

## ***Interactive comment on “Anthropogenic sulfur dioxide emissions: 1850–2005” by S. J. Smith et al.***

### **Anonymous Referee #1**

Received and published: 17 September 2010

Referee 1 comment: Anthropogenic sulfur dioxide emissions: 1850–2005 Smith, S. J. et al.

As the authors themselves points out, there exists already many global inventories of sulfur. The reasons why I still think it is enough new material in this paper to warrant publishing is in particular the attempt to include an uncertainty analysis and sector distribution. With respect to the latter I however puzzled about what sectors is actually included. I support the idea to rely on and include national emissions whenever available and judged to be of sufficient quality. Having said that, I have some concerns regarding the methodologies and presentation of results as detailed below.

Introduction Page 16112, Line 18. Sulfate aerosols are thought to have significant effects on climate. I don't think sulfate aerosols are only thought to have effects. There are multitudes of studies on this subject. Also state clearly that sulfur aerosols cause

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cooling.

**Methodology** The methodology part of the paper is extensive (about half of the paper length), still it is rather difficult to grasp what is the innovative aspect of the approach. The authors state that an analysis of differences between inventories is beyond the scope of the current project. I propose however to include a broader analysis of differences between the current and earlier inventories from the first author in order to explain better the benefits of the most recent work. To me it is not enlightening enough to simply state that (P. 16130, L. 20): “The current estimate is somewhat below many recent estimates, particularly in the 1970s and 1980s, including the previous estimate by Smith et al. (2004) using a similar methodology, but at a more aggregate scale. The major differences between these two datasets over this time period are lower emissions estimates for China and the countries of the Former Soviet Union”. The discussion could as well include the RCP inventory, and explain how a more detailed approach leads to lower emissions [if this is what the authors intend to say here].

I would further add e.g. a float diagram to clarify and make more transparent the methodology and methodological choices. This could improve greatly the readability of the methodology chapter, by making references to such a figure at relevant places in the text. A well designed figure might also help to shorten the text.

The text refers to a multitude of adjustments, but nowhere is given an indication of the size and seldom the direction (lower/higher) of these. Please add information on which magnitudes we are talking about. The size of the adjustments could also be related to uncertainty of emissions. The countries with high quality recent emission inventories will in most cases also be the countries with more data available for input to the authors’ calculations, and differences could perhaps be linked to uncertainty in methodology or specific input data.

Page 16123, Line 15-22: Taken the stated lack of data into account. How did van Aardenne et al. split NO<sub>x</sub> emissions on sectors? I do not find that NO<sub>x</sub> is a very good

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proxy for SO<sub>2</sub> sector distribution.

Results Maybe this short text includes all there is to say about the results, but I would hope that some more interpretation linked also to the two figures (of 7 figures in total) included for this section could be added. Again the lower emissions in China are pointed out, but no attempt to explain the difference is given. Interpretation of emission trends from Figure 4 could be added, in particular reasons for the steep decrease in emissions from China (opposing to satellite observations). Also material from the first to paragraphs in the discussion section belongs in my opinion here.

Are the sectors listed in Figure 2 the sectors included in the study and gridded data, or what are these? If yes, I cannot see that sectors Petroleum Combustion and Coal Combustion is detailed enough for modeling purposes. Please clarify from which sectors emissions are estimated, and make a figure with actual sector data.

Uncertainty While it is appreciated that estimates of uncertainties are included, the way uncertainties are calculated is not very clear. I propose to add an equation.

I also propose to explain better how the uncertainty bounds listed in Table 2 has been worked out. Page 16126, L. 25: “The set of uncertainty bounds given in Table 2 are applied to countries categorized depending on the estimated quality of the data used to construct the inventory values (see supplementary material).” Instead of estimated quality, I understand this is anticipated (authors’ best judgment) quality. I propose to add an example of how different assumptions come about. E.g. what uncertainty is linked to different sorts of input data missing, countries’ own estimates included, etc.

Page 16127, L. 12: “An alternative calculation assuming no correlation between values at the country level results in lower uncertainty at a global level by 3–27%, depending on the year.”

What do you want to say by this sentence? Global uncertainty is estimated to maximum 12%.

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Page 16128, L. 6 “To include the potential impact of such correlated effects, we add to the uncertainty estimate for each sector an additional uncertainty amounting to 5% of total emissions (half this value for countries with well-specified inventories), with the additional uncertainty combined again in quadrature between sectors.”

I have difficulties to understand the methodology here. Why 5% and 2.5% ? Apparently you calculate uncertainty per sector. I propose to include these uncertainty figures in the paper. If they are not calculated, please include a judgment of sector uncertainty.

Discussions This section concerns a summary of results, a comparison with both emission estimates and satellite data, and list of some improvements to be made. I do not really find so much discussions e.g about methodology, uncertainty analysis and results.

While I like the effort to compare the trends in emissions with satellite data, unfortunately the most interesting drop in Chinese emissions from 2007 onwards are not captured by the emission inventory. Is there any indication on how emissions behave in this period from potential additional data available in your database for China?

Tables and figures

Table 1: Please quantify the contribution from sectors not included here.

Table 2: Difficult to understand even after having read the supporting material, which countries are included in which category. In “I. Recent-Country-Inventory” for example, USA is in this category from 1970, while Japan is included from 1980. All other countries are included from 1990-2005. What is this based on? Further, what does e.g. OECD (pre inventory) means? I suppose 10% means +- 10%? Are the uncertainties valid for all inventory years? Please update this table.

Figure 3. Consider to include the uncertainty estimates in brackets in table 1. Figure could still be kept, but please define East Asia and South- East Asia. Consider to sort legend according to emission size at e.g. around 1970 to ease readability.

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Figure 6. Please consider to add the recent Edgar 4 V.1 emission inventory data.

Editorial General, make sure abbreviations are explained first time. E.g. RCP

Reference REAS inventory

Page 16127, Line 6: delete “that” Page 16132, Line 27: Delete “be” Page 16134, Line 5: Insert “the” before fraction

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 16111, 2010.

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10, C7692–C7696, 2010

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