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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability and budget of CO_2 in Europe: analysis of the CAATER airborne campaigns – Part 2: Comparison of CO_2 vertical variability and fluxes from observations and a modeling framework" *by* I. Xueref-Remy et al.

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The authors would like to thank Referee #1 for his constructive comments. We have taken into account all of the points that have been mentionned and especially made several technical corrections. The text has also been revised by a native English speaker. Here are the answers to your specific questions:

——-REFEREE #1 p 4276-8: Model prescribed surface fluxes for LMDZt - is it valid to use annual fossil fuel emissions? How are these quantified by season and by time of

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day (e.g. rush hours). Is there an emission cycle prescribed in the fossil fuel fluxes? These will be highly variable with daily/hourly urban conditions and weather, with a strong diurnal cycle of emission. In winds reaching the campaign sites, the previous period's fossil fuel emissions from upwind Europe may be observed above the ABL. This may affect the interpretation of the biospheric uptake in Fig 5

Authors Answer : We agree with the reviewer that using time varying fluxes for fossil fuel related emissions would be more appropriate, if the prescribed variations are well known. At the time that the LMDZt simulations have been performed to analyse the CAATER campaign, the first fossil fuel inventories were just appearing for western europe only (e.g. IER Stuttgart university) but were not completely validated for the diurnal or seasonal variations in all western countries. We decided not to use them at this time. Indeed, the impact of spatio-temporal distribution of fossil fuel emissions on surface concentrations has been studied in Peylin et al., 2009 (ACPD, 9, 7457–7503, 2009). They show that the spatio-temporal distribution of fossil fuel emission has an impact to explain the variability of CO2 concentrations but that this impact remain 2 times (close to pollutes areas) to 3 times (far from pollutes areas) smaller than the impact of the atmospheric transport (see their table 6) which dominates. They also show that moving from an annual inventory (EDGAR) to an hourly varying inventory (EDGAR hourly) has a very small impact on the biospheric uptake for western Europe (<0.02 Gt/yr) as estimated by inversion of atmospheric transport (see their table 5). Changing from one inventory to another (e.g. EDGAR annual to IER hourly) shows more impact (<0.06 Gt/yr for western Europe). Finally, while important at the surface, the impact on the CO2 concentrations is probably smaller within the PBL and even more above because of the dilution of the surface fossil emissions with height.

We propose to add the following text p4276: The use of annual emissions for fossil fuel may lead to an underestimate of the variability of simulated CO2 concentrations (Peylin et al., 2009). Some efforts has been made in past years to produce time-varying fossil fuel inventories for Europe (Pregger et al., 2007). The validation of these products for

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all European countries is still ongoing and we decided not to use them in our work.

P. Peylin, S. Houweling, M. C. Krol, U. Karstens, C. RÂĺodenbeck, C. Geels, A. Vermeulen, B. Badawy, C. Aulagnier, T. Pregger, F. Delage,G. Pieterse, P. Ciais, and M. Heimann, Importance of fossil fuel emission uncertainties over Europe for CO2 modeling: model intercomparison, Atmos. Chem. Phys. Discuss., 9, 7457–7503, 2009 Pregger, T., Scholz, Y., and Friedrich, R.: Documentation of the anthropogenic GHG emission data for Europe provided in the Frame of CarboEurope GHG and CarboEurope IP, Project report, Institut f ÂĺÍ ur Energiewirtschaft und Rationelle Energieanwendung, Universit ÂĺÍ at Stuttgart, 5 Stuttgart, Germany, 2007. 7463, 7464, 7487

——-REFEREE #1: p.4284 – maybe I've missed the detail, but are local Rn data used, from Geological Survey Information? Rn emissions are very variable (not uniform) and it would help if the Rn emission discussion gave some more geological information here.

Authors Answer: It appeared, that a few lines of the text were missing. We apologize for the inconvience. Radon data have been measured during the first CAATER campaign using our own airborne instrumentation. In order to better explain our work, we add a section on the Radon instrumentation (that section was previously in part 1 paper), and explained in details how we have applied Eq.1 to infer a CO2 flux for our case study. The authors are taking into account the fact that Radon emissions are variable: several studies have been conducted in Western Europe and estimate the variability to be of the order of 30% (Nazaroff, 1992 ; Jutzi, 2001 ; Ielsch et al, 2002 ; Szegvary et al., 2007). We use a mean value to compute the flux and treat the 30% variability as a source of uncertainty in the method. This is now explained in the paper.

——-REFEREE #1: Figure captions: The captions are not always clear – it took a while to decide whcih model was observed in fig 1 onwards. Many captions are too compressed and do not read easily – very hard work.

Authors Answer: Captions and figures have been revised and improved, we hope they

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are clear enough now.

——-REFEREE #1: It would be nice to have a regional map, especially for non-European readers.

Authors Answer: Indeed, this paper has a twin paper and both will be published together. The twin paper contains many regional maps. Taking this information into account, it seems not necessary to add a map in part 2-paper that often refers to part 1-paper.

——-REFEREE #1: Typos: various minor errors of English

Authors Answer: English minor errors have been corrected (the whole text has been reviewed by a colleague that is a native English speaker).

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 4271, 2010.