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PHONIC POLLUTION AND STRATEGIC ACOUSTIC MAPPING WITH GEOGRAPHIC INFORMATION SYSTEMS

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Abstract

The phonic pollution has become a more serious problem in the recent years, especially because of traffic increase. This kind of pollution is generated by all kinds of means of transport. One of its peculiarities is the repercussion it has on people, unlike the other types of pollution, i.e.: water pollution, air pollution, soil pollution, which can affect, to a certain extent, the entire environment. The phonic pollution is considered to be the most widely spread type. The numerous surveys made on different samples in urban areas place phonic pollution, or generically called "noise", at the top of the list of annoyances or disturbances. The main polluter is the road transport. Even since 2006, Romania has started to monitor phonic pollution as a result of road transport. The measure was taken in order to comply with the European Union regulations. The present paper presents acoustic strategic mapping using a Geographic Information System and GIS type database. There is a need to map noise to minimize the negative impact on the environment of the small vehicles, as well as of the heavy traffic.

Key words: Geographic Information System, noise, pollution

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1. Introduction

1.1. The phonic pollution

The growth in number of vehicles over the years and the production of high-powered cars lead to the production of noise that affects both people and the environment on a daily basis. In general, the highest level of noise produced as a result of traffic is found in the urban areas, but the phonic pollution occurred outside urban areas should not be underestimated. This last type of pollution is high in level along the European and national road sections where the traffic of light vehicles is closely followed by that of heavy traffic.

The aim of the paper is to outline the areas affected by phonic pollution by means of creating a specific Geographic Information System. In terms of the National Transport System, Romania has been trying to comply with the principles of The White Paper on the Common Transport Policy and with the requirements for sustainable development. Being a member of the European Union since the 1st of January 2007, Romania has been implementing the provisions of the European Parliament Decisions, and has been updating the data continuously (Grecea et al., 2013).

2. Case study

2.1. Geographic Information Systems to monitor phonic pollution

The fields that make use of Geographic Information Systems have become more and more varied, the development of information technology being the major factor that has made it possible to use these devices in the monitoring of phonic pollution as well as in other areas. In a generic sense, GIS applications provide tools that allow users to

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create interactive queries (users creates databases), analyse spatial information, edit data, maps, and present the results of all these operations. Geographic information science is underlying the geographic concepts, applications and systems (Herban et al., 2009). By using a Geographic Information System, one can efficiently manage and monitor long road sections; we have the mechanisms in place to collect evidence about implementations (Badea et al., 2011).

If the Geographic Information System is properly queried, it will lead the appropriate information on the type of pollution and also on the features of the transport network. The databases specific to phonic pollution that assist the Geographic Information System have to contain all the elements required to combine the field of transport with that of phonic pollution (Fig. 1). The solution involves the use of a geodatabase, which implicates the design and implementation of data in a relational database system (Konan-Waidhet et al., 2013). The identification of those areas having high levels of noise and the drawing up of acoustic maps has become key elements within the context of sustainable development.

In this paper, a case study was carried out on the road section DN15 11+600-21+0 near the locality Turda, Cluj County, situated in the centre of Romania (Fig. 2).

Four FENO type benchmarks have been placed on the road section under study, the determined points which are made of plastic so as to better determine one's own coordinates with a milimeter precision. The FENO landmarks have been used to create the geodesic support network which is in fact a thickening network of the Spatial National Geodesic Network. By setting the four terminals, one has intended to secure 1pt/ 2 km road section as required. It has been decided that the placing of the terminals should be in the vecinity of existing milestones so as to find them as fast as possible, to grant easy acces, to protect them and to easily identify them as can be seen in Fig. 3.

The data collected from the field by means of interpolation help generate level curves 1m equidistant from each other. For each level curve, additional information on the value of the level curve needs to be attached so as to generate the digital model of the field (Fig. 4). The ground elevation of the planimetric details is to be made with instruments and technical methods able to ensure a precision determination of ± 7 cm. The planimetric elements are to be edited for a 1:500 scale map.

