Ensemble based probabilistic forecasting of air quality in Oslo and Rotterdam

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uncert|web

uncertainty-enabled model web

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Background and purpose

- UncertWeb is a 3-year (ends February 2013) EU FP7 project addressing uncertainties in models and chain of models, and how such uncertainties can be stored and communicated between different models on the web (internet) using project developed formats and infrastructure

- The present probabilistic air quality forecasting system is defined as a use-case in this project

For more info on UncertWeb go to: www.uncertweb.org

Meteorological downscaling using 4-level nested TAPM model

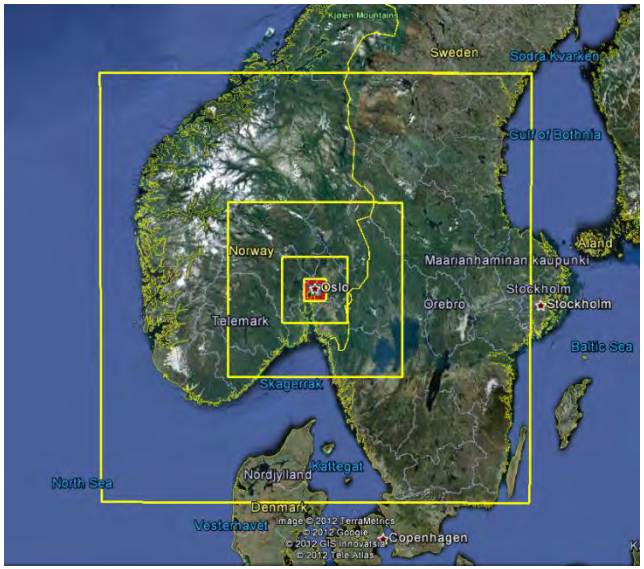
40 x 40

20 km
8 km
3 km
1 km

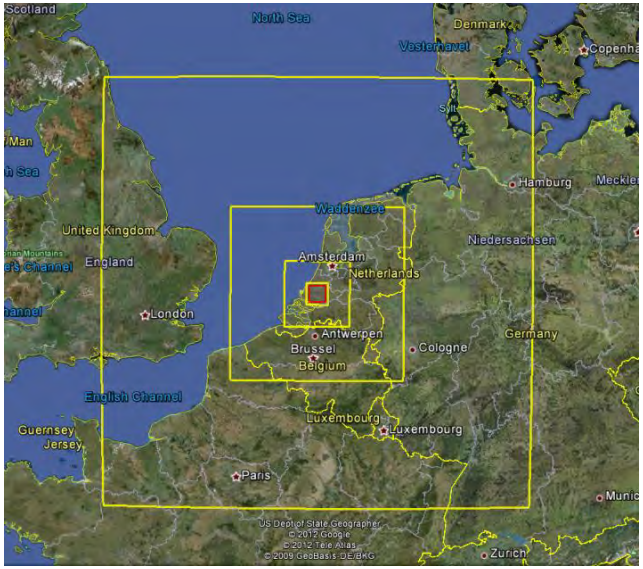
25 levels

10 m to
8 km

Oslo



Rotterdam



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- TAPM is a model from CSIRO, Australia - www.cmar.csiro.au/research/tapm
- Input: ECMWF synoptic scale control + 50 ensemble member forecast
- In Rotterdam the model performs well using standard settings
- In Oslo, with snow and ice during winter, adjustments of default sea surface temp. and deep soil temp. is necessary, in addition to model spin-up

