Atmos. Chem. Phys. Discuss., 10, C10027–C10031, 2010
www.atmos-chem-phys-discuss.net/10/C10027/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurement of fossil fuel derived carbon dioxide and other anthropogenic trace gases above Sacramento, California in Spring 2009" *by* J. C. Turnbull et al.

Anonymous Referee #2

Received and published: 18 November 2010

In this paper Turnbull et al. present a very interesting study on how to infer CO2 and other anthropogenic trace gas emissions from airborne in-situ measurements, using the carbon 14 content of CO2 to trace fossil fuel emissions and CO to partition the CO2 fossil fuel and biospheric contents. Using data recorded during a two-flights campaign other Sacramento area on 27 Feb. 2009 and 6 March 2009, they constrain the fossil fuel CO2 mole fraction in the Sacramento urban plume from ïĄĎ14C measurements, analyze the urban signature of this plume and compare the results with bottom-up inventories for several species. An attempt to partition the biospheric from the anthropogenic signal is provided using the ratio of CO over CO2 as a tracer for fossil fuel CO2 emissions. A mass balance approach is carried out to estimate the fossil

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

fuel CO2 emission flux from the Sacramento urban area.

General comments

The paper is very well constructed and well documented. The introduction summarized the state-of-the-art on uncertainties in local to regional scale emission inventories of anthropogenic species. The instrumentation used is fully adapted to the study. A strong effort to infer fossil fuel emissions from airborne observations is remarkable, as well as the attempt to compare these results to existing inventories. However, there are a few points that need to be improved: a better description of the studied site (geography, size, population; economical activities in Sacramento...) ; meteorological information during the campaign (even if no meteorological data were recorded) ; data precision and accuracy in the instrumentation description ; precision on the definition of anthropogenic CO2 that is resumed to fossil fuel CO2 without explanation before page 21588 (we learn only on that page that there is no other anthropogenic CO2 sources than fossil fuel combustion). Another point I am very concerned with, and that needs revision before publication, is the comparison undertaken between emissions inferred from some hours of airborne observations to annual inventories. The notion of variability or seasonality in the emissions is not treated. I recommend that the authors be more moderate in their conclusions and discuss the potential variability of anthropogenic emissions in Sacramento urban area. They could retranslate it into uncertainty bars associated to their results and discuss the results plus their uncertainty in the comparison to annual inventories.

My point of view is that this paper represents a very nice work that puts together several existing methods and makes of it a novative approach to the problem of urban emissions quantification. It is in the scope of ACP and suitable for publication in this journal after revision of the above mentionned point and other mentionned minor revisions. Some other details to correct are listed below.

Detailed comments

ACPD

10, C10027–C10031, 2010

Title: Since the paper focusses on emissions, and the campaign occured in Winter and not Spring, I suggest to change the title for the following: "Assessment of fossil fuel carbon dioxide and other anthropogenic trace gases emissions from airborne measurements above Sacramento California in Winter 2009": Institutions should all be shortened or long but all given in the same format.

p.21569 Line 7 : please define what you mean by "recently" Line 15: "overestimate": please quantify Line 16: "substantial differences": give numbers Line 20-22: give numbers Line 24: remove "however"

p.21570 The introduction lacks a description of Sacramento's activities (main emission sectors, at least for CO2) and information on dominant winds, plus meteo information during the flights event if they are not be provided by in-situ measurements.

p.21571 Line 15: same remark for "recently" Line 17: remove "because CO2...greenhouse gas" Line 19: After the point, add the last sentence of the section line 29 "Atmospheric observations of CO2ff ...described" (remove Finally at the start of the sentence). Line 20: Define what is CO2ff. The definition here matches with anthopogenic emissions ie FF+ciment production + biomass burning. It is necessary to explain here that ciment production+biomass burning are negligeable and thus CO2antropogenic equals CO2ff. Line 28: "Not perfectly known': be more precise and give numbers

p.21572 Line 3: add after fraction "inferred from ïĄĎC14 CO2" Line 20: two-weeks campaign

p.21573 Line 11: give the precision on the standard concentration Line 20: give the precision for CO2/CH4/H2O data measurements

p.21574 Line 25: then give the distance that the plane has been travelling during the 2 mn flask filling.

p.21576 Lines 20-23: these lines are unclear to me

ACPD

10, C10027–C10031, 2010

p.21577 Line 16/17: explain what you mean by "reasonable" Line 18: explain what you mean by "as expected"

p.21578 Lines 22-24: explain this before in your paper

p.21580 Line 3: Is there any reference on biofuel? To what extend it is developed in California / Sacramento?

Line 18: any R2 calculation has to be associated with a statistic significance test. Please calculate and give the p-values associated to the R2 coefficients.

p.21581 Line 7-9: How is the BL height measured or estimated? Line 14: OK but you rather want to precise this earlier in the text

p.21584 Line 22-26: how is this done? Is there any seasonality in emissions? This point is not treated, and comparing a campaign of a few hours to a whole year is quite challenging... please moderate your text and try to treat the seasonality factor.

p.21585 Lines 6-8: Thus comparing to annual inventories does it make sense???

p.21588 Lines 1-5: this should be explained before, as already explained above

p.21589 Line 23: How far is the hypothesis on a constant wind speed correct? You can look at wind reanalysis, make estimates and produce error bars.

p.21590 Lines 22-23: Please give a reference

p.21591 This section has to be moderated by taking into account a possible seasonal/ meteorological variability.

p.21592 Line 10: permits

Line 25-27: again, what about seasonal variability?

p.21593 This section has to be moderated by taking into account a possible seasonal/ meteorological variability.

ACPD

10, C10027–C10031, 2010

Interactive Comment

References p.21594 Line 25: add a coma between both authors.

p.21597: same remark as before

Table 1 Is column 1 really needed?

Table 2 Add a reference for CEPAM What do you mean by "VULCAN... (high value)"? Why in the legend do you mention the abbreviation "bl" that does not appear in the table itself? Add a column with the p-values associated to the R2 significance test.

Table 3 I think that the hypothesis is not correct. How could CO2 emissions calculated on a few hours be consistent with emissions from a whole year? Do you have access to seasonal inventories (winter data)? Add a column with the times of the flight segments.

Figure 1 Add the distance scale (axe on the top from zero to distance max), and draw the city borders.

Figure 2 Add (ppb) after CO on the y-axis legend.

Figure 4 What means "short tons" on the y-axis?

Figure 5a It seems we have the error on the x-axis only, not on both coordinated as indicated in the figure caption??

Figure 6 The text on the figure seems too small.

Figure 7 It would be better to add a light grey color rectangle around the data in the BL rather than a line. The range of uncertainty is very large (0.2-2 ppm: how come this large range of uncertainty??)

Figure 8 This sounds very strange, to get such negative and positive biospheric fluxes at the same moment...can you explain this??

Figure 9 It lacks a legend fot the insert (insert instead of inset).

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 21567, 2010.