Atmos. Chem. Phys. Discuss., 8, S3203–S3214, 2008
www.atmos-chem-phys-discuss.net/8/S3203/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "PM_{10} data assimilation over Europe with the optimal interpolation method" *by* M. Tombette et al.

Anonymous Referee #1

Received and published: 30 May 2008

1 General comments

This paper describes the assimilation of observations of PM_{10} from the French database BDQA (Base de Données sur la Qualité de l'Air), in a regional multi–module chemical transport model. The approach used for the assimilation is the optimal interpolation which provides adjusted initial conditions for the background model run to better match the observations at the assimilation time. The performance of the data assimilation system is assessed by comparing the model forecast with independent datasets (AirBase, EMEP), using statistical measures such as the Root Mean Square Error and the correlations. Results show that the assimilation of PM_{10} is beneficial and its impact extends beyond France, also in areas where no data where assimilated.

However, the impact of the assimilation is not long–lived and after a few hours the trajectory relaxes to that of the free–running model. Moreover, the assimilation of PM_{10} does not improve the concentrations of the single aerosol species. Experiments to assess the system sensitivity to specific assumptions and parameters such as the vertical and correlation lengths in the background error covariance matrix are also performed.

The paper presents and develops an interesting topic, namely the assimilation of aerosol observations, which is still a relatively new area of research. The assimilation results are compared with independent data using robust statistical indicators.

The style of the paper is, however, too synthetic, and there is an excessive use of parenthesis which makes some parts of the paper hard to read and interpret.

The paper could benefit from a more in–depth discussion of the motivation for pursuing aerosol assimilation in the introduction. The conclusions are also too dismissive. It would be useful for the reader to hear more ideas from the authors on how they would improve their assimilation system or whether they propose alternatives to optimal interpolation, especially in regards to the temporally localised impact of the assimilation.

For example in the operational application, the authors show that the impact of the assimilation is only evident in the improved statistics for the the one–day forecast, whereas the two–day forecast is not much better than the free–running simulation. Is this a limit of the optimal interpolation technique or is it more intrinsic to the assimilation of concentration data only, regardless the assimilation approach?

The authors mention in the abstract that they would discuss the use of variational methods for assimilation in the conclusions but this item is missing. Also missing in the conclusions is the discussion of an operational feasibility of implementing inverse methods to improve the emissions.

ACPD

8, S3203–S3214, 2008

2 Specific comments

2.1 Comments on the Introduction

There must be a better motivation to assimilate aerosol than the fact that aerosols are now a component of chemical transport model: please elaborate on that.

What do the authors mean by saying that the limit for PM_10 to exceed 50 $\mu g m^{-3}$ is set to 35 days per year? Who sets the limit and how is this limit enforced?

2.2 Comments on Section 4

The choice for the observation error in the baseline assimilation experiment is disputable. Even if the intention of the authors is to ensure that the assimilation draws mainly to the observations, it is not realistic to choose an observation error that is lower than the instrument error. Later on, in section 6, the authors show that even with a larger error (case with $\alpha = 1$), the impact of the assimilation is still positive, Moreover, the larger observation error does not impact at all the time extent of the influence of the data assimilation on the forecast, but only the amplitude of the improvement with respect to the free–running model.

Looking at equation (6) and Table 3, I cannot reconcile that in the comparison with the AirBase data the statistics for the single–species concentrations are not improved at all, while for PM_{10} (and $PM_{2.5}$) they are. I would understand better if there was some aliasing of the increment in PM_{10} into an increment on one single species, namely the main contributing species to PM_{10} at the particular station, but table 3 shows no such as thing. Do the authors have an explanation for this behaviour other than the

ACPD
8, S3203–S3214, 2008

lower number of stations for the concentration comparison with respect to the PM_{10} comparison which could skew the statistics? Have the authors looked at the values of concentrations station by station? Given the low number of stations that should not be too hard, and it could provide some insights into this behaviour.

