SMALL SCALE PARTICULATE MATTER MEASUREMENTS AND DISPERSION MODELLING IN THE INNER CITY OF LIEGE, BELGIUM

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Due to the costs of monitoring networks, models are often used as substitutes for particulate matter (PM) measurements. However, quality and uncertainty of urban and regional-scale models still need to be evaluated by comparative field measurements. The Interreg IV-A project "PMLab" aims at harmonizing PM measurement and modelling procedures between monitoring networks of the Netherlands, Germany and Belgium, hence providing consistent information on the spatial distribution of PM concentrations within the densely populated Euregio Meuse-Rhine. Within the frame of this project, an observational campaign at local scale is set up in the inner city of Liège, Belgium (pop. 190,000). Within the monitoring area, traffic is the most important air pollutant source, and has been chosen as focus of this study.

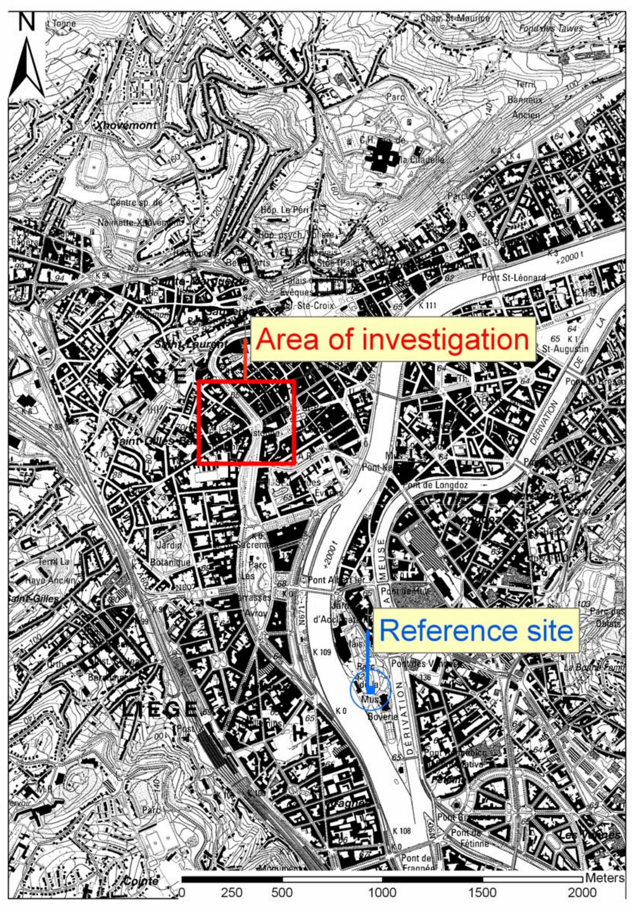

Fig. 1: Area of investigation

Area of investigation

- investigated area in this study is the inner city of Liège which is characterized by high traffic volumes and a high building density (Fig. 1)
- dominant line sources are several lanes of a boulevard with high traffic densities and a side street with medium traffic volume
- PM measurements took place at 14 mobile and 2 fixed monitoring sites: 5 situated within boulevard and 11 in two narrow side streets (Fig. 2)
- measured spatial PM-variations were compared to simulation results
- simulations were performed with Lagrangian dispersion model AUSTAL2000 provided by the German Environmental Agency