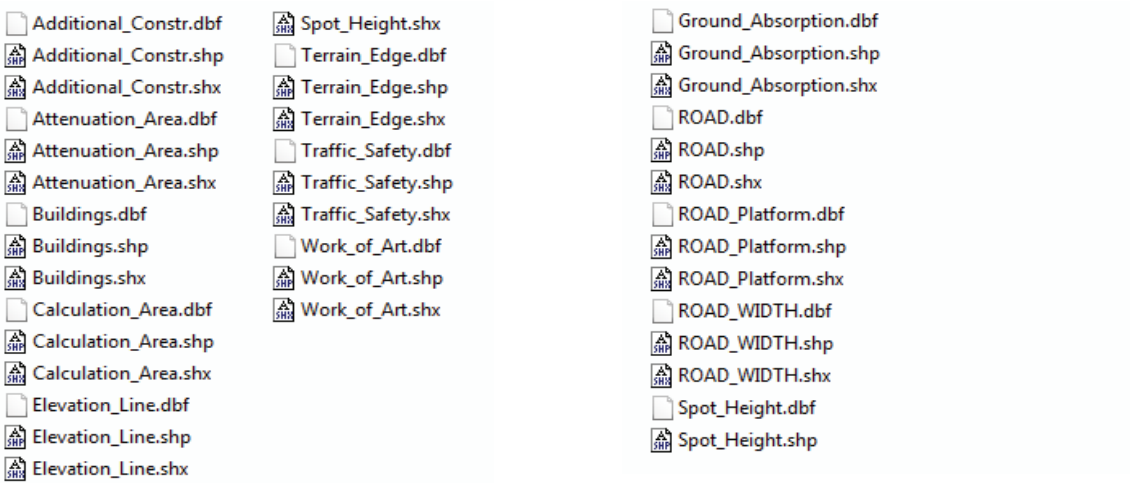

Fig. 1. Elements of a data base

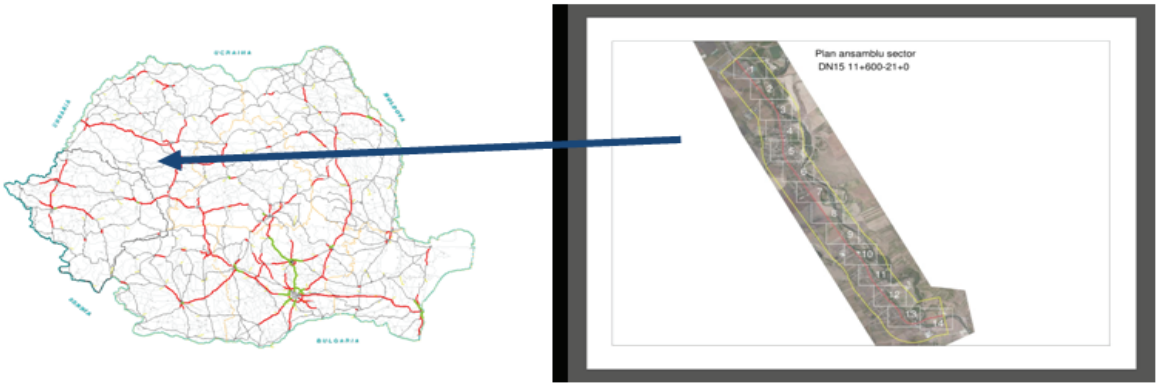

Fig. 2. Romania and the sector of road under study (http://www.geotop.ro/)

Fig. 3. Positions of the FENO landmarks

In compliance with Directive 2002/49 CE relating to the environmental noise, it has been decided that the area of noise mapping should stretch across 500 metres both to the right and left sides of the road axis.

