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## ***Interactive comment on “Anthropogenic CO<sub>2</sub> flux constraints in the Tokyo Bay Area from Lagrangian diffusive backward trajectories and high resolution in situ measurements” by I. Pisso et al.***

### **Anonymous Referee #1**

Received and published: 7 June 2012

Review of Pisso et al., Anthropogenic CO<sub>2</sub> flux constraints in the Tokyo Bay Area from Lagrangian diffusive backward trajectories and high resolution in situ measurements.

This paper describes the use of ground and aircraft based CO<sub>2</sub> measurements in combination with regional-scale Lagrangian modeling to estimate CO<sub>2</sub> fluxes from the Tokyo Bay Area from 2005–2009. Their estimated fluxes are broadly consistent with other studies, and suggest a possible underestimation of Tokyo Bay Area fluxes in the CDIAC inventory. They examine the impact on their results of using: different wind data to drive the model; only sparse surface CO<sub>2</sub> data vs including aircraft observations; and different a priori source fluxes. All of these factors are shown to cause significant dif-

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ferences in the estimated flux, and highlight the challenges in estimating regional CO<sub>2</sub> fluxes.

This is an interesting study, with some nice results, as well as demonstrating where further work is needed to improve top-down estimates of CO<sub>2</sub> fluxes at the regional scale. However, substantial revision is needed to make the paper easier to follow, to highlight the key points, and to clarify the methodology.

Specific comments: Pg 10624, lines 9-10. This estimated flux value is not given anywhere in the main text, and yet it is a key point of the paper.

Pg 10625, lines 6-10. Why is the micro-scale flux measurement approach not feasible for the larger area? Please justify this statement.

Pg 10625, lines 27 – “The Tokyo Bay Area...” This should be a separate paragraph. Some explanation of why this region was chosen should be added.

Pg 10626, lines 8-11. Which inventories show that biospheric activity is less than anthropogenic? Please reference. How much smaller is the biogenic CO<sub>2</sub> flux than the anthropogenic CO<sub>2</sub> flux, and how much bias might neglecting the biogenic component add? How reliable are the inventories referred to? This point needs to be considered in analyzing the results – can this explain why the a posteriori flux estimate is higher than the CDIAC estimate?

Pg 10626, section 2. This section is hard to follow, and the mathematical terms are not clearly explained. Please revise to clarify what was used in this study, versus a general discussion of how this might be done.

Pg 10627, section 2.1.1. Is the time resolution of the model 1 day? If so, how are higher time resolution measurements dealt with? Are they averaged to one daily measurement? What biases and uncertainties are introduced by using this time resolution?

Pg 10627, section 2.1.2 Here, the time step of the sources is referred to as between 1 and 12h, yet in the previous section, you said daily runs were used. Please explain.

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Pg 10627, line 20. Are the a priori fluxes at  $0.1 \times 0.1^\circ$  resolution, and if not, how do you obtain the higher resolution gridded data?

Pg 10627, lines 21 -22. What is the adaptive aggregation? Please explain. How do you determine the TBA vs far field (i.e. what domain is used for the TBA)?

Pg 10627, lines 23-25. "Source geometry specifications. . ." What does this mean?

Pg 10628, line 1. Please reference and describe the EDGAR and CDIAC fluxes.

Pg 10628, lines 5-10. Which sensitivity studies are you referring to? Are they published elsewhere, and if so, reference, and if not, please expand. Why is the open ocean site a good background?

Pg 10628, lines 9-14. Do these last two sentences refer to the work described in this paper, or more generally to the method? Please clarify.

Pg 10628, section 2.1.4. This section is challenging for the non-specialist to follow. Please revise this section overall to clarify what was done in this study.

Pg 10629, lines 8-11. Is this what was done here, or is this referring to other studies only?

Pg 10629, lines 12-13. What are G, t and s?

Pg 10632, lines 1-4. Why is a clean air site the most reasonable choice?

Pg 10632, section 3.1. What is the magnitude of the effect of the different calibration scales used for the different sites? Could scale offsets explain the difference in the a posteriori results when the CONTRAIL results are included or not?

Pg 10632, lines 13-19. What is the time resolution of the Tsukuba tower data? Is it aggregated to lower time resolution, and if so, how?

Pg 10632, lines 20-25. What is the time resolution of the CONTRAIL data? Is it aggregated?

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Pg 10633. Section 3.2. Please reference the inventory data sources. How much overlap is there between the two different inventories? Are they truly independent inventories? Please support your assertion that the biogenic fluxes are small relative to the anthropogenic fluxes. Please support the assertion that the clean air sites are a good choice of background.

Pg 10634, line 2. What is T255L?

Pg 10634, line 5. What months are considered winter months here?

Pg 10634, line 20. Please elaborate what the Kanto area prefecture boundary represents, for those not familiar with the local geography.

Pg 10635, lines 10 – 15. The difference in results between the two meteorologies is 10%, but this only represents the part of the meteorological uncertainty that is assessed by comparing these two meteorological data sets. What other factors might cause biases or uncertainties in the transport? Can they be assessed? Please comment on this.

Pg 10635, line 22. Why is there no data for 2008?

Pg 10635, line 27. What third party information are you referring to?

Pg 10635, Line 29. Please indicate the locations of the measurement sites in figure 3.

Pg 10636, Line 15. Please give the locations of the large power plants, and the size of their emissions.

Pg 10637, line 4. What is the “equilibrium point”? The choice of a priori flux seems to dominate the a posteriori result, with the observations only slightly nudging the result. It is difficult to understand how the a posteriori results can then be used to say anything about the true flux.

Pg 10637, lines 16-22. Where is the slow increase in the TBA flux shown? It is not clear whether this paragraph is referring to the a posteriori fluxes, the inventory data,

or both.

Pg 10637, line 24. What are the a posteriori flux values?

Pg 10638, lines 1-2. Can you calculate the overall urban region flux (eg in TgC per yr), and compare with Moriwaki and Kanda that way? This may clarify where the difference between the two studies lies.

Pg 10638, Line 4-5 . Why is a study of a park area in Germany expected to produce a similar CO<sub>2</sub> flux to the TBA?

Pg 10638, lines 10-24. What is the potential magnitude of the uncertainties in the inversion process? How does this relate to the reliability of your calculated a posteriori flux?

Pg 10638, line 26. What is a “CFL condition”?

Pg 10638, lines 25-30. If the time step of the output is 1 hour, how does that relate to the single daily runs referred to earlier?

Pg 10639, lines 1-10. Given the uncertainties in the method, how robust is the conclusion that both inventories underestimate the actual emissions? What is the method for “selection of the most appropriate inventory” that is referred to? Why is EDGAR deemed more appropriate?

Pg 10639, lines 21-27. What is the relevance of this paragraph to the present study? It looked at a different gas in a different geographic region, so it seems difficult to draw any parallels.

Pg 10640, lines 11-14. What is the justification that the addition of the CONTRAIL data improves the inversion? It certainly changes the result, but does it make it “better”? What benchmark is it compared to?

Figure 2. This figure is difficult to understand. What does the length of the vertical lines mean? Why are the lines larger at some times than others?

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Technical comments:

Presumably the measurement data was reported as mole fraction or mixing ratio, not as concentration. Please revise.

Pg 10626, line 6. Revise for grammar.

Pg 10628, lines 22-23. Revise for grammar.

Pg 10629, equation. The terms  $x$ ,  $t$ ,  $y$  and  $s$  are not defined.

Pg 10638, Line 4. Units are missing.

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 10623, 2012.

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