

Interactive comment on “Impact of wildfires on particulate matter in the Euro-Mediterranean in 2007: sensitivity to the parameterization of emissions in air quality models” by Marwa Majdi et al.

Anonymous Referee #1

The authors wish to thank the anonymous referee for the very helpful comments and corrections. All corrections have been included in this new version. A response to the general and specific comments is provided below (in blue).

General comments

The main general comment for the manuscript is that several of the results presented can be considered as tentative since they are provided for and refer to a single site (GR0039A).

We agree that the lack of available surface data close to the fire region is a limitation to our model evaluations. That is why an evaluation is also done using satellite observations.

A rural background AIRBASE station is located close to the fire region and discussed in the specific comments (comment 5). The station GR0035A is located in the same area (Athens) in Greece as the station GR0039A, already included. For GR0035A, observations show significantly higher background PM_{2.5} levels with large variability due to local influences. We consider that this specific station is probably strongly influenced by local emissions and decided not to add additional figures that may be confusing (the model resolution cannot resolve local influences). However, following to reviewer's comment, we added it in the revised version since it also shows the high spatial variability of the transported fire plumes.

In addition to observations of surface concentrations, the remote sensing observations from MODIS and AERONET are considered. Even if comparison to remote sensing adds another level of uncertainty (calculation of optical properties, vertically integrated datasets), it improves the representativity of the model validation.

A sentence on the problem of data availability for the evaluation of the composition and impact of fire plumes has been added to the conclusions (page 24, lines 4-7): “The ability of Polyphemus/Polair3D and CHIMERE to simulate regional surface PM_{2.5} concentrations and optical properties (particularly AOD) was evaluated based on comparison to available measurements (8 AIRBASE stations and 6 AERONET stations). Only two out of the 8 AIRBASE stations (GR0039A and GR0035A in Greece) and 3 out of 6 AERONET stations (Lecce University in Italy, Blida in Algeria and Bucharest in Romania) are used because they are they are the most affected by wildfires (stations where fire contribution is higher than 10%). The lack of surface observations strongly limits this evaluation but it is partly complemented by comparisons to MODIS satellite-based observations of AOD.

Comparisons to surface and remote sensing observations show that the models can simulate enhancements of a good order of magnitude and +/- 1 day uncertainty in the timing. However, more surface observations in remote regions is necessary for a precise evaluation of the simulated long-range transport from fire emissions, the aerosol speciation within the plumes and the resulting impact on air quality.”

In addition, in the manuscript more results are presented for the first summer period wildfire event (20-31 July 2007) although the maximum of emissions is during the second summer period wildfire event (24-30 August 2007) as shown in Figure 2.

More Figures and results are added in the appendix of the revised paper for the second wildfire event (24-30 August 2007). Figures of the PM_{2.5} composition in MedReg2 (most affected during that time period) are added for Polyphemus simulations (Cf. Specific comment 6). The fire contribution to PM_{2.5} composition is almost the same for both events. Figures of the mean total AOD at 550nm from MODIS, for Poly-ref and CHIMERE-ref during the second fire event also shows similar conclusions as during the first fire event.

Specific comments

1. **Page 6, lines 20-22:** Instead of primary aerosol oxidation, are you probably referring to the oxidation of I/S/L-VOCs by OH in the gas phase?

The sentence (page 6, lines 20-22): “Each primary aerosol undergoes one OH-oxidation reaction in the gas phase with ...” is replaced by “Each primary I/S/L-VOC undergoes one OH oxidation reaction in the gas phase with ...”

2. **Page 8, lines 8-9:** Please use a reference and explain why POA emissions taken into account are modeled as LVOCs.

In page 8, POA emissions are modeled as LVOC in a sensitivity study. This aims at studying the impact of ignoring I/S-VOC emissions in the gas phase and ignoring the semi-volatile properties of POA. The sentence (page 8, lines 8-9) : “fire emissions in the PBL but without I/S-VOCs” is modified to “fire emissions in the PBL but without I/S-VOC emissions in the gas phase. In this sensitivity study, the semi-volatile properties of POA are not considered, and POA emissions are modeled as LVOCs”.

3. **Pages 11-12, Section 3.3:** The overall performance of CHIMERE model is shown to be slightly better than Polyphemus model considering also the statistics in Tables 3 and 4. Under this view, you have to present results of CHIMERE model in Figures 3, 4 and 11 additional to those of Polyphemus model for comparison.

It is not easy to determine which model is better in terms of statistics, as the performance varies with the statistics considered. For PM_{2.5} statistics, the overall performance of CHIMERE is slightly better for bias, but it is slightly worse for correlation. In terms of errors, CHIMERE is slightly better for PM_{2.5}, but Polyphemus is slightly better for AERONET AOD.

However, figures for CHIMERE (Figure A.1, Figure A.2, Figure A.3) are added in the appendix A in the revised paper. Conclusions for CHIMERE are similar to those for Polyphemus.

Figure A.1 is added to the appendix A

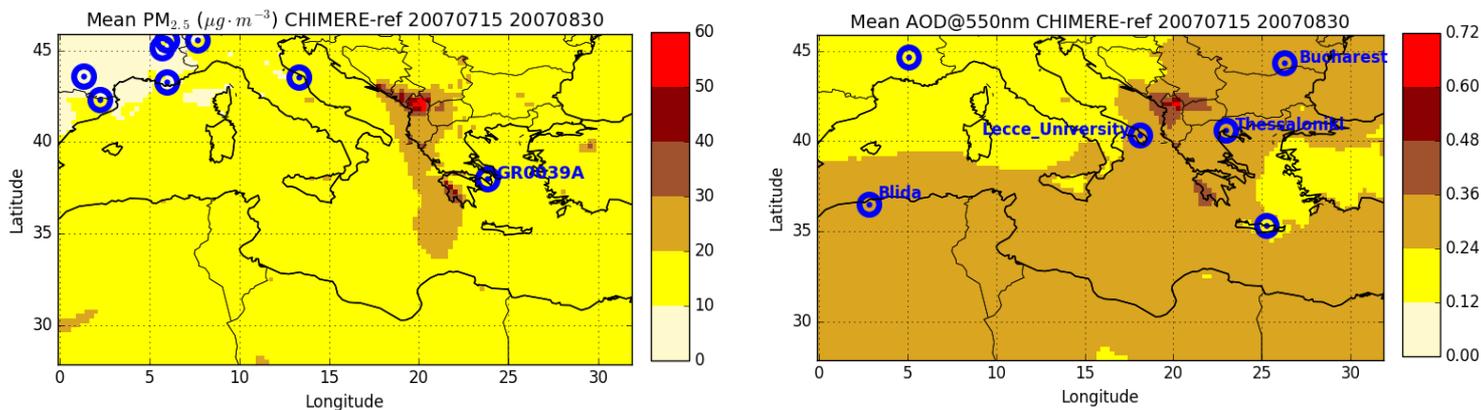


Figure A.1: “Daily mean PM_{2.5} and AOD at 550 nm from the simulation CHIMERE-ref averaged over the summer of 2007. The 8 AIRBASE and 6 AERONET stations, used in this work, are represented here in blue dots.

