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INFLUENCE OF WEATHER CONDITIONS AND GROUND ABSORPTION ON THE TRANSMISSION OF TRAFFIC NOISE

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INTRODUCTION

It is well known that a number of factors including climatic and ground conditions will influence the propagation of traffic noise over open ground.

These phenomena which may cause large variations in sound transmission (increasing with distance) bring about the allowing types of problems :

1. Setting up of a pertinent model for predicting the average L_{Aeq}
2. Indicating the way for ensuring the evaluation of the average L_{Aeq} through "in-situ" measurement.

In current schemes, for predicting the attenuation of traffic noise with the distance over a flat ground close to highway, only the ground effect is taken into account |1|, |2|. By comparing of the measurement and the calculation performed with these kind of models we often find substantial discrepencies. As a matter of fact, the extend to which ground effects are brought into play are being affected by the wind (direction and mean speed) and the refractives conditions due to wind or temperature gradients.

In |3| ATTENBOROUGH has especially dealt with the influence of the ground effect for highway noise ; although it is hard to disentangle the ground effect from the others in the case of outdoor measurements. He has shown that the ground effect decreases quickly when the mean propagation height increases, and, thus the excess attenuation from a line of trucks even for a receiver near the ground is negligible.

Our work carried out on the subject, for point source |4| leads to the same results with regard to the influence of the height.

To get back to the first problem that is the prediction of a representative average value, it seems necessary to take into account the main factors affecting the propagation of the noise, but the actual predicting

models are not quite satisfying for this purpose.

In connection with measurements frequently used to describe a situation acoustically, as we reported in |5| it is necessary to ensure that the results are significant and reproductible and also to define the main influencing parameters introduced in a model allowing to evaluate the representative value on the basis of the mean value of the parameters.

These considerations have led us to the work presented here.

As it has been done before in paper |6|, |7| our purpose is to answer the following question on the bases of many in situ measurements made under different meteorological conditions and three kinds of soils conditions :

- is the variance of the values mainly linked to the wind characteristics, the temperature gradient, the wind gradient or to the soil conditions ?

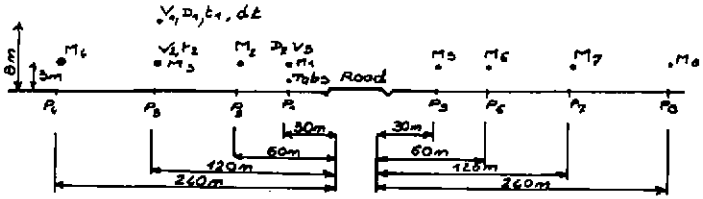
Our study is original because we have emphazised the statistical of the data and we even tried to perform a multivariate analysis.

MEASUREMENT SITE AND METHODS

Site. The road where measurements took place is situated on a flat farming country area in the north of France. The ground condition varied from friezed bare soils (winter) to tilled ground (spring) and to crops (summer).

It was a bit concrete road with an elevation of 0,5 m above the ground and with a speed limit of 90 km/h.

Method. We carried out records of the acoustic signals at distances of 30, 60, 120, 240 m from the road in the two sides and an different days. Simultaneoustly temperature and wind speed were measured at 2 points (P_1, P_2) and temperature and wind gradient were measured at P_2.



measuring sketch

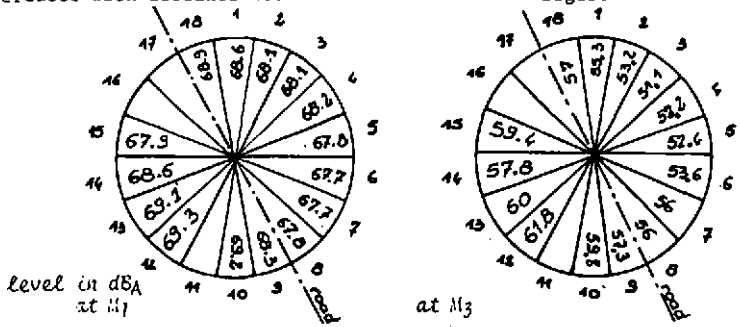
M_1 to M_8 microphones
V_1 to V_3 anemometers
Tabs temperature measuring position
dt gradient of temperature measuring position
D_1D_2 wind direction measuring position.

From recorded signals, equivalent sound level over five minutes periods were determined in dB_A. These L_{Aeq} (5 mn) values and the corresponding meteorological and traffic parameters were gathered in data file. Eighteen sectors were considered for wind direction. L_{Aeq} values obtained when the wind speed is upper than 7 m/s at 3 m high, were not taken into account.

Results

A classical statistical and a multivariate analysis of the data converge on the following results :

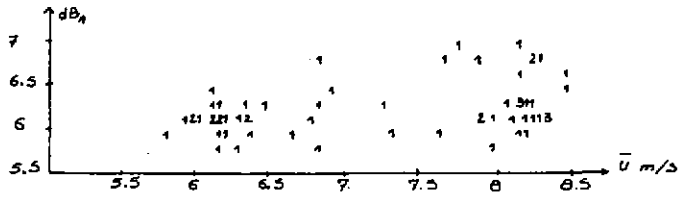
General result. The variation of wind direction is the main explanatory factor of the L_{Aeq} variance. The influence of wind direction increases with distance from the road as shown in figure 1.



Sector results. Only a little variance can be explained by the variation of meteorological parameters and ground conditions, for example :

sector 7	mean value	standard deviation	number of value
Microphone 1	67.7 dB_A	1.3 dB_A	116
Microphone 2	61.6 dB_A	1.2 dB_A	111
Microphone 3	56.0 dB_A	1.1 dB_A	59
Microphone 4	51.6 dB_A	1.2 dB_A	18
Microphone 5	67.0 dB_A	1.6 dB_A	121
Microphone 6	61.6 dB_A	1.2 dB_A	107
Microphone 7	57.9 dB_A	.93 dB_A	37

The correlation coefficients obtained between L_{Aeq} and the mean wind speed are always very low (Fig. 2). Tests show that regression coefficients are not often significant.



deviation between M_2M_3 versus mean wind speed

The influence of ground effect is negligible.

These last results are only valid for this site and a receiver located at 3 m high.

CONCLUSION

Measuring results confirm the assumption that transmission might be most stable under downwind propagation ; in that case, we obtain the lower discrepencies between measurements and operational model predictions. The predicted values are generally upper than the corresponding "in-situ" measurements.

Our experimental results have to be confirmed in other sites ; but, here and now, they show that measurement must be done in the following conditions :

- measurement height : 3 m (limited ground effect)
- loading wind 2 m/s < $\bar{u}$ < 6 m/s
- neutral stability
- 2° C < T < 25° C

So, we limit the duration related to possible variation of meteorological and ground conditions. They are very restrictive but our present knowledge does not permit us to link the values measured with any other conditions in regard to these reference one.

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