

Interactive comment on “Assessment of uncertainties of an aircraft-based mass-balance approach for quantifying urban greenhouse gas emissions” by M. O. Cambaliza et al.

Anonymous Referee #2

Received and published: 3 March 2014

The authors report an evaluation aircraft-based mass-balance estimates CO₂ and CH₄ emissions from the Indianapolis urban area. Uncertainties due to boundary layer mixing depth, horizontal wind field, flux interpolation scheme and background inflow are estimated to 1st order. Resulting emission estimates are compared with bottom-up emission estimates.

General comments:

The topic is interesting, the research was carefully conducted, the paper is generally well written, and the results contains information that will be valuable to the community.

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I would suggest the paper be published pending revisions.

The mass balance approach applied in this paper relies on measurements downwind of emission sources that are strong enough to produce mixing ratio variations that dominate over variations in upwind inflow mixing ratios. In this case, estimating background mixing ratios from the edges of horizontal transects alone seems appropriate. I would emphasize that systematic survey flights upwind of the source region of interest to show that cross-wind variations in the upwind mixing ratios are small as a prerequisite for application of this approach.

The mass balance approach also assumes that only horizontal advection is responsible for transport of emitted gases in the boundary layer. It would seem likely that some entrainment air between the boundary layer and free troposphere would produce an additional exchange term. Please comment on the relative importance of entrainment compared to uncertainties in emission estimates. If it could be significant, how could it be best diagnosed the existing flight data or alternative sampling strategies ?

Arguably, level terrain facilitated estimation and application of mean wind fields in the mass balance approach. It might be useful to point this out in the abstract following description of the estimated measurement precision.

I suggest using the term “flux” to express emission rate per unit surface area and using the word “emissions” to refer to area integrated fluxes throughout.

Specific comments:

Page 27, section 3.4.3. I would expect gas emitted from HSPP to have stack velocity and be thermally buoyant. Please report the stack height and discuss whether the emitted gas might mix differently from other surface emissions from the city.

Page 29. I am surprised by the different results for CO₂ emissions from the Harding St Power Plant (HSPP) in June 1, 2011 versus 2012 (see Tables 1 & 3, and Figure 8). It would be nice to add a comment about reason for the very large and uncertain

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estimate for 2011.

Page 22 and Table 2. Are uncertainties due each parameter (Background, CBL Depth, Perp Wind, and Interp Method) independent of each other ? What is the expected total uncertainty for each gas and date and how does that estimate compare with the observed variability at different distances?

Fig 4. Please show the measurements of CO₂ and CH₄ collected during vertical profiles and evaluate whether CBL mixing depth obtained with the GHGs is consistent with that obtained from dTheta/dZ.

Fig S7. The data from April, suggests detectable uptake of total CO₂ relative to ffCO₂. Is this the case ?

Fig S8. How large is the variation in estimated CH₄ emissions using single transect approach ?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 29895, 2013.

ACPD

13, C12635–C12637,
2014

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