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Comment on hess-2021-459

Anonymous Referee #2

Referee comment on "Extrapolating continuous vegetation water content to understand sub-daily backscatter variations" by Paul C. Vermunt et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-459-RC2, 2021

This research demonstrates the estimation of continuous vegetation water content (VWC) in corn crops at two research sites by adapting an existing method for measuring internal VWC in trees. Sub-daily VWC was succesfully calculated based on the difference between modelled transpiration and sap flow rates at the base of corn stems and constrained and validated with destructive sampling. Second, the research demonstrates the effect of diurnal variations of VWC and dew on radar backscatter. The study is innovative and is a valuable contribution to the field as itprovides new methods and insight in current questions in microwave remote sensing, such as the effect of internal VWC and surface canopy water on the radar signal. I highly recommend to publish the paper, but I have some minor comments.

I believe the data and methods can be described a bit better. If I understood correctly, backscatter data is only available for the 2018 campaign in Florida, but sub-daily destructive samples are only available for the 2019 campaign in the Netherlands. So in short, the method to calculate sub-daily VWC is developed and validated on the 2019 data and then applied to the 2018 data to assess the effect of VWC on sub-daily backscatter variations. I think the paper will be easier to follow if this is stated clearly in section 3. I would even suggest to split data and methods in different sections for clarity.

Figure 2: make the colors more intuitive, either by making the colors an indicator for drought stress (e.g. brown/red), or otherwise a colormap according to date to make it easier to interpret.

Section 3.2.1: It is unclear on which days the destructive samples were taken. It can be seen in figure 2 (but here there are only 7 days, whereas section 3.2.1 states 14 days?), but I think this information should be mentioned already here. To me it led to some confusion at line 230 in combination with section 3.2.2 where it states that because of power issues when measuring sapflow only three days have all data needed to estimate

and validate VWC: July 25, Aug. 23 and 28. A table with an overview of days with destructive samples and sapflow data yes/no would be informative.

Line 243: On July 25 all available data for the CDF-matching were used. Why? What is the difference with the other days?
Line 277: "A sharp backscatter increase after rainfall was observed in all polarizations". Yes this seem true for those rainfall events where soil moisture is also increasing strongly. The event on June 12th seems different, whehre CW increases significantly, but soil moisture shows a very small response. Here VV, HH and crosspol backscatter drop strongly, and then go back to the level before the event, or get slightly higher. Can you explain what is happening here?

Figure 8: maybe only show those days you actually used for the fit?

Figure 9: for the fit you consider the VWC of June 5 and 6 not reliable enough. But for fig 9 a and d are aggregated over 9 days. This means that you did use june 5 and 6 for figure 9, is this correct?
Line 285: delete "the"

Line 286: During the last four aggregated acquisitions... which are these?

Line 295 and onward: where do the values for changes in soil moisture, VWC and SCW come from for typical dry days?
Also the multiple linear regression to assess the effect of moisture stores on backscatter is somewhat unclear. I think it might be more sophisticated to do this calculation with all units in mm? It needs an assumption on soil depth and penetration depth, but it should be possible. If not, I think the statements in line 295 and onward are confusing, since sensitivity and mentioning e.g. "three times more sensitive" is not really the right term here since they units are not the same. Maybe change to something like: Note that the coefficients from soil and vegetation water stores (Table 1) have non-homogeneous physical units. Nonetheless, it shows us that for a typical dry day during the campaign of 2018, e.g. such as June 9th, soil moisture reduced with 0.02 m3m-3 and that this translates to a -0.5, -0.8 and -0.8 dB change in VV, HH and cross-polarized backscatter. During the same day VWC changed with 0.5 kg m-2, which would translate to a change of 1.5, 1.1 and 1.2 dB. This shows us that typical diurnal variation in VWC leads to a three times higher change in VV-polarized backscatter than a typical diurnal change in soil moisture.

Figure 10 is not discussed much in the text. It shortly states that the effect of SCW on backscatter is underestimated based on Fig. 10, but more explanation here would be good.

I suggest to split section 5.1 in two at line 330. One deals with the development and validation of the method with in situ data. The second part is applying the method to a longer period and a different region.
Line 310: what about August 23rd?
Line 352: Also here, i think using "1.5 to 3 times more sensitive" is not the right wording.
Line 366 and onward: make more clear in the text what the results are from your study. Now it is hard to discern if these results are from another study or yours.