Anonymous Referee 2:

> We thank the anonymous reviewer for the constructive and detailed feedback. We will do our best to improve our manuscript accordingly. Our response to reviewer's critique is given in blue indented text after each point addressed by the reviewer.

The paper introduces a microlysimeter for the specific purpose of measuring the deposition of water on the surfaces of the soil and the vegetation by means other than rain (dew, fog, etc.). The deposited amounts of water are quite small, yet the paper argues that they could be important for the vegetation during dry periods. The design of the set-up, with its high observation frequency and high-resolution mass measurements is explained in some detail. The instrument has been in operation in the field. Its performance is reported and evaluated.

General comments

Overall, the paper gets across the relevance of MLs and the improvements the authors have made to earlier designs. The material fits the HESS mission and its readership.

That being said, the paper is wordy and tedious at times. The authors go in so much detail that is hard to follow the line of thought. In contrast, Figure 1 leaves out many technical details, and photographs of the ML and its components are not given.

> The schematic figure 1 leaves out only 4 connection bolts, adding these connection bolts would make the figure busier. But we agree that Fig. 1 is a schematic and not a technical drawing with all details. If the latter is required, we could include a technical drawing in the Appendix, if the Editor decides this should be added. In Figure 1 we will rearrange some numbers to clearer indicate which part is meant and add photographs of the ML to present it in a clearer form.

The Introduction is comprehensive but incoherent, and would benefit from a careful revision. It can be shortened a little perhaps.

> Thanks for this suggestion. We will shorten and rearrange the introduction to increase coherence.

In Materials and Methods, there is no information at all given about the soil of the experimental site. The technical details of the ML setup and its installation and operating procedures need to be described better. The rest of the Methods are very detailed, sometimes about well-established techniques. You can shorten the text there.

> We will add information about the soil at the site. We think that adding photographs of the ML system and photographs of the installation process will also help to better understand installation and operating procedures. Moreover, we will shorten the text in the Methods section where possible.

The authors make a point about separating the various NRW modes, but given the small total flux, I do not understand why this is so important. On the other hand, the differences in soil temperature between the ML and the surrounding soil is downplayed, even though its various effects may linger into the night, when NRW occurs.

Separating various NRW inputs might be less important for plant biologists, which focus more on the reactions of the plants to water supply and are less focused on where this water came from. However, e.g. for meteorologists and agrometeorologists it is crucial how often, when and under which meteorological conditions NRW input occurs. E.g. the formation and dissipation of fog is a process that is not clearly understood. We think adding the separation of various NRW inputs makes this manuscript more interesting for a broader readership, but we agree that ecohydrologists may be mostly interested in the total NRW inputs. For the difference in soil temperature, please have a look at the response on the comment to Section 5.

The material on which the paper is based is solid, but the presentation is not so good. The paper would benefit from a thorough rewrite that increases its coherence and clarity, and reduces its size a little.

The paper mentions a supplement but I could not find that, other than the data set.

We appologize for this error, the supplement has been included as an appendix, but we overlooked the need for a change in wording. We will change "supplement" to "appendix".

Detailed comments

L34: The sentence introducing the new ML looks out of place here. You are still developing the argument for its necessity, only moving from general terms to a specific ecosystem.

We agree and will rearrange the introduction.

L39: If rainfall ('RW') is absent, NRW necessarily IS the only atmospheric source of water, because RW and NRW are mutually exclusive and complementary.

We will change the sentence to: "During drought periods, NRW inputs are the only available atmospheric water source."

L43: 'another temperate site' You did not mention the first one.

We will delete it.

L51: What do you mean by plant water status?

We mean "plant water potential", the term is quite well established in the plant physiological literature (see e.g. Jones, 2006, doi:10.1093/jxb/erl118 for a definition), but we realize now that this is not the case in the field of ecohydrology. We thus will clarify this term accordingly.

L56 and 320: You mention dew deposition on soil, but earlier you stated that does rarely occur.

It does rarely occur, but still there is the possibility that it occurs.