The sentence “Figure 13 in Appendix B shows that conclusions for CHIMERE are similar to those for Polyphemus.” is added to the revised paper (page 11, line 26).

Figure A.2 is added to the appendix C:

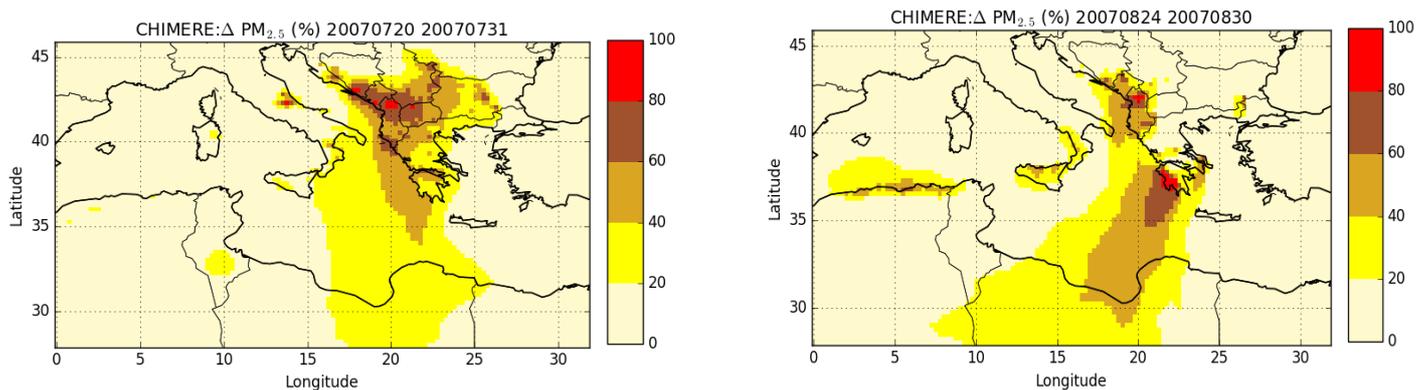


Figure A.2: “Contribution from fires to the total surface PM_{2.5} as the difference between reference simulations and simulations without fires for CHIMERE during the first (left panel) and second (right panel) fire events.”

The sentence “Figure 14 in Appendix C shows that the contribution of fires for CHIMERE are similar to that for Polyphemus.” is added to the revised paper (page 13, line 12).

Figure A.3 is added to the appendix G:

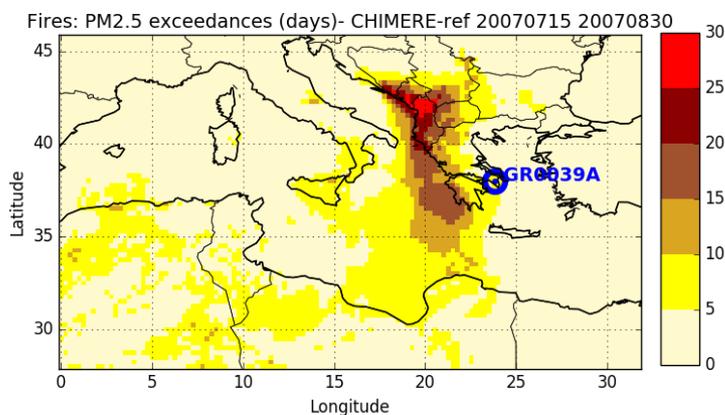


Figure A.3: PM2.5 exceedance (days) from fires simulated by CHIMERE (difference between the Poly-ref and Poly-Nofires) during the summer 2007 (from 15 July to 30 August 2007).”

The sentence “Figure 18 in Appendix G shows that conclusions for CHIMERE are similar to those for Polyphemus.” is added to the revised paper (page 23, line 14).

4. **Pages 12, Figure 3:** Presenting similar maps using the data of MODIS is necessary to support better the comments in the manuscript about Figure 3.

Comparisons to MODIS are addressed in the response to the specific comment 8.

5. **Page 13, Section 3.4.1:** Figure 4 reveals several parts of the Mediterranean area being affected by the wildfire plumes for example Central and South Italy, Sicily, Bulgaria, almost the whole country of Greece etc. In the manuscript you are referring to only 2 stations being affected by the wildfire emissions during the first event and 3 stations during the second one. Aren't there additional AIRBASE or AERONET stations that could be used to support your analysis? (For example GR0035A is also a background suburban station where PM2.5 concentrations are being measured; is there a reason for not using measured data from this station?). Is the performance of the model good also for the remaining areas that are not affected by the fires?

5.1) aren't there additional AIRBASE or AERONET stations that could be used to support your analysis?

Measurement stations have been selected using the contribution from fires. Only stations with relative contribution higher than 10% are kept. In addition, for surface concentration observations, only background suburban and background rural stations with available data during the fire events are chosen in this study (Figure 3 left panel in the paper).

In the revised paper page 15 line 2, the sentences: “Figure 6 shows time series of daily observed and simulated aerosols at stations with significant impact from fires ...” are replaced by: “ Figure 6

shows times series of daily observed and simulated aerosols at background suburban and background rural stations with available data during fire events and with a fire contribution higher than 10% ...”

As already explained in the answer to the general comments, another station in Greece (GR0035A) meets this criteria, close to the station already included and discussed in detail.

In the revised paper, we added in Figure 6 the time series of daily mean surface PM_{2.5} at that station (GR0035A). Although the temporal tendencies of the simulated PM_{2.5} concentrations at GR0035A are consistent with the observations, background PM_{2.5} levels are strongly underestimated (Bias= -85%). The observed background levels are significantly higher than those at the GR0039A station. This suggests the influence of local emissions that are missing in the model or that the resolution of the simulations does not allow to represent. This was the reason why the GR0035A was not initially considered in the paper.

However, following the reviewer's suggestion to include more surface sites, we have chosen to include it in the revised version because it is a good illustration of the high spatial variability of the transported fire plume which can not be captured in regional CTM simulations.