Urban air quality of NO2 and PM10 from NILUs EPISODE model

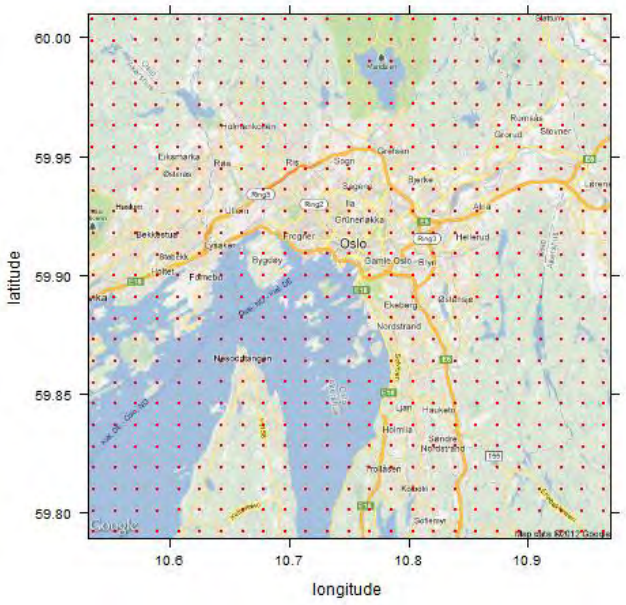
Oslo

30 x 30

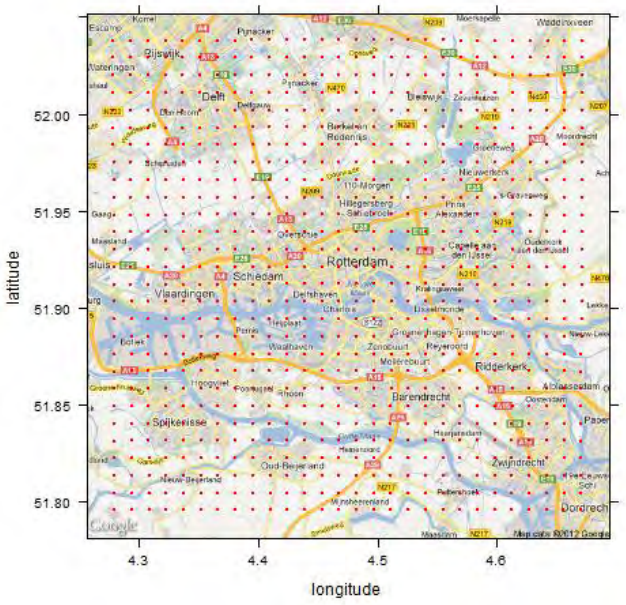
1 x 1 km^2

20 layers

17.5 m to 3750 m



Rotterdam



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17.5 m to 3750 m

- For info on the EPISODE model see: http://pandora.meng.auth.gr/mds/mds.php
- Input: Ensembles of emission, meteorology and background conc. for the urban grid
- Ensembles of 3 days forecasts of hourly concentrations in grid and receptor points
- Data stored and communicated to other models (e.g. exposure) using NetCDF-U format

Emissions of NO2, NO and PM10

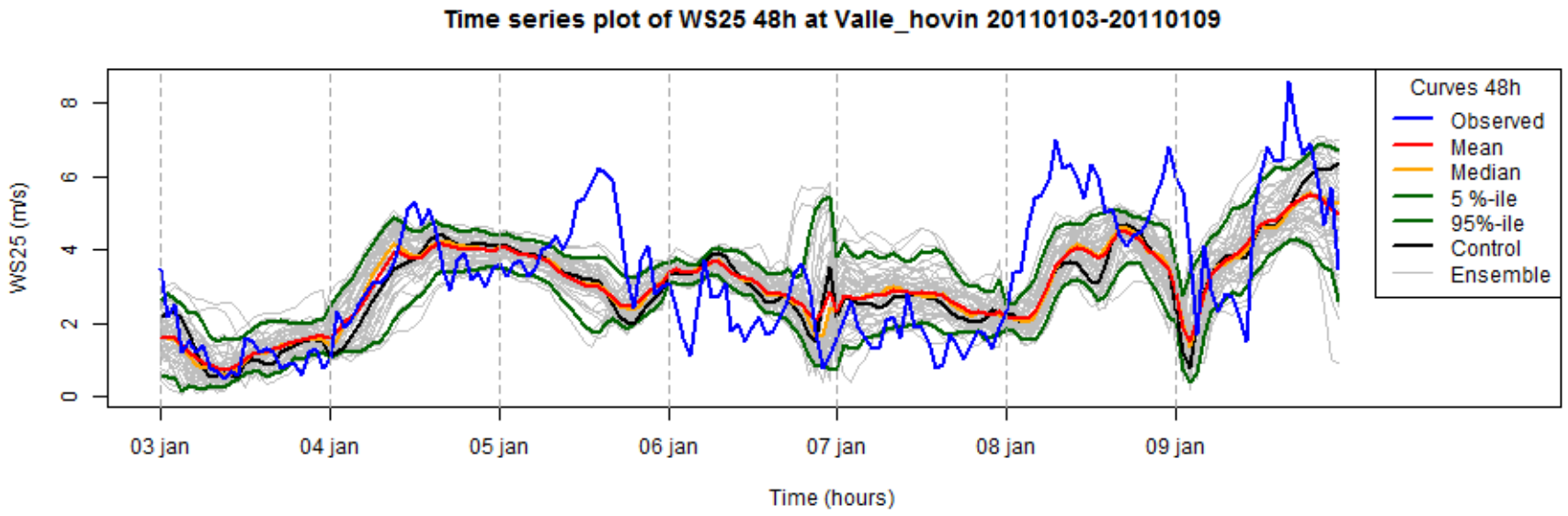
- For both cities ground level (road traffic) and upper level (home heating, shipping and industry) sources are included
  - For Rotterdam hourly gridded emissions are used
  - For Oslo gridded emissions are used for upper level, while line sources (road links) are used for traffic
- After a cube-root transformation, uncertainties in emissions are considered to be normally distributed with 10% SD at maximum emission level (higher for lower levels)
- Based on this, ensembles (samples) of gridded and line source emissions are generated on an hourly basis

