

**BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS
FACULTY OF TRANSPORTATION ENGINEERING
DEPARTMENT OF TRANSPORT TECHNOLOGY**

**ANALYSIS OF ENVIRONMENTAL FRIENDLY
CITY-LOGISTIC ORGANISATION METHODS**

PhD Theses

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Dipl. Eng. of Transportation**

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1. The research and its targets

1.1 The importance and actuality of research

75% of the European inhabitants live in town, where the environmental problems are the most sensible. The noise, the bad air quality, the increasing road transport, the damage of artificial environment, the lack of integration of environmental questions into the policies and the strategic planning generate low quality of life and health problems.

In the city one of the most important pollutant is road transport, the unnecessary car use, the non competitive public transport, the bare parking possibility, the increasing freight transport associated with unorganized loading/unloading.

The European Commission said in the Green Book published in 2007: the basis of the town transport policies is the integration of technological innovation, development of clean, safety and intelligent transport systems, economical and legally instruments.

1.2 Targets and methods

The pollution caused by city freight transport is not a central point of national transport policies. There is not plan to manage it. There is not enough information about the environmental problems of city freight transport. There is neither an appropriate emission calculation method, strategy, action plan, nor a monitoring system. In the international publications there are a lot of good practices without impact assessment methodology. These focus only to the problem.

The first priority of the PhD theses is to calculate the environmental effects of city freight transport by a method without expensive and detailed analysis.

The targets of the PhD thesis are:

- discovering and evaluate the national and international emission calculation methods;
- choosing the appropriate method for calculation environmental effects of city freight transport, and develop its input data system;
- calculating the air pollutant emissions from road transport of the country and the capital to establish the decision making process;
- what kind of activity of city freight transport is annoying;
- discovering the best practices, usability in Hungary and evaluating.

The international publications are separated into 5 main areas:

- policies related to the city freight transport;
- projects related to the city freight transport;
- targets and effects of city freight transport;
- relations between city freight transport and the environment;
- calculating methods of road emissions.

Neither in the international nor in the national literature there are not appropriate method for calculating environmental effects for city freight transport. In Hungary there is only one

unrepeatable method for calculating road emissions. Because of this fact, the central point of my thesis is a developing a method creating city freight transport emissions by international software named COPERT which has been used not yet in Hungary. This method is promoted by international organisations, creates repeatable values that are comparable with earlier data and these of other countries.

To develop the input data structure of COPERT version 5.1 I collected and analysed international and national statistical data and projects for:

- developing the classification of light and heavy duty vehicles of EURO norm and gross vehicle weight;
- creating factors for calculating annual average running performance;
- calculate running performance for light and heavy duty vehicles;
- average speed for urban, rural and highway roads;
- driving share for urban, rural and highway roads;
- daily average transport flow in and out of the capital;
- average maximum and minimum temperature data per month.

To calculate noise effects:

- I analysed the noise problem of inhabitants;
- I calculated the noise immission of Lajos street in the District III. of the capital before and after the prohibit the heavy duty vehicles;
- I analysed the traffic and its noise effects in the Nagykörút for evaluate the role of light duty vehicles in the traffic flow;
- Noise mapping.

I collected the best practises of city freight transport and evaluated the usable methodologies in Hungary.

One of the main tasks was the analysis of the relevant publications. The targets of it, was to recognise their contents and achievements.

