

TOOLKIT FOR EVALUATING REGIONAL AND LOCAL AIR QUALITY MODELS WITH OBSERVATIONS

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Summary

The Model Evaluation Toolkit provides open and intuitive tools for evaluating and comparing regional and local model concentrations with observations. It has been developed and tested during the Multi-model Air Quality System for Health Research (MAQS-Health) project and enables straightforward and consistent inter-comparison between regional model outputs and coupled system results from the MAQS-Health system. Features include automatic access to online measured data and a wide range of graphical and statistical output.

Introduction

The Model Evaluation Toolkit has been developed to provide tools for evaluating concentration outputs from the Multi-model Air Quality System for Health Research (MAQS-Health) and other air quality models. The Toolkit enables users to: compare modelled and observed data for any species for a wide range of metrics; assess and compare modelled concentration results from any of the models supported by MAQS-Health (and others); import observed data from online monitoring networks; produce report-ready graphs; produce model evaluation statistics; and obtain reproducible results with full logging.

Methodology and Results

The Model Evaluation Toolkit consists of three tools: the 'Data Input Tool' processes the modelled and observed concentration data; the 'Model Evaluation Tool' produces graphs and statistics that give an overview over all models, pollutants and stations; and the 'Model Diagnostics Tool' provides graphical tools for investigating individual stations, models and pollutants in more detail. The Toolkit runs on Linux based HPC systems (in common with the rest of the MAQS-Health system) and Windows; a User Interface is provided for Windows users. The Toolkit is open source and written in R. The Data Input Tool provides automatic access to observations from UK regulatory air quality networks; observations from other networks can be imported from file. Directly supported modelled data formats include MAQS-Health, ADMS, WRF-Chem, EMEP, CMAQ (and CAMx) and CHIMERE; concentrations from unsupported models can be imported using a simple text file. For gridded modelled data formats, values at monitoring site locations are calculated either by interpolation or by identifying the value at the nearest grid point. Observations from multiple networks can be included and multiple modelled datasets in different formats can be imported. The Model Evaluation Tool compares modelled concentrations for selected combinations of: species, modelled datasets and monitoring sites, site types or networks. The calculated ensemble median over the selected modelled datasets can also be assessed. Graphs and statistics are generated allowing for user-defined averaging times and statistics. Results can be grouped by station, station type, pollutant and model. Graphs include: scatter plots of modelled versus observed mean (Fig 1), maximum or standard deviation; frequency scatter plots where colour indicates the number of data points; FAIRMODE target plots, showing model performance accounting for measurement uncertainty; box and whisker plots; and diurnal / monthly profile plots. For assessing model performance for air quality forecasting or in terms of Air Quality Directive compliance, exceedance statistics such as the probability of detection, false alarm ratio and odds ratio can be calculated. Calculated statistics are output to readable text files. The Model Diagnostics Tool provides further graphs for more detailed investigation of individual models at individual sites, such as time series graphs, scatter plots, diurnal / monthly profile plots and pollution roses.

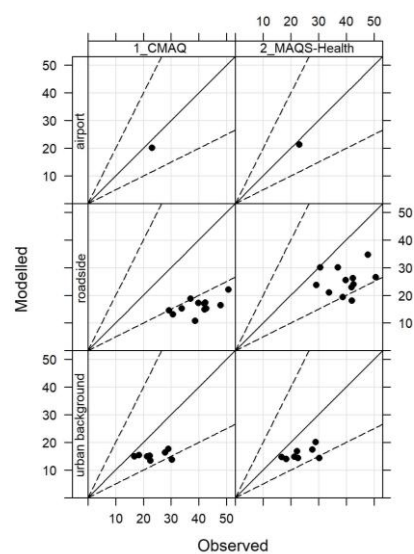
Conclusions

The Model Evaluation Toolkit provides comprehensive tools for evaluating regional and local air quality models with measurements. By supporting all the regional model formats compatible with MAQS-Health and by providing automatic access to online measured data, the Toolkit enables straightforward and consistent inter-comparison between the regional model outputs and the coupled system results from the MAQS-Health system.

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Scatter Plot: CMAQ VS MAQS-HEALTH
ALL STATIONS, 8760-HOUR MEAN NO₂ (µg m⁻³)



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Fig.1 Annual mean scatter plot