



Joint analysis of meteorology and air quality in Helsinki, using air-quality supersites and an observation network

**Curtis R Wood, J Backman*, RD Kouznetsov, L Järvi,
A Karppinen, H Hannuniemi, L Kangas**
(M Aurela, R Hillamo, K Teinilä, H Timonen, E Asmi)

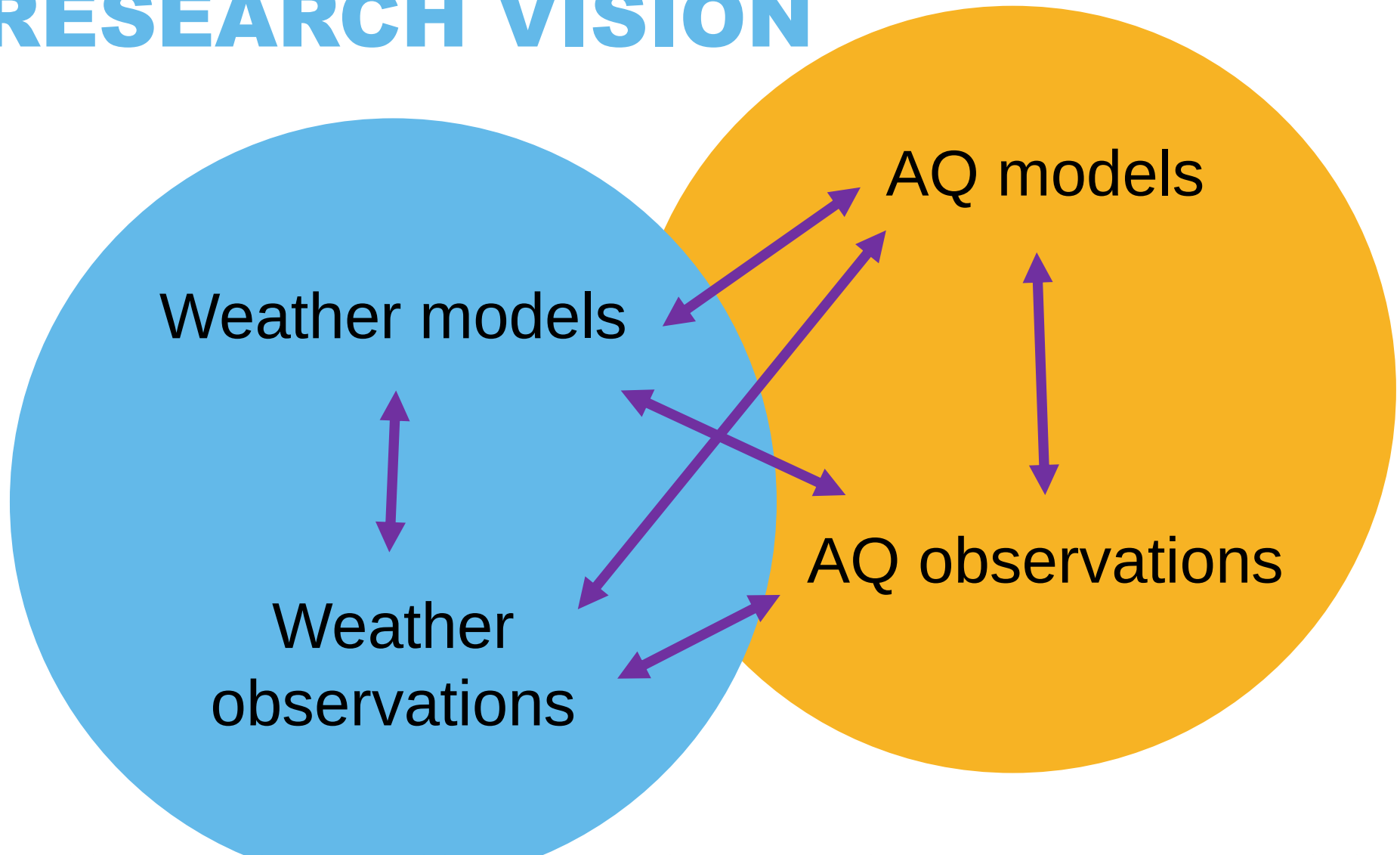
curtis.wood@fmi.fi

<http://urban.fmi.fi>

* John is the main post-doc working on this project



RESEARCH VISION



e.g. Fisher, B., Kukkonen, J., Piringer, M., Rotach, M. W. & Schatzmann, M. Meteorology applied to urban air pollution problems: concepts from COST 715. *ACP* **6**, 555–564 (2006).



FMI

- 600-700 personnel
- About ½ research, ½ operations
- Research includes met, AQ, space, oceans, etc
- Also consultancy services:
e.g. Helsinki Region Environmental Services Authority and FMI jointly evaluate impacts of various scenarios of urban development

