**Atmospheric
Chemistry
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Discussions**

Interactive
Comment

Interactive comment on "Uncertainties in estimating mercury emissions from coal-fired power plants in China" *by* Y. Wu et al.

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Response to the Reviewer #1's Comments: 1. A statement regarding the implications of the uncertainties was added according to the reviewer's comment. See lines 16-20 on page 1. 2. The year in the parentheses after the two statistical yearbooks is the publication-year of the two yearbooks instead of the data-year; indeed, the statistical data in the two yearbooks we referenced are 2003 data. There are more recent coal consumption data available now; however, the uncertainty analysis involved a lot of other data. For example, since 2003, significant amount of other types of coal (including lignite, sub-bituminous, and anthracite) has been used in power plants in China due to the increasing demand of power generation. However, we lack test data of Hg content in such coals and Hg profiles of burning such coals in China as well as

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the exact consumption share of these coals at provincial level. Furthermore, since 2003, the installation of other control technologies, such as FGD, baghouse filter, etc., is increasing, and we are short of evaluation of such control impacts on Hg in China as well. We have applied several new databases to do the point-estimate of Hg emissions in our other papers (for example, Streets et al., 2008 in the UNEP report); however, these available data are not enough for us to build the distribution curves for these new parameters. So, for now, we feel only confident to do the uncertainty analysis for the 2003 database; and we will continue our update as soon as more data become available. No revision was made for this comment. 3. An explanation of goodness-of-fit used in this study was added according to the reviewer's comment, see lines 1-11 on page 5. For the subjective judgment of distribution curves when the samples are small, we added or revised the statements to clarify how we determined the functions, see lines 1-7 on page 7 and lines 7-12 on page 8. For the impact of low lognormal P50 values versus mean values (which were used in earlier estimates) for mercury content in coal, we discussed this in the results and discussion section. Since the mercury content is the leading parameter affecting the total Hg emissions, the best estimate of total mercury emissions using stochastic simulation will be lower than other previous point estimate of total mercury emissions. In this section, we clearly stated that the previous point estimate for the power sector in China in 2003 was 100.1 Mg (Wu et al., 2006), 10.6% higher than our new best estimate P50 value (see page 11). We also added a new Table 3 (see our response below to comment 4). Via that table, we clearly see the parameter, Hg content in coal, is the only factor determining the P50 value. We added a statement to emphasize this, see lines 18-20 on page 11. Finally, a brief description of Monte Carlo sampling scheme for this study was added according to the reviewer's comment. See lines 19-25 and 27-28 on page 5. 4. We designed several scenarios to evaluate the contribution of various parameters to the uncertainties of total Hg emissions. The description of each scenario and results are summarized in a new table, Table 3 on page 20. We also added several statements in the text, see lines 8-12, lines 20-22, and lines 26-28 on page 10 to emphasize

our conclusion that the major contributor to uncertainty is mercury content, followed by control technology ESP. For figures 3-4, they clearly show the uncertainty ranges and the shape of our results. Also as we discussed in the text (see page 9-10), we can find the leading contribution of Hg content in coal to uncertainties of mercury emissions by directly comparing the shapes of the curves. 5. First we should clarify that uncertainty is naturally involved in variables for our development of Hg emission inventory. Stochastic simulation is a better approach to determine the Hg emissions. Through this study, we determined the parameter, Hg content in coal, which is the leading variable affecting the uncertainty range. With our well-established database, the lognormal distribution curves were developed. The nature of such a curve inevitably results in a lower best estimate versus our previous mean point estimate and big uncertainty range, especially at the right "long-tail" side. But, we acknowledge that additional work is needed to improve the database for other variables. We added a paragraph to explain this, see lines 3-17 on page 13. 6. We cross-checked throughout the manuscript, and made several revisions of typos, grammar, and references. 7. We have redrawn Figures 1-4 according to the reviewer's comment. And, the labels and units of the axes have been added or revised for clarity. The label in y axis for Figure 5 was revised. The five high-quality graphics were uploaded in separate files.

