Authors response to anonymous referee #1 on "Evaluation of a field-deployable Nafion™-based air drying system for collecting whole air samples and its application to stable isotope measurements of CO_2" by Paul, D. et al.

Dear Referee,

Thanks a lot for your valuable and constructive comments. We have revised our manuscript based on the comments we received. Through this document, we are addressing all comments we received, shown in *italic* font and our responses to them are shown in regular font (inserted texts are underlined).

In addition, there were some errors in the annotations of Figure 4 which has been updated (n in dry mode was 11 and not 12; standard error of the mean corresponding to $\delta^{13}C$ and $\delta^{18}O$ was changed to 0.013 and 0.005, respectively from 0.008 and 0.004).

Sincerely,

Dipayan

(on behalf of all co-authors)

- *Scientific quality: 1 The authors examine parameters required to insure the integrity of the samples, and then a NAD develop a drying system that meets these requirements based on multi-tube Nafion driers. The methods used are sound with a structure to the examination of the drying system that provides confidence that the authors are fully aware of effects that exist with other drying systems. The examination of both mole fractions and isotopic composition in a very controlled manner with techniques that are proven ensures that their results are sound. The assessment of the NAD system under conditions that closely match the real sampling environments additionally provides confidence that the experimental results are meaningful. While the assessment of the isotopic composition in section 3.3 was at a reduced flow rate compared to both normal operation and the assessment in section 3.4, the authors indicate that the lower flow rate will impact more heavily as the residence time is greater. The authors may wish to discuss the results from section 3.3 and the case 5 results from section 3.4 which are similar tests at different flow rates to demonstrate that their assertion is correct.*

Authors response: Indeed, experiment shown in Figure 4 is comparable to the results shown in Figure 6 (case 5). We have added the following text at the end of section 3.4.

"... Case 5 is in fact comparable to the experiment shown in Figure 4, only differing in their used flow rates and that the former being a flow-through semi-continuous measurement scheme. Although we have argued that higher flow rates are likely favourable for reduced isotopic exchange (observable in $\delta^{18}O$) due to the reduction in the interaction time between the NAD surface and CO_2, Case 5 is slightly more biased than expected, based on Figure 4. This is likely caused by the additional and variable interaction of the sample with the flask surface, not encountered during the flow-through experiment shown in Figure 4."

- *Presentation quality: 2 The authors provide experiments that demonstrate the ability of the NAD to sample air with minimal alteration, they compare their results to the WMO GAW compatibility goals. It should be noted that while the flask sampling on aircraft takes place in Brazil the compatibility goal for CO2 should be 0.05 ppm for the Southern Hemisphere.*

Authors response: We have added the Southern Hemisphere compatibility goals in Figure 6.

- *In section 2.1 the authors describe the use of a G2301 cavity ring down spectrometer which measure CO2, CH4 and H2O. They do not provide a measurement precision for H2O, but rather for carbon monoxide which is not measured by the instrument.*

Authors response: We have corrected this part and reads as follows:

"…The overall measurement precision of the CRDS-systems used was typically <0.03 µmol mol^{-1} (ppm) for CO_2, <0.2 nmol mol^{-1} (ppb) for CH_4, based on our long-term measurements of target cylinders, and <30 ppm for H_2O, based on manufacturers specifications."

- *A molecular sieve type 3A is employed to dry the backflush air for the Nafion, the authors may wish to provide manufacturer and grade details in section 2.2 line 140.*

Authors response: Added.

"The NAD contains two Perma Pure PD-Series™ Nafion™ dryers (PD-200T-24-MSS), a molecular sieve cartridge (type 3A, ~2 mm beads, 350 g, Sigma Aldrich), a 2 micron in-line filter (Swagelok, SS-4FW-2), stainless steel tubing and various Swagelok connectors."

