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Comparison of five general noise prediction models and their performance in estimating low frequency noise propagation

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ABSTRACT

Predicting noise impact is a valuable tool for acoustic consultants. In Australia, five common models are used to determine the propagation loss from a source to a receiver; being ISO-9613-2, CONCAWE, ENM, CNOSSOS-EU, and NORD2000. Emissions data for common construction equipment is used to compare the predicted A and C-weighted levels from these models to show there are large differences in predictions, even for simple scenarios.

1 INTRODUCTION

Environmental noise has a negative impact on human's health and well-being, ranging from general annoyance and reduced sleep quality to cardiovascular disease (WHO, 2018). Being able to predict the impact of a noisy activity allows one to migrate these negative effects. In New South Wales, Australia, projects are guided by the Noise Policy for Industry (NPfI) (EPA, 2017) in terms of the acceptable noise levels. One important assessment objective relates excessive levels of low frequency noise. This is assessed by considering both the difference between the C and A weighted levels, as well as comparing the received spectrum to a reference curve.

This paper compares the A and C weighted levels, as well of as the spectra of 5 commonly used noise models being; CNOSSOS-EU (Kephalopoulos, 2012), ISO-9613-2 (ISO, 1996), NORD2000 (Plovsing, 2001), ENM (Tonin, 1997), and CONCAWE (Manning, 1981). The methodology used, and the difference in predicted levels for a soft, flat ground scenario are discussed.

2 METHODOLOGY

2.1 Testing system

Firstly, an automated system was developed which could take a single scenario and coordinate the executation of the different models. With the system, a single scenario could be converted into inputs for the various models. This was required because ISO-9613-2, CNOSSOS-EU, and CONCAWE only give octave band predictions. These predictions are converted to third octave before comparing to NORD2000 and ENM predict in third octave bands. The system was then able extract the total loss, or the excess loss attenuation spectrum. The excess attenuation is the loss excluding geometric spreading and air absorption.

2.2 Geometric Spreading an Air Absorption

A simple model to compute the losses due to geometric spreading and air absorption was developed as a reference for the 5 test models. Geometric spreading was assumed to spread spherically a point source. Air absorption was calculated using the method of ANSI S1.26-1995 (ANSI, 1995), and modified using the Volpe method (Rickley, 2007). The Volpe method is used to convert the pure-tone absorption loss to a third octave band loss.

2.3 Model Comparisons

Models were first compared to each other in simple scenarios using pink noise (equal energy in each octrave) and the reference model. Resultant differences can then be only attributed to differences in the test model's implementation of the air absorption. Figure 1 presents an example scenario with a 1.8 metre source and 1.5 metre receiver over soft, flat ground.

3 RESULTS

3.1 Model comparison - LA and LC vs distance for soft, flat ground

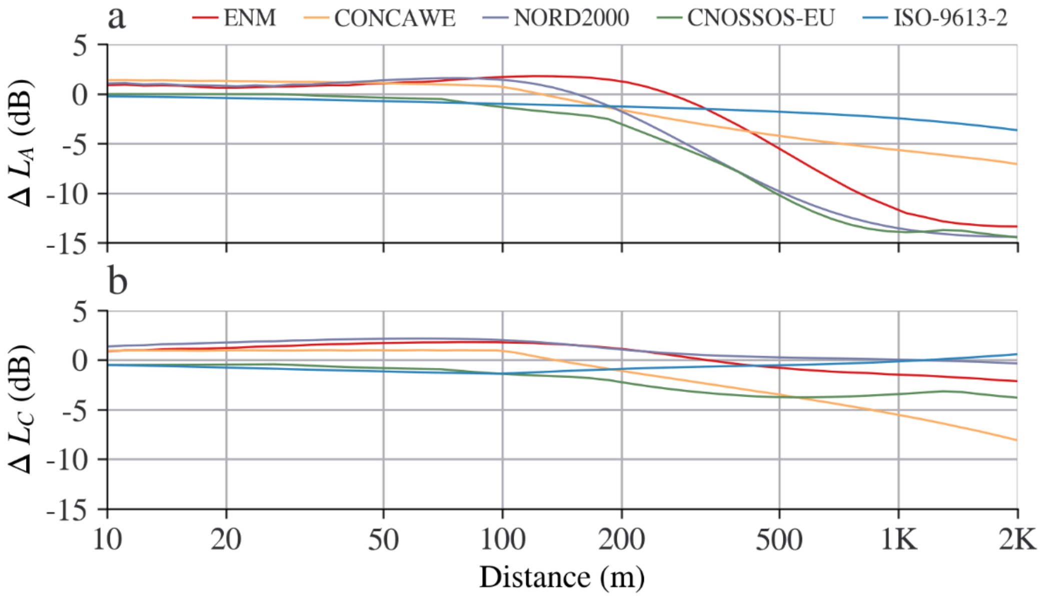

Figure 1. Excess attenuation with air absorption and geometric spreading. Figures a) and b) show A and C weighted excess attenuation, respectively, for a soft ground with 1.5-metre-high source and receivers.

Figure 1 a) shows the difference in modelled A-weighted level at the receiver and the A-weighted level calculated using the reference model. It can be seen that the three analytical based models, NORD2000, CNOSSOS-EU, and ENM, follow a similar pattern to one another. The two empirical models, CONCAWE and ISO-9613-2 do not drop off as quickly as the analytical models. It is also interesting to note ISO-9613-2 models a higher A-weighted level than CONCAWE. This is consistent with ISO-9613-2 basing the ground effect off data from favourable conditions, whereas. CONVAWE's ground effect is based off neutral conditions. In Figure 1 b) it can be seen that at less than 1 km there is generally good agreement, less than 5 dB, between all the models C-weighted levels.

In future work, it is planned to further explore the differences between models with more complex scenarios using different source spectra, and focusing on using models for low frequency assessments.

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