

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.

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General comments

The paper presents a high resolution simulation of CO₂ for a tower location in France using a coupled atmosphere-biosphere model. The month-long simulation compares well with observations. I think the paper would benefit significantly from some careful re-writing. I found some sections to be longer than necessary and numerous mistakes in the English, sometimes affecting the clarity of the text. The authors have chosen to present their simulation in the context of the modelling requirements for CO₂ inversions. I found this focus on inversions rather distracting since the paper itself does not

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involve any inversions. My preference would be to only include a short comment about inversions towards the end of the paper.

Specific comments

Title: I suggest removing the first sentence from the title

Introduction: I think the introduction is too long and consequently loses focus. There appears to be material included that does not have direct relevance to the paper while other material needs a little more introduction.

For example, the paragraph from p4747, line 28 to p4747, line 10 could be deleted since this study is not a high altitude site. I think the list of conclusions from the Geels et al, 2007 paper could also be dropped (p4749, lines 11-19) along with the paragraph on p 4751, lines 14-23. There may be other places where the text could be usefully reduced.

One addition to the introduction, that I'd recommend, is a note on how this work extends Ahmadow et al, 2007 e.g. a longer simulation, comparison with the tower rather than aircraft.

Configuration of the models: I think it could be useful to include a little more information about how the two levels of nesting work, e.g. how does the 10 km simulation interact with the 2 km simulation? You note that only results from the 2 km inner domain are presented. Do you have results for the tower location from the 10 km simulation? If so, how do they compare with the 2 km results? Given that the 2 km simulation will be more computationally expensive to run, it would worth knowing how much the simulation is improved for the extra computational cost.

I wonder if the information on the different simulations (p4753, line 27 to p4753, line 9) might be better presented as a table.

Results and discussion: Figure 2 is described as "giving insight into the weather evolution". It would be good if the main features of this weather evolution could be highlighted

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e.g. the passage of fronts, stable periods etc. The impact of the temperature on the biospheric CO₂ fluxes is noted. It might be good to show a timeseries of CO₂ fluxes from near the tower so that the reader is given an idea of how variable they are. Comparing the WRF-VPRM fluxes with those from the LMDZ and TM3 runs could also be valuable.

p 4757, line 5: Could these events be marked on the figure e.g. by using an arrow, to make it easier for the reader to find?

I found it interesting that you chose to use instantaneous values from the model but average values from the observations (p 4757, lines 22-24). Particularly in the WRF simulation, how much within-hour variability does the model produce? Is there more variability at night than during the day, as you show in Table 2 for the observations?

p 4758, line 3-5: If you present a figure with the biospheric fluxes for each model, it could be used to support the statement you make here. Also the comments about the fluxes on p 4759.

p 4759-4760: The paragraph describing the 20 May case is very long. Please consider whether any of the text can be more concise, and whether the paragraph can be split in one or two places. It would also be helpful to alert the reader to Fig 5 earlier in the paragraph. I suggest adding "shown in Fig 5" to the end of the first sentence.

p 4760, line 6: "huge respired CO₂". Do you know if the model underestimation is due to fluxes that are too small, or too much mixing?

Conclusions: The WRF simulation is noted as "computationally expensive" (p 4763, line 24). Can you quantify this somehow e.g. relative to the global models or by providing an example of how long a simulation takes on a certain type of machine.

Your simulation is for a summer case. Do you want to comment in the conclusions on whether you expect to see similar improvements in other seasons? My experience suggests that the global models do better in winter so perhaps the relative improvement

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of WRF will not be as large.

Technical corrections

There are many places throughout the manuscript where "the" is used and it is not needed or it is missing when it is needed. I have not tried to list them all here.

p 4746, line 3: Add "atmospheric" after WRF

p 4746, line 15: Replace "help constraining" with "may help to constrain"

p 4746, line 22: Remove "of" before "the mechanisms"

p 4747, line 3: Add "it" before "essential"

p 4747, line 13: Suggest "fluxes" instead of "exchange rates"

p 4747, line 14-15: Law et al, 2002 was not restricted to annual and monthly observations. The paper looked at how hourly data might be used.

p 4747, line 19: Replace "dominant fraction of the" with "most", change "was" to "were"

p 4747, line 22: Remove "recently" - tall towers have been used for at least a decade now

p 4747, line 23-24: Rewrite as "However, continental measurement sites are often located ..."

p 4749, line 20: "The two latter results are also supported by ..." Geels seems to be talking about vertical profiles near the ground while Stephens et al is based on aircraft data, so I'm not sure whether they are really comparable.

p 4750, line 3-4: Sentence beginning "Nighttime data" seems redundant.

p 4750, line 11: Replace "containing" with "which contains"

p 4750, line 21: This reads better if "significantly" is removed.

p 4750, line 27: Remove "tracer"

p 4752, line 9 and line 15, p 4753, line 20, p4755, line 2, p4764, line 13: Put parentheses around web-site addresses

p 4752, line 10: Suggest replace "in high" with "at 10 and 2 km"

p 4752, line 13: Remove parentheses from around Ahmadov et al

p 4752, line 20: "model" not "models"

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p 4752, line 21: Were the flux measurements from eddy flux towers? If so, it would be worth mentioning.

p 4752, line 22-24: Suggest replacing these two sentences with "WRF-VPRM code and an associated pre-processing tool are available freely upon request."

p 4753, line 10: You might want to give the quote the offset value.

p 4753, line 14: Delete "for each run"

p 4753, line 19-20: Since, to my knowledge, there has been no analysis of the WRF Transcom submission, it may be best to drop this sentence.

p 4753, line 24: Suggest removing sentence starting "Note .." and putting information in Table 1

p 4754, line 2: add "within the domain" after "emission fluxes"

p 4754, line 15: Add "of" before "4x5"

p 4754, line 19: Add "into" before "how"

p 4755, line 9-10: Replace "in" with "to" after "close" and replace "parts" with "edges"

p 4755, line 11: Suggest replace "it was expected that the experiment design allowed to" with "the experiment was designed to ..."

p 4755, line 16: Add "by" before "aircraft". Delete "a" before "high-precision"

p 4756, line 1-4: I think the two sentences "This feature ..." and "We chose ..." could be deleted.

p 4756, line 13-22: Is this paragraph needed here? I found it a distraction from the presentation of the results

p 4757, line 11: Delete "much"? Is LMDZ generally better than TM3 because it has had the offset adjustment to fit the European data?

p 4760, line 25: "cases" not "case", change "much" to "very"

p 4761, line 14: Replace "is" with "are"

p 4741, line 22: Replace "Later" with "On the following days"

p 4762, line 6: Replace "to note" with "noting"

p 4762, line 7: Replace "good" with "well"

p 4762, line 22: Suggest "compared" instead of "confronted"

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p 4763, line 17: Replace "proper simulation" with "properly simulating the"
p 4764, line 14: "substantial" instead of "substantially"
p 4765, line 27: "2008b" not "2008"

Table 1: Suggest adding ", 20 levels below 2 km" after "150 mb"
Some of the acronymns are undefined e.g. WSM, YSU
Why is there an exclamation mark after "coarse domain"?

Table 2: The table caption needs to give a fuller description of each of the columns in the table. For example the last column is described in the text but not in the caption.

Fig 1: What does the white dashed line on Fig 1b represent?
It might be good to mark the inner domain on Fig 1a.

Fig 5: Is the time axis local or universal time?
Is it worth adding the photosynthesis and respiration tagged tracers to Fig 5a, to support the comments made on p4759-4760

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