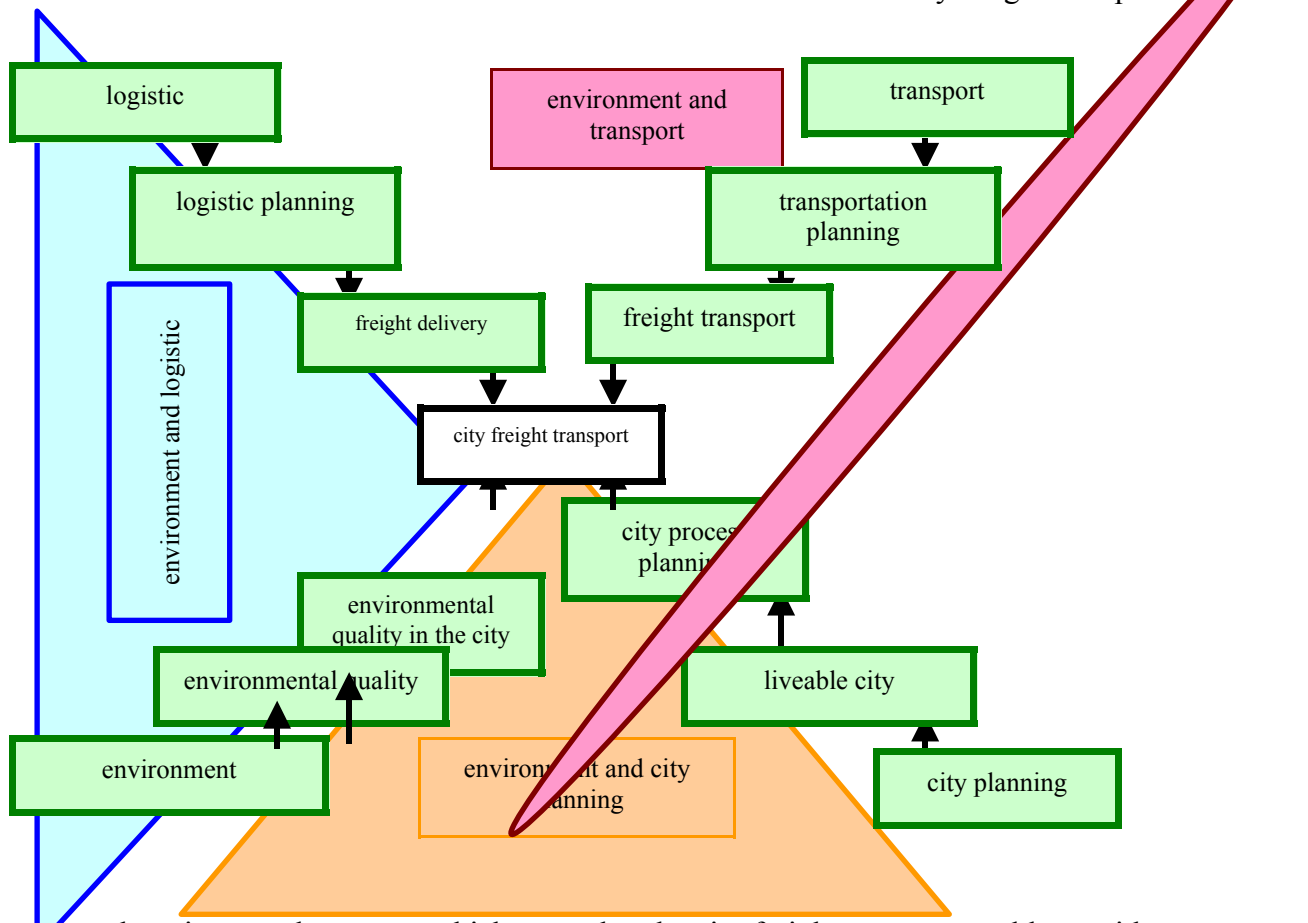
2. New scientific achievements

Theses of my research are:

1. I determined that the city freight transport is not a central point in the transport infrastructure conceptions, policies, or strategies.

The logistic process development, the transport infrastructure development and the town building have a basis condition: the integration of environmental effects into the policies. This is a priority during the planning of city freight transport too that can be environmental friendly only by harmonisation of logistics, sustainable transport and land planning. The contact system among them is located in the figure 1st.

Figure 1: System of logistic, transport, land planning and environment and their relation to the city freight transport



Up to now there is not a document, which can solve the city freight transport problem neither in the EU, nor on national level on strategic point of view. The lack of these programs degrades the necessity of solving these problems and makes the enforcement more difficult. (Own publications: [Kissd1], [Kissd2], and [Kissd7])

2. The main task of the developments is the achievement of liveable environment, the reduction of pollutant emission created by city freight transport. However there is not an exact method to calculate the environmental effects of city freight transport. The national calculation method is not appropriate to calculate these effects. Because of this fact I developed a repeatable method to calculate the emission of city freight transport, based on road transport emission calculation software, the COPERT IV. Version 5.1 (Computer Program to calculate Emission from Road Transport). (Own publications: [Kissd3], [Kissd4], and [Kissd14]).