At the GR0035A station, the second observed peak during the second fire event is more than twice higher than the observed peak at the GR0039A and is measured one day earlier. In the simulations, the enhancement due to fires is similar in shape and magnitude, clearly highlighting the difficulty to simulate the exact temporal variability of emissions and transport of fire plumes in CTMs. Moreover, the station GR0035A is probably affected by a dust episode during the second fire event. Similar conclusions are found for AOD at the station Thessaloniki (near the station GR0035A), which seems to be also affected by dust especially during the second fire event. The observed value of Angstrom exponent at Thessaloniki station is lower on the 25th August ($\alpha=0.95$) suggesting that a large fraction of coarse mode particles (probably dust transport). Here, we didn't include the Thessaloniki station due to the lack of available AOD measurements during the first fire event where the fire contribution is more pronounced.

The sentences are added to page 16 line 17: “At the GR0035A station, the temporal tendencies of the simulated PM_{2.5} concentrations are consistent with the observations, however the first PM_{2.5} peak is underestimated since PM_{2.5} levels are strongly underestimated (bias= -85%). The observed background levels are significantly higher than those at GR0035A station. This suggest the influence of local emission that are missing in the model or limitations due to the coarse model resolutions which can not represent this station.”

and we added also these sentences to page 16 line 27: “At the GR0035A station, the second observed peak during the second fire event is more than twice higher than the observed peak at the GR0039A and is measured one day earlier. In the simulations, the enhancement due to fires is similar in shape and magnitude, clearly highlighting the difficulty to simulate the exact temporal variability of emissions and transport of fire plumes in CTMs. Moreover, the station GR0035A is probably affected by a dust episode during the second fire event.”

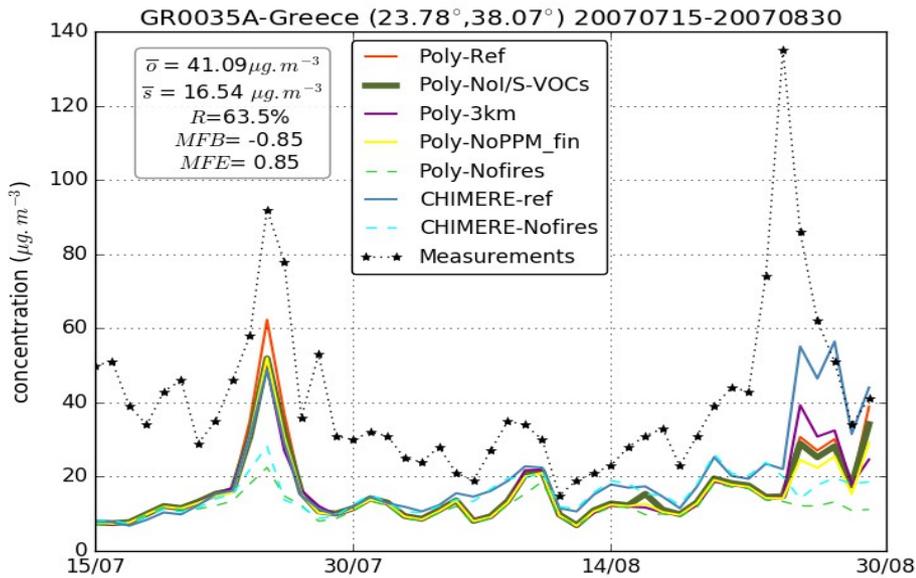


Figure 6: Times series from 15 July to 30 August of daily mean surface PM2.5 concentrations at the AIRBASE station GR0035A.

5.2) Performance of the models (CHIMERE and Polyphemus) for areas which are not affected by fires:

Table C.1: Statistics of models-to-measurements comparisons for the mean daily PM2.5 from the reference Polyphemus simulation (from 15 July to 30 August 2007).

Station	localization	Mean observed PM2.5	Mean simulated PM2.5	Correlation (%)	MFB (%)	MFE(%)
FR12021	Toulouse-France	10.48	6.44	85.5	-48	48
ES0010R	Spain	9.54	7.95	59.4	-22	36
FR15043	Grenoble-France	10.57	8.28	75.8	-26	31
FR33101	Chambéry-France	6.84	8.56	87.3	22	28
FR03043	Marseille-France	14.93	10.16	92	-43	43
FR33102	Chambéry Le haut-France	9.74	8.37	86	-17	23
IT0495A	Italy	17.39	8.19	83.4	-76	76

Table C.2: Statistics of models-to-measurements comparisons for the mean daily PM2.5 from the reference CHIMERE simulation (from 15 July to 30 August 2007).

Station	localization	Mean observed PM2.5	Mean simulated PM2.5	Correlation (%)	MFB (%)	MFE(%)
FR12021	Toulouse-France	10.48	8.80	76.6	-22	32
ES0010R	Spain	9.54	8.41	56.1	-13	30
FR15043	Grenoble-France	10.57	10.44	73.9	-3	32
FR33101	Chambery-France	6.84	10.47	67.6	40	44
FR03043	Marseille-France	14.93	10.71	85	-39	41
FR33102	Chambery Le haut-France	9.74	10.19	61.3	1	35
IT0495A	Italy	17.39	10.78	67	-49	51

Regarding the statistical evaluation of the models, the mean simulated PM2.5 at the different stations which are not affected by fires is in good agreement with the observations, except for IT0495A where PM2.5 are underestimated compared with surface PM2.5 measurements. The model performance is always met and the model goal is met only for the model errors MFEs. The models-to-measurements correlations range between 59.9 and 92% for all the stations.

Generally, the performance of the two models (Polyphemus and CHIMERE) is good for the areas which are not affected by fires, except at IT0495A where PM2.5 background levels in the simulations are underestimated most probably due to dust.

Since this paper focuses on the evaluation of models performance near the most affected stations by fires, we choose not to include the model performance at the stations which are not affected by fires in the revised paper.

6. Page 14-15, Section 3.4.2: The results presented in this section refer only to a single station and only to the fire event of the first period. Under this view, they are of very limited reference and cannot be used to characterize the aerosol composition in the Mediterranean areas affected by the fire plumes. Similar results with those presented in Figure 5 have to be presented for different stations and wider areas affected by the fire emissions and separately for both fire peak events in order possible differences to be identified.

