

Response to Reviewer #2

We have written a very long manuscript, so we would first like to thank reviewer #2 for taking the time to review our paper and for giving very useful criticism on different aspects of the paper. Their comments have led to improvements in the manuscript. We have quoted the relevant text from the review (shown in italics) and have responded below each comment in times new roman. In addition, we have prepared a revised manuscript showing the revised text in red.

General Points

It is stated that this model follows the same approach as others. Would an inter-comparison be possible?

We do not have access to other models or the necessary expertise to run them for the same specific case studies unfortunately. In addition, this would significantly widen the scope of an already long paper. That said, this would be interesting to look into and with the appearance of standardized evaluation criteria, i.e., the DELTA tool, this becomes easier. We have mentioned this as an item for future work.

I appreciate the clear statement on the PSS assumption, but there is some reference to another model which has a gas phase component - is it not possible to compare outputs from the PSS assumption? I'm not sure this assumption is worthwhile keeping for a generically useful model. Please clarify.

We do refer to another model with a more advanced photochemical scheme. This model is the EPISODE-CityChem model, an extension to EPISODE described in the second part of this two-part paper Karl et al., 2019. EPISODE-CityChem includes different possibilities for photochemical mechanisms that include the PSS as well as more comprehensive mechanisms. Karl et al., 2019 describe a comparison made between the PSS and the EmChem09 photochemical mechanism (70 compounds, 67 thermal reactions and 25 photolysis reactions). The results from this comparison show that photochemical ozone production is very small in the vicinity of highly trafficked streets and motorways; suggesting that the PSS assumption is valid close to sources of NO_x pollutions. The highest O₃ concentration difference between the PSS and EmChem09 occurred in the outflow of polluted air from the city, implying that advanced photochemistry is necessary for the accurate prediction of O₃ in the urban background. We have now made reference to these results within the discussion of the results.

We want to argue that the complexity of chemistry should relate to the model's application. The PSS approximation seems appropriate if one is mainly interested in NO₂ within polluted the urban areas. We have now made this clearer within the discussion in Sect. 4.1.2 (lines 26 onwards, page 20) and in the summary.

Minor Points

The section numbering, and reference to different sections in page 4 is confusing. When you refer to part 1, this is labelled as Section 2.

I think that confusion has been created on this page due to the way we have referred to the companion paper to this article, part two/Karl et al. 2019, and the fact we initially say "This article consists of two parts.". We had meant this to mean a two-part paper. We have really tried to make this much clearer and have removed all phrases that could be misinterpreted.

There are a number of formatting errors in the document. Please revisit the text and correct. These include: Page 4. 'Sect. 6' please be consistent in using 'Section'

The formatting requirements from GMD/Copernicus require that the abbreviations "Fig." and "Sect." be used in running text, and "Figure" and "Section" be used at the beginning of a sentence. We are

constrained by the formatting requirements here. However, we have identified some other technical errors after carefully re-reading the manuscript, so thank you for this recommendation.

Page 4. line 6'. part two (Karl et al., 2019) of this article describes the EPISODECityChem model'. Is this meant to be a new sentence?

Yes, it was a new sentence. Thank you, we have fixed this problem now.

Also what article? Karl et al 2019? You then say 'Part two describes an application of EPISODE-CityChem for the city of Hamburg'. Part 2 in this paper? I think it is another paper.

“Part two” refers to the second part of this two-part paper, which is Karl et al., 2019. As we mentioned above, we have described this in an unclear manner in such a way that left it open to interpretation. We have therefore rewritten these descriptions to be more clear.

4.1.2 Full-Year and Seasonal Model Evaluation - the formatting is tight spacing and bold, please correct

Thank you, we have now corrected this.

Page 16: 'The data sources, the methodology used, and emission reference years are summarized inTable 4 for each emission sector' there is a large gap please correct.

Thank you again, we have also corrected this error.