

ANSWER TO EDITOR'S REVIEW

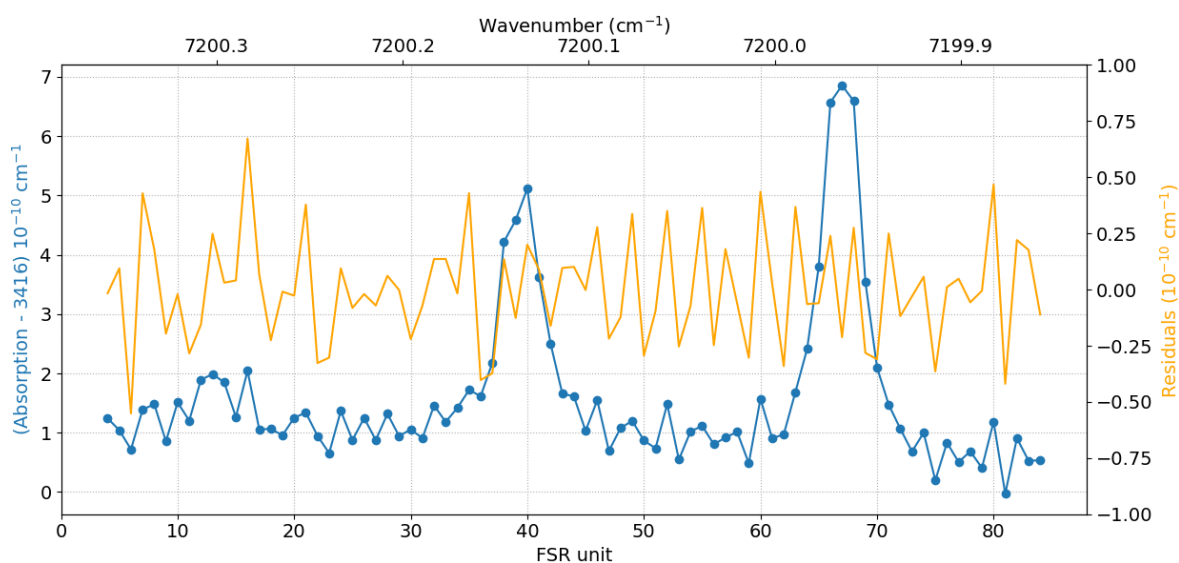
ANSWER TO REVIEWER2'S REVIEW (page 9)

Dear Authors,

I would like to thank you very much again for submission to AMT. Your manuscript underwent a thorough review process and both referees attest to the high quality of your revised submission. However, as pointed out in one of the reports, the grammar needs to be improved substantially. I therefore decide to publish subject to minor revisions (review by editor) and I ask you to consider all of the suggestions provided by the corresponding referee report as well as the comments that are detailed further below. I also have three minor topical questions that should be addressed in the revision.

1. Figure 2, which has been the subject of previous referee comments should be improved. At first sight it seems that scales of the axes on the right- and left-hand side are quite different, but as a matter of fact they are very similar. I therefore suggest that you improve readability of the graph by using units of $1\text{E-}10\text{ 1/cm}$ on the right and on the left hand side and plot (absorption - 3164) $\text{E-}10\text{ 1/cm}$ on the left instead of just the absorption signal. To ease the mind of the spectroscopically aware reader and especially to allow quick location of eventual traces of the H₂O peak, please also provide a second x-scale (x-axis on top) in wavenumber units. Finally, it is not immediately clear how the residual trace depicted in Fig. 2 has been obtained. Has the fit been applied directly to the absorption signal shown in the figure or to a background corrected version of the spectrum, and which fitting function has been used (Voigt profile, what about the empty cell signal, methane, baseline function, ...) ?

We thank the editor for this comment which helped us to improve the readability of Figure 2. The left axis has now units of $1\text{E-}10/\text{cm}$ and the background absorption offset has been subtracted. This offset corresponds to the absorption losses inside the optical cavity (e.g by light scattering on the cavity walls). We also added a secondary x axis with the wavenumber.