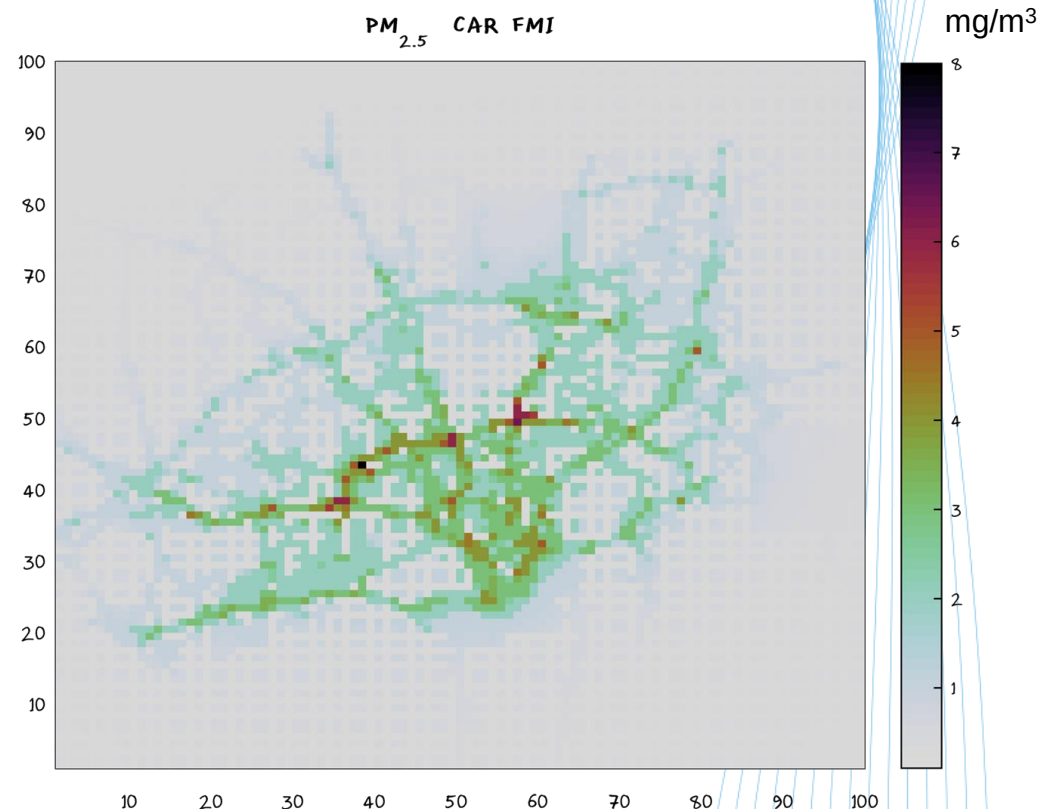




CAR-FMI (see also AQFS)

Real-time results shown on website uaqfs.fmi.fi

- We treat its as a 'black box' AQ model in this talk
- It is a simple tool based on dispersion from line sources (roads)
- PM_{2.5}, CO, NO, NO₂, NO_x, O₃
- It relies on 1-hr meteorological data (e.g. **MPP**) and traffic counts
- It is normally run for a year or two for consultancy projects – such as city planning



Kousa, A., Kukkonen, J., Karppinen, A., Aarnio, P. & Koskentalo, T. A model for evaluating the population exposure to ambient air pollution in an urban area. *Atmospheric Environment* **36**, 2109–2119 (2002).

Kauhaniemi M., Stojiljkovic A., Pirjola L., Karppinen A., Härkönen J., Kupiainen K., Kangas L., Aarnio M.A., Omstedt G., Denby B.R., Kukkonen J., 2014. Comparison of the predictions of two road dust emission models with the measurements of a mobile van. *Atmos. Chem. Phys.*, 14,9155-9169, 2014



MPP (meteorological pre-processor)

- Based on MOST/empirical relationships
- It estimates fluxes and ABL depth from simple variables (T, U, etc)
- Different local(FMI) versions exist! – we deal with one here

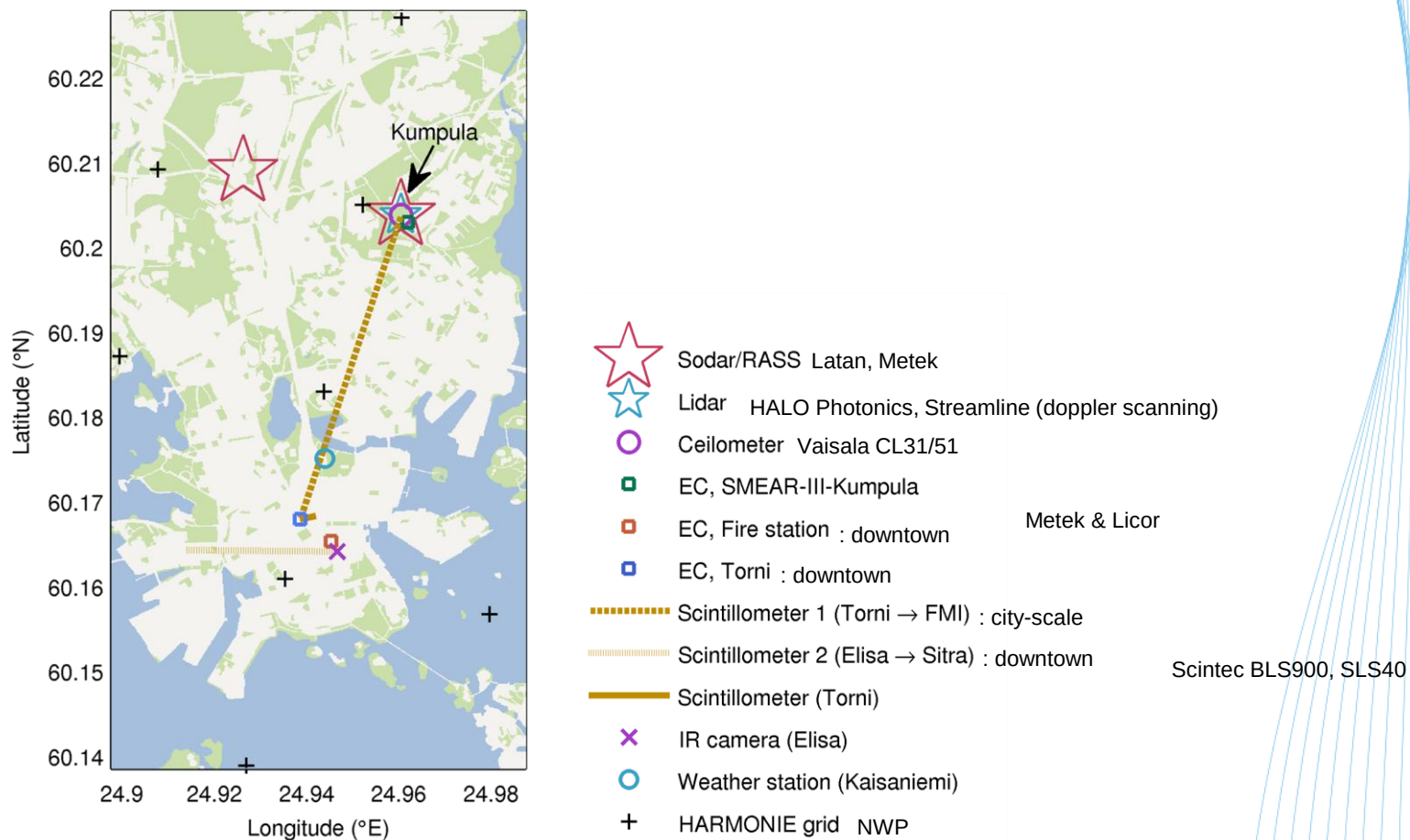
Karppinen, A., Joffre, S. & Kukkonen, J. The refinement of a meteorological preprocessor for the urban environment. *International Journal of Environment and Pollution* **14**, 565–572 (2000).

