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SHORT TERM EMISSION REGISTER LOWER AUSTRIA

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Introduction

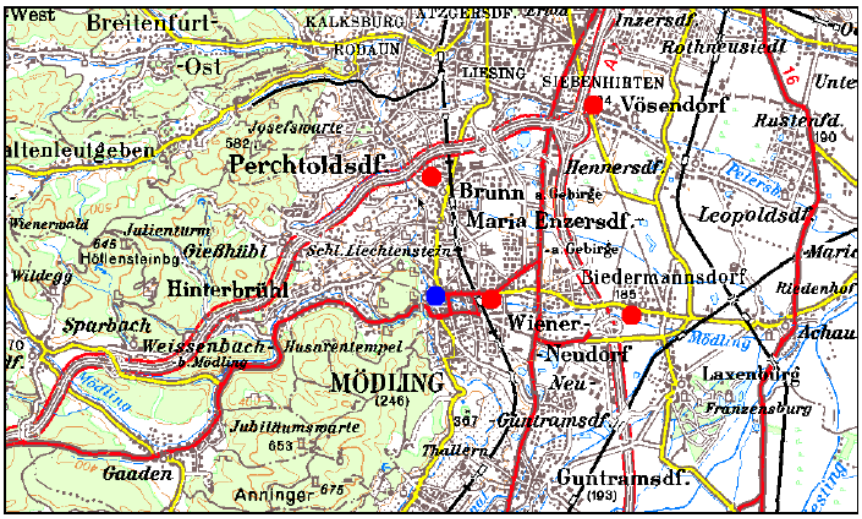
AEEG is the leading Austrian consulting firm in the field of environmental emission registers resp. inventories. Starting in 1975 with the first SO_2 - emission register of the City of Vienna the company worked out many of Austrian and Central-European emission balances and inventories (in general, but also for Kyoto-, NEC- and ozone evaluation purposes, etc.).

Short term emission registers (based e.g. on a 1-hourly-emission rate) are very rare in European countries; the first one was established in Baden-Wuerttemberg (Germany) in 1985. In Austria, such a project has never been realised before the mentioned emission register in Lower Austria.

During the course of the EU - INTERREG IIC CADSES project "Steps and Strategies for the Improvement of the Environment by Means of Transnational Co-operation and Network Formation" the first project of its kind has been realised. In accordance with the working programme, a short-term-emission-inventory and energy balance was drawn up essentially comparing energy consumption and emissions (including traffic, household and industrial emissions) in a delimited region south of Vienna.

Project area and time period

A region had to be selected: the decision was made for a region in the South of Vienna, including the villages of Voesendorf, Biedermannsdorf, Wiener Neudorf, Moedling, Maria Enzersdorf, Brunn am Gebirge.

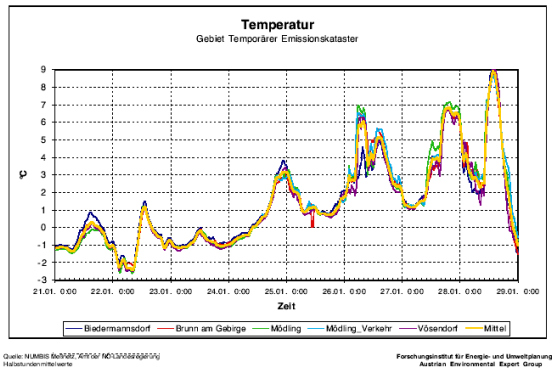


Project area and monitoring stations: **red:** non mobile monitoring station; **blue:** temporary station

The region is heavily polluted caused by the two main highways A2 and A21 (this part of A2 is the no. 6 in Europe, related to the average daily numbers of vehicles); it is also a main

residential area closer to Vienna including a smaller thermal power plant and some light industrial areas. Another advantage was, that four air pollution monitoring units are in operation since many years in that area and a mobile unit was available, too.

Monitoring unit in the historical center of Moedling.



