Atmos. Chem. Phys. Discuss., 8, S12264–S12269, 2009
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the extraction of wind information from the assimilation of ozone profiles in Météo–France 4D-Var operational NWP suite" *by* N. Semane et al.

N. Semane et al.

Received and published: 30 June 2009

We thank the referee for his/her remarks. We will quote the comments of the referee and provide our reply below.

-1) Page 16482 mentions the use of "traditional OSE" experiments in evaluating the impact of new observations in NWP. In these, forecast scores are calculated by com- parison to reference analyses, such as those from the full operational system. These OSE studies are done quite routinely (since the RMS error statistics versus analysis are very easy to calculate) and NWP people would expect to see them. Why have these not been done in the present study? Whether the results are positive or negative, it would be useful to see them.

➢➢ **We agree that forecast score calculations constitute traditional tools in the assessment of positive or negative effects of a new dataset. The OSE experiment has not be done here as the primarily aim of this study is to diagnose the dynamical impact of the ozone data assimilation more on the NWP analysis part than on the forecast one in the first approach.**

-2) Section 3.3 covers OMF wind statistics. This is a very interesting part of the study. However, one question that needs to be answered is which region of the atmosphere the results apply to. Would it be possible to resolve these results by region, such as tropics versus high latitudes? Perhaps the location of the sondes is dominated by NH high latitude locations anyway?

➢➢ **The results of OMF wind statistics cover the whole globe. Again, the purpose is to assess the global impact in the first approach.**

-3) One of the hopes for ozone assimilation has been that it might help improve winds in the upper troposphere and at the tropopause. This study shows useful improvements in the lower stratosphere, generally at levels higher than 80hPa, but not below. Could the authors comment on the prospects for improving winds in the UTLS? It would be useful to address this in the conclusions and perhaps highlight any reasons that have prevented this study from showing any real impact at these levels.

➢➢ **The fact that the first pressure 100–215.4 hPa range does not provide significantly more information in comparison to the pressure 68.1–31.6 hPa range, is probably due to a combination of factors. First, the variances of observation error for the first range are significantly greater than those of the second one. Second, the assumed horizontal correlation of background errors introduces a**

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degree of redundancy into the information provided by the observation within the scale length of the correlation. This latter is smaller for the second pressure range in comparison to the first one (see Fig. 2c). Owing to total column ozone data provided now by IASI/METOP, better and more consistent information will be available in the UTLS as the main contribution to the total column ozone originates from the UTLS region (Peuch et al., 2001).

Specific points:

1) p16475, line 2-3: these are useful references but I am not sure how they link to the sentence they are attached to. Please provide some extra linkage or explanation.

- **According to Eskes et al., 2005, the assimilation of ozone observations in a modern four-dimensional variational data assimilation (4DVAR) or Kalman filter approach will have a direct impact on the wind field (Riishøjgaard 1996).**
- **According to Geer et al., 2006, in CTM studies, the ECMWF 4D-Var operational analyses have been seen to produce better age-of-air values i.e. better stratospheric transport and mixing, than earlier 3D-Var analyses such as ERA-40 (e.g., Scheele et al., 2005).**
- **According to Lahoz et al., 2007, because 4D-Var includes the time dimension, the temporal discrepancy between the initial state is accounted for.**

-2) p16479, line 2: "generalised interpolator". Since this is part of a general description of the NWP system used, it should be mentioned that as well as including an atmospheric model and interpolation, the H() operator may also include a modelling of the

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observed quantity, such as a radiative transfer code.

➢➢**The fact that the generalised interpolator includes an atmospheric model and interpolation means that it may include a modelling of the observed quantity, such as a radiative transfer code.**

-3) p16481 / Figure 3: This is a useful figure but stage (c), the 6hr forecast, runs vertically downwards, whereas the rest of the time-dependent processes, and a time-axis, run horizontally. So stage (c) may be confusing to understand - please could you try to revise this diagram so that the 6hr forecast also runs horizontally.

➢➢**The figure 3 diagram is revised following the Referee suggestion.**

-4) p16481, line 14: "averaged in time from 23 January..." Please state what allowance has been made for spin-up in these experiments. Ozone in the lower stratosphere can easily take 7-10 days to spin up in some NWP systems. Figure 4 seems to show that over the course of a 6 hour forecast, the model ozone drifts substantially away from the analysed/observed. Could this also be a spin up effect, or is it present throughout the period?

➢➢**The ozone field is produced by MOCAGE and is only transported over the 6 hour assimilation window via ARPEGE. The spin-up time was taken into account in the MOCAGE simulation, which was performed 2 months before the beginning of the assimilation experiment starting on 23 January 2006.**

-5) p16482, line 18: Please describe in the text how the observations are perturbed.

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➢➢The complete description of the observation perturbation process is given in Desroziers et al., 2005.

-6) p16485, line 12-13: "temperature analysis response is dependent on the "drying" or "wetting" analysis effect of these radiances" I don't understand how this might happen. Please could you explain this in a little more detail in the text.

➢➢The air temperature evolution in the model is partly influenced by the air humidity parameter evolution. During the assimilation process, there are two minimization steps in which the model trajectory is updated. This allows the humidity model correction, performed via the assimilation process in the first step, to modify the temperature model field in the second step through the forward model evolution.

-7) section 3.3: (see main point 2) If possible, please break down these statistics by region, or give an indication of which part of the stratosphere they are applicable to (e.g. - mid-latitudes / vortex / tropics?)

➢➢This point has been already discussed above.

-8) p16486, line 10-11: "OMF standard deviations, not shown here, are very close". It would still be interesting to see a figure here. Also, perhaps this could be reworded for clarity as "OMF standard deviations are almost unchanged between experiments".

➢➢Done.

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-9) p16487, line 4: "No bias correction has been applied". Is it possible that, if bias corrections were applied, that the changes in mean meridional wind shown in Figure 7 would go away? The ozone observations are fighting against a large (20%) model bias, as shown in Fig. 4. This could easily lead to systematic changes in the wind fields in the analyses. Please discuss this possibility.

10) Conclusions: the conclusions should be specific about which part of the wind field has been improved in Fig. 7 - i.e. the mean meridional winds. If point 9 (mean changes due to uncorrected ozone biases) is a realistic possibility, please mention this as well.

≻≻**In response to the two comments 9 and 10, we point out that the issue of bias corrections is not investigated in this study in the first approach.**

References

Scheele, M. P., Siegmund, P. C., and van Velthoven, P. F. J.: Stratospheric age of air computed with trajectories based on various 3D-Var and 4D-Var data sets, Atmos. Chem. Phys., 5, 1-7, 2005.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 16473, 2008.