Answer to referee 3

Dear referee,
Thank you for taking the time to review the manuscript and for your relevant and numerous suggestions. You will find below the answers to your comments.
(Unless otherwise specified, figure numbers cited in this response document refer to the figures in this document and not to those in the original manuscript.)

- In the Technical Note, the authors describe the configuration of the new CEREEP-Ecotron Ile de France facility. Such experimental facilities are important for improving our understanding of processes and investigating how they change in the context of changing climatic conditions. This contribution is highly relevant, as the CZ observatories' manipulative experiments can complement and accompany it. The Technical Note will be of interest to other readers who would like to set up a similar facility or who might use it for experiments in future.

Thank you for your positive comment.

- However, I recommend providing more detail on the facility's framework conditions, e.g. which lower boundary condition was used and what potential ET can be set by the climatic conditions.

Our lysimeters have a free-draining lower boundary. Discharge occurs when the lower horizon is saturated. This is indeed a critical point that we have not mentioned enough and we will discuss it in more details in a revised manuscript by addressing the lack of capillary rise; the lacking contribution of deep water to ET (Luo et al., 2010) or the modification solute fluxes (Abdou et flury, 2004).

To calculate potential ET for each experiment, we have the temperature, the relative humidity, the light intensity and spectrum. However, we would also need robust measures of wind speed that we do not have yet. We do have data from the chamber manufacturer showing that wind speed varies from 0.05 to 0.2 m s^{-1} across the chamber diagonal at the height of the mesocosm surface. However, these data should be interpreted with caution and are not suitable for publication, as the measurement instrument used is unknown.

- It is also important to specify the respective minimum ranges for the variables that can be controlled.

We have added the following table 1 to clarify and summarise the potential of the atmospheric conditions simulator.

Table 1: Minimum and maximum values of the parameters controllable by the atmospheric conditions simulator.

Variable	**min**	**max**
Atmospheric CO2 (ppm)	Ambient value	2500
Temperature °C	6	39
Relative humidity (%)	41	95
Light intensity (µmol m^{-2} s^{-2})	0	1114
Rate of T change (°C /min^{-1})	0	0.09

- The results section would benefit from a clearer presentation of the data, rather than so many small examples for different compartments.

Several changes have been adopted:

- Table 1 (see above) is provided to clarify the **minimum and maximum values of the parameters controllable by the atmospheric conditions simulator**.
- In the initial manuscript, we intended to select results that we considered demonstrative. However, we recognise that this does not facilitate reading and may raise doubts about the robustness of the system. To address this, we show **more detailed results**: a simulation of real atmospheric conditions, an evaluation of the minimum and maximum temperatures values, an evaluation of the irrigation system, a more detailed analysis of mass data, soil temperature and water content data. Please see below in the specific comments the new results.
- The CO_2, mass, soil water content and temperature data were recorded **in the same 20-day period**, as it will be specified in the methods. We hope that this will facilitate understanding our choice of results
- We propose to structure the results section in **two subsections**: "Atmospheric conditions simulation" and "Mesocosm instrumentation"

- The discussion could also be improved.

We propose changing the structure of the discussion section to make it more pragmatic and to focus on the technical aspects of the platform. To do so, the last section 'Experimental perspectives" was removed and the two new sections should offer a more technical approach.
As result, the new structure is the following one:

- 4.1 "Replication of atmospheric conditions and ecosystems".
- 4.2 "Replication of soil ecosystems with mesocosms"
- 4.3 "Combination of mesocosms and ecotron"

The 4.1 section now allows for a **more technical discussion on the limits of the atmospheric conditions** replication that are already scattered in the manuscript or that were raised by yourself and the other referees. It addresses the following points:

- The maximum atmospheric conditions boundaries (temperature, relative humidity, light intensity and vertical distribution) / type of experiments
- The absence of wind
- The absence of pressure control
- Irrigation (intercept evaporation; flow rate)

The 4.2 section is rearranged to discuss more **specifically the limits of recreating a soil ecosystem in mesocosms.** It addresses the following points:

- Size of the mesocosm
- Lower boundary conditions / Upward water flow
- Wall effect
- The insulation of the mesocosm

The 4.3 section will discuss the main advantages of this facility compared to CZO or field experiments. It will also address the complementarity of the data.

Specific comments

- L11-13: The setup uses one climate chamber, so my question is how it enables the evaluation of future climates and extremes when it is not possible to use a reference scenario or other treatments. It would be possible to run different scenarios one after the other, but this would considerably extend the overall study period and preclude longer experiments. For example, five years per scenario would require 15 years for a reference scenario and a second scenario. I recommend providing a clearer explanation of the types of experiments that can be conducted in this facility.

Indeed, it is not possible to have a climate treatment inside the chamber. As you mention, climate comparisons require several experimental runs.
To avoid any misunderstanding, we have modified the sentence to: “It allows for the simulation of future climates or extreme events; it enables the application of different treatments **across mesocosms**, facilitating the isolation of processes and the assessment of anthropogenic impacts; and it provides automated data acquisition.”
We also propose to clarify this limit in the 4.1 section of the discussion.

- L45: This is an important point. The question is how this experimental data from a simulator can be related to the field. I suggest adding to this discussion later, as experiments often have specific limitations. It would be useful to clarify what can and cannot be done.

The limits of indoor experiments is a broad topic, which is addressed throughout the manuscript (size; climate conditions; lower boundary conditions; soil temperature). The table indicating the minimum and maximum ranges for the climatic variables can thus give a clearer overview of what type of experiment is achievable. Besides, discussing the limits of the non-buried lysimeters (lower boundary conditions; soil temperature) should also clarify.

- L Fig.1: Looking at Figure 1b, I am wondering why the lysimeter cylinders and isolation foam were chosen to be black. Due to their low albedo, they will perfectly absorb energy and lead to enhanced evapotranspiration and soil temperature.

We do agree. Unfortunately, we did not have the choice of the colour when constructing them as they are made from recycled water pipes that were black.

- L65: What about wind speed? This is an important factor affecting the atmosphere's demand for evapotranspiration. Also, how is air pressure controlled?

Unfortunately, **we do not simulate wind**. It would be possible to introduce fans but this would require an other thorough assessment. We do mention the absence of wind in section 4.1 of the discussion though.
Air pressure is also not controlled. We added the following sentence in section 4.1: “Lastly, **air pressure is not monitored**, whereas it is one of the parameters influencing gas fluxes in soils (Wyatt et al., 2015).”

- L70-75: Please report the temperature range that can be set by this controlled circuit here. How are the fans located and distributed across the chamber to avoid creating a localised source of air exchange over a specific lysimeter that could affect surface-atmosphere interactions? I recommend adding this information to the technical view in Figure 1a.

The temperature range is now specified in the table.
Please see the following Fig. 1 showing the 4 fans above the lamps.

Figure 1: Photograph of the chamber's ceiling

We will add their position in the technical view.

We modified the following sentence: "Once mixed, this air is brought back to the chamber through a honeycomb grid to break up the airflow and promote a more homogeneous air distribution."

- It would also be useful to know how long it takes to adapt to new temperature conditions, or whether there is a specific delay in the technical setup to match the climate conditions of a scenario, e.g. reaching XX°C in one hour. Please clarify this.

We tested the min and max temperatures of the chamber. Please see Fig. 11 below that we will add in the supplements. We calculated the rate of temperature change during the five heating and cooling phases and included the results in table.

- L76-81: Is this measured by only one sensor in the entire chamber? Wouldn't it be necessary to use several sensors to ensure homogeneous conditions for the different lysimeters and prevent inhomogeneous mixing?

