Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-655

Anonymous Referee #1

Referee comment on "Simulation of the effects of low volatility organic compounds on aerosol number concentrations in Europe" by David Patoulias and Spyros N. Pandis, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-655-RC1, 2021

The paper titled "Simulation of the effects of low volatility organic compounds" describes additions to the secondary organic aerosol treatment in the advanced chemistry aerosol model PMCAMx-UF. The paper include a quite extensive comparison with measurements during a period of measurement campaigns including high frequency output from a Zeppeliner. Creating a good dataset for comparison is hard and takes time.
The paper also include a general overview of the model in particular on the aerosol physics. The summary is helpful, but lacks clear information on which part of the model system is new compared to older papers. Based on the summary I presume that the new parts are the ELVOC and IVOC as described by the experiments although this should be made more clear in the description or perhaps even in the introduction. This being unclear is the main reason why I placed the paper in the major revision category.

The sensitivity tests that show the impact of the additional parameterisations show is an important part, but the set-up of this experiments is unclear and should be presented earlier in the paper. Even including the small supplementary table in the main paper will help the understanding. The case definition may also be used more throughout the paper in particular in tables and figures.

Personally I also find the structure in which a sensitivity excluding a parameter change but describing the impact as a change towards the baseline simulation is non-intuitive but again as long as the cases are clearly described this should be understandable. The equation describing this (1) is only defined for ELVOC. I think you should add the same for IVOCs

With respect to the comparison with measurements. Probably beyond the scope of the article but any possibility to discuss whether a change is significant or not?

Specifics:

Line 20. Presumably size = diameter everywhere?
Line 25. Was this a hypothesis or the output of the model?
line 27: decreases --> decreased
line 43 and 48 : An increase in CCN does not imply an increase in CDNC. Depending on

the size of the original particles and avaialbe water vapor one may even see the inverse result. Can --> May ?

Line 64-79 As far as I understand the yield factors from VOC pre-cursors have been relatively constant with time. The addition of ELVOC does not change the total amount of SOA but give a different distribution of solubility. I.e is the ELVOC a modification of the traditional treatment or and additional source.?

line 90. How do you decide best treatment for comparison with 2 different estimates? Sum of relative differences?

line 93-95. "Use" or "Extend" --> as discussed in the beginning of this review.

line 100. The general model discussions on the previous page use N3 and N50. Can this be connected to the N10 and N100 discussed here?

line 113-115: This is the same as base case?

line 150. I presume negligble effects of gravitational settling refers to the impact on coagulation not the overall deposition?

line 218. The boundary conditions are identical to Patoulias et al (2018)

Line 225. References e.g. version of Global Forecast System

line 265. Organic carbon refers to the measurements? Model calculate organic mass

line 303: What are the linit for no bias? (+- 0.5 % is quite strict if that is the limit)

line 345-351: Any mass observations avaialbe for the PEGASOS flights?

Line 404-408. Although it is only one site S4 show a quite pronunced difference between the cases. May be interesting to include in the paper Is the deviation between measurements and model for the smallest particles a question of detection limit or actual difference

line 453. From 35 to 35 % I think can be called constant even if the is a "numerical change"

Table 1 and 2. Given that the individual stations are not discussed in the text, I think that the tables can be moved into supplementary material and replaced by totals or regional values.

Table 4,5 7,8 : Only need fractional or absolute change. Move the other into supplementary