*Referee #2:*

*The authors have made significant improvements to the manuscript since their first submission and it is increasingly clear what the contribution of this work is to the literature. However, there are still a lot of presentation issues - particularly with the methods sections - with the revised manuscript that make it hard to evaluate the results from the work. For instance, there is little detail for each process that is modeled in terms of what has been done before, what is new, and what the different terminology and equations stand for. Even within each process, the structure of the mathematical formulation is not very clear and at times hard to follow. Below, I list a few examples:*

To our knowledge, the main studies on "what has been done before" are cited in the introduction and are described in the method section. As this study cover several subjects that has been scarcely taken into account. As stated into the text, all the parameterizations described in the text are new (and explanations were given on how they differ). The results given by the parameterizations for oligomerizations and for the uptake of pinonaldehyde were compared to the results obtained with existing parameterizations.

However, the text was modified to take into account each comment.

*1. See paragraph 3 in the abstract. The authors make qualitative judgements about their model results, e.g., 'satisfactory results', 'strong effect', and 'too significant', without being specific or quantitative. The last sentence in paragraph 3 in the abstract about 'less volatile or more reactive aldehydes...' is hard to connect to the earlier sentence.*

"satisfactory results (bias lower than 20\%)" replaced by "satisfactory results (bias lower than 20%)

"The uptake of pinonaldehyde (which is15 a high volatility SVOC) onto acidic aerosol was found to be too to be significant under atmospheric conditions" changed to "The uptake of pinonaldehyde (which is a high volatility SVOC) onto acidic aerosol was found to be too slow to be significant under atmospheric conditions (no significant amount of SOA formed after 3 days of evolution)"

"Oligomerization was found to have a strong effect on SOA composition" changed to "Oligomerization was found to have a strong effect on SOA composition"

"Less volatile or more reactive aldehydes could nevertheless react with acidic aerosols." Replaced by "he uptake of aldehydes could nevertheless be an important SOA formation pathway for less volatile or more reactive aldehydes then pinonaldehyde."

*2. Section 2.2.1: What xylene are the authors referring to? m-, o-, or p-xylene? Why is table 7 referred to after table 3? Shouldn't it be table 4?*

It is already written in section 2.2.1 and the abstract that xylenes correspond o-xylene in this study. Several references to o-xylenes are added to the text. The order of tables is corrected.

*3. Page 7, line 32: What is the meaning of the sentence 'chemical rates are more consistent with*

*thermodynamic equilibrium by computing rates using activities'? What is activity and how is it defined here?*

The text was modify to provide more information:

"In this study, the net flux of oligomerization $J_{oligo}$ is computed using activities. Activity is often seen as the "apparent concentration" of a compound in thermodynamics. It is linked to the chemical potential (molar Gibbs free energy of a particular component) by the following equation:

$$a_i = exp(\frac{\mu_i - \mu_i^0}{RT})$$

with $a_i$ the activity of compound i, $\mu_i$ is the chemical potential of compound i and $\mu_i^0$ the chemical potential under standard conditions, R is the gas constant, T is thermodynamic temperature.

Activities (calculated here on the mole fraction basis) are used instead of concentrations for two main reasons. First, chemical rates are more consistent with thermodynamic equilibrium by computing rates using activities. For example, in the case of a simple one product (A) giving one product (B) equilibrium reaction, if chemical reactions are written using concentrations, the net flux of reaction J would be computed with the following equation:

$$J = k_1 C_A - k_{-1} C_B$$

with $k_1$ the forward kinetic parameter, $k_{-1}$ the reverse kinetic parameter, $C_A$ the concentration of compound A and $C_B$ the concentration of compound B. At equilibrium, J would be equal to zero and the equilibrium constant would then correspond to the ratio of concentrations instead of a ratio of activities.

This paradox can be lifted by using activities instead of concentrations. Second, some studies (Madon and Iglesia, 2000; Rahimpour, 2004) expressed the need to compute chemical rates using activities and showed that better results are obtained for non-ideal systems.

The net flux of oligomerization $J_{oligo}$ is therefore computed with the following equations:

$$J_{oligo} = -\frac{dX_{a,monomer}}{dt} = k_{oligo} a_{a,monomer} - k_{reverse} a_{a,oligomer}$$

with $X_{a,monomer}$ the molar fraction of compound a, $a_{a,monomer}$ the activity on a molar fraction basis of compound a and $a_{a,oligomer}$ the activity on a molar fraction basis of the oligomer formed from compound a. Activities are computed with the AIOMFAC model (Zuend et al., 2008, 2011; Zuend and Seinfeld, 2012; Ganbavale et al., 2015)."

*4. Page 8: What are the different terms in equation 5? What do the '-1' and '-2' superscripts mean?*

The terms were defined previously in the text (except for $a_{H2O}$ for which the definition is added). -1 and -2 does not represent superscripts but "minus 1" and "minus 2" in power functions.

The equations were modified to improve the readability. For example:

$$(K_{oligo}^{eq})^{m_{oligo}-1} = \frac{a_{a,oligomer}(a_{H_2O})^{m_{oligo}-1}}{a_{a,monomer}(a_{monomer})^{m_{oligo}-1}}$$

*5. There were a lot of grammatically incorrect phrases, which made it hard to understand their meaning, e.g., 'uptake kinetic rate of aldehydes', 'particle but a kinetic of uptake', 'kinetic of uptake can be linked to the kinetic of transformation'.*

Corrected.

*6. What does the product BiA0D represent? It is introduced on page 10 without any context.*

BiA0D = pinonaldehyde (notation from the $H^2O$ mechanism). The text was modified to better explain this.

*7. What does 'according to experimental conditions' on page 10, line 11 mean?*

"the pH of particles and activities of compounds were computed with AIOMFAC (…) according to experimental conditions." Changed to "the pH of particles and activities of compounds were computed with AIOMFAC (…) depending on the conditions (humidity, temperature, concentrations, etc…) of the experiments of Liggio and Li (2006b)."