Very satisfactory revision and a few remarks for further improvement

This is the first iteration of the manuscript by Santos et al. The authors have indeed provided very satisfactory answers to all the questions/remarks raised and the modifications they have performed have improved the manuscript considerably. Thereby I would recommend the manuscript for publication in AMT after the following four points are addressed. I would also recommend a final "scanning" of the manuscript for possible language use glitches.

1 Allan variance tests

The authors have performed a very useful Allan variance test. The results of the test however are not discussed thoroughly and the test could be described/introduced a litte bit better in the opening of section 3.2.

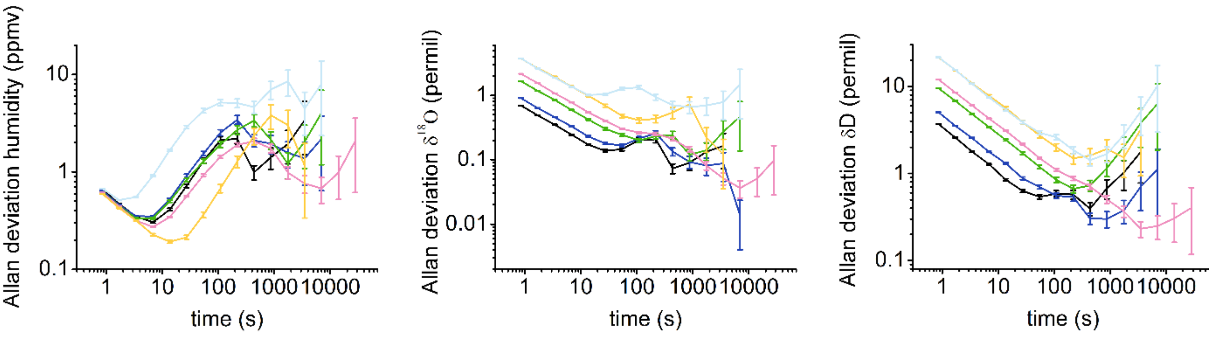
Some readers may not be familiar with the term Allan variance and how such a test is performed and data-processed. Please provide some information on the aspects of your test that would help the reader learn more about your methods and not only your results.

From the plots of the results there emerge some interesting findings. Firstly the stability of your water concentation signal seems to be much worse when compared to the δ18O signal. However this does not seem to affect your ability to improve your signal-to-noise in the δ18O signal by further averaging your measurements. In other words to say that your isotope signal depends strongly on the humidity level is not exactly right. Another important finding is that for averaging times around 500 s the signal-to-noise seems to be very comparable between all humidity levels. This is also important to note.

I would encourage the authors to look closely at the results of the Allan variance test and commend carefully on them. Suggestions for optimal averaging times can be drawn. Interestingly enough the δ18O and δDsignal at the level of 320 ppm seem to show the best performance with respect to stability and potential for improving the signal-to-noise through averaging. It could also be a random result. Whatever the case I would recommend utilising this test even more for the further development of the system and dare to go even lower in concentration (100, 200 ppm) to see if this stability is observed there. These further tests would be extremely welcome as an addition to the current revised version but I would not require them for publication.

>> Indeed, this part could be improved and we followed the advice of the reviewer. First, we present now two additional Allan variances obtained at 170 ppmv with 2 different stability results for this humidity level: in one case the Allan variance is very stable (yellow curve on new figure 3) and in the other case, the minimum Allan variance is significantly higher while still under 10 ppmv (blue curve on new figure 3). For both cases, the minimum Allan variance for δ^{18}O and δD is significantly higher than the one obtained at higher humidity level (black and blue curves on new figure 3).

We have inserted this new figure in the revised manuscript with a text to follow the reviewer advice and better explain the Allan variance concept and how we use it:



(a) (b) (c)

Figure 3: *Allan deviation over 4 hours for different humidity levels (black 1,080 ppmv; dark blue 770 ppmv; green 400 ppmv; pink 320 ppmv; yellow and light blue 170 ppmv) for humidity (a), $\delta^{18}O$ (b) and δD (c).*

A proper approach to quantify the stability of our system is to use the Allan variance defined as:

$$\sigma_y^2(t) = \frac{1}{2}(\langle y_{n+1} - y_n\rangle^2) \qquad \text{(eq. 3)}$$

where y_n are the successive measurements over a period t.