We agree that additional sensors would be valuable to further assess the spatial homogeneity of environmental conditions within the chamber. However, the current system was designed with a single control sensor, and the installation of multiple sensors was not planned as part of this study. While this represents a limitation of the setup, addressing it would require significant modifications that are beyond the scope of the present work.

- Could you also please report the RH range that can be achieved by the system, e.g. 5% to 110%?

The RH range has been added to the table.

- L82: One limitation of this set-up is that potential greenhouse gas (GHG) emissions between different mesocosms cannot be defined.

It is possible to fit a transparent dome, as for measurement on the field. Please see in the following Fig. 2 an example with a similar mesocosm.

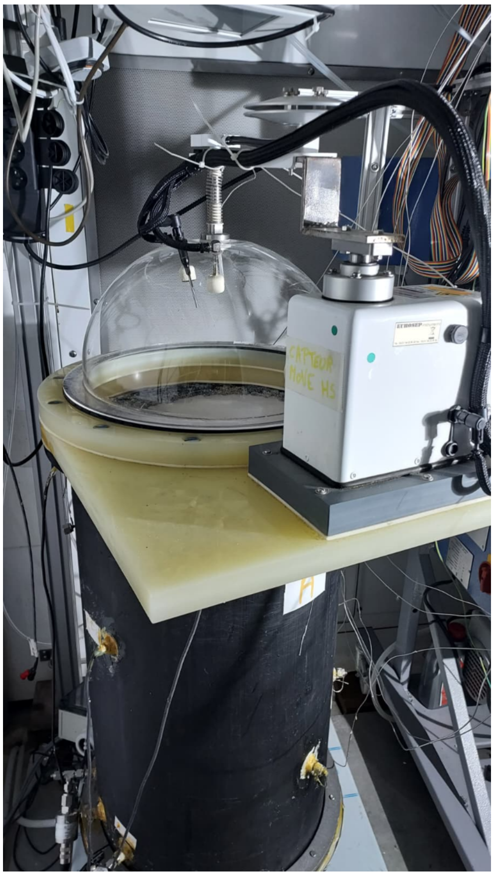


Figure 2: Photograph of a gas collection device installed on a mesocosm.

- L83: Please also provide the system's minimum and maximum CO2 values here. This information is important for general knowledge and for anyone else who might request to use this setup.

The minimum value is the ambient value, as this chamber is not designed to decrease the CO_2 concentration, as specified in the text. Regarding the maximum, there is no theoretical maximum. It is possible to continuously inject CO_2, and also to increase the injection rate if the latter appeared not to be sufficient to counter the leaks of the systems. However, air renewal is recommended for the sanity of the ecosystem, and maintaining CO2 at very high value, like in a martian atmosphere for example, might be very costly, and is definitely not recommended.
In the table stating the maximum and mimimum atmospheric conditions achievable, we propose the theoretical maximum of 2500 ppm, which goes beyond even the most pessimistic scenarios of the IPCC for planet earth for the end of the century, and, more importantly, is a level of concentration at which human cognitive abilities are significantly affected (Satish et al., 2012). The latter point is a compromise that requires careful consideration prior to an experiment.

- L90: Could you please explain in more detail how the lysimeter is distributed across the surface? How homogeneous can water infiltration be when using these six drippers? Could you also provide the minimum amount that could be added to the surface by this dripping system?

We modified the sentence: “To date, six drippers (13312-20, GARDENA, Ulm, Germany) with a constant flow rate of 2 L min^{-1} are installed in each mesocosm, **arranged on a 25-cm-diameter circle centered within the mesocosm.**”
Infiltration is dependent on the type of soil and on the numbers of drippers. Unfortunately, we do not have a proper modelling to show the infiltration.
We clarified in the text how irrigation is controlled with the actual setup: “To launch irrigation, a mecanic garden timer (PNR11, SFC Jardibric, Boigny-sur-Bionnne, France) is switched on to open the valve and allow water to flow to all the drippers. The boost pump then starts up if necessary. The amount of irrigation is set by the flow rate of the drippers and the number of drippers per mescosom. Besides, the garden timer allows fractionation of the irrigation time to avoid excessively high rates. For instance, with six drippers with a 2 L.min^{-1} irrigation rate, the valves open for 30 seconds every three minutes during a rain event to maintain a 2 L.min^{-1} rate in average.”

- Another point to consider is that, due to drip irrigation, intercept evaporation is neglected. Also, plants can transpire during irrigation events, which requires weight measurements to be taken at a high temporal resolution to avoid losing information.

Indeed, intercept evaporation is neglected. We propose to add this to the discussion.
Mass data are recorded at 75-second intervals. This sampling frequency is relatively high and is comparable to that used in high-precision lysimeter networks, such as the German network, where data are typically recorded at 1-minute intervals (Pütz et al., 2016).
Plants can transpire during irrigation events. This is the reason why in our initial manuscript, we chose to calculcate ET by using the theorical irrigation, i.e., the data calculation from the drippers flow rate and the irrigation time, rather than using the mass data to obtain irrigation data. However, in a revised manuscript, we propose to calculate the irrigation rate from the mass data, which offers a better precision. This relies on the assumption that ET during precipitation is negligible (Peters et al., 2014).

- 185: 450 µmol m -2 s -1 is very low. For growth of major crops much higher values are of need. This could be a major limitation of the system. Please clarify this

To tackle this, we added LED bars. We now have 29 bars, compared to 13 in the initial version. The maximal light intensity ranges now from 1114 to 1491 µmol m^{-2} s^{-2} for the least and most illuminated mesocosms, respectively. We should be able to provide a mapping of light intensity in the revised version of the manuscript.

- L96: Please provide information on the intensity of light reaching the surface and the top of a canopy, for example at a height of 1.5 m above the soil. What about the light spectrum? Please also provide the light spectrum that is crucial for plant growth.

In our setup, it is not possible to achieve the same level of homogeneity in light intensity at the surface of the mesocosms and at other heights. This is due to the fact that the mesocosms do not have their own light source but instead receive light from different LED bars, meaning that the relative contribution of each LED bar varies with height within the mesocosm. We propose to insert this limit in the discussion. Wee added LED bars to increase the light intensity (see above). We should be able to provide measures at different heights in a revised manuscript.

Regarding the spectrum, we provided in the results the light spectrum in Fig.3 (Fig. 4 of the initial manuscript).

