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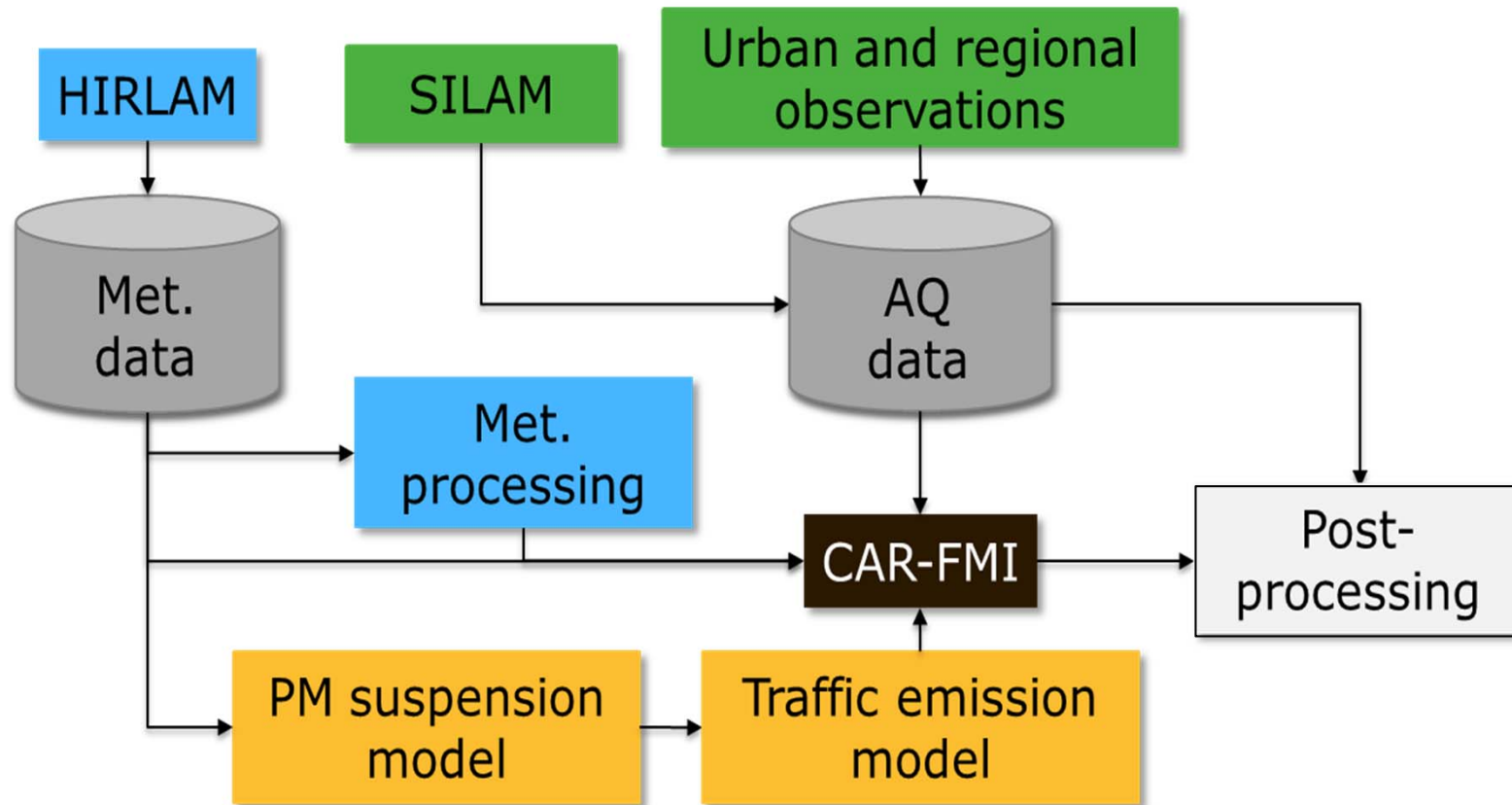
Development and evaluation of the local air quality forecast system

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HARMO14 (Kos)
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The local air quality forecast system





The local air quality forecast system:

Data retrieval

- Hourly meteorological forecasts by the **HIRLAM**

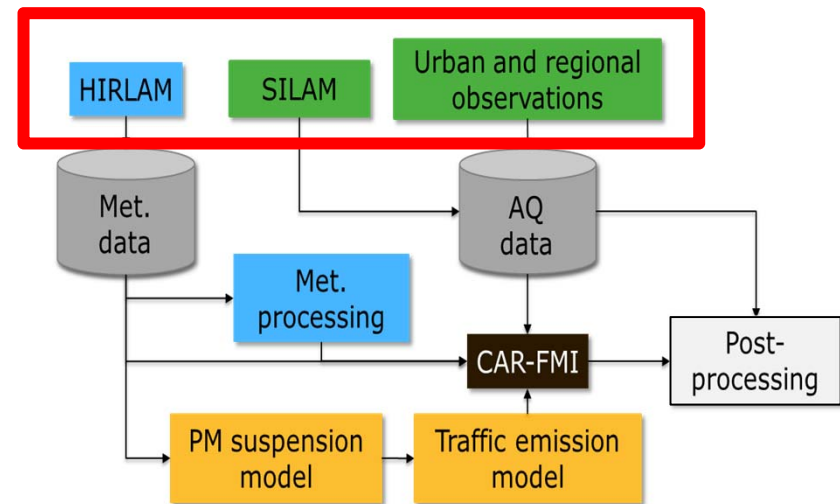
T, RH, Prec., WS, WD, DPT, P, Clouds, GR, ...

- Hourly background concentrations forecasted by the **SILAM**

NO₂, NO, O₃, CO, PM_{2.5}, PM₁₀

- Urban and regional observations from **the national air quality portal**

NO₂, NO, O₃, CO, PM_{2.5}, PM₁₀



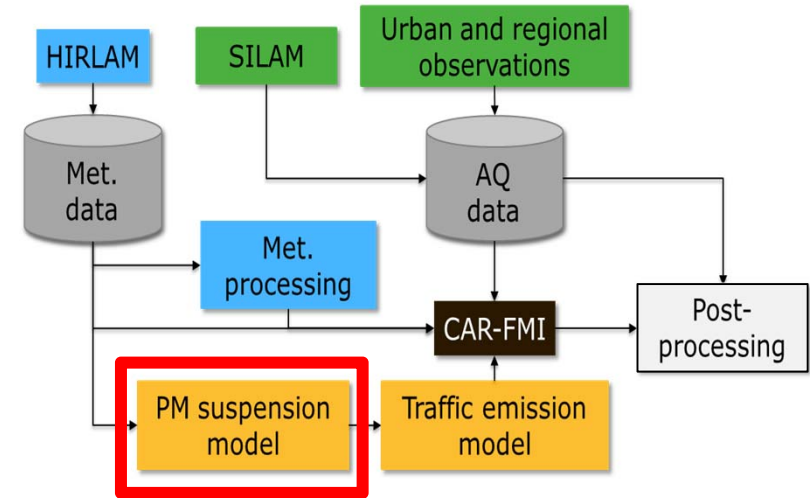
HIRLAM (High resolution limited area model)

