

Comment on “Quantifying the sensitivity of aerosol optical properties to the parameterizations of physico-chemical processes during the 2010 Russian wildfires and heatwave ” by Laura Palacios-Peña et al. (2020)

Summary/recommendation:

This paper focuses on a studying the impact of key processes on aerosol optical properties representation. To that end, the authors conducted different sensitivity tests, modifying dry deposition, convective transport, relative humidity and wet scavenging during the 2010 Russian heatwave/wildfires episode using WRF-CHEM. They showed that changes in these key processes (mainly dry deposition, convective transport and relative humidity) lead to changes in the sulphate-nitrate-SOA formation and thus to larger impact on AOD representation.

The scientific approach is sound and the work presented is substantial. However, the conclusions and discussions deserve more work before publication. The risk is that the impact of the publication to a broader scientific community remains limited unless the authors put the conclusions into a wider perspective.

I do recommend the publication of the current manuscript in ACP journal if the authors consider these minor revisions in order to make a nice addition to the literature. I request that the authors consider the following points as they revise this manuscript:

General comments:

1/ In this paper, the authors chose to focus on the 2010 Russian heatwave/wildfires episode. However, I would have also liked to see a section dedicated to a scientific discussion including more references to previous works on the subject aiming other simulation periods, other regions affected by wildfires ... in order to have wider conclusions and to highlight the significance of these results.

2/ The authors mentioned (only in the conclusion) that other processes (not discussed in their work) may also impact the aerosol optical properties representation. I believe that the paper could be further strengthened by adding a section in which the authors can compare their findings to more references that also discussed and analyzed the sensitivity of aerosol properties to other crucial parameters (such as, aerosol mixing state).

Specific comments:

1/ Page 1, lines 10 -11: Please clarify if these differences are absolute or relative.

2/ Page 3, lines 74-76: “The sensitivity tests were carried out using the WRF-Chem regional fully-coupled model by modifying dry deposition, sub-grid convective transport, relative humidity and wet scavenging.” This sentence is repeated twice in the paper (here and in the abstract). Please formulate in a different way.

3/Page 3, line 83: Please add the wavelengths at which the aerosol optical properties (AOD, extinction and backscatter coefficients) are calculated.

4/ Page 5, lines 142-144: How these fire emissions are taken into account in the model? Can the authors give a brief description of the inventory and the uncertainties of the fire emissions used in this work.

5/ Page 6, section 2.3 : I think that the authors should better have two different sections: a section where they explain why they chose these “key sources” and another section where they describe the different sensitivity tests considered in their study.

6/ Page 7, line 208; “... showed the strongest response located over the wildfires area, but less significant.”, what do you mean here by “less significant”?

7/ Page 7, line 194: “The top-right figure shows the mean bias“. Does the top-right figure in figure 2 shows the mean relative differences or the mean bias between experiments and the base case? Please clarify.

8/ Page 8, line 229: What are these “SOA”?

9/ Page 8, lines 228-229: Why did the authors evaluate only these species concentrations?

10/ Page 9, lines 251-252: How did the authors calculate the mean absolute error for the profiles? Can the authors add a definition of the statistical indicators used in their sensitivity study?

11/ Page 10, line 315: Figures 2 and 3 in the supplementary material are not described or used in the text at all. Please add them.

12/ Page 11, line 333: What is the “Greenfield gap”? Please explain and add a reference.

13/ Page 13, line 397: “In order to reduce (or, at least, quantify) this uncertainty ...” How can we use the findings of this paper to reduce uncertainties? Please explain.

14/ Page 13, line 409-410: Can the authors give more details about these papers' findings in order to highlight these similarities?

15/ Page 14, line 422: what are these VOC?

Technical comments:

1/ Page 1, line 6: Please add a comma, after “ In order to achieve this objective sensitivity”.

2/ Page 1, line 7 and Page 5, line 122: Please replace “fully coupled” by “fully-coupled”.

3/ Page 2, line 23: Please correct “larger uncertainty” by “large uncertainty”.

4/ Page 2, line 47: “Please correct “high influenced” by “highly influenced”.

5/ Page 5, line 141: Please correct (PM₁₀ ..).

6/ Page 7, line 211: “ provoke” please correct.

7/ Page 8, line 225: Please replace “time mean” by “temporal mean”.

8/ Page 10, line 288: “hydroxyl radical” please correct.

9/ Page 10, line 300: “does not provoke” please correct.

10/ Page 12, line 377: Please add a comma after “ For the species, ... ”

11/ Page 16, References section: in the ACP journal, the name of the journals should be cited in abbreviations. Please correct.

12/ Page 24, Figure 1: for the clearness of the figure, please fill the box (for the fire-affected target area) with a more transparent color.