You need to have a careful look at the Introduction. Although I agree with the arguments it presents, they are presented in a confusing order. Above I mentioned the Introduction of a lysimeter in the middle of a discussion about NRW. Elsewhere too you jump between general statements and location-specific arguments without a logical connection between the two. This compromises the coherence of the text and disrupts the flow of thought. All the elements the Introduction needs are there, but please present them in a more coherent order and use more paragraphs as compartments for different focal points of the Introduction.

We will rearrange the introduction as recommended by the reviewer and will delete and shorten where necessary and meaningful.

Section 2: Some subsections are not directly important to understand the ML setup. Perhaps the very detailed material can be placed in the supplement.

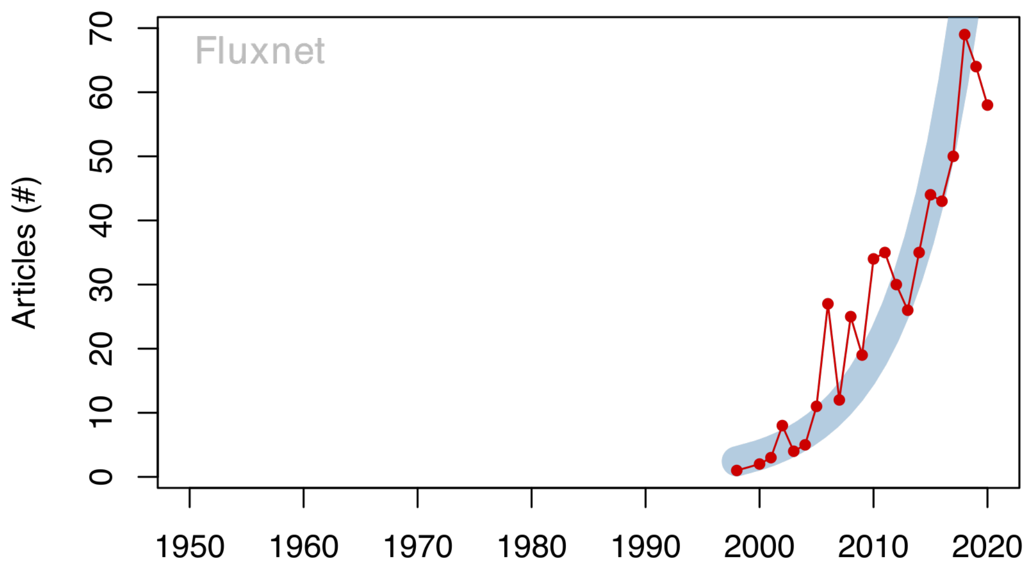
We will move these less directly important subsections to the appendix, i.e. 2.2.3 Soil monolith preparation.

Section 2.1: Please give some information about the soil.

We will add: "The soil at the site is a silt loam mixture (56% silt, 37% sand, 7% clay), with a bulk density of 1.12 ± 0.03 g cm^{-3} and an organic C content of 4.4 ± 0.2% (Stiehl-Braun et al., 2011)."

L124: What is FluxNet? Do we need to know?

This is part of the site information to tell readers in which network this site is embedded. Below is a statistics extracted from the Scopus database on the increasing importance of FluxNet in the field of eddy covariance flux measurements of H_2O and CO_2 fluxes. It is thus not surprising that the name is new to some readers, but this might change rapidly if the spread of FluxNet data usage continues at its current pace. Thus, we prefer to keep this information and expect that readers not interested in it will simply ignore.



L154: Instead of the width and the thickness it is probably better to give the outer and inner diameter of the ML tube.

> We will change it according to your suggestions.

L173-174: How do you level the load cell and the ML during installation in the field? I cannot see the adjustment screws in the figure or how you can reach them during the installation process.

