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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Black carbon ageing in the Canadian Centre for Climate modelling and analysis atmospheric general circulation model" *by* B. Croft et al.

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The authors thank Frank Dentener for his interest in this work.

In regard to terminology, in future versions of this manuscript we plan to better clarify that by soluble/mixed BC, we refer to black carbon aerosol that could act as a cloud condensation or ice nuclei, whereas insoluble BC refers to aerosol that can not participate in cloud processes.

In regard to our conclusions on which ageing scheme is better based on the evaluation with measurements, we have recently completed a more detailed statistical analysis of our results. Three additional remote sites have also been included. These are

Barrow, Cape Grim, and Amundsen-Scott, South Pole. Including all seven datasets, the correlation between observed and monthly monthly mean surface layer concentrations suggests that the seasonal cycle is best captured by the simulation COND-COAG, but the correlation coefficient for the simulation COND-COAG-OXID is only minimally less. The FIX-LIFE simulation gave the lowest correlation coefficient. In the global mean of the sites we have examined, the simulation COND-COAG-OXID gives the model to observed ratio closest to unity. This analysis suggests that the COND-COAG-OXID parameterization does perform best, and clearly illustrates the deficiency of the FIX-LIFE parameterization. The details and discussion of this analysis will be included in future versions of this manuscript.

We acknowledge that the sensitivity study related to emissions is not highly important to this study. However, we think that it is a useful point to note that the factor of two uncertainty in the black carbon emissions inventories has a more significant impact on the modelled BC concentrations than does the choice between any of the BC ageing parameterizations that we present. However, we do plan to restructure this subsection to include the sensitivity of our results to model related issues such as resolution.

We have recently completed a 3-year T63 resolution model run of the COND- COAG-OXID simulation. In comparison to the T47 resolution run, we found that the burden was only slightly smaller, by about 3%. The wet and dry deposition continued to be 75% and 25% of the total deposition, respectively. The global and annual mean lifetime is essentially unchanged at 4.8 days for this simulation. These results will be included in future version of our paper.

We also note that the wet scavenging depends on the precipitation rate, which is a function of the cloud droplet number concentration and the liq- uid water content in our model. However, since the cloud droplet number is presently in no way linked to the black carbon aerosol, we do not expect the nonlinearities involving wet removal of BC to be significant.

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Regarding the wet removal process, yes, the main removal in the 'no-ageing' simulation is the below cloud scavenging. This is currently parameterized with the same scavenging rate for both the fresh and the aged BC. To our knowledge no AGCMs have used different rates for this process. We think that this pa- rameterization does need further investigation since if the below cloud removal of the fresh BC is too quick, the modelled BC concentrations may be too low.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 1383, 2005.