3. The national input data basis of COPERT IV. version 5.1 has not yet been created. I developed this input database from national road transport fleet database, road transport traffic counting data, and international publications related to the running performance, driving share and average driving speed (ARTEMIS [Art1], MEET [Me1]). I made the EURO norm classification of light and heavy duty vehicles for the country and calculated the running performance after the classification for years 2004 – 2007. The annual average running performance of a light/heavy duty vehicles is:

$$\dot{A}ÉFT(k; n) = \frac{\dot{A}NFT(k; n) \cdot 365 \cdot 100}{F(k; n) \cdot (100 - s_v(k, n))}$$

where:

- $\dot{A}ÉFT$: annual average running performance of a light/heavy duty vehicles;
- $\dot{A}NFT$: daily average running performance out of city;
- s_v : driving share in the city (%);
- F : sum piece of vehicles (gasoline and diesel);
- k : light duty vehicles;
- n : heavy duty vehicles.

From the annual average running performance of a vehicle I calculated the annual average running performance of the EURO norm classification fleets:

$$\dot{A}ÉFT_{EURO} = \dot{A}ÉFT(k; n) \cdot \prod_1^n f_n(k)$$

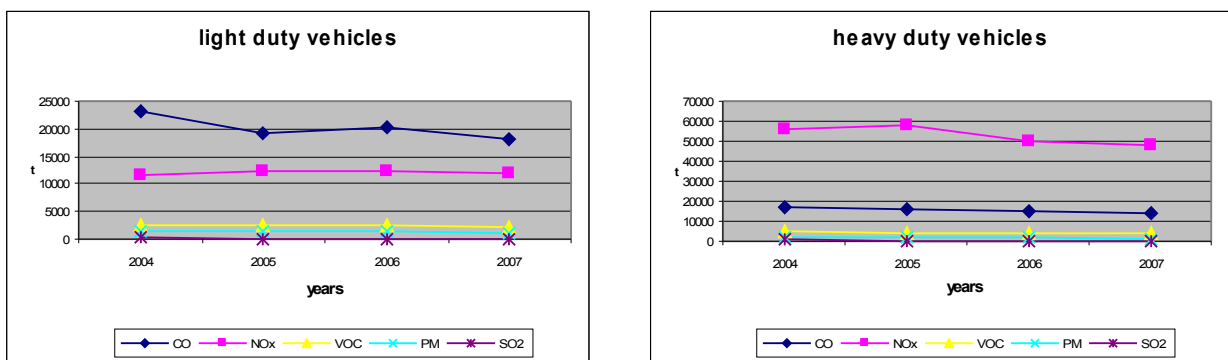
where:

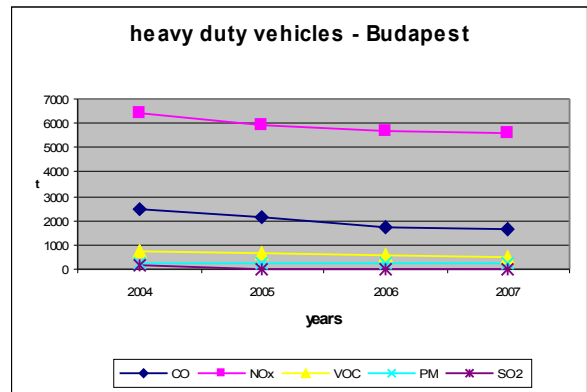
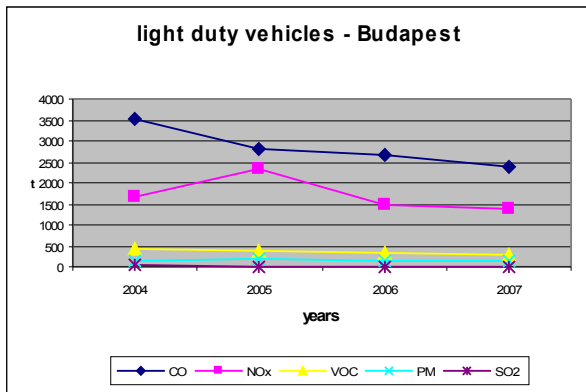
- f_n : factors

For the capital I analysed the traffic flow in and out of Budapest for one day. After the national characteristics I created the classification of EURO norm and running performance (only up to 7,5 t gross vehicle weight) for the years 2004-2007.

