The manuscript "Non-destructive estimates of soil carbonic anhydrase activity and soil water oxygen isotope composition" by Jones et al. describes in detail their suggested method to estimate the activity of carbonic anhydrase in soils using the $\delta^{18}O$ signal in CO2 soil vapor flux. The manuscript is very well prepared with a detailed description in the methods section and a good presentation of their findings in tables and figures. The study is of general interest to the readership of Hydrology and Earth System Science and I recommend publication after addressing the comments below.

General comments

To my understanding, the non-destructive soil water $\delta^{18}O$ estimations would be either limited to an integrated signal (no depth information) or would need to be conducted with in-situ devices sampling the soil vapor. Thus, the title is a bit misleading as one is often interested in the depth information of the soil water isotope composition. I think that this lack of depth information should be also discussed in the manuscript.

I do not agree with the interpretation of Figure 5 that $\delta_{sm,eq}$ is in equilibrium with waters in hygroscopic water (see P14 L31). Given that the difference between $\delta_{sm,eq}$ and $\delta_{sm,ce}$ is smallest for wettest soils reveals the opposite: The wetter the soil, the smaller is the ratio between volumes of soil water in soil pores and volume of waters in soil pores plus hygroscopic waters. If equilibration would preferably take place with the hygroscopic water, the differences should be highest for wetter soil, as the hygroscopic water would become small relative to the bulk pore water volume (Figure 1).
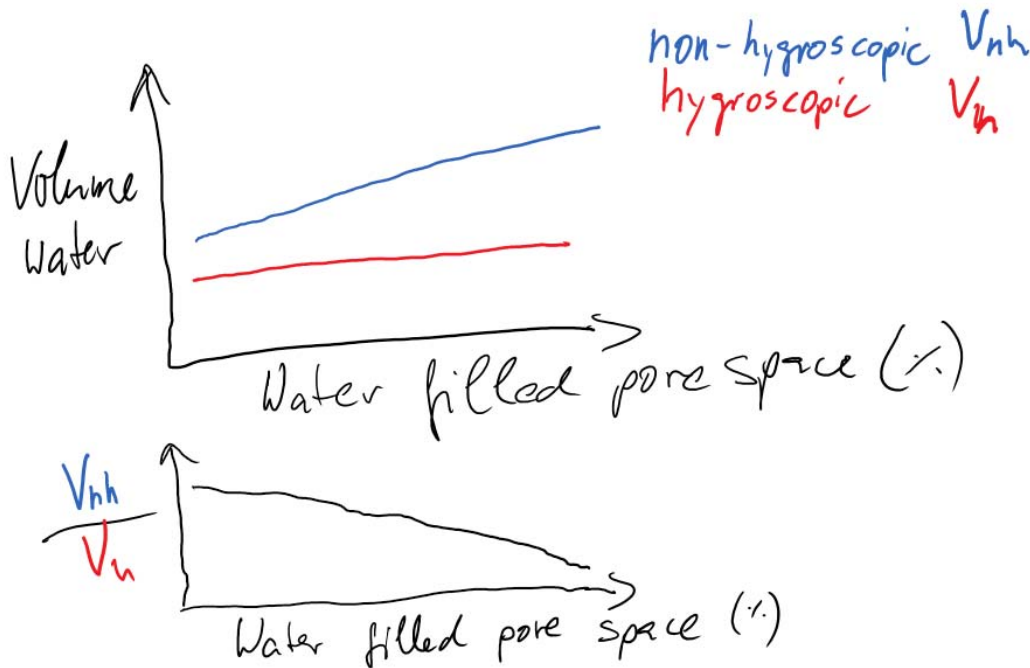

Figure 1 Upper panel: Volume of water that is hygroscopic bound (red) and that is not hygroscopic bound (blue) as a function of the water filled pore space. Lower panel: The ratio between both as a function of the water filled pore space.

Specific comments:

P1 L30: As outlined above, I do not understand that conclusion as I would interpret the Figure 5 differently.

P4 L8: I am missing a clear research question here. You present the research gap, but do not state any hypothesis or research question before getting to the objectives in L9ff.

P12 L16: I suggest providing statistical tests rather than using "broadly". Also for the L19 "distinct".

P12 L31: You do not present $\delta_{sm,eq}$ in the Figure 3. Please add.

P14 L14: I do not like "immobile" water pool and encourage to use a different term, as the soil water held at low pressure heads is less mobile, but not stagnant. However, I know that this is widely used and common nomenclature is missing. Maybe "less mobile" or "water at lower pressure heads"? Or instead "mobile and immobile" using "bulk soil water"?

P15 L2-L6: This reads more like results and introducing a new figure would also better fit to the results section.

P15 L7: You do not have a data point at 95% water filled pore space. Therefore, I prefer you refer here to 75%.

Table 2: Be consistent with the decimal places for the delta-values.

Table 3: In the 5th column, it should be "$\tilde{a}$" not "$\tilde{A}$"

Figure 2: Is the dotted grey line showing the measurements at 1Hz and the dots, diamonds and triangles are showing the average values integrated over time?

Figure 3: Consider adding the $\delta_{sm,eq}$ as you refer to that in the manuscript.