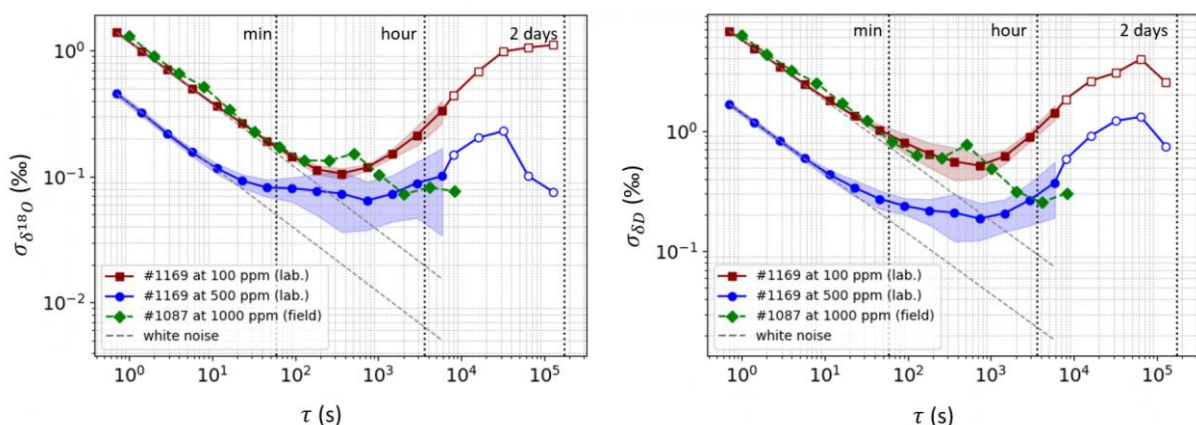
The fit has been applied directly to the absorption signal shown in the figure with Voigt profiles for the water and methane absorption lines, and the background absorption (the baseline) is fitted with a quadratic function.

A sentence has been added (line 86 in the marked-up manuscript): “The spectral fitting is performed using Voigt profiles for the water and methane absorption lines and an additional quadratic baseline to account for background absorption losses.”

2. The absolute numbers for the 2-day stability are certainly not critical for the outcome and conclusions of the paper, but the last data points of all four blue and red curves in Fig. 4 are likely artifacts and need to be verified and/or removed. At least, these points don't seem to be produced by a conventional Allan deviation analysis, which provides data points that are equally spaced on a logarithmic scale (at $\tau = \Delta t \cdot 2^n$, where $\Delta t = 8\,000$ s and $n = 0, 1, 2, \dots$). While points at 8 000 s, 16 000 s, 32 000 s, 64 000 s and 128 000 s are shown correctly in Figure 4, the next point should be at 256 000 s, but it is at 172 800 s! Moreover, and this is even more puzzling on Figure 4, the y-values at $t = 2$ days are identical to the y-values at 128 000 s. This points to a critical problem in the analysis software or the production of the graph. Therefore, I need to ask you to carefully check your data using independently verified and freely available software, such as DATAPLOT from NIST or the avar function provided in the statistical software R. These software packages also provide error bars which for long integration times are currently missing in the graph.

On a related issue, when mentioning the stability over two days (lines 161-162), it would be more appropriate to use the maximum of the deviation curves between 10000 and 100000 s. Please also add "P. Werle, R. Mücke, and F. Slemr. The limits of signal averaging in atmospheric trace-gas monitoring by tunable diode-laser absorption spectroscopy (TDLAS). Appl. Phys. B, 57:131–139, 1993" to your list of references. These authors have brought the Allan variance stability analysis to the domain of environmental spectroscopy.