Zilitinkevich, S., Esau, I. and Baklanov, A. (2007), Further comments on the equilibrium height of neutral and stable planetary boundary layers. *Q.J.R. Meteorol. Soc.*, 133: 265–271. doi: 10.1002/qj.27



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Wood, C. R. *et al.* An overview on the Urban Boundary-layer Atmosphere Network in Helsinki. *BAMS* **11**, (2013).



FINNISH METEOROLOGICAL INSTITUTE

Helsinki latest papers (2015)

Nordbo A, Karsisto P, Matikainen L, Wood CR, Järvi L
Urban surface cover determined with airborne lidar -- implications to surface energy balance modelling.

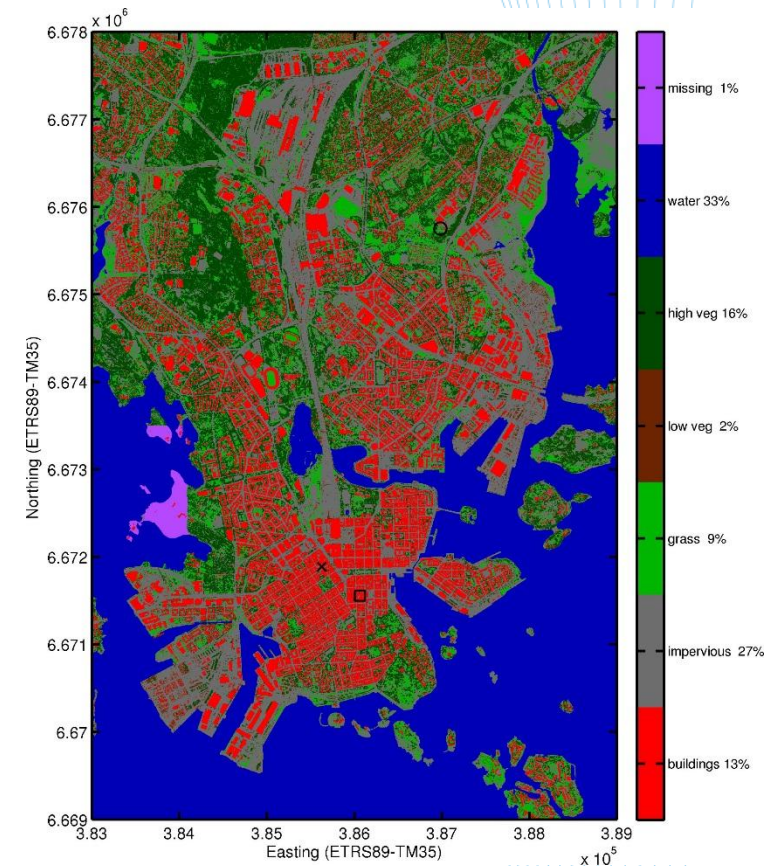
Urban Climate

Antti Hellsten, Sofia-M. Luukkonen, Gerald Steinfeld, Farah Kanani-Sühring, Tiina Markkanen, Leena Järvi, Juha Lento, Timo Vesala, Siegfried Raasch.

Footprint Evaluation for Flux and Concentration Measurements for an Urban-Like Canopy with Coupled Lagrangian Stochastic and Large-Eddy Simulation Models.

