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MAPPING OF NOISE BY USING GIS IN ŞANLIURFA

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Abstract. Traffic noise results from highways where the most important source of noise in cities. This noise has the properties of linear source. Constitution of noise maps has become compulsory to see the regions that are influenced from the noise, and to put forward the future environmental approaches. During the mapping of the noise, generally two fundamental problems are encountered, excessive time requirement for the measurement of noise and determining the method for the constitution of maps.

This study was conducted in Sanliurfa city of Turkey, in 3×4 km area. Continuous weekly data were obtained in 11 measurement points. By using these data in (GIS) environment, preparation of the most reliable map in the shortest time is achieved by the interpolation method.

Keywords: GIS, interpolation, noise maps, noise sources, traffic noise

1. Introduction

Noise pollution is defined as; involuntarily sound that causes negative physiological and psychological effects on the humanbeings (Varlitoprak *et al.*, 1991). Investigating the reaction to the noise pollution that is shown by the residents in the regions and studies for the determination of precautions for this situation has been continuing since 1950's. European Commission accepted the preparation of noise maps for the cities, where population is 100 000 and more, in every five years period (European Commission, 1996).

The most important noise sources are airways, railways and highways. The noisiest of all is the highways because of its intensity and continuity. Analyzing and modeling of traffic noise help the planning of environmental friendly roads. By means of these analyzes and models, designs and projects for reducing of the noise levels are exposed (Nelson, 1987). The measurement units that are used in these sorts of studies are expected to change according to the national standards of each countries. While the preparation of the noise maps; environmental conditions, noise levels, negative effective relations and furthermore interaction between noise levels and fountain properties should be defined (Avsar, 1998). To obtain the correct results from noise measurement points, data should be collected in at least 24 h period by using sensitive noise pressure measuring techniques (Pamanikabud, 1996).

In general, physiological sources are taken into consideration in noise measurement studies. These are; plane source, point source and line source. Most of the noise sources appear in cities show line source characteristics. However, because of the difficulties those are encountered during the preparation of noise maps, the line-source noise sites are generally considered as point sources. But these kinds of approaches usually tend to decrease reliability of the noise maps.

The aim of this study is to produce a reliable line source noise map in a possible shortest time based on road traffic by using GIS (geographical information system).

2. Materials and Methods

All the measurement were carried out at 5 min intervals through 24 h for 7 days at each measurement points (11 measument points). Main junctions of the city were selected as measurig points regardless of any geometry. In the measurement area, there were mainly houses, hospitals, schools which were reinforced concrete type of buildings with an average height of 3–8 m. There was not any factory which may cause noise. All the road in the measurement were coated with asphalt.

Noise measurements have been carried out 1 m in front of the selected places such as hospital, school and houses. Height of the measuring instrument was 3 m above the ground all the time. The type of the vehicles varied from motocycle to lorries, however, dominant type of the vehicles were cars, buses, trucks and motocycles. Speed of vehicles varied from 30 to 70 km/h. The average speed was 50 km/h.

In the preparation of noise maps, GIS technology is used because of its supplied advantages, as the most of the researches have been carried out by this technique (Pamanikabud, 1996; Anile *et al.*, 2003). Interpolation method is used by taking into consideration of data obtained from noise sources and distances between sources (ESRI, 2002). In GIS environment, point source noise map is obtained as defined above.

Images are obtained from pixels in computer. Analyzes are made by inserting data into the each pixel, that turns into image, by the help of GIS. While each pixel is accepted as a single point, these consecutive points (pixels) completely lye on line as shown in Figure 1. According to this definition, line source noise map is occurred in GIS environment.

Field work is carried on, in June–December 2003, in Sanliurfa City of Turkey, inside 3×4 km area. By considering the intensity of the noise, 11 measurement stations were defined. In each measurement point, weekly data were obtained continuously. Mean of 5 min noise data was used. Noise levels are measured by using "Rion NL-31" noise measurement equipment.

