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Noise mapping for large urban areas - the city of Vienna

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1 Introduction

The agglomeration of Vienna is the only agglomeration in Austria exceeding 250.000 people and includes the City of Vienna and 5 further municipalities. These are Brunn am Gebirge, Maria Enzersdorf, Mödling, Perchtoldsdorf and Wiener Neudorf. The area of the agglomeration is about 460 km².

The maps required by the environmental noise directive 2002/49/EG were calculated in CADNA/A using the geographical model of the Vienna city map and the equivalent data for the other five municipalities.

2 Data available

2.1 Acoustical data

The required acoustical data are the sound power levels for the industrial sources (IPPC-plants) and the traffic data for rail and road traffic on the other hand.

According to the Austrian law, emission data for the IPPC-plants has to bee delivered by the owners of the plants until December 2007.

The traffic data for rail traffic was delivered by the railway (or tram) companies as traffic flow per annum for each relevant group of the rolling stock as well as the relevant speed for each of the train categories.

2.2 Geographical data

The geographical data was available in digital form as

3D data for:

- height contours (1 m contours)
- height of eaves

2D data for:

- vegetation
- forests
- bridges
- road axes
- rails

3 Calculation model

3.1 Software

The software program used, was CADNA/A in program version 3.7 from Datakustik GmbH in Greifenberg (Germany).

3.2 Hardware

The calculations were carried out by about 15 personal computers parallel.

3.3 Calculation model

The calculation model contains about 530.000 buildings, about 89.000 height contours, more than 184.000 ground absorption elements, nearly 4000 forest elements and about 3000 bridges. The data set was about 1,5 GB. The area covered by the calculation model was about 460 km².

3.4 Noise sources

The noise sources included in the calculation model were:

about 4.000 km roads

about 250 km railways and trams

23 industrial plants (IPPC plants).

3.5 Data simplification

The calculation model was simplified by a reduction or simplification of objects.

The number of ground absorption elements was reduced to elements larger than 10 m² and the number of forest elements was reduced to elements larger than 100 m².

The height contours were simplified by reducing the number of data points in each contour line (because sometimes the distance between the data points were only a few centimeters).

These simplifications caused a reduction of the model size by about 1 GB.

4 Problems

The most difficult task was the implementation of the bridges in the calculation model. Since the bridges were only 2D objects in the Vienna digital map system, it was necessary to edit each bridge by hand and determine the absolute elevation of the bridge. This task took about 2 weeks of labor for 2 persons and was the most time consuming task in the whole process.

5 Effects of ground absorption

The Austrian guideline for the calculation of the strategic noise maps according to the environmental noise directive of the European Union – ÖAL-Richtlinie Nr. 36 Blatt 2 [1] states, that the exact ground properties can be used, or instead of the exact data a generalized ground factor of G = 0,6 according to ISO 9613-2 [2] is applied.

Fig.1 Difference between the calculation with the exact ground model and the ground properties set to G = 0,6
A difference of less than 1 dB is represented by green color, a. difference between 1 dB and 2 dB is represented by yellow color and a difference between 2 dB and 3 dB is represented by gray color

The difference of the two methods was calculated. Figure 1 and 2 shows the difference between the two calculations.

For most parts of the agglomeration the difference was less than 1 dB. Only in few areas the difference was between 1 and 2 dB.

Conclusion

For the strategic noise maps according to the environmental noise directive of the European Union a simplified ground model is sufficient. There is no reduction in the accuracy of the noise maps by the simplification of the ground model, but there is a big reduction in the model size and therefore the model is a lot easier to handle (especially through the 2 GB memory limitation of the 32 bit Windows operating system).

References

[1] GAL-Richtlinie Nr. 36 Blatt 2 - Erstellung von Lärmkarten und Konfliktzonenplänen und Planung von Lärmminderungsmaßnahmen - Anforderungen im Anwendungsbereich der Umgebungslärmrichtlinie 2002/49/EG (2006)

[2] ISO 9613-2 Acoustics- Attenuation of sound during propagation outdoors — Part 2: General method of calculation (1996)

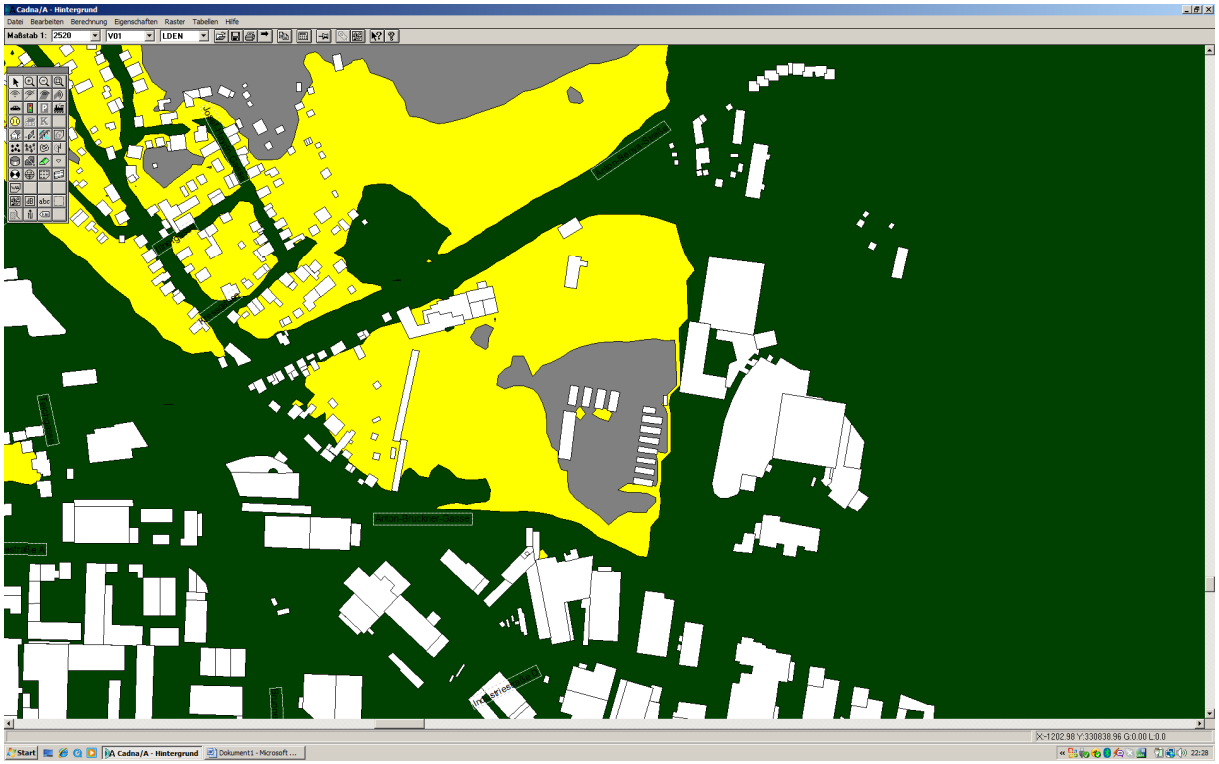

Fig.2 Difference between the calculation with the exact ground model and the ground properties set to G = 0,6
A difference of less than 1 dB is represented by green color, a. difference between 1 dB and 2 dB is represented by yellow color and a difference between 2 dB and 3 dB is represented by gray color