BLMet

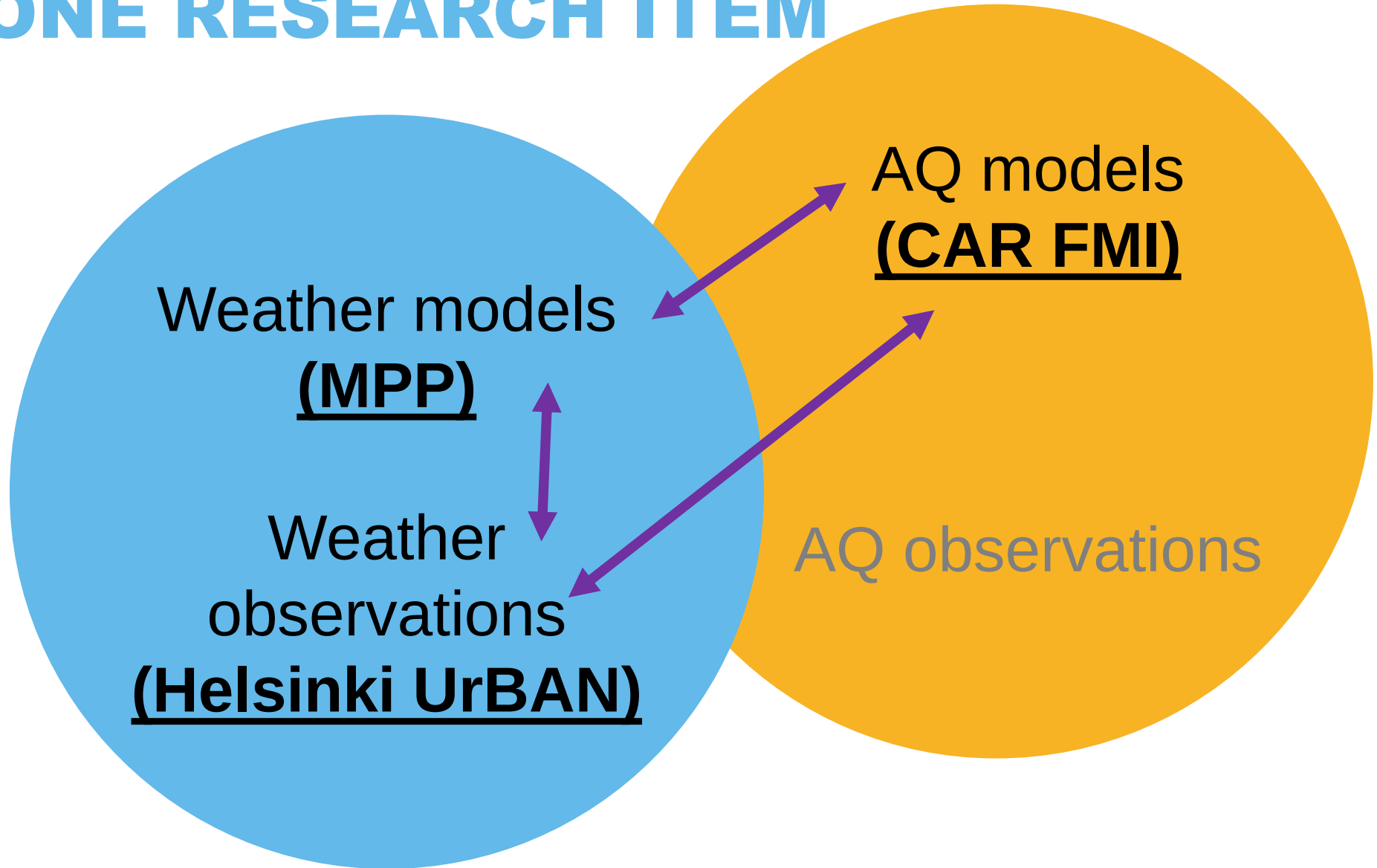
<http://urban.fmi.fi>



LES for downtown Helsinki
– further work underway.



