

We thank the two anonymous referees for helping improving our paper. Here in the following, a point by point response to their comments can be found (our replies are in *italics*).

Referee #1

General comment:

I think this paper is suitable for publication in AMT - it deals with a topic of current interest in the Earth Observation community, namely, observing system simulation experiments (OSSEs) to assess the added value of new observation types. In this case, the OSSEs concern lower tropospheric ozone observations, and the impact of approximations to the OSSE methodology. I recommend the paper be accepted for AMT once the authors address the following points, which mainly concern clarification and quantification of statements made, and technical comments.

Thanks for the kind words

Specific comments:

1) P. 2415, L. 14: What do you mean by “peculiar”? Do you mean unusual? And, if so, what is unusual about this event?

We have eliminated the word “peculiar” (indeed it is a normal ozone pollution event)

2) P. 2416, L. 9: Lahoz et al. (2007) do recommend to ESA the use of OSSEs, but do not discuss OSSEs for NWP. Relatively recent OSSEs for meteorological parameters, such as winds, include: Lahoz et al. (2005) and Tan et al. (2007). They could be mentioned here instead of Lahoz et al. (2007).

We agree and we now cite Lahoz et al., 2005 and Tan et al., 2007 instead of Lahoz et al., 2007.

3) P. 2417, L. 1: Another model besides a CTM could be used.

We agree and we corrected the text accordingly.

4) P. 2417, L. 27: Which parameter? Thermal contrast?

Yes. We have changed the sentence and we now mention explicitly thermal contrast.

5) P. 2418, L. 1: Please expand on what you mean by limited scene dependence?

In the revised manuscript we specify “the one described in the lines above”.

6) P. 2419, L. 18: Carbon monoxide is often used for identifying long range transport of pollutants.

We have added the sentence: “Monitoring carbon monoxide is also important to trace long-range transport of pollutants”.

7) P. 2419, L. 21: MAGEAQ, although receiving favourable comments, was not selected

for EE-8

We have changed the sentence “MAGEAQ has been a candidate for the ESA’s Earth Explorer 8 call for proposals.” to “MAGEAQ has been a candidate for the ESA’s Earth Explorer 8 call for proposals, but not selected.”

8) P. 2421, L. 25: As far as I can tell, Natraj et al. (2011) discuss OSSEs but do not perform them. I suggest you remove this reference and retain Zoogman et al.

Done.

9) P. 2422, L. 21: Could you quantify the expression “qualitatively similar”?

We use the word “qualitatively” to say that we are not searching for something “quantitative”. A quantitative metrics is quite difficult to define in this context, and probably not even very useful.

10) P. 2425, L. 10: Is the correlation really negative and large in magnitude?

Yes, it is.

11) P. 2426, L. 10: An example of what?

We changed the sentence to “Other areas, such as...”.

12) P. 2428, L. 19: In Eq. (3) what is “lg”?

It is the logarithm.

13) P. 2430, L. 12+: Are these differences significant?

Yes, the difference full_RT-NR reaches values of about 30%, which is a significant difference. Indeed, we say that in that region the total retrieval error is 7.4% on the 20/08/2013 at 09:00 UTC (page 2428, line 13).

14) P. 2431, L. 27+: If I read this correctly, you are saying that the results from the approximation are better than for the full RT. Is this correct? If not, please reword.

The results from the approximations are not better, they are only closer to the NR. This means that the approximations are too optimistic in the description of the behaviour of the simulated observing system, thus finally not accurate to reproduce the full radiative transfer calculation, which is the repeatedly stated throughout the manuscript.

15) P. 2448, Fig. 11: Are the differences plotted significant? Have you discussed this in the text?

Please refer to comment #13

Technical comments:

We accept all Referee's comments and we have changed the text accordingly.

Referee #2

General comment:

This paper evaluates approximations used in an observation simulator in OSSE. This type of OSSE is unique. The results may be preliminary but are worth publishing. The manuscript requires some clarification.

Thanks for the kind words

Specific comments:

1) Some abbreviations could be avoided. Many abbreviations are used but not used consistently and more familiar abbreviations could be used. A list of abbreviations would help.

We decided that adding a list of abbreviations would be the more reasonable solution. Consequently, a list of abbreviations is present in the revised manuscript.

2) I had trouble understanding what the “control run” is. I expect a control run to be an assimilation run without experimental observations. But it seems to be some thing else in this paper.

The assimilation run is indeed the control run with pseudo-observation assimilated in it (P. 2416, L. 16)

3) What is “m” in this equation [Eq. 1]?

It is a typo. We eliminated it.

4) Where are xpo, xnr and xapriori defined? Are they defined in the same location or different locations?

As we state at the beginning of section 2.3, we use a notation which is consistent with Rodgers (2000).

5) “NR pseudo-reality” is often used. Is this just the NR values?

Yes, it is just the NR values. Following also one specific comment of Reviewer #1, we eliminated “pseudo-reality” from “NR pseudo-reality”.

6) The first paragraph of the conclusion can be reorganized for easy reading. Breaking it into three paragraphs may help.

We agree and we have reorganized the conclusions into different paragraphs.