

## ***Interactive comment on “The detection of carbon dioxide leaks using quasi-tomographic laser absorption spectroscopy measurements in variable wind” by Z. H. Levine et al.***

**Anonymous Referee #2**

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### General comments

In this paper the authors propose to use laser absorption spectroscopy, in a 2D layout, for the identification of leaks in the surrounding of hypothetical storage sites of carbon dioxide. The overall approach is convincing and the authors provide meaningful elements to demonstrate the ability of their technique to meet the objectives. The subject of this investigation is relevant and the quality of the presentation is good. Overall, I consider this paper to meet the scope of AMT. However, before publication I recommend authors to solve the not secondary ambiguities raised in the following section.

### Specific comments

C4124

I have found rather unusual the ordering of sections in chapter 4. Actually, the common procedure is to test a new technique with simulated observations first. Then, if the outcome of this phase is positive, the next step would be to carry out experimental validations (if the opportunity exists). Is there any specific reason for reversing this logical sequence? It would be wise to add a paragraph at the end of Sect. 1 to explain the rationale of the following sections (this comment is somewhat related to the next point).

About the experimental result - At the end of section 4.1 the reader is left with an open question about the presence of a real CO<sub>2</sub> leak in that farm outside of Fort Wayne. Since I supposed this section to report a validation exercise, my first hypothesis was for a source of CO<sub>2</sub> to be present at a known position with a known leak rate (possibly placed on purpose for this experiment). If this is the case, it should be specified in the text together with the conclusion that the known position of the leak matches the position “of the leak found in the experiment” (red dot in figure1) and/or the maximum of log likelihood (black dot in figure 4). However, at line 15 of the conclusions section I find that “we did not independently verify the nature and strength of the source”. This makes me to suspect that your claim to “have made a preliminary measurement” is based on only the “correctness of the model and the experimental signal-to-noise”. If this is the case your experimental result cannot be considered a validation of the proposed technique. You should clearly specify these points in section 4.1. As a side consideration: I don't see prohibitive to make use of an independent instrument (a portable mass spectrometer?) in the identified leak position or (even better) to open a CO<sub>2</sub> bottle in the experiment theater.

page (P) 12298, line (l)16. “carbon dioxide including carbon and oxygen”: the specification “including carbon and oxygen” is unnecessary since no other interpretation is possible in chemistry.

P 12300, l 20. “the plume is proportional”: the plume function or size? Please specify.

C4125

P 12302, l 7. (micro)mol mol<sup>-1</sup> here and throughout the text: (in the original text it was (micro)mol/mol) is an ambiguous notation because the numerator refers to moles of CO<sub>2</sub> while the denominator refers to moles of dry atmosphere. I suggest to provide here the extended definition of “(micro)mol mol<sup>-1</sup>” by specifying that you will use this notation throughout the text.

P 12309, l 5-6. You should specify the criterion for choosing these two values of Q: are they representative of “substantial amounts” of CO<sub>2</sub> (see conclusions at line 3) and of small amounts of CO<sub>2</sub> respectively?

P 12325, Figure 8. The meaning of the plots in this figure should be specified in the caption by referring to the color and the style of the reported lines. Most of the lengthy caption should be transferred within the paper text.

#### Technical corrections

P 12299, l 14. “is proportional to the square root. . .” should be “is proportional to both the square root. . .” (if this is the right meaning).

P 12299, l 22. We call this the “leak problem” in the following: I was not able to find any further occurrence of “leak problem” in the following. Anyway the dot should be omitted after “wind”.

P 12299, l 25. Hartl et al. (2006) and co-workers: delete “et al.” or “and co-workers”.

P 12300, l 6. “Humphries et al. (2012); Luhar et al. (2014)” should be “(Humphries et al., 2012; Luhar et al., 2014)”.

P 12301, l 5. “to more compactly with” should be “to, more compactly, with”.

P 12302, Eq. (5). The first character of this equation looks like a “slash”. It would be wise to use a font more similar to capital “i”.

P12307, l 4. “Dobler et al. (2015)” should be “(Dobler et al.,2015)”.

C4126

P 12308, l 6. “from from”. Same page l 13 “that that”.

P 12312, l 2. “The experimental portion was this work” please correct.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 12297, 2015.

C4127