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Atmospheric Measurement Techniques Discussions

Interactive comment on "An improved water correction function for Picarro greenhouse gas analyzers" *by* Friedemann Reum et al.

Anonymous Referee #1

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General comments

This paper describes the high accuracy correction function for the water vapor interferences on the CO2 and CH4 measurements using the wavelength-scanned cavity ring-down spectroscopy, which has been widely used instrument for the atmospheric greenhouse gas measurements. While several past studies proposed empirical correction function for the water vapor interferences expressed as second order polynomial model, the authors pointed out the presence of additional water vapor interference on the cavity pressure measurements, which results in undercorrection of the CO2 and CH4 measurements using the empirical correction function for humid air samples, especially at low water vapor content. Based on their experiments, the authors improved the empirical correction function and demonstrated that significant differences

occurred in the correction values between the previous and the improved correction function when these functions were applied to the field observation data.

The paper's topic is interesting, and may be an important contribution for the atmospheric greenhouse gas measurement community. However, I feel that the manuscript unfortunately suffers from redundancy, unclear writing, bad organization, and confusing data analysis. All these problems make it extremely difficult to follow. Furthermore, significance of the measurement biases due to the water vapor interference on the cavity pressure measurements was inconsistent across the instruments. I am uncertain of this study, and therefore I think it would be better to revise the experimental methodology carefully and needs further investigation. I am very afraid, but I suggest rejection of this manuscript from AMT. I encourage the author to rewrite the manuscript from scratch with the help of the coauthors for clarity after consideration of my comments.

Specific comments (Major comments)

I have great concern about the experiment for the estimation of the quantitative relationship among the readings of external pressure sensor, CO2, CH4, and internal pressure sensor. The author used the Mg(ClO4)2 cartridge to shield the external pressure sensor from humidity change. The external pressure sensor measurements can also be biased by the presence of water vapor? Then I wonder why the author did not use the pressure sensor independent of the water vapor presence for the experiments. Since the experimental system can be highly complex due to the installation of the Mg(ClO4)2 cartridge, I have no idea what the external pressure sensor measures. In addition, there are several other concerns as described below:

1. What was temperature control for the humidification unit? The slight temperature change will affect the solubility of CO2 and CH4 in the de-ionized water which results in change in the mole fractions of CO2 and CH4 in the sample air, especially for CO2.

2. There is no detailed information for the Mg(ClO4)2 reagent, but the author used CO2-saturated Mg(ClO4)2 reagent to avoid CO2 loss on the reagent?

3. The author used the needle valve to adjust the pressure readings close to those of the internal pressure sensor, but what was the stability of the sample pressure downstream the needle valve? The pressure change can cause the increased CO2 absorption/desorption on Mg(ClO4)2 reagent.

4. Depending on the water vapor absorption on the Mg(ClO4)2 reagent, magnitude of the pressure loss in the Mg(ClO4)2 cartridge may be changed, resulting in the pressure gradient between up- and downstream the cartridge.

5. The author checked complete removal of water vapor behind the Mg(ClO4)2 cartridge at the external pressure sensor?

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