The noise measured in 11 points is transmitted to the computer as points by the help of GIS. In this study, ArcGIS 8.1. was used as software. Transmitted data are

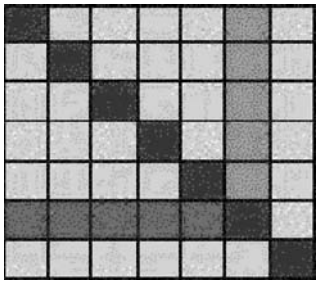

Figure 1. Occurrence of lines by pixels on the images.

evaluated in GIS environment by separated interpolation methods as point source and line source.

While preparing line source map, each pixel (cell) had been adjusted as 10 m and through the highway, where the reference value was accepted, reference values were inputted for each pixel. In the preparation of line source noise map, it is important to define two borders that constitute a line. Because of this purpose, border values were constituted. During the constitution of these border values, 11 measurement points were accepted as reference points. Three dB differences in noise levels are understood only by humans (Karpuzcu, 1996). Away from the points that are accepted as reference points (100 m and/or 200 m), new tests which lasted 2 h are done. Points, in where, the differences between the measurements in the reference point and the around was found as greater than 3 dB, are accepted as geographical region. Accordingly, in the preparation of the line source noise maps, noise value difference between the geographical borders is less or equal to 3 dB.

3. Results

3.1. Point source noise map

Interpolation in GIS technology is used for the calculation of unknown noise level for each geographic point. In GIS software, data required for making interpolation processes are generally point sources. However; noise caused by highways, railways and airways, as previously explained, are not point, but linear sources. The noise map, that is obtained by using the noise data and evaluating the results of the noise occurred in highways as a point source, is shown in Figure 2. The information given as a line on the legend of the map indicates the construction of highways, and the points given in the map indicate the noise measurement points. The highest noise value was measured as 82 dB. Away from the locations where measurement were done, the values of the noise decreased. When the map is examined, the same situation is seen for the other locations.

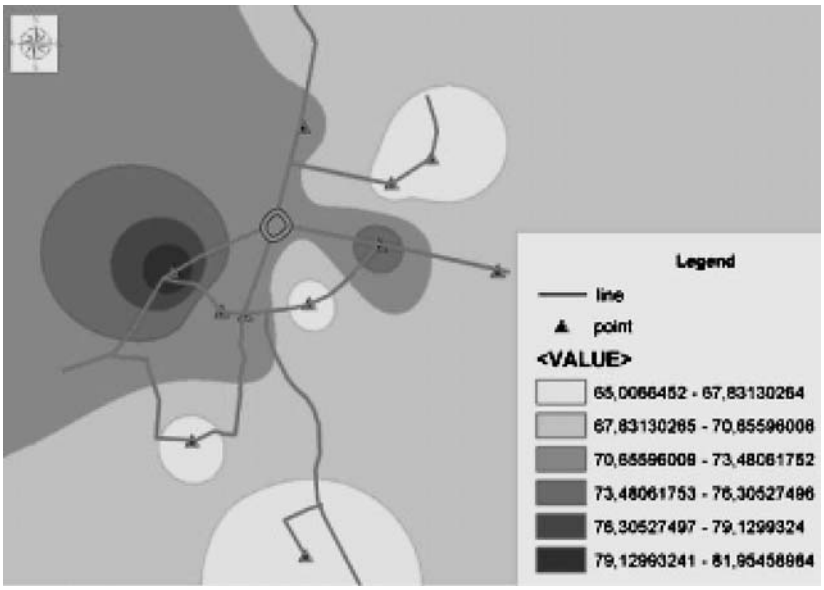

Figure 2. Point sourced map of traffic noise occurred in highways.

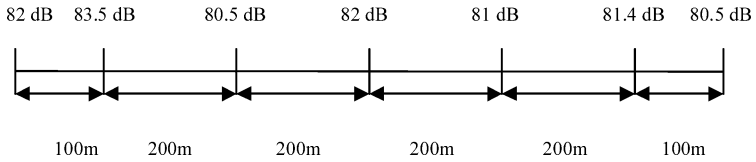

Figure 3. Noise measurement locations and values along the highway.

3.2. LINEAR SOURCE NOISE MAP

Figure 3 represents 1 km-long highway. Mid point is accepted as reference point. Measurements have been done in the reference point at 5-min intervals, and in the other points during daylight between 1100–1300 o'clock for one week. The arithmetical mean of all data obtained in the reference point (between 1100–1300 o'clock) is 82 dB.