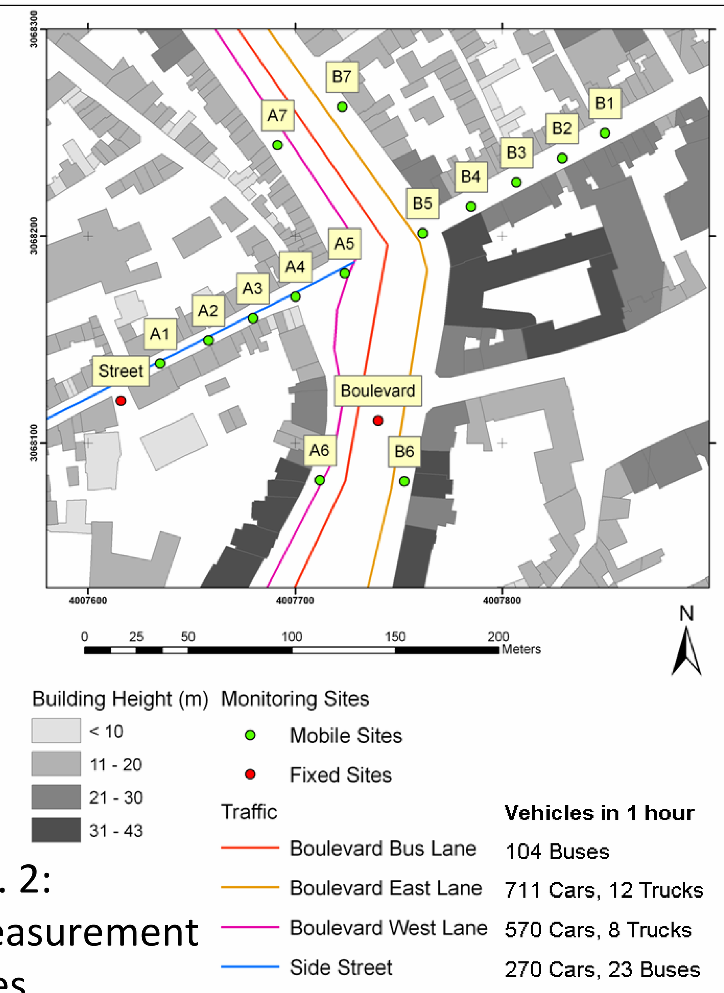

Fig. 2: Measurement sites

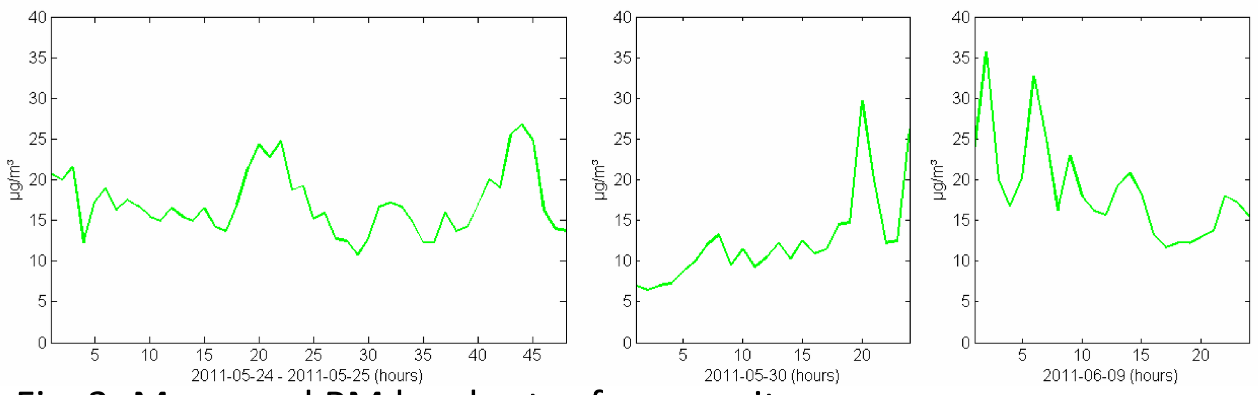

Fig. 3: Measured PM levels at reference site

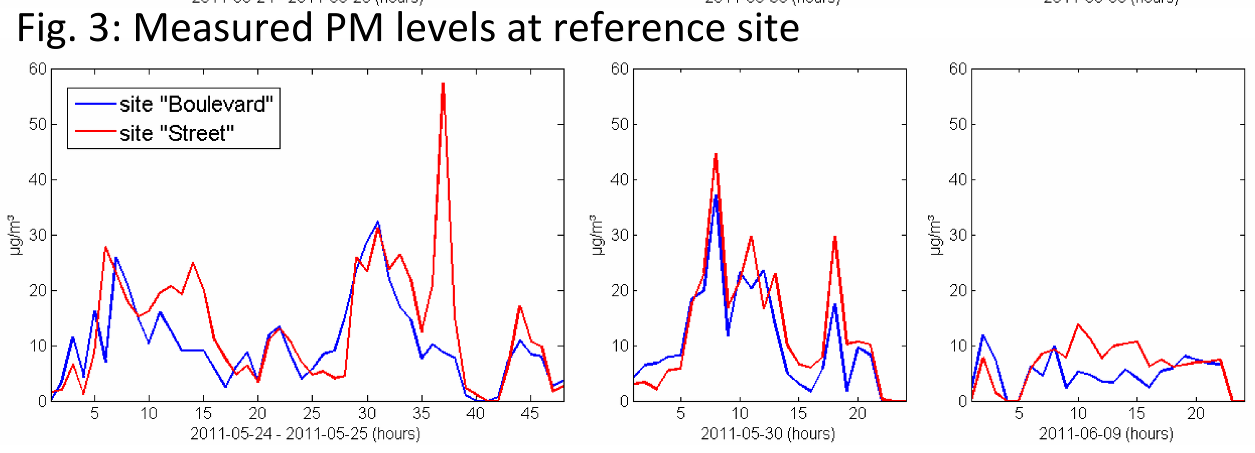

Fig. 4: Measured PM levels at permanent sites "Boulevard" and "Street"

Measured PM levels

- background PM concentrations at reference site (Fig. 3) were subtracted from PM levels at permanent sites "Street" and "Boulevard", focussing only on additional concentrations caused by local traffic
- site "Street" shows higher additional concentrations than site "Boulevard" during all 4 days (Fig. 4)
- highest absolute and additional average PM levels were measured within the relatively narrow side street west of the boulevard at site A3 (Fig. 5)

