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Interactive comment on “Can we use hourly CO₂ concentration data in inversions? Comparing high resolution WRF-VPRM simulations with coastal tower measurements of CO₂” by R. Ahmadov et al.

R. Ahmadov et al.

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We are grateful to the reviewer for his valuable comments and suggested corrections. Here we answer to the comments:

Specific comments:

We have compressed the text, especially the introduction, changed the title and made linguistic improvements as the reviewer suggested. Title: The new title contains the phrase "two global CO₂ transport models" as suggested.

Abstract: We have included a statement about the role of PBL parameterization on CO₂ simulation by the presented models in the conclusion section. We certainly agree

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Discussion Paper



with the reviewer that not only the spatial resolution, also PBL simulation plays an important role in the modeling of CO₂ transport. It would be interesting to study this question for the presented models; however this would require running the models in the same spatial resolution and other settings. Consequently it would more feasible to do this kind of study within the WRF model in future.

P. 4752, line 20: The order of the sentences has been changed.

P. 4754, line 20-21: We have changed the sentence to: "The TM3 model results are based on a global inversion using atmospheric CO₂ concentration measurements".

Section 3: We have included a sentence explaining the choice of the Biscarosse site rather than other surface CO₂ stations. Section 3, last sentence: The Biscarosse tower is under influence of the easterly winds as well as westerlies, the weather data during the campaign clearly showed this. Otherwise we would not see the large diurnal amplitude of CO₂ as shown in Figure 3. Consequently we think this site is quite useful in terms of using its data in the inversions, see e.g. (Lauvaux et al., 2008). However we agree with the reviewer in that the sentence was too strong and we have modified a bit.

Section 4: We have compressed it. 4756, lines 25-26: We have changed the sentence to "The figures show how well the models perform in capturing..."

4758, lines 26-27: It was unclear and thus has been reformulated to "enhancement of both the biospheric and anthropogenic CO₂ fields".

P. 4759, line 4: We have changed the sentence to make it clearer to a reader.

P. 4759, line 8: The sentence has been changed to "During persistent strong westerly winds..."

P. 4759, lines 16-17: Here we are talking about 3D "rectifier effect" caused by the correlation between advection and CO₂ fluxes. This is not the same as the classical "rectifier effect" term related to the vertical mixing.

P. 4760, line 3: We have added a phrase saying that the nocturnal stagnation on May-20 is caused by land- sea breeze and synoptic wind;

P. 4760-4761 divided paragraph: The "synoptic disturbance" term used here implies not only westerlies, but also cold and cloudy conditions occurring together. In such weather biospheric fluxes are diminished in the coastal region and the tower detected CO2 signal does not possess a noticeable change over a day, even if the wind direction changes.

P. 4761, lines 21-22: "All models show..." sentence has been rephrased to "The WRF-VPRM and the LMDZ models show quite good agreement against the observation until 27th of May".

P. 4762, lines 8-10: We say: It is a well-known problem for the meteorological and transport models to represent the nocturnal PBL, WRF has such difficulties too.

P. 4763, lines 2-4: We have deleted the sentence "The case of May 20th ...", since we discuss this case thoroughly in the previous section.

P. 4763, lines 17-18: To make it more exact we modified the sentence to: "the proper representation of the covariance between meteorology and biospheric CO2 fluxes is necessary to capture rectifier effects (both, the normal rectification effect as well as the 3D rectification effect) in order to avoid bias errors".

P. 4763, line 20: Since the current work exhibits the advantages of the regional model compared to the global ones, one can expect using the mesoscale models in the regional inversion of CO2 (Lauvaux et al., 2008). The problems discussed by Gerbig et al., 2009 also justifies our expectations in using the high- resolution modeling systems in assimilation of point measurements. However as the reviewer remarked our statement may sound very confident and therefore we have rewritten the sentence as: "This is likely to improve the inversion accuracy, and could extend inverse modeling to "difficult sites"...".

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Technical corrections:

We have taken into account all the technical corrections suggested by the reviewer. P. 4754, lines 17-20: The sentence has been changed to "The purpose of the adding this model to the comparison is..."

P. 4754, lines 20-23: The second sentence has been removed.

P. 4754, lines 20-23: The sentence has been reformulated. Figure 3 has been widened as per the reviewer's suggestion. All other corrections regarding improvement of the language have been implemented.

References:

Gerbig, C., Dolman, H. and Heimann, M.: On observational and modelling strategies targeted at regional carbon exchange over continents. Biogeosciences Discussions 6, 1317-1343, 2009.

Lauvaux, T., Uliasz, M., Sarrat, C. et al.: Mesoscale inversion: first results from the CERES campaign with synthetic data. Atmospheric Chemistry and Physics, 8, 3459-3471, 2008.

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