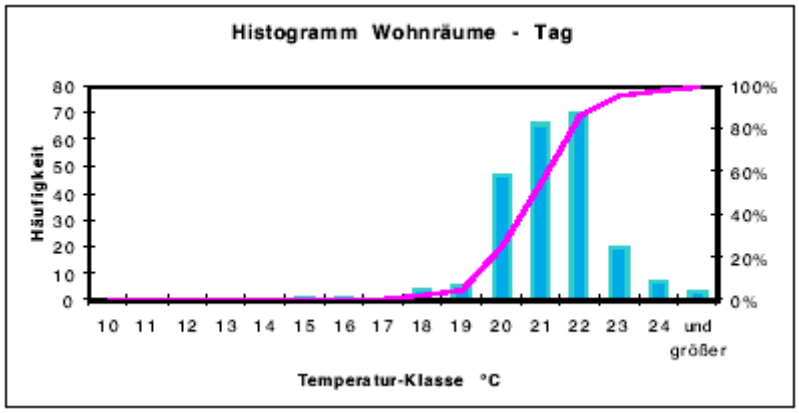
The time period was selected according to the more than one decade weather monitoring data from January 21 - 28, 2001. (The coldest temperatures in the year have been selected). For the first half of the week the presumption was ok., in the second half the temperature was a little bit too high. All meteorological parameters have been evaluated exactly.

Emission data (including energy data)

During the research work, the emission data have been calculated on a hourly or half-hourly basis in the following sectors:

- Power plant: Energy consumption, CO- and NO_x - emission data were provided by the power plant operator
- Traffic: Principally the whole traffic network of Lower Austria is available in the EDABA database ("EmissionsDatenBank" , emission database of AEEG); the actual traffic data came from 4 automatically traffic monitoring units at the highways A2, A21, A23 and the main road B17. Additionally traffic counts have been undertaken on critical points and statistical traffic data were used. EDABA was also very useful for the calculation of time related traffic data based on statistical traffic distribution in Lower Austria including network traffic in the cities according to the Austrian standards M9470. Railway lines in the region are operated with electricity, the Danube is 25 km away; therefore no emissions from trains or ships had to be included.

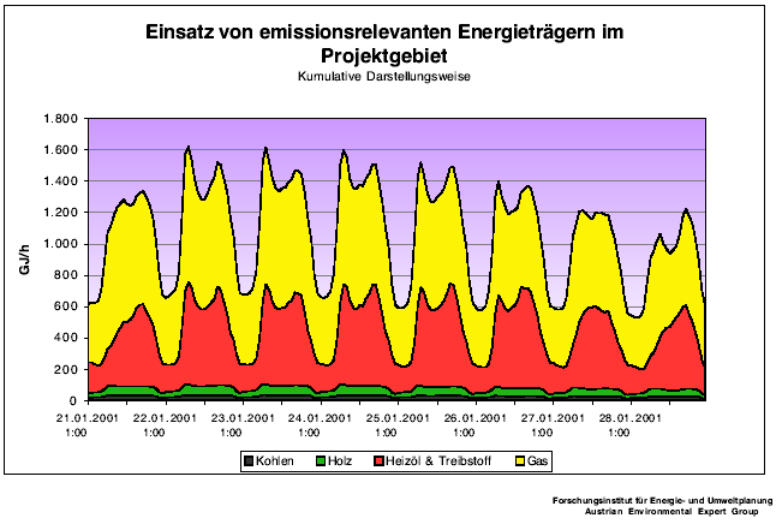
- Household and Small industry: The two natural gas supplying companies WIENGAS and EVN have been very helpful in providing consumption data. Using computerised natural gas supply valves half-hourly-consumption figures were estimated. Also a special point of view was given to the oil-consumption in the region and energy data came from surveys in that area like the emission inventory of Lower Austria, the environmental action plan "Thermenregion" and from a special case study in households of the region (survey of real room temperatures, heating times and energy consumption habits). Please see the following example below of real temperatures in living rooms during the daytime-period (including frequency in %). Energy data from Small industries came also from EDABA, using statistical models of industrial sectors and employment.

