

Interactive comment on “Modelling CO₂ weather – why horizontal resolution matters” by Anna Agustí-Panareda et al.

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Received and published: 3 May 2019

The authors would like to thank the reviewers for the comments which have been addressed below and have contributed to improve the clarity of the manuscript. All the corrections in the revised manuscript have been highlighted in blue and bold phase (see Supplement file including revised manuscript and supplement).

Minor comments

- **1. P2, L2-4: These 2 sentences seem contradictory. Please resolve the conflict.**

C1

The last sentence has been re-written to clarify the difficulty in extrapolating the results to higher resolutions: "It is clear from the results that an additional increase in resolution might reduce errors even further. However, the horizontal resolution sensitivity tests indicate that the change in the CO₂ and wind modelling error with resolution is not linear, making it difficult to **quantify the improvement** beyond the tested resolutions."

- **2. P3, L6: “being” should be “whether”**
Done.
- **3. P4, L8: Figure 3 is referenced before Figure 2 (P6, L21), therefore please reorder these figures.**
Done.
- **4. P4, L15: Table A3 is referenced before Table A2. Please reverse the order of these Tables.**
Done.
- **5. P5, L17: “semi-lagrangian” needs a capital L**
Done.
- **6. P6, L1- 4: Do the net sources and sinks of biogenic fluxes have the same value across horizontal resolutions? Are the global net fluxes the same for all resolutions? An example showing biogenic fluxes from different resolutions would be helpful in this regard.**

A figure with the monthly mean NEE from the 9km-EXP and 80km-EXP simulations has been added in the Supplement (see Fig. S1). The difference in their global budget is less than 1%. This has been mentioned in the revised manuscript.

C2

- **7. P6, L14: “Semi-Implicit Semi-” doesn’t need any capitals.**

Done.

- **8. P8, L12-13: “Since most low resolution models used in atmospheric inversions tend to use the model sampling ASL at mountain sites. . .” Please add some references here to back up this statement.**

Done.

- **9. P9, section 3.1 and Fig. 4: Care must be taken when interpreting meteorological forecasts at 1000 hPa because this level frequently requires extrapolation (below mountains and at locations with surface pressure below 1000 hPa). Some caveats regarding the use of this level should be mentioned.**

A cautionary note has been added to the revised manuscript (see Fig. 4 caption): "Note that the number of data at 1000-hPa level might be lower than the other levels as observations will be missing when the surface pressure is lower than 1000 hPa."

- **10. P9, L15-16: Diagnostics computed with observations at screen level are mentioned but not shown. It would be worth showing these figures because of the issues with observations at 1000 hPa mentioned in point 9, and because there are far more observations from surface stations than there are radiosonde observations at 1000 hPa.**

The global RMSE and global bias reduction are shown in the revised manuscript with consistent values to the 1000hPa winds.

- **11. P9, L32: “reflect on” should be “reflect”**

Done.

C3

- **12. P10, L2: “Figs. 5c and 5d” should be “Figs. 6a and 6b”**

Done.

- **13. LP11, L17: “summer (winter)”. Should this be “boreal summer (winter)”? There may be similar issues occurring elsewhere, for example on P14, L15. Please review the entire manuscript to ensure clarity when discussing seasons in regard to global results.**

Done. When summer/winter is used it is valid for either both hemispheres or a specific site. When winter/summer refer to the January/July plots, then "boreal" is used.

- **14. P13, L13: “an” should be “and”.**

Done.

- **15. P14, L33 and P15 L1: please keep consistency between “sec.” and “section”.**

Done.

- **16. P16, L26: “at least 4 km”. Do you mean “at most 4 km”? Also it would be clearer to talk about grid spacing rather than resolution.**

The sentence has been re-written to explain that 4km is the minimum horizontal resolution required. A clarification of the equivalence between horizontal resolution and model grid spacing has been included in the introduction.

- **17. Tables S3, S4: It would be helpful for the reader to provide the difference in bias and possibly also for standard error, as it is for RMSE. Also, it would be better to order the stations by latitude rather than by name, to better see if there are any patterns with respect to latitude**

Done.

C4

Please also note the supplement to this comment:
<https://www.atmos-chem-phys-discuss.net/acp-2019-177/acp-2019-177-AC1-supplement.pdf>

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-177>, 2019.