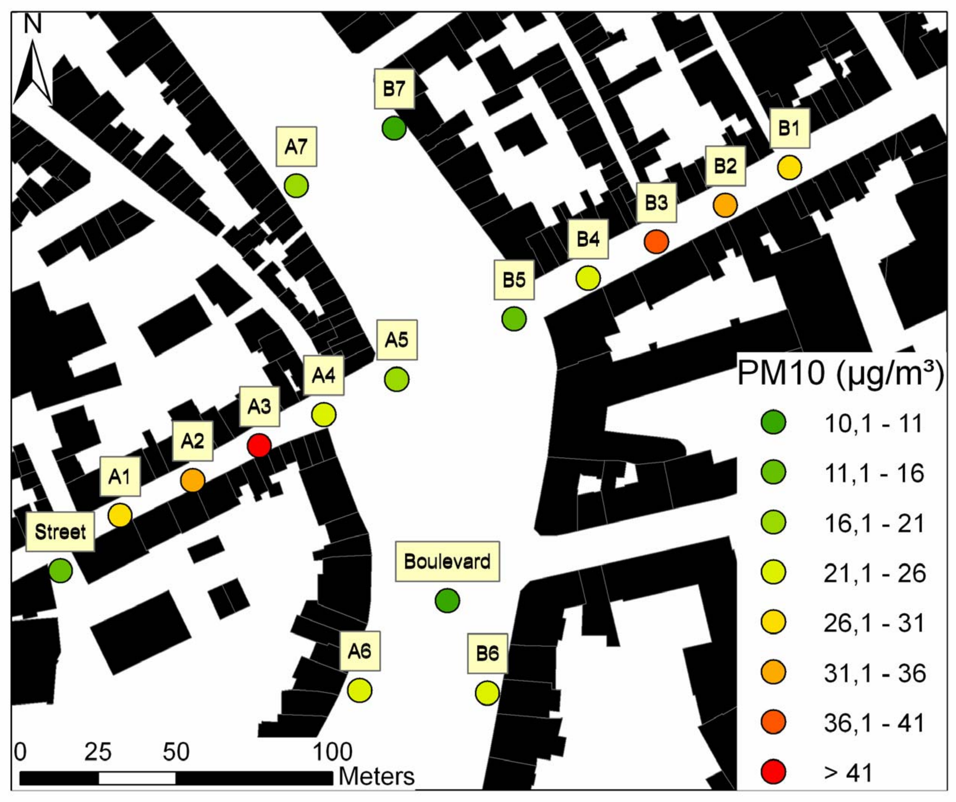

Fig. 5: Mean additional PM10 concentrations

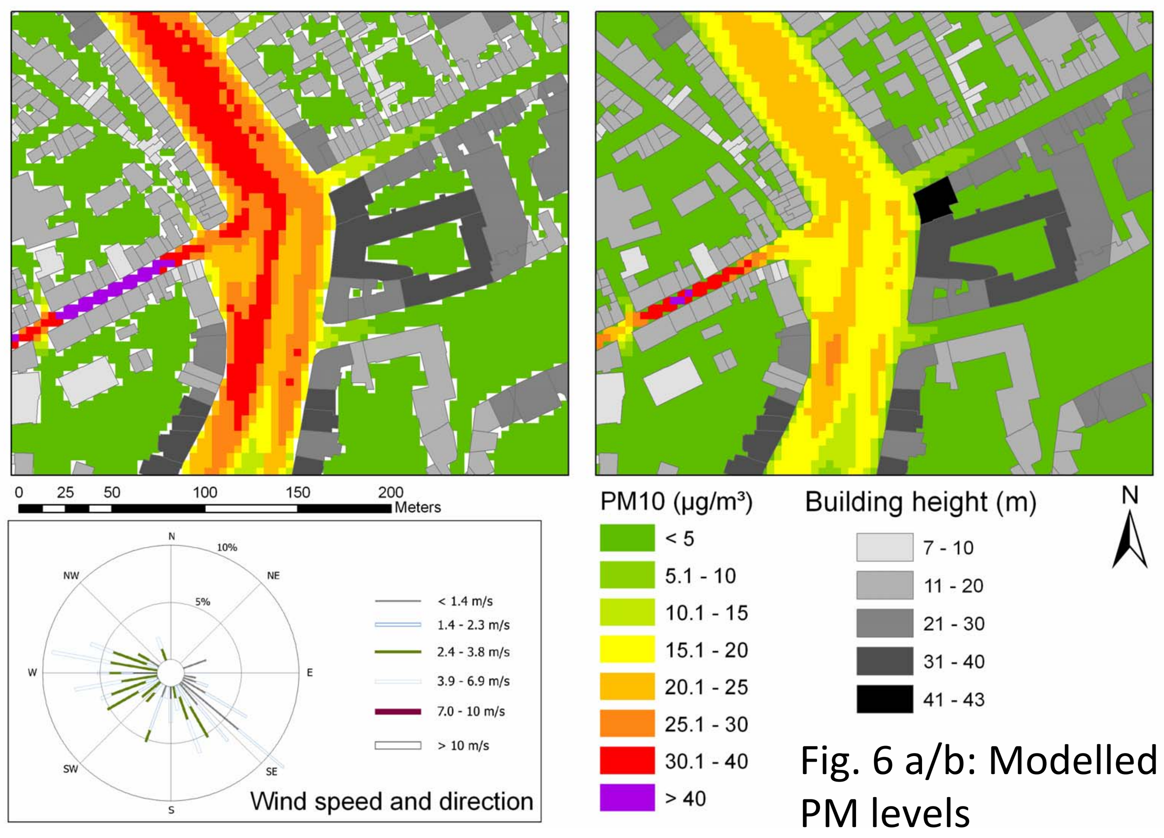

Fig. 6 a/b: Modelled PM levels

Modelled PM levels

- wind fields and pollutant dispersion were modelled for 4 stability classes reaching from slightly stable (class 3) to unstable (class 6) daytime conditions (Fig. 6 a: class 3; Fig. 6 b: class 5)
- Fig. 7 shows good accordance between model and measured concentrations, except for sites B1, B2, B3, B4 where the model clearly underestimates PM10 levels (blue line: modelled values <0.5 * measured values)