Figure 5 page 15 is replaced by Figure D.1 and Figure D.2 in the revised paper. Figure D.1 and Figure D.2 show the composition of surface PM2.5 concentrations for two wider areas which are the subregions: MedReg1 (for the first fire event) and MedReg2 (for the second fire event). These two subregions are the areas most affected by fires (high fire emissions (Figure 2)) especially during the first fire event for Medreg1 and during the second fire event for MedReg2.

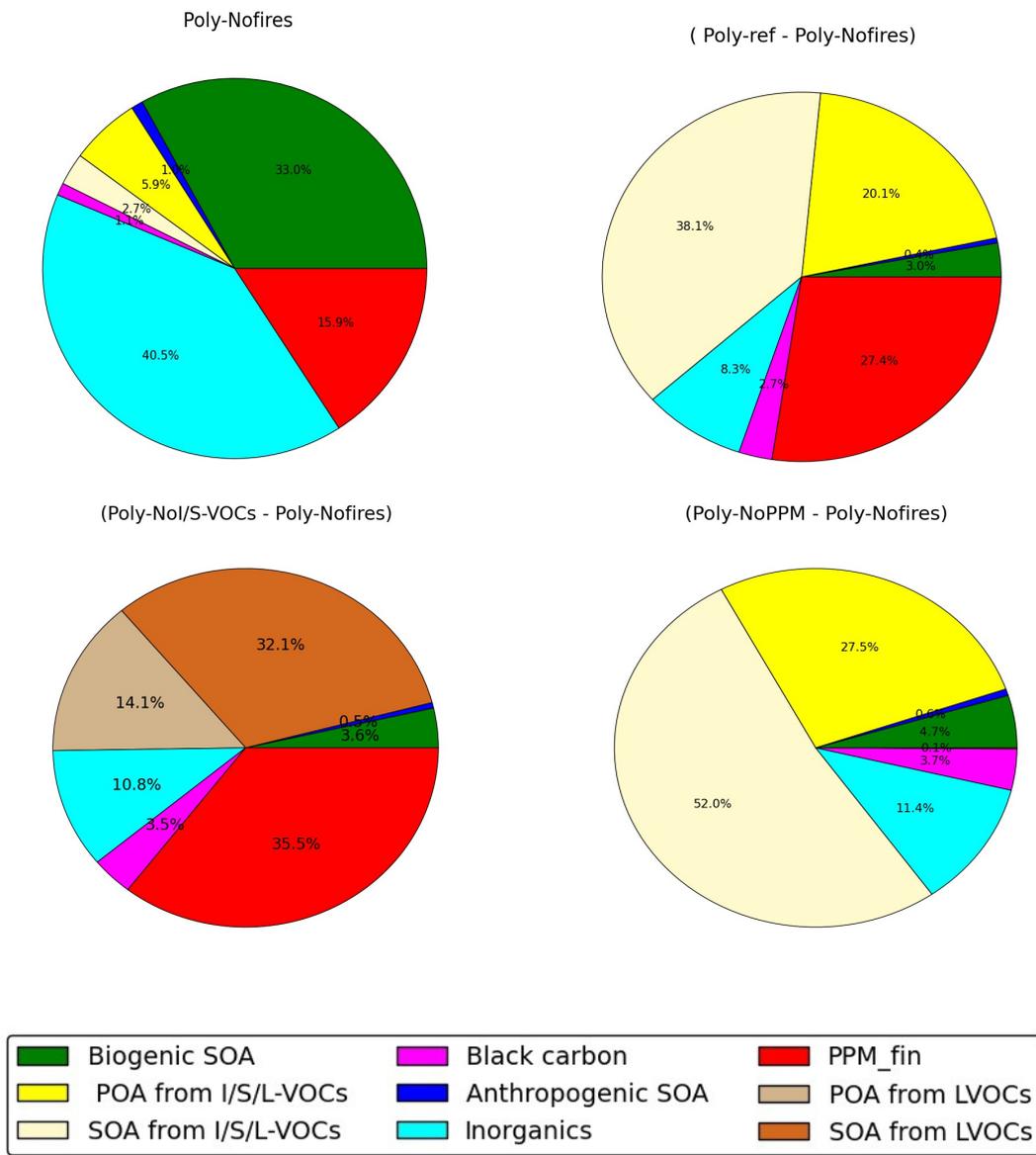


Figure D.1: Composition of surface PM_{2.5} concentration over MedReg1 during the first fire event (upper left panel, simulation Poly-Nofires). Composition of surface PM_{2.5} concentration due to fires (upper right panel: simulation Poly-ref; lower left panel: simulation Poly-NoI/S-VOCs; lower right panel: simulation Poly-NoPPM).

