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Atmospheric Measurement Techniques Discussions

Interactive comment on "A dedicated robust instrument for water vapor generation at low humidity for use with a laser water isotope analyzer in cold and dry polar regions." *by* Christophe Leroy-Dos Santos et al.

Anonymous Referee #1

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General comment The manuscript describes a custom evaporator, specifically designed for low humidity areas. Such device was tested in Antarctica for more than one year. The main difference with published literature that report similar devices (e.g. Gkinis et al., 2010 for CFA system) is that water flux into the evaporating chamber is injected with a syringe (which allows very precise tuning of mass flow). Secondly, there is a very precise control of dry gas flux and pressure inside the evaporation chamber. The study presents one of the few instruments (with the micro drop device of Iannone et al. 2009) that can provide stable vapor signal at very low humidity values, suitable

for isotopic analysis with laser analyzers. For this reason I think that the manuscript is well suited for AMT and I only suggest minor revision.

Technical comments: 1- This study represents an extension of the work shown in Landsberg (2014). However, in his study a strong influence of the lead screw rotation was identified as one of the main source of noise in the water vapor signal at low humidity. Is the choice of the pump a critical point for the development of the instrument? There are other critical points for designing/replicating this device that must be taken into account (e.g. how important is the choice mass flow and pressure controller? The authors should discuss this point e.g. in section 2.2.

2- Since large stability of water vapor flux is expected by such device, one would expect an analysis of the stability of water vapor signal, at least in terms of the mixing ratio. An analysis of stability could be the identification/absence of trend during different humidity steps or the analysis of mixing ratio standard deviation as a function of different instrumental configuration (e.g. dry air flux, syringe speed etc). A stability analysis would provide additional evidence of the robustness/reliability of the instrument.

Other minor comments

L136 Period.

L147-148 What is the reason for using fractionation factors of Cappa et al. (2003)?

Figure 2. Check part labels (A/B) because different names are used in text, in table 1 (F1, G1 etc..) and in Figure 3.

L245 In relationship with my technical comment #2: what stable means? No trend observed in mixing ratio? Low RSD?

Figure 4. It is not clear how long it takes the signal to stabilize and whether this stabilization period is related to the humidity level. From Fig.4 it seems so, because injection steps are characterised by different lengths.

Section 3.2 Maybe, two words here (or a simple scatter plot, boxplot) about a possible relationship between precision and humidity level could help the reader understand the stability of the system.

Section 3.3, Figure 5 and Section 4: humidity correction is important. I would like to point out to the authors that a correction based on the difference between observed and reference values for a single standard might not be enough, as recently highlighted out in Weng et al. 2020. Under the perspective of the influence of both humidity and isotopic composition, the correction function should represent a plane and not a line (as one could expect from Figure 4). Moreover, from Figure 4 it is not clear if the scatterplots reports the difference between a single standard (obs-ref) or for different standards (with different isotopic composition) because the plural "standards" word was used. Maybe the authors could highlight that under low humidity and low isotopic variability, the humidity response of the instrument can be determined by analysing one (or two) standard(s).

Cappa, Christopher D., et al. "Isotopic fractionation of water during evaporation." Journal of Geophysical Research: Atmospheres 108.D16 (2003).

Gkinis, Vasileios, et al. "A continuous stream flash evaporator for the calibration of an IR cavity ring-down spectrometer for the isotopic analysis of water." Isotopes in environmental and health studies 46.4 (2010): 463-475.

Iannone, Rosario Q., et al. "A microdrop generator for the calibration of a water vapor isotope ratio spectrometer." Journal of Atmospheric and Oceanic Technology 26.7 (2009): 1275-1288.

Landsberg, Janek. "Development of an OF-CEAS laser spectrometer for water vapor isotope measurements at low water concentrations." University of Groningen (2014).

Weng, Yongbiao, Alexandra Touzeau, and Harald Sodemann. "Correcting the impact of the isotope composition on the mixing ratio dependency of water vapour isotope

measurements with cavity ring-down spectrometers." Atmospheric Measurement Techniques 13.6 (2020): 3167-3190.

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