

Interactive comment on “Diurnal tracking of anthropogenic CO₂ emissions in the Los Angeles basin megacity during spring, 2010” by S. Newman et al.

Anonymous Referee #1

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This paper presents measurements, made during the Calnex-LA campaign, of CO, CO₂ and planetary boundary layer height (PBLH). The authors use these observations to attempt to determine the fraction of locally-emitted CO₂ that is of fossil fuel origin in the LA basin.

The paper is mostly well written and concise. However, several points require clarification before it can be published.

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1 Major comments

- The main result of the paper is that around 100% of the locally emitted CO₂ in LA is of fossil fuel origin during the day, compared to around 50% at night. This result seems to agree with expectations and with previous finding. Therefore, I was left wondering what we have really learnt from this work? Is the main innovation in this paper that the technique is more “affordable and simple” than previous methods (P5773 L7), or are there wider implications? More detail should be given to convince the reader about the novelty of these results. Furthermore, it should be explained how we might expect these findings to be used in future work. The suggestion that the authors make in this regard is that satellites should be able to detect the midday fossil CO₂ signal in a mega-city. Perhaps this could be elaborated upon. For example, we would hope that e.g. OCO-2 should be able to simply ‘detect’ the urban CO₂ plume from a large city like LA, but is the size of the signal found by the authors large enough, relative to the expected measurement uncertainty, to be able to constrain emissions?
- The background mixing ratio measurements seem to me to be a key quantity in this work. However, the background sites are not mentioned in the main body of the text, but probably should be.
- In Appendix B1 it is stated that CO₂ background levels were assumed constant throughout the time period. However, Figure A2 shows a clear diurnal cycle at the background site (Palos Verdes). Presumably this indicates a significant local influence at the background site? Therefore, two things occur to me: 1) can it really be assumed that it is a true background site? 2) By assuming a constant background when it actually appears that the LA background does have a diurnal cycle, is it not likely that the results presented apply to an area much larger than the urban LA region? How are the results different if the diurnal cycle of the *difference* between these two sites is plotted (perhaps filtering for instances

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where the wind passed along a trajectory from one to the other)?

- CO background levels were taken from GLOBALVIEW-CO. Can we be sure that these globally-averaged mixing ratios really apply to the area directly upwind of LA?
- The "fossil CO₂" diurnal cycle has a single peak around noon. Does this seem reasonable for LA? In many cities, emissions are expected to peak during the morning and evenings.

2 Minor comments

- If 50% of the nocturnal CO₂ is of biogenic origin, but 100% of the midday is fossil origin, does this mean that all of the biogenic CO₂ has been flushed out of the urban boundary layer between the morning and night? Do calculations of the ventilation rate substantiate this?
- The campaign covers a relatively short period (1 month) in 2010. How might the results vary with time of year or inter-annually?
- In section B3 it is stated that 100 particles were traced in the particle dispersion model. Is this enough to remove noise from the calculate footprints? Previous studies have used tens of thousands of particles for each measurement.
- P5773, L16: "... variability OF emission sources..."?
- P5773, L18: "... The large magnitude of emissions IS easily detected..."?
- P5774, L6: "The latter..." instead of "This last..."?
- P5774, L24: "... on the roof OF a trailer"
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- P5778, L2: "... technique is not as successful as using radiocarbon...". This is rather subjective. Please explain in more how and why it is more successful.
- P5781, L16: Daily calibration: can we be sure that there was no diurnal instrument drift (e.g. due to temperature fluctuations)?
- P5785, L2: Extrapolation of La Jolla data. Was this extrapolation in space or time? If the latter, then when were the La Jolla data collected?
- P5786: Which meteorological observations have been used to constrain the WRF winds, and at what resolution?
- Figure 1A: it would be helpful if both of these maps were on the same scale.

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