ONE RESEARCH ITEM



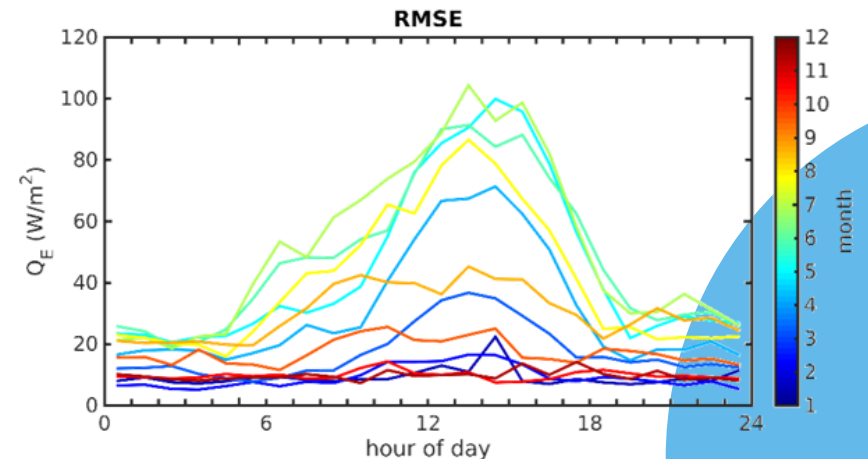
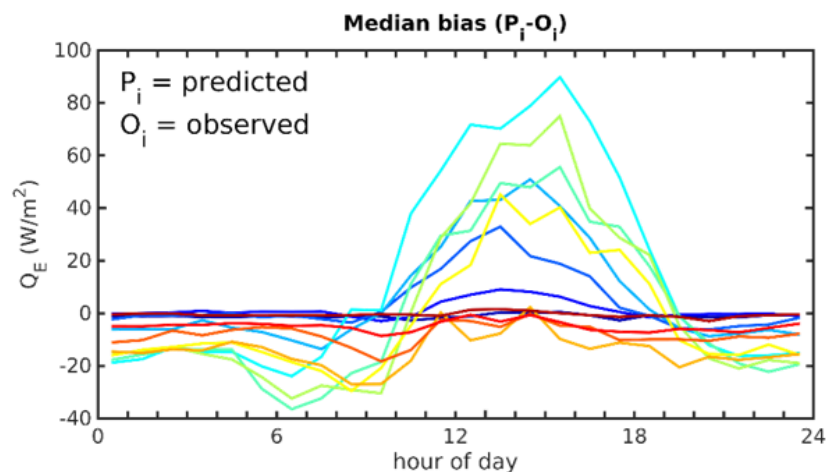
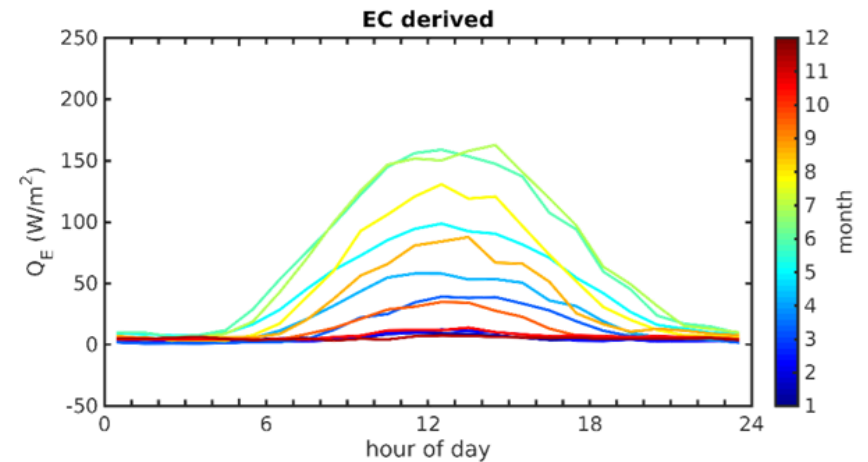
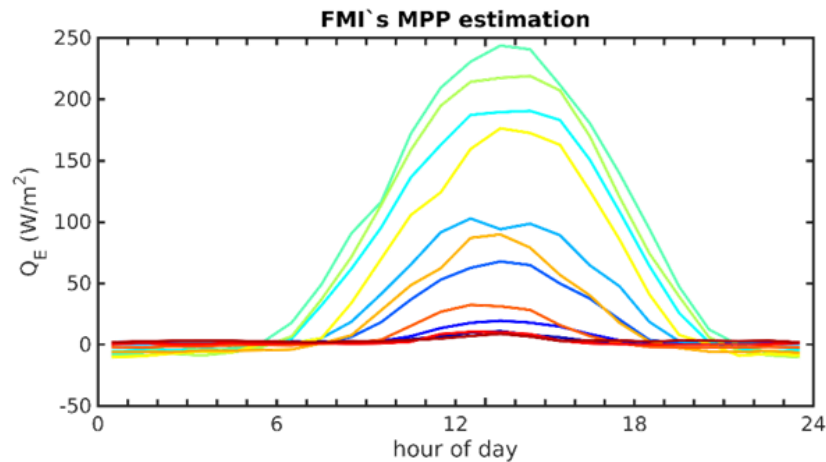


Part of 1 work package: MPP and obs comparison

Observations from Kumpula (semi-urban)
1.1.2011 – 31.8.2013 (80-90% coverage)

