The paper discusses the development of a semi-explicit reduced organic aerosol mechanism for sesquiterpenes (Bcary), with the aim for employing it in air quality and large scale models. GENOA mechanism is based on the widely used near-explicit Master chemical mechanism (MCM). The mechanism used different strategies namely, lumping, replacing, jumping an removing to reduce the MCM scheme. The reduction procedure is tested under various environmental conditions (RH, temp etc.), resulting in a final reduced mechanism (Rdc.) suitable to simulate SOA. The simulated SOA using Rdc has low average error when compared to the near-explicit MCM scheme. This is a well thought out work, with suitable implications to better reproduce SOA in large scale and air-quality models. I would therefore, recommend the publication of this work after the authors have answered the following questions:

General

The main question is why did the authors chose sesquiterpenes? Why not isoprene or monoterpenes? The motivation to use sesquiterpenes should be highlighted.

Since GENOA is a semi-explicit mechanism, can it be used with any box or air quality model?

Although comparison has been made against MCM, the performance of a model can be made by comparing it against exisiting experimental SOA yields. There has been quite a lot of published experimental Bcary SOA yield experiments. I would suggest the authors to discuss GENOA derived SOA yields in comparison to these expeiments.

Is GENOA a carbon number conserving mechanism. Its is not clear from the manuscript if the mechanism is carbon conserving or not? If it is not then how do the authors justify it?’

Specific questions

L13-15: Motivation → Although the health and climate effects of aerosols are introduced in every paper, the authors should maybe consider to explain these in a few words or a sentence. Also, it would be nice to explain why there is a need to improve the SOA representation in AQMs.

L18-22: This sentence seems to contain quite a lot of information. I would suggest the authors to rephrase it into smaller sentences.

L24: “box models”. Although, it is true that explicit schemes are used in box models due to relaxed computational burdens, they have been also been used in 1-D column models or 2-D Lagrangian models (these are still not as computationally expensive compared to AQMs or Global climate models).

L32: “carbon-bond” instead of “carbon-bound”.

L34-35: Are all the above mechanisms (lumped, CB05, MCM, GECKO-A) developed primarily for ozone simulation? Also it would be good to give examples of a few model species.

L55: “suitable to”

L 112-113: Why is this order used in the reduction strategy for BCARY? How would any other order influence the reduction strategy?

Table1: Typo in reaction 8. I think it is supposed to say 0.2BCBOH instead of 0.2BCAOH.

Table2: Typo in lumped reaction R2: 0.753 * ($f_{w,a}$ BCANO3 + $f_{w,b}$ BCBNO3 + $f_{w,c}$ BCCNO3). I would guess the factor is 0.247 instead of 0.753.

Table2: $C_{r,b}$ and $C_{r,c}$ are not defined. It should be defined similar to $C_{r,a}$ for better clarity.

L119: It would be much clear to write it as “In this example, a total of 12 chemical reactions involving three organic compounds are reduced to **five** reactions (4 lumped (R_{1-4}) + 1 surrogate (R0))”.

L122-123: How are the BCARY isomers undergoing similar reactions with HO_2,NO and NO_3? Are the authors referring to the R_{1-4} in the lumped scheme. Please make this clear to the readers.

Why is $C_{r,a,b,c}$ an arithmetic mean of 5 day simulations? I.e was this 5 day period selected?

L129: kinetic → kinetics

L130: weighting → weighing

L135: What is this specific behavior?

L162: Aren’t alkoxy radicals are $RO^{\cdot}$

L179: Can the authors explain what the maximum hourly branching ratio is?

L185: Do the authors mean that that after one loop of reduction (as shown in Figure 1), the subsequent reduction is carried out in the reverse order? And why is saturation vapor pressure used only for the lumping strategy. This part needs more clarity.

Table 5: Are the two conditions ADD1 and ADD2 high or low NO_x regimes?

Figure 2: How do I interpret this? Is the top bar representing 0H and the bottom one representing 12 h? Please add this to the figure caption, since 0 h and 12 h are not represented by empty and hashed lines.

L233: I wonder what are the conditions which cause such low O_3 and NO_3 concentrations?

L258: Is Kelvin effect not taken into account for gas-to-particle partitioning?

L262: “vapor pressure is computed using Mydral and Talkowsky”. This phrase is repeated already in the earlier part of the sentence.

Appendix A: It should be “v1:Nannolal (2008)” not Nannolal 2004.

Appendix A, L485: There seems to be a contradiction here. The authors say that v1b2 (Nannolal and Jacob and reid) show the best estimate in comparison with the experiments *“As shown in Fig. A1, the SOA distribution simulated with "v1b2" agrees best with the experimental data. Therefore, this method with the vapor pressure computed by Myrdal and Yalkowsky (1997) and the boiling point computed by Joback and Reid (1987) is used in the BCARY reduction*”. But in the manuscript why has Mydral and Talkowsky been selected in place of Nannolal 2008. Why?

L275: I think it would be better to rephrase the sentence defining the FME. Is it so that the simulation error is the larger FME of the two errors I.e the FME of day 1 and the FME of rest of the simulation days? This has be more clear in the text.

Eq 1: What does i1 and i2 represent?

L283: Why does the ε_{pre} vary in such a way with respect to ε_{ref}. More explanation is need here.

L288: Is this true? As mentioned the <3% avg error is for pre-testing + training dataset. Will the average error still be < 3% for test dataset?

L303: How does GENOA decide what condensable species to remove? Is it based on species super saturation values?

L326: Effective partitioning coeff. is temperature dependent. What is the assumed temperature for the classification of SVOCs, LVOCs and ELVOCs? And since the authors use a range of temperatures in their training conditions (268-302 K) does it really make any sense in classifying the SVOCs, LVOCs and ELVOCs at an arbitrary temperature?

L332: Are the species in the reduced Rdc and Khan 2017 mechanism overlapping or identical?

L341: Condensable species drop to less than 20 ? It seems that the condensable species is ~10 % of its original values (10% of 493 ~48/49 species or thereabout) as shown in Figure 3. Also ε_{pre} is not shown in Figure 3. Also on L 346 it is mentioned as 41 species on the 75th time. So what is the correct number?

L346-348: Aren't all the reduction strategies trained first with training data sent and then with pre-testing data set? So what is the difference here between, lumping, jumping and replacing compared to other strategies?

L351: "evacuated" → "evaluated"

L358: It should be specified that lumping reduces the condensable species by 35 %.

L366: There is not mC133O in Figure 4.

L392: Why is more uncertainty found in regions with low RH and high temperatures? Is it because the training data set does not have enough data to work with in these conditions? Looking at figure 6, it shows that even Russian data points have high uncertainty between 3-6%. This cannot be only due to low RH and high temperature. What could be the other possible reasons for that?

Figure 8: Didn't the authors claim that PAN is under-represented in GENOA on L 418? But Figure 8 shows higher PAN concentrations for GENOA and lower for MCM.

L438: It should be explained why due to different volatility species Rdc delays SOA production. Is it due to low LVOC concentrations or high ELVOC concentrationss?