

Large scale noise mapping in GIS

Florian Pfäfflin, Volker Diegmann

IVU Umwelt GmbH, Burgweg 10, D-79350 Sexau, Germany, Email:fpf@ivu-umwelt.de

Introduction

Acoustic models used in simulations of environmental noise impact have become more and more complex during recent years. Due to new EU-Guidelines and increasing attention of affected persons, requirements have risen both for the quality of input and for the temporal and spatial resolution of results.

In addition to small-scale simulations within cities or in the course of local constructions, noise simulations are more and more demanded and performed on a regional scale or even for large areas.

This puts new demands on software strategies and data handling. The direct integration of noise calculation models into a Geographic Information System (GIS) is an ideal basis to meet the requirements of noise simulations and keep expenses for data provision and handling low at the same time.

This integration allows for the direct use of existing data and provides results that are directly available in the GIS for further processing. Complex data conversions are obsolete and there are no more data redundancies.

LimA in ArcGIS

With ArcGIS 8, ESRI provides an integrated and scalable family of GIS software products that is ideal to set up and maintain model data for environmental analysis in GIS. Result data of such environmental analysis can as well be organized within ArcGIS.

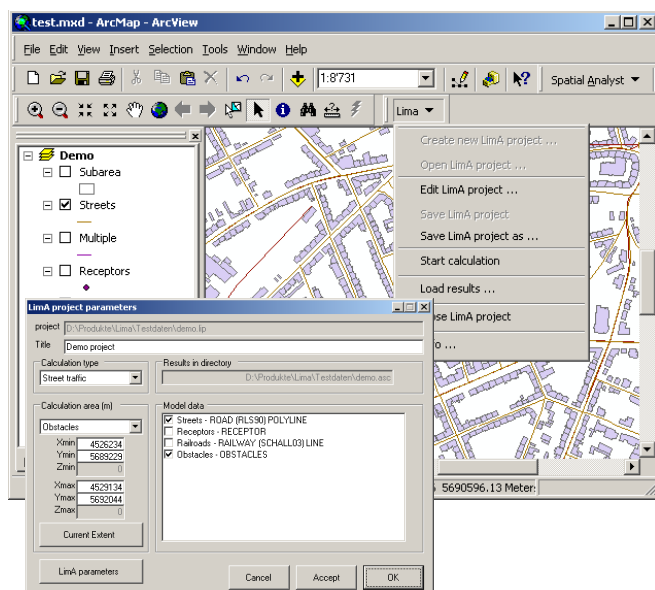


Figure 1: Integration of LimA into ArcGIS and interaction between GIS and model

IVU Umwelt GmbH and Stapelfeldt Ingenieurgesellschaft present the integration of a complex suite of Programs for Environmental Analysis (LimA) into ArcGIS (see Figure 1).

LimA calculation modules are called via the GIS user interface to analyse e. g. acoustic conditions. Direct software interaction with the running LimA calculation core is possible to support user requests for instant calculations.

The integration of LimA in ArcGIS provides advantages in several aspects of any noise mapping projects, in particular large-scale. ArcGIS and LimA facilities of defining new object types and attributes help to simplify customisation demands, e. g. define road, rail or industry source objects with specific emission parameters.

Calculation results of noise levels and noise exposure indicators are directly available within the GIS for analyses and presentation. By merging the results with other information further conclusions can be made, e. g., how many inhabitants suffer from noise impact and which kind of road causes the dominant noise level.

Examples

Integration of 3D city models



Figure 2: Digital 3D model of a city as input for noise simulation

Noise calculation and mapping for cities generally requires a digital three-dimensional city model (see Figure 2).

Those 3D models are more and more available for a number of cities. Compared to maintenance in a model-specific user environment, the creation, processing and visualization of the data within a GIS has many advantages, such as, e. g. a well known user interface, sharing data with other projects and making use of the GIS-functionalities. With the integration of the noise calculation model in the GIS the

direct use of those 3D models is possible, allowing for effective calculations for entire cities.

Screening of noise impact for an area of 18,000 km² in Germany

A federal state of Germany has been a pilot scheme for the task of calculating noise levels covering an area of 18,000 km². The aim was to find out how many inhabitants suffer from noise impact and which type of road (highway, country road, small street) causes the dominant noise level. The entire road network, totalling 26,000 km, the terrain and the residential areas were included. Input data was gathered from several completely heterogeneous data bases and could be integrated reasonably only in a GIS. GIS was also indispensable for further processing and aggregation of the input data.

The area was computed with a high-resolution 20 m grid mapping. As computation time had to be kept manageable without neglecting significant model information, attenuation was used in this screening approach and buildings and other artificial obstacles were not considered specifically. The hot spots identified by the screening will be investigated in greater detail under consideration of obstacles. Terrain information, however, was incorporated in the calculations since preliminary investigations have shown a considerable effect of the topography.

In accordance with the project requirements, the different road types were considered separately in the noise level calculations.

Calculated results of noise levels and noise exposure indicators were then analysed and presented in the GIS (see Figure 3).

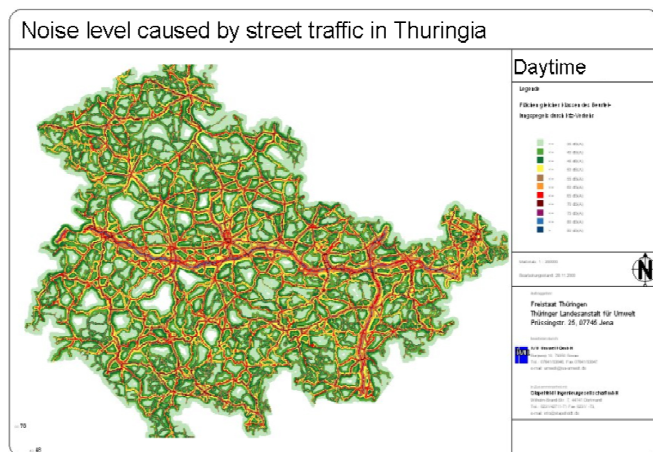


Figure 3: Results of a noise level calculation for the German free state of Thuringia

Based on the thus created high resolution noise maps for the entire free state, noise related zoning is now possible. Regions with a low exposure can easily be identified and, for instance, be put under further protection. Likewise, expected noise levels can be considered when defining new building areas.

As all model data is completely available in the GIS, the calculation of scenarios, e. g. traffic limitations or construction of by-passes, is easily possible.