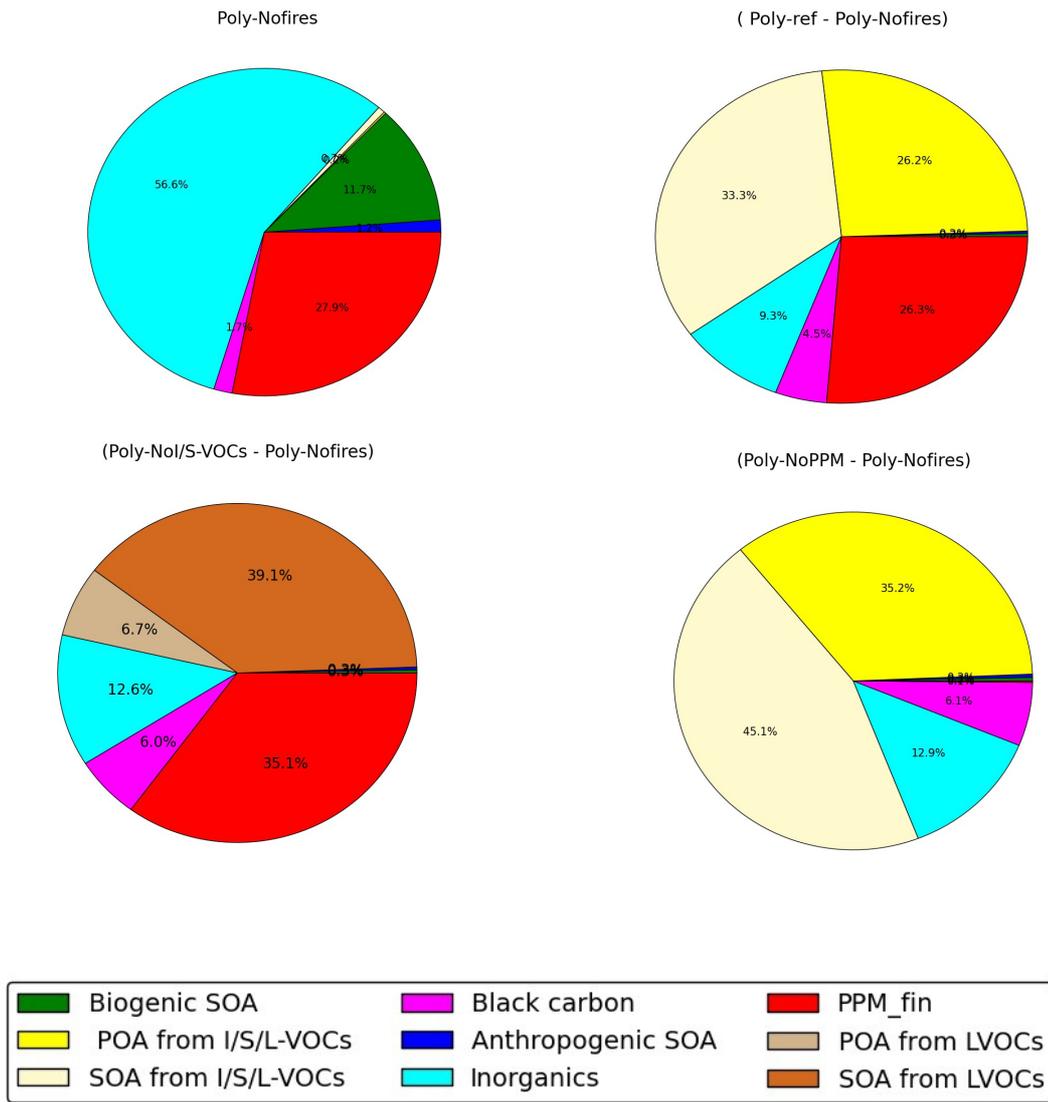


Figure D.2: Composition of surface PM_{2.5} concentration over MedReg2 during the second fire event (upper left panel, simulation Poly-Nofires). Composition of surface PM_{2.5} concentration due to fires (upper right panel: simulation Poly-ref; lower left panel: simulation Poly-NoI/S/L-VOCs; lower right panel: simulation Poly-NoPPM).

Similar composition is found for surface PM_{2.5} concentrations over two wider areas: MedReg2 during the second fire event and over MedReg1 during the first fire event for both models (CHIMERE and Polyphemus).

During the first fire event over MedReg1, organic aerosols contribute significantly to surface PM_{2.5} concentrations. Their contribution is larger than those of other species such as inorganics (11%) PPMfine (dust) (15%) and black carbon (5%). When we consider fire emissions, we found that organic aerosols which are mostly composed of POA and SOA from I/S/L-VOCs, are predominant in the contribution of fires (between 47% and 85% of the contribution). Lower contribution are found for inorganics (8% to 13%) and black carbon (3% to 6%).

During the second fire event over MedReg2, PM_{2.5} composition in Poly-Nofire is similar to PM_{2.5} composition during the first fire event over MedReg1. The same conclusions are found as during the first fire event: the organic aerosols are the most important contributor in the composition of PM_{2.5} from fires (46% to 81%). Lower contributions are found for inorganics (9 to 12%) and black carbon (5 to 6%).

The sentences (page 14 line 2-23) are corrected as followed: “The composition of surface PM2.5 concentrations simulated during the first fire event over MedReg1 and during the second one over MedReg2 are shown in Figure D.1 and Figure D.2 respectively. These two subregions are the areas most affected by fires (high fire emissions (Figure 2)) especially during the first fire event for Medreg1 and during the second fire event for MedReg2.

The upper left panel shows the composition of surface PM2.5 concentrations for the simulation without fire Poly-NoFires (background surface PM2.5 concentrations), while the upper right panel shows the composition of surface PM2.5 concentrations due to fires (differences between the simulations Poly-ref and Poly-Nofires). If wildfires are not taken into account (simulation without fire) and during the first fire event over MedReg1, organic and inorganic aerosols contribute equally (42.6%, 40.5%) to the surface PM2.5 concentrations. The contribution of PPMfine (dust), black carbon are lower (15% , 1%). As noted by Chrit et al. (2017), most of summer organic aerosols are from biogenic sources in this region.

If wildfires are not taken into account during the second fire event over MedReg2, inorganics and PPMfine are the predominant component in the composition of PM2.5 concentrations (56.5% and 27.9%). Lower contributions are noticed for black carbon (1.2%) and organic aerosols (14.3%).

Figure 5 also shows the composition of surface PM2.5 concentrations due to fires for the simulations Poly-ref, Poly-NoI/S-VOCs and Poly-NoPPM (differences between the simulations Poly-ref and Poly-Nofires, between the simulations Poly-NoI/S-VOCs and Poly-Nofires and between the simulations Poly-NoPPM and Poly-Nofires respectively). During the first fire event over MedReg1, organic aerosol is predominant in the contribution of fires (between 47% and 85% of the contribution). Organic aerosol is mostly composed of POA and SOA from I/S/L-VOCs (46% to 80%). Note that POA and SOA from L-VOCs (low volatile organic compounds) are important even in the simulation when I/S-VOCs are not taken into account in fire emissions (46%), because POA are then assigned to L-VOCs. The contribution from inorganics (8% to 13%) and black carbon (3% to 6%) are low. During the second fire event over MedReg2, similar PM2.5 composition is found. Organic aerosols (mainly the POA and SOA from I/S/L-VOCs) are the most important component contributing in the composition of PM2.5 from fires (between 46% and 81% of the contribution). The contribution from inorganics (9% to 12%) and black carbon (5 to 6%) are lower. Similar PM2.5 composition is found not only during the second fire event over MedReg2 but also in the concentrations simulated by CHIMERE (not shown here). Surface PM2.5 concentrations from fire simulated by CHIMERE are composed in the first and second fire events mainly of organic aerosols, mostly composed of primary organic carbon (OCAR) (46%) which corresponds to I/S/L-VOCs in Polyphemus, and of PPMfine (39%). The contributions from inorganics (9%), black carbon (5.2%) and SOA from VOCs (2.7%) are low.”

7. Page 16, lines 4-8: Comments for Figure 8 is better to be written at the end of the section 3.4.3 after the comments for Figures 6 and 7.

Comments for Figure 8 are moved at the end of the section 3.4.3 (page 17 line 2).

8. Page 16, Figure 8: Please present and comment on similar maps based on the models and MODIS results for the second fire event in August.

Figure E.1 is added to Appendix D and E.2 are added to Appendix E in the revised paper.

