

## ***Interactive comment on “Sensitivity of inferred regional CO source estimates to the vertical structure in CO as observed by MOPITT” by Z. Jiang et al.***

### **Anonymous Referee #1**

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Review: Z. Jiang, et al., 2014: Sensitivity of inferred regional CO source estimates to vertical structure in CO as observed by MOPITT, considered for publication in ACPD and ACP.

I think the paper can be published but should be shortened and checked for spelling mistakes. I thought the contrasting results on emission estimates of two different OH fields were quite interesting. It is not an overly long paper but sometimes it is not very concise.

1. Line 10: "the CO emissions in the GEOS-Chem model and accounts for the vertical

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smoothing of the MOPITT retrieval".

You mean equation (1) is applied to model profiles and smoothed by the averaging kernels? If so, please make a reference to equation (1).

You should also include a single line sentence or short reference why the adjoint does not give you error bars in the posterior emissions estimates.

2. Figure 2:

Maybe you should put forward a sentence or two about how the OSSE should ideally look. As far as I understand it, in a perfect world the grid boxes would have a color of yellow which corresponds to the number 1. But it seems to me that there are still a considerable number of grid boxes which are either much lower than 1 or much higher, respectively. It further looks like the OSSE does a better job at the equatorial regions. I think this needs particular consideration as your main results in the following sections adjust emissions to higher values in the extratropics. Did you include the distribution of the MOPITT observations in your pseudo observations and therefore the OSSE reflects the less stringent constraint at higher latitudes? If so please clarify in the text.

3. Results and discussion

You need to go through the text again and make it shorter by at least 30%. The text does not have a very good focus.

3.1 Figure 3:

Just a comment. Please tell the reader how are you smoothing the GEOS-Chem model output on the vertical grid. Are you just using 1 model grid box that corresponds to the actual altitude of GMD observation?

3.2. Figure 4:

Is this Figure 4 really needed here? Also, one could probably guess but there is no explanation if the "difference between two types of scaling factors" is the left panel

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minus middle panel or vice versa.

### 3.3. Figure 5 and Figure 6:

I do not know if this would be easy to do. If so, you should consider merging Figure 5 with Figure 6. Figure 5 is essentially the summary of Figure 6 on an annual scale. Again Figure 6 does not say if the "difference" is based on surface inversion minus profile inversion or vice versa.

### 3.4 Figure 8:

Is this Figure essential? I think everything is being said already in Table 1. However, you could expand Table 1 so that it includes all the seasonal values instead of Figure 8. On another note: I would also multiply the values in the color table of Figure 8 by 100. You also need to state the unit in the Figure legend. Table 1 shows the "Relative difference between surface and profile inversion" with the % unit?

## 4. Section 4.3 Ideal Tracer Experiments

The prior two sections 4.1 and 4.2, respectively are much too long but this section is rather short. You need to explain a little bit more what you exactly did here. You are saying you emit 3.33 Tg CO/day in each of the defined tagged regions, and 1/30 of that is being destroyed after each simulation day?

4.1 I think (if easy to do) Figure 10a and Figure 10b could be combined into 2 useful single Figures for  $P > 700$  hPa and  $700 > P > 250$  hPa, respectively. As far as I understand every subfigure in Figure 10 tells the story for each individual tagged tracer. But it is also obvious from the Figures that the partial columns of the tagged tracers are confined in the individual tagged regions (although there may be some overlap through to transport).

### 4.2. Figure 10a and 10b

It is not really clear from that Figure or from the text in section 4.3 what the actual units

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of the color bars are.

### 4.3. Table 2

Again how do units in Table 2 relate to Figure 10a and 10b, respectively? And what is "Upper fraction (%)"?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 22939, 2014.

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