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comment**

Interactive comment on "Composition of gaseous organic carbon during ECOCEM in Beirut, Lebanon: new observational constraints for VOC anthropogenic emission evaluation in the Middle East" *by* Thérèse Salameh et al.

Anonymous Referee #1

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Review of 'Composition of gaseous organic carbon during ECOCEM in Beirut, Lebanon: new observational constraints for VOC anthropogenic emission evaluation in the Middle East'

ACPD Manuscript: This paper provides a nice presentation of emission ratios (ER) calculated by two different methods, and then follows up with a comparison with regional to global emission inventories. This paper is especially relevant given the lack of measurement data from this region of the world. Overall, the paper is well organized, and quite relevant. I would however like to see a few revisions before it is accepted for

Discussion paper

publication. More general comments and specific edits/suggestions, including some language corrections, follow.

General comments:

-In general, the paper cites a lot of work from authors, which is fine given the lack of work in this region on the topic, but it would be good if there could also be some more citations that are beyond self-citation. For example, on L238, that toluene and xylenes are related to traffic sources, there are references other than Salameh 2016 that are earlier and more authoritative on this, as this is something that is more broadly true and not limited to the Middle East. It would be good to integrate some of these as well.

L95: CO is not inert. It is much less reactive than many of the VOCs but it is definitely not inert.

P7: this text discusses where speciations in emission inventories come from, but it does not make clear which species/speciation information is used from which sources for the comparisons in the study. Please try to be more explicit/clearer about this, since a variety of inventories, etc are discussed.

L202-204: This sentence does not make sense. Why does what is said above make the approach for Beirut valid? Please explain this more clearly.

L252: I find it very hard to believe that photochemical removal/photochemistry is truly 'negligible' in winter.

L270-274: Here the authors state that ER were derived using all the data 'since there is no effect of photochemistry even during the day in summer'. That simply cannot be true. No photochemistry during summer mid-day? If the authors wanted to argue that the LRF were derived based on all data because the emissions were fresh and therefore had not undergone significant photochemistry I could follow the argument/logic, but to state no photochemistry seems very unreasonable. Also, in section 4 the degree of chemical removal is stated to be kOH dependent. Overall, the discussion in section

4 and section 5 should be made more consistent, but if 'no photochemistry' rather than e.g., 'fresh emissions' wants to be argued, the data to prove this will need to be much more substantial. That there is substantial influence from emissions is discussed and a relevant point.

Section 5.2: It would be helpful to bring Figure 4 into the discussion earlier. I think visualizing this and referring to the plot will help the explanation. It would also be helpful if a number of points could be more explicitly mentioned. The ER is determined by extrapolating the photochemical age to t=0, so that means the y-intercept is the ER, correct? State this explicitly. Photochemical age is being shown on the x-axis, but what does that correspond to in terms of the equation that is shown? It would be good to be explicit about this too.

L319-322: the r2 values and stdev values are listed, but nothing about their implications is mentioned or explained. It would be good to include one sentence as to what these values are telling the reader.

Section 6: it would help the reader follow the comparisons if the section were better organized, either by city or compound class. There is a lot of back and forth and it makes it rather confusing and more difficult than necessary to follow, as I think this is a very interesting and relevant part of the paper.

Section 7.1: can you clarify which method used to calculate the ERs was used in this comparison with EI? I realize the agreement between the methods was quite good, but it would still be helpful to mention if it was the LRF or PA method.

L390-393/Figure 8: to state that more reactive VOCs are reasonably well represented is difficult to determine from this plot, as some of the compounds are labeled but others are not. I think I would try to be a bit more specific about this and avoid blanket statements. Also because looking at these figures I'm not sure that there is a clear pattern, and it seems that some are just better than others, and it would be much better if this were just discussed more explicitly in the text rather than trying to draw very general

conclusions and then listing a bunch of exceptions. Maybe it would be worth considering different shapes for the different species, or more labeling, or possibly color coding based on reactivity?

