Review of Jo et al (2023)

I have reviewed the authors' response to my original comments, and I thank them for largely addressing my concerns. However, I believe further work is required to address fully the concerns raised in the following comments. For completeness, I include my original comment, the authors' response, and my subsequent response.

Comment 6

"These physicochemical parameters are universalized for five major precursor groups in UNIPAR (Table 1)." What does this mean?
Response: The sentence has been revised to clearly explain what five major precursor groups are as follows,

"These physicochemical parameters are unified for five major precursor groups (aromatics, alkanes, terpene, sesquiterpene, and isoprene) as shown in Table 1."

Reviewer response:
While you have changed "universalized" to "unified", it is still unclear to me what this means. Do you mean that physicochemical parameters are the same for aromatics, alkanes, terpene, sesquiterpene, and isoprene? This appears to be the case looking at Table 1 (although I note the value is 51 for isoprene and 50 for all the others). Could you say the "physicochemical parameters are the same for the five major precursor groups"?

Comment 8

Have the emissions been validated? A bias in these emissions could mean the SOA model is getting the right/wrong answers for the wrong reasons in some cases. Fig 3 suggests a low bias in SOA which might come in part from an emissions bias.
Response: The emission data used in this study are based on California ARB(Air Resources Board)'s regional inventories and their own estimates and emission monitoring data for local sources. The emission processing went through QA/QC procedures.

Reviewer response:
It is good to see the authors are using a validated emission inventory. The use of the California ARB's regional inventory and a citation to its documentation and evaluation should be included in the main text.

Comment 13

"The underestimation of SOA mass can be attributed to missing precursor HCs and unidentified chemistry in the gas and aerosol phases. For example, the SOA model is currently missing phenols, branched and cyclic alkanes, and polyaromatic hydrocarbons (i.e., naphthalene)." I'm not clear this is true without an evaluation of the emissions of the precursor species.

Response: The parameters in UNIAPR are continuously updated with the better gas mechanisms and expanded to include missing hydrocarbons. To support this information, we added citations as follows,

"For example, the precursor HCs such as phenols (Bruns et al., 2016; Majdi et al., 2019; Choi and Jang, 2022), branched and cyclic alkanes (Chan et al., 2013; Gentner et al., 2017; Madhu et al., 2023), and polyaromatic hydrocarbons (i.e., naphthalene) (Riva et al., 2015; Wang et al., 2021) are currently missing in the UNIPAR model."

Reviewer response:
I don't view this as an acceptable response, and it does not address my concerns. I understand that UNIPAR undergoes constant development (and that is a good thing) but that is not the issue at hand here. The issue at hand is whether the omission of these key species is a major driver of the SOA low bias or whether the low bias is being caused by deficiency in the model elsewhere.

A range of citations have been given but no context provided, and this is insufficient. It is the job of the author to provide convincing evidence to support their claim. These papers may refer to the SOA yield from the various omitted species, but it is not clear. The authors should highlight key features of these papers both in their response to the reviewers, and in the main text for the benefit of other readers. They should make it clear if these omitted species do indeed produce SOA at appreciable yields.

One of UNIPAR's key aims to simulate SOA well so drivers of its biases must be explored in detail. To fully support their claim that the underestimation of SOA is attributable to these missing precursors, rather than another deficiency in the mechanism, the authors should estimate the production of SOA from these missing species (regional emissions times approximate SOA yield) and show how this extra SOA production term might help resolve the model low bias by putting it into context with the SOA production currently included in this version of UNIPAR for the simulations considered.

Comment 24
Data Accessibility. In the interests of community modelling and FAIR principles, I would like to see the code and model data uploaded to a freely accessible repository such as Github or Zenodo.

Response: The code of the CAMx-UNIPAR model is available upon request in Github.
CAMx-UNIPAR ver. 1.1, which included aromatics and biogenic daytime, is available in GitHub. The updated CAMx-UNIPAR ver. 1.2 has been preparing to include various precursors including alkanes (linear and branched alkanes), updated aromatics, and day/night biogenics. The updated version will include more hydrocarbons than the simulation of this study.

Reviewer response:
This response has only partially answered my original comment. The code of the CAMx-UNIPAR should be freely available on GitHub (not available on request) and the web address clearly provided.

There is also no comment on the availability on model data. This must be made available on a repository such as Zenodo and clearly signposted in the text so as to be inline with Copernicus' data accessibility policy.