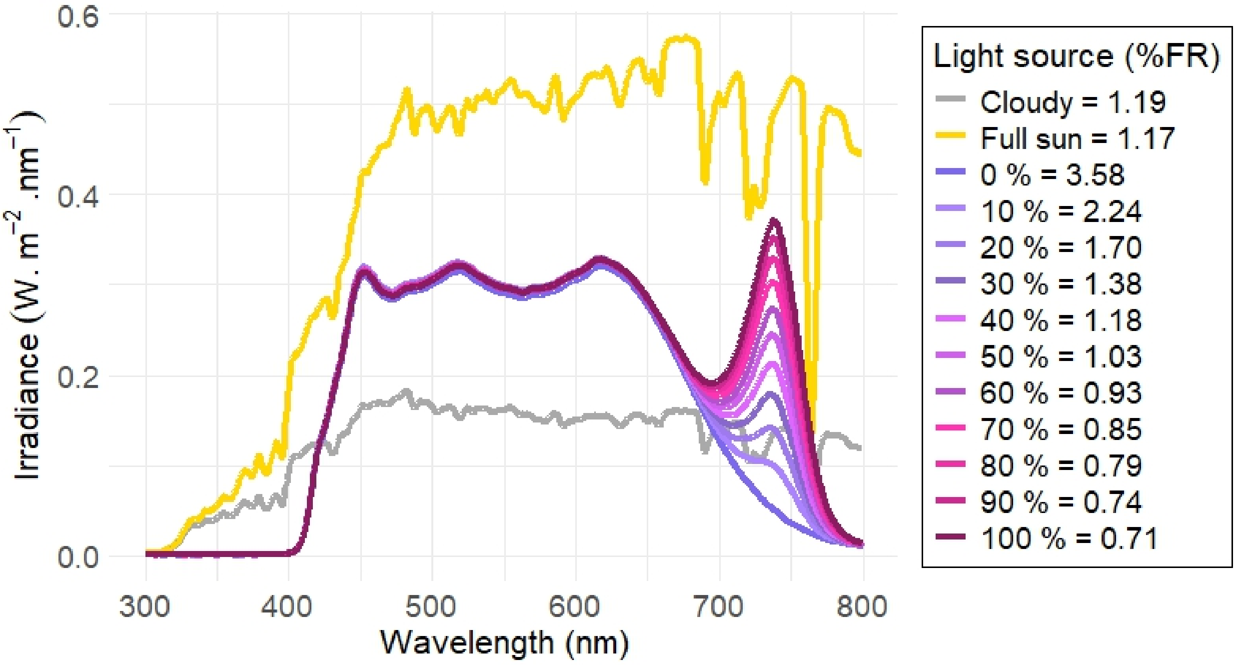


Figure 3. Fig. 4 of the initial manuscript. Light spectrum of artificial lights and sunlight. Sunlight was measured during both clear and cloudy sky conditions, on 10 January 2025. For the artificial lights, we set the sun-like source to 100 % and we varied the near-infrared source from 0 to 100 %. We report the R:FR ratios in the legend. The ratio was calculated by using the amount of photons integrated in the range 650 to 670 nm for red and 720 to 740 nm for far-red.

- L103: Please also describe the surface area of the system. The dimensions of the lysimeter column are crucial for determining the type of vegetation that can grow. I hope this will be covered later in the discussion.

We modified the sentence: “The mesocosms are 72-cm-high columns made of black HDPE with a diameter of 36.5 cm, corresponding to a surface area of 0.105 m^2.”
We do have a section discussing the size of the mesocosms, and the root system they can host without affecting it too much:
“Poorter et al. (2012) recommend for the mesocosms to not exceed 2 g of total biomass for a rooting volume of 1 L to limit pot size effects, and to remain below 1 g L-1 to be optimal. For the 75-L columns with a surface of 0.105 cm^2, this translates into 14.4 and 7.2 tons of dry biomass per hectare, respectively. It allows to grow a broad range of crops but can be limiting forthe higher end, such as miscanthus. However, rooting is likely to be limited by the column height as plant roots often exceed 72 cm (Canadell et al., 1996).

- L110: What about the possibility of direct upward water flow? This is usually found in sites with a shallow groundwater table, but it is also important in spring and summer, as water from deeper soil depths in the field can be used for ET. Could you please explain why such an important feature is not included in the setup? This is especially important for a setting which a relative shallow soil column.

Our lysimeters have a free-draining lower boundary. As mentionned above, we will provide a more complete discussion on this limits by addressing the lack of capillary rise; the lacking contribution of deep water to ET (Luo et al., 2010) or the modification solute fluxes (Abdou et flury, 2004).

We did not control the bottom boundary for several reasons. If we are to adjust the pressure head of the soil, consistent measures have to be made in the corresponding undisturbed soil, still in place (Groh et al., 2016). This is a dataset that is needed prior to the experiment if we simulate a climate from the past, or that is needed in real time. Both options require extra logistics, especially if we are working with a soil from a remote location. If we are working with different treatments, for instance bare soil v.s. planted soils, a measure from the field would be necessary for every treatment. Besides, simulating climate change scenarios also adds extra complexity, even though modelling approaches may help tackling this issue (Groh et al., 2016).

In the case of with a control of the water flow, external water may be added (Dietrich et al., 2016). While it makes sense for hydrological scientific questions, it may also interfere with geochemical measurements.

Besides, this is a compromise we chose because it involved further equipment and expertise knowledge for maintaining the system (Pütz et al., 2018). We wanted to create a platform that scientists could easily get familiar with.

- L110-118: Why not use the lysimeter weight directly to obtain components of the water cycle? By e.g. using algorithms developed to interpret lysimeter weight data (Hannes et al., 2015; Peters et al., 2017) as described in Schrader et al. (2013).
- L213: So please use such smoothing filter when showing the water balance components. I suggest using a more sophisticated method e.g. AWAT (Peters et al., 2014; Peters et al., 2017) or method suggested by Hannes et al. (2015).
- L209-211: Please explain why ET was negative. For the review process, please provide a figure showing the lysimeter weights, seepage water and climatic conditions at the time when negative ET was detected. Single peaks and longer negative ET values are visible after irrigation events. Was the presence of dew neglected during this time? To get a complete picture, please also add other variables, i.e. humidity and temperature during this time, as well as seepage.

The initial idea was to show ET calculated with different data and not just mass and tipping buckets data. Therefore we used in the initial manuscript the flow rate of the drippers and the irrigation time to calculate precipitation/irrigation. We recognise that this is not a robust approach.
In a revised manuscript we propose to completely change the calculation method. We use the AWAT filtering routine (Peters, 2014) to analyse mass data and to calculate then irrigation and ET.
Therefore, we propose to reshape our method section and not use use any more the equation from Pütz et al. (2018). We make the assumption that ET during irrigation is negligible.
We used the mass M of the system:
$M = M_{lys} + M_{out\_cum}$
with M_{lys} the mass of the lysimeter, transformed in mm, given by the scales, and M_{out_cum} the cumulative mass, also in mm, given by the tipping buckets.
We then used the AWAT filtering routine to process the M raw data. First, we calculated the signal strength by fitting a polynomial to each data point. The maximum polynomial order was set to four. The data were then smoothed using a moving average algorithm. The window size for this algorithm varied according to the signal strength. We defined the minimum and maximum window values as 76 seconds and 1920 seconds, respectively. Finally, we filtered out non-significant M changes by applying a thresholding routine. All cumulative changes smaller than the threshold were discarded. We set the minimum and maximum threshold values to 1 mm and 3 mm, respectively.
The whole method is described in Peters et al. (2014) and we provide our R code for the AWAT function at the end of the document, and we will add it to the supplements.
We then derive irrigation from positive changes of M, and ET from negative changes of M, as suggested by Schrader et al. (2013).

Please see below Fig. 4-5 that we intend to show in the results section. We first show the raw M data, along with the drainage data and the data after filtering.

