

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

Anonymous Referee #2

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This paper focuses on improving the accuracy of GHG dry mole fraction measurements in humid air made by Picarro cavity ring-down spectrometers. The authors derived the sensitivity of the cavity pressure to water vapor, and presented an enhanced water correction function by introducing an additional term to the traditional parabolic water correction function, which primarily affects the low vapor range of 0.05 to about 0.5%. The corrected biases were up to 40% of the WMO inter-laboratory compatibility goals (0.037 ppm for CO₂ and 0.85 ppb for CH₄). This definitely contributes to the community efforts to meet the WMO inter-laboratory compatibility goals for accurate GHG measurements. As the biases discussed here are small, many factors could have an impact on the significance of the results. In my opinion, the authors did a good job in bringing up and discussing the potential issues, however, failed to present them in a

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clearly and well-structured way. Therefore, I can recommend publication of the paper in AMT after addressing the following concerns.

General The results of the enhanced water correction function for CO₂ are not convincing. It will be helpful to summarize and list in a table all the factors that may cause a bias on the order of 0.037 ppm for CO₂ and 0.85 ppb for CH₄, and provide reasonable estimates of their associated uncertainties. For example, factors that may affect CO₂ on this order of magnitude include

1) tank regulator effects that cause CO₂ coming out of tanks drifting 2) uncertainties introduced by the sensitivity of CO₂ to cavity pressure, e.g. 0.502 ppm/Torr (Table 2) was derived for Picarro #3, and 0.466 ppm/Torr was reported by Filges et al., 2015; 3) solubility of CO₂ in water; 4) adsorption of CO₂ by magnesium perchlorate, especially under changing pressure. In addition, the specified standard errors in the existing tables provide little information, as they are derived from the fit assuming statistical noise only, and are usually much lower than the overall uncertainties associated with the numbers.

Detailed comments:

Page 3 Line 9 The considerable amount of water used (500 ml) here will affect CO₂ mole fractions. Has this effect been characterized?

Page 4 Line 22 Was there no offset in the cavity pressure compared to the external pressure measurement?

Page 9 Section 3.5.2 Which model was used? III or IV?

Page 13 Line 17 – 18 It is not clear what is said here. Rephrase the sentence.

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