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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity of tracer transport to model resolution, forcing data and tracer lifetime in the general circulation model ECHAM5" *by* A. Aghedo et al.

Anonymous Referee #2

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General comments:

This paper addresses the differences in modelled tracer transport as a result of different model resolutions, tracer lifetimes, and circulation fields. The results are interesting, as they indicate that there can be significant differences in tracer distributions between two experiments, resulting only from the use of different model resolutions. Generally, the paper is well written, however the discussion of the results could be improved, in particular, the exceptions to general statements about the effect of model resolution need to be pointed out.

Points 1-14 are issues that should be addressed before publication.

Points 15 -26 are minor technical corrections.

Specific comments:

1) Why was the T63L31 resolution chosen to test the tracer lifetimes, and the effect of meteorology? How would the results of these tests have differed if a different resolution had been chosen?

2) At several points, it is mentioned that the inter-hemispheric transport times are lower than those in the literature. The authors suggest that the results of Levin and Hesshaimer (1996) may overestimate the transport time, however they point out that the results of Czeplak and Junge (1974) are also larger than those presented. A discussion of the reasons for the lower estimate with ECHAM5 should be included

3) I'm not totally clear on how the tropopause tracers were set up. Is the altitude of the tropopause fixed in the model, and are the tracers released at single model level in each region (N,S,T), through the middle of which runs the tropopause (as it appears in Figure 1)? Or can the level of the tropopause change? At different vertical resolutions, is the fraction of the tracer being released into the troposphere and the stratosphere identical? Similarly, when the horizontal resolution changes, does this affect the total volume of source model boxes for the tropopause tracer which is in the stratosphere and the troposphere?

4)pg 142 - The 50 month lifetime tracer required a longer spinup time, and therefore this experiment was run for 13 years, where as the others were run for 5 years. In order to evaluate the effect of tracer lifetime, all tracers should be run in the same model experiment, which is run for 13 years. The last 4 years can be analysed for all tracers then. That way, differences in circulation will not affect the results.

5) Page 144, line 4-5: The author writes "most of the simulations reached a quasi steady state over the last 4-year period". How can the results be compared for those simulations which did not reach steady state?

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6)Page 144, line 14 and 15 - Some discussion of the reasons for the lower Ri,r values of the L19 runs vs the L31 runs is needed.

7) Page 144, line 17. Horizontal resolution does make a difference for several of the tracers, for example: trop T, T106L31/T63L31 are rather different from T42L31; stratT, T63L31 differs from T42L31, in addition to the differences between T106 and the other L31 experiments, which were pointed out by the authors. The differences between T63L31 and T42L31 in the stratT and tropT panels of Fig 2 are similar to those of the surfT tracer for the T21L19 and T42L19 experiments, which was pointed out by the authors as a "notable exception".

8) Page 144, line 21-22 this appears to be related to what I wrote in point 3. If the position of the source regions changes relative to the tropopause, it is rather hard to quantify the effect of the resolution on the results. If this is the case, the tropopause tracers should be removed from this study.

9) Page 145, lines 22-24 The T106L31 results do not fit in with the trend of increasing transport with increasing model resolution. This should be mentioned.

10)Page 145, line 24-26 If the coarse resolution model simulations have increased vertical mixing, I would have expected the export fluxes from the source regions to be larger than in the fine resolution simulations. Figure 2 shows that this was not the case.

11) Page 146, line 20-23: The T21L19 simulation shows a smaller vertical transport in the case of the StratS tracer below 750hPa, than the two L31 simulations.

12) Page 148, line19-21: It looks like the vertical resolution is more important than the horizontal resolution for inter-hemispheric transport time. A comment to that effect could be included. I take it that "AMIP2 runs" refers to the runs in this paper that were set up in a similar way to the AMIP2 study, and not to runs from the Gates et al. 1999 publication. If this is the case, they should not be described as AMIP2 runs, it is confusing. Likewise for the use of this term on page 150.

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13) Page 149, line 11: The statement that transport is more vigorous in the finer resolution models is a bit too general. Table 2 shows the opposite, for vertical transport. It is interesting that in Table 2, the vertical transport mostly increases between T21L19 and T42L19, but in the L31 simulations, it decreases with increasing horizontal resolution.

14) Page 149, line 28-page 150, line 1: "tracer lifetime has a strong influence on the seasonal cycle of the tracers”: As far as I can see, this was not discussed earlier in the paper, nor was any evidence to support this statement presented.

Technical corrections:

15) Page 139, line 11 - The word "hinted" is not really appropriate. Genthon and Armengaud (1995) actually suggested rather strongly that model resolution affected the results, although the conclusion was based on results from different models or model versions.

16) pg 140, line 5: "time scale" ->"time scales", or replace "are" with "is".

17) pg 140, line 123 - "citepsimbur81" appears instead of the citation.

18)pg 140 line 24- page 141 line 4 - I do not see why the description of the cloud scheme, and the transport of water vapour, ice etc. is necessary. I suggest removing it.

19) pg 142 line 17 - the lifetime is "normally 5 months" - I suppose you mean it is 5 months, except in the experiments where the influence of the tracer lifetime is being investigated? I suggest you state that explicitly.

20) Page 144, line 19: ‘resolution yields larger’

21) Page 145, line 6: change "is" to "are"

22) Page 146, line 13 "50 months surface’ -> ‘50 month lifetime surface’

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23) Page 149 line 12: ‘are mostly’ should be changed to ‘is mostly’

24) Page 149 line 25: ‘lifetime’ should be ’lifetimes’

25) Page 149 line 25: ‘the 50 months surface’ should be ‘The 50 month lifetime surface’

26) Page 149 line 26: change ‘vary’ to ‘varies’

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 137, 2008.