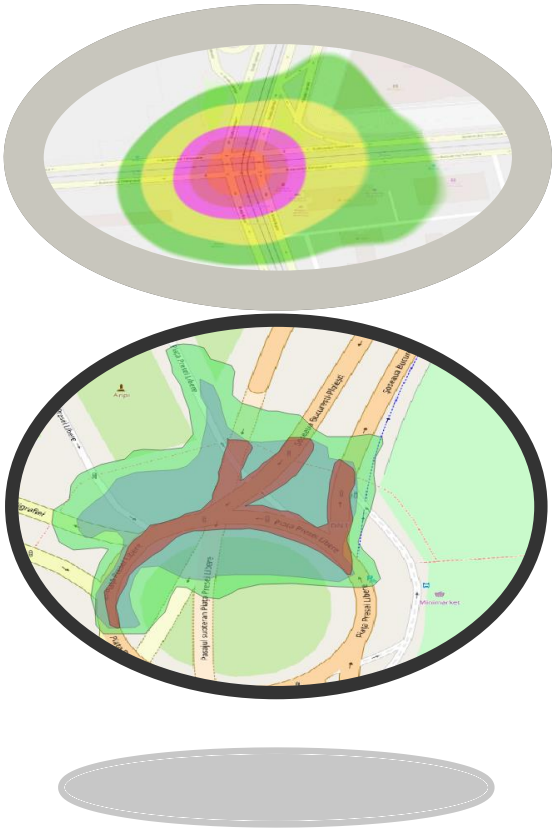
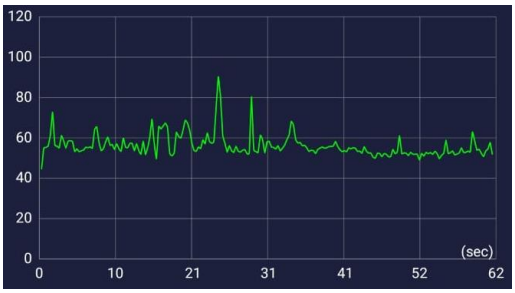
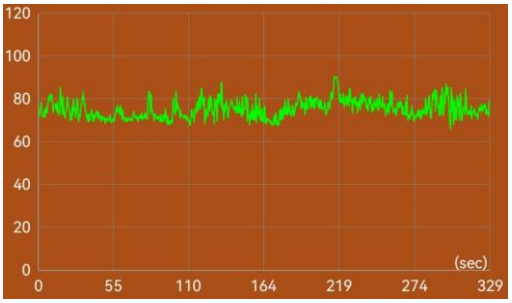


Figure 8. Noise map in QGIS

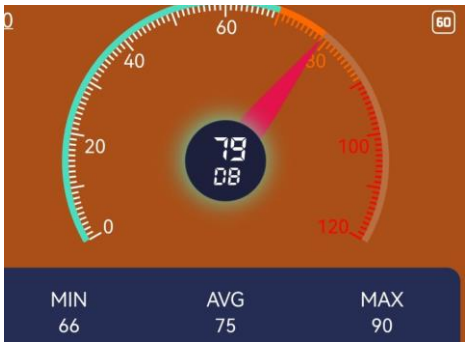
RESULTS AND DISCUSSIONS

Graphical interpretation of noise level values relative to time (the period of a single measurement).



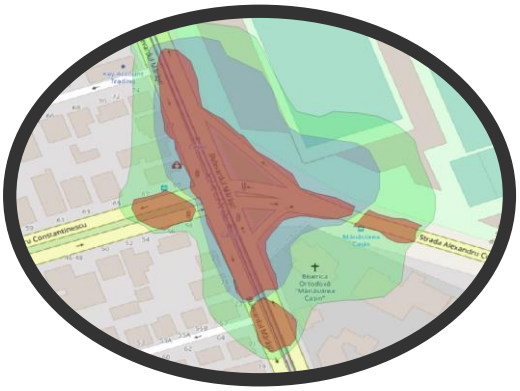


Icons of noise levels measured over a certain period of time



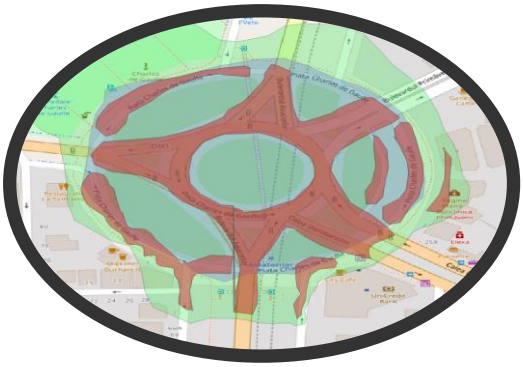
-In the noise map, the roundabout at the ”Piața Presei Libere “ is represented.
-This area was intense affected by the traffic, pretty much at any time.
Probably this is why there aren’t any school or residential apartment.
-The forest canopy from the Herăstrău Park reduce the noise pollution from the traffic.

- In the noise map, the Cașin intersection is represented.
- This area is not that highly noise polluted, but the public transportation by its kind (tram, bus) makes the zone to be affected.
-The buildings near the road (the houses, the rugby field, the church) dissipate the noise in much proportion.



This is the roundabout “Charles de Gaulle” represented by the noise map.

- There are many ambulances which travels a lot trough this roundabout because there is a big Hospital nearby.
- This is one of the busiest intersection in the north side of the capital.

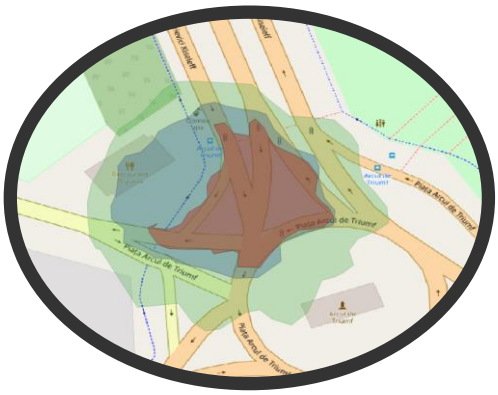


- In the noise map, the Campus University is represented.

-This zone is not much affected by the noise, there are no big boulevards or street and there is a quiet time period for all the residence.
-In this perimeter the students are the most of the noise pollution factor which happens in the studying programs.

This is the romanian “Arc de Triumf” - Arch of Triumph which is represented in the thermal map.

- This intersection is highly circulated because it connects some of the biggest boulevards in the city.
- Also in the middle of the intersection, there is a tourist attraction.



CONCLUSIONS

- In this paper, we present how to obtain geospatial noise maps and the differences that exist between areas with very intense traffic (crowded intersections - Arcul de Triumf and Casa Presei) and green areas where the noise level is very low (King Mihai I Park – Herăstrău Park and Herăstrau Agronomy Campus) located in the northern part of Bucharest.
- We recorded the noise level values with the Sound Meter Coolexp application and a Uni-t UT353 sound level meter.
- We graphically interpreted the obtained values and represented them in the form of graphs.
- We used the obtained data to create geospatial noise maps with the QGIS application.

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