

Interactive comment on “On the impact of recent developments of an atmospheric general circulation model on the simulation of CO₂ transport” by Marine Remaud et al.

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This study describes in some detail the impact of various developments of the LMDz GCM on the simulation of several trace gases. Although the new physics parameterization scheme makes the most difference in the simulated trace gases between the model cases run here, in the comparisons with observed mixing ratios there was no clear improvement in the newest versions of the model. If anything, the new physics seems to be worse at tracer transport due to the relatively weak vertical transport. This is somewhat of a null result but is important nevertheless because it shows the persistence of transport related deficiencies in model trace gas simulations. These deficien-

C1

cies clearly will not be easily solved by going to higher horizontal or vertical resolution as shown here. Thus, the problem will not be fixed by more computing power.

The results are well described and organized and the topic is relevant for the journal so I recommend publication with consideration of the comments below.

Specific comments:

Pg. 1, line 16: change “further” to “due”

Pg. 2, line 3: remove “Already”

Pg. 4, line 13: remove “s” from “precipitations”

Pg. 4, line 22: “The motivation behind this change was to depart. . .”

Pg. 5, line 6: looks like “1989” should be “1998”

Pg. 8, Figure 2: The color bar is all white in my version

Pg. 10, line 6: add “s” to end of “day”

Pg. 10, line 12: remove “Recalling Table 1,”

Pg. 10, line 16: “. . .manifests from the thermal activity that transports tracers. . .”

Pg. 10, line 26: the SF₆ lifetime is actually most likely less than 1000 years based on a recent paper of mine (Ray et al., JGR, 2017). Not necessarily relevant to your discussion but just thought I would point it out.

Pg. 10, line 34: add “s” to end of “dynamic”. Also, this result of higher stratospheric SF₆ mixing ratios is quite interesting since the Brewer Dobson circulation is driven by wave activity propagating up from the troposphere. A faster circulation would require more wave activity. Yet, the decrease in deep convection seen in the Rn222 suggest less convectively driven waves so it must be from a different source, likely planetary scale Rossby waves.

C2

Pg. 12, lines 4 and 5: remove “s” from the end of “exchanges”

Pg. 12, line 6: “. . .correlated with the efficiency. . .”

Pg. 12, line 19: remove “Recalling Table 1,”

Pg. 12, line 29: change “outreach” to “exceed”

Pg. 12, line 32: remove “while zooming over this region”

Pg. 13, Figure 4: Very difficult to see the features in the maps with such light colors.

Pg. 14, line 16: change “obtain” to “obtained”

Pg. 15, Table 2 and Section 4.2.1: Are there any measurements being compared to here? This section is a subsection under Section 4 Comparison with observations but it’s not clear if the gradients shown are relative to observed MLO values or not.

Pg. 15, line 20: one of “modelled” or “simulated” should be “observed” I assume

Pg. 15, lines 20-21: what’s described here is not what’s shown on Figure 6. The correlations are on the top row and the ratios on the bottom.

Pg. 16, Figure 6: there’s really no point in labeling the individual stations with numbers on the plots since they are too small to see. Just labeling the different colors should be sufficient. Also, there appears to be an axis label problem on 6d.

Pg. 16, line 1: “bottom” should be “top”

Pg. 16, line 4: the station names should be capitalized in the text, here and in all other places. It’s much easier to identify that you are referring to a station when the name is capitalized and you have a mixture of upper and lowercase references that makes it confusing.

Pg. 17, line 2: change “there” to “they”

Pg. 17, line 4: change “over” to “out of”

C3

Pg. 17, line 13: change “et” to “at”

Pg. 17, Figure 7: it would be helpful to make the zero line on the y axis clearer. Also, the y axis label on the bottom row should be delta CO₂.

Pg. 18, line 10: if you’re going to use numbers on the plot it would help to reference them by number here rather than the station abbreviation since that means the reader has to refer back to the previous figure to what numbers the abbreviations correspond to. Also, change “term” to “terms”.

Pg. 18, Figure 8: it’s hard to tell if any of the model runs are better than the others in this figure. Should I be able to tell?

Pg. 19, line 14: the phrase “for a little majority” is confusing

Pg. 19, line 15: change “supplementary” to “supplement”

Pg. 20, line 1: add “s” to end of “mean”

Pg. 21, line 4: remove “In parallel,”

Pg. 21, line 9: change “misfits” to another term, perhaps “bias”. The term “misfits” is used in other places as well and I would recommend they all be changed.

Pg. 21, line 15: remove “an” before “enhanced”

Pg. 21, line 23: change “than” to “as”

Pg. 22, Figure 10: include the x-axis tick marks on the top of each plot so it’s easier to see how the top of each profile differs from zero. Same for Figures 11-13.

Pg. 23, line 4: change to “constraints”

Pg. 24, lines 5-6: “. . .has not enabled the variability of the CO₂ fluxes to be improved so far. . .”

Pg. 24, line 20: add “in the new physics” after “5 km”

C4

Pg. 26: I would change the Section 5 title to “Conclusions”

Pg. 26, line 3: “. . .benefits from a more elaborate radiative. . .”

Pg. 26, line 4: change “on” to “in”

Pg. 26, line 25: “. . .synoptic and diurnal scales. . .”

Pg. 27, line 8: “. . .latitudes further due to less. . .”

Pg. 27, line 12: “sensible” should be changed to “sensitive”

Pg. 27, line 13: “. . .enabled assessment of the quality. . .”

Pg. 27, line 33: change “heaviness” to “expense”

Pg. 28, line 13: remove “much”

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