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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Top-down estimates of benzene and toluene emissions in Pearl River Delta and Hong Kong, China" *by* X. Fang et al.

Anonymous Referee #1

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General comments

This paper provides estimates of Benzene and Toluene for the Pearl Delta Region and Hong Kong in China, using an inversion method. To the author's and my knowledge, these are the first top-down estimates produced for this region. The author uses data from two sites in this study: data from the Heshan site was used within the inversion, whereas data from the Tai Mo Shan site were used for model validation. Emission estimates were made for the month of November 2010. Estimates were compared to various bottom-up estimates for this month and also for annual estimates. I would recommend this paper for publishing once to comments below have been addressed. The paper is well structured and written clearly. Some figures are too small to be able to see the details discussed in the paper however. More detail about the uncertain-

ties associated with the setup and with the emission results are needed. This study could be strengthened further with an additional discussion into where the bottom-up inventories could be limited / inaccurate (see comments below) – if this information is available to the author.

Specific comments

Page 24842 Lines 15-17: Are the minor sources for both benzene and toluene or just toluene? I think this just needs to be made clearer.

Page 24843-4 Section 2.1: I would describe both sites using m.a.s.l as well as describing that the Heshan site is 60 m.a.g.l. It is easier to understand the differences between the two sites. Is the TMS site also rural?

Page 24844 Section 2.2: I think the relationship between the FELXPART model and how emission sensitivities are produced needs to be described in further detail here. Otherwise, it's difficult for readers to understand how this is produced. For example, how do particles being measured backwards in time, driven by meteorological data, produce the emissions sensitivities with units s g-1 m2? I realise this is explained in Stohl's paper but this is a key part to understanding how your modelled observations are synthesised and should therefore be explained within this paper.

Page 24844 Lines 22-23: Is there any particular reason why you chose a RMSE cost function? How are modelling uncertainties incorporated into this cost function?

Page 24848 Line 25: 'between the simulations and the observations' – do you mean the agreement between the a posteriori simulations and the observations are better than the a priori simulations and the observations? If yes, make this clearer.

Page 24849 Line 13: The term 'Uncertainty reduction' should be further explained to how these values are calculated. How are uncertainties calculated within this inversion model?

Page 24850 Lines 10-21: Out of interest, was there a particular reason why the Heshan

site data was used in the inversion and the Mt. TMS was chosen to verify? Did you try the inversion the other way around and compare the a posterior emissions produced? Did you try a 2-site inversion? If you have specific reasons for doing it this way, I think the readers would be interested in these reasons.

Page 24853 Line 6: Suggested re-phrase – 'have not changed much' to 'have remained relatively stable'

Page 24853 Paragraphs 2-3: A suggestion, if you know how the bottom-up inventories differ to each other you could draw some potentially useful comments about which sources may be incorrectly represented.

Page 24854 Section 3.6: Would be worth also suggesting multiple site inversion analysis, with more thorough measurement data, to better constrain the inversion. For example, many US and global studies have incorporated more than one measurement site within their analysis.

Figure 1: I think the place labels are too small and should be made bigger, especially as you refer to these place names throughout the paper. The units of the scale are also small and should maybe be increased to the same size as the equivalent units in Figure 2.

Figure 3: The two maps under the time series are too small to read the text clearly.

Figure 6: The figures here are too small to look at in detail. I would suggest orientating them differently. This comment applies to the equivalent Toluene figure in the supplementary material.

Figure 8: The arrows needs to be explained in the figure caption. Explain how their gradients are determined and what they are showing. If they are not scientifically determined (i.e. through regression) then I do not think they add much to the figure and would suggest removing them.

Technical corrections

Title: 'in Pearl River Delta' to 'in the Pearl River Delta'

Page 24841 Line 6: 'in Pearl River Delta' to 'in the Pearl River Delta'

Page 24842 Line 7: 'Guangzhou, Shenzen in PDR, and Hong Kong are' to 'Guangzhou and Shenzen, located in the PRD, and Hong Kong are' ... Otherwise it reads like Guangzhou is in a separate regions to the PRD and HK.

Page 24842 Line 19: add a comma (,) after 'For example'

Page 24842 Line 14: 'In PRD' to 'In the PRD'

Page 24842 Line 11: delete 'the most' as it's written twice

Page 24843 Line 15: 'period at Heshan site' to 'period at the Heshan site'

Page 24849 Line 9: 'of PRD' to 'of the PRD'

Page 24849 Line 12: 'of PRD' to 'of the PRD'

Page 24850 Line 1: 'in PRD' to 'in the PRD'

Page 24850 Line 3: 'for PRD' to 'for the PRD'

Page 24852 Line 1: 'in PRD' to 'in the PRD'

Page 24852 Line 10: 'in PRD' to 'in the PRD'

Page 24853 Line 18: 'in PRD' to 'in the PRD'

Page 24853 Line 22: 'in PRD' to 'in the PRD'

Page 24854 Line 5: 'in PRD' to 'in the PRD'

Page 24854 Line 17: Remove 'in the future' It is not needed when using the term 'are urgently needed'

Page 24854 Line 19: 'in PRD' to 'in the PRD'

Page 24854 Line 21: ‘in PRD’ to ‘in the PRD’ and ‘of PRD’ to ‘of the PRD’

Page 24855 Line 6: ‘in PRD’ to ‘in the PRD’

Page 24855 Line 10: ‘in PRD’ to ‘in the PRD’

Page 24868 Line 6: ‘for PRD’ to ‘for the PRD’ and ‘within PRD’ to ‘within the PRD’ (Figure 6)

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 24839, 2015.