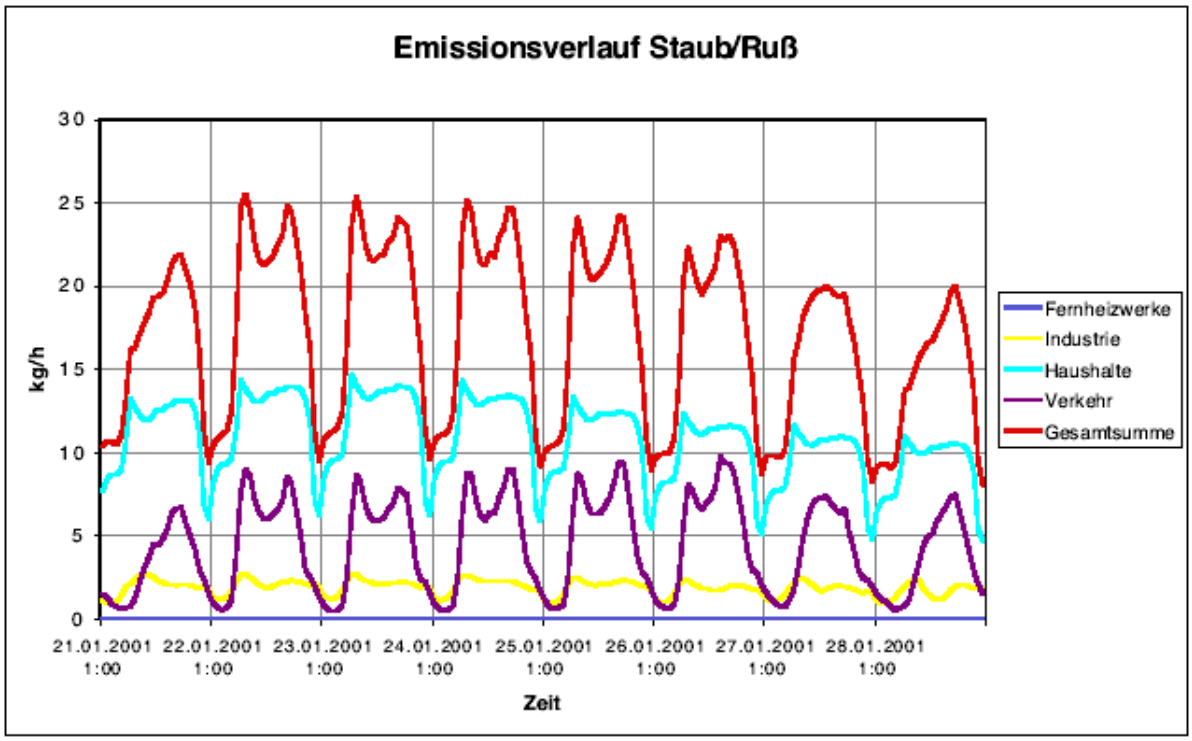


- Industry: Emission resp. energy data from medium and large industrial plants came directly from the plant operators or have been surveyed carefully during the research work. There is not real heavy industry (like steel plants, refineries, etc.) located in that area, therefore the amount of emission is limited but all data were included in the calculations.