Please also note the supplement to this comment:
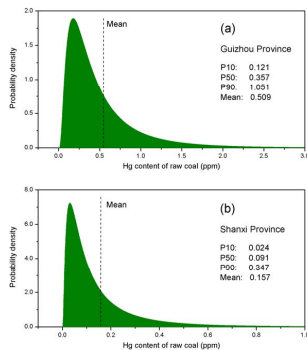http://www.atmos-chem-phys-discuss.net/9/C11520/2010/acpd-9-C11520-2010-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 23565, 2009.

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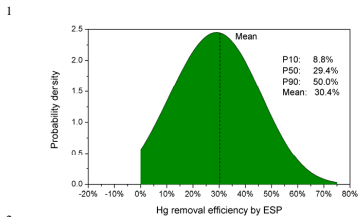Printer-friendly Version

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(a)

Guizhou Province

P10: 0.121
P50: 0.357
P90: 1.051
Mean: 0.509

Mean

Probability density

Hg content of raw coal (ppm)

(b)

Shanxi Province

P10: 0.024
P50: 0.091
P90: 0.347
Mean: 0.157

Mean

Probability density

Hg content of raw coal (ppm)

1
2
3
4

- 1 -

Fig. 1. Distribution function curves for Hg Content of Raw Coal, (a) Guizhou Province; and (b) Shanxi Province.

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1

2

Fig. 2. Distribution function curve for Hg removal efficiency by ESP.

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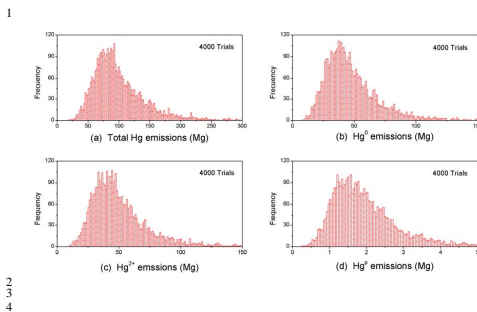
Fig. 3. The output distribution function curves for emissions of a) total Hg, b) Hg0, c) Hg2+, and d) Hgp, from coal-fired power plants in China in 2003.
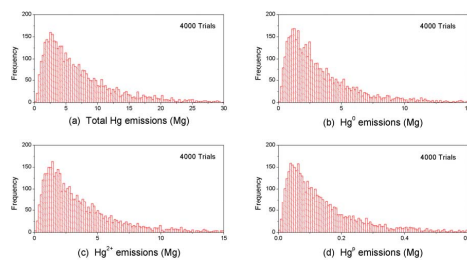
Fig. 4. The output distribution function curves for emissions of a) total Hg, b) Hg0, c) Hg2+, and d) Hgp, from coal-fired power plants in Guizhou in 2003.
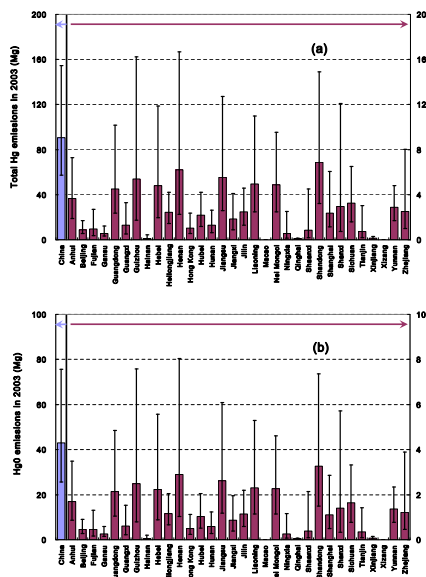
Fig. 5. Fig. 5. The best estimate and its uncertainty range of emissions of a) total Hg, b) Hg0, c) Hg2+, and d) Hgp, from coal-fired power plants for the whole of China and by each province in 2003.