Assessment of methods for simplified traffic noise mapping of small cities: Casework of the city of Valdivia, Chile

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HIGHLIGHTS

- A simplified traffic noise mapping method is successfully applied to a small city.
- A road traffic noise prediction model is applied to a small city of Chile.
- A simplified acoustic method for modeling buildings produces acceptable results.
- An official road classification can be used for road traffic noise modeling.
- A road traffic noise map is developed at low cost and with limited information.

GRAPHICAL ABSTRACT
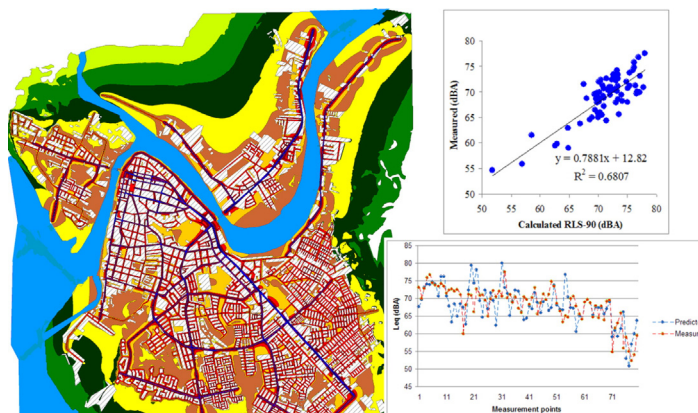
ARTICLE INFO

ABSTRACT

In many countries such as Chile, there is scarce official information for generating accurate noise maps. Therefore, specific simplification methods are becoming a real need for the acoustic community in developing countries. Thus, the main purpose of this work was to evaluate and apply simplified methods to generate a cost-effective traffic noise map of a small city of Chile. The experimental design involved the simplification of the cartographic information on buildings by clustering the households within a block, and the classification of the vehicular traffic flows into categories to generate an inexpensive noise map. The streets have been classified according to the official road classification of the country. Segregation of vehicles from light, heavy and motorbikes is made to account for traffic flow. In addition, a number of road traffic noise models were compared with noise measurements and consequently the road traffic model RLS-90 was chosen to generate the noise map of the city using the Computer Aided Noise Abatement (CadnaA) software. It was observed a direct dependence between noise levels and traffic flow versus each category of street used. The methodology developed in this study appears to be convenient in developing countries to obtain accurate approximations to develop inexpensive traffic noise maps.

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1. Introduction

Environmental noise pollution has been a growing worldwide problem over the last few years mostly due to the increasing use of vehicles in cities. This fact has not only contributed to raise greenhouse gas

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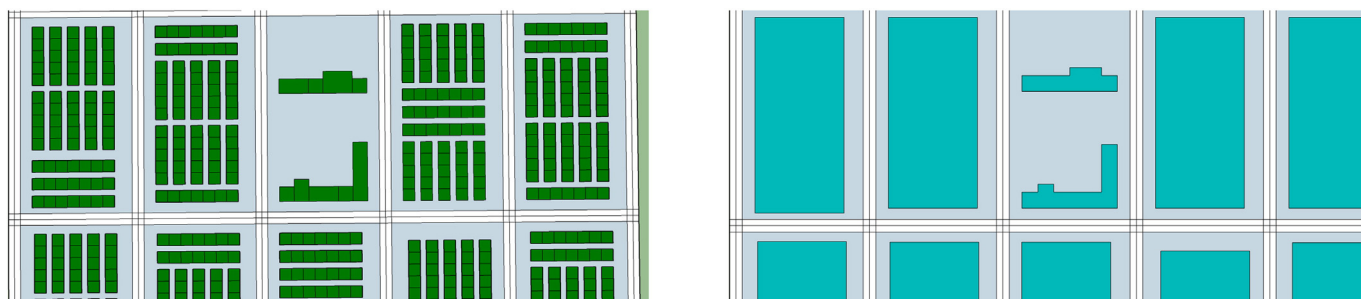E-mail address: jparenas@uach.cl (J.P. Arenas).

Fig. 1. Example of building simplification. A partially-occupied block is shown.

emissions but it also has produced an increase in annoying noise and noisy environments which has been reported by numerous studies (Belojevic et al., 2008; Pathak et al., 2008; Paunovic et al., 2009; Szeremeta and Zannin, 2009; Di et al., 2012; Halonen et al., 2012; Paviotti and Vogiatzis, 2012; Vogiatzis, 2013). Some previous works have analyzed the relationship between traffic and pollutants, i.e. physical, such as noise, or chemical (Barrigón Morillas et al., 2005; Su et al., 2008; Can et al., 2011a, 2011b; Foraster et al., 2011) and methods for the calculation of the external cost of road traffic noise have also been reported (Maibach et al., 2008; European Union, 2011; Moliner et al., 2013). Moreover, recent studies suggest that both road traffic noise and air pollution exposure are risk factors for stroke (Sorensen et al., 2014). Thus, road traffic noise is clearly an invisible pollutant that can harm human health.

Daytime equivalent sound pressure levels above 65 dBA have become unacceptable in many cities, although many residential areas are located in acoustically deficient areas with levels ranging between 55 and 65 dBA (Zannin et al., 2013). About 20% of the EU population is estimated to suffer noise levels considered to be unacceptable, and 45% is residing in areas where noise can cause serious annoyance (Affenzeller and Rust, 2005). According to a published report by the World Health Organization (WHO) "Noise pollution is the second largest environmental threat to health after air pollution, and responsible for, according to estimates of the health agency, 50,000 heart attacks every year in Europe" (WHO, 2011).

In this sense, noise maps are an important tool to provide relevant information to local and global action plans (Klaeboe et al., 2006; Guedes et al., 2011; Vogiatzis, 2011). In urban administration and planning, noise mapping is a very useful tool for generating information about environmental impacts and enabling the visualization of noise pollution in the urban landscape (Zannin et al., 2013) and many cities in the world have produced their noise maps. Research on noise maps is a subject of great interest in European countries (Vogiatzis and Remy, 2014) where the use of GIS has provided relevant information

Fig. 2. Road classification according to the Road Authority of the city of Valdivia. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article.)