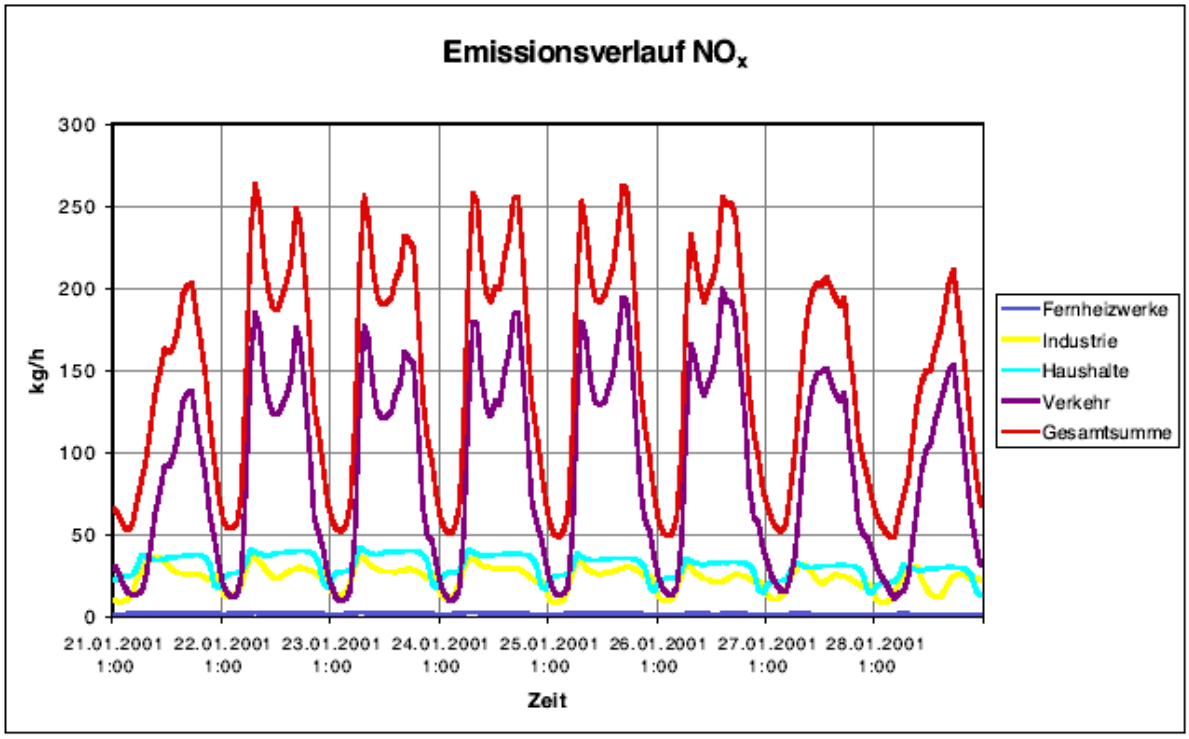
- Other sources: Minor sources like agriculture (small amount of agricultural land, winter time), infrastructure (like hospitals, schools etc.) did not have any impact.

Following the energy consumption of the different sectors the energy situation and the emission curves for NO_x and dust (TSP) are demonstrated (black: coal, green: firewood, red: oil for heating purposes/diesel/gasoline, yellow: NG)





blue: power plant, yellow: industry, turquoise: household, violet: traffic, red: total.



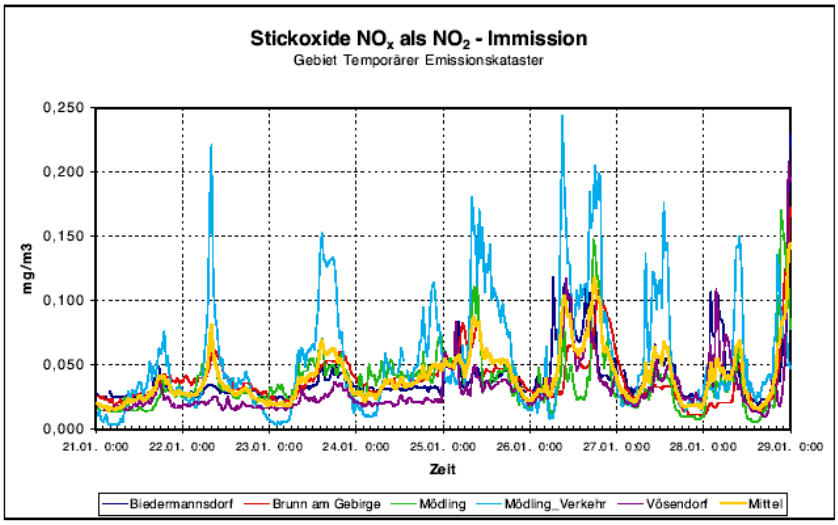
The emission has been calculated for the chemical substances SO_2, NO_x, CO, CO_2, Hydrofluorides (HF), volatile organic compounds (CxHy) and dust & aerosols (TSP).

Ambient pollution

As mentioned, 4 permanent monitoring stations (during the experiment a fifth mobile one was added) are permanently in operation. Ambient pollution 1/2-hour-mean concentrations for the following substances were available: SO_2, NO, NO_2, NO_x, CO, O_3 (two stations only).

