

Interactive comment on “Anthropogenic, biomass burning, and volcanic emissions of black carbon, organic carbon, and SO₂ from 1980 to 2010 for hindcast model experiments” by T. Diehl et al.

Anonymous Referee #2

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General Comments:

The manuscript presents two global emission inventories of SO₂, black carbon (BC), and organic carbon (OC) for the period 1980 – 2010. The manuscript contains a detailed comparison of the two inventories, referred to as A2-MAP and A2-ACCMIP in the manuscript. A2-MAP is actually 2 different versions of a dataset prepared with similar approaches but with some different choices, e.g., for the source data used for specific sectors. Both the A2-MAP and A2-ACCMIP datasets include land-based sources, biomass burning, ships, and aircraft, and the A2-MAP inventory additionally includes SO₂ emissions from volcanoes. These inventories are intended for use in aerosol

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hindcast modeling, which seeks to understand the impacts of emissions changes on atmospheric aerosol components and their consequent effects on radiative forcing and to quantify how emissions changes in one part of the world impact other regions via intercontinental transport. Hindcast modeling is a major effort of modeling experiments such as AeroCom and ACCMIP and is critical to informing climate assessment efforts such as the IPCC AR5.

The methods section lays out in great detail how the emissions estimates in both inventories were derived for the different sectors over the 30-year period. The inventories' predictions for SO₂, BC and OC are compared globally and regionally. The temporal trends predicted by the inventories are described in terms of economic and political factors and pollution control decisions. The differences between the datasets are explained by the specific methodological choices made in preparing them. Detailed examination of some of key factors influencing emissions predictions for some sectors is presented, and guidance is given for how these might be applied for a specific modeling need. Uncertainties in emissions estimates for each of these pollutants both globally and regionally are also presented.

I think that the manuscript is certainly of interest to ACP, and I recommend that it be published once some issues are corrected. My suggestions for improving the manuscript focus on clarifying the presentation and helping readers understand the big picture of what they should take away from this very detailed work. For example, the authors should be clearer about whether the inventories discussed here are the same or different from those presented in other publications. Is some of the analysis presented here also published in the paper by Granier et al. (2011)? Also, are there overlaps in the input data and methods between the A2-MAP and A2-ACCMIP inventories, or are they fully independent? Finally, the authors should emphasize that these are two of a very small number of publicly available, gridded, global historic emission inventories, and that's why we need to know the important differences between them to understand their general usefulness for various modeling applications. *****

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Specific Comments:

Abstract. Mention the actual names of the two inventories right here in the abstract. There are not very many global inventories, and the community should know by reading the abstract which of them you're comparing.

A2-ACCMIP vs MACCity: In Sections 1 and 3, it's implied that the A2-ACCMIP inventory is the same as the MACCity inventory presented in Granier et al. (2011). If they are the same, changing the name of the dataset in this manuscript will be very confusing to readers. If they are not the same, a clearer explanation is needed of precisely how these two seemingly very similar datasets differ. Furthermore, if the inventories are the same, then please comment more fully on how your findings compare to what is already presented in Granier et al. (2011) with respect to SO₂ and BC.

A2-MAP-v1: Have the BC and SO₂ estimates from the A2-MAP-v1 inventory already been presented in Granier et al. (2011), labeled as "AEROCOM" in that work?

A2-MAP vs A2-ACCMIP: It would help to have a brief explanation of whether any of the same methods/input datasets are used in both of these inventories. Are these inventories fully independent? There is a lot of detail in the methods sections, but I still can't tell for sure if they have anything in common. Is it totally fortuitous that the inventories' estimates are nearly identical for some regions (as shown in Figs 2-4)?

A2-ACCMIP vs ACCMIP: When the years of the A2-ACCMIP and the ACCMIP/RCP8.5 datasets coincide (1980, 1990, 2000, 2005, and 2010), shouldn't the emissions values be identical? It appears that they differ slightly for some species in some regions.

Section 4.5.2: Is there a reason why only OC biomass burning predictions are compared on a regional basis, and the same regional comparisons aren't done for burning emissions of SO₂ and BC?

Section 5.4: It's not clear what the basis is for these recommendations, other than citing Chin et al (2000). Could you provide 1 or 2 sentences to explain them?

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Section 5.5: The uncertainty and global/regional inventory difference discussion presents information from this work as well as other papers, including Bond et al. (2004), Smith et al. (2011), and Petrenko et al. (2012). Aren't the comparisons of Granier et al. (2011) also relevant here?

Section 6: Emphasize the need for objective analysis of these and other inventories using observations. Beyond AOD retrievals, one could also use more direct observations of SO₂, BC and OC to evaluate inventory estimates. To truly understand uncertainties in these inventories, we must move beyond the inventories themselves.

***** Technical Corrections:

p. 24902, l. 12: Change "in a resolution" to "at a resolution"

p. 24908, l. 25: Move the full name of GFEDv2 from here to the first mention of GFEDv2 on p. 24905.

p. 24911, l. 1: Change "is leveling" to "levels".

p. 24918, l. 23: Insert "Biomass Burning" between "Global" and "emissions"

p. 24919, l. 17: Insert "Biomass Burning" between "Regional" and "emissions"

p. 24921, l. 21: Change "to choose" to "choosing"

p. 24923, l. 13: Change "to evenly distribute" to "evenly distributing"

p. 24923, l. 15: Change "to inject" to "injecting"

p. 24923, l. 16: Change "burn out the emissions" to "almost completely combust their fuel"

p. 24925, l. 3: Change "to evenly distribute" to "evenly distributing"

p. 24925, l. 6: Change "to apply" to "applying"

Table 1. Add definitions for the abbreviations of the regions (i.e. NAB) used for compar-

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ing biomass burning emissions to the caption, and indicate that the regions are shown in Figure 11.

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