Interactive comment on "Two global climatologies of daily fire emission injection heights since 2003" *by* S. Rémy et al.

Anonymous Referee #1

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General Comments

Emissions from vegetation fires contribute a major part of the atmospheric aerosol load and contribute to the chemical composition of the atmosphere. A crucial parameter that determines the atmospheric concentrations of gaseous and particulate matter released by fires is the effective source height. The burning vegetation releases heat into the atmosphere producing buoyancy that can lead to local plume rise in the order of several thousand meters. Beside the buoyancy the environmental conditions like static stability and wind shear are major factors that determine the plume rise. Atmospheric models describing the spatial and temporal distribution of gases and aerosols therefore urgently need emission data that beside source strength also need the effective source height or profiles of the emission strength.

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The authors describe how the injection heights are provided within the GFAS. They use two fundamental different approaches. They call it the semi-empirical parameterization of Sofiev et al. (2012) and the analytical one-dimensional plume rise model (Paugham et al., 2015). The results are evaluated with plume heights derived from satellite data (MPHP data set). This work is of great significance since the emission heights are a key parameter for aerosol modelling studies. In two case studies the extended GFAS dataset is used to improve the simulated aerosol distribution.

The paper is therefore an important contribution for the modelling community. Unfortunately, in its present form the paper has to be rejected due to the lack of presentation quality. Examples (there would be many things more to add) leading to my overall judgment of the paper are given in the specific comments.

As there are native speakers in the list of authors I would encourage them to check the language style, the grammar, and the wording of the paper.

In the following I will make a detailed suggestion for a revised version and highly encourage the authors to re-submit their important description of the new created input data for the modelling community.

The general structure of the revised manuscript should be:

1 Introduction The introduction needs no subsections. It should summarize the current state in the field and at the end explain what the reader can expect from the current paper.

2 Methodology and data used for validation In this section a sketch is to be included to explain the output of the two plume rise models. It is important to show the reader what injection height, top of the plume, bottom of the plume, mean height of maximum injection, plume height and others are. Symbols should be defined for these quantities for both plume rise models. Use this sketch to explain in which way the emissions are distributed in the vertical by both models. 2.1 Plume rise model (PRM) Explain what the

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basic idea behind this model is, what the input data, and what the output of the model is. 2.2 Plume rise model IS4FIRES Explain what is the basic idea behind this model, what is the input data, and what is the output of the model. 2.3 MISR plume height data set MPHP2 Explain and assess the method by which this data set is produced

3 Integration in GFAS

4. Intercomparison of simulated and observed plume heights

Explain Figure 1

4.1 Comparison of PRM and IS4FIRES results Present and discuss Figure 5 and Figure 6. Present and discuss Table 1 4.2 Comparison with MPHP2

Present and discuss Figure 7 and Figure 8

Present and discuss Table 2 and 3.

In my view Figures 2, 3, and 4 can be removed. If the authors have good reasons to keep them they should be placed here to assess the differences in Figures 7 and 8.

Figures 14 -16 can be removed from the paper. In my view the calculated trends are not significant (prove me if I am wrong). If the authors intend to present the year to year variation of the emission height for both plume rise models they should present Figure 14 and skip figures 15 and 16.

5. Comparison of modelled and measured extinction coefficients for two field campaigns I leave it to the authors if this section is included in the revised version of their paper. If yes they should focus on the extinction coefficient and give a detailed description of how the extinction coefficient is calculated and how they interpret the difference between model results and observations.

6 Summary

Specific comments

Abstract: Explain IS4FIRES. Please check the wording semi-empirical and analytical FRP??PRM. PRM is a numerical not an analytical model. Change 0.1°resolution into 0.1° resolution. Give the name of the new data set of satellite-based plume height observations. Add 'instead of zero plume height or IS4FIRES in the last sentence of the abstract.

Page 2 lines 5-35 These lines are full spelling and grammar errors. Examples are 'Black Carbon' and 'organic carbon', missing or wrong punctuation marks, and wrong style of citations. Extend the checking to the whole paper. Please explain: FLAMBE, GFED, FINN, QFED. Line 22: Modify into 'the recent addition of emission heights'. Line 31: What do you mean by fire smoke releases?

