**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Influence of future air pollution mitigation strategies on total aerosol radiative forcing" *by* S. Kloster et al.

Anonymous Referee #1

Received and published: 3 July 2008

This is a well written, interesting paper presenting new results on the aerosol RF response to potential air pollution emissions changes. The response can be quite large, and the topic is well worth the detailed investigation presented here. The paper is rather long, as both the modeling is described and many different sensitivity studies are performed, but its good to have all this information in one place so this is acceptable. I believe the paper could be strengthened with a few changes suggested here, and should then be ready for publication in ACP.

Specific comments

I have three substantial requests:

1) P 5586: I suggest the authors add a section 5.3 on the additivity of aerosol and

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oxidant perturbations. Though I hate to suggest an addition to an already long paper, all the material is there and this would be a useful addition to have a short discussion of this aspect of non-linearity. It seems oddly left out at present.

2) While Figure 2a shows the zonal mean TOA SW forcing, this is really one of the main results of the study and the paper should include another figure showing the spatial maps of this forcing in the various experiments (at least those with substantial responses over at least some areas). The reader is at present left with only tables and line charts and cannot get a good sense of the more localized RFs that result from the emission and oxidant changes explored here, though the text describes local changes that appear to be more substantial than large-area means.

3) Figure A1c shows a fairly substantial positive bias in BC. Its difficult to tell on a log scale, but it appears to be around 50-100%. This needs to be explicitly acknowledged in the text as a caveat to the study (the BC responses may be an upper limit?).

Additional comments:

P5568, L5: Section 2.2: While later on the authors explain that oxidants are prescribed with offline fields, I feel this information needs to be in section 2.2. While not part of the aerosol model per se, its intrinsic to aerosol chemical processing. Additionally, the description that is eventually given of offline oxidants is not sufficient. Are all oxidants offline? Including hydrogen peroxide? It may be reasonable for OH and ozone, but for soluble hydrogen peroxide this may cause substantial biases.

P5570, L26: Its not clear what the global mean decrease of 13% refers to here. SO2 oxidation, surface sulfate, or what? Please clarify.

P5571, L9: As youve just discussed the models underestimate of BC over North America, itd be better to say the model shows reasonably good agreement here.

P5571, L23: The authors point out that one of the conventional definitions of RF includes fixed tropospheric temperatures. This is important in the case where adjusted

RF is calculated, meaning that stratospheric temperatures are allowed to adjust while those in the troposphere are not. However, I dont believe this is the case in this study. The authors should clarify where they are applying the nudging. If its the entire atmosphere, as I suspect, then they need to clarify that they are not simply holding tropospheric temperatures fixed while allowing the stratosphere to adjust, as the current wording implies. Instead, they are calculating something more akin to instantaneous forcing rather than adjusted, though its not exactly that either due to the aerosol indirect effects.

P5572, L7: Its probably worth noting that the CLE scenario assumes full compliance with legislation (which is clearly optimistic).

P5572, L23: Please identify the aircraft emissions used along with the shipping here and in Table 1.

P5576, L2-5: This description of sea salt, dust and DMS emissions belongs in section 3.1, not in the results.

P5576, L8-9: It sounds odd to say that global emissions decrease over particular source regions. This sentence could be rewritten.

P5577, L22: Please elaborate on why emissions at a lower latitude would lead to a longer lifetime. One might suppose wet removal would be faster at lower latitudes, hence the opposite response.

P5578, L3: It would be helpful to the reader if the authors explained more explicitly how sulfate affects carbonaceous aerosols in their model in the interaction referred to here. Thus far theyve only said that theyre internally mixed, but a short qualitative description of sulfates influence on the BC/POM hydrophobic/hydrophilic transition would be useful here.

P5579, L15: The authors use the term RF perturbation. The word perturbation is redundant, as forcing already requires a perturbation. It would be more descriptive to

use TOA RF instead.

P5579, L19: The authors say they diagnosed atmospheric RF, but then proceed to describe that this is the atmospheric absorption and not the RF at all. Please just call this atmospheric absorption.

P5579, L27: Its unclear to me what is meant by total aerosol RF here. Is this TOA RF, surface RF, atmospheric absorption, or does total now refer to direct plus indirect? Please be specific.

P5581, L7 and L15: I dont see how you can get either of these numbers from the MFR vs MFR Europe or MFR vs MFR Asia experiments. They dont seem consistent with the local or global numbers given in the text.

P5582, L10: The oxidant changes used in the sensitivity studies are assumed to span a realistic range. It seems they may cover the range of changes that might result from anthropogenic emissions, but its worth pointing out that they do not account for potential changes in natural emissions under a changing climate (e.g. biogenic VOCs, methane). In addition, the OH changes will be very sensitive to the ratio of NOx to CO+VOC changes, as these push OH in opposite directions, so that oxidant changes could be rather different than those used here if species specific emissions were to evolve differently.

P5582, L27: I dont follow what pronounced differences refers to here. Between no change in oxidants and changing oxidants, or no change in oxidants and present-day runs?

P5585, L13: The section 5.2.1 discusses the additivity of aerosol RF. This is the whole and only point of section 5.2, so this subsection heading should be removed.

P5588, L1-2: The last sentence of this paragraph is repetitive and should be cut. The total and Asian values have been given already, so readers can easily do the math themselves.

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P5589, L8: A comment should be added at the end of the line about oxidants changing: … as a result of air pollution mitigation and climate change, the latter of which was not included here.

P5589, L25: The word globally should be inserted after production. The paper has shown that substantial local changes are possible (Figure 3, for example), which could also be noted here if the authors like.

P5589, L26: I suggest adding likely to be before rather small here.

P5590, L13: The authors should cite previous work on air quality/climate linkages here, such as the recent multi-model study of Shindell et al., JGR, 2008. That study explored the climate impacts of various potential air pollution emissions trajectories, so is quite relevant to this work.

Technical corrections:

P5564, L19: Cloud should be could.

P5565, L7: Should be legislation was, not legislations were.

P5565, L13: Should be legislation has, not legislations have.

P5570, L28-29: The model setup has already been explained nicely, so please delete everything after the words: this study.

P5574, L7: Delete to after using.

P5579, L1: Delete thereby at start of line.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 5563, 2008.