

## ***Interactive comment on “Modelling CO<sub>2</sub> weather – why horizontal resolution matters” by Anna Agustí-Panareda et al.***

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The authors would like to thank the reviewer 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 both revised manuscript and supplement).

### **General comments**

- **Impact of horizontal resolution on representation errors (P11-12, Fig. 11): I see data gaps in Fig. 11. In my understanding, the representation errors**

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are calculated using the standard deviations of modeled concentrations at a fine scale (9km interpolated to 0.1 degree) within the global grid boxes of 1 degree  $\times$  1 degree. In that case, I can't understand why such data gaps exist? Had any filtering been adopted? Please clarify.

The grey area which appears as data gaps shows the regions where  $\sigma$  is less than the threshold value of 1ppm for surface CO<sub>2</sub> and 0.1ppm for XCO<sub>2</sub>. This has now been clarified in all the relevant figure captions.

- **Also, it would be very helpful if the manuscript includes the monthly averaged modeled simulations at 9 and 80 km resolutions (spatial plot) for surface and column concentrations. I would suggest authors include those plots, allowing the reader to do the visual comparison in terms of statistical (as done in Fig.11) and model-predicted (9 km vs. 80 km) sub-grid variability.**

Monthly mean plots of surface CO<sub>2</sub> and XCO<sub>2</sub> have been included in the Supplement (see Figs S6 and S7) to provide a visual illustration of the small-scale variability associated with the 9km-EXP simulation compared to the 80km-EXP simulation.

- **Table 3 and Fig. 5: Why there exists difference (in magnitude) between the standard deviation of inter-station RMSE (sigma-RMSE) given in Table 3 ((in brackets and in bold, last column) and those given in Fig. 5 (a) and (b)? I assume that the authors used "All stations" in January and July for these calculations.**

Table 3 had not been updated when the number of observations was slightly changed (e.g. only the top level at the tower sites is used as listed in Table A1). This has now been corrected in the revised manuscript, so that Table 3 and Fig. 5 are consistent.

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- **Fig. 7 (b): XCO<sub>2</sub> daily min vs. daily mean/max in July. It's rather surprising to see the high RMSE values for daily min. What caused RMSE (daily min) to be almost doubled compared to RMSE (daily mean) and RMSE (daily max, nighttime?), given that RMSE (hourly) doesn't show this high value?**

The XCO<sub>2</sub> from TCCON is only available during daytime. This has been clarified in the revised manuscript. The CO<sub>2</sub> daily minimum in July (boreal summer) is more uncertain than the daily maximum because it is controlled by the dominant biogenic fluxes associated with photosynthesis (i.e. negative XCO<sub>2</sub> anomalies); whereas in January most sites (i.e. those in NH) are dominated by respiration, affecting the daily maximum variability and its RMSE. This has also been clarified in the revised manuscript.

### Minor comments

- **Fig. 1: In Fig. Caption, please indicate the model's resolution used.**

Done.

- **Fig. 5, 6 and 7: In Fig. Caption, the standard deviation of R is not mentioned though it is given in the plot. You may please rewrite as: "The standard deviation of the plotted variable from each station is shown. . ."**

Done.

- **Table 2: Since there is no change in flux datasets used for different experiments, please remove the last column and indicate details of CO<sub>2</sub> fluxes in the figure caption.**

Done.

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Please also note the supplement to this comment:

<https://www.atmos-chem-phys-discuss.net/acp-2019-177/acp-2019-177-AC2-supplement.pdf>

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

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