2.3 Comments on Section 7

This section needs to be expanded (see also general comments). The authors should discuss the merits and shortcomings of the optimal interpolation approach with respect to choosing other methods, as announced in the abstract.

3 Technical corrections

Page 9608:

line 07 Replace “Then, the method is applied.." with “The method is then applied..."

line 13 Place “the" in front of “assimilation"

line 15 Replace “a few choices (e.g. ...)." with “possible alternatives. e.g. for the background error statistics, and for the optimisation variables."

line 19 Add “atmospheric components" after “modeling"

line 20 Remove “and" and “for". Replace “important" with “substantial"

line 22 Replace “measurements" with “observations"

line 24 Replace the parenthesis with commas

ACPD
8, S3203–S3214, 2008

line 25 Remove “of the modeler"

line 26 Provide a reference for the statement ending in “forecast itself".

Page 9609:

line 02 Replace “DA....methods:" with “The are many existing approaches to DA:"

line 09 Remove “(inverse modeling)".

line 25 Insert reference to Mallet et a. 2007 in parenthesis.

line 27 Replace “Indeed" with “Currently" and remove “currently" before “ no adjoint"

line 28 Remove parenthesis and add “which is a" before “discontinuous model..."

line 29 Remove parenthesis and add “in the" before “definition"

Page 9610:

line 02 Remove sentence in parenthesis

line 03 Replace “conceivable" with “practical".

line 11 Replace “their concentration" with “its concentration".

line 19 Add “for aerosol assimilation" after “Variational methods". Replace “were also" with “have also been".

line 22 Replace “sketch answers to" with “address"

Page 9611:

ACPD

8, S3203–S3214, 2008

Interactive Comment

line 05 Replace “meanwhile" with “at the same time".

line 06 Replace “relatively low (a few days)" with “of the order of few days". Replace “;" with “and".

line 07 Replace “So" with “For this reason".

line 10 Replace “It consists in determinating if" with “It aims to determine whether". Remove parenthesis and replace them with commas: “(...)" “ ,...,"

line 20 Replace “(which may not be realistic)." with “, which may not be a realistic assumption."

Page 9612:

line 02 Equation (1) - notation “argmin J" not clear

line 09 Add “and under the assumption of linearity" after “minimization".

line 14 Insert “to be" before “applied". Replace “to coincide with the observations" with “in order to better match the observations"

line 19 Eliminate parenthesis and add “which are" before “supposed".

line 22 Replace “this is reasonable ... ground stations." with “it is a reasonable assumption for instruments located at different ground stations".

Page 9613:

line 06 replace “:" with “according to which". Provide a reference for the Balgovind approach.

line 13 Replace “Forecasted" with “Forecast"

ACPD

8, S3203–S3214, 2008

line 22 What is the “granulometry" of the model?

Page 9614:

line 07 replace “managed by" with “predicted with". What does the acronym “SORGAM" stand for?

line 09 replace “(0.01 μm, 10 μm) " with “0.01-10.0 μm".

line 10 replace “and which is" by “,"

line 12 replace “hereafter" with “here". Replace “(with or without assimilation)" with “with and without assimilation". Add “performed" after “are"

line 13 replace “first" with “previous"

line 14 replace “evaluates" with “evaluated"

line 16-17 remove “as the other models do in general". After “wintertime." add a sentence “Other models also show similar behaviour".

line 18-19 Replace “The main points are quoted hereafter." with “The main characteristics of the model configuration are summarised here".

line 25 add “for 2001" after “ECMWF raw data"

Page 9615:

line 04 What does “mechanism" means in this context? Please reword.

line 09 Add “," before “VSRM"

line 14 What does the acronym “EMEP" stand for?