Page 3: Lines 4-6: Please replace these lines and add a sketch as described in the general comments above. Line 6: Maximum injection of what? Line 9: What about static stability and vertical wind shear of the environment? Both quantities are input data for PRM. Line 32: What do you mean by 'coherent climatology'?

Page 4: Line 9: Explain MPHP. Line 11: Your write: This study will be an occasion to revisit their conclusion. Yes indeed, but I did not found this revision in the paper. Line 19: Explain SEAC4RS. Replace 'Forecast' by 'Simulations'.

Page 5: Line 1: What is 'a successful plume' ? Line 17: Replace '20km' by '20 km'. Line 19: What time interval is used for the update of the atmospheric variables taken from ECMWF forecasts? Line 22: Add a multiplication dot to equation 1. Line 23: Explain how the fitting is performed in more detail and give the value of ïĄć used in your study. Line 28: Which injection height is applied in case of smoldering fires?

Page 6: Line 12: CAMS was already explained, so you can use it instead of explaining again.. Line 16: GFAS was already explained... Line 20: Explain NASA. Line 20-22 'FRP observations ... are not used, as they differ from MODIS. Please explain that in more detail. Is it because you just like MODIS more than METEOSAT? Line 23: Replace '°resolution' by '° resolution'. Check 'resp.'

Page 7: Line 3: Replace 'cover' by 'covers'. Line 12-13: Then, the injection profiles...
Please explain that in more detail. Line 22: Check '5mn'. Line 24: Replace '°GFAS' by
'° GFAS'. Line 29: Check '5mn'. Line 30: 'maximum' of what?

Page 8: Line 1: What do you mean by density plots? Line 8: Are you talking about
population density? Line 10: Which injection height is used if none is calculated?

Lines 13-30: The usage of injection height by IS4FIRES, mean height of maximum
injection, mean height of injection is totally confusing without having a sketch explaining
the different quantities.

Line 31: Change 'For' into 'for'.

Page 9: Line 1: What do you mean by dispersion? Line 3-10 referring to Figure 4: It is
hard to understand why FRP shows almost no dependence on FRP. Can you explain
this? Have you performed single column sensitivity runs with PRM varying FRP? Line
5: Change 'shows' into 'show'. Line 13: What exactly do you mean by 'injection height
climatologies'?

Page 10: Line 9: I cannot see the day to day variability from figure 6. Line 25: Please
quantify. Is that true in all heights?

Page 11: Line 9: What means 'two times as important as the RMSE'?

Page 12: Line 10: What do you mean by 'smoke fire'? Line 27: How did you quantify
that ECMWF underestimates PBL height?

Page 13: Line 6: What are these six parameters? Line 18: Cams was already ex-
plained. Line 26: You excluded sulphates from 'biomass burning aerosol'. Why?

Page 14: Lines 1-4: You should have explained that earlier. It explains why IS4FIRES
is not used. Section 4.2: You are comparing simulated extinction coefficients with
observations. Which optical properties and which assumptions were used to calculate
the modelled extinction coefficients?

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Page 15: Line 9-10: Figure 12 does not show any height of the mixed layer. Line 12:
Figure 13 a shows no latitude. Line 15: Where is Figure 13d?

Page 16: Line 30: What follows is rather a Summary than a Conclusion.

Page 17: Line 12-13: How should this optimal combination look like?

Figure 3: What is the difference between injection height and height of maximum injec-
tion. What is the' Sofiev height' of injection? It is useless to label the values of a PDF
with less dense and dense. Please give numbers, you must have calculated them.

Figure 4: It is useless to label the values of a PDF with less dense and dense. Please
give numbers, you must have calculated them. Are you sure that the results of PRM
are independent of FRP? This is an input parameter of PRM. In case you are right why
is this input parameter needed then?

Figure 6: What is the Sofiev plume height? What is the colour code? What is a density
plot? Top figure is not complete.

Figure 7: What means SOFIEV in the legend? Why did you use two reddish colours?
This makes it hard to distinguish.

Figure 9: What means PRM mean height? Why do you need a,b,c,d when you indi-
cated these figures by top, bottom etc?

Figure 13: From this Figure it is hard to see that the variable plume height improves
the results in comparison with observations.

Figure 16: What is the colour code of the dots? What is the Sofiev injection height?