SILAM (System for integrated modelling of atmospheric composition)

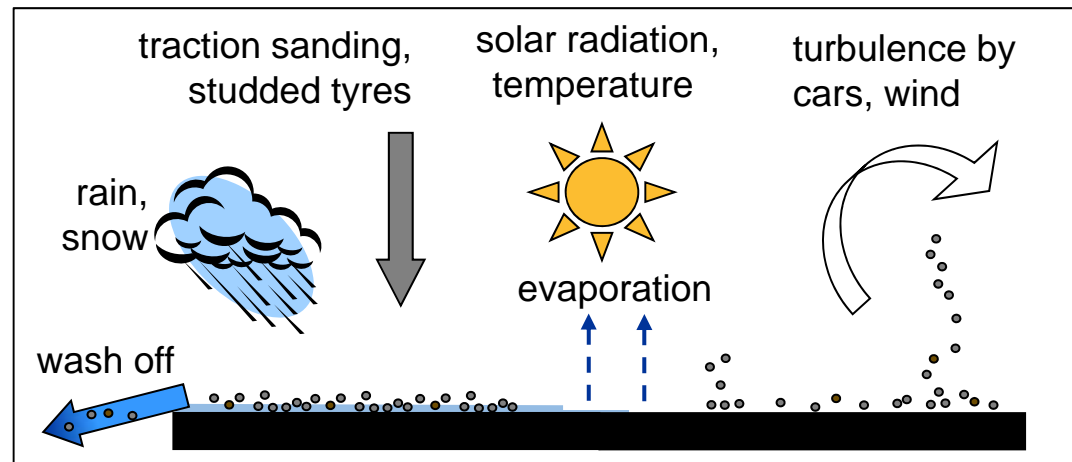


The local air quality forecast system: Suspension emission model

- Revised version of the Swedish PM emission model (Omstedt et al., 2005).
- Baseline set by reference emission factors.
- Emission factors computed for "sanding" and "non-sanding" periods.

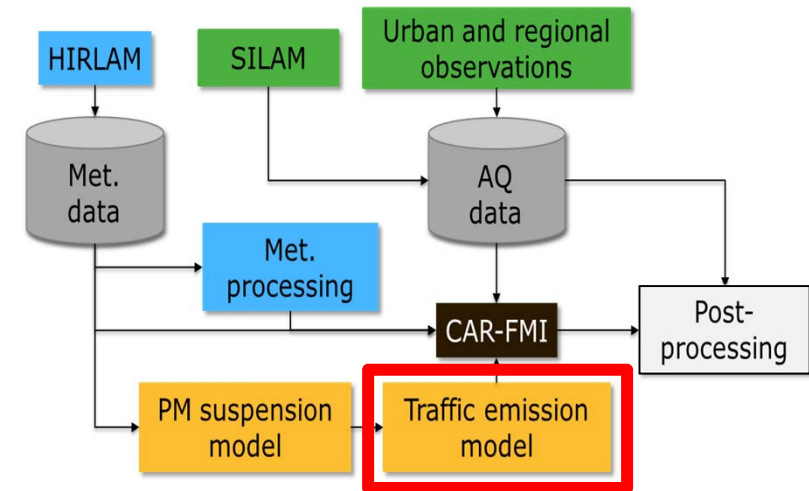


The main sources and formation processes of PM10.



The local air quality forecast system: Traffic emission model

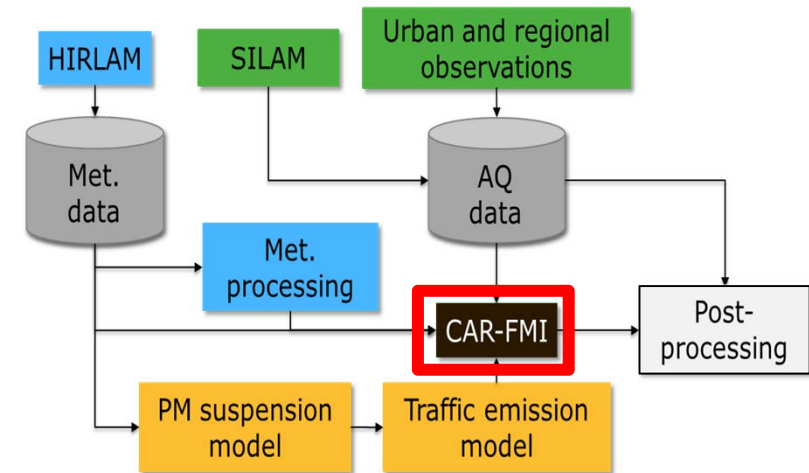
- Exhaust emission factors for NO_x, CO, and PM_{2.5}
- Suspension emission factors for PM₁₀
- Hourly average traffic volume
- Hourly average travel speed (for exhausts)
- Line source coordinates





The local air quality forecast system: Dispersion model (CAR-FMI)

- Dispersion of traffic-originated pollution from an open road network
- Gaussian dilution equation for a finite line source
- Dry deposition of particles
- Basic NO_x-O₂-O₃ chemistry