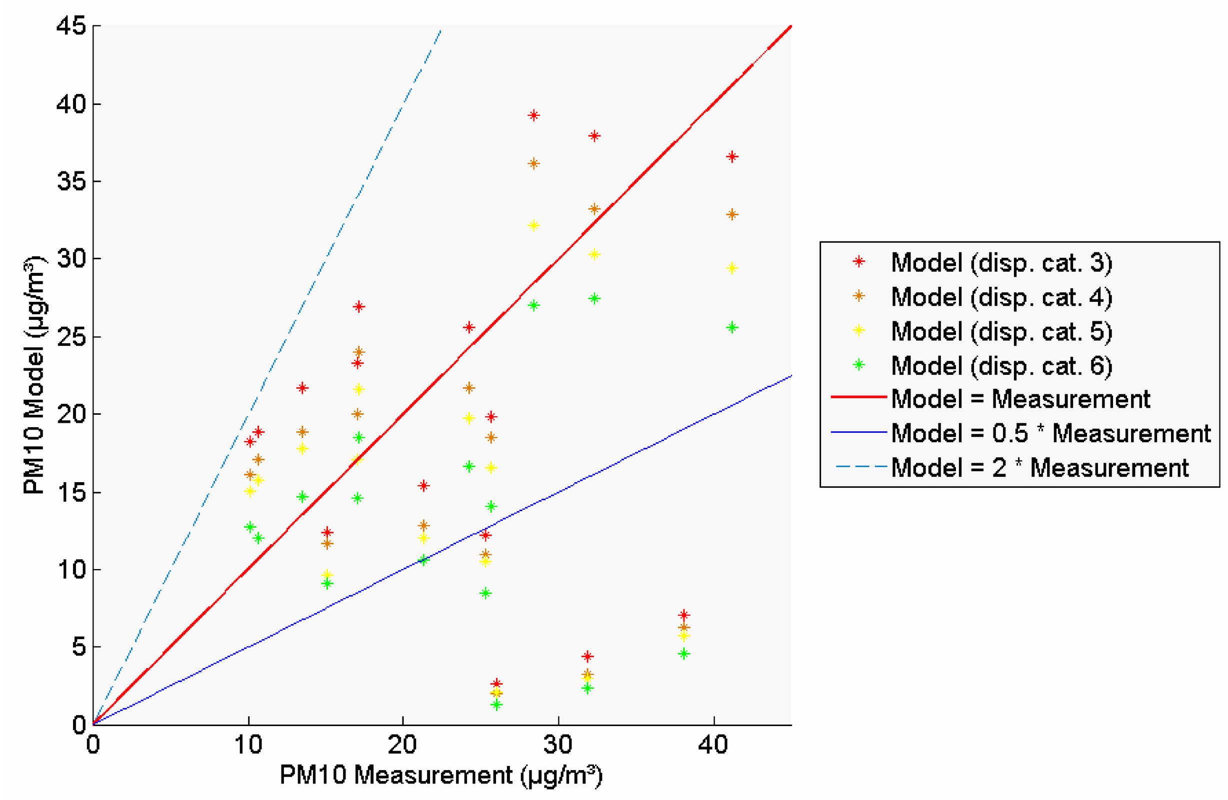

Fig. 7: Comparison between modelled and measured PM levels

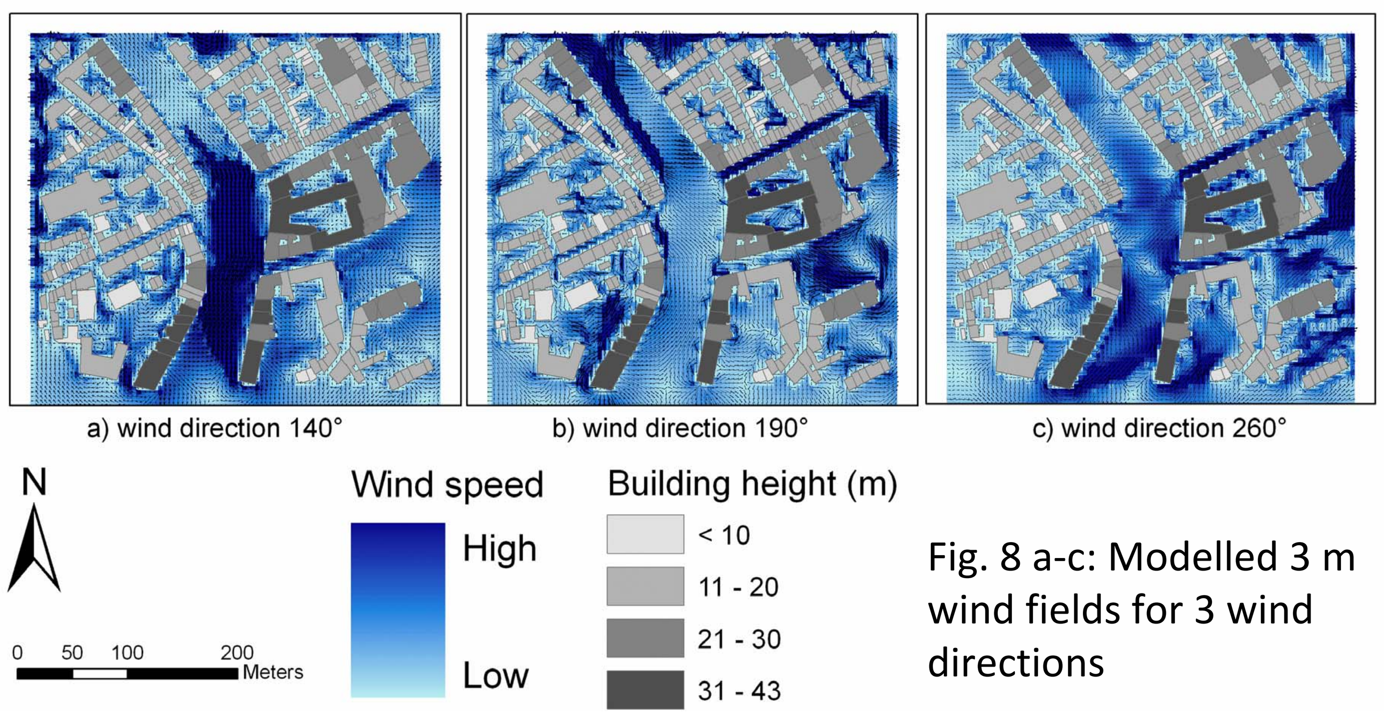

Fig. 8 a-c: Modelled 3 m wind fields for 3 wind directions

Modelled wind fields

- Fig. 8 a-c shows wind fields in 3 m for wind directions 140°, 190° and 260°, according to the prevailing wind directions on the 4 measurement days
- low wind speeds simulated within the western side street for all wind directions are in accordance with mobile wind measurements
- for the opposite side street the model simulates relatively high wind speeds for southerly and westerly wind directions, which is in contrast to the relatively low measured wind speeds

