

Interactive comment on “Errors in top-down estimates of emissions using a known source” by Wayne M. Angevine et al.

Anonymous Referee #2

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The paper presents a careful assessment of uncertainties in estimation of emissions from atmospheric plume observations. It is certainly of interest to the scientific community. In general the paper is well written, and I recommend publication after the following concerns have been addressed.

General Comments:

There are only a very few references used in the Introduction. For mass balance for example, here are two exemplary references: Karion, A., Sweeney, C., Pétron, G., Frost, G., Michael Hardesty, R., Kofler, J., Miller, B. R., Newberger, T., Wolter, S., Banta, R., Brewer, A., Dlugokencky, E., Lang, P., Montzka, S. A., Schnell, R., Tans, P., Trainer, M., Zamora, R., and Conley, S.: Methane emissions estimate from airborne measurements over a western United States natural gas field, *Geophysical Research Letters*,

40, 4393-4397, doi:10.1002/grl.50811, 2013. Turnbull, J. C., Karion, A., Fischer, M. L., Faloona, I., Guilderson, T., Lehman, S. J., Miller, B. R., Miller, J. B., Montzka, S., Sherwood, T., Saripalli, S., Sweeney, C., and Tans, P. P.: Assessment of fossil fuel carbon dioxide and other anthropogenic trace gas emissions from airborne measurements over Sacramento, California in spring 2009, *Atmos. Chem. Phys.*, 11, 705-721, 10.5194/acp-11-705-2011, 2011. Also, the sections on errors, uncertainty, and ensemble forecasting could benefit from some key references. Furthermore, some references should be used in the discussion of the mixing height and well-mixedness (lines 386 – 395).

Specific comments

Fig. 1 missing? The Fig. 1 caption does not quite fit to any of the figures I can see in the manuscript. indicates “The x marks the power plant location“, but I can’t find the figure with an “x“. A map showing the power plant location as well as the locations/directions of the transects and the orientation of the cross sections shown in Fig. 5 is certainly required.

Fig. 4, bottom panel: The figure is not very clear. Each transect has a specific colour, and ensemble estimates are offset in x-value, but e.g. for the 2nd transect there are three different x-values. For clarity it would be better to reduce the x-offset between estimates within each transect, and to mention in the caption that also the error estimate for the observed mass balance is shown for the 2nd transect.

Fig. 5: It would be informative to also show the simulated mixing height as function of latitude, and the exact location of the different transects (also for Fig. 7).

Line 254: “along-wind direction” is this the wind direction at the source, at the measurement location, or is this along a mean wind trajectory?

Fig. 7: Most cross sections show minima in mixing ratios at a latitude of around 32.6. Is this due to changes in wind speed or wind direction? Maybe a figure showing a map of

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a horizontal cross section (lat-lon) for one of the simulated plumes at different heights would help.

Line 293: Do the ERA5 mixing heights show a significant temporal change?

Line 391: Both, potential temperature and water vapour mixing ratio show gradients across the top of the PBL (although of opposite sign), so why should one quantity be well mixed in the PBL and not the other? A reference would be needed here.

Line 410: “esimate” > “estimate”

Line 410: It would be interesting to examine the correlation (positive or negative) between wind speed and mixing height in the ensemble fields, this would help clarifying the issue of compensating errors.

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