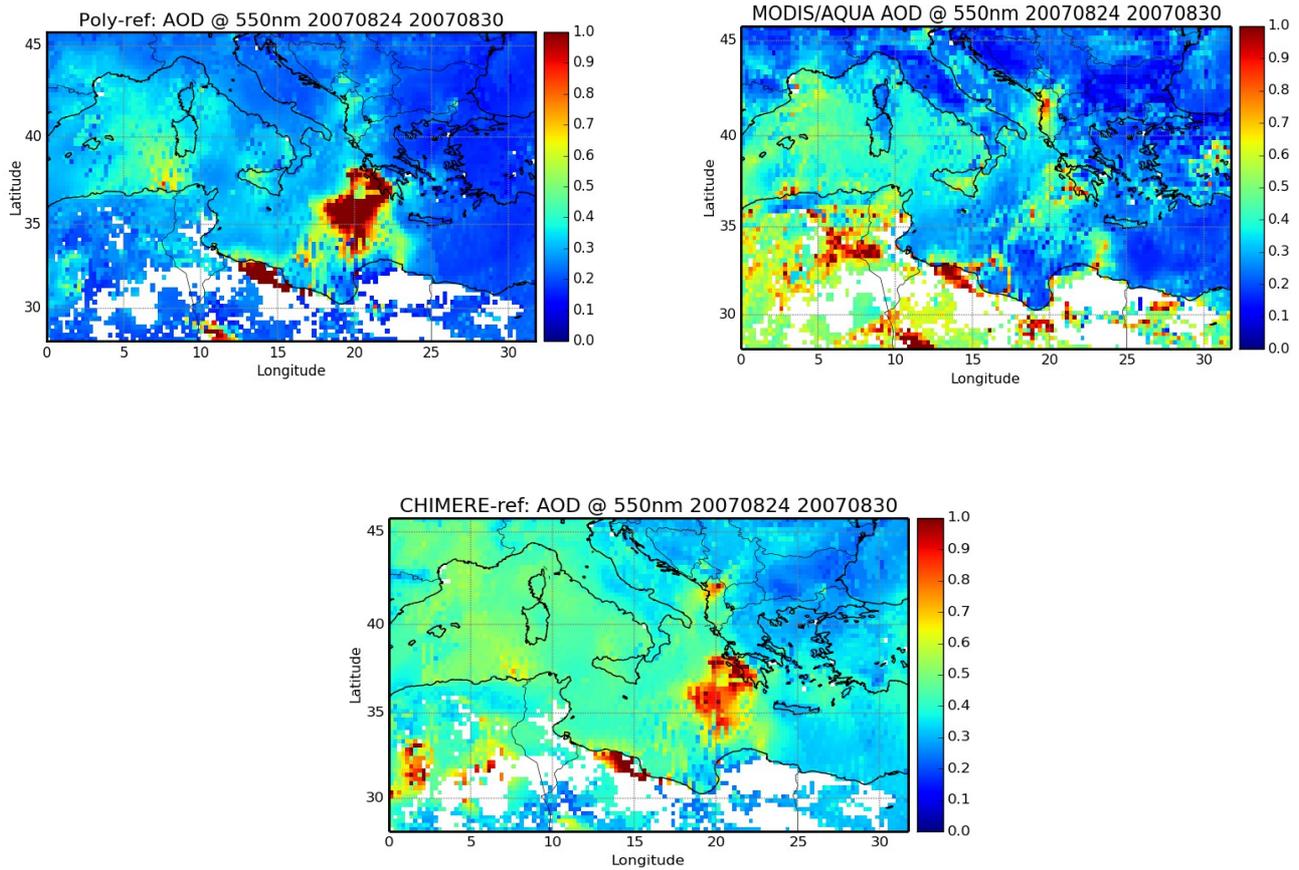


Figure E.1: “Mean total AOD (at 550 nm) from MODIS/AQUA, Poly-Ref and CHIMERE-ref during the second fire event (24-30 August 2007).”

These sentences are added (page 17 line 6) (after moving the comments for Figure 8 at the end of the section 3.43 page 17 line 2): “ During the second fire event in Greece, the simulated AOD for Poly-ref and for CHIMERE-ref is about 1 and 0.9 respectively as shown in Figure 16 in Appendix D. The observed AOD can reach 0.9. However, both models overestimate AOD values in the fire plume (reaching ~ 0.98 for Poly-ref and 0.88 for CHIMERE-ref against 0.7-0.8 in Greece and 0.5 from MODIS. The fire plume is less pronounced in observations than in simulations.

Day-to-day comparisons for four selected days (24, 25, 27 and 29 August 2007) are shown in Figure 17 in Appendix E. The simulated AOD is consistent with the observations in terms of localization and general transport pathways. However, the simulated AOD is much higher in the Greek fires' plume compared with MODIS observations during the peak of emissions (25-29 August). This probably reflects too low temporal variability in the emissions. In the simulations, emissions are assumed constant during the day but comparisons suggest shorter temporal variability. This is also apparent in the time series of Figure 7 in the paper, over region MedReg2: the peak for the second fire event is twice longer in the simulations (double peak starting on the 25 August 2007) than in the observations. This peak over two days instead of one in the simulations suggests an overestimate of emissions during this event which is also observed with respect to surface observations in Greece. The first peak corresponds better to observations. This shows that uncertainties are not only related to total emissions but also to their temporal variability and the associated transport pathways.”

