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Interactive comment on "Global distribution of CO_2 in the Upper-Troposphere and Stratosphere" *by* M. Diallo et al.

Anonymous Referee #1

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Review of acp 2016-0382

Global distribution of CO2 in the upper-troposphere and stratosphere

by Diallo et al.

This paper presents a new data base of monthly zonal mean distribution of CO2 in the UTS on global scale. The subject of the paper is scientifically very relevant and the scientific approach and applied methods are in principle acceptable.

Although the paper contains some interesting material which should be published, the manuscript itself has poor quality in many parts. The preparation of the manuscript was not done with the necessary care. Several paragraphs and sections need substantial revisions! The structure of the paper is fair but the grammatically preparation is super-

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Discussion paper

ficial and the discussion with regard to the scientific content is inadequate. Particularly Chapters 5 and 6 are unclear and both do not contain a detailed discussion of the data product. In the following here are my major points and general concerns:

- In Section 3.1, I am missing a critical discussion of the boundary conditions for your exercise, for instance regarding the used data (i.e. the 1989-1999 time period from ground stations): what are the uncertainties of the calculated trajectories (e.g. with respect to the linear interpolation along latitudes (page 8, line 15-16))? Why are the CO_2 values from the CarbonTracker considered only at 5 km altitude? Are the results of TRACZILLA affected by the assumed initial conditions? How reliable are the TM5 results in comparison to other CTMs? At least it would be necessary citing relevant literature to motivate your approach – this section does not show any reference.

- Regarding Chapter 4, I am missing at least a final statement (paragraph) discussing the uncertainties with respect to the final data product. For example regarding the point mentioned on page 13, lines 18-19: "After the backward integration of few months, then the air particles of the diffusive run are fixed by using the ages calculated from the global initialization." What does this mean? How reliable are these assumptions? What is the range of uncertainties here? Again, no reference is cited in this connection. Similar on page 14, line 7 you stated: "... with a diffusivity parameter k equal to 0.1 ...". It would be helpful to provide more information and a critical discussion of the assumptions used here.

- Chapter 5 is really poor. The description and explanation of results in Section 5.1 is very vague and need a substantial revision. This kind of evaluation (i.e. a comparison of colored lines) presented here is not sufficient. For example (page 14, line 24): "The large peaks seen, e.g. ... are due to dives and the discontinuities on ... are also due to fast altitude changes." It is difficult to understand what you are meaning. In particular the mentioned flights are not fitting together, some of them are missed ... and by the way, Figure 2 is not mentioned at all in Section 5.1. Figure 2 is showing some discrepancies? What are the specific reasons? What is the grey shaded area standing for in Fig. 2? What is needed here is a detailed description of the data and a critical discussion of the strength and weaknesses. Your final statement (page 15, line 11) "... explains very well the measurements ..." is not sufficient.

I have the same concerns with respect to the other sections in Chapter 5. In the beginning of Section 5.2 a detailed comparison is announced, but it is definitely not given in the following. It is still a description of pictures. And it is a mess: Four balloon flights are presented in Fig. 3, three of them are "showing" a good agreement (but only two of them are mentioned in the text; page 15, line 19); one shows significant differences!? The explanation at the end (lines 22-23) is " ... the errors of the reanalysis which are not accounted in our statistical test might be large enough to explain the shift." This is definitely not an adequate explanation!

In Section 5.3 you said that you choose the latitude ranges 10S-20N and 50-60N. What is the reason for chosen these bins? Why are the latitudinal bins different? A more detailed discussion is necessary. Again a statement like "The origin of this discrepancy is unclear, but is perhaps due to the fact that previous studies ...". By the way: which studies (no references are given)? And at the end of this section the sentence (page 17, lines 5-7) "The large discrepancies ..., as it will be confirmed shortly." is not comprehensible to me.

- What I have said in general with regard to Chapter 5 is also valid for Chapter 6. A more detailed discussion of the results and their evaluation are required. Some particular points with respect to Chapter 6: You are discussing results of the year 2010 only in Sections 6.1 and 6.2. What are the other 9 years showing (regarding annual cycle, variability, fluctuations, etc.)? Are they "identical" (similar) or different? Is 2010 exemplarily for the other years? Beyond that, no results are showed in Section 6.2 (not either in other sections) regarding the upper stratosphere (all figures show results at altitudes below 35 km). With regard to the Conclusions you stated (page 21, line 3): "In the deep stratosphere, we have found ... ". This remark is not supported by investigations presented before.

- A separate discussion Chapter at the end is necessary, especially an assessment and classification of the data set regarding the current knowledge. In particular to point out the "new" findings and a rating about the quality of the provided data set would be helpful. As announced in the Introduction (page 6, line 21) "The global (!) distributions of CO2 and its transport in the UTS (!) are investigated . . .". Therefore, it would be nice to see some "global" charts, covering the entire stratosphere in this paper: The final sentence of your manuscript (page 21, lines 12-13) makes me curious, but no respective illustrations are shown in this paper. Could you please show (and discuss!) some examples, not only to motivate using this comprehensive data set?

- Section 7 (Conclusions) provides mostly a brief summary of things which have been stated before.

Minor points:

- Many acronyms are not explains, in particular in the Introduction.

- Page 3, line 19: . . . increase global change . . .

- Page 4, line 14: . . .observations that have high resolution and are very localized, . . .

- Page 5, line 29 and in particular on Page 7, line 3: TRACZILLA is not explained (at least references are required).

- Page 10, lines 14-17: need a Revision

- Page 10, line 22: "It is assumed that the vertical mixing is fast . . ." Why? Reference is needed? How fast? Please explain.

- Page 14, line 7: Units should be corrected.

- Page 15, lines 15-16: ". . . of four middle latitude stratospheric balloon flights . . .".

- Page 20, lines 4-5: ". . . based on 22 years of data . . . over the last 11 years . . .". Sentence should be revised.

- Page 21, line 3: "In the deep stratosphere we have found . . . " no results are shown or discussed in detail.

- Figure 4: the chosen latitudinal bins do not exactly correspond to the coordinates of the stations providing the measurements.

- Figure 6: the box in the right figure (top right) says "2000-2011"; should be 2000-2010.

From my point of view this paper needs a substantial revision. I believe that many things have to be done before the paper can be published in ACP. The manuscript is far away from been ready. It definitely cannot be published as is. Of course, the results should be published, but the scientific content as presented, is too vague. The paper definitely needs especially a more critical explanation and discussion of the results; it is necessary to point out the strength and weaknesses (data quality) of the data set in more detail and to discuss the uncertainties. And finally, the quality of the presentation is in parts really poor. Only if the complete manuscript will be significantly revised, it might be considered in ACP; the revised version should be again get another round of reviews (2 reviews).

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