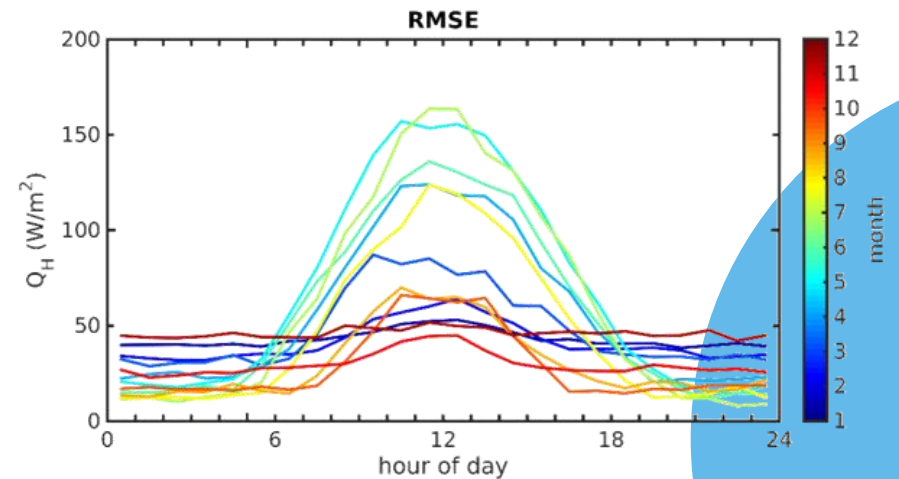
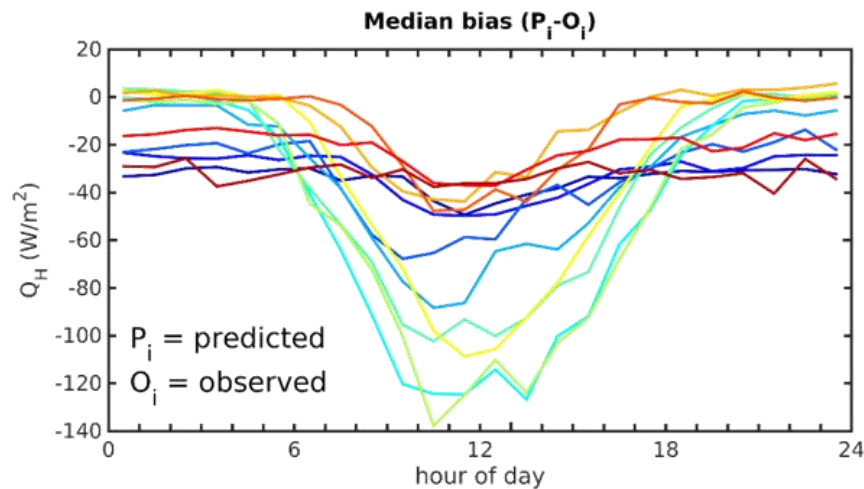
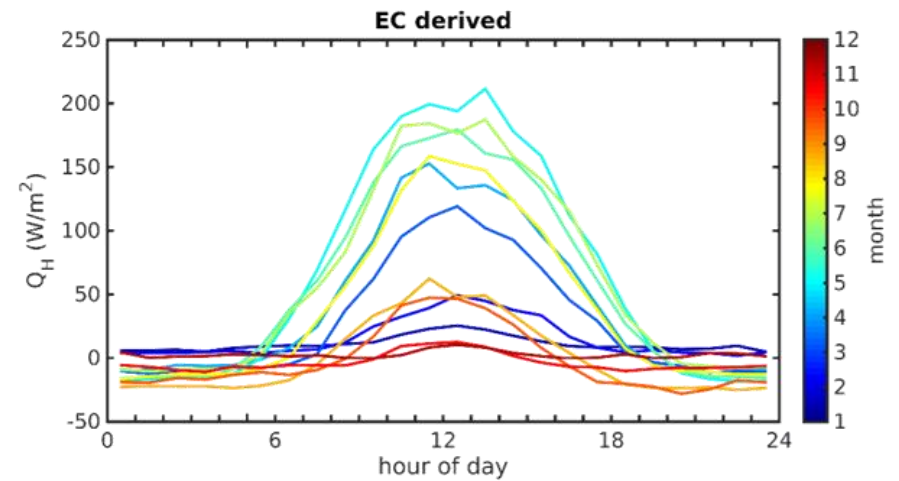
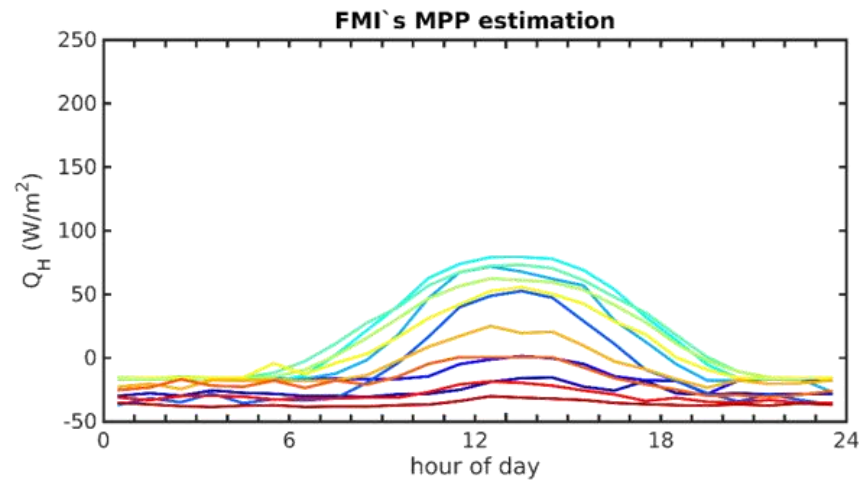


