hess-2021-519	Submitted on Oct 2021
Lysimeter based evaporation and condensation dynamics in a Mediterranean ecosystem	
Handling Editor	Lixin Wang
Manuscript type	Research article
Status	Final response (HESS discussion)

Anwers to Referee #2 Giora Kidron

General comments

The authors presented a thorough and clearly written research paper, which I enjoyed reading. There are some points, however, that should be pointed out, whether in order to clarify some issues or to point to possible directions for future research.

Thank you very much for the comments and suggestions and for helping us to improve the manuscript. We considered them very helpful and changed the manuscript accordingly. Below, we provide answers to your comments (in italic).

1. Unfortunately, the reader is not provided with a full description of the lysimeter. I assume that the lysimeter is covered with vegetation which reflects the vegetation at the site. Data regarding the cover and height of the vegetation at the site, along with photographs would have been helpful.

Thank you very much for this comment, it is now clear to us that we should refer more clearly to the work of Perez-Priego et al. 2017, where a more detailed description of the setup is published. We added the following sentence to section 2.2 accordingly: "A full description of the technical details of the lysimeters is given in Perez-Priego et al. 2017."

We further followed your recommendation and added information on the vegetation in section 2.2 and added photographs of the setup and lysimeter cover in the Appendix (Figure A1):

"The lysimeters were installed in 2015 by excavating undisturbed soil monoliths from open grassland areas. The natural herbaceous vegetation cover was preserved. Pictures of the lysimeter columns and an aerial photograph of the site are shown in Fig. A1."

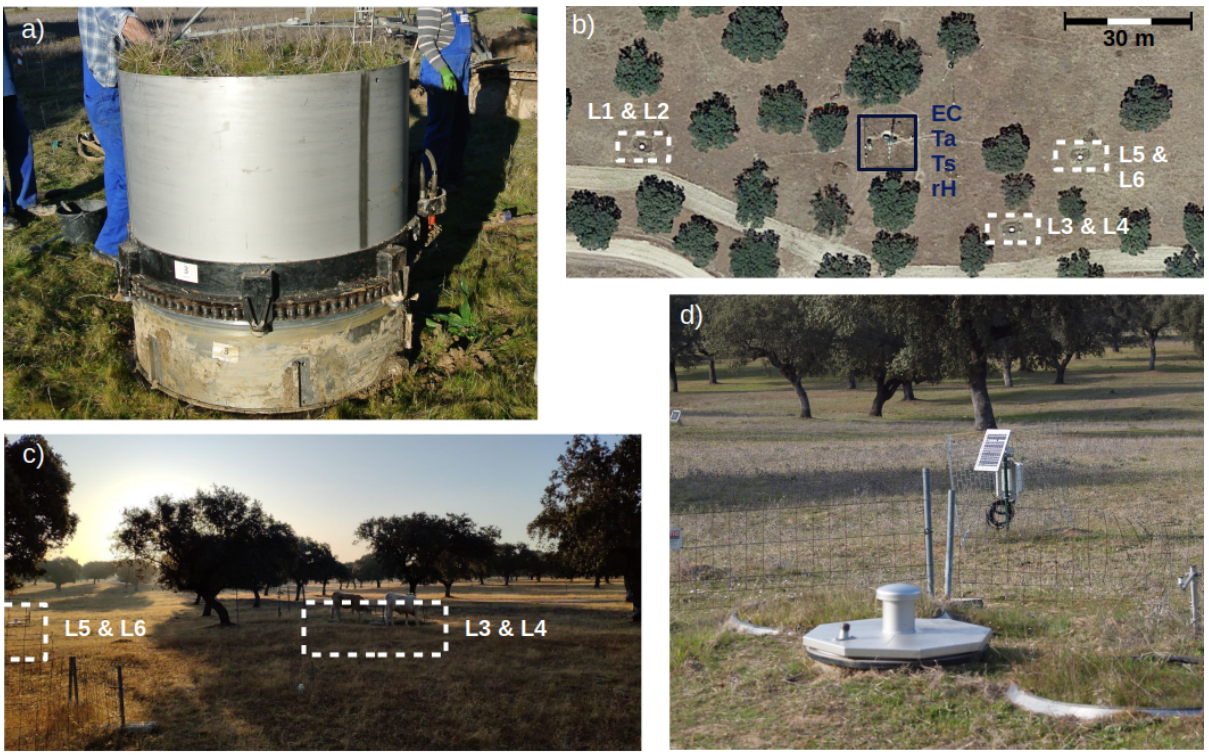

Figure 1. A1. Pictures of a) intact, vegetated soil monolith in the lysimeter vessel after excavation for installation in 2015 (picture by Oscar Perez-Priego); b) aerial view of the measurement setup with the lysimeter stations marked by white rectangles, and the EC and meteorological sensors marked by dark blue rectangles (Map data from: Google Earth, Image Inst. Geogr. Nacional); c) exemplary image of the site on 26.09.2019 at 8:30 in the morning to illustrate the heterogeneous shading conditions caused by the singular standing trees; d) lysimeter column 3 on March 03rd, 2022. The low fence around the station is installed to allow grazing of cows on the column during the grazing period while reducing the risk of cows stepping on them (picture by Gerardo Moreno).

