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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mapping CH_4 : CO_2 ratios in Los Angeles with CLARS-FTS from Mount Wilson, California" *by* K. W. Wong et al.

Anonymous Referee #2

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The authors report column depths of CO2 and CH4 measured with an open-path FTS from a mountain top site overlooking Los Angeles, CA, and use the slopes of background subtracted column depths (XCH4xs/XCO2xs) to estimate CH4 emissions in proportion to total fossil fuel CO2 emissions expected from California State inventory.

General comments:

The approach represents a new application of ground-based open-path remote sensing to estimate GHG emissions from an urban area and will likely be of interest to the atmospheric science community. The paper is reasonably well written though could be substantially improved in terms of both technical completeness and clarity. In particular, the paper suffers from several sections with unclear writing and sections which

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miss key points regarding the range of assumptions required to derive the results that are reported (see comments below).

In addition, the paper promotes a future space mission. This seems inappropriate given that the observing strategy from space will yield very dilute optical paths compared to those obtained from the mountain top. I suggest reducing the emphasis on the satellite (e.g., Section 4.3) or adding additional quantitive information regarding the differences between the observing strategies.

The paper weakly supports the uncertainty estimates on CH4 emissions. I suggest the authors consider and address how each of the sources of uncertainty are estimated and justified.

First, can CO2 and CH4 emissions from the LA Megacity be estimated with stated accuracy from the product of California's total GHG emissions weighted by the fraction of CA's population residing in the MegaCity ? Please include this in the the assumptions section (4.1) and discuss the following: - what is the definition of the spatial domain being considered at the MegaCity ? this affects not only the population being considered but also the relative contributions of CO2 and CH4 sources. - Why aren't agricultural CH4 emissions included if the domain includes Chino, CA. - What is the justification for omitting biosphere CO2 fluxes in the estimate of CO2 exchange, particularly in winter ? - what is the justification for suggesting that Mega City CO2 fluxes are proportional to the fraction of CA population known to within 10% ?

Second, how are the XCH4xs/XCO2xs slope estimated ? Does this assume all errors are random among the 27 paths (6.4 ± 0.5 ppb CH4 (ppm CO2)-1) to within $\sim$ 8%. This is not discussed in the text or justified in any manner. In particular, the uncertainty Figure 5 shows regions with higher (e.g., Montebello, Walnut, Yorba Linda, Fullerton) and lower (Hollywood, East Los Angles, Long Beach, Palo Verdes) XCH4xs/XCO2xs slopes. This doesn't support the implicit assumption of random error in the variation of XCH4xs/XCO2xs slopes. It would seem more appropriate to state an upper estimate

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of systematic uncertainties that includes the range of slopes obtained across sites.

Also, the assumption of negligible bias in XCH4xs/XCO2xs slope due to aerosols is needs at least some simple quantitative justification.

Last, please expand observations and emissions estimates sections to include description of the in-situ measurements at Mt Wilson and Pasadena that are included in Table 4.

Specific comments:

Abstract. Where does the uncertainty in inventory-based CH4 emissions derived ?

pg. 17040, line 15. Please qualify the statement to include the expected accuracy obtained using 8 point observing sites.

pg 17049, line 1. likely typo: “are DUE to . . . “

Section 4.1 Assumptions

Assumptions 1&2. While likely true, the reasons for including assumptions 1&2 are not clearly motivated. Please add statements for each, clearly identifying why it matters to the emissions analysis.

Assumption 3. Are aerosol biases in the background subtracted column ratios XCH4(XS):XCH4(XS) small enough to not compromise analysis for emissions ? The paper must include a quantitative estimates or at least an upper limit on this bias.

Assumption 4. How much data is retained after filtering in each season ? How are uncertainties propagated into annual mean ?

pg 17051, line 27. The bottom-up estimate of CH4 emissions is unclear. Why are agricultural CH4 emissions subtracted from CARB inventory. There are non-zero CH4 emissions expected from dairies in the Chino area.

pg 17052, line 9. How is 0.06 TgCH4 yr-1 uncertainty CH4 emissions obtained

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? Uncertainties in bottom-up CO2 emissions was estimated as 166 $\pm$ 23 Tg CO2 year$-$1 (more like sqrt(2) * 10% $\sim$ 14%). Also, as above, how was uncertainty in XCH4xs/XCO2xs slope obtained?

pg 17052, lines 14-20. The statements concerning spatial variation in XCH4xs/XCO2xs slopes suggests uncertainties are likely greater than estimated from Eq (3). It would appear more appropriate to state a range of CH4 emissions assuming the range of slopes obtained.

Table 4. Why are there two CH4 emissions results (0.40 $\pm$ 0.10 and 0.60 $\pm$ 0.10) reported for Wunch et al ? In addition, the previous study by Hsu et al. (2009) used methane and carbon monoxide (not carbon dioxide) measurements to compute CH4:CO slopes and CH4 emissions. Is new data being reported from the work of Hsu et al (2009) and here in Table 4 ?

Figure 5. Please mark the location of Mt Wilson on maps.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 17037, 2014.