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Atmospheric Measurement Techniques Discussions

Interactive comment on "A new non-resonant laser-induced fluorescence instrument for the airborne in situ measurement of formaldehyde" *by* Jason M. St. Clair et al.

Anonymous Referee #1

Received and published: 9 September 2017

General comments:

The manuscript entitled "A new non-resonant laser-induced fluorescence instrument for the airborne in situ measurement of formaldehyde", by J. M. St. Clair, et al., demonstrates a new instrument for measuring formaldehyde in aircraft campaigns. The paper describes in detail the technical aspects of the new LIF instrument, including the custom-built optical system, sampling technique, and the methods for processing the fluorescence time profiles. It is a very well written paper, and it carefully describes a novel instrument that should be of use to the atmospheric chemistry community. Publication is recommended, following the consideration of a few minor comments:

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Discussion paper

Specific comments:

Section 3.3 – Can you address what, if any, losses of HCHO are expected on the in-line particle filter (or even on the pressure controller)? Has this been tested? Were any laboratory calibrations conducted with the particle filters in place to make sure they match calibrations without filters?

P5L13 – Particle filters were used when “high aerosol loading is expected”. Does this mean they were used in any non-laboratory deployment?

P5L15 – “The element retains 93% of the particles with a 0.01 um diameter.” Does this mean it retains 93% of all particles larger than 0.01 um? Or is there some diameter over which it retains close to 100% of particles? What percentage of particle smaller than 0.01 um are retained, and do you expect this to make a difference in your analysis?

Section 3.3 – Is the inlet system here similar to the one shown in Fig. 5 of Carzorla et al? If not, describe the inlet used here. Is there anything in addition to the particle filter?

Section 3.5 –Clarify in the beginning of this section that both the exemplar fits and the gated spectra have their long-lived components removed before further analysis. The number system in this section makes it vague.

Section 3.5.1 – A figure in the supporting documents showing a raw spectrum and the long-lived component would be helpful in demonstrating how large this component is relative to the total signal. Or state it explicitly in the text.

Section 3.5.2 – How sensitive is the shape of the HCHO exemplar to the concentration of HCHO used? Why use the profile with 25 ppbv HCHO, instead of an average of several concentrations (scaled, presumably)?

P7L29 – What is the typical agreement between the two detection axes? State this.

Section 3.5.3 – Consider making a figure for the supporting documents showing a

spectrum with shading to indicate where the gating occurs.

P10L11 – It's not clear where the 100 pptv value comes from. . .

Section 5 – Is there any reason to believe the "air exemplars" or the long-lived component might be different in-flight than on the ground? How consistent are the auxiliary measurements (i.e. detector internal pressure, laser head temperature) during vertical profiles?

Figures 4 and 5 – What concentrations of HCHO do these examples correspond to? Can you put this information either on the plot or in the caption?

Table 1 – This table (and possibly Figure 11) could move to the supporting documents, as the focus of this paper is really on the instrument technique, and not on the measured spatial distribution of formaldehyde. You could give the details for the two flights in the caption for Figure 12 and leave out the rest.

Technical comments:

P3L8 – "In practice, the laser is turned on. . ." is odd phrasing, as it implies that something else was supposed to happen in theory.

P6L20 – "The fluorescence signal at the end of the bin-resolved data ($\sim$400 ns after the laser pulse). . ." Change to >400 ns, since you are taking the signal from 400-500 ns.

P6L24 – State what times bins 75-100 correspond to. Same comment for bins 87-100 on P6L27.

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