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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Results from a new linear O_3 scheme with embedded heterogeneous chemistry compared with the parent full-chemistry 3-D CTM" *by* B. M. Monge-Sanz et al.

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This paper introduces a linear ozone chemistry scheme with a consistent representation of heterogeneous chemistry. The new scheme is validated inside a CTM, and it is shown to work well in representing polar ozone loss, providing a better way to represent heterogeneous chemistry than that currently used in the ECMWF system. The material is well presented and is ready for final publication with only minor changes.

1) p12995, l6 - To my knowledge, only O3 and H2O are prognostic variables in operational NWP systems. Include CH4 and CFCs in this list only if there are references to back this up (and please supply them).

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2) p12996, l25-29 - Any criticism of cold-tracer approach needs to be balanced and properly justified. As it stands, the paper says that the COPCAT approach is superior, but without including any new evidence. Ideally (though not required for publication) this paper would test it alongside the other approaches. Failing that, discussion of the cold tracer is necessary, but can only be speculative. The following points should be considered:

a) Yes, the cold-tracer may need retuning from year to year. But COPCAT does too, as stated later in the second to last paragraph of the introduction.

b) The cold-tracer would likely do a much better job in non-zonally symmetric situations, particularly the Arctic winter. A discussion does occur later in the introduction, but ideally all discussions on the cold-tracer should be merged.

c) A cold-tracer, by definition, requires an extra tracer, but in NWP, this extra computational overhead would generally be undesirable.

3) p12999, l23 - Please introduce the TOMCAT box model and describe how it relates to SLIMCAT. NWP readers will not necessarily know what a box model is.

4) p13000, l3 - "initial state" - what is this? From the previous sentence, a January - December 2000 mean is implied.

5) p13000, l12 - "initial state on 15th of each month" - what does this mean? "Initial state" implies some re-initialisation is going on. Is "state at 00Z on 15th of each month" intended?

6) p13000, l24 - "... ozone is initialised with the average field over the first day" - why is this done? What is the significance?

7) p13002, l10 - ".. linear squares fit to the points..". If only two or three points are fitted, why use least squares? I'd have expected either two or three point numerical differentiation to be applied here. Please explain / justify your fitting in more detail in the text.

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8) p13003, 17 - Give a published reference to the HALOE data.

9) p13003, l21 - Please state the percentage of cases where the annual mean is substituted in place of the monthly mean.

10) p13004, l4 - "differences can only be due to the use of COPCAT instead of the full chemistry". What is the effect of any approximations in going from SLIMCAT to the box model, TOMCAT?

11) p13004, l25 (and later discussion on p13008) - Could the 60DU bias in Arctic regions come from the use of zonal mean chemistry in COPCAT being inappropriate to the highly non-zonal nature of the northern stratospheric winter? This is one area where the cold tracer would be expected to do better. Please discuss in the text.

12) Figure 6. The blue and black lines are indistinguishable.

13) p13005, l12-23 - Discussion on mid and upper-stratosphere biases. Please cover the following in the paper:

a) Why use the CHEM2D / Fortuin and Kelder climatology? What about the climatology in the ECMWF scheme, how does this compare? This would perhaps have been more relevant to the rest of the paper.

b) Please state what observations the Fortuin & Kelder climatology is based on.

c) Please note the existence of much previous work on substituting one ozone climatology for another in a linear scheme, e.g. Eskes et al. (2003), McCormack et al. (2006), Geer et al. (2007), all of which are already in the reference list.

d) Figure 7 - blue and black solid lines are indistinguishable ; HALOE (the red line) should be included in the key on the figure itself.

e) "the minimum .. is around 60DU higher". The Fortuin and Kelder climatology does not have values for latitudes greater than 80 degrees. Could interpolation/extrapolation to 90S have caused the problem?

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14) p13006, l6 - "both schemes underestimate column values" - this could be linked back to Fig. 7

Typos etc.

1) Abstract, l15-16 Full stop after "observations"; capitalise "However"

2) p12995, l10 "by" -> "in" ; remove "numerical"

3) p12995, l14 "considered point" -> "point considered"

4) p12995, l24 "come from" -> "are derived from"

5) p12996, l2 "obtained with" -> "are derived from"

6) p12996, l24 "discussed in Sect. 1" - we are in section 1 already

7) p13002, l12 "shown ranges" -> ranges shown" ; "dependence with" -> "dependence on"

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 12993, 2010.