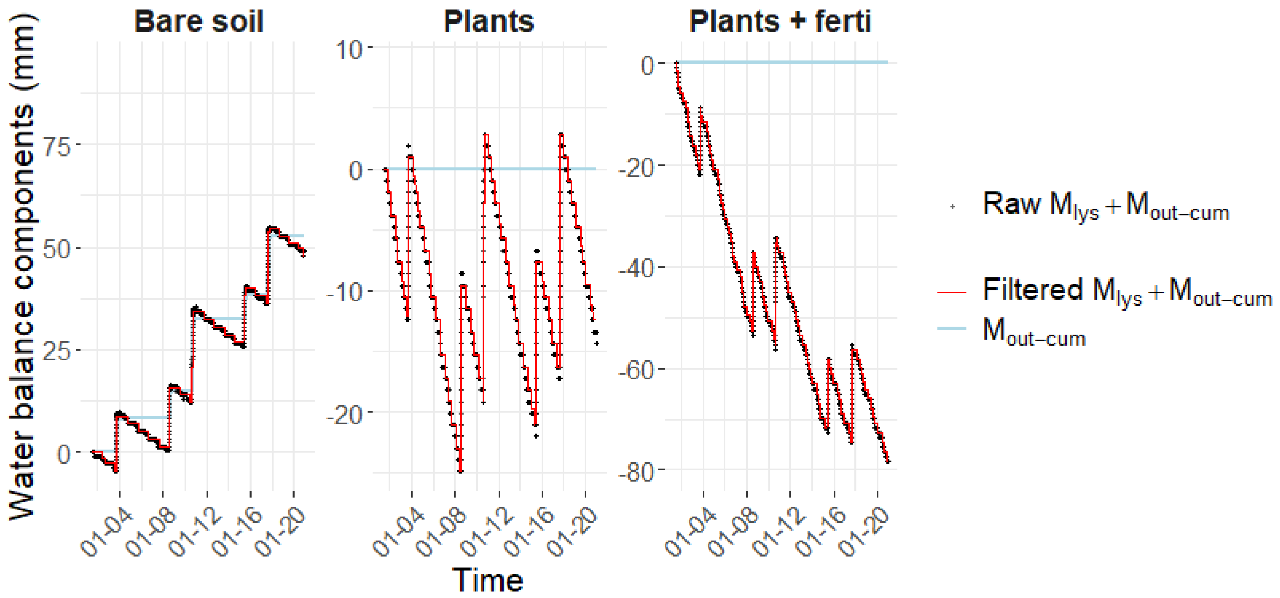


Figure 4: Comparison of raw mass data with data filtered using the AWAT filter routine. We also report M_{out_cum} corresponding to the drainage, measured with the tipping buckets.

- L206: I would also recommend showing a figure illustrating the diurnal pattern of lysimeter weights, temperature, relative humidity and seepage. After all, the system itself should be evaluated, not just parts of it.

We then show results of cumulative ET, with a zoom on three diel cycles.
Please note that the period is not the same as in the original manuscript for two reasons. 1) We wanted to have measures for CO2; soil water content and temperature and M_{lys} + M_{out_cum} from the same period. We therefore grouped the measurement in a 20-day period. 2) We chose a period later in the experiment, so that plants without fertilisation had more time to develop.

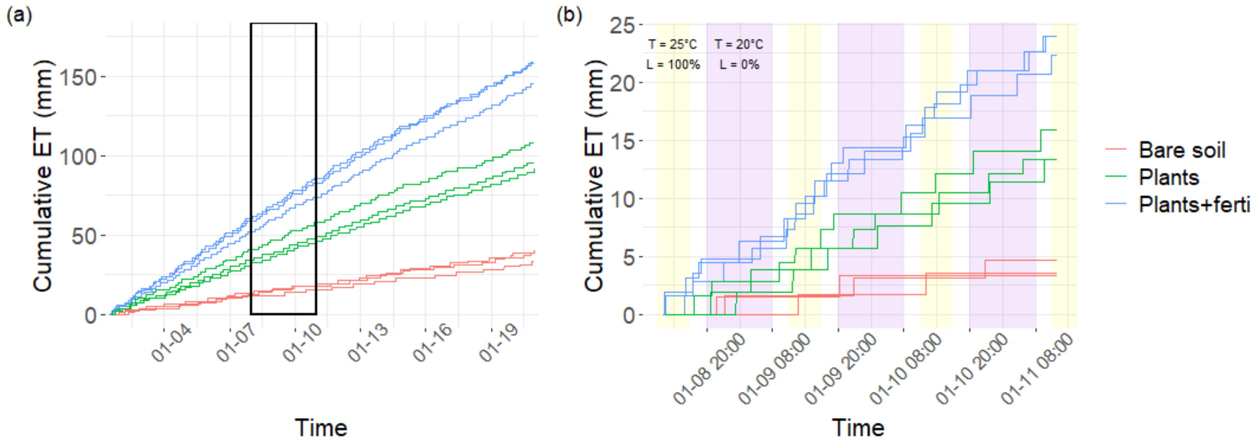


Figure 5: a) Cumulative ET over a 20-day period and b) zoom on three diel cycles. The yellow areas represent daytime, while the purple areas represent nighttime. In between, the sunrise and sunset periods are defined, with a linear increase or decrease in temperature and light intensity, respectively. Please note that the RH was set to 50 % throughout the experiment.

Estimating irrigation with the mass data also allowed us to compare the results to the setpoint, calculated with the flow rate of the drippers and the irrigation time. We propose to present in the results the following Fig. 6 as an evaluation of the irrigation system.

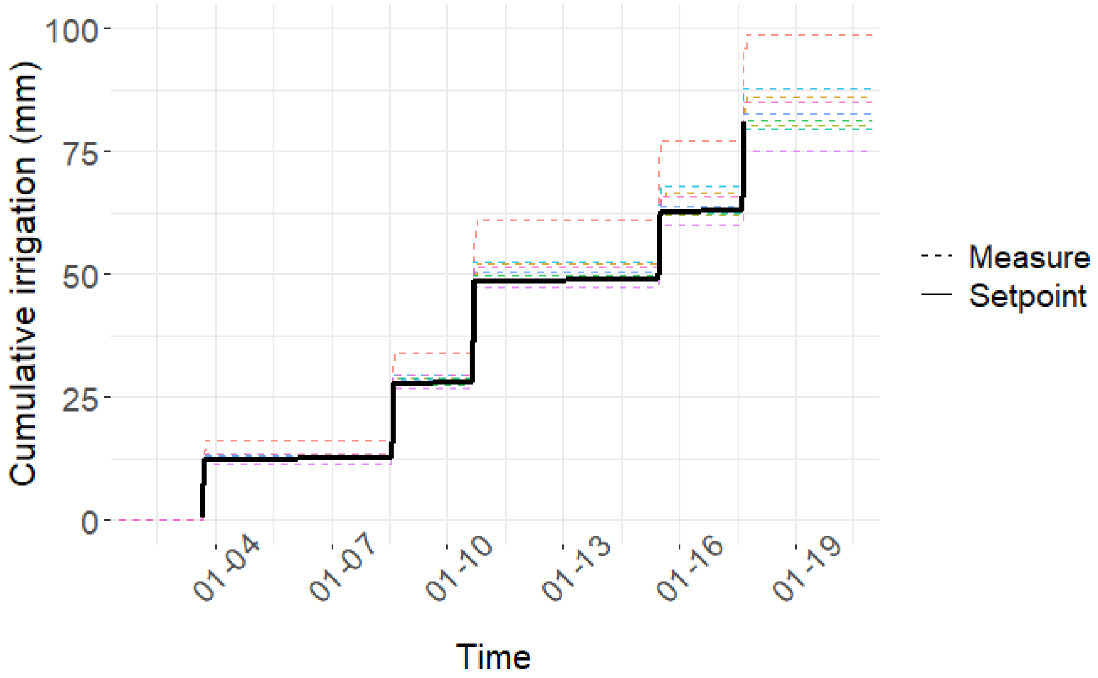
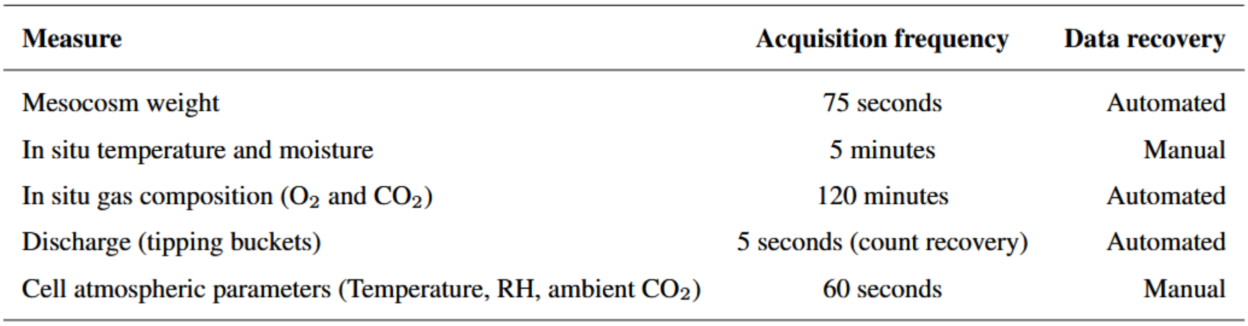