We thank the editor for pointing out several aspects of this figure and the error on the last point of the curve at $t = 2$ days, which is now removed. We propose a new way of presenting the Allan deviation of the 100 ppm and 500 ppm calibrations. This should help to clarify the figure and answer the questions



- The long-term AD including “the gaps” and starting at $t = 8000$ s is now showed with empty markers to be clearly distinguished from the more classic AD determination (without gaps). There is a poor confidence on the last point of this AD so we decided to remove it.

- From $\tau = 8000$ s, the points corresponding to AD without gaps (red and blue filled markers) are overlapping with the long-term AD points within the uncertainty ; to avoid any confusion (particularly concerning spacing between points) we no longer plot them in Figure 4.
- This Allan deviation has been compared to adev and oadev function available in the Python package "AllanTools" (see <https://allantools.readthedocs.io/en/latest>) which provide the same results.
- The maximum values of AD between 10000 and 100000 s have been added in the text (line 174 and 175 of the marked-up revised manuscript).

Thanks for the reference suggestion. It has been added (line 108 of the marked-up revised manuscript)

3. Five different standards are used. It would be convenient to summarise their isotope composition in one Table.

A table has been added :

	$\delta^{18}\text{O}$	δD
Ross 7	$(-18.94 \pm 0.05) \text{‰}$	$(-146.0 \pm 0.7) \text{‰}$
AO1	$(-30.60 \pm 0.05) \text{‰}$	$(-238.3 \pm 0.7) \text{‰}$
TD3	$(-40.19 \pm 0.05) \text{‰}$	$(-313.6 \pm 0.7) \text{‰}$
FP5	$(-50.52 \pm 0.05) \text{‰}$	$(-394.7 \pm 0.7) \text{‰}$
OC4	$(-53.93 \pm 0.05) \text{‰}$	$(-422.7 \pm 0.7) \text{‰}$

Table 1: List of in-house standards used in this study and their SMOW/SLAP calibrated $\delta^{18}\text{O}$ and δD values (determined with a Picarro analyser for δD and mass spectrometry for $\delta^{18}\text{O}$).

Wording & grammar suggestions

(in the following, the abbreviation 'l.' is used to indicate a line number)

We thank the editor for this careful reading improving the quality of the manuscript. The line numbers below correspond to the marked-up version of the revised manuscript.

General comment: The use of commas and points in decimal numbers is confusing. For example, sometimes a comma is used to separate three digits (line 142 '8,000 s', l. 247 '50-1,500 ppm'), sometimes it is not (eg. line 162 '1000 ppm', l. 241 'above 1000 ppm', l 264 '50 to 6500 ppm', etc.). This even occurs on the same page of the manuscript and triggers the question whether the comma is a decimal comma or not. The general recommendation for scientific publications (see BIPM, IUPAC, etc.) is that thin spaces can be used to group digits and that 'neither dots nor commas are ever inserted in the spaces between groups'. I would like to ask you to comply with this convention.

We removed all the digits separators; thin spaces have been inserted

I. 19-20 Please revise the last phrase 'The high finesse instrument demonstrates a stability up to two days of acquisition with a limit of detection down to 10 ppmv humidity for δD and 100 ppmv for $\delta^{18}O$.' Please rephrase. Information given in the abstract should be concise and clear, but here one can only guess what a 2 day stability means if one has read the article and the numbers for the detection limits (δD , $\delta^{18}O$) are missing entirely.

The last sentence has been rephrased and now reads : "With a drift calibration every 48 hours, the stability demonstrated by the high finesse instrument allows to study diurnal cycles down to 10 ppmv humidity for δD and 100 ppmv for $\delta^{18}O$."

I. 28 delete 'such'.

done

I. 31 'The CRDS method is commonly implemented by Picarro company, and gives a high stability through the measurement of the photon lifetime inside the optical cavity instead of the direct absorbed light.' If the main intention is to inform the reader on the physical principles, I suggest to write 'The CRDS method, which is commonly implemented by Picarro, achieves a high measurement stability through the'

done

I. 53 'This technique was first implemented for water vapour isotope analysis with a laboratory prototype (Landsberg et al., 2014) but never successfully deployed in the field, with stable working conditions.' -> 'This technique was first implemented for water vapour isotope analysis using a laboratory prototype under stable working conditions (Landsberg et al., 2014), but never successfully deployed in the field.'

