

## ***Interactive comment on “Ethane measurement by Picarro CRDS G2201-i in laboratory and field conditions: potential and limitations” by Sara M. Defratyka et al.***

### **Anonymous Referee #3**

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#### General Comments

This manuscript assesses the ethane measurement obtained using the Picarro G2201-i and tests its ability to provide meaningful data for determining C<sub>2</sub>H<sub>6</sub>:CH<sub>4</sub> in methane plumes, with the goal of source attribution. The instrument is tested and calibrated in the laboratory, subjected to controlled release experiments, and taken to measure real sources in the field. The authors find that, due mostly to the low precision of the ethane measurement ( $\sim 50$  ppb), the G2201-i can only realistically be used for ethane-to-methane ratios in methane peaks that are at least 1 ppm above the background. Furthermore, the measurement as presented must be taken under stationary

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conditions (i.e., with the mobile platform parked within a plume for  $\sim 30$  min) or the noise of the ethane measurement becomes unacceptably high.

The use of the G2201-i for the described applications seems extremely limited, especially in light of the other available instruments that can do this type of measurement much better (LGR, Aerodyne, and other Picarro models). However, the authors do recognize that in order to use the Picarro G2201-i for ethane field measurements (which in turn are to be used only in the calculation of ethane-to-methane ratios rather than absolute ethane mixing ratios), the instrument response must be extensively characterized. This work is done, and the limitations of the G2201-i for the purposes described are appropriately determined and discussed.

There is a lot of information presented on the experimental details of previous work, which, in my opinion, obscures the experimental design and the main conclusions of the current manuscript somewhat. It makes it difficult for the reader to focus on the important points of the manuscript (one of which is the many conditions that need to be satisfied to obtain useful ethane information from the G2201-i). I recommend the authors try to streamline the manuscript as much as possible so that the important points are evident. Additionally, I recommend careful proofreading of the manuscript, which contains many small grammar errors, some of which are highlighted below under “Technical Comments”.

#### Specific Comments

Lines 53-58: How does this study differ from Assan et al? Is the system just characterized better? Is the only difference, as mentioned later in lines 361+, that the instrument was put in a car (which must remain stationary within a plume for  $\sim 30$  mins to take a useful measurement)? If so, that should be made clear early on.

Lines 62+: Did you use the monitoring mode in addition to the replay mode for the Aircore in the current study? I think some more information on how the Aircore was used specifically for this study should be included, although I would add this information

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later in the methods section.

Lines 82 – 85: This background information on how ethane is measured and reported for an isotopic methane/carbon dioxide instrument should be moved to the abstract and introduction.

Lines 81+ (Materials and Methods section): To make each factor investigated clear, consider re-formatting with subheadings, such as, 1.1 Laboratory 1.1.1 Interference Correction on Ethane and Water Sensitivity 1.1.2 Ethane Calibration Factors 1.1.3 Precision and Allan Variance 1.1.4 Time drift Because the water vapor sensitivity tests are tests on the validity of the interference corrections, I think this should be discussed at the same time as the interference correction in general.

Lines 147+: I have some confusion about what Protocol 1, 2, and 3 are. Are these described clearly somewhere? I would add relevant details here in the methods section.

Lines 151-152: Delete “The measurement setup used here is the same as in the field” and only mention in section 2.3.

Lines 154-159: The point that true “mobile” measurements are not conducted (i.e., while the vehicle is moving) should be highlighted earlier in the manuscript. It is an important point that is somewhat hidden here. Also- please add information here about the specifics of the Aircore setup as used in this study (e.g., flow rates, different modes, car stopped or moving).

Line 174- 178: I question whether any of the information about the failed bag measurements should be included in the main manuscript, especially given the issues with sampling and bag preparation mentioned later (in lines 284+). Maybe make a very abbreviated reference to them, and then move all other bag information to the supporting information.

Lines 195+, Section 3.1: Suggest headings that are the same as those suggested above for section 2.1 to help organize the information.

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Line 201: Can you specify what a “low amount of C<sub>2</sub>H<sub>6</sub>” means?

Line 356: Please clarify what “10 mins of ambient air collection was measured during 20 minutes” means.

Lines 384-390: Please revise this section on Aircore and CRDS flow rates for clarity. How are the Aircore and CRDS flows related? Were there reasons for the chosen flows?

Line 398: Do you mean the “first comparisons” of ethane mixing ratios with GC-FID match up in a relative sense? The word “indicative” is confusing here.

Line 431: Please clarify what the “flushing issue” to be solved is.

#### Technical Comments

Line 43: “source” should be “sources”

Line 54: “measure of” should be “measurement of”

Line 60: Change “allows to improve time resolution” to “allows improvement of time resolution”

Line 77: Change “instrument to ethane” to “instrument for ethane”

Line 165: Change “find” to “found”

Line 167: Change “emission flux” to “gas flow rate”

Line 168: Change “could vary” to “were varied”

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-410, 2020.

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