Figure 6: evaluation of the drippers. The dotted lines (measure) represent cumulative irrigation calculated with mass data. Each colour represents one mesocosm.

- What is the temporal resolution of the weighing system? In general, the subsection is highly fragmented. Perhaps it would be worth merging some parts and information to improve understanding of the water balance. For example, temporal resolution is required, not just weighing resolution.

In fact, the temporal resolution is 75 seconds. This value is reported in the following table present in the original manuscript. We will add two columns presenting the resolution, as well as the instrument names for more clarity.



Measure	**Acquisition frequency**	**Data recovery**
Mesocosm weight	75 seconds	Automated
In situ temperature and moisture	5 minutes	Manual
In situ gas composition (O_2 and CO_2)	120 minutes	Automated
Discharge (tipping buckets)	5 seconds (count recovery)	Automated
Cell atmospheric parameters (Temperature, RH, ambient CO_2)	60 seconds	Manual

Figure 7: caption of the Table 1 from the original manuscript

- L100: It is unclear how biomass can be monitored here with a resolution similar to that of the water balance components. As the plant grows inside the lysimeter, water is only redistributed into the plant from the soil. Therefore, I still don't understand why biomass is included.

Yes, we did not include the biomass in our calculations and I recognise putting it in the equation is misleading. In a revised version, we propose to remove this equation and to calculate ET in another way, as mentioned above.

- L116: That’s very vague, and the microclimatic conditions close to the surface will differ from those measured above the lysimeter in the chamber. These conditions are crucial for dew formation. Perhaps a setup with a leaf wetness sensor could help to distinguish between rainfall and non-rainfall more effectively (Binks et al., 2021; Groh et al., 2026).

You are right, and our experimental setup is not intended to investigate dew formation. Moreover, we avoid extensive use of the humidifier and take care to protect all electrical connections from condensation. We therefore removed this sentence and add in the discussion that we can not simulate dew.

- L135: I am wondering about the acquisition frequency of the mesocosm weight. Why is it measured at 75-second intervals and not at least every 60 seconds, and how can this be combined with discharge observations (tipping buckets)? Later, the authors describe that the water cycle is analyzed on a 5-minute basis. It remains unclear to me why such a great system reduces its ability in high temporal resolution analysis.

The scale's internal program limits data transfers to once every 75 seconds. This sampling frequency is already relatively high and is comparable to that used in high-precision lysimeter networks, such as the German network, where data are typically recorded at 1-minute intervals (Pütz et al., 2016).
We will specify in the results: “To combine tipping bucket and mass data, we aggregated the tipping bucket data over 75-second intervals.”
The 5-minute basis is not used any more with the new calculations of ET.

- L141: Could you please explain how water is extracted from the soil via the suction cells? Also, please clarify whether this is a permanent process or only occurs during specific periods.

It is only during specific periods, chosen by the researchers.
We will add the following Fig. 8 in the supplements. And we will add this methods section: “The quartz suction cells are each connected to a 50 mL centrifuge tube via a hose passing through a perforated cap (Fig. 8). Each tube is connected to a vacuum pump, which is activated to collect pore water. Multiple tubes can be connected together, allowing several suction cells to be operated with a single pump. Note that the number of suction cells that can be operated simultaneously depends on the soil type and its water content.”

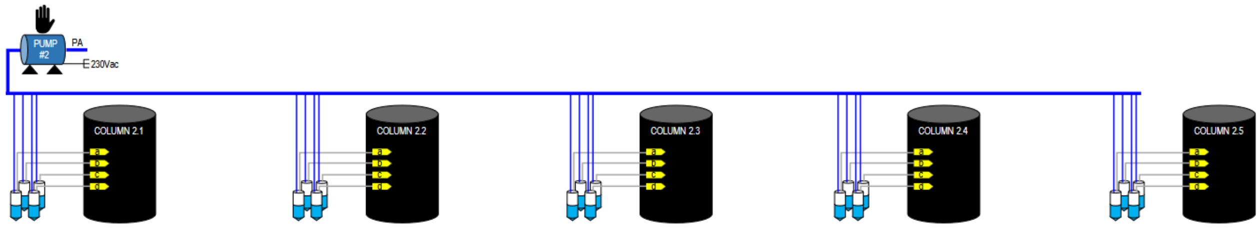


Figure 8: Schematic view of the vacuum system designed to activate the quartz suction cells.

- L145: It is unclear whether a classical seepage face or a suction-controlled system is being used here. If the former, please explain how the bottom was prepared to enable this. This could also be a significant limitation, particularly with regard to water flow and solutes, since seepage face boundaries only release water when the gravel layer is saturated, which has an impact on solutes (anaerobic conditions). Please take a closer look at, for example, Abdou and Flury (2004) or Boesten (2007)

- L304: As it was unclear which boundary conditions were used for the lysimeter, please clarify this setting, as it may have a significant impact on solutes, given that water only leaves the system under saturated conditions, which affects biogeochemical processes.

We use a classical seepage face. We will state it clearly in the manuscript. We added this resuls section: “In the initial setup, **we used a 3-cm-high polypropylene grid to create a void beneath the substrate and facilitate drainage.** The substrate was supported by an 80 µm nylon mesh placed on the grid. Note that it is also possible to use gravel instead.”
Besides, we will also specify in the caption of the schematic representation of the instrumented mesocosm (Fig. 9) (Fig. 2 of the manuscript) that the grid is there to create the seepage face.
Thank you for the references, we will add this to the discussion.

- L145: Using an autosampler is very helpful. However, removing 24 samples, especially during periods of high water content in the column and at weekends, may restrict the frequency with which soil water can be measured. I am just curious about how the later sample can be automatically related to a specific time period, and what would happen if more than 50 ml of water were required for the analysis of solutes.

When there is too much water, it flows in the overflow tank below, as shown in the following figure. We completed the results section: “2) Dynamically, by sampling in a 50-mL tube situated directly at the outlet of the drainage pipe with an autosampler (Fig. 2 *(initial manuscript)*). **This tube is used only when the autosampler is operating. Excess water flows into an overflow tank, i.e., the collection reservoir below, and is not sampled. The sample corresponding to the pumping interval is representative of the period since the last sampling event. Note that sampling from the collection reservoir during an autosampler run may introduce bias, as 50 mL have been removed.** ”

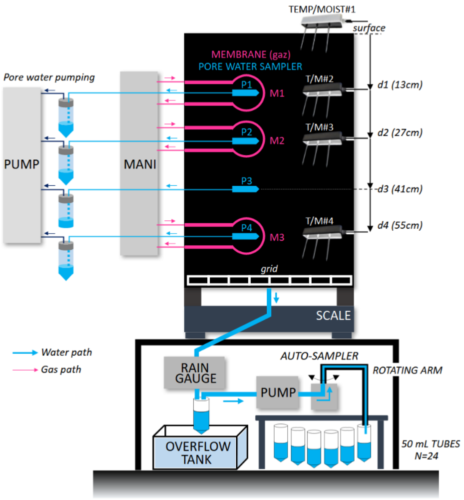


Figure 9: Figure 2 of the initial manuscript.