An Allan variance plot as a function of averaging time is indeed useful to determine the optimal time over which the sample humidity and the isotopic composition should be averaged to obtain a precise determination (low standard deviation) and avoid drift. Figure 3 displays the Allan deviation (square root of the Allan variance) in δ^{18}O, δD and humidity obtained by running a long plateau of standard A or standard B in the "infuse" mode over 4 hours for different humidity levels. The humidity variance always stays below 10 ppmv over the 4 hours test and the δ^{18}O and δD Allan deviations display minimum values below 1 ‰ and 7 ‰ respectively. The minimum value for the δ^{18}O and δD Allan deviation is generally obtained for about 15 minutes of measurement. While the Allan deviation of δ^{18}O and δD is dependent on the analyzer used, we observe that the Allan deviation at 1000 s (17 minutes) for δ^{18}O and δD also depends to some extent on the humidity level: the lowest levels are obtained for humidity levels of 770-1,080 ppmv and the highest levels are obtained for humidity level of 170 ppmv.

2 Effect of air flow and Table S2

A description of how this test is performed and the results of the test itself belong in the main part of the manuscript. Please provide more text introducing the experiment and the methodology used.

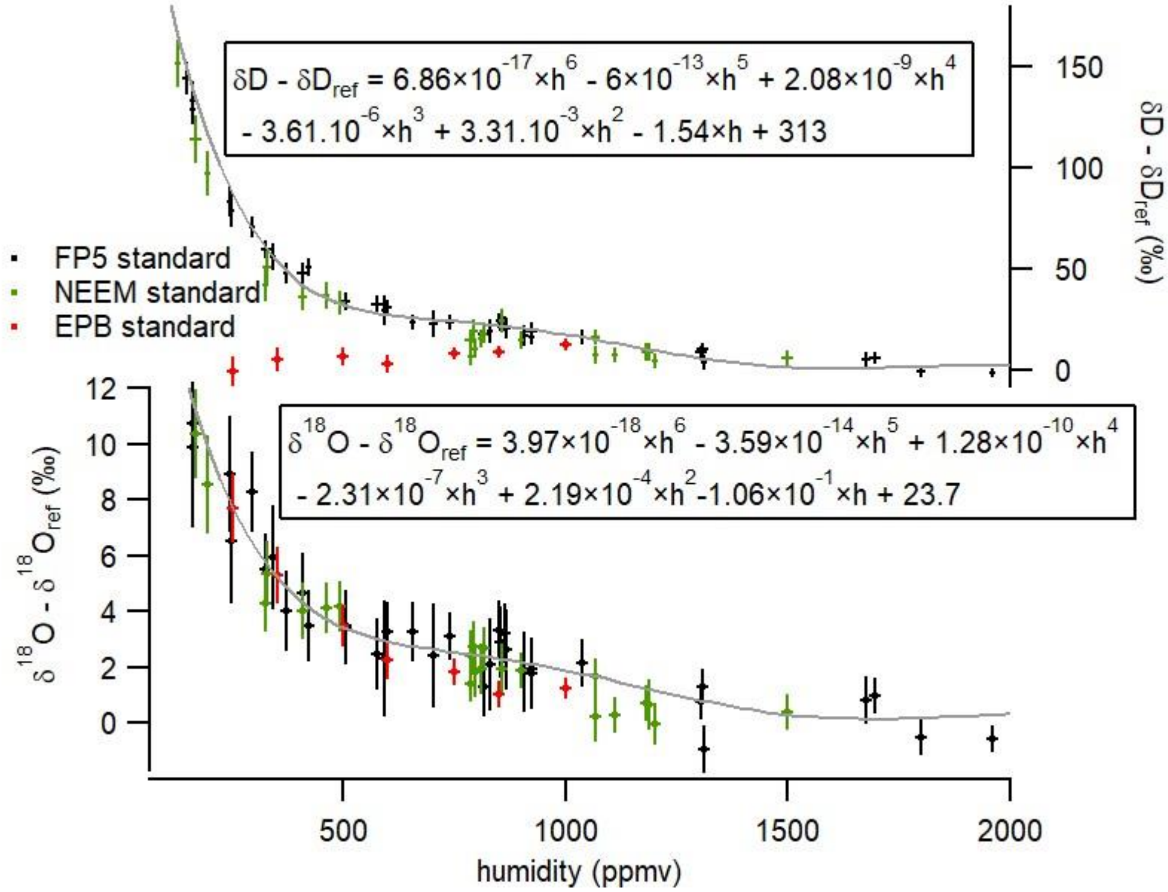
>> The Table S2 has been placed in the main text and an explanation has also been written as follows:

"The stability of the instrument has been tested over a large range of parameters. We show an example in Table 2. We modified the air flow associated with standard A (the same results can be obtained with standard B) between 200 and 400 sccm with an air flow on channel B of half the value of channel A. The infusion rate was varied between 0.03 and 0.14 μL/min in order to produce humidity levels of 400 and 800 ppmv. The 1σ standard deviations observed over 10 minutes plateaus are comparable to the standard deviation obtained when the air flow is set to 300 sccm."

