Answer to the Editor

First of all, we would like to thank the Editor for accepting our paper for publication.

We copy here the question of the Editor in italic font. The answer follows in normal font.

Comment 1:

> *Although you answered the referee regarding the question of the cost function (see below), it was not clear to me if the RfullExp and RdiagExp options actually converge on the same retrieval solution (to within the expected formal retrieval errors, although you do indicate that the RfullExp solution "generally larger errors"). However, I assume you tested this and therefore please clarify in the final m/s e.g. in Fig 6 "all" around 200 hPa are the blue and green lines separated by more than the RMS of their combined retrieval errors?*

Answer 1:

> In our 3D data assimilation framework, the 'retrieval solution' corresponds to a global ozone 3D analysis. RfullExp and RdiagExp do not converge to the same 3D analysis since the two analyses are the result of two different minimization problems (i.e. based on different input error covariances).
>
> It is worth reminding that we have discussed two aspects in our paper: the estimation of the R-matrix (interchannel error covariances) and its impact on the assimilation results. Hence, two type of errors were discussed: the observation errors (i.e. the R-matrix, further used as input to compute *RfullExp*) and the error of the *RfullExp* analysis.
>
> Concerning the observations error, the estimated R-matrix shows larger errors in terms of standard deviation (Fig 1) and interchannel error correlations (Fig 2) comparing with the diagonal R-matrix (lower standard deviation and neglected interchannel error-correlations) used in RdiagExp. We referred to this when we employed the expression 'generally larger errors' (In our answer to the comment 3 of the referee, specific comments in the latest revision).

Concerning the analysis error, it is not feasible to compute and store the analysis' error covariance in the framework of 3D-Var due to its huge size. This is somewhat different with respect to satellites 'retrievals', where 1D algorithms are used and retrievals errors are generally delivered as output. Therefore, to quantify the impact of using an estimated matrix, we have compared our results to independent data and with respect to a free run (no assimilation) for both experiments (RfullExp and RdiagExp). The use of an estimated R-matrix (the case of RfullExp) has remarkably reduced the error of the analysis in the stratosphere comparing to RdiagExp (Fig 6). Around 200 hPa, the RdiagExp analysis error is smaller than RfullExp (Fig 6 'all'). However, we cannot verify whether this difference sits within the correspondent analysis ('retrieval') errors, since we have no access to their values.

Comment 2:

In the above revised text, I suggest replacing 'conduct' with 'lead'.

Answer 2:

Corrected.