

General comments on Vira et al.

This reasonably well written paper discusses the performance of a chemical data assimilation system used to assimilate near-surface observations of ozone and NO₂. The discussion about the construction of the background error covariance matrix is thorough. On the other hand, I think the authors could provide more details on the behaviour of the system regarding bias, as well as on the possibilities of extending the results beyond the time windows identified in the paper, e.g., 24 hours for ozone (I understand the other referee mentions these issues as well). Finally, there are some issues about the English, notably the lack of the definite article “the” in many places, but this should be easy to fix.

In general, although the results shown in this paper are commonplace (e.g., similar results have been shown for other assimilation systems), it provides information on the performance of another assimilation system used to study the atmosphere, in this case, the distribution of tropospheric chemical species involved in the determination of air quality. I recommend publication once the above comments and the specific comments below are addressed.

Specific comments

P. 5590

L. 3: Introduce acronym for SILAM, if there is one. Please introduce acronyms when first used, both in the abstract and the main text. “...for the year...”.

L. 11: I suggest “...error covariance matrices which...”.

L. 21: Could you list some of these computational methods and observational datasets?

P. 5591

L. 1: Do you need “classically”?

L. 16+: I think that for completeness, it would be helpful to mention publications that discuss assimilation of ozone and NO₂ in the stratosphere. An example would be Errera et al. (2008) – reference indicated below.

L. 23: Employed to do what?

P. 5592

L. 12: “...the adjusted initial...extended for up...”.

L. 24: “...error matrices...”.

P. 5593

L. 2+: I suggest you identify here what you do in each Section of the paper.

L. 4: I suggest “...the observation datasets used...”.

L. 12-17: Is the separate assimilation of ozone and NO₂ an issue, technical and/or scientific?

P. 5594:

L. 25: I suggest “utilizes” -> “uses”.

P. 5595

L. 5: "...about a third...".

L.7-8: Could you elaborate on the representativeness issue?

L. 25: I suggest "...is the non-linear observation...".

P. 5596

L. 2: If the assimilation of ozone and NO₂ is done separately, i.e., the state vector has either ozone or NO₂ fields, please indicate.

L. 26: I suggest: "forecasted" -> "forecast".

P. 5597

L. 10: Identify the variables x and y in the definition of the correlation function.

P. 5598

L. 12: When is the iteration stopped? What criterion is followed?

P. 5599

L. 12: "...on the lowest...".

P. 5600

L. 4: I suggest: "...values are generally not reduced...".

L. 6: adapted -> adopted.

L. 24: Do you mean positively correlate?

P. 5601

L. 7: "...benefits from having...".

L. 23: "...especially the case for NO₂, a result which is...".

L. 27: I suggest: "...assimilation had a variable effect on...".

P. 5602

L. 7: "...why the assimilation...".

L. 16: "---had only a minor...".

P. 5603

L. 4: "...UTC from the analysis...".

L. 9: "---initializing from the analysis...".

L. 13: I suggest: "...observed at the EMEP...".

L. 15: I suggest: "...expected to fall away more...".

L. 21: Maybe I am missing something, but it is not immediately clear to me what is the link with summertime. Could you please elaborate?

P. 5604

L. 4: "...in the assimilation...".

L. 10: "...for a maximum...".

L. 11: Could you provide examples of these previous studies?

L. 14: I suggest "...but agree well with...".

L. 18+: Could you discuss further work? A few lines would suffice.

P. 5614

Fig. 1 caption: Identify the colour styles.

P. 5615

Fig. 2 caption: Identify the units. Same for Figs. 4, 5, and 7.

P. 5616

Fig. 3 caption: Identify the end points of the colour scale. For example, red/blue indicate relatively high/low concentrations of ozone and NO₂.

References

Errera, Q., F. Daerden, S. Chabrilat, J.C. Lambert, W.A. Lahoz, S. Viscardy, S. Bonjean and D. Fonteyn, 2008: 4D-Var assimilation of MIPAS chemical observations: Ozone and nitrogen dioxide analyses. *Atmos. Chem. Phys.*, **8**, 6169-6187.