

## ***Interactive comment on “Evaluation of cloud convection and tracer transport in a three-dimensional chemical transport model” by W. Feng et al.***

**Anonymous Referee #1**

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This manuscript presents an investigation of the convective scheme included in the TOMCAT global CTM. Mass fluxes and precipitation rates are compared for several different model versions to investigate the effects of model resolution, aspects of the convective scheme, use of different forcing data, and the use of archived mass fluxes vs. diagnosed convection. The study is interesting, and documents the first step of a re-evaluation of transport in TOMCAT. There are however a few minor improvements which could be made in the presentation, in particular the section comparing model results with radon.

Specific points: Most of the analysis involves zonal mean plots. A useful addition to

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the paper would be maps of mass flux, and a comparison with archived mass flux or observation based precipitation data sets– Do the various changes to the model cause longitudinal changes in the convection distribution, do the changes have different effects over land and sea?

pg 22959, line 18-21 – Please comment briefly on how you created the higher resolution data set – was it a simple interpolation of the coarser one? Or was data from another source included?

pg 22960, line 27 – “Run P\_det is the same as E\_Elnewconv ...” This description is not entirely accurate, according to table 1 it also uses a lower vertical resolution and the resolution of the evaporation flux data set is lower. There needs to be a specific discussion of how these changes affect the comparison, if at all.

Pg 22962 line 25, Please find a better reference for the difficulties of estimating precipitation from cloud-top temperature.

Pg 22963, line 17, the word “likely” can be removed.

22964, 24 – remove “a”

22965, 2 – The inclusion of downdrafts and mid level convection evens out much of the asymmetry in the updraft contours between the northern and southern hemispheres, at least for the weaker updraft contours ( $<1E-5$ ). A comment on the reasons for this would be good.

22966, The effect of changing only the vertical resolution should be discussed (i.e. the difference between A\_E40 and K\_L31, and K\_L31 should be included in figure 5.

22966, The different horizontal resolutions are compared. Run E\_Elnewvap uses ERA-interim data while the others use operational data. Although this will not change the results, it should be pointed out to the reader.

22967, 11 – “span” – as only the ERA-interim mass fluxes are plotted, “are similar to”

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may be a better comparison.

22967, 10, -remove the second instance of “that”

22967,14 – the sharp fall off of runs N\_1991 and P\_det should be mentioned, as it's not so different to that of the other runs, it just occurs at 200 instead of 300hPa.

22967,25 – does ->do

22969,14 I don't understand the sentence beginning “In the tropics..” Which run underestimated precipitation in the extra tropics? Both B\_EI and A\_E40 look to me like they have higher extra tropical values than GPI and CMAP. On the other hand if you meant A\_E40 gives lower values than ERA-40 then I wouldn't imply that the ERA-40 data is correct by calling the model results an underestimation.

Line 21 -24– Several runs are said to overestimate the observations. This is only true in parts of the tropics. North or south of 25-30 deg, all the runs dramatically underestimate the observations. This needs to be commented on and explained.

P22970, 6 – What are the reasons for this over estimation?

P22970, - Please provide references for the radon data you use in fig 11/12 . Information on the measurement technique and other back ground data would also be useful for all of the measurements discussed. Figure 12, panels C and D are not discussed. Discussion of Figure 12: how many profiles are included in the averages for the measurements? How do the model results compare to the different profiles? Are there some regions where the models do not match the observations, or do the errors average out to produce the reasonable comparison?

P22970 – It should be mentioned somewhere that vertical transport is not the only factor that affects the radon profile – horizontal mixing, particularly near coastal or snow covered areas may play a role, as there is a strong spatial gradient in radon emissions here.

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P22970 I21, you should define NARE somewhere.

P22970 Discussion of Figure 13 – There were huge day to day variations, and I don't think the data constrains the model results. Do the models reproduce the variations?

P22972 I19 – Another significant disagreement is the latitudinal distribution (at mid-high latitudes the modelled mass fluxes and precipitation are way too low).

P22973, I4, Probably better to write something like “convection parameters in the Tiedtke scheme”

L7 – Do you mean “Moreover it is not clear IF the changes.....”?

Figures: For most figures the axis and legend labels and numbering are way too small. Please also consider increasing the line thickness, in line plots as it is hard to tell the difference between the line colours.

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