- *The authors have prepared a well structured and readable manuscript. There are several typographical errors that if resolved would improve the paper. Some examples of these are: Page 2 ln35, missing word after that. "We estimated that least 8 flasks ..." Page 9 ln 223, A comma is required after "each" in the text. "24-inch Perma Pure PD-Series gas dryers containing 200 Nafion tubes each in a stainless steel tube shell"*

Authors response: We have corrected these sentences:

"…We estimated that at least 8 flasks can be sampled (at an overpressure of 275 kPa) with a water vapour content below −2 °C dew point temperature during a typical flight sampling up to 5 km altitude over the Amazon, whereas the remaining samples would stay well below 5 °C dew point temperature (at 275 kPa)."

"…Due to the relatively high flow rate of the PCP-PFP sampling system of up to 15 L/min we choose to use the 24-inch Perma Pure PD-Series gas dryers containing 200 Nafion™ tubes each, in a stainless steel tube shell designed for high flows up 40 L/min."

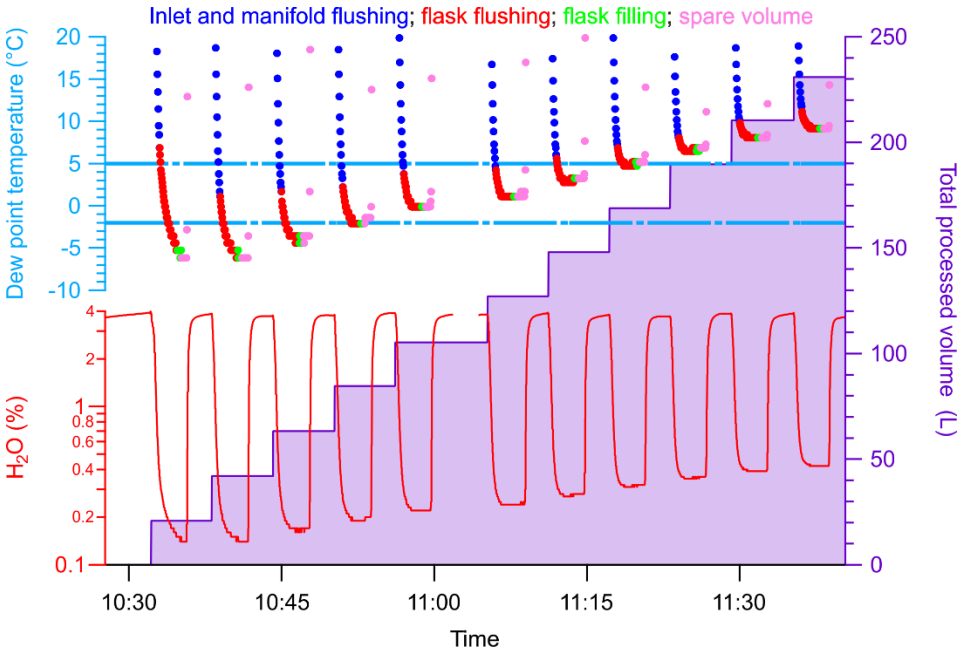
- *The GAW report 242 should include the names of the editors in the reference.*

Authors response: This reference has been modified to:

19th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases and Related Measurement Techniques (GGMT-2017), 27-31 August 2017, Dübendorf, Switzerland, Edited by Andrew Crotwell and Martin Steinbacher, GAW Report No. 242, 2017.

- *Figure 2. The scale for H2O % needs some attention between 0.1 and 1 as the decimal place is not present.*

Authors response: The figure has been updated:



- *Figure 5. The authors refer to the excess flow line within the text and state that the CRDS instrument and the hygrometer are both attached to this line. In the Figure 5 this is depicted as two separate lines. The authors may wish to clarify either the text or the figure to indicate clearly the configuration used.*

Authors response: The schematic shown in Figure 5 depicts the correct configuration and the text has been adjusted accordingly.

"A Picarro CRDS was used to measure the stability of CO_2, CH_4, and H_2O in the flow exiting the buffer volume, as shown in Figure 5."