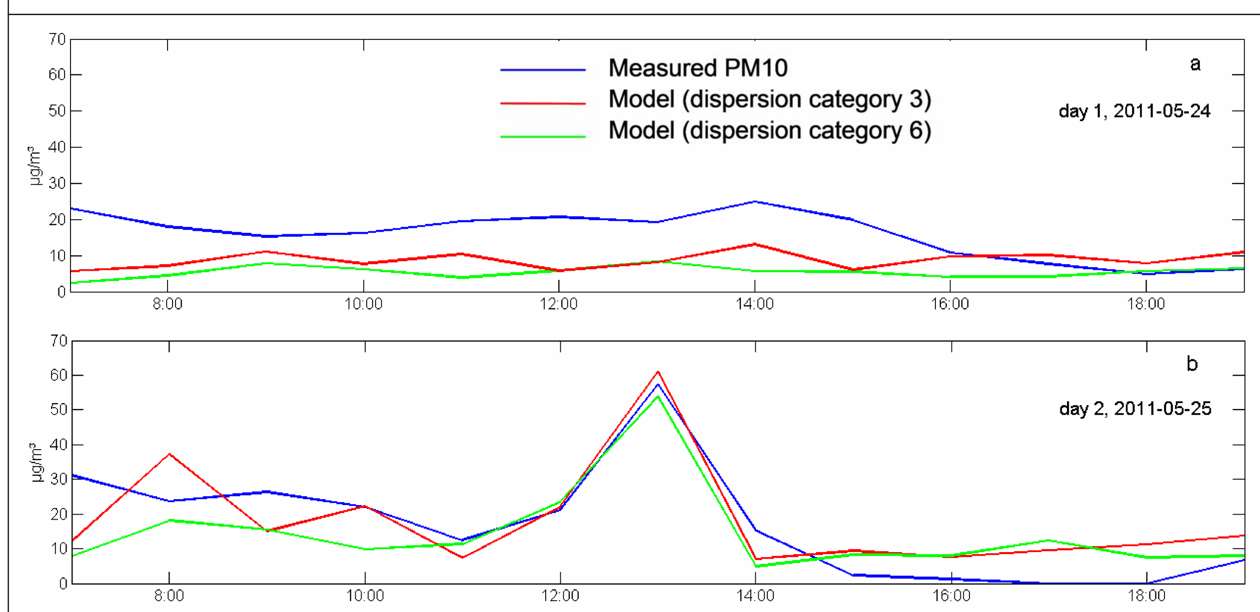

Fig. 9 a/b: Measured and modelled PM10 time series at site "Street"

Modelled and measured PM time series

- Figs. 9 a-d show PM10 time series for site "Street" over the 4 measurement days for measured and modelled PM10 levels
- on day 2 (Fig. 9 b) the high peak in the early afternoon is well reproduced by the model both in magnitude and timing

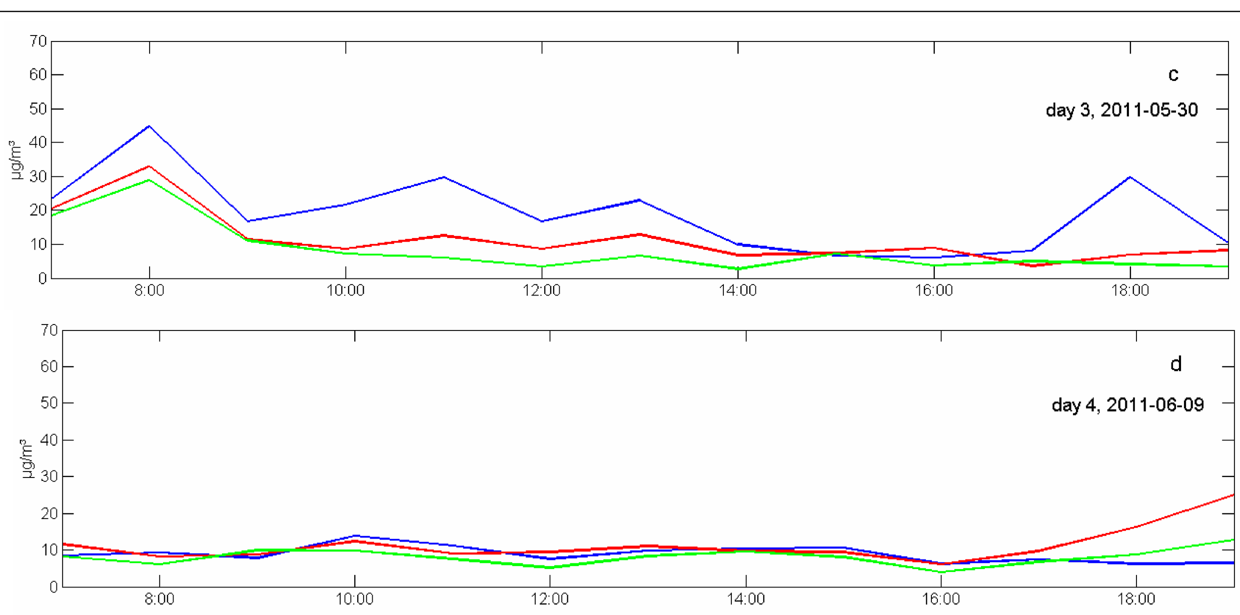

Fig. 9 c/d: Measured and modelled PM10 time series at site "Street"

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