You are right, it is recommended not to use the autosampler during the week-end, unless overtime is paid by the employer.
If more than 50 mL is required, we do not have a better solution than increasing the acquistion frequency of acquisition to have two samples instead of one in the same interval. You can then mix

them. Note that the acquisition frequency is often not the limiting factor; rather, it is the amount of drainage.

- L154: Are those the min and max values that can be set for the simulator?

No, min and max values are now reported in table 1.

- L179-188: A more thorough test of different situations and combinations of conditions would be useful for capturing its ability to simulate predefined climatic conditions, especially with regard to air temperature and relative humidity (RH). It is also unclear which atmospheric demands are set for plants due to temperature, RH and light, as these are crucial in combination for plant transpiration and evaporation. I therefore recommend providing an estimate of reference evapotranspiration based on climatic conditions.

In the initial manuscript, we arbitrarily created an artificial climate that allowed strong variations that are not necessarily present in a real climate. Therefore, we chose now instead to simulate a real french climate from meteorological data, that still offers substantial daily variations. We propose to show in the results the following Fig. 10 displaying the temperature and relative humidity simulations.

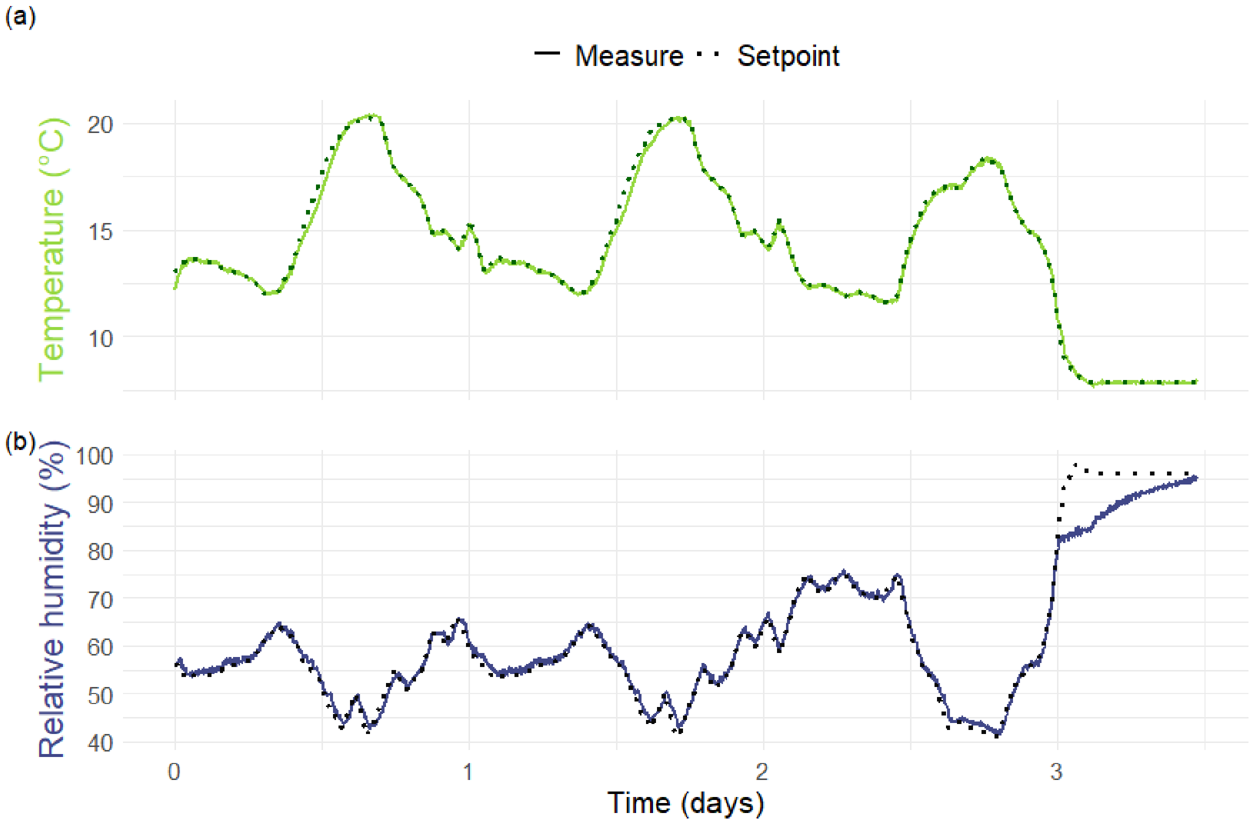


Figure 10. Temperature and relative humidity results of a simulation from french spring meteorological data. Data were recorded in Lons-le-Saunier (46°41'34" N, 5°31'04" E) from 20 to 22 March 2025.

Regarding the CO_2 atmospheric concentrations, we still think that it is relevant to show arbitrarily selected data, as it highlights the potential of the ecotron to simulate an atmospheric CO_2 increase. We propose to keep the panel of Fig. 3 from the initial manuscript showing atmospheric CO_2 concentration, but to move it to the supplements to facilitate reading.

We also add in the supplements the following Fig. 11 showing the min and max temperatures that we tested.

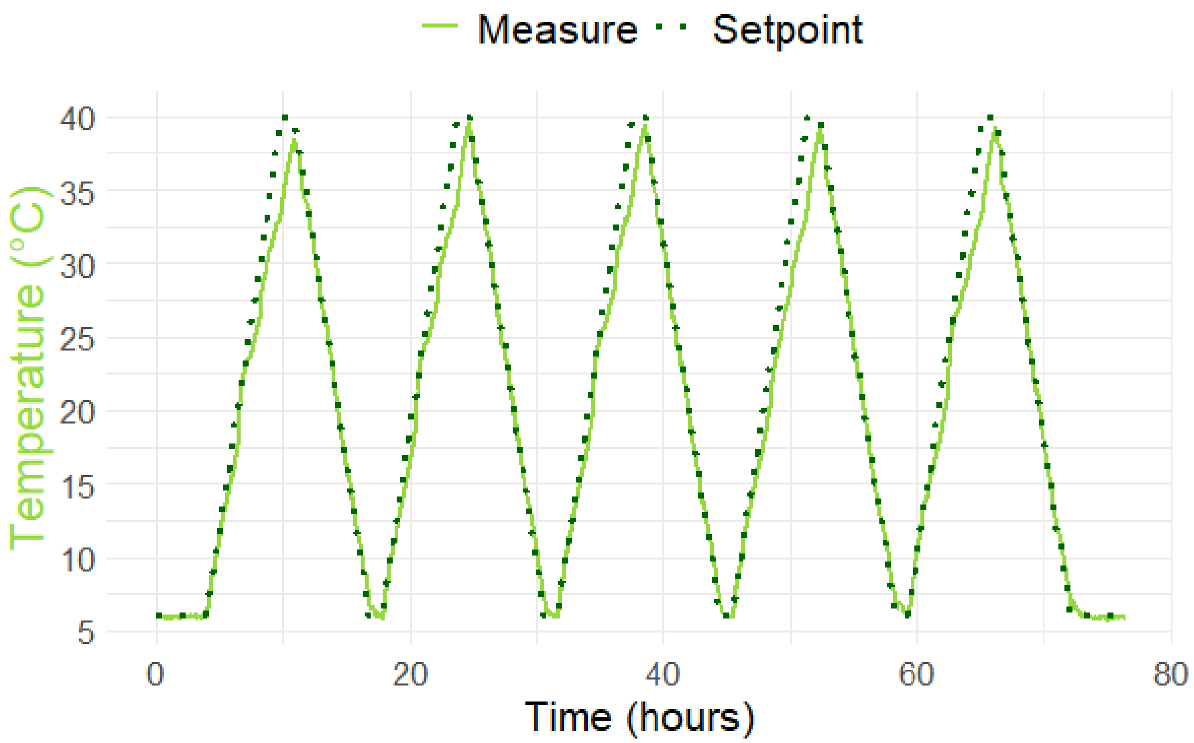


Figure 11: Temperature simulations. The setpoint ranged from 6 to 40 °C.