> The adjustment screws (=adjustable support feet) are shown in Fig. 1 as component "h". We will add a further component to Fig. 1 (counter nut) to explain the "H" like structure better. Furthermore, we will add a photograph of the weighing platform and the adjustable support feet, which are basically machine screws (bolts) with a counter nut (otherwise the weighing platform would move). We could reach them with a prolonged hexagon socket wrench. We will add that to the text.

Fig. 1: What are the structures on either side of the load cell that look like an H on its side? The text mentions machine screws (bolts?) but I cannot find these in the figure. I also think it would be helpful to add a photograph of the instrument to the figure, as well as a scale or a set of dimensions within the drawing.

> The drawing has no scale, because it is a schematic drawing. Dimensions are mentioned in the text. But adding detailed photographs to our revised manuscript version will indeed improve the understanding by the readers.

Section 2.2.3: I estimate a filled ML weighs about 100 kg. How did you handle it when you excavated the monolith and when you installed the monolith in its field setup?

> The ML mass was lower than 20 kg for all three ML (ML pot size of 25 cm diameter x 25 cm depth). The maximum capacity of the load cell was also 20 kg. At the day of installation, we were three people at the site, and we were able to transfer the monoliths to the ML pots and afterwards the whole weighing platform to the outer part. For heavier weights one would need a crane, we agree, but with this weight it is not an issue.

The ML pots were closed on one side. In order to transfer the monolith from the sampling pot to its ML pot you need to place both pots with the open sides against each other, so you end up with a cylinder that is closed on both sides. How did you transfer the monolith from one half of that cylinder to the other?

> We will add some photographs to the appendix, we think that helps to understand this process better. Basically, we took it out from one ML pot and transferred it by hand, in upright position, to another ML pot.

L240: What was the size of the averaging window?

> We will add the size of the averaging window was 100 values (this was the maximum that this microcontroller could handle). Thus, with a sampling frequency of 3.3 Hz, the averaging window had a length of 30.3 seconds.

Section 2.2.6: it is helpful to mention here somewhere what the resolution of the load cell is converted to mm water layer.

> This information is not available. The load cell itself outputs only a voltage, that's why also the company does not provide such a measure. The resolution depends on the parts of the system, e.g. if one uses a 8-Bit or a 16-Bit analog digital converter, the calibration range and many other factors. We provide information about the resolution of our system in Section 3.1, thus in the results section, not in the methods section, because this is a setup-dependent value. Here we specify the SE of the measurements of the three ML as ± 0.31, ± 0.14 and ± 0.11 g, respectively. We'll add the lacking units to all reported figures in the revisions.

L279: Why the < sign in the sensitivity of the temperature sensor? Now we still do not know its sensitivity.

> The company (Testo AG, Lenzkirch, Germany) provides the sensitivity for this instrument in this way: "Sensitivity: < 50 mK at +30 °C". The sensitivity might be temperature dependent, so it could be in the range from 0 to 50 mK, depending on temperature. Thus, reporting the value with a < sign means "better than" or "at most" and is thus a conservative estimate of the true sensitivity.

L283-284: ‚we considered standard deviation to account for spatial variability.' I do not understand this.

> We will change it to: "To compare thermal images of the ML surface with the control, we compared the variance (F-test). Data were bootstrapped to reduce sample size from > 30k to 30 samples using the scikit-learn package in Python (Pedregosa et al., 2011)." Furthermore we will add to the results section: "The variance of canopy temperature between the ML vegetation and the control were not statistically significant different (F-test, $p > 0.05$, $n = 30$)."

L327: Accuracy of what? In the section that follows you use the term accuracy a lot, but I believe you sometimes mean precision (e.g., https://www.mccdaq.com/TechTips/TechTip-1.aspx).

> We will change to: "Accuracy of the ML system". In the text we will carefully check the correct usage of accuracy vs. precision. Where a calibration with calibration mass was possible, we will retain the term accuracy. In cases where an absolute standard could not be used, we will adopt the term "precision" instead.

L328: Please give more significant digits for the correlation coefficient.

> We will give more significant digits for the correlation coefficient.