ACPD

8, S3203–S3214, 2008

Interactive Comment

line 19 Replace “As a result," with “Hence,"

line 22 what is intended by “station types"?

line 23 remove “too". Replace “On the contrary" with “Since".

line 23 remove “so"

line 25 replace “comparisons" with “validation"

Page 9616:

line 03 replace “(at 0.5^o resolution)." with “at a resolution of 0.5^o."

line 04 Remove “Crosswise"

line 05 replace “In a" with “As a". Remove “would like to".

line 08 remove “(one-hour forecast)"

line 20-21 replace “The statistical measures are defined in the..hereafter" with “The statistical measures which were used in the analysis of the results are: the Root Mean Square Error (RMSE), the correlation, the Mean Fractional Error (MFE) and the Mean Fractional Bias (MFB), defined below." Move lines 5-13 on page 9617 at this point and add “where $o_{j\,j=1,n}$ and $s_{j\,j=1,n}$ are the observed and simulated concentrations respectively.

line 21 Insert “large" before “number of AirBase..."

Page 9617:

ines 04-13 remove.

ACPD

8, S3203–S3214, 2008

Interactive Comment

ines 16-17 replace sentence “The statistics of border...Netherlands" with “The statistics of border or nearby countries in Northern–Central Europe (Belgium, Switzerland, Germany, Great Britain and the Netherlands) are also improved with the exception of the correlations.

Page 9618:

line 07 replace “(if we except France)" with “with the exception of France".

line 17 replace “conclude on" with “make conclusions about"

line 19 replace “distribution on" with “partitioning in different"

line 26 replace “(see the results on the AirBase network)" with “, as seen previously in the comparisons with the AirBase network data."

line 28 replace “periurban" with “suburban"

line 29 replace “background-concentrations" with “background concentration".

Page 9619:

line 13 replace “are carried out" with “were carried out". Replace “is assimilated" with “was assimilated"

line 14 replace “the model forecasts" with “the model was let run freely and produce forecasts for"

line 15 replace “assimilates" with “assimilated" and “forecasts" with “forecast"

line 16 replace “assimilates" with “assimilated"

line 17 replace “forecasts" with “forecast"

ACPD
8, S3203–S3214, 2008

line 20 remove “in this section"

Page 9620:

line 01 insert “the" before “two-day forecast"

line 03 insert “than the free–running model" after “statistics"

line 08 replace “In this section, we carry out...parameters" with “Tests with different configurations were carried over a shorter period to estimate the effective time scales of the DA impact. The data is assimilated over a period and then the model is free-running for the remaining days. The aim of these tests is to find out key parameters".

line 18 replace “In this section" with “In this set of experiments"

line 19-20 replace “()" with “„"

line 27 replace “will also been" with “is also"

Page 9621:

line 03 reformulate sentence - it is not clear what is meant by “the model shows the same uncertainties for all species".

line 10 Explain or provide a reference why “the observations depend" on organic species".

line 14 Replace “Anyway" with “However"

line 19 Remove “really". Remove “Indeed"

line 21 replace “will take" with “takes"

ACPD

8, S3203–S3214, 2008

Interactive Comment

line 24 replace sentence “For this reason,...impacted" with “For this reason, the scavanging which depends in particle size and could therefore explain the differences in the PM_{10} budgets between simulations, is not affected."

Page 9622:

line 03 insert “the" before “emissions" and remove “for example"

line 04 remove “,as expected, rather"

line 05 replace “(see the evolution ... mean.)" with “, particularly in the evolution of the mean."

line 10 replace “over" with “above"

Page 9623:

line 01 Add “and future perspectives"

line 08-10 The sentence “For example, the EMEP...statistics" is not clear, please reformulate.

line 13 replace “spoiling the" with “worse"

line 26 replace “withdrawn" with “lowered".

Figures and tables

Figure 1 from the text it is not clear what the “background" stations are. Does it mean that they are located in rural, low–traffic locations? Please explain.

ACPD

8, S3203–S3214, 2008

Figure 2 missing labels (a) and (b) in the plots. Please explain how the circle diameters are proportional to the statistical indicator.

Table 3 replace “chlore" with “chlorine"

ACPD

8, S3203–S3214, 2008