MACC background ensemble of NO2, O3 and PM10

- Regional background concentrations for Oslo and Rotterdam are based on the GEMS/MACC RAQ model ensemble
  - CHIMERE; EMEP; EURAD; LOTOS-EUROS; MATCH; MOZART; SILAM
- Currently we use data from this ensemble for the period 1 Nov 2010 – 30 Apr 2011 kindly provided by Météo-France
- Using a cube-root transformation uncertainties in background concentration are considered to be normally distributed with mean and SD tentatively set to ensemble mean and SD

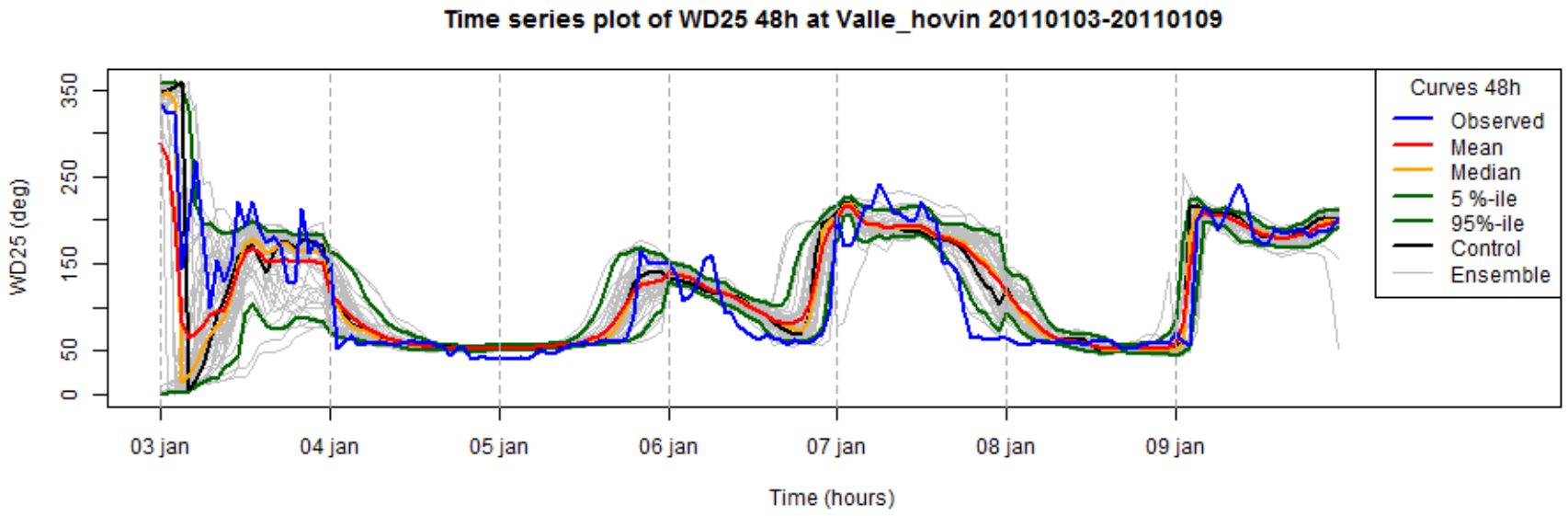
Oslo PAQFS results

Valle Hovin: Wind speed at 25 m 2nd day forecasts 3 Jan – 9 Jan 2011



