Modeled black carbon radiative forcing and atmospheric lifetime in AeroCom Phase II constrained by aircraft observations

Responses to reviewers

We thank both reviewers for their positive assessment of our paper, and for their helpful comments. Point-by-point responses and details of the changes made to the paper can be found inline below.

Reviewer #1:

The following few points may be helpful.

Page 20089 line 14: The models are comparing with data collected between 2008 and 2012, however the emissions used in the model are from a decade before (2000). Given that some regions used in the study are subject to rapidly changing emissions, what impact may this have on the results?

Page 20093 line 25 to page 20094 line 5: Whilst I agree with the points made, it is also worth pointing out that the A-FORCE measurements do not extend to the elevated altitudes measured in HIPPO and to a lesser extent in the other studies. It should be pointed out that there is a significant model to model variability at altitude in this and other regions but the measurement data is not available to confirm whether upper tropospheric BC values are similar in this region to the remote Pacific and continental north America.

We agree with both of these related points. In the text, we have added the following sections:

We note, however, that the A-FORCE data do not extend as far up in the atmosphere as HIPPO did, and that we find significant intermodel variability at p<400hPa also for the near-source A-FORCE and HIPPO America regions.

While the aircraft data in the present study were taken over the period 2008-2012, the models used emissions from year 2000. BC emissions have increased in the intervening period (e.g. Wang et al., Trend in Global Black Carbon Emissions from 1960 to 2007, Environ Sci Technol, 48, 6780-6787, 2014, indicates a global mean increase of ~10%), indicating that any overestimation of concentrations by the models would have been strengthened had they used a more recent emission inventory. One model (CAM4-Oslo) delivered results for both year 2000 and 2006 emissions, reflecting this increase. In remote regions (e.g. the HIPPO regions in Figure 1), the resulting 20%-30% increase in concentration is found to be evenly distributed throughout the vertical profile, except in the range 1000-800hPa where no significant increase was found. It is clear that for future comparisons, model calculations with updated emission inventories are desirable.

Page 20099 lines 11-15: This statement is not true close to polluted regions and is contradicted later in the paragraph. I suggest rephrasing.

We agree. The start of the conclusions section now reads:

We have compared recent aircraft based measurements of BC concentration with state of the art global aerosol-climate models. In remote regions where BC concentration are dominated by long range transport, and at high altitudes, there is a tendency for the models to overestimate the aircraft measurements, where and when the effects of fires are small.

I am not sure how it can be improved, but figure 2 is very hard to read clearly and easily.

While we agree that the figure is dense with information, we still wish to present the data on a unified plot. In the final paper, where the page orientation is standard, the plot will hopefully come out better. A number of minor fixes have been made to improve clarity (see e.g. response to comment nr. 2 from Reviewer 2).