3 Humidity correction equation

The equation the authors provide is a high order polynomial, which from my experience is prone to overfitting and erroneous behavior at the edges of the fitted interval. I would appreciate a Figure 5 that is big in size with the correction curve included in the plot. Discuss edge effects using the polynomial correction (if any) and define limits if such effects are apparent.

>> We followed this suggestion with the new figure 5 displayed below. We also added a sentence to specify the range of validity of equations 4 and 5, see below:



*“**Figure 5**: Influence of humidity on the isotopic composition ($\delta^{18}O$ and δD) of the vapor obtained with the LHLG with 3 water lab-standards. The error bars are calculated as the standard deviation (1σ) over the generated values by the L2130-i instrument during 10 minutes at 1 second resolution (i.e. without any pre-averaging of the raw dataseries). The $\delta^{18}O_{ref}$ and δD_{ref} are the values of the injected water standards at 2,000 ppmv. The grey lines represent the polynomial fits for the influence of humidity on the water isotopic composition (equations 3 and 4 also written on the graph).”*

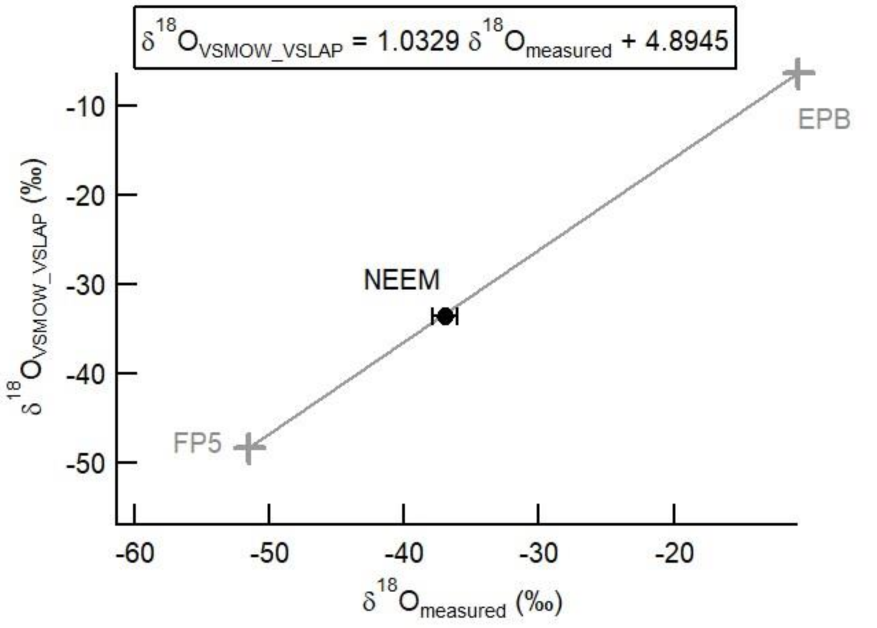
[…]

“These curves are valid only for a given Picarro analyzer and for humidity lower than 70 ppmv and higher than 2,000 ppmv. Outside this calibration range, the extrapolation of the polynomial function may lead to anomalous corrections.”

4 VSMOW-SLAP

Section 3.5 is too short and in my view should have a title that refer to the term SMOW-SLAP calibration. I would also like to see a calibration curve where the two extreme points (EPB, FP5) are used to define the line of calibration and NEEM is treated as an unknown. Even though to some they may appear trivial it is good practice if you write the equations on the slope and intercept of the calibration line. It also needs to be stressed out that the use of the standard waters and the calibration procedure is not there only for the assessment of the accuracy but it is a vital part of the post processing of the vapour measurements. The term VSMOW is not found in neither the abstract nor the introduction of the manuscript. It needs to be mentioned so the reader knows that the authors have addressed the essential step of the SMOW-SLAP calibration.

>> A calibration curve has been added as in figure S3 below (the equation with slope and intercept is also given):



<u>Figure S3</u>: *VSMOW-VSLAP δ^{18}O values vs measured δ^{18}O values for three standards (FP5 and EPB in grey; NEEM in black). The relationship between VSMOW-VSLAP and measured δ^{18}O values for FP5 and EPB (equation given in the box) are used to check the accuracy of the system when measuring standard NEEM as an unknown sample.*

The title of the section has been modified as:

3.5- Accuracy of the system and calibration on the VSMOW-VSLAP scale

A sentence has been added in the abstract:

We checked the stability of the system as well as its accuracy when expressing the measured isotopic composition of water vapor on the VSMOW-VSLAP scale.

We modified one sentence of the introduction:

Obtaining continuous and accurate measurements of the water vapor isotopic composition expressed on the VSMOW-VSLAP scale at Concordia station in central Antarctica is a key scientific challenge since the deep ice core drilled there, EPICA Dome C, provides the oldest continuous water isotopic record expressed on the VSMOW-VSLAP scale to date (Jouzel et al., 2007).