Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-443-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global and regional radiative forcing from 20 BC, OC and SO_4 – an HTAP2 multi-model study" *by* Camilla Weum Stjern et al.

Anonymous Referee #1

Received and published: 30 June 2016

This is a well-written study that evaluates changes in radiative forcing caused by 20% reductions in regional emissions of aerosols and aerosol precursors (BC, OC, and SO2), using 10 models contributing to the HTAP2 project. The paper includes helpful discussion on spatial variability in forcing efficiency and forcing perturbations, as well as comparisons of contributions to forcing from local and remote emissions and an evaluation of the importance of using vertically-resolved aerosol fields for achieving accuracy in total aerosol forcing. The scope of the paper is somewhat narrow, as it only describes direct aerosol forcing from the models, but the evaluation of radiative forcing from 10 models contributing to a community experiment certainly makes this study worthy of publication. I have minor suggestions for revisions, as described below.

Printer-friendly version

Discussion paper

General comments:

Was direct aerosol forcing calculated internally by any of the contributing aerosol models? If so, it would be very helpful to compare these forcing estimates with those obtained by running the aerosol fields through the authors' radiative kernels. This could offer an indication of how much additional variability in forcing might be expected from different model cloud fields, assumed aerosol optical properties, and radiative transfer codes.

Minor comments:

Abstract: It would be helpful to include some of the overarching quantitative results in the abstract, namely the model-mean changes (and perhaps inter-model standard deviation) in global radiative forcing resulting from the emissions perturbations. I view these numbers as headline results from the study that should be reported in the abstract.

Introduction (and last sentence of abstract): I suggest mentioning that although BC radiative efficiency increases with BC altitude, the associated surface temperature change does not, and can even become opposite of the sign of TOA forcing when the BC is located at sufficiently high altitude.

line 75: "on" -> "of"

line 105-109: How do the HTAP2 results compare with these HTAP1 results?

Section 2.1, line 132: Please list the global annual emissions of each species, as represented in the inventories applied.

Section 2.1, paragraph 2: Please mention here that all models use prescribed meteorology (rather, e.g., than prescribed SSTs with online meteorology), assuming this is indeed true.

lines 155-158: How much error does this interpolation technique introduce to the es-

timates of column-integrated aerosol abundance (burden), as opposed to using each host model's pressure fields self-consistently with their aerosol fields? It is probably small, but worth mentioning. (And why were these calculations done with OsloCTM pressure/mass fields instead of the native model's fields?)

Section 2.2, paragraph 1: What spectral resolution (or how many spectral bands) was applied in the radiative transfer calculations?

line 168: Did all models provide separate mixing ratios for "aged" and "non-aged" BC? If not, how did you partition the BC fields into these two components for the radiative forcing calculations?

line 180-181: I assume that the forcings presented here are instantaneous forcings, rather than adjusted or effective forcings, but please clarify this.

line 194: Are the vertically-averaged AFEs weighted by aerosol mass? (presumably so).

Section 3 / Figure 1: I think it would also be quite useful to show/describe the inter-model variability (e.g., standard deviation or normalized standard deviation) in aerosol burden. This would provide a nice depiction to readers of where the models tend to differ from each other the most. Deviation plots could either be included in Figure 2 or added as a separate figure.

Lines 301-312: Could non-linear chemical processes provide an alternative explanation for this odd behavior of increasing aerosol concentrations in response to emissions reductions?

lines 394-402: Are the intermodel differences in radiative forcing larger or smaller than the differences found by Yu et al (2013) for HTAP1 simulations? Presumably they are smaller because of the use of identical emissions data in HTAP2, but it would be helpful to provide a semi-quantitative comparison of the inter-model variability between these two studies.

line 499: "...13% of global deaths" - Is this 13% of the deaths caused by inhalation of fine particulate matter? Please clarify.

Figure 1: Do the median fields shown here represent fields from a single (median) model, or is the median computed at each gridcell from all models? Please clarify.

Figure 2: Are the SO2 emissions reported in Tg of S or Tg of SO2? Please clarify.

Figure 8: It seems the units here should have a vertical component, e.g., mW/m2/Pa or mW/m2/m or mW/m2/layer. Is this so? Otherwise, how does one obtain the typical column radiative forcing (W/m2) from these vertical profiles? Please clarify.

Table 2: It would be helpful to also include the multi-model standard deviations for convective mass flux, precipitation, and cloud, if at all possible.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-443, 2016.

Printer-friendly version

Discussion paper