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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatial and temporal variability of urban fluxes of methane, carbon monoxide and carbon dioxide above London, UK" *by* Carole Helfter et al.

Anonymous Referee #3

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General Comments

The authors present a multi-year dataset of greenhouse gas flux measurements from a heavily urbanized region, investigate the spatial and temporal patterns in those fluxes, and attempt to attribute those patterns to specific sources and processes. I agree with the authors that their dataset is unique in the literature, that the richness of the dataset offers an interesting opportunity to link observed fluxes with underlying physical processes and socioeconomic patterns, and that their exploratory analysis warrants publication.

My main criticism is that the readability of the paper is compromised by rambling writing and unrefined arguments. The paper would benefit from heavy editing to remove un-

necessary or repetitive statements, and improve its structure and organization. I also encourage the authors to go beyond the descriptive and clearly state what they think their most significant discoveries are.

Specific Comments

The division of topics between sections 2 & 3 is confusing, where some methodology is first mentioned in section 2 and then discussed more fully in section 3. The description of the correction for high frequency attenuation is an example. Moving sections 3.1-3.2.3 to the methods section and merging redundant sentences would help.

With regards to the methodology, I am concerned that the low data rate, heterogeneous surface, and tall measurement height violate the requirements of sound eddy-covariance measurements. The comparisons with the closed-path sensors elsewhere on the BT tower and at King's College offer nice checks and allay some of my concern. It would be nice to have a better way to check for vertical storage errors. I am very concerned that the header of Table 1 suggests that sonic anemometer data was missing for 6 months of the analysis period.

Technical Comments

Abstract – The second half has too much detail, especially when you start to talk about the different wind sectors. The abstract should also answer the question of why this work is important. The last sentence currently is not an adequate answer to that question.

Pg 1 – In the context of the motivation given for the study, I wonder whether eddy-flux is the really right tool for emissions verification. In natural systems, where it has been most widely applied, there is the problem of the representivity of individual towers and up-scaling across heterogeneous ecosystems. In urban environments, this problem is even more acute. Eddy-flux in cities seems like it would be more useful for investigating mechanisms and drivers of emissions.

Pg 1, ln 10 – This reference of 70% of emissions is from cities is often inappropriately used to motivate urban studies. It should say 70% is attributable to cities because the number includes not only emissions that emanate directly from cities, but also upstream emissions, such as for power production, that occur outside of cities. Therefore, atmospheric measurements located in cities would not necessarily be sensitive to 70% of anthropogenic emissions.

Pg 1, ln 11 – "verify GHG emissions" could be changed to "evaluate reported GHG emissions"

Pg 3, ln 6 – You give the mean building height in the vicinity of the measurement, but what is the maximum building height? This would seem important to ensure that the air flow is not impeded around the sensor.

Pg 3, ln 17 – How do you know that weekly calibration was adequate? Your standard gases were mixtures in nitrogen, but the CRDS requires natural air standards. See Nara et al. 2012 (www.atmos-meas-tech.net/5/2689/2012/amt-5-2689-2012.html).

Pg 5, ln 21 – A semicolon is not necessary. A period will suffice.

Pg 5, ln 25 – Is the seasonal difference in the length-scale of the footprint, mainly a function of wind-speed?

Pg 5, ln 27 – It would be nice to include a map to help the reader visualize the nearby landscape.

Pg 6, ln 19 – Not just increased scatter but the residuals look like they are biased high. Could this affect the mean results?

Pg 7, ln 2 – This would also result in the wrong time of day being attributed to the flux.

Pg 8, ln 7 – How long do the periods need to be for this assumption to hold? This requirement to analyze long periods only seems counter to the discussion of hour-to-hour differences in the previous paragraph.

Pg 9, ln 8 – insert "natural" gas

Pg 9, ln 2 – "pollutants" could be changed to "gases"

Pg 9, ln 20 – Suggest deleting the statement about the gas supply pressure since it is highly speculative and you have zero information about actual supply line pressures. All that you can really say is that methane fluxes (natural gas or other) appear to vary diurnally.

Pg 9, ln 22 – Insert paragraph break at "Segregating. . ."

Pg 10, ln 11 – Could you actually predict the seasonal difference in CO emissions using the known temperature-dependence of vehicle CO emissions, temperature and vehicle-count data, or is this already done in the inventory model?

Pg 10, ln 22 – Why the difference between your result and the previous London study? It might be worth briefly summarizing previous results for London in the introduction.

Pg 11, ln 11 – Seasonal difference in natural gas emission in Boston were not significant.

Pg 11, ln 13 – "Although individually small. . ." – incomplete sentence

Pg 11, ln 15 – Post-meter emissions could vary seasonally if they are correlated with appliance use.

Pg 13, ln 13 – Why are natural gas leaks any more likely as a source than sewage, for example, which could also be correlated with air temperature

Pg 13, ln 15 – Change "the easiest. . .to get right" to "most accurately represented"

Table 1 – The "Aircraft measurements" footnote should be below the table.

Figure 1 – Use units of km instead of m so that plot is not so cluttered with zeros.

Figure 4 – Could just label each sub-panel so hatched lines are not needed.

Figure 5 – I do not know what “diurnal average” means. What does each point on the plot represent?

Figure 6 – The y-axes on several panels have unnecessarily large ranges.

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