L393/L402/L405/L467: in a number of cases the authors state that species are 'reasonably represented' or 'reasonably underestimated'. This seems rather subjective, also because 'reasonably represented' seems to be agreement by within a factor of 2. I would suggest either trying to avoid such subjective statements, or defining somewhere that 'reasonable' is somehow tied to this specific range. At the end of L406, I would suggest to not leave it with reasonably represented, but go further to state that these can still use improvement. (I leave that to the author's discretion.)

L402: the authors state that xylenes are reasonably underestimated, but it seems from the figure that some of the dots for xylenes are as far out as the benzene dots. Please explain what this means or ideally be more specific, as mentioned in the above comment.

L397-406: it would help to explain this method a bit more clearly. Are the ratios always [beirut]/[accmip]? Include this.

L418-420: If this sentence is referring to Figure 10, it seems that a number of the EMEP dots are beyond the 2:1 line for overestimation and even one beyond for underestimation, which is not what the sentence states.

L416-422: generally this section seems to draw conclusions that are far too generalized and not really supported by the figures when one examines the details. A more explicit discussion is warranted to avoid blanket statements.

Conclusions: given many of the above comments requesting more explicit discussion and less generalizations, please make sure that the conclusions text is updated to reflect the revised discussion.

L473-474/L476-477: yes! This is a very important point. Thank you for including it.

Specific edits:

L4: write out volatile organic compounds first followed by the VOCs abbreviation in parentheses.

L36-39: This sentence, 'Future projections...' seems redundant with the previous sentence. Please correct.

L60: '...the road transport sector by the Middle East...' the 'by' should be 'in'

L64: suggest to change this sentence for language to 'The same picture is presented by emission inventories.'

L71 & L73: no 's' after RCP

L71: Replace 'On the opposite' with 'In contrast'

L72: replace 'reaching respectively' with 'with totals of' and move 'respectively' to the end of the sentence.

L80: '...and even more so in cities..' add the 'so'

L111: change '..region at a whole...' to '...region as a whole..'

L112: change 'strong' to 'significant'

L136-137: suggest to change the sentence to read '...proposed by Salameh et al. (2014) by samplinng close to emission sources in real-world operating conditions as far as possible.'

L142: remove 'ambient'

L146-147: suggest to change the sentence to '...by a forested pine and high density residential area.'

L176: change 'each sectoral layer' to 'each sector'

L182: remove 'only'

L212: would be good to include/mention that the tracer was acetylene. (again, not inert, just less reactive)

L224: change 'neglected' to 'less'

L235-236: aromatics and alkanes should be singular

L250: 'on' should be replaced by 'in' before LRF

L328-329: please be clearer whether the more than 80% of the species was true for both seasons or just one season was sufficient to be included.

L371-372: this sentence does not make sense. Differences compared to what? Mecca? Also, 'opposite' should be 'in comparison' or 'in contrast' to.

L394: replace 'remarkable' with 'significant' or something else more appropriate.

L403: replace 'lay around' with 'are closer to'

L429: replace 'homogeneity' with 'agreement'

L436: I would suggest that 'poorer in alkenes' be 'poorer in some alkenes'

L439: suggest to end the sentence after 'MEA', and then revising the next sentence to 'This could be indicative for other MEA countries where emissions data and measurements are scarce.'

Table 2: at the very end of the table caption, please add '..for the VOC/acetylene ERs'

Table 2: at the end of the table, 'nd: not determined' is included but does not show up in the table.

Table 3: in the table caption, the parentheses need to be fixed.

Figure 2/3: having the middle thickness line as a dashed line would help readability

Figure 7: swapping the summer Beijing plot with the summer Mecca plot would put the two Beijing plots next to each other, which is more logical for the reader.

Figure 9: given that the plots seem to be organized by compound class, it would be good to include these compound class labels in the top left corner of the plots for orientation. I also assume that the 'all data' in grey dots is also just for those compound classes. But maybe this is not the case?

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