L365: with your measurement frequency, individual eddies in the near-surface atmosphere can affect individual measurements. How did you use wind speed readings to correct for the effect of wind on the readings? Or do you mean you can only discard wind effects if the wind speed is low? In that case, do your data allow to place an upper limit in the wind speed below which its effects can be ignored?

Yes, we wanted to express that we can exclude wind effects at low wind speeds. We will try to make this clearer in the text. We have not identified a certain wind threshold after which the ML system delivers biased values, however Nolz et al. 2013 reported a three times lower accuracy of lysimeters for a wind speed > 5 m s^{-1}. We will rephrase to: "ML data influenced by high wind speed fluctuations (> 5 m s^{-1}) could be excluded during such periods to avoid a misinterpretation as water vapor adsorption event. However, during the potential water vapor adsorption period remained below 1 m s^{-1}."

Table 1: In the two right-most columns, are the signs of the table entries reversed if the visibility exceeds 1000 m and the temperature is above freezing, respectively? The minus sign could be interpreted as leading to water loss from the ML, but it only signals an absence of the corresponding mode of water deposition. Perhaps explain this in the table heading.

We will add this information according to your suggestions.

L393: Do you know what effect the closed lysimeter bottom has on the temperature profile inside the ML, compared to in situ values? Also, the ML was 4 degrees warmer at the end of the afternoon (Fig. 5), which you discuss in detail later on. Were you able to determine the cause of the temperature difference? Correction: I see that you discuss this later on.

Thanks for having taken note of our discussion on this important aspect.

L426-436: The MLs had a lower soil water content than the surrounding soil. You state that this did not affect the NRW. However, it does affect the level of water stress experienced by the plants. In combination this leads to the conclusion that MLs can be used to measure NRW as long as the difference in water stress inside and outside the ML does not lead to changes in soil temperature, canopy architecture, plant height, etc., but cannot be used to study the effect of NRW on the water stress of the vegetation. For that you need deeper lysimeters. Is this correct?

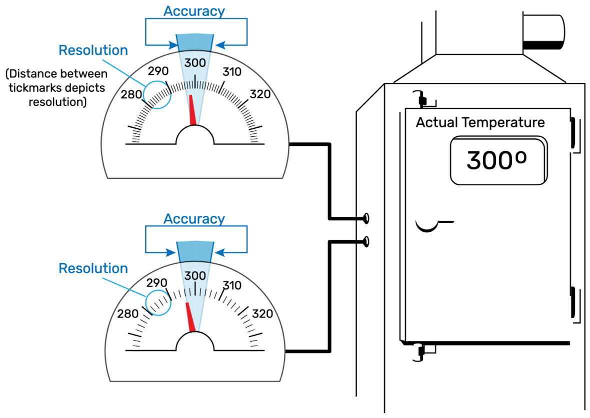
Yes, this is correct, deeper and wider (greater diameter) lysimeters are necessary to minimize such artefacts, but also normal size lysimeters (taking on the order of one ton of soil) face the oasis problem that conditions inside a lysimeter are never perfectly equal to conditions in undisturbed soils. With respect to our ML system that aims at resolving small NRW inputs, we will add: "The ML system can be used to measure NRW inputs as long as the difference in soil moisture during prolonged drought periods does not influence plant height or canopy architecture.". However, we think that a ML system might still be useful to study the effect of NRW on water stress. The ML system can be used to detect NRW inputs. Plant water stress measurements can be done next to the MLs. During destructive plant water stress measurements, e.g. water potential measurements with a pressure bomb, it is anyways considered to measure in the field in order to avoid manipulation of ML vegetation.

Section 3.6: You present many numbers in the text, which is rather tedious. This information can better be organized in tables.

We will collect these values in a new table to reduce numbers reported in the text.

Section 4.1: I believe you mean resolution instead of accuracy.