The trend of the emission is stationary and by small decrease. In the capital the decreasing is more express (Figure 2). The cause of that is the rejuvenescent fleet, the increase of vehicle fleet in the EURO III category, and the introduction of EURO IV in 2007. (Own publications: [Kissd3], [Kissd4], and [Kissd14])

Figure 2nd: CO, NOx, VOC, PM and SO₂ emissions of light and heavy duty vehicles in the country and in the capital in years 2004-2007



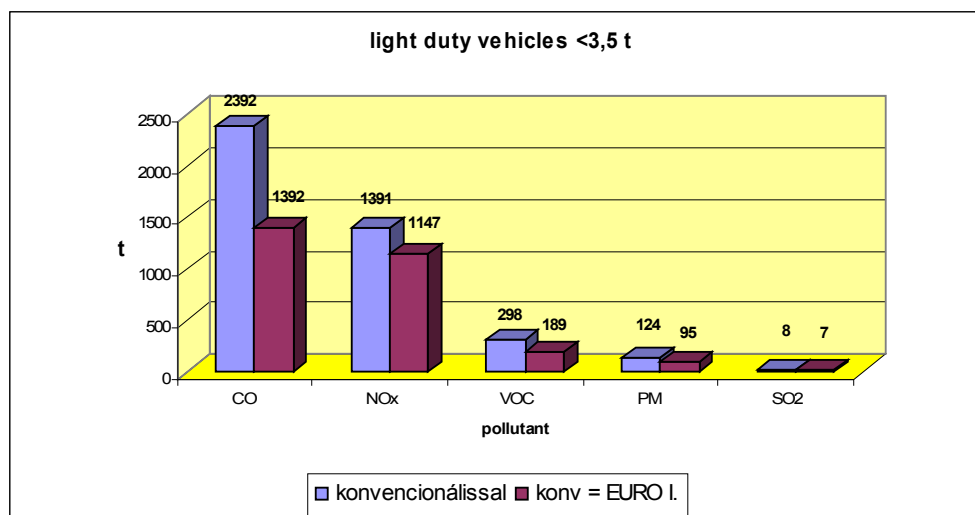


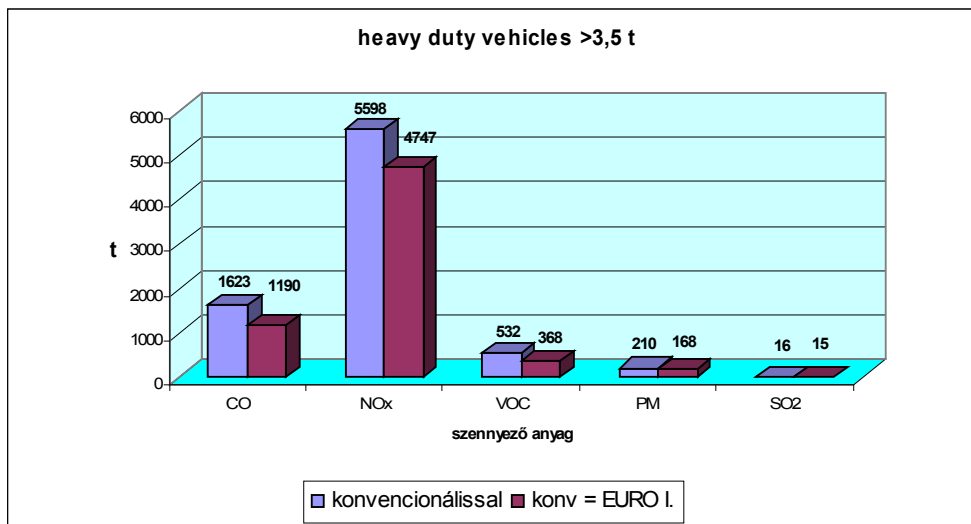
4. After analysis of the best practices of city freight transport I developed the most appropriate methodologies for Hungary. The groups of them are:
1. traffic management and approvals;
 2. fiscal and legal instruments;
 3. technologies and improvements;
 4. private initiatives.

I confirmed that the most effective solutions in environmental point of view is the LEZ (LEZ = Low Emission Zones). The introduction of LEZ in the capital has positive effects on the emissions. An introduction a minimum requirement EURO I. barrier, the conventional fleet must be appropriate to the new limit value. The conventional = EURO I change can do 0-40% emission reduction (Figure 3).

(Own publications: [Kissd6], [Kissd7], [Kissd8], [Kissd9], [Kissd10], and [Kissd11])

Figure 3: Effect of the introduction of LEZ with a minimum EURO I. requirement





5. The most frequent residential complaints are noise problems caused by city freight transport. The relation activities are:

- traffic noise;
- night delivery;
- noisy loading and unloading;
- delivery and purchase traffic;
- vehicles storage;
- handling.

