

We would like to thank Referee #2 for very helpful comments and suggestions. All of the comments and suggestions have been considered. Point by point responses to these comments are listed below.

Referee #2 comments:

The title should be clarified to emphasize the unique aspects of this study – perhaps “Molecular composition of biogenic secondary organic aerosol following additional aging” or something that better describes the study?

Authors’ response: As suggested, the title has been clarified. A new title is *“Molecular composition of fresh and aged secondary organic aerosol from a mixture of biogenic volatile compounds: a high resolution mass spectrometry study”*.

Also, the authors use the term “ultrahigh resolution” mass spectrometry; however, they use an Orbitrap with a resolution of 100,000 at m/z 400, which is typically not considered to be “ultrahigh”, rather just “high resolution”. This phrasing should be fixed throughout the manuscript so that it is not misleading.

Authors’ response: Corrected

Otherwise, the manuscript is well-written.

I agree with many of the comments of referee #1. Here are additional comments:

Introduction: The intro is well-written and provides great justification for the study. In discussing oligomer content of α -pinene SOA, however, the authors should consider the work of Hall and Johnston (2011, *Aerosol Sci. Technol.*).

Authors’ response: The suggested reference has been added to the text.

Page 5369, Lines 6-7: What fraction of peaks was shared between the spectra?

Authors’ response: In this sentence we are not comparing elemental composition but emphasising that all spectra contained distinct groups of oligomers. To clarify this, the sentence (lines 6-7) has been rephrased: *“Irrespectively of the applied atmospheric oxidation conditions, the mass spectra from all SOA samples contained distinct groups of monomers, dimers and trimers in the mass range 100-650.”*

Page 5370, Lines 3-4: Odd phrasing.

Authors’ response: The sentence has been changed to: *“In addition, the data was visualised using carbon oxidation state (OS_C) plots.”*

Page 5371, Lines 5-7: What study is this result from? This is not clear.

Authors’ response: The sentence was a continuation of the previous statement. To clarify this, the reference was added to the statement.

Additional list of molecular formulae for fresh SOA: It would be useful to add an additional column to this to note if this peak has been observed previously in lab studies, and if so, what precursor(s) it is attributed to.

Authors' response: Direct infusion analysis does not allow structural identification. For example, in our preceding study (Kourtchev et al., 2014) we demonstrated that the mass spectra from chamber experiments and ambient OA from Hyytiälä, Finland were dominated by an ion at m/z 185.0818. While in α -pinene experiments this ion corresponded to *cis*-pinic acid, in the BVOC mixture experiments and Hyytiälä ambient samples this ion was related to three (i.e. *cis*-pinic acid, homoterpenylic acid, and *cis*-caric acid) and five (i.e. *cis*-pinic acid, homoterpenylic acid, limonic acid, ketolimononic acid and *cis*-caric acid) different compounds, respectively. Therefore, we feel that providing source information for more than 600 molecular formulae and comparing it with the previous studies would be highly speculative.

References:

Kourtchev, I., Fuller, S. J., Giorio, C., Healy, R. M., Wilson, E., O'Connor, I., Wenger, J. C., McLeod, M., Aalto, J., Ruuskanen, T. M., Maenhaut, W., Jones, R., Venables, D. S., Sodeau, J. R., Kulmala, M., and Kalberer, M.: Molecular composition of biogenic secondary organic aerosols using ultrahigh-resolution mass spectrometry: comparing laboratory and field studies, *Atmos. Chem. Phys.*, 14, 2155-2167, 2014.