

## ***Interactive comment on “Possible climatic implications of high altitude emissions of black carbon” by Gaurav Govardhan et al.***

### **Anonymous Referee #2**

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This study investigates the reasons behind measured high-altitude BC layers over India for 3 separate days using a chemistry transport model. The topic is relevant and within the scope of ACP. The introduction is clear and well-written. When it comes to the general presentation of the results and the figures, however, I think this manuscript needs further work before I can recommend it for publication. First, the aircraft emissions in this study were scaled, but this is only mentioned in one sentence and never mentioned again in the abstract or conclusion. The authors correctly states that the uncertainties in emissions are large, but it is not clear to me why the emissions were scaled, by how much, and how this could be justified. Second, the manuscript is written like a story (‘then we did this and then we did that’), and it needs to be rewritten to a more common form with ‘Methods’ and Results’ clearly separated. I also miss a ‘Discussion’ section where the authors discuss some of the uncertainties with their study, e.g. the limitation

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of data (only 3 days), the scaling of the emissions etc. Third, the figures need to be plotted on the same format, and some of them can be combined or removed. Finally, I think there is a tendency for the interpretation of the results to be slightly overstated. The study itself is interesting, and it would read much better with a plain description of the results, without any 'convincing'. There are also use of words like 'significance difference' without any significance testing mentioned.

Specific comments:

Abstract: Please specify the 3 dates for the measurements, and that you scaled the aircraft emissions.

Fig1: What does the error bars illustrate? Do you know why the error bars are much larger in a) and b) compared to c)?

Chapter 2: Can you add a small paragraph on how BC were measured using an Aethalometer, e.g. filter-based absorption. What are the uncertainties on separating out other absorbing components, like dust? Can you also report on the MAC that was used? I suggest specifying that 'elemental carbon' is measured (eBC), as suggested in literature (Petzold et al 2013 and references within).

I suggest to drop Fig3.

There are many figures and I think it would be easier to read if some of the figures could be combined. For instance, maybe Fig1 and Fig2 and Fig5/6 can be merged into one bigger figure (with 9 equally sized panels) so it is easier to compare the peaks? In that case; can you plot the panels on the same y axis, some goes up to 10 km vs. 9 km vs 12km. I find it confusing that the axis and panels are plotted differently for each figure, e.g. comparing Fig 5 and Fig6, where the black line in Fig5 are the same as blue line in Fig6 (?). I suggest dropping Fig5 as the same info is in Fig6. Fig 9 and Fig 10 can also be combined (with 9 panels).

P6 L16: Can you report numbers for the differences in magnitudes you are referring

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to? It is hard to read on the figure.

P6 L25: What do you mean by 'the simulated BC significantly match the observation'? Did you do any significance testing on this? Again, it is difficult to compare the model and the observations since the plots are so different (axis).

P7 L5: What do you mean by the meteorology being benign? And that the long-range transport of BC is unlikely?

Your manuscript is written more like a story, and how you came about with the different hypothesis, but I suggest rewriting the manuscript with the more common separation of 'Methods' and 'Results', which means e.g. that 4.3 and 4.6 (until L15 on P10) should be moved to 'Methods' along with everything else in Results that explains the methods you have used. Parts of 4.7 explaining background for convective lifting can be moved to introduction (and the rest to methods). Same goes for Conclusions.

P7 L32: This is the first time and only place you say that you have scaled the aircraft emissions you have used. How did you modify the emissions? You also need to mention this in the abstract/introduction, throughout the text and in the conclusions.

P9 L29: How is 'soot' defined in this context?

P8 L7: 'the nature of the layers (sharp and confined) looks very similar'. Please rewrite. Also, the peaks are much smaller in magnitude and are not located at the same altitudes as the observations?

P8 L11: 'This clearly highlights the role played by aircraft emissions' However, you did scale the emissions? You need to emphasis this more. Do you see the peaks when you run with unscaled emissions?

P8 L34: 'Beyond 4 km, the profiles are identical'. It is hard to say this without any significance testing.

P9 L23: '..the observed BC profiles causes more heating near the surface'. Did you

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show that the observed BC profiles cause this heating?

P10 L29: 'The identical nature of (..), brings out the average pattern'. I do not understand this sentence.

P11 L21: I am not sure if I understand your explanation of 'normal' and 'extreme' profiles in terms of the starting point. Area in the model?

Fig 13 is very difficult to read.

Technical corrections:

P2 L1: What is 'such an' refer to here? I suggest to remove.

P2 L12: Can you provide references to precip/convection?

P6 L3: 1st – first

P6 L8: either remove 'etc..' or replace by explaining the other discrepancies.

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