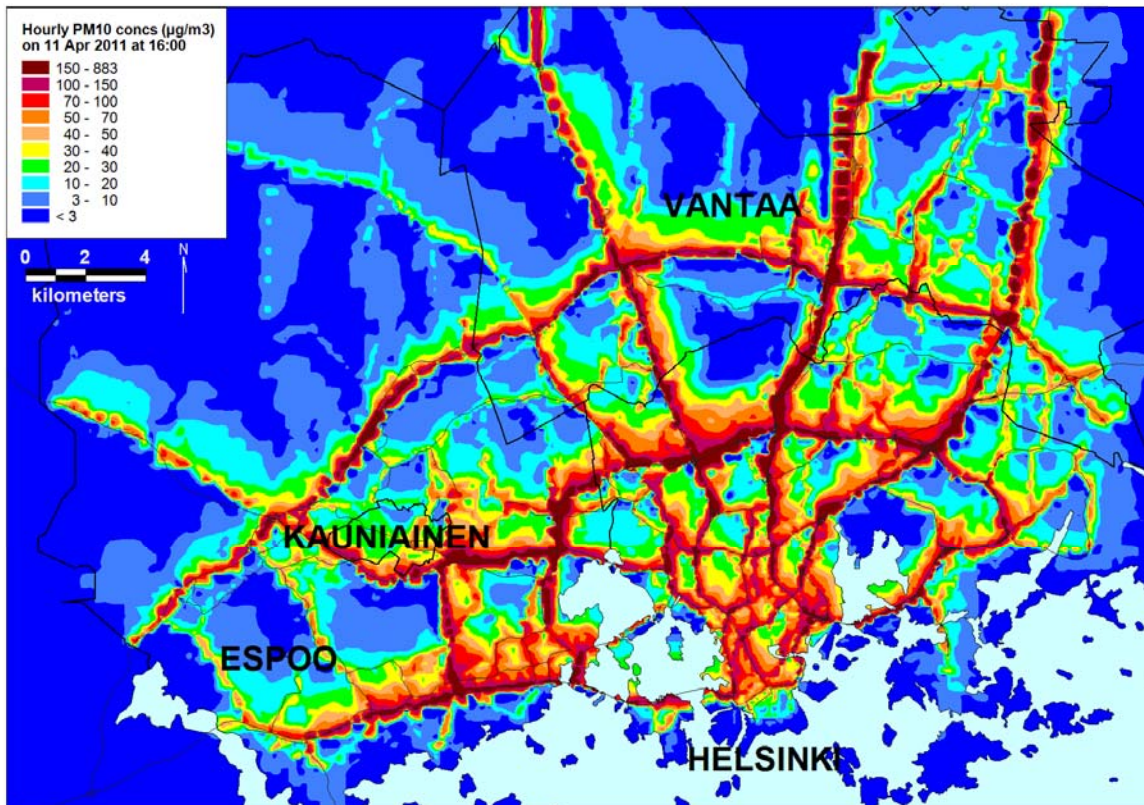
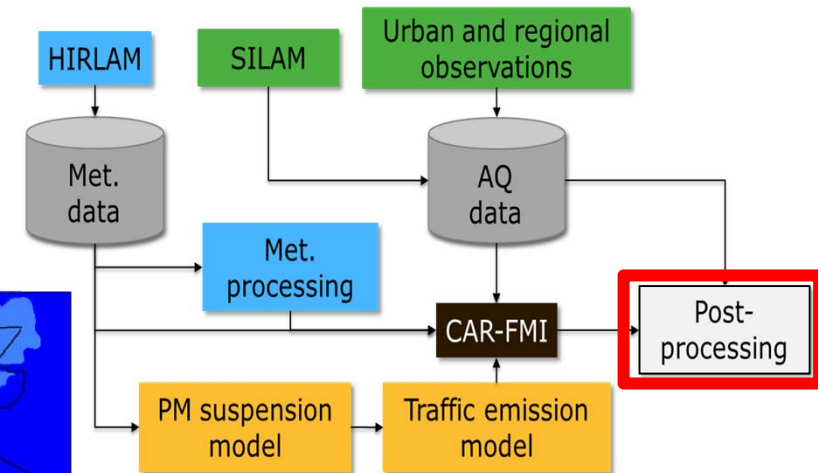


CAR-FMI (Contaminants in the Air from a Road; Härkönen, 2002)



The local air quality forecast system: **output**

- 44 hour forecast four times a day
- Hourly mean NO₂, NO, CO, O₃, PM_{2.5}, and PM₁₀ concentrations on a grid

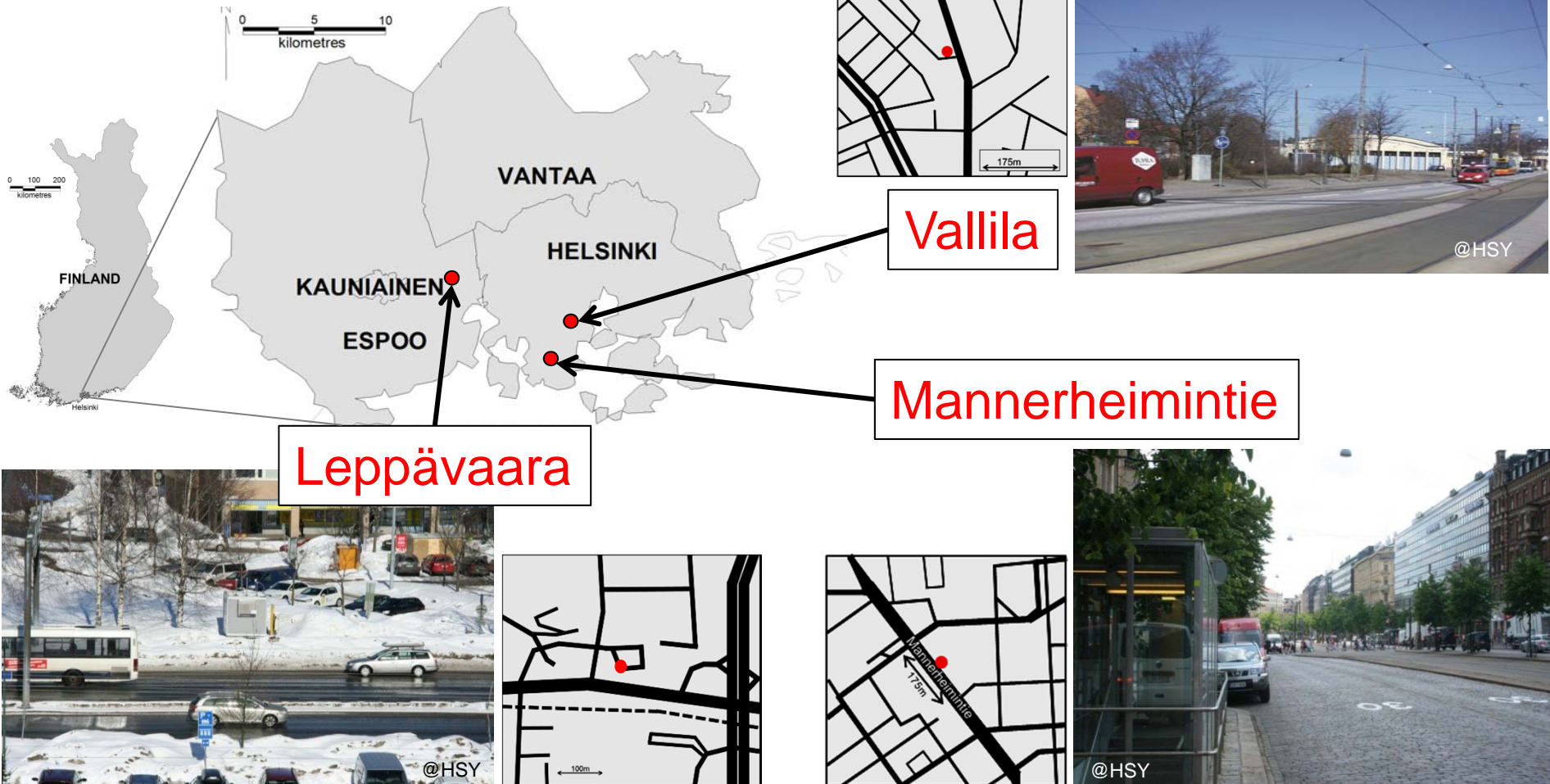


Hourly average PM₁₀ concentrations on 11.4.2011 (at 16) at the Helsinki metropolitan area (computed at 14).



