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Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #2

Received and published: 16 June 2019

The manuscript by St. Clair et al. describes the NASA Compact Airborne Formaldehyde Experiment (CAFE) instrument which is the successor to the NASA Compact Formaldehyde Fluorescence Experiment (COFFEE) instrument. The authors provide a thorough and very detailed description of all instrument components on CAFE and show some intercomparison data from ATom-3 comparing CAFE (a non-resonant laser-induced fluorescence (LIF) instrument) to a resonant LIF instrument (ISAF).

In terms of general comments, there needs to be more discussion or data intercomparison with COFFEE since the manuscript's title emphasizes the idea that CAFE is the new and improved version of COFFEE. CAFE is clearly more versatile than COF-

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FEE in terms of flying on different types of aircraft, but when CAFE and COFFEE's precision are compared in Section 3.2, COFFEE is shown to be slightly outperforming CAFE (even with CAFE's higher laser power). Explicitly listing out all of the design differences between CAFE and COFFEE in a single section or table will help the reader to quickly understand how this manuscript advances and improves upon the COFFEE manuscript (St. Clair et al., AMT, 2017).

The manuscript fits well within the scope of AMT, and I recommend publication after attention to the previous general comment and the following specific comments/technical corrections.

Specific Comments:

- Page 3, Line 9: (Minor comment) Just to aid in reader understanding, please explain in the manuscript why the baffle opening diameter increases slightly in size as the baffles approach the detection cell.

- Page 3, Line 13-14: Why isn't the inner surface of the detection cell also coated with Acktar (like the baffles) in order to minimize scatter?

- Section 2: It's clear that the two detection axes have different filters, but there should be a statement somewhere in Section 2 that explicitly mentions the rationale for the two detection axes. It's not immediately clear from the text how the data from the two detection axes are combined or used to get the 1s data (cyan circles) shown in Figure 5.

- Page 7, Line 6: Please state the humidity that this zero was performed at since it seems like CAFE's accuracy is affected by whether there's water present in the air sample, and the instrument's precision is affected by the presence of the water-blocking long pass filters. A similar dry experiment should be done without the water-blocking long pass filters in place and its results mentioned in the manuscript (to represent UT/LS conditions).

- Figure 3: Mention in the caption how much of the possible HCHO fluorescence signal is attenuated by the filters.

Technical Corrections:

- Abstract: Formadehyde should be Formaldehyde

- Abstract: Mention CAFE accuracy in abstract of +/- 20%[HCHO] + 100 ppt

- Page 5, Line 4: Use Celsius

- Page 6, Line 21: sLm should be defined back on Page 4, Line 26 since that's the first appearance of the unit

- Figure 2: Beam path is faint and hard to see in figure

- Figure 9: Mention that the York fit is used in the figure caption

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