Sentence rephrased as : " This technique was first implemented for water vapour isotope analysis with a laboratory prototype under stable working conditions (Landsberg et al., 2014), but never successfully deployed in the field for extended periods.

I. 54 Start phrase with 'In this paper, we present'

done

I. 67 Cite in text 'For a complete description of the ProCeaS[®] system, the reader may refer to the recent article of Piel et al. describing the OF-CEAS spectrometer used for atmospheric O₂ isotopes measurement (Piel et al., 2024).' -> 'For a complete description of the ProCeaS[®] system, the reader may refer to the recent article of Piel et al. (2024) describing the OF-CEAS spectrometer used for atmospheric O₂ isotopic measurement.'

done

I. 69 'Water isotopes OF-CEAS spectrometers use ...' -> 'The OF-CEAS spectrometers for the measurements of water isotopologues use ...'

done

I. 74 'retrieved from HITRAN database' -> 'calculated from the HITRAN 2020 database'

done

I. 78 'is performed' -> 'is achieved'

done

I. 81 'the shown spectrum' -> 'the spectrum'

done

I. 82 'Nitrogen' -> 'nitrogen'

done

I. 86 'in a various range of gas matrices (pure nitrogen, atmospheric dry air and finally synthetic air with a low water content).' -> 'for a wide range of different gas matrices (pure nitrogen, atmospheric dry air and finally synthetic air with a low water content).'

done

The titles of Figs 1 and 2 should be deleted. The second seems to be inappropriate as it is essentially the spectrum of a very dry cavity.

Titles have been deleted

I. 94 'in 600 ms' -> 'within 600 ms'

done

I. 95 'correct' -> 'useful'

done

I. 96 'In order to keep a fast, real time data acquisition, the fitting algorithm is tuned so that most parameters are fixed.' -> 'In order to keep the data acquisition fast and in real time, the fitting algorithm is tuned by fixing most parameters.'

done

I. 113 'maximal' -> 'maximum'

done

I. 117 Start phrase with 'In this section we present'

done

I. 125 'from few hours' -> 'from a few hours'

done

I. 139 'two first' -> 'first two'

done

I. 143 8,000s -> '8000 s'

done

I. 155 Use 'tau' instead of 't' in the white noise law.

done

I. 159 'arising along the laser to cavity optical path' -> 'arising along the optical path between laser and cavity'

done

I. 161 'After two days, we calculate an AD ...' -> 'At a delay of two days, we observe an AD ...'

done

I. 164 'hourly region' -> 'on the time scale of a few hours'

done

I. 177 Write 'In Figure 5, we present ...'

done

I. 200 'Indeed, large temperature variation' -> 'Indeed, large temperature variations'

done

I. 205 Replace 'lightly' by 'slightly' in Table 1, I likewise recommend to replace 'highly depleted' by 'strongly depleted'

done, and elsewhere in the manuscript as well

I. 235 Start phrase with 'In Figure 6, we show'

done

L. 223 - 225 Use italics for mathematical symbols f, h.

I. 258 Avoid using the comma as a separator for

done

I. 271 'further away than the large water absorption peak' -> 'further away from the large water absorption peak'

done

I. 279 'linear, global' -> 'global linear'

done

I. 288 'inside' -> 'within'

done

I. 327 'we plotted the associated standard deviation after 24 hours $\sigma(\delta_i)$ as predicted by the Allan deviation study' -> 'we plotted the Allan deviation for 24 hours $\sigma(24h)$ as predicted by the study in section xxx' If you want to indicate the delta values, use the subscript notation as in Fig. 4.