Model performance during road dust episodes

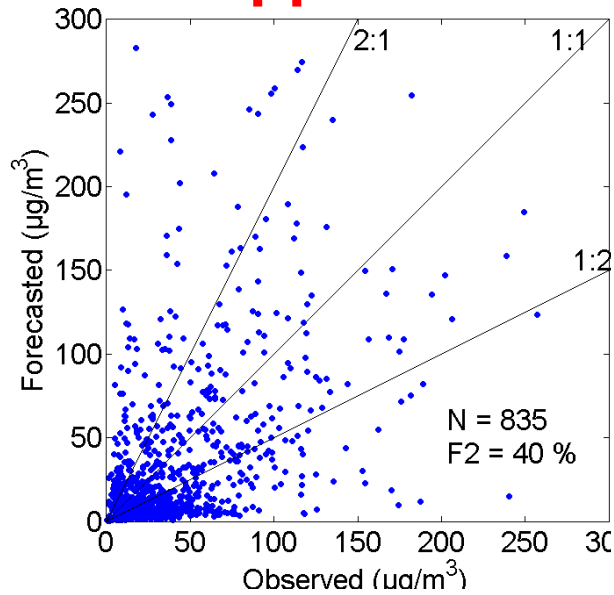
- **Study period:** from 24 March to 30 April 2011
- **Study sites:**





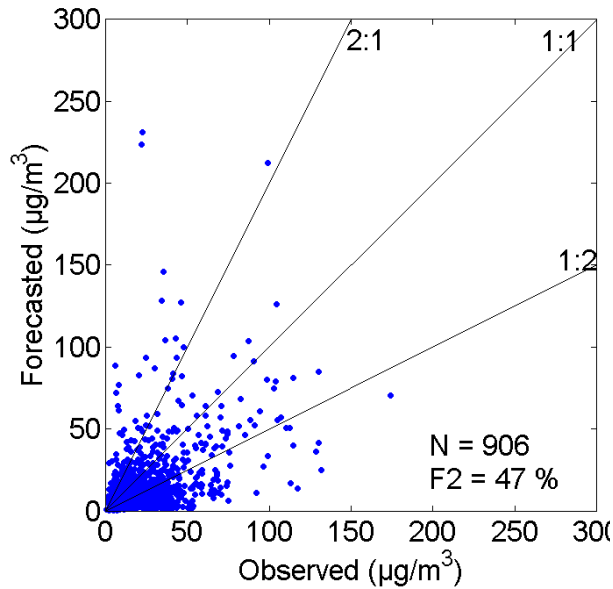
Results: Hourly PM10 concentrations

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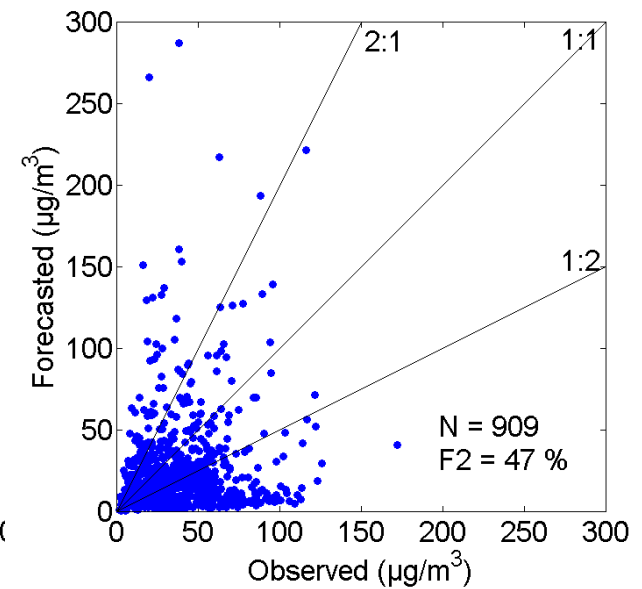
IA = 0.60
FB = -0.11