In the comparison of the sound pressure levels in the reference point with the levels at the other points in the same hour intervals, the highest sound pressure level is measured as 83.5 dB (reference point is included), the lowest value is measured as 80.5 dB. Difference between these levels is (83.5–80.5 dB) 3 dB. Since this sound pressure level is acceptable, for each point of the 1 km-long highway, the level in the reference point is used. Geographical region, where the difference between the measurements are reached to 3 dB, is formed the border of line sources.

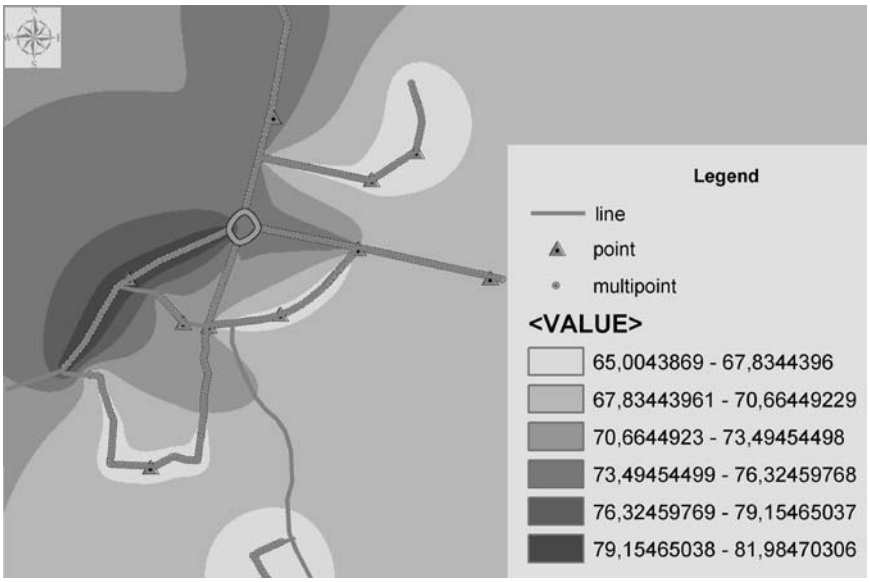

Figure 4. Line source map of traffic noise occurred in highways.

By determining the line sources (Figure 1), line source map is prepared in GIS environment by interpolation method (Figure 4). When the map is examined it can be seen that the noise values between two borders do not change (Figure 1).

4. Discussion and Conclusion

In the residential regions, where the noise maps were prepared, it is false to expect that the sound pressure level read from the map is the same for all points. Near the very noisy highways, some structures for noise absorber can be existed. Noise values read from the noise map of this residential region can be more than the real values. Noise maps are used to inspect the noise sources in the settlement regions scientifically. As a result of these determinations, it helps to expose of the solutions.

In order to reduce the effects of the sudden changes on sound levels of the measurement points, more healthy results were obtained by collecting the data for a week.

In the study of Kluijver and Stoter in 2001 (Kluijver and Stoter, 2003), in a settlement region that have an area of 3×2 km, 600 measurement points of 100 m apart from each other points, raster image of the region was determined. Furthermore, for the regions those have the shielding as noise barriers very intensively, extra 400 measurements points were included. For the region that have total 6 km^2 1000 measurement points were used. The mentioned value gives an opinion about how long away from each other the necessary measurements can be taken. By the

method constituted in this study, the possibility of constitutes of the noise maps in lesser time is shown.

As it is discussed previously, in point source noise maps (Figure 2), through the highway, noise values are decreasing. However, if the difference of 3 dB that is intelligible for humans is ignored, it is seen that the intensity of the noise value is not changed and through the roadway the same value of the noise continues. In the prepared line source map (Figure 4), this problem have been solved. Accordingly, line source maps offer more certain knowledge with respect to point source maps.

GIS should be perceived as a computer aided system to convert earth shapes and events occured on the earth into maps and to make analyzes of them (Yomralioglu, 2002). By the constituted method it is possible to apply line source maps to all GIS software. Furthermore, GIS technology offers an opportunity of data update and changing can be followed by the periodical updates.

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