Evaluation of the OSPM model against the data measured during one year in Runeberg Street, Helsinki

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1 Introduction

A measuring campaign was conducted in a street canyon (Runeberg St.) in Helsinki in 1997. Hourly mean concentrations of CO, NO_X, NO_2 and O_3 were measured at street and roof levels, the latter in order to determine the urban background concentrations. The relevant hourly meteorological parameters were measured at roof level; these included wind speed and direction, temperature and solar radiation (Fig 1.).

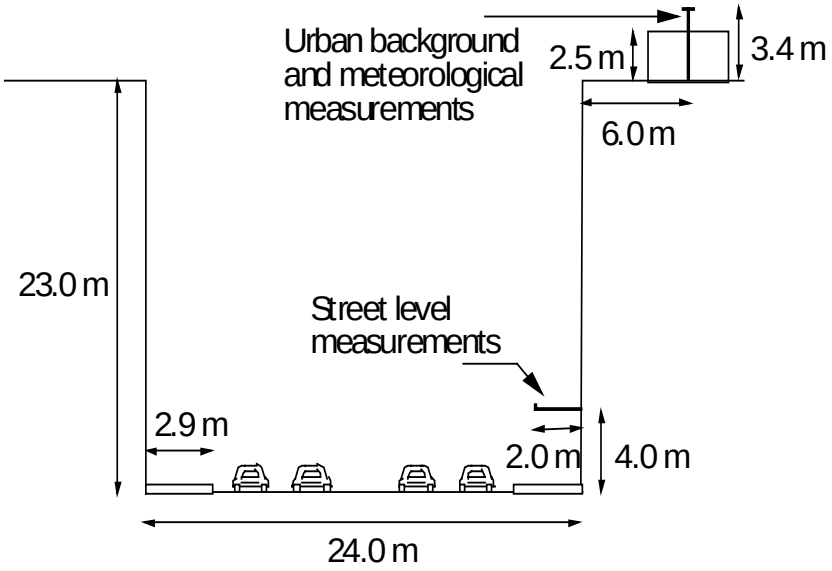


Figure 1 Vertical cross-section of the street canyon showing the locations of the measurement points at street and roof levels.

2 Methods

Hourly street level measurements and on-site electronic traffic counts were conducted throughout the whole of 1997; roof level measurements were conducted for approximately two months, from 3 March to 30 April in 1997 (the latter will be called “the intensive measurements period”). CO and NO_X emissions from traffic were computed using measured hourly traffic volumes and evaluated emission factors. The Operational Street Pollution Model (OSPM) was used to calculate the street concentrations and the results were compared with the measurements. We have previously analyzed the results during the intensive measurements period; for details the reader is referred to Kukkonen et al. (2000, 2001).

This paper addresses the predicted and measured hourly data for the whole of 1997. As the roof level concentration measurements were not available for the whole year, we applied computed urban background concentration values. We utilized an urban modelling system for evaluating the traffic volumes, emissions from stationary and vehicular sources, and atmospheric dispersion of pollution (Karppinen et al., 2000). The relevant meteorological parameters were estimated using a meteorological pre-processor and the data from synoptic and sounding stations (Fig 2.).