In our understanding accuracy is "how close a reported measurement is to the true value being measured." (https://www.opto22.com/support/resources-tools/demos/accuracy-vs-resolution). The reported measurements are in our case the readings from the microcontroller and the true values stem from the calibration mass as they are used to calibrate commercial scales in grocery stores and elsewhere. We define the term "accuracy" in the introduction: "In this study, weighing accuracy denotes the difference between the measured mass (determined with a ML) and the control (calibrated mass).". "Resolution is the smallest change that can be measured." (https://www.opto22.com/support/resources-tools/demos/accuracy-vs-resolution). So, resolution must be smaller than the accuracy, we report a resolution of 0.0002 mm. In the text we will carefully check the correct usage of accuracy vs. precision. Where a calibration with calibrated mass was possible we will retain the term accuracy. In cases where an absolute standard could not be used, we will adopt the term "precision" instead.



Source: https://www.opto22.com/support/resources-tools/demos/accuracy-vs-resolution

L505: stable decimal place: the meaning of this depends on the units you choose, which you specify elsewhere. I think it is better to rephrase and state the resolution you achieved, compared to that of earlier instruments.

We will delete the sentence to avoid confusion. The resolution is described later on in the same paragraph.

L516: According to the dimension (L105), the ML pots have a volume of 67 liters. They cannot possibly weigh not even 20 kg at that size.

The dimension of the ML pots is 25 cm in diameter and 25 cm in depth (see lines 160–161). Converted to meters and calculating the volume yields $(0.25/2)^2 \times \pi \times 0.25 = 0.0122719\ m^3$, which corresponds to the 12.2 liters that we report. All three ML had a mass under 20 kg on the order of 15 kg. Maybe you calculated the 67 liters with the dimensions of the outer part (45 cm in diameter x 47.2 cm in depth). The outer part is to protect the inner part and is not the ML pot.

L521: I have the impression this confusion in terminology also appears in this paper.

We defined these terms in the introduction and tried to stick to this definition throughout the manuscript. "In this study, weighing accuracy denotes the difference between the measured mass (determined with a ML) and the control (calibrated mass). Precision reflects the reliability of the measurements, and it specifies to what extent the experiment can be repeated. On the other hand, resolution is the smallest distinguishable unit for an observable change in mass and thus determines the upper limit of precision." In the revisions we will take great care to rectify potential conflicts between the terms "accuracy" and "precisition" as mentioned in earlier responses.

L550: The grass, not the grasslands, grow.

We will change it to: "The highest NRW inputs occurred during the months of main grass growth (April–September), indicating a potential hydro ecological relevance."

L550: The claim that NRW is highly relevant is a bit too fast. To validate that claim you have to show that it can substantially reduce water stress and/or significantly increases actual transpiration.

We will rephrase to: "…indicating a potential hydro ecological relevance". In fact, local farmers concluded that the surprising October grass harvest (after a drought with very little rain only terminating the drought), so we probably somewhat overemphasised this aspect based on local understanding of farmers, and thus a more neutral wording is indeed a good idea.

L558-559: 'However, the NRW inputs of the potential water vapor adsorption events were with < 1 mm' I do not understand this, please rephrase.

We will rephrase to: "However, the NRW inputs of the potential water vapor adsorption events were rather low (0.03 – 0.13 mm)."

L588: But you did not measure the plant mass (impossible to do non-destructively) or the leaf area index, so you may, in fact, have had reduced plant growth that you did not see.

We will change to: "In this study, this had however no influence on plant standing height because measurements of plant height (before the drought period) and measurement of overall vegetation height (after the drought period) were not statistically different."

L625: ...on plants... Just above you limit yourself to grass. I believe you demonstrated that your system works for short vegetation. For high plants (Maize, shrubs) I am less sure. Also, for vegetation with interlocking leaves, or plants that can be flattened by wind (e.g., barley) and then get back up again, your very sensitive mass measurements may be compromised. Later you claim your system works for plants up to 120 cm. What is the rationale for this value?

