

Interactive comment on “Atmospheric inversion of SO₂ and primary aerosol emissions for the year 2010” by N. Huneus et al.

Anonymous Referee #2

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Aerosol particles represent the largest source of uncertainty in estimating the total anthropogenic radiative forcing due to large uncertainties in the temporal and spatial distribution of the different aerosol emissions. The manuscript 'Atmospheric inversion of SO₂ and primary aerosol emissions for the year 2010' by Huneus et al. presents estimates of emission fluxes for sulphur dioxide and different aerosol types like black carbon, particulate organic matter, sea salt and desert dust. Basically, the MODIS aerosol optical depth is assimilated into a global aerosol model to estimate the emission of the monthly aerosol emissions based on an improved method described in Huneus et al. (2012). The resulting emissions are compared against the assimilated observations, ground-based measurements as well as projected emission for the same year. The sensitivity of the inversion system to the choice of the first guess of biomass burning and anthropogenic emissions is also investigated. The paper is well written

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and should be published after addressing a few specific comments and technical corrections outlined below.

Specific Comments:

p6166, I9: I recommend the use of either Pg or Tg for all species.

p6169, I21: Since the instrument details (i.e. MODIS) are given for GFAS, it should be mentioned which satellite instrument(s) GFED is based on.

p6171, I1: On page 6168 the large diversity in dust and sea-salt emission is mentioned. Could you state out more clearly why the sensitivity study on the a priori inventories only covers fossil fuel and biomass burning?

p6171, I20: Add a general literature reference where the equations can be found.

p6173, I6: How is the fine mode defined?

p6178, I25: What does EPA stand for?

p6179, I25: For the DD and SS emissions the reader is referred to HCB12. This makes the remaining part of the paragraph obsolete. Otherwise, the information about how the DD emissions are obtained from the wind speed should be added.

p6180, I1: How do the emission of the inventories differ? Which one is supposed to be 'better'? Mention if this is discussed elsewhere in the paper or in another publication.

p6181, I3-8: Are the abbreviations like ACCMIP used in this publication only or are they more general terms used elsewhere? If yes, where? What about moving this paragraph to the end of Section 3 where the emission studies are introduced?

p6183, I10-11: Does this mean that GFAS is more realistic?

p6185, I1: I can only identify four regions, namely NOAM, EURO, INDIA and SEAS.

p6185, I7: Do you want to refer to Figure 3 instead? Figure 4 is dealing with SO₂ emissions

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p6186, I1: Maybe you could use a term like 'both BB inventories' instead of 'both inventories' to clearly differentiate from the four anthropogenic inventories (ACFED,..).

p6186, I3: I suppose Fig. 8 is meant.

p6186, I19: I do not understand the phrase 'distinctive time series ..'. Please clarify.

p6186, I22: Refer to Table 6 and maybe add '(ACFED)' after 'reference setup'.

p6187, I18: Could you specify what this information is, please?

p6188, I22/23: What would be needed to do so?

p6201/6202: Both, Table 1 and 2 are part of Table 3 and 4. Avoiding this repetition should be possible with additional explanations.

p6203: AERONET could be mentioned in the caption, too.

p6205/6206: Table 5 is not needed, since the results are part of Table 6.

Technical Corrections:

p6172, I 10: The equation numbers appears twice. Please remove one.

p6182, I14: 'errors ... are' or 'error ...is'

p6185, I26: add a comma or 'and' between CEAF and SOAF

p6210: A thick horizontal line at 0 would help to read the figures.

p6211: Increase the range of the y-axis to avoid that the top of the POM AN-ACFED bar does not coincide with the plot frame.

p6211/6214: replace OM with POM in the x-axis description

p6217: use identical terms in figure title (e.g. ACCMIP-GFED) and caption (ACFED). Explain the terms DDF and DDC.