

In this manuscript, Arineh Cholakian et al. apply the CHIMERE CTM to the European domain and the Mediterranean region. They present the differences in BSOA by comparing 5 years in the past (historical) and 5 years in the future. The choice of the years aimed to maximize the differences between future and historic simulations regarding the change in temperature.

The authors explored three schemes (i) a molecular single-step oxidation scheme, (ii) a standard VBS scheme with anthropogenic SVOC aging only and (iii) a modified VBS scheme containing functionalization, fragmentation and formation of non-volatile SOA for all SVOC species. The year 2013 was used in order to evaluate the schemes for the European region.

Major comments

For the entire manuscript it is not clear if the authors refer to PM_{10} or $PM_{2.5}$ BSOA mass concentration. Please clarify.

P7 line 15. The observations are filter-based or online measurements; PM_{10} , $PM_{2.5}$, PM_1 ?

P7 line 24. The authors should explain the correlation. A coefficient of determination (R^2) should be used instead of correlation coefficient (R).

P7 line 25-27. “The three schemes perform reasonably well according to the criteria introduced by Boylan and Russell (2006), with the values for all the schemes falling into in zone 1 for both mean fractional bias and mean fractional error.” Please provide more information about the criteria by Boylan and Russell (2006). Provide more information about Taylor diagram.

P7 line 27-29. “Each one of the schemes performs better for a specific period; modified VBS in summer, CHIMERE standard scheme during winter, and the standard VBS scheme showing average performance during the whole year.” This result is not clear in Figure 3 or 4. Please provide which statistical metric is used for this statement.

Figures 4 and 5. The authors, currently present together European sub-domain and Mediterranean Sea sub-domain. It would be better if they split the two regions, as Mediterranean is discussed in the next chapter. In Fig.4 keep only a, b and c, and add from Fig. 5 the EUR-related figures. The same applies for MED-related ones, keep d, e and f and MED from Fig.5.

P8 lines 14-15. Please provide which correlation the authors are referring to.

P9 line 3-4. “We address results for BSOA, as it makes the major contribution to OA during summer (between 40 and 78% for different schemes in the historic scenario)” In which figure is this shown?

P9 lines 5-6. “while for SOA_{2p} an increase of +94% is calculated, this percentage raises to +135% for SOA_{vbs} and +189% for SOA_{mod} ” These numbers do not correspond to Fig.4 c1 and summer season.

P10 lines 5-8. The numbers given in the manuscript are not consistent to figure 4 c.1. Please confirm the right one.

P10 lines 11-13. The numbers given in the manuscript are not consistent to figure 4 c.2. Please confirm the right one.

P10 line 25. How were calculated these percentages? How are they linked to Fig. 5?

P10 line 25-26. "SOA2p indicates a higher increase in nonfossil contribution compared to other schemes." This cannot be stated unless the actual concentrations are shown. Please clarify if the authors are referring to the percentage of the increase.

P11 line 4-5. From Fig. 5 HOA is not that much different between SOA2p and SOAmod schemes. In contrast, SVOOA is a lot higher in the SOA2p than SOAmod. Please clarify if the authors are referring to actual concentrations. If yes, please provide a figure.

P11 lines 5-6. A more in depth explanation of why the LVOOA is underestimated is needed.

A suggestion to the authors would be the addition of a distribution of simulated organic aerosol (OA) in volatility bins for each scheme.

P11 lines 8-9. "The contribution of HOA in future scenarios becomes less compared with historic simulations, probably since more BSOA formation happens in future scenarios". Please verify if this applies for the actual concentration of HOA, as from Fig.5 the HOA contribution slightly changed between the historic and future simulations.

P12 lines 5-7. "However, the predicted increase for the future is higher for SOAvbs and SOAmod (figure 6, second column), reaching a maximum of 300% increase for the SOAmod scheme." These numbers are not shown in Fig. 6 column 2. Is the second column referring to annual or summer period?

P12 Figure 6. Please clarify the second column if it is from summer period. Add the summer indication also in the caption for columns first and third. A suggestion would be to add the corresponding figure 6 for the annual simulation.

P13 lines 22-24. The authors state that BSOA in SOAmod scheme presents the highest change. This is not true for the actual concentrations of BSOA, as SOA2p shows the highest absolute change. Also, regarding the relative change this applies only during summer period.

P13 lines 29-30. The statement is not true according to Fig. 5. The fossil sources are the major contributors only in the case of SOAvbs.

P14 Figure 7. Please use the same axis for the two cases. Also, it is not clear where the cycles and cubes are in the figures. The use of the coefficient of determination (R^2) instead of correlation coefficient (R) is advised.

P15 line 22. Change the corresponding numbers according to the main manuscript.

P16 line 4. Change the corresponding numbers according to the main manuscript. Currently are not consistent.

A clarification between absolute and relative changes and annual and summer period should be made for the whole manuscript.

Minor comments:

P2 line 12. Remove commas after the dots in reference.

P2 line 31. Remove comma after the dot in reference.

P2 line 32. Define CHIMERE.

P2 line 34. Remove all the dots in $\mu\text{g}\cdot\text{m}^{-3}$

P2 line 35. Remove comma after the dot in reference.

P5 line 12. Remove commas after the dots in reference.

P5 line 31. Add a dot after Cholakian.

P7 line 12. Define ECMWF.

P7 line 13. Define MEGAN.

P8 lines 11-12. Remove dots in $\text{molecules}\cdot\text{cm}^2$

P8 Figure 3. Check the order of the months. June-July-August are before March-April-May. Please magnify the table. Replace bials with bias.

P9 Figure 4. Line2. Please add next to historic simulations, also future simulations.

P10 line 12. Change august to August.

P12 Figure 6. Remove dots from units.

P15 line 6. Change VBS mod to SOAmod.