&

I. 329 An Allan deviation is not a standard deviation: 'standard deviation' -> 'Allan deviation'. Please make according corrections also in the manuscript.

For these two comments, in fact we have modified the first manuscript to follow the request of one reviewer (reviewer 3): " - The caption is confusing. The authors are not plotting Allan deviation after 24 hours, they are plotting the predicted standard deviation after 24 hours of integration as predicted from an Allan variance analysis."

So we feel quite uncomfortable changing now, but we can discuss it further

I. 328 use superscript for 18

done

I. 335 'This threshold value is indicated on the figure by the horizontal dotted line' -> 'These threshold values are indicated on the figure by the horizontal dashed lines'

done

I. 340 'led' -> 'leads'

done

I. 330 'correct' -> 'proper'

done

I. 338 'that we should preferably consider δD to $\delta 18O$ in very dry environments.' -> 'that we should prefer acquisitions of δD over measurements of $\delta 18O$ in very dry environments.'

done

I. 342 'showed' -> 'shows'

done

I. 355 'We compare in Figure' -> 'In Figure , we compare'

done

I. 359 'This shows the ability for the OF-CEAS technique to capture with a high precision transient events' -> 'This shows the ability of the OF-CEAS technique to capture transient events at high precision'

done

I. 369 'on the Allan' -> 'by the Allan'

done

I. 376 'This leads for the OF-CEAS' -> 'This leads'

done

I. 394 replace by a more appropriate term the word 'global', or delete it.

removed

I. 395 'The low humidity divergence' -> 'The divergence at low humidity'

done

I. 398 'to changing gas mixture can' -> 'to a changing gas mixture can'

done

I. 412 'and in particular possible methane contribution (see Figure 1) ...' -> 'and in particular a possible contribution from methane (see Figure 1) ...'

done

I. 416 'those'-> 'these'

done

I. 416 'Such artefacts are complicated to evaluate ...' -> 'Such artifacts are difficult to evaluate ...'

done; we kept artefacts as more in line with GB English like "vapour" (see your recommendation below)

I. 422 'vapor'->'vapour', please check all instances

done and checked

I. 423 'great interest for' -> 'great interest in'

done

I. 438 'through long-term' -> 'through a long-term'

done

I. 446 'like in-situ measurement of the isotopic composition of individual snowflakes.' -> 'like the in-situ measurement of the isotopic composition of individual snowflakes.'

done

I. 449 'The OF-CEAS analyser limitations highlighted in this article concern the instabilities encountered in the hourly range, which we attribute to parasitic interferences.' -> 'The OF-CEAS

analyser limitations highlighted in this article are instabilities that develop at the time scale of a quarter-hour or so, which we tentatively attribute to the evolution of parasitic interferences.'

[Done](#)

ANSWER TO REVIEWER2'S REVIEW

I think the authors have adequately responded to my previous review, except for improving the grammar. I think the manuscript will be ready for publication after incorporating the below edits or completing a thorough proofread themselves. The below suggested clerical edits use line numbers from the track-changes document with file name "egusphere-2024-2149-ATC1.pdf".

We would like to thank the reviewer for this thorough and careful edit work.

line 22 - "Stable water vapour isotopes" should read "Water vapour stable isotope", and note 'isotope' is singular in this case

DONE

line 31 - either change "by Picarro company" to read "by the Picarro company" or "by Picarro". Below, on line 55, you have "with the AP2E company". Be consistent.

DONE and whole manuscript checked

line 33 - "stable water vapour isotopes" should read "water vapour stable isotopes"; check throughout manuscript for this change; you are measuring the stable isotopes in water vapour, not the isotopes in stable water vapour.

