

Suggestions for revision:

The recent revision has greatly improved the manuscript, and in my opinion could be improved to be ready for publication after a final set of revisions. The requested revisions mostly cover the results & discussion as to my opinion some conclusions are made to lightly and/or are not completely supported by the results the authors show. A few comments/edits are minor details and will only take a few minutes to correct. A few others are more in depth and touch the basis of the manuscript. The authors do not need to completely agree to all statements but some elaboration will be needed to convince me and to my expectation most of the readers.

Minor edits:

Table 1; Add a description of MB and MNB, also add this to the text. Add the number of observations?

Discussion of Table 1;; you show correlations of around 0.001 to 0.05. At this point statistics about slopes and MB become more or less irrelevant as you are applying fits to clouds of scatter. Maybe some explanation as to why the correlations are so low, at least mention it in the text. Correlations are almost not mentioned in the text, unless they are high ~ 0.7 ..., don't hide the fact that the model misrepresents the measured values even after the CMAQab additions.

Table 2; similarly to table 1, add a description of MB and MNB. Add the number of observations?

See the in depth comments for an explanation/question on the effect of wind speed in combination with wind direction and possible sources.

Table 3; add description of MB and MNB. Add the number of observations?

Figure 1; Colorbar label: Add an E to mission. Also change font to the same font of the colorbar ticks?

Figure 2; If possible add Wind Direction, My explanation is added in the in depth comments.

Figure 3; If possible make one big figure with 4 subplots using figure 3a b and 9 a b. This will make it easier for the reader to compare the old and new situations,

Also add the Blue "observed" plot to 9b.

Figure 4, Good figure, as for colors, maybe blue and red? Easier to distinguish the differences.

Figure 5, Maybe also add 2010/06/16 CMAQ B for the top figure? Else remove the top subplot. What about CMAQ AB? Another possibility: Change it to 2 figures, one for 2010/06/16 and one for 2016/05/24 both with 3 subplots, CMAQ base, B and AB. Also show the figures in chronological order.

Figure 7, Add in CMAQ B, CMAQ AB for comparison.

Page 7, line 28; W is a weighting matrix, add a few words on how the matrix is calculated (possible effects following such a mapping).

In depth comments/discussion:

Overall & page 11 line 12-20 about the scaling factor of the emissions; You describe that you directly scale emissions needed to match a ratio of measured to modelled concentrations. What you more or less assume in this case is that the ammonia emissions is linearly related to ammonia concentration.

Can you shortly discuss the scientific basis behind this assumption, and why not use a somewhat lower or constant factor?

Page 10, line 10-14, you mention the effect of hourly varying emissions, and that the diurnal variation is missing. What about the monthly variation of the different sources?

Overall & discussion of effects of transport; I do not fully agree with the explanation / conclusion that transport of ammonia does not seem to be a major factor. Although you cover the basis of wind direction there is a short discussion missing on the effects of wind speed. Towards the north-west the ratio between livestock/fertilizer applications is probably different compared to the local conditions at Bakersfield, CA. As my personal knowledge of the counties surrounding Bakersfield is non-existing I cannot couple the summary of the sources given in S2 to the concentrations measured at the Bakersfield site (when combining this to the wind speeds, and assuming a more or less constant wind direction. Would it be possible to add a figure in which you compare windplots of the model (a) with measured concentrations (b). Radially you can show the measured concentrations, coloring can show the wind speed (or vice versa). This will support the explanation that transport / horizontal misrepresentation of the emissions are not a major cause of the difference between model and measured concentrations. To somewhat support my statement; you show that the model underestimates the RVMR to the north west compared to the satellite, while locally its basically the same, wind speeds increase to the end of the day compared to the overpass time of TES (13:30). Even if you would perfectly model the local emissions in the Bakersfield model cells, the misrepresentation to the north-west could possibly cause of bias shown in figure 3 & 9.

Table S2; Add some coordinates or relative position compared to Bakersfield. Or a small map showing the counties? Also what does Farming Operation mean? And what about livestock? Is this part of Farming Operation?

Overall discussion of the statistics in Table 1 & 2; What I am missing is a in depth discussion of the statistics given in Tabel 1 and 2. What essentially is shown in Table 1 is that there is zero correlation between the model and the measurements, i.e. any statements made on the bias will not convince anyone and I think it does not fully reflect the performance of the CMAQ model as even using CMAQab only gives a correlation of 0.05. A few lines on why these correlations are so low will improve the manuscript and re-establish faith in the CMAQ models capabilities to simulate NH3.

Table 2 & Section 4.2; At a first glance I would conclude that CMAQ base is better than CMAQab or CMAQb. Even though the diurnal variation is improved for the hours between 1 AM and 6 AM, the overall levels for the other $\frac{3}{4}$ of the day are still too high or too low depending on the hour. Only a short discussion is given of CMAQB and CMAQab, page 12, line 24-31. You correctly point out that the emissions are now far too high for most of the day for both "improvements". The same is visible in Table 1 and somewhat less in table 3 as TES only gives a snapshot of the situation at 13:00.

This brings me to a point to question the value of CMAQb and CMAQab to the manuscript. While the authors do a good job describing the possible causes of error in the base model, the new additions do not improve the model and are thus somewhat irrelevant in the current state besides showing that it is not correct to scale emissions following concentrations and that the current bi-directional schemes are far from perfect, things that have been shown before. I would like to put forward two possible approaches to make the manuscript ready for publication.

1. Change the manuscript to fully focus on the performance of CMAQbase & CMAQb. These two versions of the model have been described before in earlier publications and only a small addition to the result section, to better cover the CMAQ b results, will be needed to

improve the manuscript enough for publication. Especially as possible causes of CMAQb are already mentioned in the discussion.

2. If the authors want to keep in the CMAQb model more work will be needed. Rethink the scaling of the emissions, improve the description of the scientific basis behind the scaling as it is currently somewhat lacking. Furthermore make the improved CMAQab version the focus of the manuscript. In the current state it is mentioned in only a few sentences, raising the question why it is included in the first place, except to somewhat improve the diurnal variation, at which CMAQab is currently doing a poor job.