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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: A diagnostic for ozone contributions of various NO_x emissions in multi-decadal chemistry-climate model simulations" *by* V. Grewe

Anonymous Referee #2

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This paper describes a "tagged" (also called colored or marked) tracer concept that is computationally efficient, and can be used for long-term chemistry climate calculations. I like that finally somebody devotes a paper to the topic- whereas other authors did not discuss the topic in great length.

The author has chosen the form of "Technical Note", however by doing so sometimes in depth and necessary information is unnessarily lacking. This is an opportunity to do a better job than previous authors, and therefore I would recommend to substantially improve the manuscripts prior to publication in ACP.

Detailed comments:

p. 328 Various authors have indeed used the concept of marked tracers. The main rationale of this paper seems to have a computationally efficient method; since other methods "vastly increase computing time prohibiting climate simulations". This is not my own experience, the costs of the calculations were increased by about 20 percent, compared to a model version omitting marked tracers. How many additional tracers does the method described here require, and how does it compared to what other authors used? What is the additional cost of the method here, and if this information is available, that of other works? I suggest to give an overview of the literature approach in tabular form. Also explain here that the marked tracer approach assumes that chemistry is NOx limited.

p. 328 More state-of-the art sensitivity analysis is increasing/reducing sources by e.g. 10 percent; the delta-method. This method is extensively use in air pollution modeling, and too a large extent avoids non-linear effects. You use this method yourself in section 3.

p. 329 I am somewhat confused by the way the box model is introduced and on the basis of that a more general theory is introduced. I suggest to reverse this - introduce the theory and then show that for one case it is working reasonably. Explain better why you think this example is so representative- e.g. NOx in the PBL has a lifetime of few hours-day.

p. 330 The nomenclature on p. 330 is confusing- more simple would be Xi=NOy,i ; repeat here again what is NOy. xi=NOx,i and Yi=O3,i. Why are the indexes of Yn+1 on top? Call production of O3 Po3,i etc.

p. 330 Give an overview table with these terms.

p. 330 evolution= temporal evolution Ydot = dY/dt

p. 331 like said before; you cannot base a theory on a single case. Rather say: we now assume that at any given point and time the ratio of NOx,i to NOx = NOy,i to NOy.

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Interactive Comment

Explain what you call a reasonable agreement.

p. 332 I like the attempt for error analysis, but I am bit worried by the results. I am surprised by the large deviations of -40 to + 5 % for recalculated ozone and ŚtrueŠ ozone, when you introduce such small disturbances. Are these for single gridboxes and timesteps, or rather for larger timeframes and domains? What is the average deviation? Did you try much smaller disturbance (e.g. 1%), and do the results get better? Can you make an estimate to what extent non-linearity in the transport model could contribute to the differences? The problem is that your "test" method should be more reliable before you can compare the tagged tracer approach.

p.332 THe figure caption of FIgure 3 is not clear. What is the reason for the SH lower atmosphere not having reliable values fo Fa?

p. 334 I am confused as to what you have exactly done to calculate Fr. Did you increase 'source' by 'source' the emissions by 5% for the delta method as well as the tagged tracer; and then evaluate the difference against a base case? I am confused again by the exact meaning of the indices.

p. 334 Fig 2; Suggest to give also the contributions for July- when NH photochemistry is much more active. How do these results compare to other more extensive marked tracer results?

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 327, 2004.