Geoscientific
Model Development
Discussions

Interactive comment on "Validation of reactive gases and aerosols in the MACC global analysis and forecast system" *by* H. Eskes et al.

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Response to anonymous referee 2

The manuscript by Eskes et al. provides an outline of the global validation component of the European MACC project. The MACC project seeks to establish and evaluate atmospheric composition modelling tools. Basic model configurations are described, an overview of metrics is given, and the recent performance of operational part of the system is evaluated. Particular weight is attached to the importance of having easily accessible metrics of model performance so that end-users of the MACC (and subsequently CAMS) data can assess the quality of that data. The format and content of the manuscript are appropriate, and when published the paper will provide a very useful reference point for users of MACC / CAMS data. I would recommend addressing

the general and specific comments listed below, prior to publication, however.

We thank the reviewer for her/his positive judgement, and for the useful detailed comments made.

I would also recommend a detailed reading by a native English speaker to pick up on a few instances of slightly awkward phrases.

We have carefully gone through the whole document and made small modifications to the text. In particular, we have included the textual suggestions from all three referees.

General comments

Many acronyms are not defined, e.g. ECMWF, IFS, FTIR, SDs

We have checked all acronyms and expanded them in the revised manuscript.

I would like to see more development / justification / discussion of the metrics used – this would seem to be a focal point of the manuscript. The formulae behind the calculation of the metrics is presented, but there is very little justification given for why those metrics are suited. What do they tell us, what are their limitations?

We assume that the reader is familiar with the basic concepts of bias, rms and correlation. The MNMB and FGE are are special forms of bias and rms type of measures, which indeed need some explanation. The main reasons for adopting these metrics is provided in the text (p 1128, l22 and following paragraph). The limit values of the expressions were also discussed.

In the new manuscript this paragraph is extended: "The MNMB and FGE are alternatives for the more commonly used mean bias and the root-mean-square error respectively. The normalised approach in the MNMB and FGE provides errors in a relative sense, which is easier to comprehend by users not very familiar with the concentration ranges and their units. The fractional gross error is a linear measure, and has the advantage compared to the more common root-mean-square measure that it is not

dominated by outliers. Both MNMB and FGE are defined relative to the mean of the observation and the model value, $(f_i + o_i)/2$, which improves over expressions where the observation alone is used as reference. For instance, surface ozone observations do in practice give readings equal to 0, which causes the division by o_i to become infinity."

Furthermore, the presented model / obs comparisons summaries don't appear to make full use of the metrics outlined. In fact in many parts of the manuscript a qualitative description of model performance is given instead of the metrics. Why describe the metrics if they're not going to be used in the evaluation summaries?

We can sympathise with this remark, but do not fully agree. The metrics are used extensively in the MACC validation activities. One example of this is is Fig. 4. The present paper shows just a couple of examples from the validation work, and more examples can be found in the validation reports (see references). In practice, validation should always start by making more simple direct comparisons in the form of maps and time series. The metrics quantify the comparisons, but to interpret the quantitative results it is crucial to display the modelled and measured values. This is also mentioned on p1127 and is one of the scoring recommendations, so it is already covered by the original manuscript.

In the revised manuscript figure 7 will be replaced. It will display both correlation and MNMB.

Specific comments

Page 1121, line 18: 'Haiden et al., 2014' does not appear in Reference list

Reference has been added to the revised manuscript.

Page 1122, line 7: 'Copernicus' (unavoidably) refers to one of two different entities in the context of the manuscript. I would suggest adding 'EGU' before 'Copernicus' in this instance

Done.

Page 1122, line 20: Author name not given in citation

"Eskes" has been added.

Page 1123, lines 12-14: Better word for 'aspects' might be 'species' or 'quantities'? Otherwise the meaning of the sentence is not clear

Agree. Text now mentions "species".

Page 1126, line 26: '...this report...'. Not clear which report is being referred to – the present manuscript, or the 'living document on the evaluation methodology'?

It is the latter. Text has been modified to make this explicit.

Page 1128, equations 1-3: 'N' not defined

Definition of N has been added to the revised manuscript.

Page 1130, paragraph beginning on line 18: this paragraph seems a bit out of place – better placed in Section 9.6?

We agree. The paragraph has been moved to 9.6. The introductory line on the three models in the first paragraph of sec 9.6 has been removed.

Page 1131, line 14: in the model simulations without data assimilation, where are the initial conditions derived from?

Initial conditions are taken from the run of the previous day. The total length of the simulations is such that the impact of the original initial state is negligible.

Page 1135, line 13: give value of 'low bias'

The sentence has been modified: " The correct timing of the dust event in the MACC o- suite is further confirmed by the time series at the available AERONET sites (black dots), although the modelled optical depth has a moderate low bias of about 0.1 com-

pared to the observations. "

Page 1140, Section 9.4: Is there any value in presenting a figure (time-series) of HCHO? As per the other quantities?

We considered this. Such a decision is a matter of finding a good balance between the amount of detail and keeping the length of the paper within reasonable limits. There are a few motivations not to include it: 1. Figure 5 already shows an example of the use of SCIAMACHY/GOME-2 for validation, and 2. there are no HCHO observations assimilated. The figures in the paper serve as examples for the range of activities in the validation subproject. Much more detail, including HCHO figures, can be found in the validation reports.

Page 1140, Section 9.5: (Aerosol evaluation) gives percentage biases – are these based on the MNMB? It would be preferable to retain the same metric for all modelled quantities. If percentages are considered appropriate please list formula for reference (as per other metrics)

In the new manuscript figure 7 will be replaced, and the lower panel will show the MNMB. Aso the text will be adjusted accordingly.

Page 1143: line 7: '>5%' should be '<5%'? Or perhaps better to present MNMB rather than percentage?

'>5%' is replaced by '<5%'.

Page 1159, Caption for Table 1: 'quantities' instead of 'aspects'?

Has been replaced.

Page 1161, Figure 2: Extra AERONET sites marked on maps but not referred to?

The caption of the figure includes the names of the stations corresponding to the dots. Results are shown for two stations. We feel this is clear enough. We could have shown results for the other stations, but this would not have changed the conclusions.

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Page 1161, Caption for Figure 2: Date given in caption different to that on maps (22 June vs 25 June)

Caption is adjusted to 22 June.

Page 1162, Figure 3: MACC o-suite values are daily means?

No, these are 12 utc snapshots. Caption text has been adjusted accordingly.

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