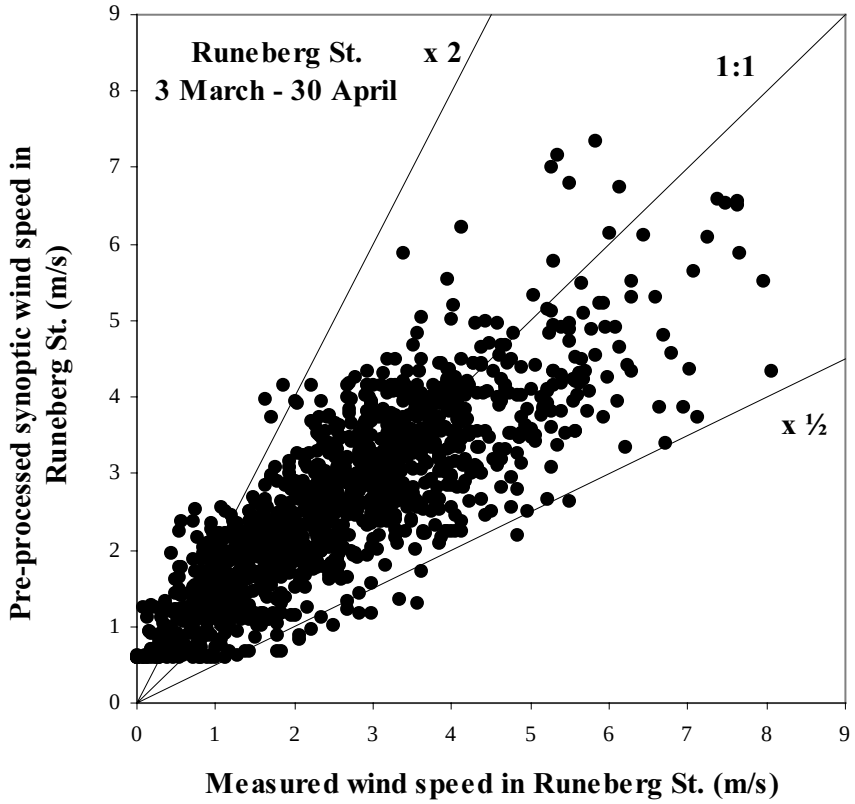


Figure 2 Comparison between the hourly wind speed values that were measured on-site at the roof level in Runeberg St. and those that were obtained from synoptic stations using a meteorological pre-processing model. The data corresponds to the so-called intensive measurements period, from 3 March to 30 April, 1997.

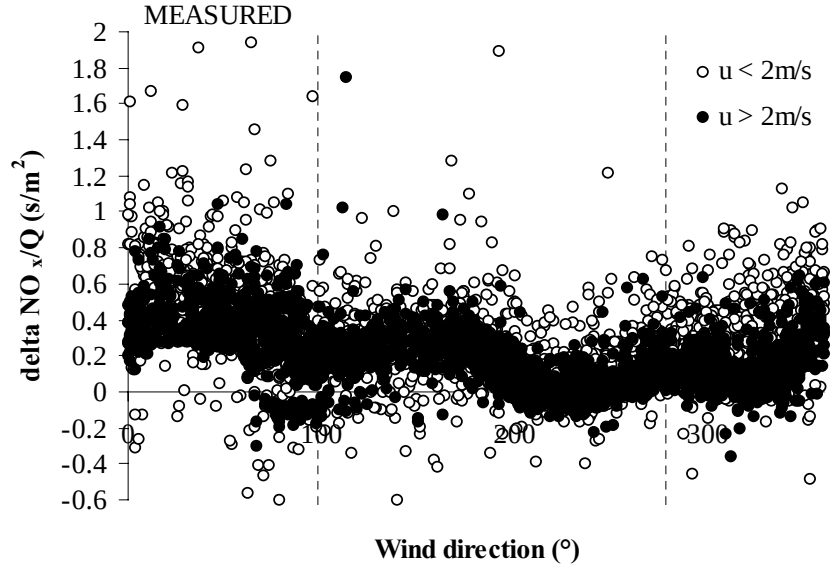
3 Results

We analyze the agreement between measured and predicted concentrations in terms of the statistical parameters (Table 1).

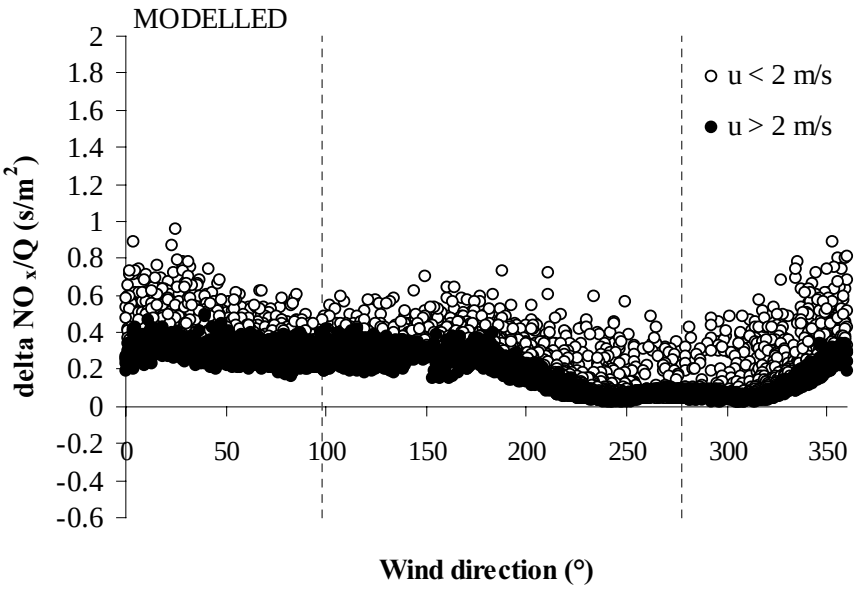
The agreement between the measured and predicted values is also analyzed in terms of its dependence on wind speed and direction (Fig 3a-b.). The results show that the utilization of computed urban background concentrations as input values to the OSPM model yield a fairly good agreement with measured street level data.

