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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cross-validation of inferred daytime airborne CO_2 urban-regional scale surface fluxes with eddy-covariance observations and emissions inventories in Greater London" *by* A. Font et al.

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Dear Dr. Maness, We would like to thank you for the positive comments and suggestions made on the manuscript. Please find below the answers to the specific comments raised, along with an explanation of how the suggestions have been incorporated into the revised version of the manuscript.

Yours sincerely,

A. Font on behalf of the co-authors.

Answer to comments from Dr. Maness.

»1. The paper now includes a brief statement of why the data on October 12 and October 19 were not included in the IMBL calculations. However, I am still unclear on why the advection term on October 19 could not be quantified. I would like to see a sentence or two in the text that spells this out explicitly.

The horizontal transects undertaken in London on the 19th October were perpendicular to the main wind speed and not parallel as required to calculate $\Delta CO2/\Delta x$. Thus, the spatial gradient of CO2 in London could not be quantified. This is now stated in lines 241-243 of the revised manuscript.

»2. More information is still needed regarding the described error propagation. For example, does the listed standard deviation reflect both the accuracy and precision of the measurements? Also, how are the errors in the various measurements calculated? For example, the mixing heights in section 3.2 are quoted to great precision, even though they are estimated from visual inspection. Is an error in the mixing height included in the error propagation, and if so, how is it estimated? This information on the error propagation is especially crucial, given the reference to it and its significance in the last part of the discussion section.

In the previous manuscript the propagation of errors was based on the standard deviations measured from the data used to calculate the different parameters in the IMBL equation. However, the analysis did not quantify the effects of the assumptions in applying the IMBL method in an urban area. The propagation of the standard deviation in each term of the IMBL equation was not accurate enough to account for the unknowns of the methodology. Thus, a sensitivity analysis has been undertaken in the revised version. The main unknowns from the method are the determination of the CO2 con-

centration representative of the urban mixing layer, the uniformity of the spatial gradient in time, the mixing layer height in the urban region and the vertical wind speed at the top of the boundary layer. These are now analyzed through a sensitivity test and a range of IMBL fluxes are given for each day.

As noted by the referee, the mixing layer height was quoted to great precision in the analysis of propagation of errors in the previous version. This was inappropriate given the mixing layer height was determined from visual inspection of vertical profiles from outside Greater London. Hence, IMBL fluxes have been recalculated by increasing mixing layer heights by 50 and 100 m in accordance with findings from previous studies that observed an increase between 50 and 100 m in the mixing layer height in London compared to a suburban site 50 km north (Spanton and Williams, 1988). Current work by Halios and Barlow et al. (2013, EMS Conference 2013) suggest that could be larger but this work is still in progress.

»3. A number of the quantitative results reported have changed since the last draft. For example, in section 3.2, the current draft reports the urban-regional CO2 surface flux on 13 October 2011 as 50.7$\pm$18.8 μmol CO2 m-2 s-1, whereas the previous draft quoted an uncertainty of 9.2 μmol CO2 m-2 s-1. The corresponding uncertainty on 17 October 2011 has also increased. Uncertainties for the results on 24 October 2011 and 25 October 2011 have also changed (e.g., compare Figure 6 in the previous draft to the current draft). Changes to the text are not necessarily required to adequately address this comment. However, as it is not clear to me from the present manuscript the reasons for these changes, I would like a concise summary of all the quantitative results that have changed, and a corresponding brief explanation.

In the process of revising the previous version of the manuscript, an error in the code for calculating errors using standard deviations was detected. Amending the error resulted in a change in the calculated uncertainties.

As explained in point 2, the uncertainty analysis has been recalculated and the uncer-

tainty value from the propagation of errors is no longer in the manuscript.

»4. The aspect ratio for all subpanels in Figure 2 is misleading. Could the authors please edit this figure such that the aspect ratio is the same as that used in Figure 1?

Figure 2 has been corrected.

References Spanton, A. M., Williams, M. L.: A comparison of the structure of the atmospheric boundary layers in central London and a rural suburban site using acoustic sounding, Atmospheric Environment, 22 (2), 211–223, 1988.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 13465, 2013.