DONE and whole manuscript checked

add comma after "e.g." throughout manuscript; you are saying "for example, cold fronts, cyclones"

DONE and whole manuscript checked

line 36 - change "on board of boats" to read "on board boats"

DONE

line 37 - change "number of studies is also" to read "number of studies are also"

DONE

line 41 - change "isotopic records in ice core which" to read "isotopic records in ice cores, which"

DONE

line 43 - change "However, CRDS struggle" to read "However, CRDS struggles"

DONE

line 45 - change "or in altitude" to read "or at altitude"

DONE

line 48 - change ", allowing to narrow down" to read ", to narrow down"

And

line 49 - change "the cavity resonances (Morville" to read "the cavity resonance (Morville" OR if you wish to keep resonances plural, then change "laser emission frequency by locking it to the cavity resonances" to read "laser emission frequencies by locking them to the cavity resonances". The plural form is consistent with the following sentences.

We have rephrased this sentence to make it clearer : "This allows us to stabilise the laser emission frequency by locking it successively to the multiple cavity resonances (Morville et al., 2014; Romanini et al., 2014)."

line 58 - change "water vapour isotopes monitoring" to read "water vapour isotope monitoring"
DONE

line 65 - change "in term of robustness" to read "in terms of robustness"
DONE

line 68 - change "atmospheric O2 isotopes measurement " to read "atmospheric O2 isotopic measurement "
DONE

line 69 - change "Water isotopes OF-CEAS" to read "Water isotope OF-CEAS"
sentence modified following the suggestion proposed by the editor → "The OF-CEAS spectrometers for the measurement of water isotopologues "

line 74 - change "from HITRAN database" to read "from the HITRAN database"
DONE

Figure 1 minor suggestion - place the dotted red sum line behind the H2O blue line.
We prefer to leave the Figure as it is, since if we place the dotted line behind the blue line, it will no longer be visible.

Figure 2 caption - change the comma at the end of "than 52 ms," to a period.
DONE

line 97 - change "time is of 52 ms in" to "time is 52 ms in" or "time is approximately 52 ms in"
DONE

lines 109, 110 - change "gives an easy access" to "gives easy access"
DONE

line 114 - change "This permits to assess the spectrometer" to read "This permits the spectrometer to assess"

We have changed to "This allows the assessment of the spectrometer stability"

line 117 - change "by AP2E company." to read "by AP2E."
We changed to read "by the AP2E company" for consistency with previous corrections (your suggestion for line 31)

line 124, 125 - change "perform Allan deviations (AD) measurements" to read "perform Allan deviation (AD) measurements"
DONE

line 148 - reword "The use of the second dataset enables to reach a time range" to read "Using the second dataset allows for a time range"
DONE

line 157 - This sentence is rather confusing as structured; consider rewording it to make the comparison more apparent: "The ADs of the low-humidity analyser follow a white noise decay during several minutes, with a minimal value of 0.1 ‰ (resp. 0.06 ‰) for $\delta^{18}\text{O}$ at 100 ppm (resp. 500 ppm) and 0.5 ‰ (resp. 0.2 ‰) for δD at 100 ppm (resp. 500 ppm)."

The reworded sentence reads "The ADs of the low-humidity analyser follow a white noise decay during several minutes, with a minimal value for $\delta^{18}\text{O}$ of 0.1 ‰ at 100 ppm and 0.06 ‰ at 500 ppm (0.5 ‰ and 0.2 ‰ for δD at 100 ppm and 500 ppm, respectively)"

line 161 - Similarly, this sentence has the same confusing comparison structure: "After two days, we calculate an AD of 1 ‰ (resp. 0.09 ‰) for $\delta^{18}\text{O}$ at 100 ppm (resp. 500 ppm) and of 2.5 ‰ (resp. 0.7 ‰) for δD at 100 ppm (resp. 500 ppm)."

Similar rewording done

line 174 - change "two standards injections" to read "two standard injected"

DONE

line 177 - change "performed all over" to read "performed over"

DONE

line 182 - change "After a filtering" to read "After filtering"

DONE

line 184 - change "calibrations for the CRDS analyser" to read "calibrations for the CRDS analysers"

the corrected sentence reads "we obtain 138 calibrations for the OF-CEAS analyser and 146 calibrations for the CRDS analyser"

Figure 5 caption, line 194 - the sentence starting with "The blue line (resp. green line)" is confusing as worded similar to the above line 157, and 161 comments.