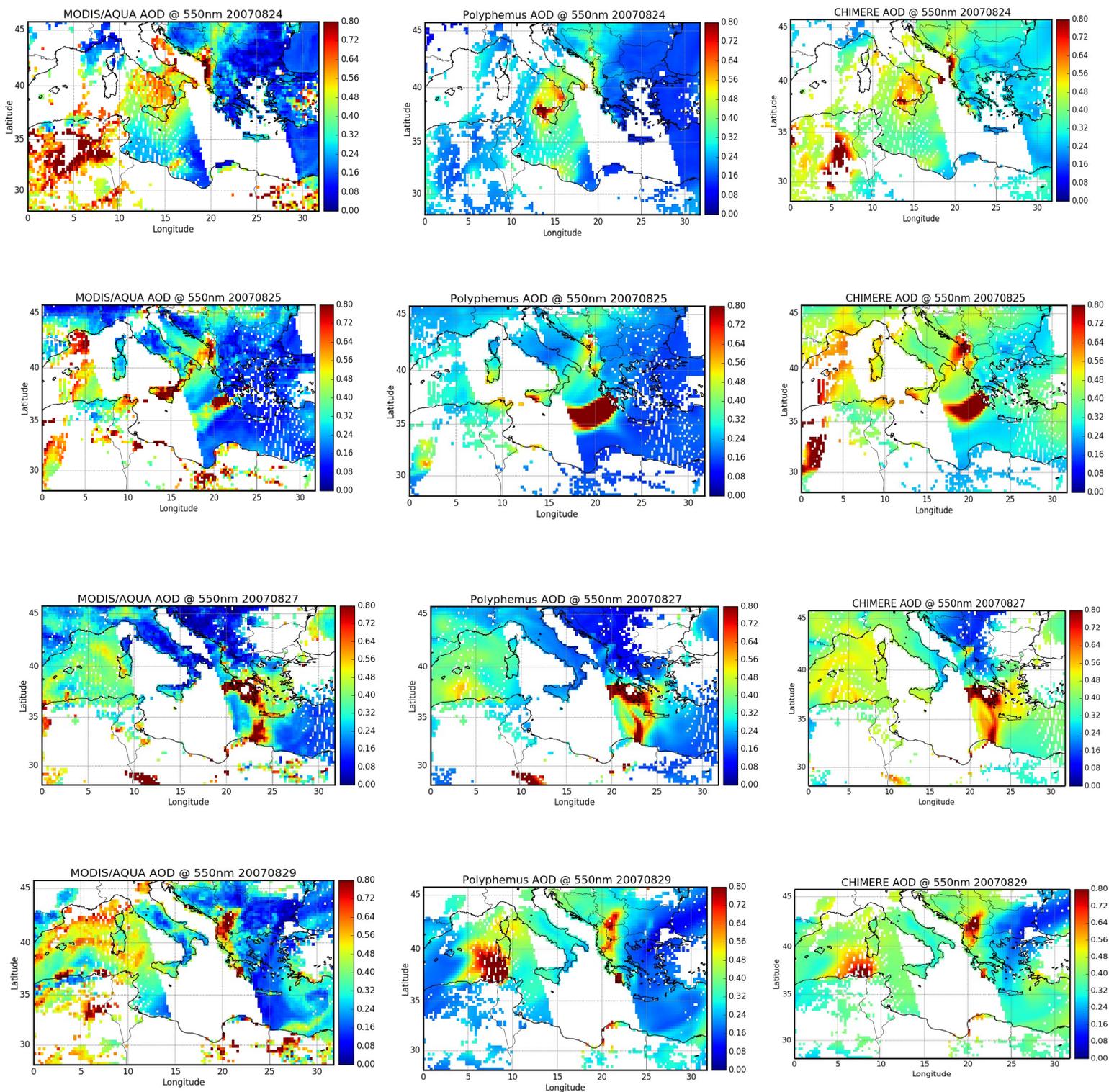


Figure E.2: “Total AOD (at 550 nm) from MODIS/AQUA and the corresponding Polyphemus AOD (Poly-Ref) and CHIMERE AOD (CHIMERE-ref) for four selected days (24, 25, 27 and 29 August 2007).”

9. Page 23, Section 4.1: In lines 10-12, it is commented that according to the Polyphemus model results the number of days, when the WHO air quality limit for the daily PM2.5 values is exceeded in GR0039A station, is 7 while the corresponding number based on measurements is 14. This corresponds to a -50% bias by the model. Is it acceptable? No data are provided for additional stations in the study area rendering the results presenting in this section very tentative. Further evidence is necessary to prove the acceptable performance of Poly-ref runs (and CHIMERE-ref runs, please see na previous comment) in the estimation of the PM2.5 air quality exceedences supporting better the necessity for the maps in the Figure 11 to be presented.

Table F.1: Modeled and observed PM2.5 exceedances at each AIRBASE stations. Values between brackets correspond to modeled PM2.5 exceedances for simulations without fire emissions (Poly-Nofires and CHIMERE-Nofires).

Airbase station	Observed PM2.5 exceedances			Modeled PM2.5 exceedances Poly-ref			Modeled PM2.5 exceedances CHIMERE-ref		
	Whole period	First fire event	Second fire event	Whole period	First fire event	Second fire event	Whole period	First fire event	Second fire event
GR0039A	14	5	5	7 (0)	3 (0)	4 (0)	9 (2)	3 (1)	5 (0)
GR0035A	37	12	7	7 (0)	3 (0)	4 (0)	9 (2)	3 (1)	5 (0)
IT0459A	4	2	2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FR12021	0	0	0	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)	2 (2)
ES0010R	0	0	0	1 (1)	0 (0)	1 (1)	2 (2)	0 (0)	2 (2)
FR15043	0	0	0	0 (0)	0 (0)	0 (0)	4 (4)	0 (0)	4 (4)
FR33101	0	0	0	0 (0)	0 (0)	0 (0)	3 (3)	0 (0)	3 (3)
FR03043	5	0	3	2 (2)	0 (0)	2 (2)	4 (4)	0 (0)	4 (4)
FR33102	0	0	0	0 (0)	0 (0)	0 (0)	3 (3)	0 (0)	3 (3)

Table F.1 is added to the revised paper in the appendix F.

The sentences in page 23, lines 10-12: “The number of exceedances predicted by the model is first compared to exceedances observed by AIRBASE (only one station is available). During the summer 2007, 14 PM2.5 exceedances were observed and only 7 are simulated at GR0039A by Poly-ref and 9 by CHIMERE-ref.” are replaced by “Table 5 in Appendix F presents the modeled and observed PM2.5 exceedances at each AIRBASE stations during the whole summer 2007 and during fire events. Generally, the models (Polyphemus and CHIMERE) underestimates PM2.5 air quality exceedances because the horizontal resolution used here does not allow the representation of local pollution (especially for the station GR0035A). Better performance is observed during fire events than the whole period. Near fire regions, at the stations GR0039A, the number of exceedance is well-modeled, in spite of the slight underestimation during both fire events compared to the observed PM2.5 exceedances. However, at the GR0035A station, the underestimation of PM2.5 exceedances is sharp. This can be explained by the strong underestimation of the background PM2.5 levels as shown in Figure 6. Far from fire regions, the PM2.5 exceedances modeled by Polyphemus are in a good agreement with the observed ones especially during the two fire events. The simulated PM2.5 exceedances by CHIMERE in the fire plume are overestimated at some stations .”

10. Page 23, Figure 11: Figure 11 is not clearly explained in the manuscript. What is presented in Figure 11 (left panel)? Is it the additional days with exceedences due to fires (i.e. (days with exceedences Poly-ref) minus (days with exceedences Poly-Nofires))?

