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***Interactive comment on "Global distribution  
of CO<sub>2</sub> in the Upper-Troposphere and  
Stratosphere" by Diallo et al.***

**Diallo, Legras, Ray, Engel and Anël**

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## Answer to anonymous referee #3

We thank referee #3 for his comments and suggestions. Comments by the referee are highlighted and followed by our answers.

### *Major Comments:*

1. *My only major point is the quality of the text (outline, titles of the sections and sub sections). I am not a native speaker but my feeling is that not only the structure of the paper but also the quality of many sentences can be significantly improved.*

We have rephrase some of the titles and improve the discussions

### *Minor Comments:*

1. *Abstract L 1*

*please remove relevant. You can only hope that this will be a relevant data set.*

Done

2. *Abstract L 8*

*I would replace guided by driven*

Done

3. *Abstract L 11*

*...with mid-latitude vertical profiles measured in situ from aircraft and balloons exhibit a remarkable agreement...(you should not give a complete description of the used data in the abstract)*

Done

4. *Abstract L 17*

*...out of the tropics to the mid and high latitude stratosphere (but mainly into the northern lowermost stratosphere around 15 km - is it not something that follows from your Fig. 6)*

Yes! Rephrase

5. *Abstract L 21*

*...and is nearly constant above 35 km (is it what you would like to say ?)*

Yes exact! Rephrase

6. *P.4 L3*

*These studies.... - please rewrite this sentence*

Rephrase

7. *P.4 L 12*

*...to help to validate the stratospheric representation in global CTMs...*

Rephrase

8. *P.4 L14*

*...to the very localized in situ observations which have high spatial resolution, a large spatial...*

Rephrase

9. *P.4 L18*

*Chadin et al showed.... (please rewrite this sentence)*

Rephrase

10. *P.5 L5*

*...are also weak... (what do you mean ?)*

Rephrase

11. *P.5 L21/22*

*models lack of realistic stratospheric influence - not clear, please explain*

Rephrase

12. **P.6 L10**

*The small scale variability....and the scarcity of suitable observations ... (I would recommend to reformulate this sentence)*

Rephrase

13. **P.7 L14 Trajectory starting....(you are using backward trajectories, so maybe you would like to write: Trajectories reaching the boundary layer during the backward integration...**

The reconstruct with model is done in two steps:

1-) We calculate the trajectories by integrating them backward in time.

2-) We post-treat these trajectories by assigning them within CarbonTracker CO2 in the troposphere at 500hPa.

14. **Section: Data**

*You should shortly describe here the aim of both upcoming subsections*

Done

15. **Section 4 and 4.1**

*I think, you should use a different title like Reconstruction of CO2 and describe it accordingly. Initialization is a very misleading term. So you use backward trajectories plus Carbon Tracker/WDCGG data in the boundary layer to reconstruct CO2 everywhere in the UT/S region. Please reformulate the text between L10 and L20....*

Title and sentences rephrased

16. **P.11 L14**

*Maybe you should change  $b_0$  (which is too close to  $b$ ) to something different.*

Done

17. **P.12 eq (2) and (3)**

*Maybe you should avoid to introduce Corr, i.e. use only one formula in two lines*

We have used one line formula as suggested.

18. **P.11 eg. (1)**

*You also did not clearly explain that you need your eq. (1)-(3) only for CO2 reconstruction cases which are older than 10 years and you do not have any information from the backward trajectories. Maybe you should reformulate some sentences...*

Yes right. We include these comments explicitly.

19. **P.12 4.2.1**

*Once again: for me it not a flight track initialization but much more a Lagrangian reconstruction of CO2 along the flight track - maybe you should reformulate it*

Yes! Rephrase

20. **P.12-13**

*You repeat here many arguments and formulations from Legras et al., 2005. I do not think this is necessary. I strongly recommend to remove this part and cite the original papers. Instead of this, you should better explain your eq (7), i.e. how displacement in the geometric space is related to a displacement in  $\theta$ -space.*

We have shortened this discussion.

21. **P.14, 4.2.2**

*Once again, please use the term Reconstruction in the title of this section and change accordingly the following text...*

Done!

22. **P.14 5.1**

*Here, I miss any reference to Fig 2.*

Corrected

23. **P.14 L 24**

*Your abbreviations of the dates are not clear and maybe you should the notation like 26th February 2000, etc.*

Figure notation is included in order to overcome this.

24. **P.15 L 6**

*aging vortex core*

Corrected

25. **P.15 L 7**

*corrective step in this instance - I do not understand what you mean*

This was belonging to the applied correction to the remaining air parcels into the stratosphere after the 10-yr backward integration using equations 1-3.

26. **P.16 L 6**

*accurate - please remove it*

Done

27. **P.16 L 8**

*...from the global reconstruction calculated by...*

Rephrase

28. *In Fig 4a and 4b you denote the regions as tropospheric and stratospheric boundaries. However, in the model there is only one lower boundary prescribed by the Carbon Tracker values. You should exactly say what you mean with your boundaries. For me, 4a validate your model in the middle troposphere around 7-9 km and 4b in the region between 16-17 km. Please clarify this point.*

What we mean here by tropospheric boundaries is that we evaluate our model in the middle troposphere around 7-9 km which is not far away our trajectories CO2 assignment and by stratospheric boundaries the near tropical tropopause layer where the air enters the stratosphere. We have improved it.

29. **P.17 L 3**  
*with respect to*  
Done.
30. **P.17 L 4-7**  
*please give a more detailed explanation of the discrepancies. as it will be confirmed shortly could be replaced by We discuss this point in the next section.*  
Need to be done
31. **P.17 L 12**  
*...derived from our Lagrangian reconstruction*  
Done
32. **P.17 L 19**  
*grows*  
Done
33. **P.17 L 21**  
*in the southern hemisphere*  
Done
34. **P.18 L 4**  
*propagates*  
Done
35. **P.18 L 5**  
*is removed from the atmosphere due to...*  
Done

36. **P.18 L 6**  
*into the lower stratosphere driven by the lower branch...*

Done

37. **P.18 L 9**  
*west side (can you give more detail how the Asian monsoon anticyclone contributes to this transport*

We notice just the Asian monsoon anticyclone contributes to this transport as well discussed in Park et al., 2009, Randel et al. 2010 and Pan et al., 2016 which were specifically focused on this contribution on pollutant transport. In our fig.6(a,b), we can clear see the "cheminay" further during the summer months June and July between 10-40° N.

38. **P.18 L 13**  
*which is maximum...*

Done

39. **P.19 L 1-2** *localized gradient, etc. - please give a more detailed explanation*

Done