The sentence has been reworded and reads "The blue line corresponds to the AP2E OF-CEAS dataset smoothed over a 5-point window, and similarly the green line corresponds to the smoothed Picarro CRDS dataset."

line 199 - change "that the analysers calibrations" to read "that the analysers' calibrations"

DONE

line 201 - change "variation have been registered" to read "variation has been registered"

changed to "variations have been registered"

line 202 - change "This points out the need for a" to read "This underscores the need for a"

DONE

line 212 - change "such as spectroscopic effect affecting the fitting procedure, or memory effect)" to read "such as spectroscopic fitting or memory)"

We feel that this suggested wording is too abbreviated and would prefer to keep the original sentence.

line 214 - remove "contents"

DONE

line 221 - change "using the additionnal calibrated" to read "using the additional calibrated"

DONE

line 224 - remove "then"

DONE

line 239 - change "various series of measurement" to read "various measurements"

DONE

line 241 - change "and finish with the" to read "and finishes with a"

DONE

line 246 - change "A first humidity sequence" to read "An initial humidity sequence"

DONE

Figure 6 caption, line 264 - change "The y-axis are" to read "The y-axes are"

DONE

line 272 - change "observe a larger noise" to read "observed increased noise"

DONE

line 284 - change "and for longer time period" to read "and for longer time periods"

DONE

line 292 - I believe a negative sign is missing in the phrase "0.7 ‰ for $\delta^{18}\text{O}$ ". Based on Figure 7, TD3 is below the expected value.

Yes, we were thinking in terms of absolute value, but you are right → corrected

Figure 7 caption, line 297 and elsewhere - You have many notations to express "VSMOW-SLAP". I see "IAEA VSMOW/SLAP" and "VSMOW-calibrated" and "VSMOW-SLAP". Pick one notation and change throughout. I prefer one without "IAEA".

We changed to VSMOW-SLAP in all the document

line 323 - By now I am accustomed to the "(resp.)" structure. However, I still think the authors should consider an alternative. Furthermore, the "(resp. dD)" needs a delta symbol rather than a lower case d.

So we keep the "resp." structure in short sentences only. dD changed to δD

line 328 - superscript the 18 in " $\delta^{18}\text{O}$ "

DONE

line 332 - change "are of the order of 10 ‰" to read "are of order 10 ‰"

DONE

line 340 - change "water vapour isotopes monitoring" to read "water-vapour-isotope monitoring"

DONE

line 355 - I suggest changing "permits to reach extreme levels of precision at low water concentrations" to read "allows for high isotope-ratio precision at low water concentrations"

DONE

line 356 - change "at 2 minutes of the" to read "at 2 minutes integration of the"

DONE

line 359 - change "to capture with a high" to "to capture high"

changed to "to capture transient events at high precision" (editor's suggestion)

line 372 - change "acquisition time – enabled to keeping enough precision to " to read "acquisition time, allowing for enough precision to "

sentence modified

line 375 - change "quantify the water isotopes concentration" to read "quantify the water isotope concentration"

DONE

line 388 - change "and tubings before" to read "and tubing before"

DONE

line 390 - change "over all the year" to read "over a year"

changed to "over the whole year" (to imply the different climatic conditions of the year, and not only the duration)

line 415 - change "We emphasize thus the " to read "We emphasize the "

DONE

line 427 - change "offers also the" to read "offers the"

DONE

line 428 - change "like for example various" to read "like various"

DONE

line 433 - change "spectrometers based on the OF-CEAS" to read "spectrometers using the OF-CEAS"

DONE

line 440 - change "drift on neither instrument" to read "drift on either instrument"

DONE