The biggest problem is the traffic noise. To calculate it I made measures for calculate noise effects of city freight transport in Budapest. In Lajos street District III. and in Nagykörút Podmaniczky street to Dohány street I accounted the traffic.

In the Lajos street the transit heavy duty vehicles have a significant noise effect over 3dB(A). In the figure 4 and 5 noise map show the noise immissions with the transit traffic and without it in day and in the night.

In Nagykörút the role of the light duty vehicles in the noise situation is not relevant.

To decrease noise effect the most important arrangement is the prohibit the transit heavy duty vehicle traffic in the capital.

(Own publications: [Kissd3], [Kissd4], and [Kissd13])

Figure 4: Noise immission in Lajos street in day (6-22 h) before and after the prohibition of heavy duty vehicles

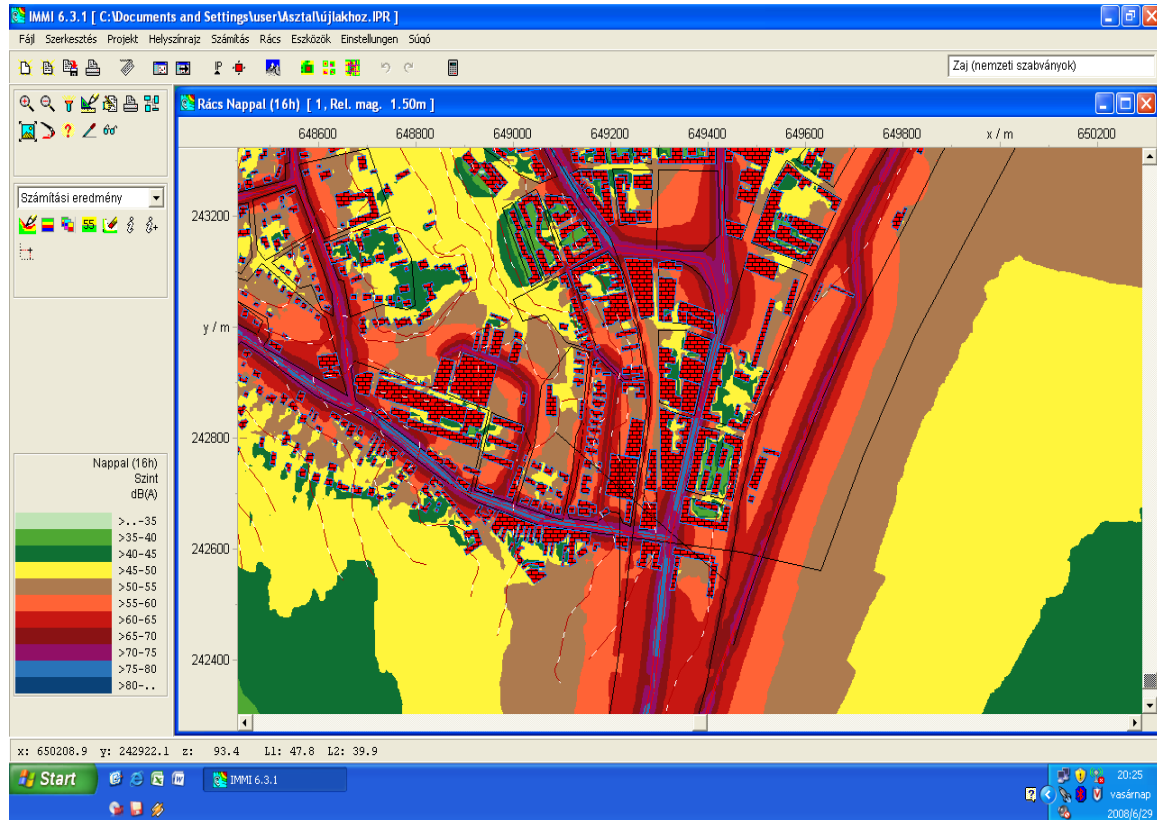
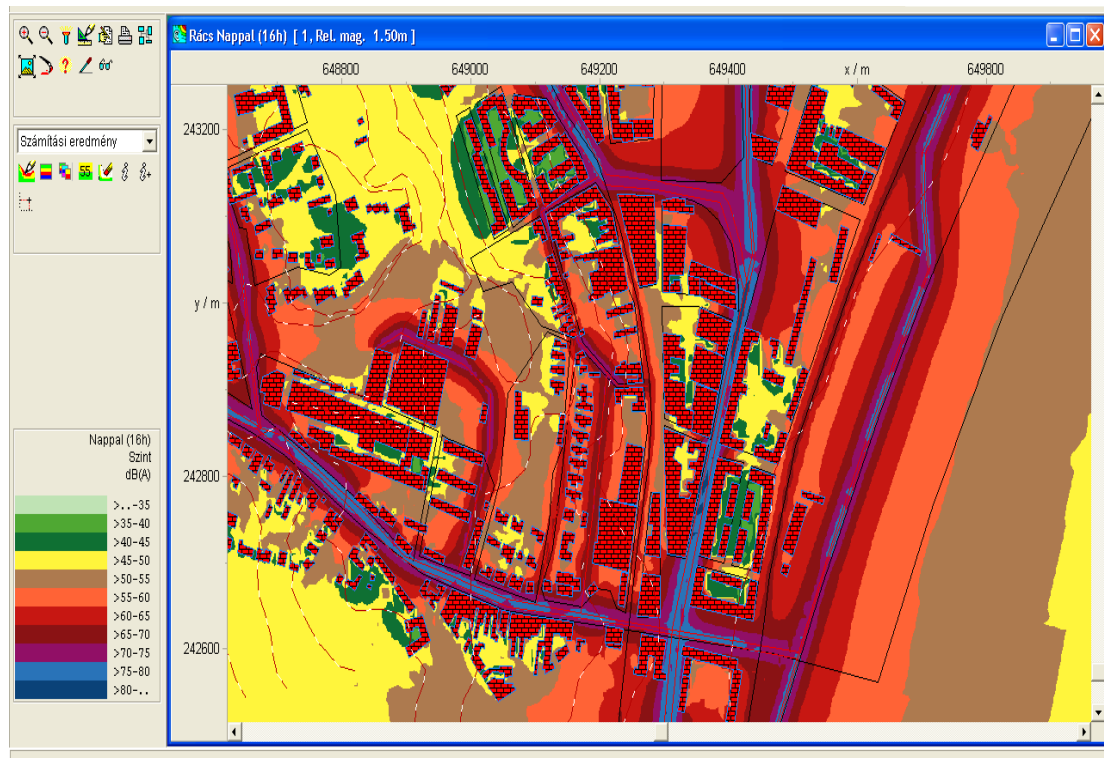
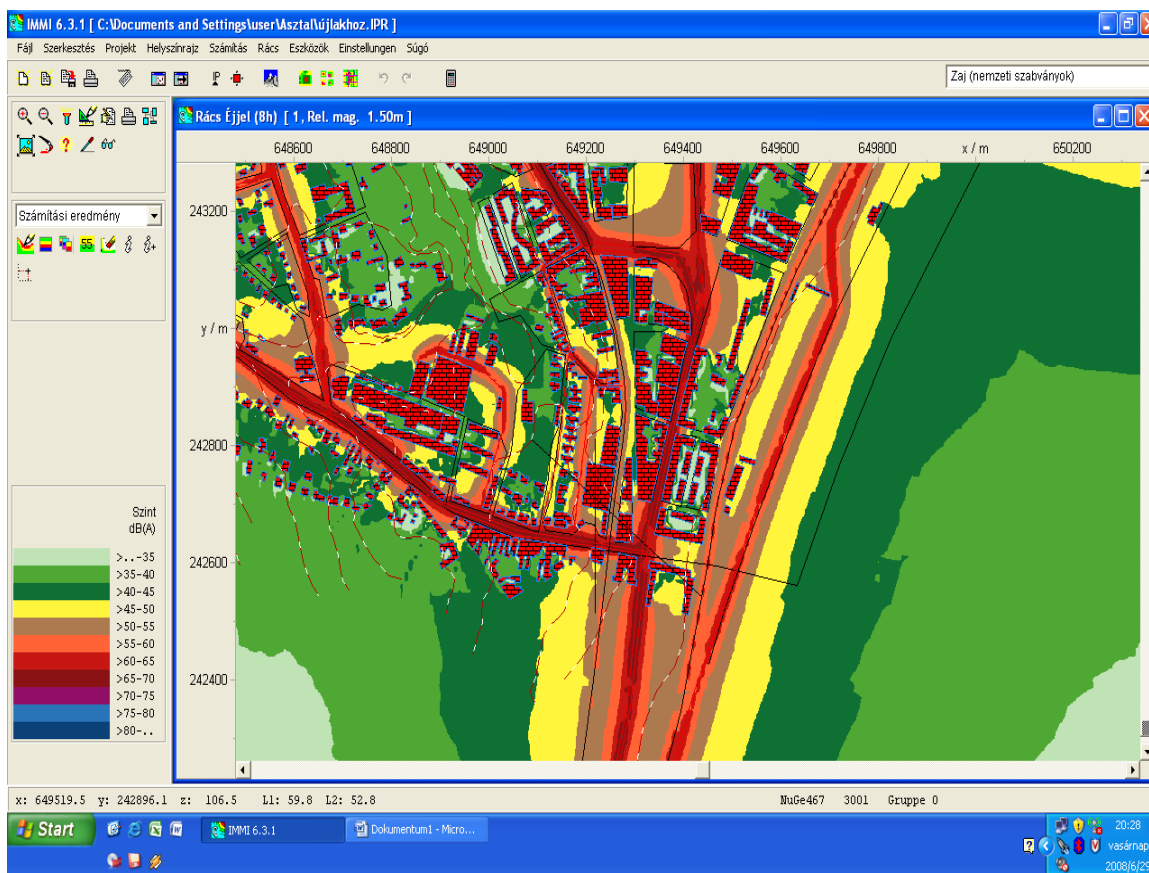
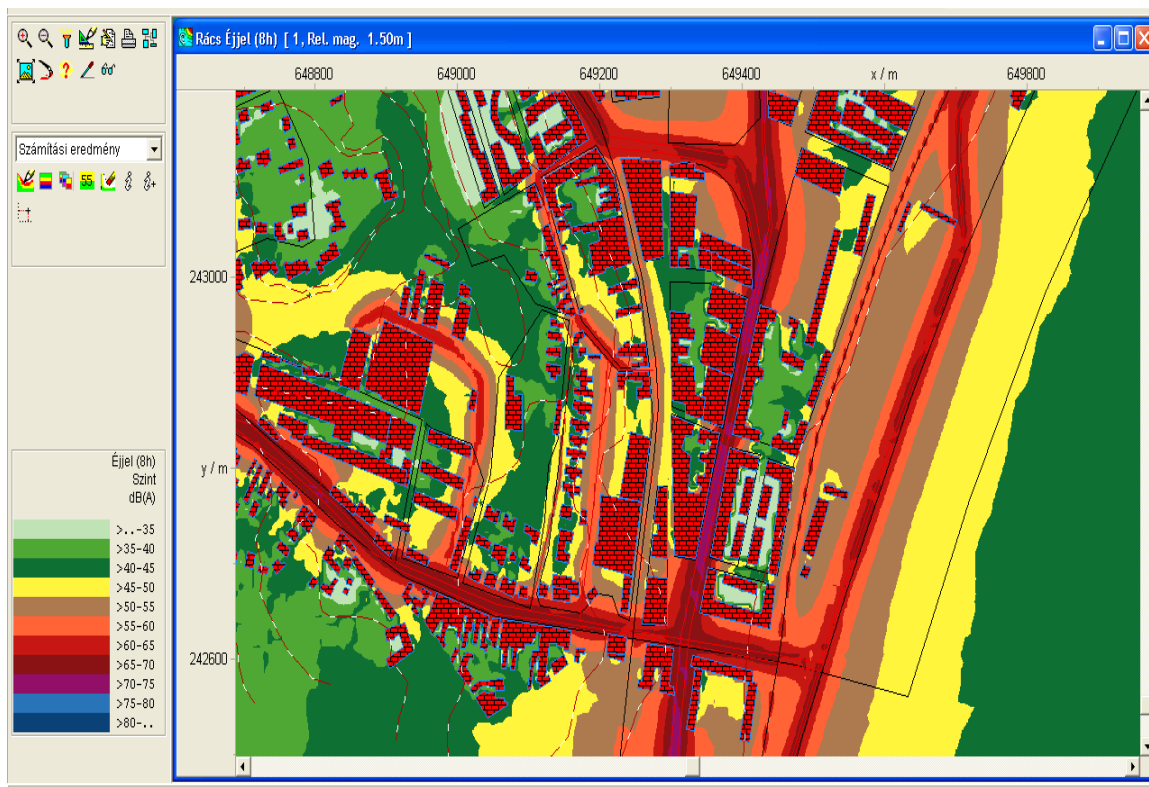


