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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A quantitative analysis of grid-related systematic errors in oxidising capacity and ozone production rates in chemistry transport models" *by* J. G. Esler et al.

Anonymous Referee #1

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General Comments.

The paper presents a numerical treatment of errors induced by the artificial mixing of species due to limited resolution of atmospheric chemistry transport models. Changes in predicted OH concentrations and ozone production rates for varying model resolutions are presented for simulations using the TOMCAT and ECHAM4 models with comparison against flight measurements. The paper contains a lot of numerical experiments leading to a final message that is important although somewhat obvious i.e. that predictions from grid based models are sensitive to the grid resolution used. Although this study may be of use to practitioners using the TOMCAT and ECHAM4 models, there have been numerous studies of this type over the last decade or so,

some of which have been more systematic than the one presented here. The subject of grid generated diffusion has received some very in depth treatment from the numerical mathematics community and methods for estimating spatial errors have even been derived which are used for example in adaptive grid based models. Some reference to previous work addressing similar problems should be made.

Specific Comments.

One aspect of the work that concerns me is that grid based errors are generally linked to concentration gradients. Within a grid based model these gradients are driven by the resolution of the grid as well emissions information (amongst other things). Therefore there is a feedback between the resolution of the emissions data-base used and the model grid required to achieve a converged solution. If point sources are part of the emissions data then the resolution requirements can be quite high, whereas if a spatially averaged emissions data base is used the model may converge more easily, simply because the emissions information is too coarse. The use of the term ŞsystematicŤ when referring to grid based errors therefore seems to be misleading since the situation is much more complex and depends on the inputs to the model. It is not clear that the authors have considered the impact of poor resolution emissions information on their results. If an emissions inventory is highly spatially averaged then higher model resolution will not necessarily improve the agreement with measurements. In order to really understand model grid based errors then a high resolution emissions inventory would be required. Some discussion of this point is required.

The authors quite rightly point out the importance of vertical grid resolution that has not been considered in this work. Again, errors due to vertical resolution will appear in regions of steep spatial gradients (e.g. at the top of the boundary layer). It will be important to consider such effects in any future studies Ű and in fact this subject has received less attention in previous studies and would perhaps form a more interesting case study.

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Technical Comments.

The paper seems to be technically sound.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 2533, 2004.