Vallila



IA = 0.54
FB = -0.34

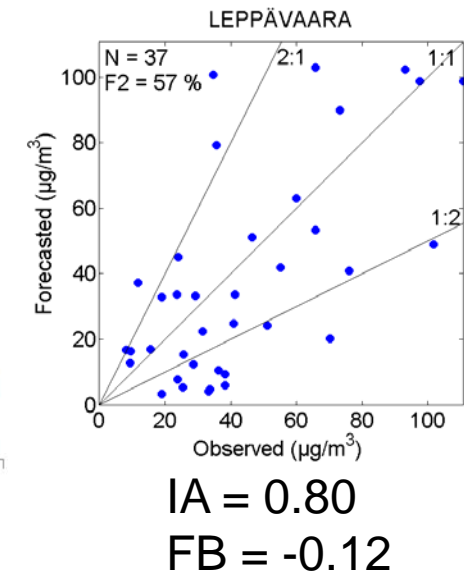
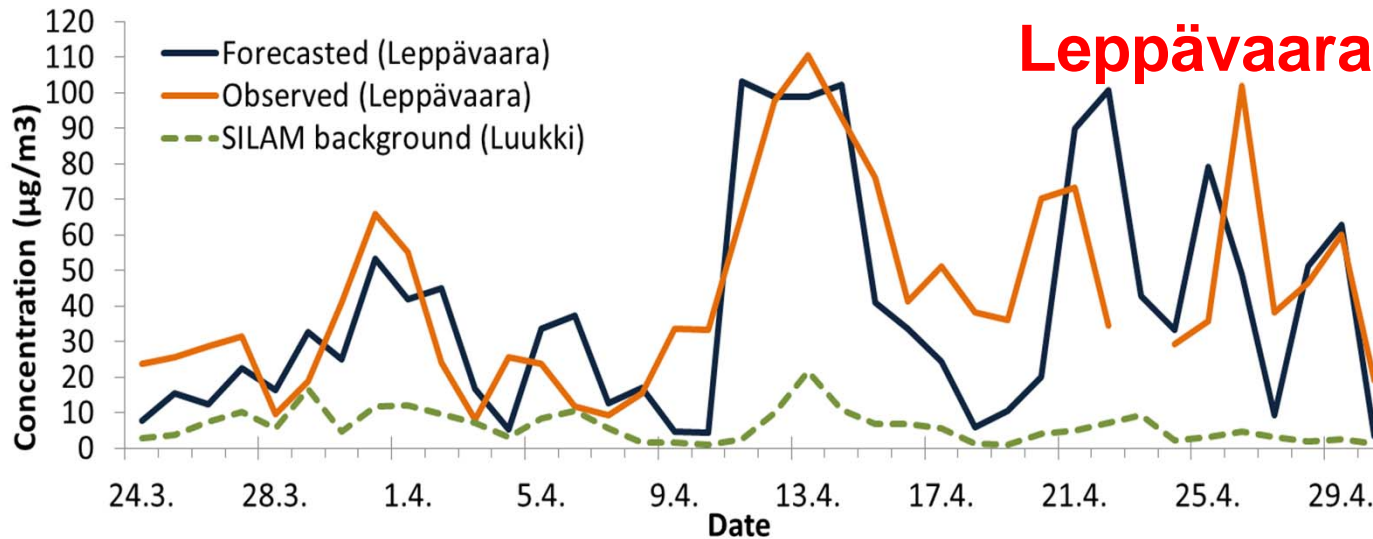
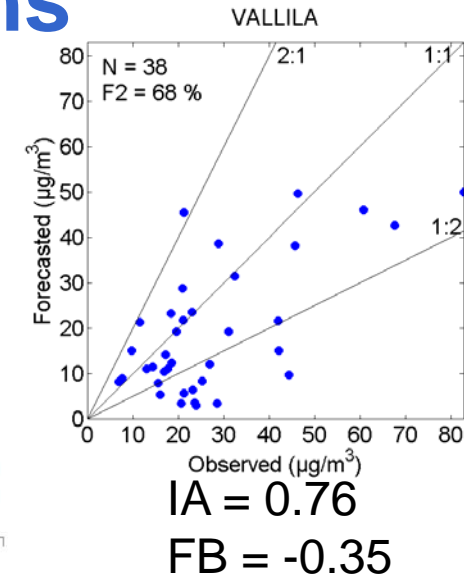
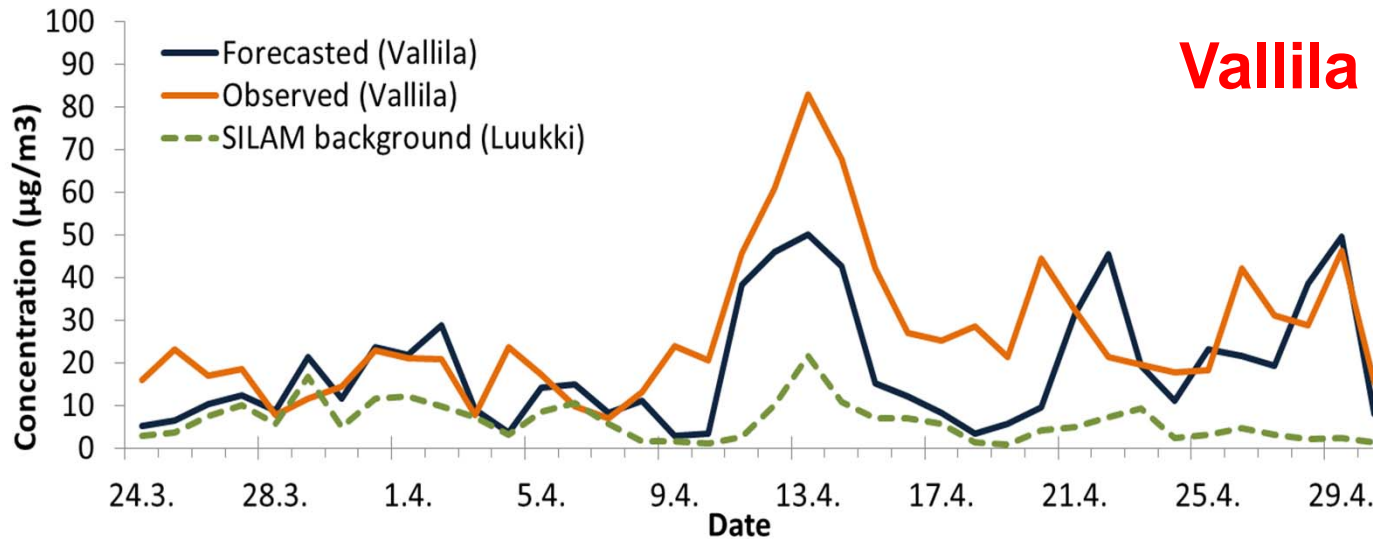
Mannerheimintie