Table 1 A summary of the measured and modelled concentrations for whole of the year 1997 data. The results are also given separately for the two wind speed classes. BG is the modelled background, FB is the fractional bias, IA is the index of agreement and N is the number of observations.

	All year 1997 data			u > 2 m/s			u < 2 m/s		
	NO_x ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	NO_x ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	NO_x (mg/m^3)	NO_2 (mg/m^3)	CO (mg/m^3)
Measured	155.2	38.2	0.72	120.2	31.2	0.62	196.0	46.4	0.84
Modelled	153.8	46.6	0.77	119.8	41.5	0.65	193.2	52.5	0.94
BG	27.0	16.3	0.30	19.7	14.1	0.2	35.6	18.8	0.4
FB	-0.9 %	19.8 %	5.8 %						
IA	0.89	0.81	0.87						
N	7074	7074	7225	3799	3801	3908	3275	3273	3317



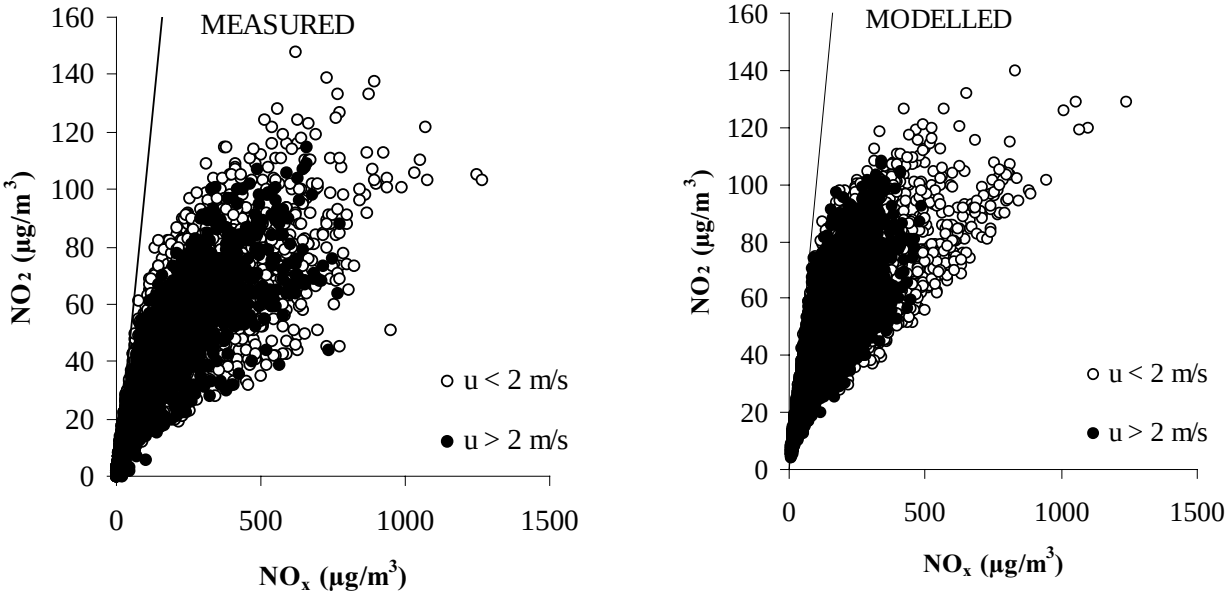
(a)



(b)

Figures 3a-b The dependence on wind direction of measured and predicted normalised hourly NO_x concentrations, (C(street level)–C(roof level))/Q, where C is the concentration and Q is the vehicular emission from the street. The data includes only daytime hours during the whole year 1997; it has been categorised into two wind speed classes. The dotted vertical lines indicate the directions for which wind direction is perpendicular to the street.

In Figures 4a-b are results of the dependency of street level NO_2 concentration on NO_x concentration for all year 1997 data.



(a) (b)

Figures 4a-b. The dependency of street level NO_2 concentrations on NO_x concentrations, for the measured and predicted results. The upper limit of NO_2 concentrations is shown by the 1:1 line.

The database, which contains all measured and predicted hourly data during 1997, is available for further testing of OSPM or other street canyon dispersion models. The dataset is particularly useful in one respect: it contains a larger proportion of low wind speed cases, compared with other available street canyon measurement datasets.

References

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