$|Q_E|$ over estimated in MPP





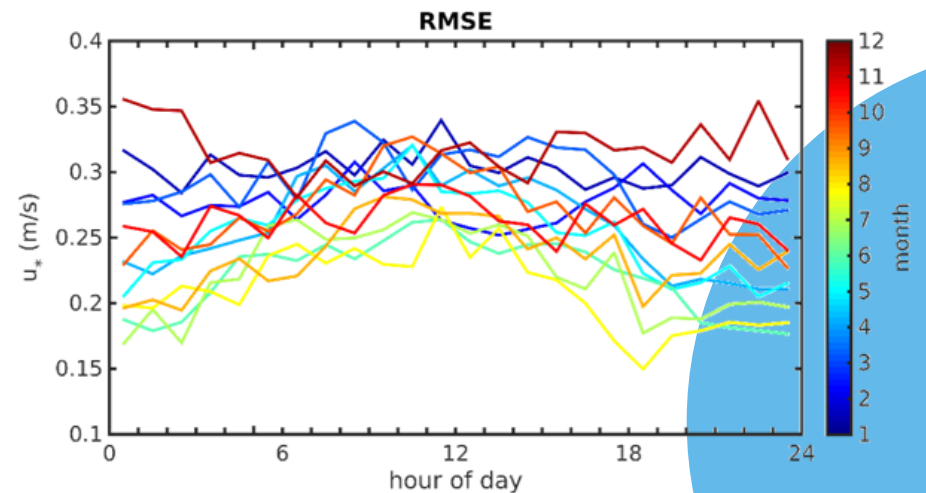
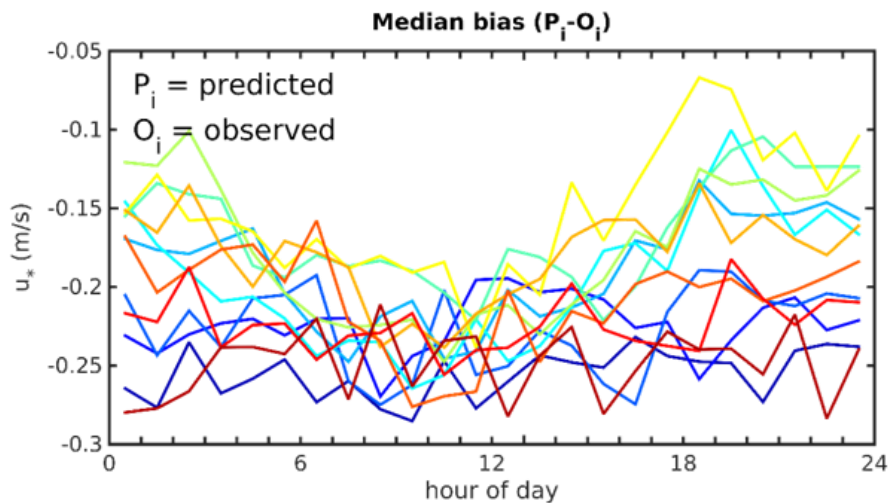
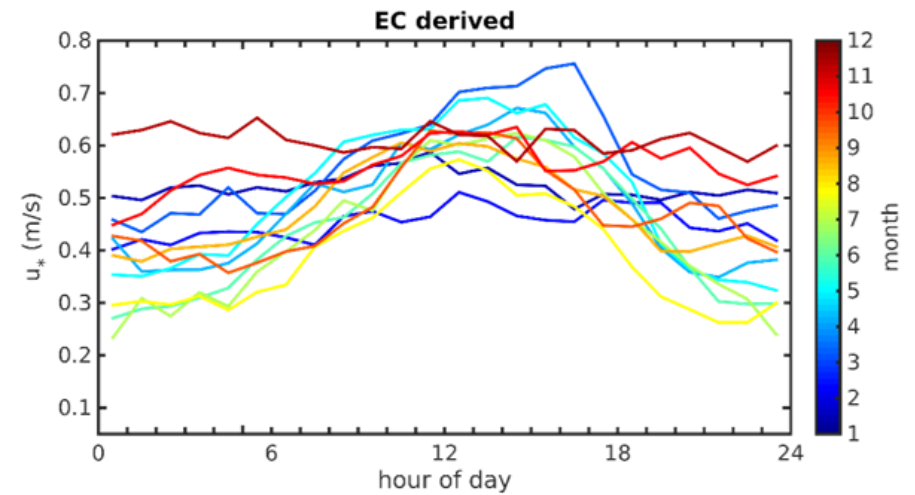
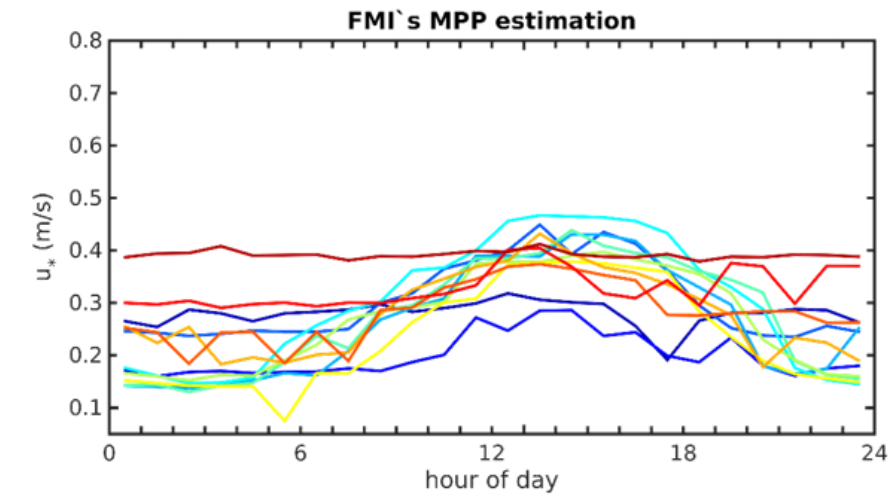
Q_H underestimated in MPP





