Atmos. Meas. Tech. Discuss., 6, C2557–C2560, 2013
www.atmos-meas-tech-discuss.net/6/C2557/2013/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Cavity ring-down spectroscopy sensor for detection of hydrogen chloride" *by* C. L. Hagen et al.

Anonymous Referee #1

Received and published: 12 September 2013

1. The manuscript describes an instrument based on cw cavity ringdown spectroscopy for fast and high sensitivity detection of HCl. As the authors state, there is need for development of such instrumentation, for all the reasons they state. The instrument represents a clear advance in this direction and the content is well suited for AMT. I see no major shortcomings of the manuscript but believe the manuscript can be improved by addressing the comments below, in particular the first two.

One comment is that the manuscript is written, as if this was the first instrument using a cavity based technique in the NIR to measure HCl. However, Los Gatos Research already offers such an instrument commercially, with many of the advantages the work here mentions (telecomm, non-cryogenic, compact, etc.). I think it is important for the manuscript to:

a. acknowledge this fact clearly (I realize it is a different cavity based technique).

b. Compare the size, weight and power consumption of the instruments.

c. If possible compare the detection limits. Unfortunately, it is likely impossible to compare the time response/cavity effects.

2. page 7231 last paragraph: The discussion of the time response needs to be extended with more data shown.

a. steps from both zero HCl to high HCl concentration and high HCl to zero HCl concentration need to be shown

b. these need to be shown for low and high relative humidity (RH).

It was not clear to me at what RH the test was done. The reason this matters is that the wall absorption effects might have a strong and non-obvious RH effect. For example, for some setups and compounds introduction of humid air into an apparently clean system can release compounds. The step-down to zero HCL concentration is important as a critical aspect of the instrument is how long it takes until concentrations close to the detection limit can be observed after exposure to high HCl concentrations. In addition, there often is more than one time-scale and it would be interesting to investigate this. A minor aspect is mentioning the time scale for the CIMS, which I believe was not mentioned. I strongly suggest extension of this section, which is critical for a compound such as HCl.

Minor comments:

p. 7222, 1st paragraph: Some references for cw (sweep and switch) CRDS need to be included as it is a well-established technique.

p. 7223: HITRAN simulations: were isotopes, such as HDO included?

p. 7224, line 20: For an instrument description more details on the reference cell need to be added, e.g., What is the partial pressure of HCl, is there a balance gas, what is

the pathlength, does the pressure have to be identical to the cell pressure and if not why, e.g., no shift in line position, or irrelevant?).

p. 7225, line 6-7: It would be useful for readers not so familiar with cavity enhanced spectroscopy to explain why two different radii for the mirrors are used and how they relate to the cavity length.

p. 7225 line 11, 12: Please add the wavelength of highest sensitivity of these detectors.

p. 7225 line 29: How does digital equipment (computer) scan continuously. I assume there is a minimum step size in the current? Please give more details on how the scan is conducted.

p. 7226 line 11-15. How many individual ring downs do the 30 scans over the feature in 30 seconds correspond to. From the 25 s-1 mentioned previously I assume it should be about 750 individual ringdowns? It would be helpful to mention this number here.

p. 7226 line 25-equation 2: For readers not so familiar with the method, it should be stated whether this is the HCL concentration in the cell or the ambient one? (dilution/purge flow and reduced pressure in cell).

p. 7227 line 25-: Please add more details of the virtual impactor. What type of pump is used, as one of the claims made is that this instrument has low pumping requirements, and tubing diameter, length, details of the T used to split the flow.

p. 7229: should the smaller length (absorption vs. cavity) be used here? Is the 11 ppt the mixing ratio in the cell as ambient would be slightly higher due to purge dilution? Please clarify.

p. 7232: The description of the ambient measurements needs to be extended. Relevant details such as inlet lengths, inlet material, flow rates through the inlets, individual or common inlet.

p. 7233 line 13 “somewhat”: it is a specific amount smaller, I would assume?

Figure 3: I would suggest showing the Fabry Perot Etalon instead of the reference cell and explanation of this in the caption. Define ROC in figure, please.

Figure 4: Please add number of data points total shown.

Figure 9: see second comment for additional figures and information (RH) for this figure

Figure 10: I would suggest showing binned data rather than smoothed data, which tends to take out features.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 7217, 2013.