Atmospheric
Chemistry
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Discussions

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**Interactive
comment**

Interactive comment on "Spatiotemporal patterns of the fossil-fuel CO$_2$ signal in central Europe: Results from a high-resolution atmospheric transport model" *by* Yu Liu et al.

Anonymous Referee #1

General:
The paper rises very important and actual topic how the fossil-fuel related contributions to the global CO2 distribution can be separated from the other CO2-related sources and sinks. Using a validated model, the spatiotemporal patterns of CO2 are discussed which might help to discern the anthropogenic contributions from the other possible sources of variability whereas both, in situ and satellite-based strategies are considered. The paper is well-written and gives new and important insights. However, there is still one (major) point which have to be discussed before this paper can (and should) be published.

Major points:

1. My main concern is related to the description/handling of the background contribution (L212-217) as derived from the CarbonTracker data set and used to prescribe the boundaries. Do you use mixing ratios or fluxes at these boundaries? Because CarbonTracker data contains CO_2 mixing ratios for sources within and without your model domain (which is central and southern Europe) I have a feeling that your boundary conditions contain both information although the CO_2 contribution from the inside should be resolved by your model. I am not sure but it looks like for the boundary conditions you would take into account the "same type of information" twice: from your simulation and from the CarbonTracker data. At least, would be good to have a more detailed description, how you handle boundary conditions and especially this point.

Minor points:

1. L14
   "...their co-variance leads to a fossil-fuel diurnal rectifier.." - For "no-experts" difficult to understand.

2. L82
   Maybe you should explain with 1-2 sentence what is "rectification".

3. L113
   You mean "potentially reduced emissions".

4. L155-57
   It would be nice to understand this formula without checking other literature. What is K? I think K should be the highest level of the model ?. Would be good to have this formula as a separate equation.

5. L349
   Maybe: "by the diurnal and seasonal variations" and remove the last part of the sentence.

6. L385
   ...uniform negative distribution for XCO_2 in Fig. 6c contrasts...

7. L445
   ...in particular, what is the contribution of diurnal (and seasonal)...

8. L490
   ...Figure Fig....

9. L724
   "...up to 110%...". Not clear what does it exactly mean. Please explain.

10. Figure 4
    Figure 4a shows the anomaly and not the absolute value. You should explain how this anomaly is defined (in caption and main text). Same for Figure 4b. Figure 4d does not show any structure (maybe you should change the color bar). It is not clear for me what should I see. Impact of the boundaries on the main domain of your model? See also my major point.

11. Figure 5
    Please add notation: a), b), c) d).

12. Figure 6
    Please explain/define the anomalies

13. Figure 8
    Please add that all panels are for the surface layer (10m)

14. Figure 9
There are some lines which look like ship connections. Maybe you would like to explain it.

15. Figure 11
This figure is not mentioned in the text. Also you write sometimes "Figure" and sometimes "Fig."

16. Figure 13a
There are enhanced values in north-east (over the North Sea). Maybe you should explain this feature in the text.

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Discussion paper