u^* underestimated in MPP

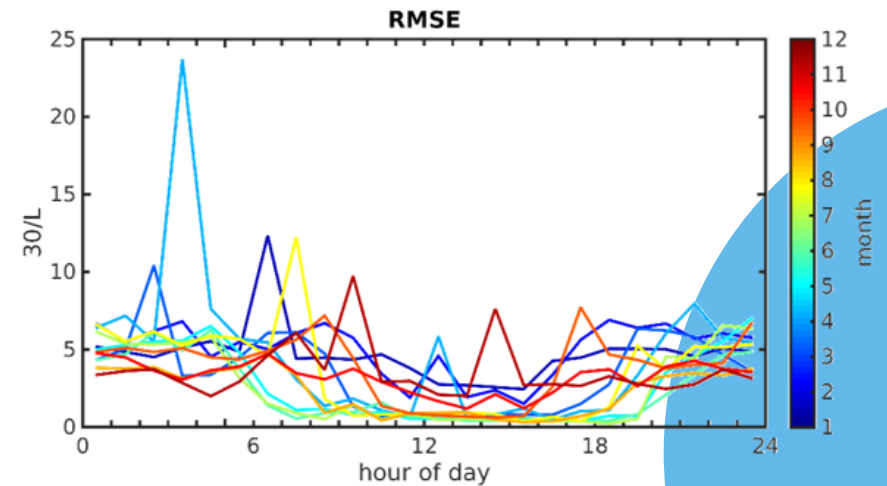
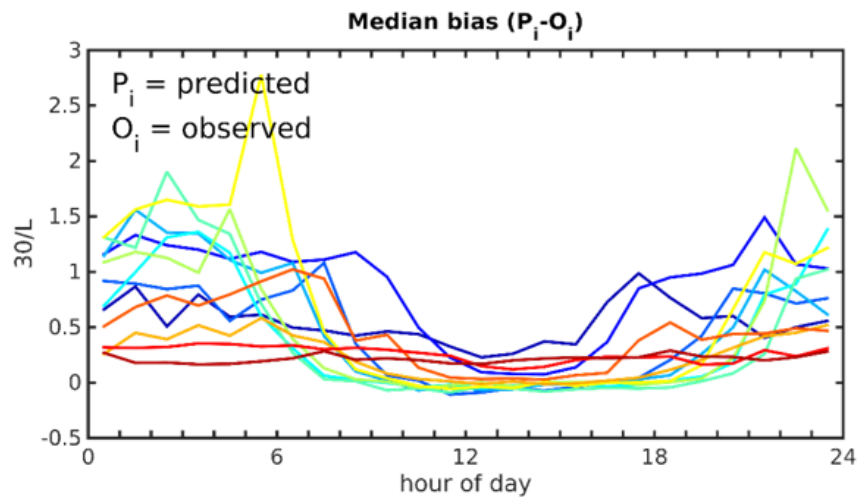
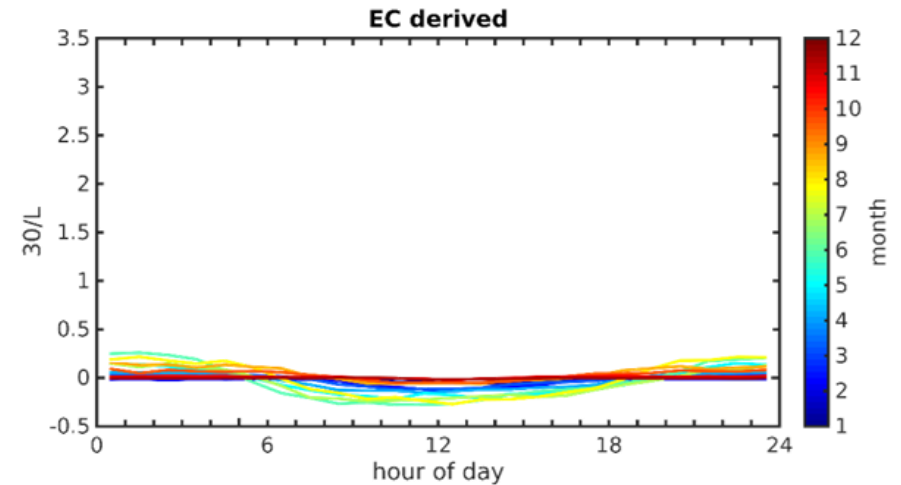
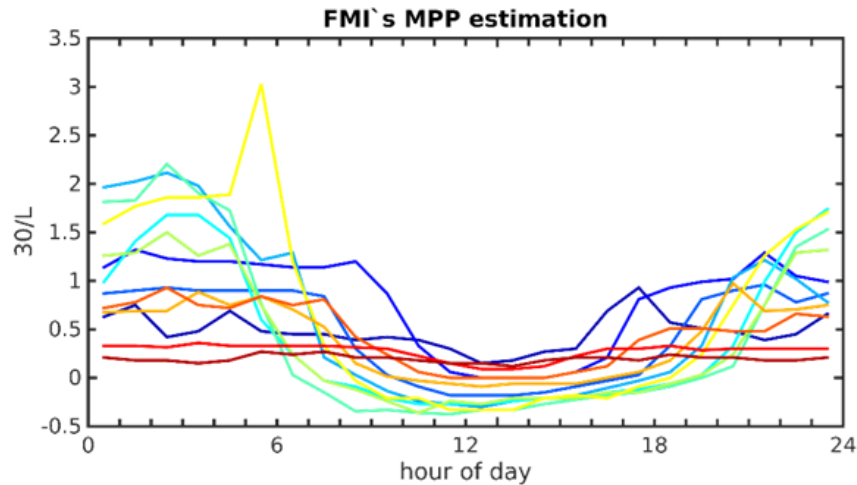
-> Need to check z_0 in MPP





z/L over estimated in MPP

-> Largely due to u^{*3}





Open Questions

Weather models
(MPP)

Weather
observations
(Helsinki UrBAN)

AQ models
(CAR FMI)

- ✓ Are the errors a general MPP problem? (1) Bowen, (2) z0
- ✓ Is this site specific?
- ✓ How important is this for the output FMI air-quality models such as CAR-FMI?
- ✓ Is it worth replacing those MPP data with flux observations directly or with NWP fluxes?



FINNISH METEOROLOGICAL INSTITUTE

Curtis R Wood
curtis.wood@fmi.fi
<http://urban.fmi.fi>

Finnish Meteorological Institute
Erik Palménin aukio 1,
FI-00560 Helsinki
P.O.Box 503, FI-00101 Helsinki

WWW.FMI.FI

Twitter: @meteorologit @IlmaTiede

Facebook: FMIBeta