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Interactive Comment

Interactive comment on "Technical Note: Chemistry-climate model SOCOL: version 2.0 with improved transport and chemistry/microphysics schemes" *by* M. Schraner et al.

Anonymous Referee #1

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The article by M. Schraner et al. provides details of the evolution of the SOCOL model as the authors attempt to minimize the effects of numerical artefacts introduced by the use of a non-conservative semi-Lagrangian advection scheme, and associated mass correction, for chemical tracers in SOCOL, a CTM coupled interactively to the MA-ECHAM4 GCM. A key diagnostic of CCM performance that arose from the previous CCMVal intercomparison of CCMs (Eyring et al., JGR, 111, doi:10.1029/2006JD007327, 2006) was the amount of reactive chlorine (Cly) in the Antarctic vortex during spring. Since the evolution of polar ozone depletion is critically dependent on the amount of chlorine within the vortex during springtime, less weight was given to the predictions of those models that were unable to reproduce the observed amount of chlorine in the recent past. Unfortunately SOCOL was one of the models that displayed a very significant underprediction of Cly. The present paper details a number of changes made to improve the performance of SOCOL for tracer advection, with presumably one of the aims to improve Cly in the Antarctic vortex.

In general the paper provides a nice narrative of the attempts to diagnose and minimize errors that arise from using an inherently non-conservative semi-Lagrangian transport scheme for horizontal advection. It is correctly prefaced as a 'Technical Note' and should be of interest to those whom actively develop models.

To shorten the paper slightly I would suggest removing discussion of version 1.3 of SOCOL, where additional short-lived tracers are included as advected species. This change in itself has only a small effect on the model results and could be folded into the changes described in version 1.4. A reduced number of model variations described in the paper will making reading easier.

I find the changes to the mass correction for ozone introduced in version 1.5, restricting the correction to between 40N and 40S, understandable from a pragmatic point of view, but somewhat controversial. The authors attempt to justify the choice by analyzing where errors in ozone mass are occurring (Figure 6), but find very significant errors for ozone at high southern latitudes during austral spring and implicitly tolerate these by turning off the mass correction at these latitudes. By only applying the mass correction to lower latitudes, where the photochemical lifetime of ozone is much shorter, the effects of the mass correction on the model is being 'hidden', to some extent, because the mass correction term will compete with photochemical terms in the ozone budget. While such a choice will help the model distribution of ozone, it means that regions of the model where the photochemical lifetime is longest, and advection correspondingly more important, are the regions of the model where advection is unconstrained. What I find hardest to justify is the fact that the application of the mass correction on restricted latitudes is only used for ozone. The need for these ad hoc choices would seem to underline a very significant drawback to the use of interpolating

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semi-Lagrangian schemes for transport of chemical species.

Figure 12. This figure is adapted from Figure 12b from Eyring et al. (2006) to show the range of October Cly at 50 hPa and 80S calculated by the models that participated in CCMVal. While the authors state that the range shown here includes all models except SOCOL, it is clear the range still includes the ECHAM39C model. The ECHAM39C model was very similar to SOCOL for Cly in the springtime Antarctic vortex, being one of the two outliers for this measure, and I find no value in defining the range to exclude SOCOL while including ECHAM39C. It is my opinion that the range of CCM predictions would be more accurately represented here if the range shown in Figure 12 omitted both SOCOL and ECHAM39C, as the remaining models are much more closely clustered together. As it stands, the statement that SOCOL 'now lies in the range of the other participating CCMs' rings a little hollow. With the revised group of models defining the range, the lower bounds of the range would be above 2.0 ppbv after 1995.

Have the authors analyzed the age of air in SOCOL? Part of getting enough Cly into the Antarctic vortex is having old enough air descending inside the vortex - older air having had more time to break down the ozone depleting substances and release the chlorine to Cly. Having too young an age of air may be part of the reason why, even with the modifications to the tracer transport, the Cly in SOCOL is towards the lower end of the CCMVal models.

A minor typographical comment: Page 11123, Line 26. I believe the refence to 'vs2.2' should be 'vs2.0'? This error is reproduced a few times in subsequent text.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 11103, 2008.