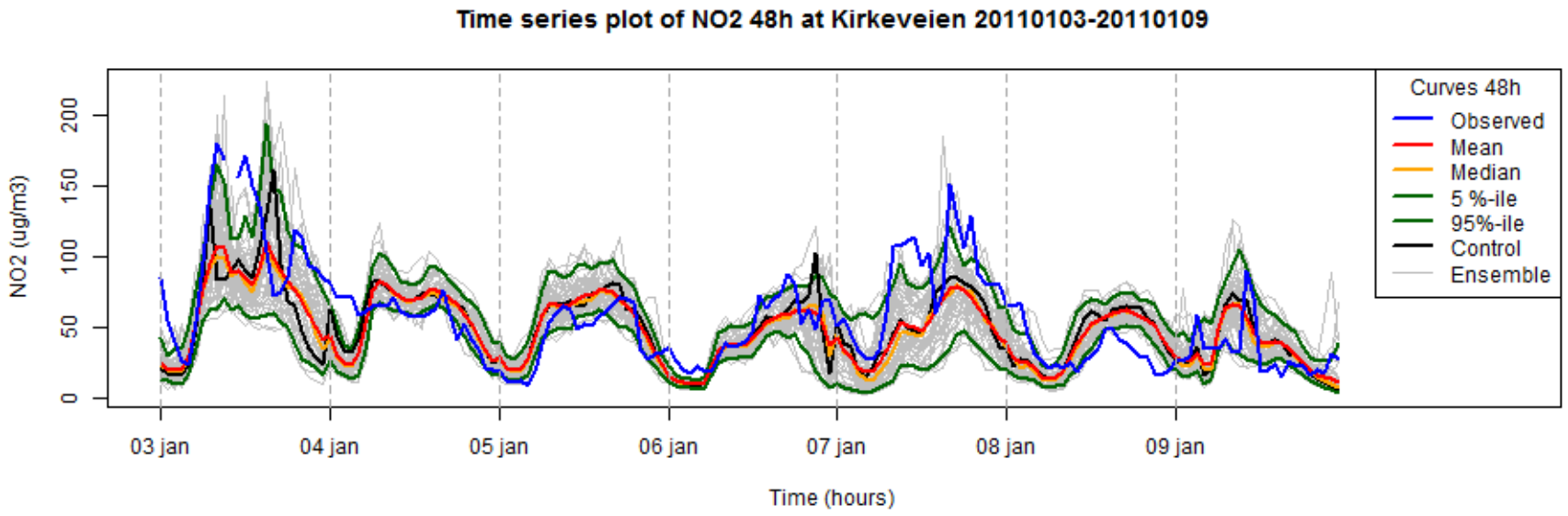
Oslo PAQFS results

Valle Hovin: Wind direction at 25 m 2nd day forecasts 3 Jan – 9 Jan 2011



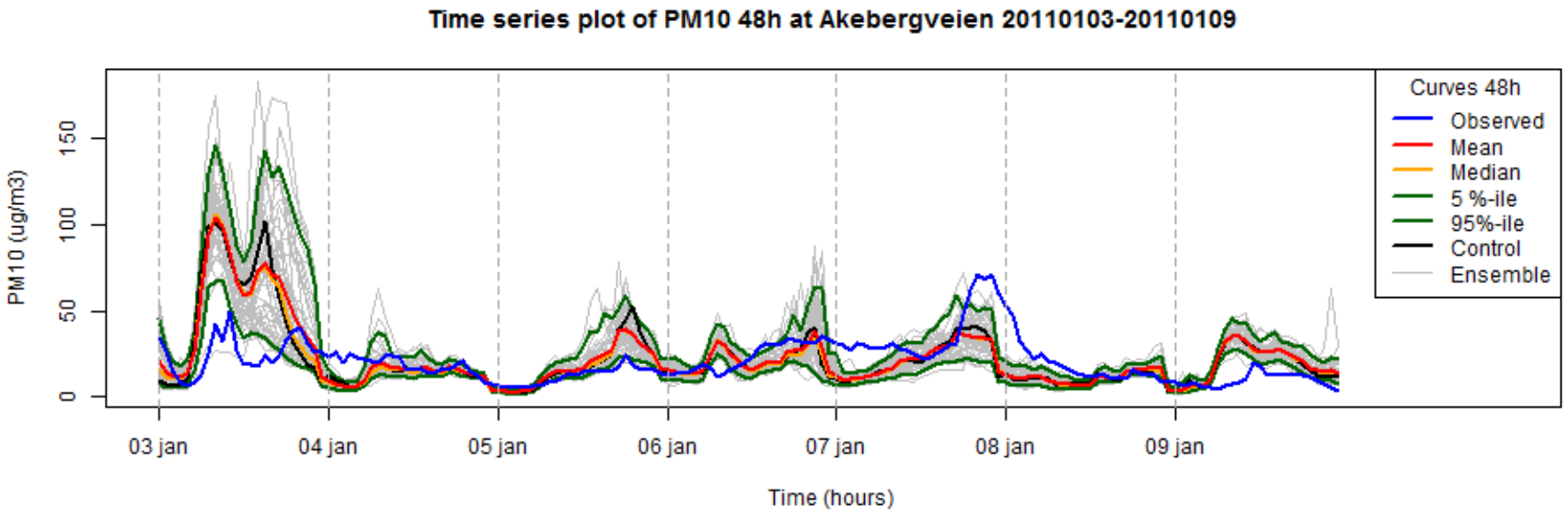
Oslo PAQFS results

Kirkeveien: NO2 concentration 2nd day forecasts 3 Jan – 9 Jan 2011



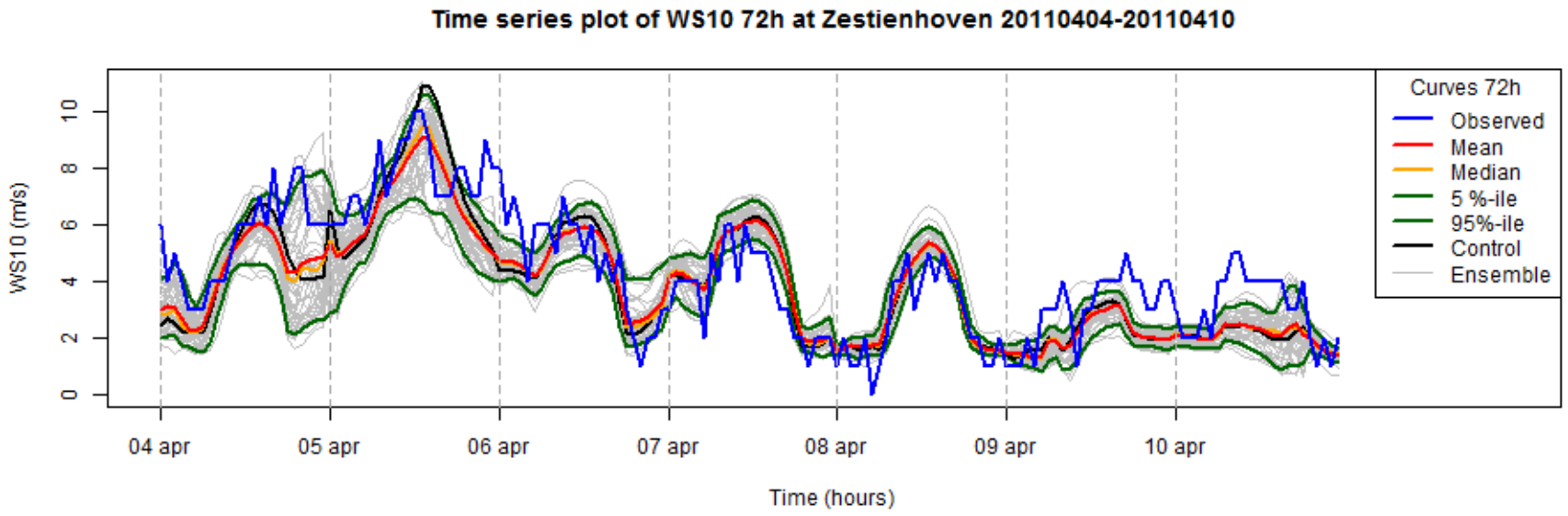
Oslo PAQFS results