Figure 5: Noise immission in Lajos street in the night (22-6 h) befor and after the prohibition of heavy duty vehicles



3. Usability of the new scientific achievements

Without repeatable methods it is not possible to create pollutant emissions of city freight transport. A new method is necessary to calculate faithfully the emissions. That is the COPERT IV. Version 5.1 common methodology. It needs input database that must be developed. The calculation is repeatable and its data structure is documented.

With the method:

- the emission calculation can run in all situation, there is no need other emission factors;
- it is useable national and local level too;
- it is common, follow able, a módszertan repeatable;
- the software is promoted by the EU.

The calculated emission is useable for giving data to the EU. Appropriate for companies to calculate its fleet emissions. It can be based the decision making process like in he capital planned LEZ in the end of 2008.

The authorities can it use successful for transport management and it is useable for education also.

4. Szakirodalom

4.1 *PhD related publications*

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- [Kissd2]: Kiss D.: Nagyvárosok levegője, Környezetvédelmi Füzetek, BME – OMIKK, Budapest, 2002. 47. p.
- [Kissd3]: Kiss D.: A hazai tehergépjármű állomány környezeti állapota levegőtisztaság-védelmi és zajvédelmi szempontból, VII. Nemzetközi környezetvédelmi szakmai diákkonferencia, Mezőtúr, 2002. július 4-6., pp. 48.
- [Kissd4]: Kiss D.: A közúti áruszállítási forgalom okozta környezeti terhelések, Közlekedéstudományi Szemle, 2002. Budapest, LII. évf. 9. szám, pp. 331-336.
- [Kissd5]: Kiss D.: A városi áruszállítás okozta környezetterhelés csökkentése city logisztika megvalósításával, VIII. Nemzetközi környezetvédelmi szakmai diákkonferencia, Mezőtúr, 2003. július 3-5., pp. 24.
- [Kissd6]: Kiss D.: City-Logisztika – környezetkímélő városi áruszállítás, BME – OMIKK, Budapest, 2003. 80. p.
- [Kissd7]: Kiss D.: Policies, regulations and development activities related to urban freight distribution in the European Union, Periodica Polytechnica ser. transp. eng. vol. 32. No. 1-2, pp. 21-34 (2004)
- [Kissd8]: Kiss D.: Lakosság, fuvarozók, környezetvédelem, Közút, 2004. március pp. 24-26.
- [Kissd9]: Kiss D.: Városi áruszállítás vasúton, Logisztika, BME – OMIKK, Budapest, 2004/6. szám, pp. 45-52.
- [Kissd10]: Kiss D.: Környezetkímélőbb nehézteher-forgalom, Logisztika, BME – OMIKK, Budapest, 2005/4. szám, pp. 28-41.

- [Kissd11]: Kiss D.: CityFreight – projekt az innovatív városi áruszállítás megvalósítására, Logisztika, BME – OMIKK, Budapest, 2006/1. szám, pp. 33-40.
- [Kissd12]: Kiss D.: Az Európai Unió Városi Környezet Tematikus Stratégiája és hatása a hazai közlekedés fejlesztésére, Városi Közlekedés, 2006/2. szám, pp. 92-98.
- [Kissd13]: Kiss D.: Új autópályaszakasz és elkerülő út átadásának környezeti hatása a kiváltott főközlekedési útvonalak mentén elhelyezkedő települések zajhelyzetére, Környezetvédelem, 2006/19-20. p. 113-122.
- [Kissd14]: Kiss D.: A városi áruszállítási forgalom légszennyező hatásának számszerűsítése, Városi Közlekedés, 2008/3. szám p. 147-153.

4.2 Other publications

- [Kissd15]: Kiss D.: Traffic regulation and environment on Margaret Island in Budapest, A vision of car free cities in central and eastern Europe, Berlin 2001., pp. 53-57.
- [Kissd16]: Kiss D.: A magyarországi zajszabályozás és az EU zajpolitikája, konferencia - előadás, MicroCAD 2001, Nemzetközi Tudományos Konferencia, Miskolc, 2001. pp. 59-64.