OpenDA applications

OpenDA

Testing different filters for the LOTOS-EUROS regional air quality model

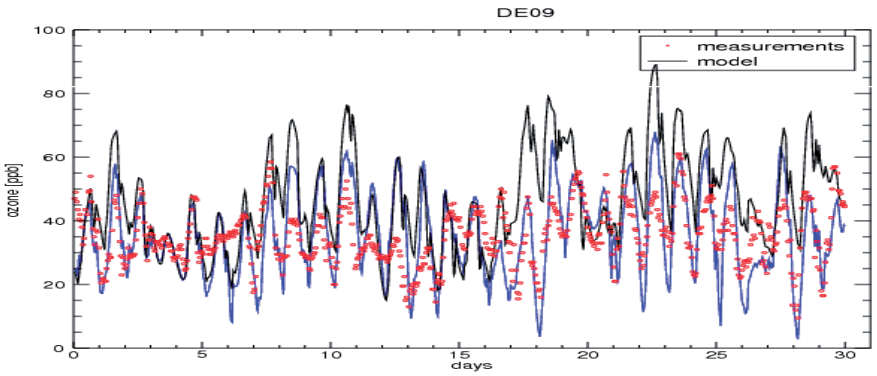

Figure 1: Timeseries of ozone concentration in location DE09 before assimilation (black line) and after assimilation (blue line), compared to observations (red dots).

LOTOS-EUROS

LOTOS-EUROS is a regional air quality model that is used operationally to predict concentrations of trace gases and air quality parameters for the Netherlands. If a serious smog episode is predicted, appropriate countermeasures can be taken and warnings can be issued for people that are sensitive to smog. Input for the model are the emissions from traffic and industry and natural emissions. These are usually poorly known and introduce a major uncertainty in the predictions. Data-assimilation can be used to significantly reduce this uncertainty.

Experiment: Testing different filters

LOTOS-EUROS was connected to OpenDA. This took an effort of just some five days. Once the connection was made, four different data-assimilation methods (and several variations thereof) were tested to determine which one is the most appropriate for this application. As each of these filters was available in OpenDA, applying them involved no more than creating a different control file.

The data-assimilation methods that were tested, were all different approximations of the Kalman filter: *the ensemble filter, the ensemble square root filter, the reduced rank square root filter and the coffee filter*. The filters were applied to a simulation of one month, simulating full chemistry and assimilating hourly measurements from ground based stations from across Europe. The emissions of NOx and organic compounds were marked at uncertain as well as 5 deposition parameters. A number of observation locations (the analysis sites) was selected from which observations were used in the assimilation. The data from the remaining locations (validation sites) was not used for assimilation but only to assess the impact of the assimilation.

Results

As expected, the assimilation removed the largest bias, leading to model outcomes that better match the observations. Given the fact that the uncertainty model was extremely simple (no spatial variation in the uncertainty), the improvements are remarkable. In most of the validation stations, the difference between predictions and observations is reduced. Also, improved estimates of the uncertain emissions and depositions were obtained as these are provided by the filter. With respect to the different filters, the ensemble filters (both the regular ensemble filter and the ensemble square root filter) gave better results than the other filters.

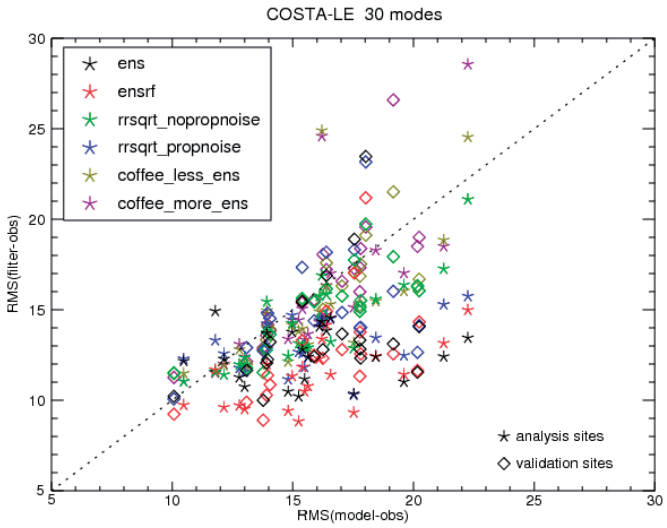

Figure 2: Comparison of the RMS in observation stations before (y-axis) and after (x-axis) assimilation for different data-assimila

Conclusions

Introducing OpenDA to LOTOS-EUROS proved to be a relatively small effort. It gives a very versatile environment for experimenting with data-assimilation, using different filters and settings to find an optimal configuration. The same environment can be used for parameter-estimation, which is of high interest to the LOTOS-EUROS users.

References

www.openda.org