We will rephrase: "Thus, we conclude that our novel ML design is suitable for quantifying nocturnal NRW inputs on grasses and forbs in grasslands reliably and accurately at high temporal resolution.". The claim for up to 120 cm comes from another site, where the grass was that high. However, this other site was not part of this study, hence we will rephrase: "This ML size allowed natural plant growth and such a ML system can therefore be used in different ecosystems with most short to mid-size statured grasses and forbs or similar vegetation up to ca. 40 cm."

L689: You reported a diameter of 45 cm above, yet here you state that its area is comparable to 25 by 25 cm, which is 0.4 times your ML-area.

The 45 cm are the dimensions of the outer part: "The outer part (Fig. 1a) was made by a cylindrical PVC-U tube (VINK Schweiz GmbH, Dietikon, Switzerland; od45 cm x h42 cm x id44.64 cm) with an open top and a closed bottom." (lines 153-155). The dimension of the ML pot is 25 cm in diameter by 25 cm in depth: "The ML pot was made of a cylindrical PVC-U tube (VINK Schweiz GmbH, Dietikon, Switzerland; od25 cm, h25 cm, id24.8 cm)" (lines 160-163). We realize that our abbreviations: "For better readability, abbreviations for dimensions were used before the corresponding value (d for diameter, h for height or depth, t for thickness)." (lines 150-151) can easily be misunderstood and hence in the revision we will consistently use "25 cm diameter x 25 cm depth".

L694: 'simulate' is not really the right word here. 'Represents', 'reproduce', or 'mimick' are all better, depending on what you want to convey.

We will rephrase and use "represents".

Section 5: You leave out the discrepancy in soil temperatures inside and outside the ML, but it worries me. The temperature difference affects the heat balance of the soil. Liquid water is less viscous in warmer soil, so the hydraulic conductivity increases for a given water content, which will have an effect on the vertical distribution of water and water uptake by roots. A change in the soil temperature affects the partitioning of the incoming energy between heating up the soil and generating evaporation. It also changes the microclimate near the soil surface. Even if the temperature difference vanishes at night, its effects on the soil hydrology may linger. I cannot offer a remedy, and I do not believe it invalidates your measurements, but it is an issue that deserves attention and hopefully can be improved if you continue your work.

To better account for this issue, we will add that higher soil temperatures in ML pots could influence hydraulic characteristics of soil water and the heat balance of the soil which in consequence could lead to biased latent and sensible heat fluxes. We will suggest that further studies should primarily focus to get rid of soil temperature differences between ML pots and the surrounding soil.

Appendix A: It will be challenging to measure drainage with the accuracy necessary for reliable NRW quantification. A few droplets in the outlet tube may have a sizeable effect on the estimated NRW. This appendix is too detailed and wordy. Please condense it to get the message across better.

We completely agree on this aspect of reduced accuracy (see our response to the commenter, Dr. Groh). We provided this information because some anonymous reviewer of an earlier manuscript version insisted on this. The sensor could be placed in an outlet tube with a very steep angle or a PTFE outlet tube (very low friction coefficient). This must be further developed, as we detail in our response to Dr. Groh. In the appendix we provide information on water drainage rates of a ML pot of given size and provide potential solutions. The potential solutions must be tested and adapted if necessary. We will shorten appendix A by moving numbers to a table and by deleting some sentences.

Jones, H. G.: Monitoring plant and soil water status: established and novel methods revisited and their relevance to studies of drought tolerance, J. Exp. Bot., 58(2), 119–130, doi:10.1093/jxb/erl118, 2006.

Nolz, R., Kammerer, G. and Cepuder, P.: Interpretation of lysimeter weighing data affected by wind, J. Plant Nutr. Soil Sci., 176(2), 200–208, doi:10.1002/jpln.201200342, 2013.

Stiehl-Braun, P. A., Hartmann, A. A., Kandeler, E., Buchmann, N. and Niklaus, P. A.: Interactive effects of drought and N fertilization on the spatial distribution of methane assimilation in grassland soils, Glob. Chang. Biol., 17(8), 2629–2639, doi:10.1111/j.1365-2486.2011.02410.x, 2011.