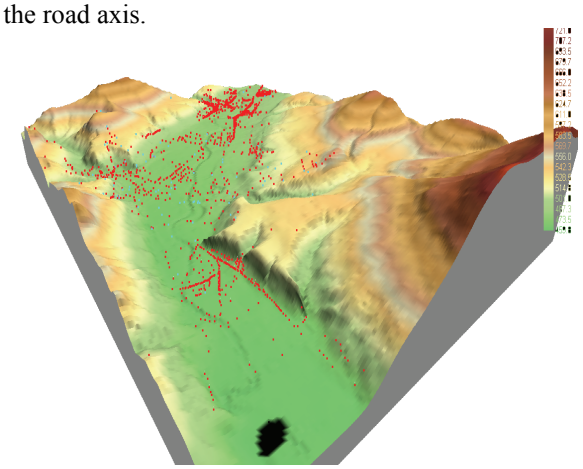

Fig. 4. Digital modelling of land

Elements from the field have been topographically gathered as precisely as possible, thus allowing the drawing up of the electronic digital map in MapSys format but afterwards saving it in a DWG extension. For each element of a kind, one has used a specific layer and, for the urban areas, one has also introduced the corresponding photogram. (Fig. 5.) For the described GIS to become a very complex one, considerable data input should be performed, such as:

- **Land**: contours lines, land boundary (footprint, safety zones and protection areas)
- **Road**: road axis, mileage, roadway platform, works of art, specific facilities, traffic safety facilities;
- **Buildings**: floor space, height, number of floors, use of the building (residential, industrial), the estimated number of housing, the estimated number of inhabitants;
- **Soundproofing panels**
- **Ground attenuation**: it implies highlighting the sound absorption areas by the type of the soil, absorbing or reflecting (Table 1).

2.2. Noise map

Noise is defined as a multitude of overlaid sounds. However, the sounds are part of our everyday life and help us communicate. Physically they represent waves which make up stimuli (physical) for ears. The problem occurs when the noise becomes annoying, i.e. when it exceeds the accepted noise limit. (Mocuţa et al., 2009).

The phonic pollution is a result of industrialization, migration of people, and of the large demand of products. All these factors lead to an excessive traffic increase. Noise has become a major problem not only in metropolitan cities, but also in small villages crossed by national or county roads.

Ensuring that debates are underpinned by solid information we were able to achieve noise maps. The simplicity of using intelligent digital map makes it possible to effectively and clearly display the relevant information, which is so necessary in the process of decision making. Modern GIS technologies use digital information, for which various digitized data creation methods are used. The most common method of data creation is digitization, where a hard copy map or survey plan is transferred into a digital medium through the use of a computer-aided design (CAD) program, and geo-referencing capabilities (Herban et al., 2012).

Considering the current need of permanent updating these maps can only be made with the use of a performant Geographic Information System. More than this, if the system is managed and monitored adequately by highly trained personnel it can provide useful information in fighting and preventing phonic pollution (Grecea et al., 2013). GIS often leads to identifying the optimal location for an investment, the study of the impact upon the environment complying with the general policy of sustainable development (Grecea et al., 2012).