IA = 0.35
FB = -0.33

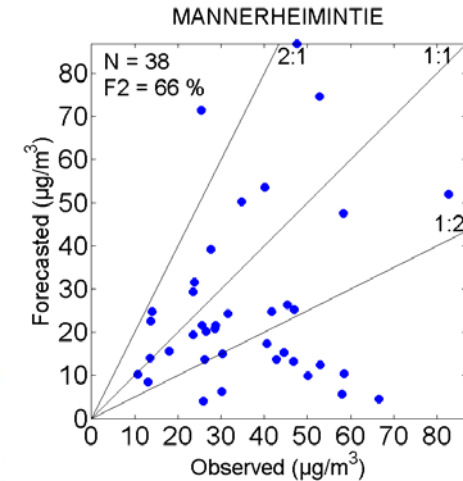
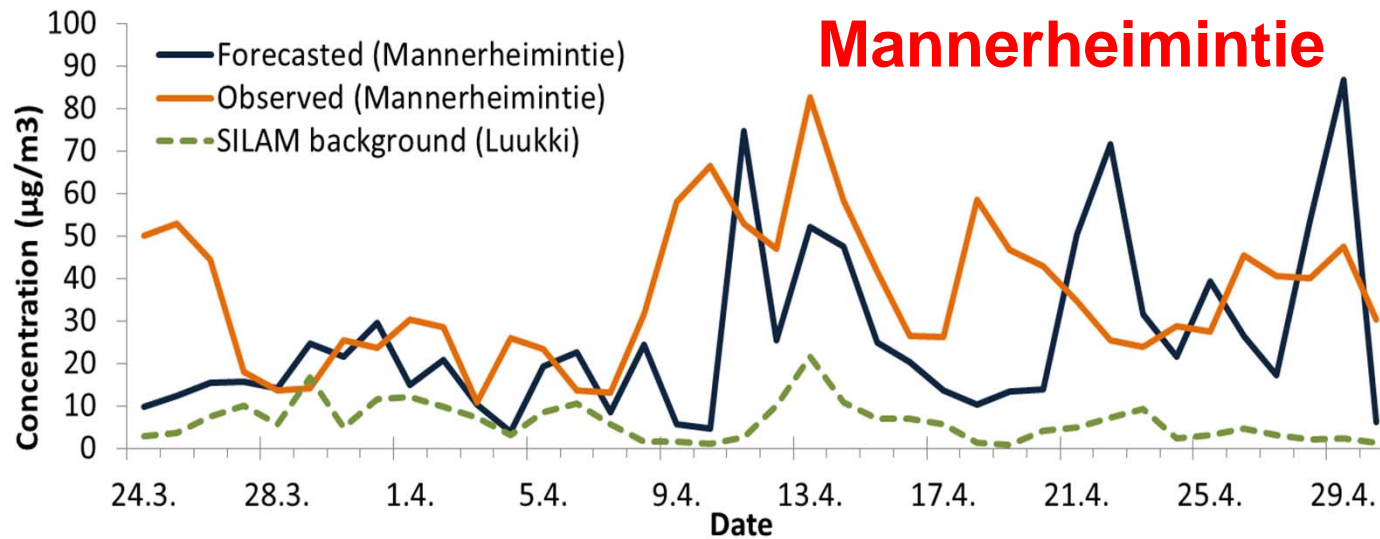


Results: Daily PM10 concentrations





Results: Daily PM10 concentrations



IA = 0.53
FB = -0.34

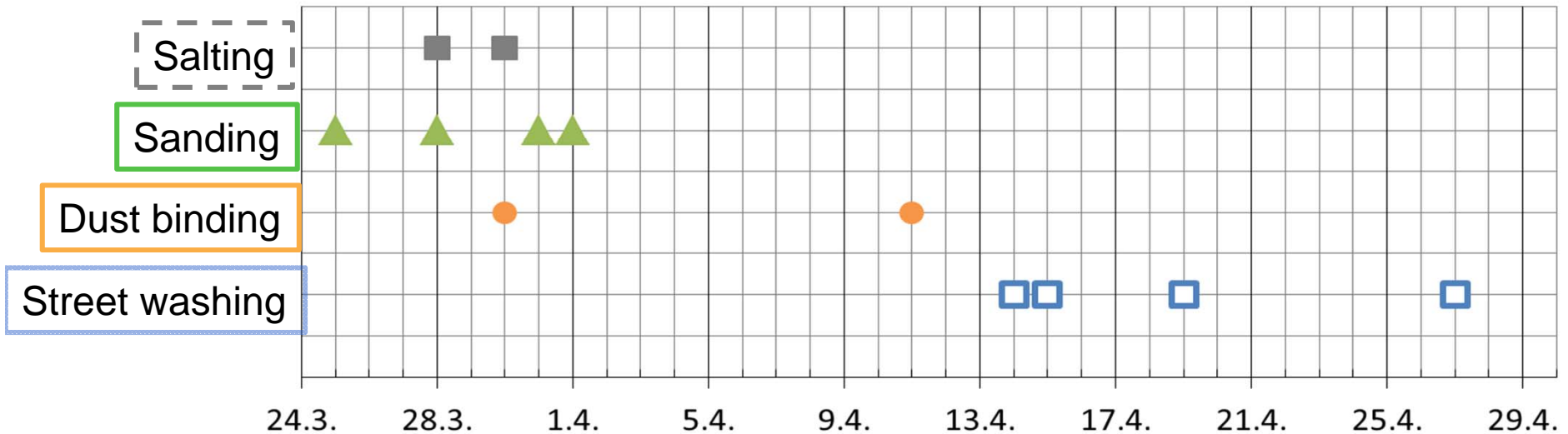
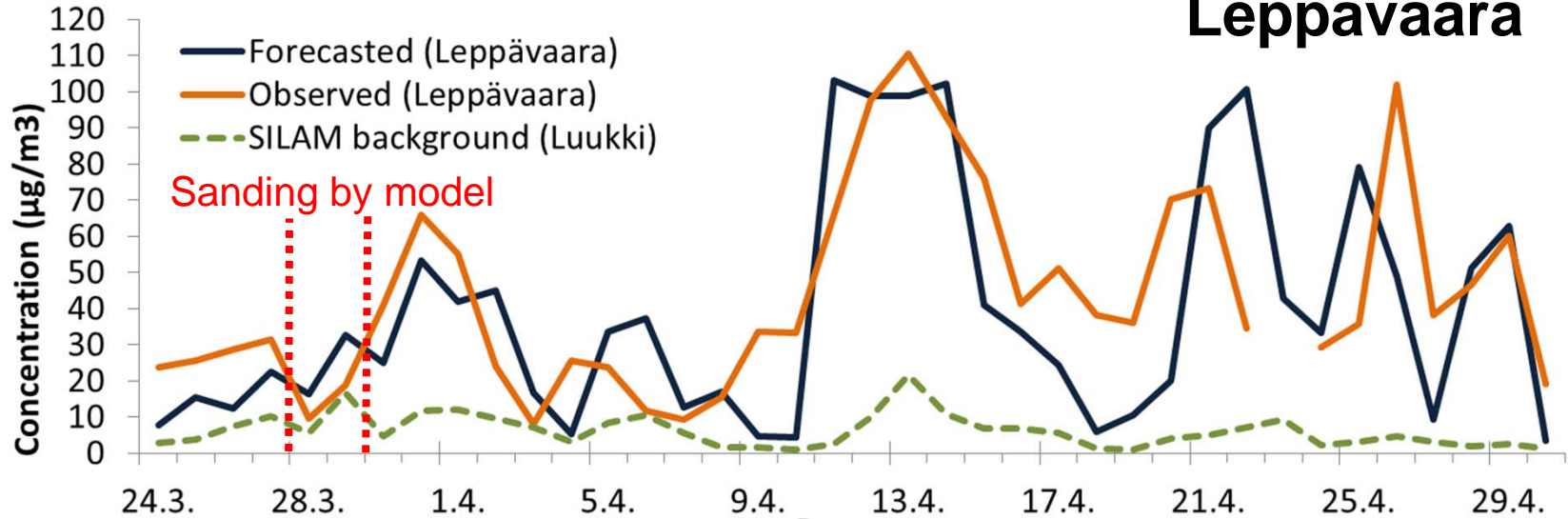
Difficult street environment:

- Stone-block pavement
- Traffic lights and low speed limit
- Congested traffic
- Tram lines
- Wide street canyon



Street maintenance

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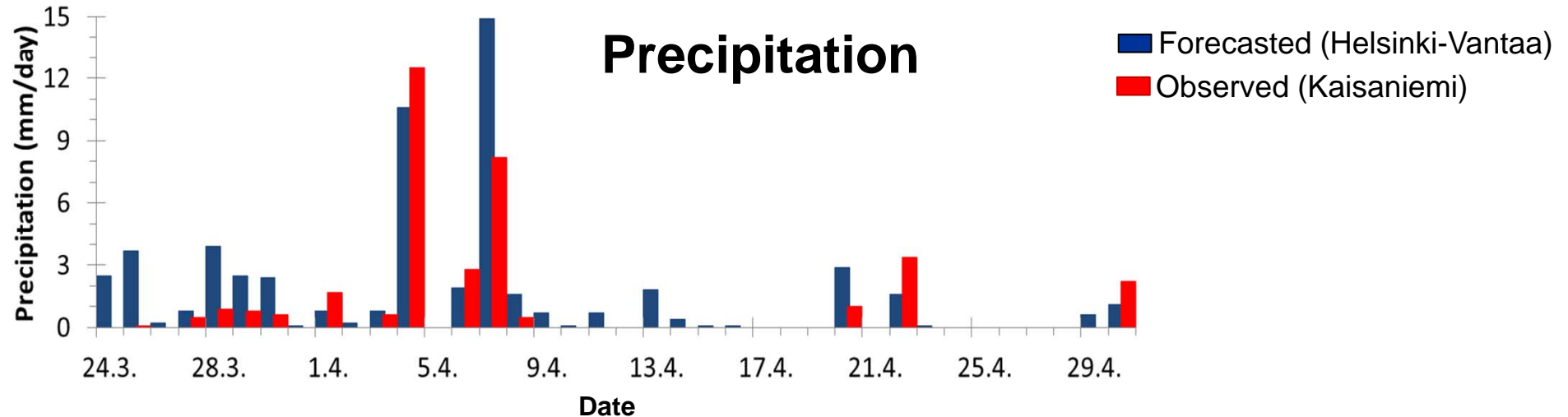
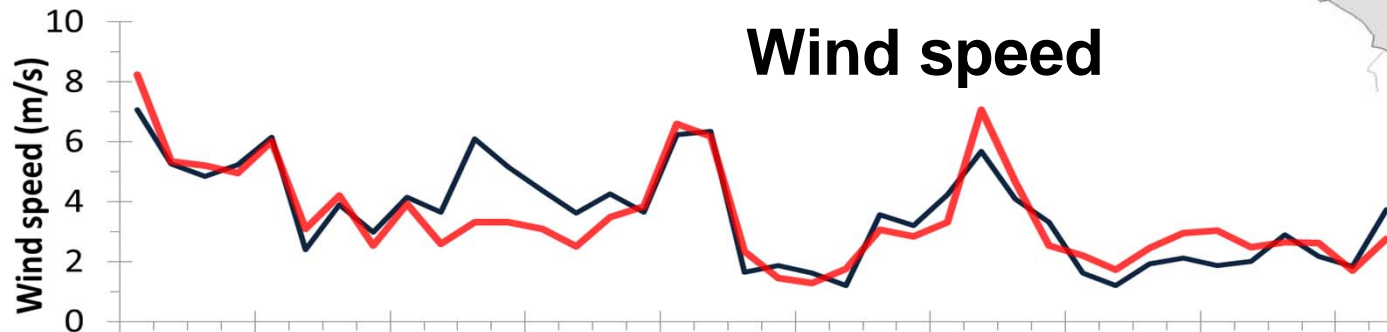
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Meteorological data

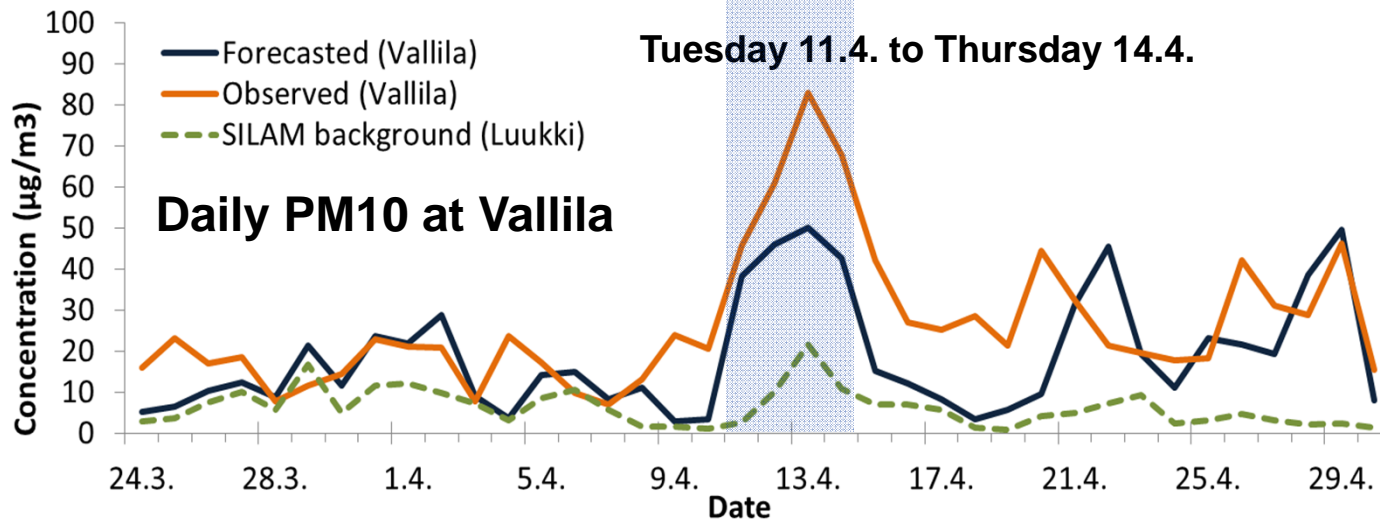
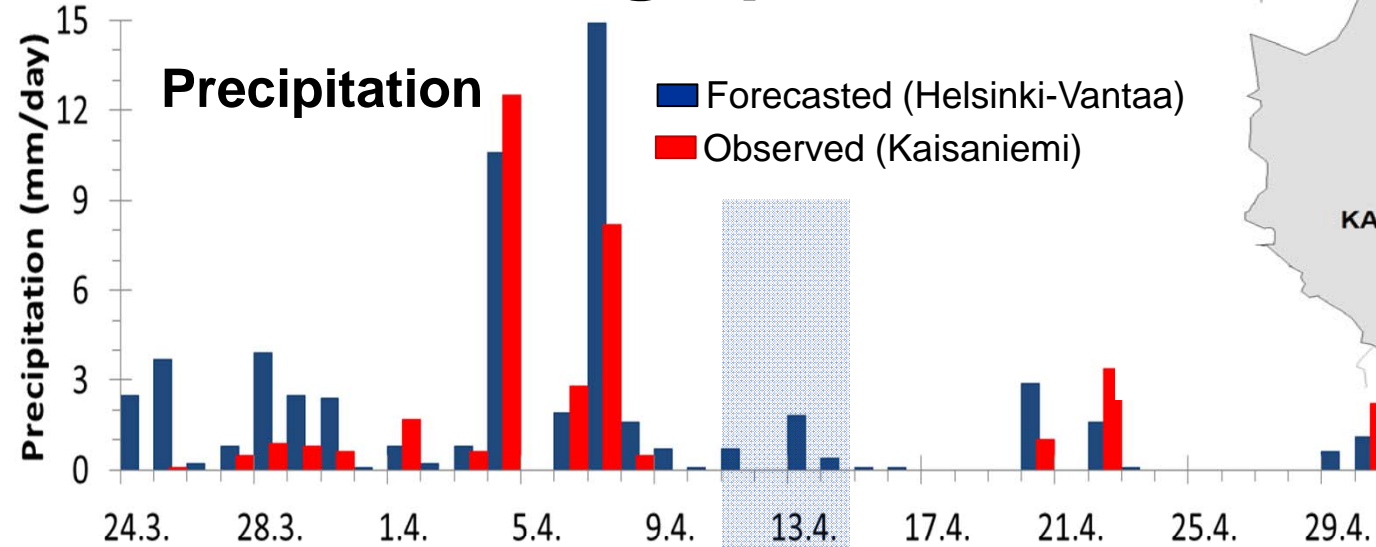
Forecasted (at Helsinki-Vantaa) vs. observed (at Kaisaniemi)