Åkerbergveien: PM10 concentration 2nd day forecasts 3 Jan – 9 Jan 2011



Rotterdam PAQFS results

Zestienhoven: Wind speed at 10 m 3rd day forecasts 4 Apr – 10 Apr 2011



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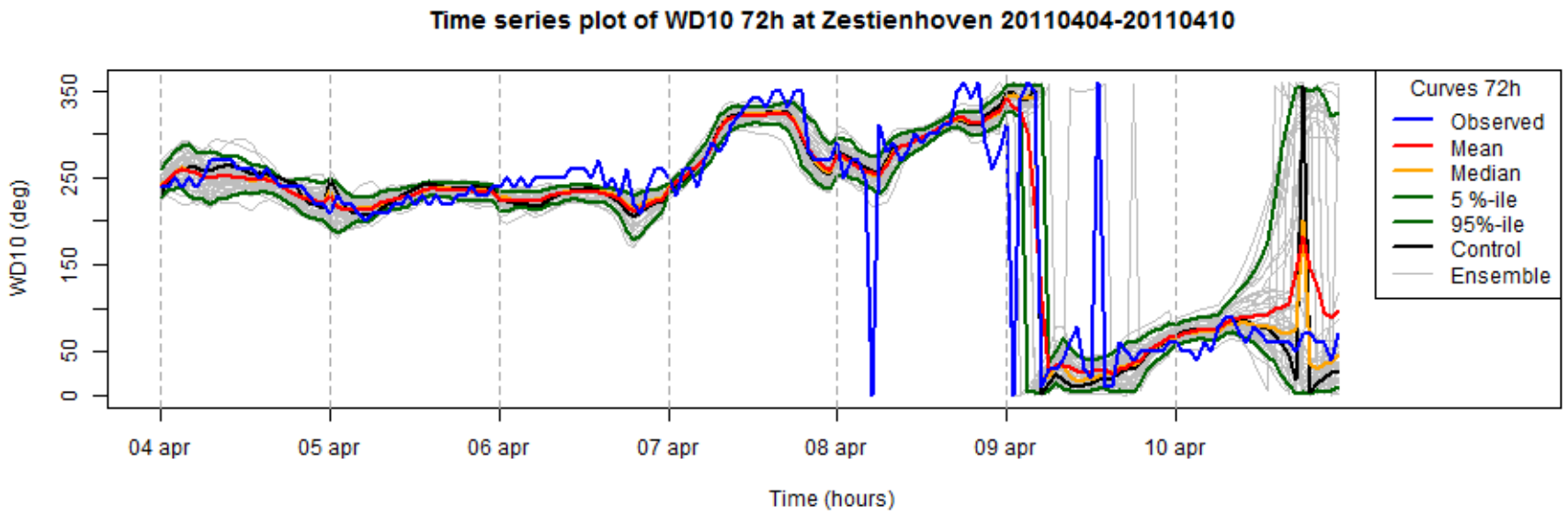
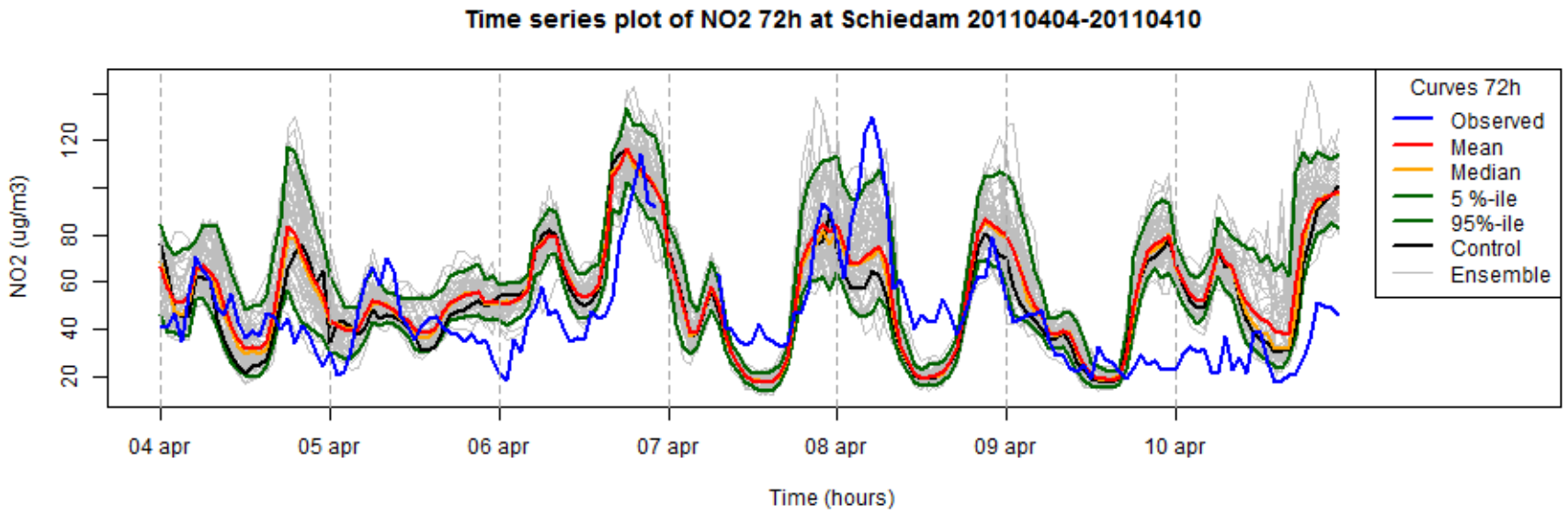


