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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Toward consistency between bottom-up CO_2 emissions trends and top-down atmospheric measurements in the Los Angeles megacity" *by* S. Newman et al.

Anonymous Referee #1

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General comment:

The heart of the paper by Newman et al., (2015) is an 8 year data set of CO2, δ13C(CO2) and Δ14C(CO2) in Pasadena, CA, USA, as well as a 4 year data set of CO2, δ13C(CO2) and Δ14C(CO2) in Palos Verdes, CA, USA. The authors carefully analyze the distinct patterns and trends of the CO2 data sets and show how CO2, δ13C(CO2) and Δ14C(CO2) can be used to distinguish between CO2 from biosphere, fossil fuel, natural gas combustion and petrol combustion. The authors compare the relative contributions of the CO2 sectors as well as their long-term trend and seasonality to different state emission inventories as well as to the Hestia emission inventory for

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LA. They find a decrease of 10% of fossil fuel CO2 in Pasadena, which is consistent to state emission inventories. The authors argue that the seasonal fossil fuel variations in Pasadena can be explained by a seasonally varying catchment area of fossil fuel emissions. The seasonal cycle of fossil fuel contributions is consistent (in pattern) with the emissions from the Hestia emission inventory when taking into account the seasonal change in wind patterns. The study is clearly structured and very useful as it shows how well trends in top-down and bottom-up approaches agree and how valuable a high spatial resolution of CO2 emission inventories may be. The authors might want to consider elaborating the information surplus from their measurements in comparison to state emission inventories and to higher resolved emission inventories.

I recommend this manuscript for submission in ACP following some minor revisions.

Specific comments:

Abstract, p. 29593 l.23 The absolute agreement between the bottom up Hestia and top-down approach is not assessed. Therefore, the word ”consistent” may be misleading. At some latter point in the manuscript it may be worthwhile to clearly state that emission inventories are not validated absolutely, but only trends (and relative contributions) of bottom-up and top-down approaches are compared.

p. 29597 l.12 The PDB scale has long been replaced by the VPDB scale and it is recommended to use the VPDB scale.

p. 29597 l.14-17 In this study, an integrated 14C(CO2) sample is obtained by combining 3-7 CO2 samples (afternoon) into one sample. Thus, 14C(CO2) from this integrated sample provides the average fossil fuel CO2 offset. In this manuscript, the monthly-integrated source signature δss is used to obtain a value for δff. However, averaging the source signature δff over time is only valid if δff and δbio do not change over time as otherwise correlation between cff and δff and cbio and δbio can lead to biases (Vardag et al., 2015). As the CO2 samples are always taken during the same (short) time of the day and the integration period is not long, it may be that the effect of the integration

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is small. However, it might be worthwhile to check and mention this in the manuscript.

p. 29599 l.20 Please give information on the background Δ14C values such as sampling resolution, precision etc.

p. 29601 Section 2.3.3. The samples used were all taken during the afternoon hours. However, Miller and Tans (2003) have pointed out that the determination of source signature does not work when CO2 sinks with a different signature than the sources occur. If this is the case in your setting, it may lead to potential biases of the source signature, which should be discussed here.

p. 29602 l.11 The authors use δbio of -26.6, δng of -40.2 and δpet of -25.5 without stating an uncertainty or typical variation within one year. It should be elaborated how these uncertainties (especially on a seasonal scale) influence the results for cff, cbio, cpet and cng. This should also be included in Fig. 3.

p.29606 l.16-22 This section is a bit confusing as the assumption of having no biospheric influence is not correct and also not used in this study. It might be more straightforward to leave this passage out as it seems to be of no use for the reader at this point.

p. 29607 l.5 Throughout the manuscript emission and concentration are used synonymously. Without a model, only the contribution of fossil fuel CO2 can be derived but not the fossil fuel CO2 emission. Please correct this in the entire manuscript.

p. 29608 l.9 Jiang et al. (2012) concluded that the semi-annual oscillation is a consequence of a combination of gross primary production (GPP) and respiration (resp), not net primary production (NPP=GPP+resp) and respiration.

Fig. 11 It might be worthwhile to insert error bars on cpet and cng.

p. 29612 l.2 Could the lag be an artifact of not including seasonal variations of the source signatures (e.g. δbio) into the consideration?

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Fig. 12 The uncertainty of cpet should be included in this Figure. Why do EIA and ARB statistics differ by a factor 10^3 ? Please elaborate what “mo” stands for in the unit of [kg CO2/mo] ?

p.29612 l.20 They agree in the direction of the sub-annual variation, but not in their absolute values.

Fig. 14 Same emission sectors should have the same y-scale so that differences between emission inventories become obvious. This is the case for the green and black axes in Fig 14.

p.29613 l.6-7 It is interesting that the increase in natural gas consumption is seen earlier in the data than in the emission inventories. If other sectors have not changed significantly (as one might expect?), this might point towards a false emission inventory and might be worth to point out here.

p. 29613 l.27 What about long-term changes in source signature of natural gas or petrol? Only if the endmembers of the signature do not change over time it is possible to validate emission inventories as presented here.

p. 29615 l.9-14 What are typical uncertainties of the emission inventories used? What are the uncertainties of the top-down approach?

p. 29638 Fig. A3 Please explain why the long-term trend (last row) changes after removing the average (repeated seasonal cycle).

Technical corrections:

p. 29594 l.13 This is only true in very large cities (Megacities).

p. 29595 l.27 It is not clear what “all three” refers to here.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 29591, 2015.