- L208: Please add also the reference or potential ET in the plot (e.g. Medicago Sativa + fertilization up to 13%).

To calculate potential ET for each experiment, we have the temperature, the relative humidity, the light intensity and spectrum. However, we would also need robust measures of wind speed that we do not have yet. We do have data from the chamber manufacturer showing that wind speed varies from 0.05 to 0.2 m s^{-1} across the chamber diagonal at the height of the mesocosm surface. However, these data should be interpreted with caution and are not suitable for publication, as the measurement instrument used is unknown.

- L190: I'm just wondering why only 14 water samples with enough water (50 ml) to measure EC were collected during an event with 277 mm of rainfall in 42 hours. I would have expected a much higher frequency of measurements.

Besides EC, other analysis were carried out such as major element analysis with ICP-AES. As these analysis are costly and require filtration and acidification, this limits the number of samples.

- L208: What causes such large deviations between replications over such a short period of time?

While variability can be explained by plant biomass, it is very pronounced in between the bare soil lysimeters. Our variabilty mainly came from the irrigation. As you can see in Fig. 6, over a 20 days period and a cumulative irrigation of 80 mm, differences between mesocosms may reach more than

10 % of the setpoint. This largely explained the variability. Now that we estimated irrigation with the mass data, the variability is reduced (Fig. 5).

- L227-231: A review paper by Breuer et al. (2003) on rooting depth found that crops had an average maximum rooting depth of 1.43 m, while grasses, forbs and herbs had an average maximum rooting depth of 0.93 m. This is a major limitation of the facility, and it remains unclear which plants can grow without their rooting space being artificially limited. Table 6 provides more details on specific crops and grasses, showing that only 16% of the crops, grasses, forbs and herbs have a maximum rooting depth below 75 cm.

Thank you for the reference, we will add your suggestion to our point.

- L234: The water observed leaving the lysimeter is seepage at 75 cm.
- L234: Please bear in mind that seepage water collected at 75 cm cannot be directly related to groundwater recharge. It would also be worth briefly discussing this, especially given that no water can move upwards in this setting.

You are right, this is far fetched. We introduced this in the 4.2 section by discussing the lower boundary counditions. The mention of the evaluation of groundwater recharge will be nuanced.

- L243: A recent overview of CZ across the globe, including the respective land cover types, has been published by Arora et al. (2023).

Thank you. The map provided by Arora et al. (2023) is consistent with the one from Banwart et al. (2013). We added the citation.

- L263: It is not clear why the size should reduce the occurrence of preferential flow.

Our sentence is misleading, we wanted to highlight the fact that preferential flow is not taken into account. We modified the sentence: “However, the limited size of the mesocosms **does not allow the representation** of key water transfer processes in the deeper vadose zone, such as preferential flow (Hendrickx and Flury, 2001), which is therefore not accounted for in our experimental design.”

- L266-268: Another major limitation is the water required for ET processes and its implications for ecosystem services.

We introduced in the discussion the lacking contribution of deep water to ET (Luo et al., 2010).

- L269: There is also no possibility to control the temperature boundary condition.

Indeed. We introduced this major limitation in the abstract: “Its main limits are the limited size of the lysimeters and **the exposition of their walls, which influences the heat exchange between the soil and the atmosphere, unlike buried lysimeters.**”
Besides, We propose to show in the results section the following Fig. 12 that shows diel cycles of temperature and moisture for a bare soil and a planted lysimeter. Showing this results will fuek the discussion.

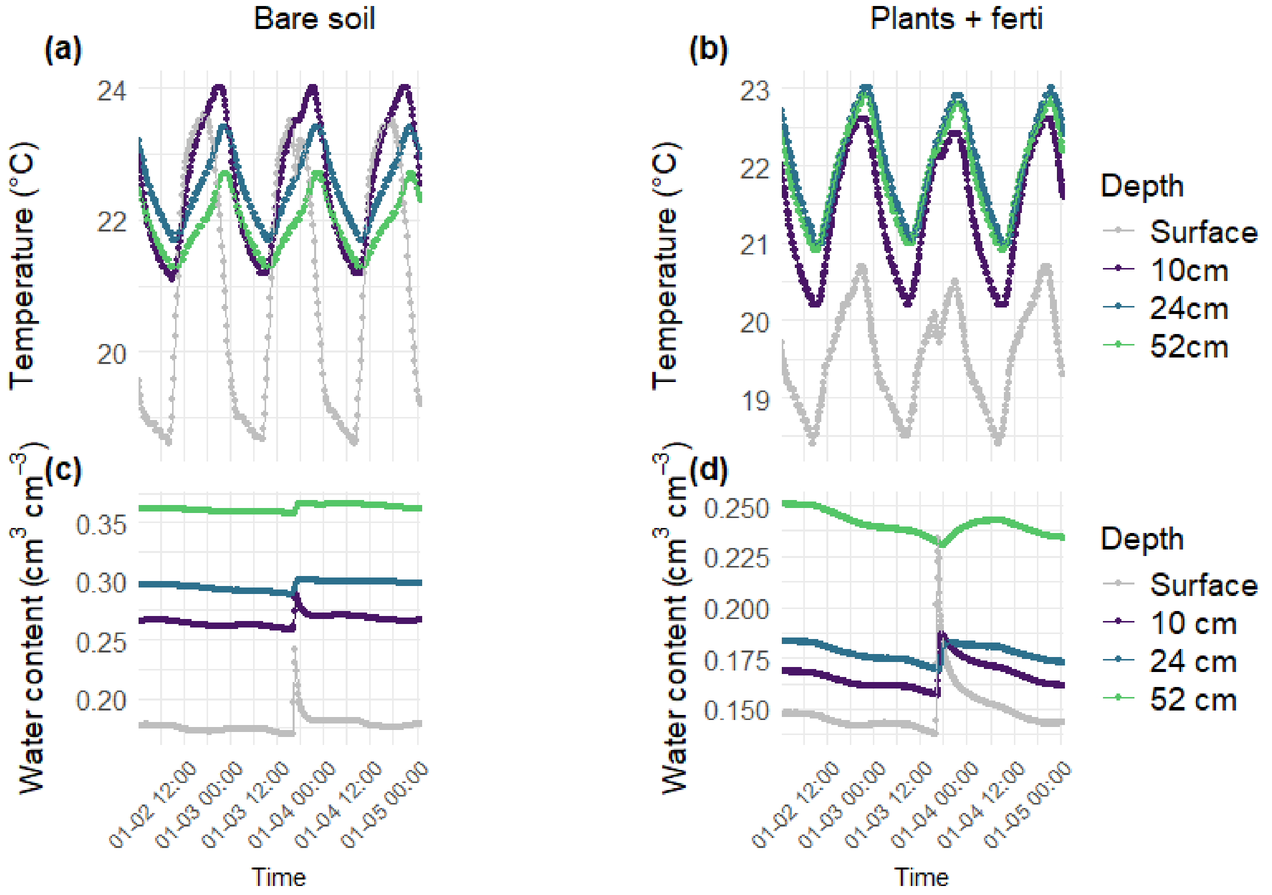


Figure 12: Diel cycles of soil temperature and water content, observed in two mesocsosms, at the surface and in three horrizons.