As example, a graph for NO_x is demonstrated:

Moedling-Verkehr = Moedling mobile station especially for traffic



Quelle: NUMBIS Meßnetz, Amt der NÖ-Landesregierung
Halbstundenmittelwerte

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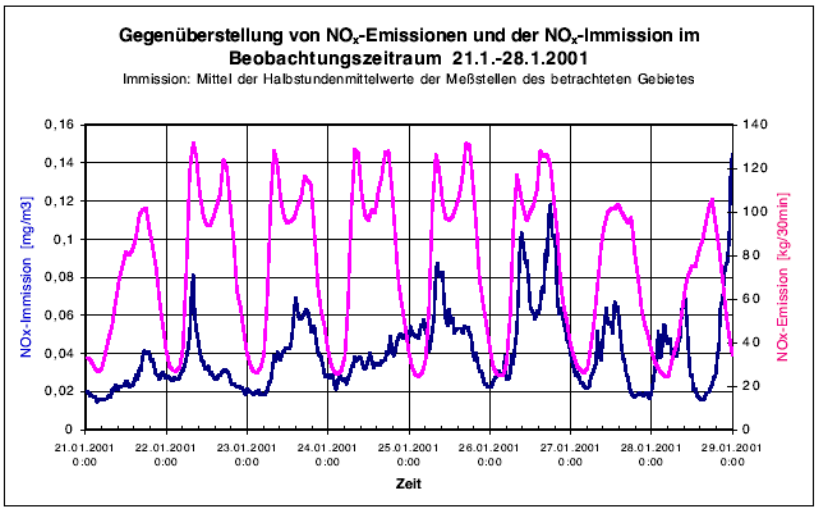
Results

We tried to combine ambient pollution data with emission data. First, as it can be seen in the figure below, we haven't been very successfully. (see NO_x)



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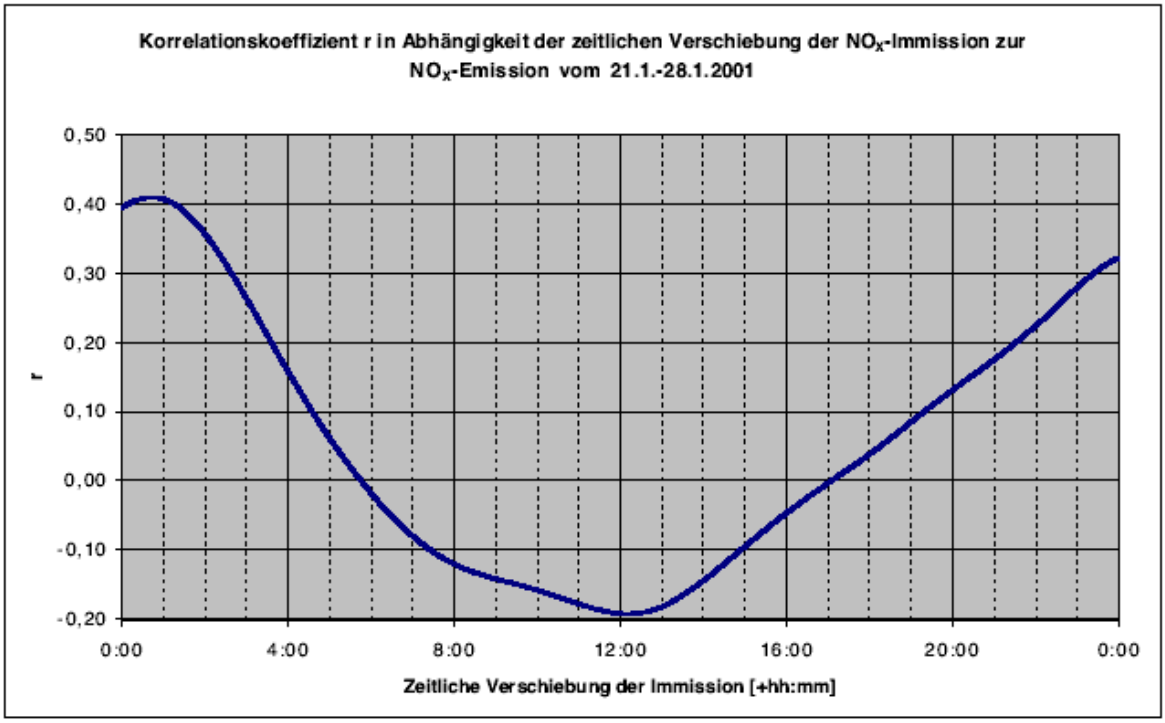
Afterwards we tried to calculate the detailed connection between different emission sources and ambient pollution monitoring curves for the substances SO_2, NO_x, CO and dust & aerosols including "delay time" - calculations between the time of the emissions and the receiving time within the monitoring network. It was necessary to calculate the correlation coefficient in steps of 5-minutes by 5 minutes.