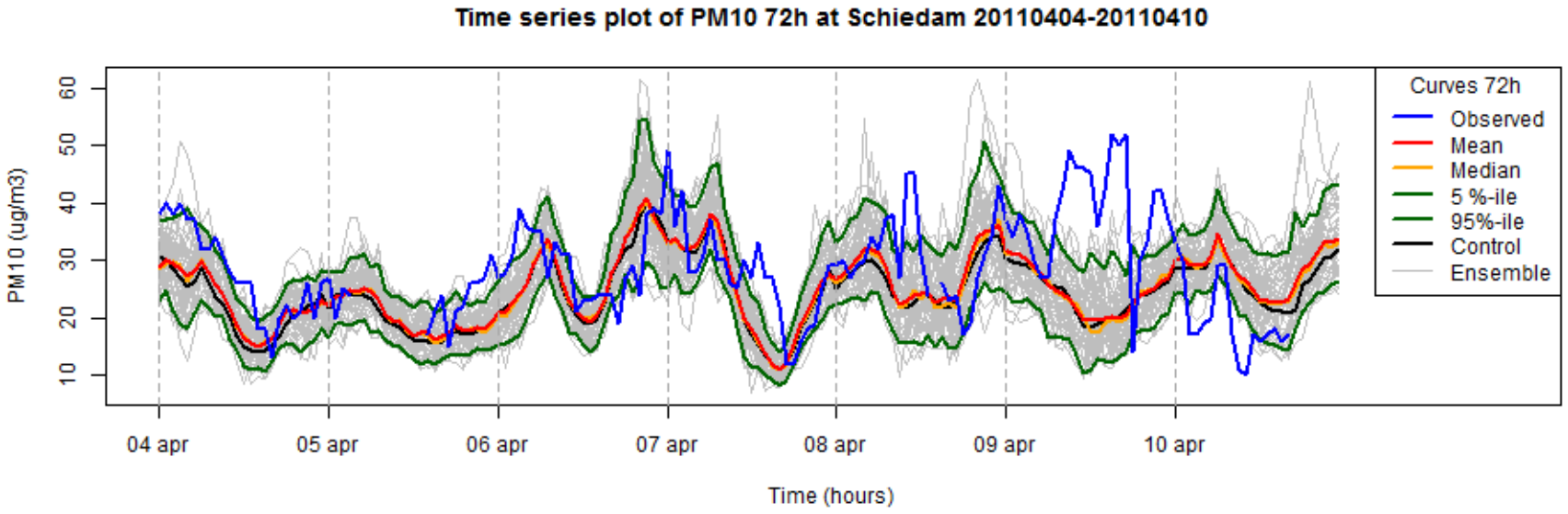
Rotterdam PAQFS results

Schiedam: NO2 concentration 3rd day forecasts 4 Apr – 10 Apr 2011



Rotterdam PAQFS results

Schiedam: PM10 concentration 3rd day forecasts 4 Apr – 10 Apr 2011



Further work

- Improve calibration and sharpness of the current system by introducing stochastic models with parameters, which can then be estimated using observations
- Move from offline to more online use of data, including downloading of ECMWF and MACC data in near real time
- Running the system on a faster multi-core computer
- Long term goal: Introduce the system in Norway's current AQFS (Better City Air) replacing the current deterministic forecasting system in the larger Norwegian cities

For more info on Better City Air go to: www.luftkvalitet.info (in Norwegian)

Thanks for your attention

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