In the text, we will add this result section: “We see in the bare soil, which is saturated with water at the bottom, that the daily temperature range decreases with depth. Soil temperature varies by 3 °C at a depth of 10 cm in this three-day period: from 21 to 24 °C, compared to 1.5 °C at 52 cm: from 21.2 to 22.7 °C. For the planted lysimeter, the difference between horizons is less pronounced. Temperature varies by 1.8 °C at a depth of 10 cm: from 20.1 to 22.9 °C, compared to 2.2 °C at 10 cm: from 20.9 to 23.1 °C.

We thus see that there is a temperature gradient. We compared that with cycles of temperature observed in the Landscape Evolution Observatory, which is an experimental platform featuring artificial watersheds with a surface area of 330 m^2 made of the same basaltic substrate as in our experiment (Pangle et al., 2015). At a depth of 50 cm, in the latter platform, the daily temperature range is less than 1 °C whereas it can reach up to more than 10 °C at a depth of 5 cm for the same climatic conditions. Even though we did not use the same climatic conditions as Pangle et al. (2015), this comparison shows that the buffering effect of soil is more pronounced in the artificial watersheds than in the lysimeters.”

- L290: I'm not sure if this section is necessary for the technical note. I would suggest focusing more on the setting, and discussing the opportunities and limitations more broadly.

Your comment echoes that of the referee 1. **We decided to remove this section.**

- 297: How can the authors quantify the difference between treatments with and without ERW when CO2 release over time cannot be differentiated? Please clarify this.

Indeed, we did not go into the detail in the text. It has been proposed that CO_2 sequestration through chemical weathering could be quantified with a combination of O_2 and CO_2 measurements (Sánchez-Cañete et al., 2018; Angert et al., 2015). This proposition refers to the Apparent Respiratory Quotient (ARQ), a ratio between CO_2 an O_2 efflux, which is modulated by diffusion coefficients of both gas. The theory is the following: heterotrophic or autotrophic respiration consumes O_2 and releases CO_2, whereas chemical weathering consumes CO_2 without affecting O_2 concentration for the majority of reactions. As a result, the ARQ helps to separate this two biogeochemical processes.
However, we chose to remove this section. The reference to ERW therefore no longer appears. The following sentence is still present in section 4.3, to illustrate the potential of measuring several gases: “It is originally equipped to measure O_2 and CO_2, which are involved in biotic and abiotic CZ processes. Combining CO_2 and O_2 measurements allows the calculation of ratios such as the Apparent Respiratory Quotient, which can help distinguish between sources and sinks of CO_2 (Sánchez-Cañete et al., 2018).”

- L316: The wall effects appear here for the first time. I am not sure if this is the right place to discuss it, but I suggest doing so earlier.

We do agree and we moved it to the 4.2 discussion section.

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AWAT_2014_function

Hulin Baptiste

2026-06-03

Filtering routine to be iterated on lysimeters M data (Mlys +Mout_cum). Based on the recommendation from Peters et al. (2014). https://doi.org/10.5194/hess-18-1189-2014

```
AWAT_filter <- function(y, t,
                        wmin=76,
                        wmax=1920,
                        delta_min=1,
                        delta_max=3,
                        max_degree=4){

  N <- length(y)

  best_degree <- rep(NA,N)
  best_AICc <- rep(NA,N)

  yhat <- rep(NA,N)
  Bi <- rep(NA,N)
  wi <- rep(wmax,N)
  delta <- rep(NA,N)

  ########################
  # STEP 1
  ########################

  for(i in 1:N){

    center <- t[i]

    ind <- which(abs(t-center) <= wmax/2)

    if(length(ind)==0) next

    xw <- t[ind]-center
    yw <- y[ind]

    good <- complete.cases(xw,yw)

    xw <- xw[good]
    yw <- yw[good]

    r <- length(yw)

    if(r < (max_degree+2)) next

    models <- vector("list",max_degree+1)
    AICc_values <- rep(NA,max_degree+1)

    for(k in 0:max_degree){

      n <- k+1
```

```r
    if((r-n-1)<=0) next

    X <- sapply(
      0:k,
      function(j) xw^j
    )

    fit <- tryCatch(
      lm(yw ~ X -1),
      error=function(e) NULL
    )

    if(is.null(fit)) next

    models[[k+1]] <- fit

    SSQ <- sum(residuals(fit)^2, na.rm=TRUE)
    SSQ <- max(SSQ,1e-12)

    AICc_values[k+1] <-
      r*log(SSQ/r)+
      2*n+
      (2*n*(n+1))/(r-n-1)
  }

  if(all(is.na(AICc_values))) next

  best <- which.min(AICc_values)

  best_fit <- models[[best]]

  if(is.null(best_fit)) next

  Sres <- sum(residuals(best_fit)^2)

  Sdat <- sum(
    (yw-mean(yw,na.rm=TRUE))^2
  )

  Bi[i] <- ifelse(
    Sdat<1e-12,
    1,
    Sres/Sdat
  )

  yhat[i] <- coef(best_fit)[1]

  t975 <- qnorm(.975)

  delta_raw <- Sres*t975

  delta[i] <- max(
    delta_min,
    min(delta_raw,delta_max)
  )
```

```r
}

########################
# STEP 2
########################

wi <- pmax(wmin,Bi*wmax)
wi <- pmin(wmax,wi)

########################
# STEP 3
########################

y_smooth <- rep(NA,N)

for(i in 1:N){

  if(is.na(wi[i])) next

  ind <- which(
    abs(t-t[i])<=wi[i]/2
  )

  y_smooth[i] <- mean(
    y[ind],
    na.rm=TRUE
  )

}

########################
# STEP 4
########################

y_threshold <- y_smooth
for(i in 2:N){

  if(is.na(y_threshold[i-1])) next

  if(is.na(y_smooth[i]) || is.na(delta[i])){

    y_threshold[i] <- y_threshold[i-1]
    next
  }

  diff_i <- abs(
    y_smooth[i] - y_threshold[i-1]
  )

  if(is.na(diff_i)){
    y_threshold[i] <- y_threshold[i-1]
    next
  }

  if(diff_i < delta[i]){
```

```
      y_threshold[i] <- y_threshold[i-1]

    } else {

      y_threshold[i] <- y_smooth[i]
    }
  }

  ########################
  # ET + P
  ########################

  dM <- c(
    NA,
    diff(y_threshold)
  )

  P <- ifelse(
    is.na(dM),
    0,
    ifelse(dM>0,dM,0)
  )

  ET <- ifelse(
    is.na(dM),
    0,
    ifelse(dM<0,-dM,0)
  )

  return(
    list(
      yhat=yhat,
      Bi=Bi,
      wi=wi,
      delta=delta,
      y_smooth=y_smooth,
      y_threshold=y_threshold,
      P=P,
      ET=ET,
      P_cum=cumsum(P),
      ET_cum=cumsum(ET)
    )
  )

}
```