Now, in our point of view this study can be mentioned as a pioneering project in the field of environmental sciences **finding really a correlation between emission and ambient monitoring in a local area.** It would have been easy in a small closed valley in the Alps but it was astonishing and exciting within an area of 55.000 inhabitants near the capital of Vienna (that come up to a number of about 2 millions inhabitants in the whole area). Following the example NO_x it is shown that the maximum of correlation is about 0,4 after less than 1 hour of the emission.

$$r = \frac{Cov_{xy}}{s_x \cdot s_y} = \frac{\sum_{i=1}^{n} (x_i - \bar{x}) \cdot (y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 \cdot \sum_{i=1}^{n} (y_i - \bar{y})^2}}$$



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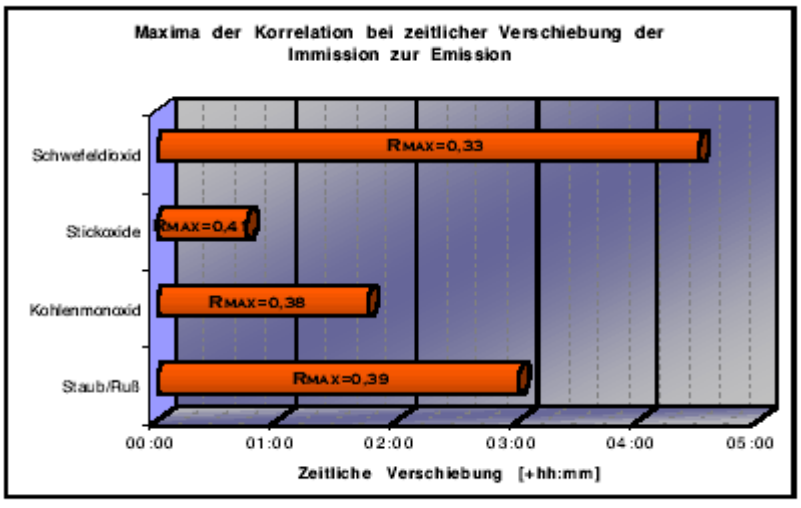
In the similar way we found the delay times for the other substances Schwefeldioxid (sulfur dioxide, SO_2, Rmax = 33, delay time about 4 1/2 hours), as mentioned Stickoxide (nitrogen oxides, NO_x, Rmax = 0,41, delay time about 45 minutes), Kohlenmonoxid (carbon monoxide, CO, Rmax = 0,38, delay time nearly 2 hours) and Staub/Russ (dust & aerosols, TSP, Rmax = 0,39, delay time about 3 hours).



Conclusions

Starting from this very interesting results, the output of the experiment and the study can be used and is used as a detailed planning instrument (e.g. for detailed emission evaluations, for air pollution meteorological modelling purposes and for emission and ambient pollution forecasts - especially ozone action plans; action plans for reaching the NEC-directive, plans to meet the requirements for the "Kyoto" - protocol, etc.). Also, the project had the target to give proof of the relation between the amount of emission and ambient pollution data in a defined region.

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1. G.Schoerner; R.Schoenstein,
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Kurzzeitemissionskataster in umgrenzter Region
Short term emission inventory in a defined region.
April 2002

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Homepage: A full copy of the study in German language can be obtained on the homepage
www.aeeg.at → Downloads.