

Interactive comment on “Design and performance of a Nafion dryer for continuous operation at CO₂ and CH₄ air monitoring sites” by L. R. Welp et al.

Anonymous Referee #2

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Review of ‘Design and performance of a Nafion dryer for continuous operation at CO₂ and CH₄ air monitoring sites’ by Welp et al.

The submitted manuscript presents the design of a sampling and drying setup for continuous carbon dioxide and methane observations with a cavity ringdown spectrometer. The experiments are carefully designed and performed. The paper is scientifically sound and well written. The manuscript is definitely within the scope of ‘Atmospheric Measurement Techniques’ and is of sufficient originality to merit publication in this journal. There are only minor comments that might be considered by the authors before publication in AMT:

General comments:

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The authors cite several times Rella (2010), especially in the introduction. Rella (2010) is a non-reviewed Picarro report. Please refer to the newer, more elaborate and peer-reviewed publication Rella et al., 2012, AMTD (reference below) wherever possible.

I miss a clear statement if the influence of the remaining water will be corrected during the continuous monitoring and if all analyzers within the Earth Networks network use the same correction parameters. While it is mentioned that there was an application of the H₂O correction during the described experiments, it isn’t really clear to me how it will be done during the continuous operation within the network. So far it is only mentioned ‘The simple, partial drying technique we present here does not eliminate the water vapor influence, but reduces the water vapor correction by an order of magnitude or more, thus eliminating the need to characterize the water vapor correction on each instrument before deployment.’ (page 5452) and ‘The setup eliminates the need for establishing the H₂O correction on each analyzer and monitoring its stability over time. It also reduces post-processing of the data.’ (page 5460). Why does it reduce post-processing of the data? Does it mean that there is no H₂O correction planned?

The authors use the parameters proposed by Chen et al. (2010) for the H₂O correction. Chen et al. used an older model, a G1301 Picarro analyser in his study. According to my knowledge, the H₂O outputs of the G1xxx and the G2xxx series analyzers are processed differently in Picarro’s data acquisition software, leading to non-identical H₂O readings and, thus, to different corrections functions. Did you try to reproduce Chen’s approach to retrieve individual parameters for the analyzer used in the present study?

There are two differences between the setup used for the tests presented here and the setup to be operated in the network: flow restriction with the needle valves and critical orifices, respectively, and Nafion dryer temperatures of 24C and 45C, respectively. No guess is made if the different approaches of flow restrictions could influence the results. The temperature influence is only covered by one sentence: ‘However, we do not expect the warmer temperatures to affect the CO₂ and CH₄ permeability tested

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here.' (page 5455). Did the authors repeat any of the experiments shown here with one of the final setups to be employed in the Earth Network network?

Specific comments:

Page 5450, lines 18 – 20: I agree that the systematic differences are well within the WMO compatibility goals for CH₄ but it is not the case for CO₂ since the compatibility goals (at least for the Southern Hemisphere) are 0.05ppm, i.e. as large as the observed bias.

Page 5451, lines 6 – 9: The statement about the data quality requirements doesn't only hold true for the Earth Networks network but for all greenhouse gas monitoring networks.

Page 5452, lines 28 – 29: The choice also depends on the presence of skilled local operators and the frequency of maintenance visits.

Page 5453, lines 1 – 8: did the authors also try other setups? E.g. to use the exhaust flow of the analyser as Nafion counterflow. This setup would allow directing only 70 ml/min through the Nafion. Please elaborate why the present setup was chosen.

Page 5454, lines 14 – 16: what was done to leak-tight the pump?

Page 5457, line 11: according to the current specsheet for a G2301 analyzer available on the Picarro webpage, the respective precisions (5-min averages) are 25ppb for CO₂ and 0.22ppb for CH₄. An analyser with a 5-min precision of 50ppb for CH₄, as stated in the present manuscript, wouldn't be suitable for monitoring purposes trying to meet the WMO compatibility goals.

Page 5457, line 19, Figure 3: was the CRDS analyser calibrated for H₂O? If not, it is misleading to provide numbers such as 0.00002%. H₂O readings shown in Figure 3 are negative.

Technical corrections:

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Page 5452, line4: 'Rella, 2010' is an in-text citation.

Page 5452, lines 25 – 28: incomplete sentence; rephrase it.

Page 5455, line 18: explain acronym 'SIO' first time it is mentioned.

References: please add weblink for Rella, 2010.

Table 1: 24 May 2011 and 30 May 2011 should read 24 May 2012 and 30 May 2012.

Figure 3, top panel: reduce y-axis range.

Reference:

Rella C. W., H. Chen, A. E. Andrews, A. Filges, C. Gerbig, J. Hatakka, A. Karion, N. L. Miles, S. J. Richardson, M. Steinbacher, C. Sweeney, B. Wastine, C. Zellweger, 2012. High accuracy measurements of dry mole fractions of carbon dioxide and methane in humid air, *Atmospheric Measurement Techniques Discussion*, 5, 5823-5888.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, 5, 5449, 2012.

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