Hourly data	Temperature	Wind speed	Relative humidity	Precipitation
IA	0.92	0.90	0.64	0.66
FB	-0.52	0.04	0.22	0.46





Met data during episode





Conclusions

- The accuracy of the system regarding daily values is fairly good.
- However, concentrations are under-predicted and the result varies a lot by location.
- Uncertainties caused by
 - the local street and traffic conditions
 - forecasted meteorological and background concentration data.
- Further development, e.g., by considering
 - travel speed dependency in the suspension emission modelling
 - the output of the road weather model in the computation of the sanding and salting days



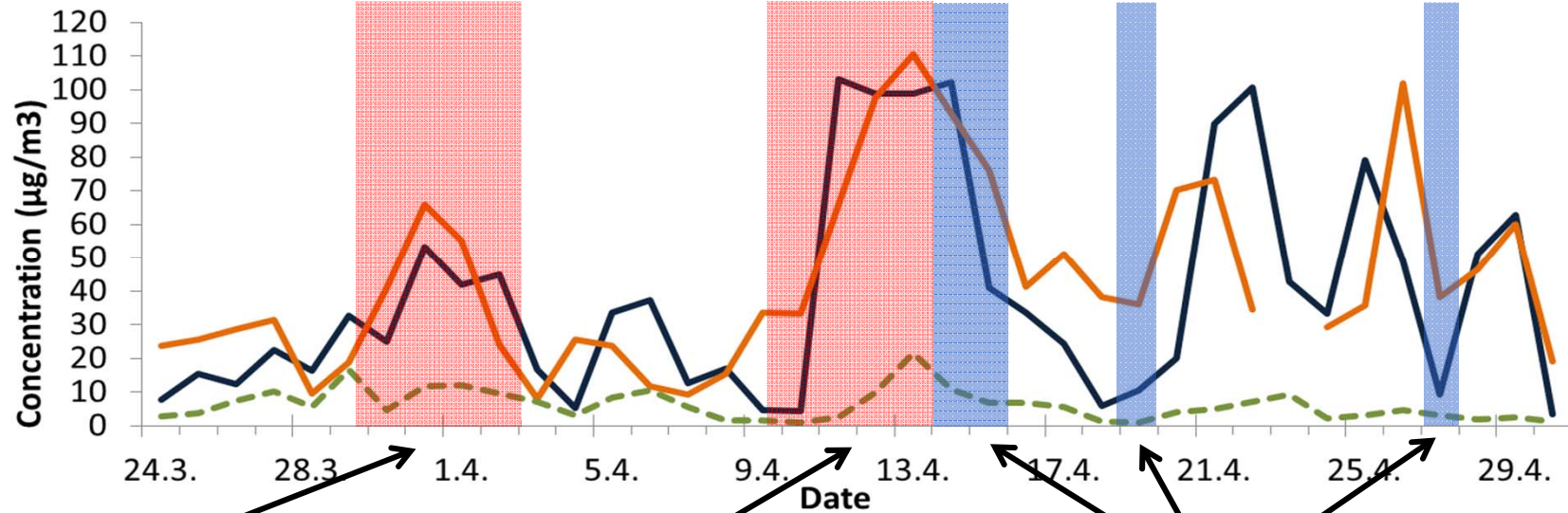
References

- HSY, 2011: Photos of the study areas. The Helsinki Region Environmental Services Authority.
- Härkönen, J., 2002: Regulatory dispersion modelling of traffic-originated pollution, Finnish Meteorological Institute Contributions 38, Helsinki, University press, ISBN 951-697-564-X, 103 p.
- Kauhaniemi, M., Kukkonen, J., Härkönen, J., Nikmo, J., Kangas, L., Omstedt, G., Ketzel, M., Kousa, A., Haakana, M., Karppinen, A. 2011: Evaluation of a road dust suspension model for predicting the concentrations of PM10 in a street canyon. Atmospheric Environment, 45, 3646-3654.
- Kupiainen, K. 2011: Street maintenance data, Nordic Envicon Oy, Life+/REDUST project.
- Omstedt, G., Bringfelt, B., Johansson, C., 2005: A model for vehicle-induced non-tailpipe emissions of particles along Swedish roads. Atmospheric Environment, 39, 6088-6097.



Street maintenance

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PM10 increase due to the sanding and relatively dry conditions

PM10 increase due to the accumulated dust and dry conditions

PM10 decrease due to the washing of street surfaces