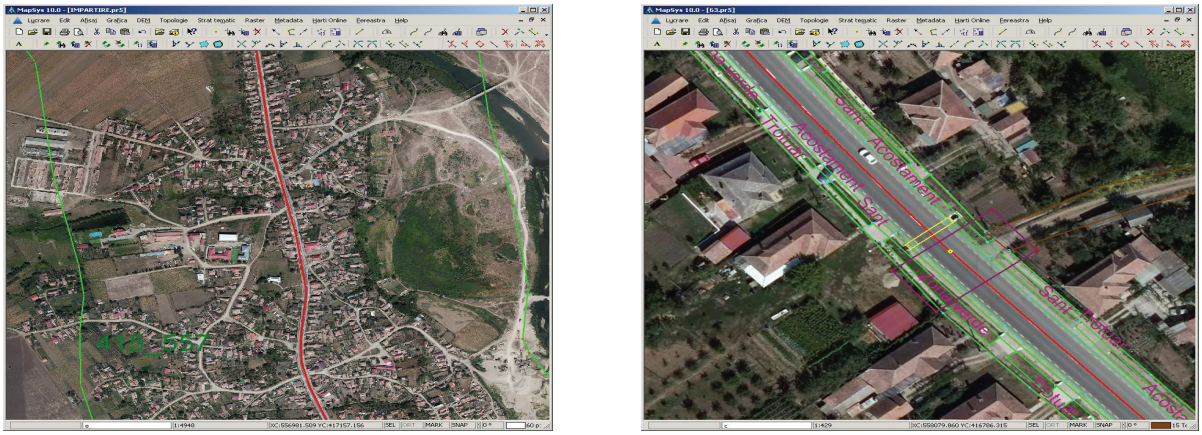

Fig. 5. Elements from the field with the specific layer

Table 1. Attenuation area

Layer name	*The entity type*	*Colour Code*	*Signification*
Attenuation Area_G	Closed polyline	11	Representation of attenuation area
Attenuation Area_T	Text	11	Information about soil absorption (1) and reflective soil (2)

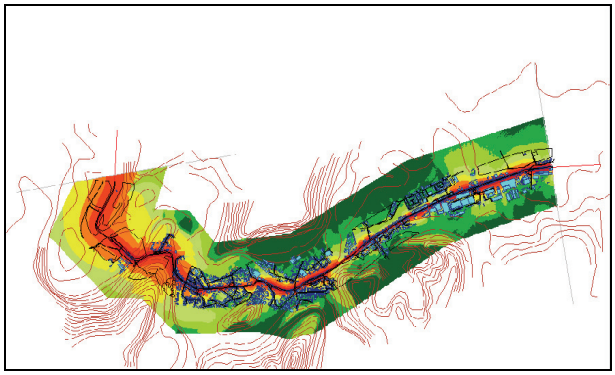

Fig. 6. Noise map: DN15 11+600-21+0, Romania (http://www.andnet.ro/)

3. Conclusions

Geographic Information System (GIS) usually aims to produce maps and plans, managing the number of persons affected by phonic pollution, identifying the optimal location for an investment, the study of the impact of an objective upon the environment complying with the general policy of sustainable development.

It is necessary to conduct a series of surveillance operations, evaluations, prognosis and warnings for operative intervention in order to maintain environmental quality. Monitoring and management activity using GIS strategic noise maps has the effect of contributing to environmental impact assessment to improve environmental management.

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References

Badea A-C., Badea Gh., Didulescu C., Badescu G., Savu A., (2011), *Some Features of Project Management Using Dedicated Software in the Land Surveying Works*, Proceeding MCBANTA'11,The12th WSEAS International Conference on Mathematics and Computers i Biology, Business and Acoustics, World Scientific and Engineering Academy and Society (WSEAS) Stevens Point, Wisconsin, 6-81.

Grecea C., Mușat C.C., Vîlceanu C.B., (2012), GIS – An efficient support for urban planning- framework of Timișoara, Romania, *SGEM2012 Conference Proceedings*, **2**, 1057-1064.

Grecea C., Mușat C.C., Moscovici A.M., (2013), Noise management and noise monitoring with geographic information systems, *13th SGEM GeoConference on Informatics, Geoinformatics and Remote Sensing, SGEM2013 Conference Proceedings*, vol. 2, 797-804.

Herban I.S., Grecea C., Mușat C.C., (2009), Using a geographic information system (GIS) for modeling, manage and develop urban data from Timișoara City, International Conference of BENA, Pollution Management and Environmental Protection, Tirana, Albania, 2009, *Journal of Environmental Protection and Ecology*, **13**,1616-1624.

Herban I.S., Grecea C., Dimen L., (2012), Managing spatial data regarding the Romanian road network using GIS technology, *SGEM2012 Conference Proceedings*, **2**, 1095-1103.

Konan-Waidhet A.B., Dibi B., Kouadio K.E., Savane I., Nedeff V., Lazar G., (2013), Improving food security using GIS database for mechanized rice farms management in north-western Cote d'Ivoire. *Environmental Engineering and Management Journal*, **12**, 41-48.

Mocuţa G.E., Jujescu F., Don A.N., Radu L.E., (2009), Noise pollution - a consequence of the transportation field development, *AGIR Bulletin* (Romania), No. 4, On line at: http://www.agir.ro/buletine/519.pdf