Review of "Measurement report: Airborne measurements of NOx fluxes over Los Angeles during the RECAP-CA 2021 campaign," Nussbaumer et al., ACP (2023)

Summary

This paper presents airborne observations of NOx fluxes over Los Angeles during June 2021. Flux and footprint calculations are discussed in detail. Some analysis is presented regarding spatial and temporal variability, and a comparison against an emission inventory shows under and over-prediction at different locations. The writing is generally clear, and the number and style of figures is appropriate. The degree of analysis is sufficient for a measurement report.

Publication is recommended after consideration of the following comments, which I would characterize as "minor" because there are no fatal flaws.

General Comments

Lag-covariance, cospectra, and detrending: In two of the three cases in Figs S2/S3, it is difficult to identify a clear lag peak even for temperature. The cospectra do not look like canonical boundary layer turbulence (see Kaimal 1972/76) with multiple peaks at low frequencies. I have a few suggestions on how to deal with this. First, was the NOx data detrended prior to calculating these? While this is not strictly necessary for wavelet fluxes, I have found it helps to remove non-turbulent low-frequency variability when generating these plots, especially the lag covariance. Second, in Sect. 2 (possibly in a new subsection) it would be prudent to add some explicit discussion of these plots and the implications for data quality and limitations – especially since this is a "Measurement Report." Also, for airborne fluxes it is more appropriate to use a length scale for cospectra (L = aircraft speed / frequency).

NOx units: mg m^{-3} is a non-standard unit for atmospheric chemistry. Please use mixing ratio units (e.g., ppbv).

Archived Data: For anyone else who wants to use this data, this needs a little work.

- A text file is fine, but ideally this would be in ICARTT format (https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/icartt-file-format) or similar for easy sharing and also to ensure appropriate metadata is included. Some of that information is in the manuscript, but it should be in the data file too.
- Would be wise to include a link or DOI for the paper in the data file.
- Pressure or GPS altitude should be included in addition to radar altitude
- The raw NOx flux should be included as well as the moving average.
- Temperature fluxes?
- The "footprints" file appears to just contain an index to footprints. In this case, I feel like it could just be included in the main data file? Also, I know the footprints are likely to large (data-wise) to archive, but it would help to provide some information to users on how they can get them (even if it

means contacting you). Alternatively, you can provide sufficient data in the file for people to calculate footprints themselves.

Specific Comments

L9: quantify what is meant by “too high” and “too low.”

L67: by sampling speed, do you mean aircraft speed, or the speed of air in the inlet? Aircraft speed is more relevant for effective spatial resolution.

L87: Is a 10-second average detection limit relevant, given typical turbulence scales?

L132: How do you determine the boundary layer depth? How uniform is it spatially (or how uniform do you assume it is)?

L180: What are uncertainties in m and c? Are uncertainties in the divergence fit propagated to fluxes?

L187: What is the reason for the 20% choice? Seems arbitrary as written.

L189: “where the measured air masses originated” is not quite right. It is more like the area over which surface source and sinks influence the observed flux. Suggest rephrasing.

L266: is the weekday/weekend difference consistent with expectations from prior observations and literature (e.g., concentrations at ground or airborne)?

L271: Could you have sub-selected the fluxes for footprints over land only? Not suggesting you do this now, but a recommendation for future work.

L291: this equation seems unnecessary. Might be easier to change the colorbar label in Fig. 6c to say RECAP – CARB? Also, would it make more sense to reverse this so that inventory overprediction is red?

L322: This threw me off, as I had assumed that Fig. 6 was utilizing divergence-corrected fluxes. Suggest clarifying this at the beginning of Sect 3.2.

Conclusions: this section is short. I realize this is a measurement report, but this is an opportunity to provide guidance for future work. What else could be done with this data? What data are you missing that you would want if we did this experiment again? How would you do it differently?

Technical Comments

L12: (NO_2),

L27: provides (the verb is referencing a single item “the combination”)

L28: the phrase starting with “that describe” is oddly-worded, and this first sentence is very long. Suggest breaking up and rewording.

L56: identified as a key

L67: approximately

L74: nitpicky point, but the coastal legs seems to be NW – SE.

L100: using omega for vertical wind is atypical, I think. Small w is more standard.

L106: replace “steady state conditions” with “stationarity.” These are not synonymous, especially in the context of chemistry. Also on L109.

L106: similarly, but “homogeneous horizontal air masses” do you mean ergodicity?

L123: integrated across scales

L125: “Eq. (6) where . . .”. Also, it might be easier for readers to put variable descriptions after the equation.

L165: suggest deleting “mostly through differing wind speeds with altitude.”

L170: “in dependence of” is not the right phrasing. Maybe something like “flux vertical profile in a BLH-normalized coordinate system”? But that feels awkward too.

L207: define z0.

Figure 4: consider adding arrows for mean wind direction.

L256: delete “significant.” Let readers decide.

Figure 5: define components of box plots in caption.

L292: Section 3.1,

L318: Amazon (capitalize)

L333: no need to redefine RECAP

L334: downtown (lower case)

L338: 4 km upwind