In the next revision, please make clear in the track-change version which **text was deleted**, changed and added. This can be achieved by using 'track change mode' in word or by using 'Latexdiff' for Latex files. While I could see where text was added, I could only identify deleted text by tediously comparing the previous and current files next to each other.

Abstract:

General comment: Please be aware that the following guidelines are for now just a recommendation but soon mandatory in ACP.

ACP recommendation: Abstracts should have fewer than 250 words and provide a concise and accessible summary of the purpose, results and implications of the research. ACP expects that abstracts will normally include the following components:
1) The topic of the article and why it is important
2) The status of scientific understanding
3) The gap in knowledge being addressed
4) The objectives, questions or hypotheses of the study
5) The approach such as modelling, measurements, machine learning, etc.
6) The main results with important quantitative information if appropriate
7) The importance and implications of the results

Your current abstract is about twice as long (~490 words). Please improve it and make it more concise and accessible.

Specific comments
l. 20: what is the 'alleviated aerosol effect via the dropped PM2.5'? Do you simply mean 'lower PM2.5'?

l. 22: replace 'secondary inorganic aerosols' by 'secondary inorganics'

l. 29: (i) replace 'was' by 'were'; (ii) why 'acidic aqueous oxidation'? Is acidity necessary? (iii) replace 'with α-dicarbonyls' by 'of α-dicarbonyls'

l. 30: replace 'determined by' by 'depending on'

Introduction:
l. 47: replace 'hygroscopic property' by 'hygroscopicity'

l. 63/4: "More oxidized SOA are largely produced from aqueous oxidation, while less oxidized SOA are largely derived from gaseous photochemical oxidation (Hu et al., 2017; Yu et al., 2019)." – this sentence seems out of place here as the text before and after is only about diacids and not about total SOA. Either delete this sentence here or correct if Hu and Yu's studies are specifically about diacids as well.

In the previous revision, I had commented: *l. 58 – 67: (i) There are many lab and model studies that have explored the formation of oxalic acid, e.g. (Carlton et al., 2007; Crahan et al., 2004; Perri et al., 2009; Warneck, 2003). In these studies, the main oxidant was OH. Please comment on this and include appropriate references.*

Neither could I find my comment in your author response, nor any related changes in the manuscript. This comment remains, now referring to l. 70 ff. Please either justify why you did not address it or make appropriate changes.

Section 3:

General comment:
My previous comment was not addressed in the text. "*The subsections of Section 3 still have very little connection to each other. Instead of being repetitive, previously identified findings should be used and referred to in the further discussion: what did you conclude on the formation processes of C2 in Section 3.2, how are these conclusions corroborated (or contradicted) in Section 3.3, what additional insight is gained in Sections 3.3, 3.4 and 3.5 etc."*

I was not asking about a summary of your results in your author response. However, I was suggesting that you refer to the individual sections in the manuscript. This could be done by cross-referencing the subsections, e.g. 'the findings discussed in Section 3.X are further supported by additional analysis.... ". Currently Section 3 reads like individual lab reports on disconnected analyses. However, a scientific article requires that you connect the different parts of your study to justify the needs of the various analyses to come to comprehensive conclusions. Please make clear in every subsection what additional information was found on top of the findings that were presented in the previous sections. This way you demonstrate how the information derived from the various analyses build upon and complement each other.

Specific comments

l. 185: 'Lack' implies the absence of HOx radicals. However, even during wintertime, the concentration of HOx is not zero.

l. 190: What do you mean by 'aerosol effect'? Please clarify. In the next sentence you refer to the 'aerosol radiative effect' – is this the effect you mean?

l. 210: replace 'on' by 'of' (Comparison of...)

l. 348: In l. 339 you state correctly that Gly and MGly are products from gas phase oxidation. Here you state now that LWC and RH promote the formation of these carbonyls. To my knowledge, only the oxidation products (e.g. glyoxylic acid) is formed in the aqueous phase and then oxidized to oxalic acid. I am not aware of any study that shows efficient formation of glyoxal and methylglyoxal are formed in the aqueous phase.
Please add a reference to support your statement or correct the text.

l. 364ff: This text is very unsatisfying and vague: 1) A correlation between acidity and C2 does not necessarily imply an acid-catalyzed mechanism. It could be a secondary factor, e.g. more SO2 leads to more sulfate and lower pH, which in turn enhances solubility of glyoxal.
This is, of course, speculation – however, so is also concluding on an acid-catalyzed C2 formation, which would imply that protons are involved in the chemical pathways under the conditions present.

I understand that likely the LWC was different between the experiments by Jang et al. (2002), Surratt (2007) and Tan et al., respectively. However, were indeed pH and organic precursors very different? How do you know?

Please clarify this text and separate clearly observed trends from speculations and conclusions that cannot be proven based on the current data set.

l. 394: My previous comment remains *'In your response to my previous round of reviews, you stated that O3 is just a proxy for photochemical activity. The text here implies that O3 was directly involved in the formation. Please be consistent.'*
Your response was not satisfying 'O3 can be considered as a proxy for photochemical activity, which does not mean that O3 can‟t be involved in the formation.'

I agree that O3 may be ONE oxidant that could possibly lead to diacid formation. However, other oxidants likely play a role too, which is not reflected in your current text. I suggest replacing the sentence

"In view of the significant enhancement of O3 concentration and solar radiation during the LCD, it could be concluded that the production of C2 and related compounds may be closely involved in the gaseous photochemical pathways driven by the higher O3 concentration and stronger solar radiation."

By

"In view of the significant enhancement of O3 concentration and solar radiation during the LCD, it could be concluded that the production of C2 and related compounds may be driven by the higher oxidant concentrations."

l. 397: replace 'SOA' by 'compounds'

l. 401: since you cannot conclude on the absolute importance of O3 in the diacid formation as compared to other oxidation pathways, I suggest adding 'or related oxidants' after 'O3' in this sentence.

l. 424: The studies by Carlton, Fu and Warneck referenced earlier in this paragraph refer to the formation of C2 by oxidation of (M)Gly in the aqueous phase. Thus, I do not understand your concluding sentence at the end of the paragraph.
Again, in the correlation of C2 and C2/(m)Gly with O3, O3 should be considered a proxy for other oxidants such as OH. Higher OH may trigger then more C2 formation in the aqueous phase. Note that the oxidation of glyoxal in the gas phase – both by O3 and OH – does not lead to C2.

Section 4

In my previous comment *"This last section is merely a summary of your results. However, conclusions are not given, e.g. How do your results compare with previous studies? What do your results mean for our understanding of the state and/or behaviour of the atmosphere?"* was not sufficiently addressed.

The added are very vague and general statements that repeat largely previous knowledge. Please address the questions posed in my previous comments.