This sentence (page 23 lines 13-15): “Figure 11 shows the simulated number of days concerned by a PM2.5 exceedance from fires (difference of PM2.5 exceedance days between the Poly-ref and Poly-Nofires). Most are concentrated around fire sources, mainly in Balkan (30 days).” is replaced by “Figure 11 shows the additional days with PM2.5 exceedences due to fires simulated by Polyphemus (difference of PM2.5 exceedance days between the Poly-ref and Poly-Nofires). Most are concentrated around fire sources, mainly in Balkan (30 days).”

Figure 11 's caption “PM2.5 exceedance (days) from fires simulated by Polyphemus (difference between the Poly-ref and Poly-Nofires) (upper left panel) and simulated by CHIMERE (difference between the Poly-ref and Poly-Nofires) (upper right panel) and the maximum dispersion (σ) related to fire emissions for PM2.5 exceedences days (lower left panel) during the summer 2007 (from 15 July to 30 August 2007).” is replaced by “The additional days with PM2.5 exceedences due to fires simulated by Polyphemus (difference between the Poly-ref and Poly-Nofires) and the maximum dispersion (σ) related to fire emissions for additional days of PM2.5 exceedences due to fires (lower left panel) during the summer 2007 (from 15 July to 30 August 2007).”

11. Page 23, lines 16-18: It is commented by the authors that PM2.5 concentrations are composed mainly of organic matter. However adding the percentages in the parentheses (i.e. 7.3% for POA and 19.1% for SOA), a percentage total contribution of 26.1% is estimated. Is this contribution to PM2.5 the main? Please clarify.

The sentence (page 23, lines 16-18): “During the fire periods, surface PM2.5 concentrations simulated in Poly-ref in MedReg1 and MedReg2 sub-regions are composed mainly of primary organic matter (7.3% with 92% due to fire) and secondary organic aerosol (19.1% with 78.9% due to fires).” is replaced by “During the fire periods, surface PM2.5 concentrations simulated in Poly-ref in MedReg1 and MedReg2 subregions are composed mainly of OM (54% with 61.6% due to fire for MedReg1 and 52.3% with 60.1% due to fires for MedReg2), and inorganics (27% with 8% due to fires for MedReg1 and 15% with 9% due to fires for MedReg2).”

P.S.: During each fire event, over each subregion, the percentage (P) presenting the contribution of each component (X) from fire, is calculated as follows : $P\% = [X]_{poly-ref} - [X]_{poly-Nofire} / [PM2.5]_{Poly-ref}$.

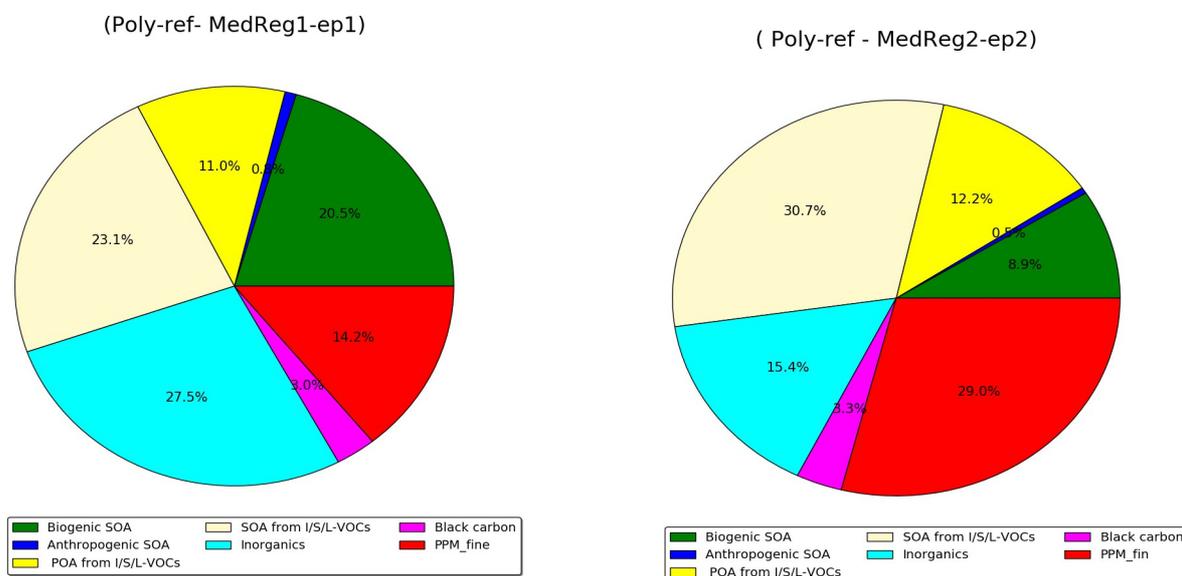


Figure: composition of surface concentrations over MedReg1 during the first fire event and MedReg2 during the second fire event for simulation Poly-Ref.

12. Page 24, lines 9-10: The percentages have been estimated for one site and for one fire event and have a very limited reference (spatial and temporal). Please see a previous comment of mine so as to update the conclusions.

We replaced the percentages given for one site and for one fire event by percentages for wider areas during the two fire events : MedReg1 during the first fire event and MedReg2 during the second fire event.

The sentence in page 24, lines 9-10 : “Near fires, PM2.5 is mostly composed of organic aerosol (52% to 87%), with a strong contribution from I/S/L-VOCs (62% to 84%).” is replaced by “Near fires, PM2.5 is mostly composed of organic aerosol (47% to 85%), with a strong contribution from I/S/L-VOCs (46% to 80%).”

13. Page 24, lines 10-12: Which Figure or Table supports these high correlation values and where in the manuscript are these results commented? Is it Figure 7?

Figure 7 supports these high correlation values. These results are commented (page 15 lines 6-8).

14. Page 24, lines 14-16: This conclusion is not straightforward and requires further clarifications not only in conclusions but also in the manuscript. In addition, it is not clear how overestimations in simulated results may indicate missing emissions.

Indeed, this sentence is not clear. The sentence (page 24, lines 14-16): “The overestimation is very low (10%) in the simulation Poly-NoPPM, where I/S-VOCs are taken into account, but unidentified primary particles emitted from biomass burning are not. ” is replaced in the revised paper by “Since unidentified primary particles (PPMfine) emitted from biomass burning are not considered in Poly-NoPPM, the simulated AOD values are getting closer to MODIS observations. This suggest that PPMfine could correspond to I/S-VOCs.