2. Scholars tend to refer to the amount of NRW that they obtained as representative of their site. Consequently, a comparison with other sites is often made, and similar values are taken as a supportive evidence for the reliability of the newly published data. Differences may be explained to stem from "site-specific timing" (l 302), but this may however not necessarily be the case. The authors were indeed aware of the complexity stemming from the sharp temperature gradient above ground, and the Td was corrected to that of 10 cm above ground. One however should note that this height above ground yielded the highest NRW in the Negev (Kidron, 1998, 2010). At higher height a decrease in NRW took place due to higher wind turbulence while at lower height a decrease in NRW stemmed from the heat emitted from the soil. While the 10 cm height taken by the authors is relevant for plants (as correctly indicated by the authors, and was in line with eddy covariance measurements), it is not necessarily relevant for biocrusts.

If we understand correctly, the comment refers to the effect of the height of the vegetation on the amount of NRW (or dew in particular) and the effect of the sensor height to estimate if conditions are suitable for dew formation.

Concerning the amount of NRW it should not differ since in this setup the quantification is independent of height in contrast to the cloth plate or Plexiglas methods used in Kidron et al. (1998, 2010).

Concerning the reference height, we received a similar comment from referee # 3, Werner Eugster, on the approximated height. He suggested we should use an approximation for 1 cm height above the surface because this height was used in the work from Monteith 1957. As the reviewer points out here, the 10 cm height is relevant for vegetation at our site which has a mean canopy height of 0.1 m (Migliavacca et al. 2017). Biocrusts in contrast are rather rare which might be a consequence of regular grazing (Concostrina-Zubiri et al. 2017).

Since we nevertheless understood that the manuscript is lacking more explicit reasoning for the readers we added some sentences on the effect of surface height on dew amounts and the relevance to take into account measurement height and the height of the condensation surfaces (vegetation or biocrust).

"Since the installation height of the sensor is 1 m we needed to approximate a value that better reflects T_{dew} at the height of the condensation surfaces. Despite a reference height of 1 cm is generally used (Monteith, 1957), we approximated 10 cm which reflects the average canopy height of the herbaceous layer."

3. Large lysimeters may better reflect the NRW. The extent to which heat loss through the walls of a large lysimeter will affect the NRW in comparison to the large effect recorded for microlysimeters (MLs) has yet to be evaluated.

Yes, we agree. We are also not aware of a study that analyzes this effect. We added a sentence in the discussion to point out that in face of the identified overestimation of Micro-Lysimeters a similar analysis for large weighing lysimeters would be recommended before excluding the possibility of the same underlying effect (despite the lower boundary heat exchange system).

"Despite the lysimeters being built in a way that heat losses are prevented, the extent to which heat loss through walls of a large lysimeter will affect NRW despite the lower boundary control has yet to be evaluated."

> Once MLs are used, as was the case for the Tabernas (Uclés et al., 2013, 2014, 2015, 2016), one may have assumed, based on the published NRW that the Tabernas may be considered as a 'dew desert' and that NRW has an important contribution to the biocrusts there. However, based on data from the Negev (Kidron and Kronenfeld, 2020a, 2020b; Kidron et al., 2021) and analysis of the microclimatological variables in the Tabernas (Kidron and Lázaro, 2020; Kidron and Kronenfeld, 2020c), the published data for the Tabernas should be taken with caution. It is not merely the distance from the Mediterranean (l 294), but rather the method used that may largely explain the differences in the reported NRW between the current site and the Tabernas.

Thank you for this informative assessment. We changed the sentence in the following way:

"In a similar semi-arid steppe ecosystem in Spain, the mean number of days per year with suitable conditions for dew formation was 285 days (Uclés, 2014), however, this finding is based on measurements with micro-lysimeters and might therefore overestimate the real dew formation frequency (Kidron and Kronenfeld, 2020a, b)."

4. Certainly, while the method employed by the authors may yield relatively reliable values in comparison to other methods which use lysimeters, **verification against manual measurements is necessary.** I assume that in this case, vapor condensation on the plant leaves should be measured. For a comparison to other sites (including the Tabernas) where great efforts were made to evaluate the amount of NRW obtained by biocrusts, direct NRW measurements also at the surface would be helpful.

We fully agree with the reviewer that this would be most desirable and would also help identify whether the large weighing lysimeters potentially overestimate NRWI similar to Micro-lysimeters, as pointed out in comment 3.

However, since the start of this analysis, the traveling regulations were forcing us to cancel several field campaigns in which such data could have been collected. Therefore, the manual sampling was unfortunately not possible to perform and included in this analysis.

To point out this shortcoming of our study and that the NRW amounts should be handled carefully we extended the Discussion and the Outlook by the following sentences:

Discussion: "However, NRW sums often deviated between different measurement instruments and manual sampling (Kidron and Starinsky, 2019; Kidron et al., 2000). Unfortunately, quantitative validation of NRW sums was not possible in our current study."

Outlook: "Until a quantitative validation has been carried out for NRW from large weighing lysimeters, the measured sums should be interpreted with caution. Ideally, such validation would take the form of several campaigns with a manual sampling of soil and plants throughout the year to cover the seasonally varying NRW fluxes."

References

Concostrina-Zubiri, L., Molla, I., Velizarova, E., & Branquinho, C. (2017). Grazing or not grazing: implications for ecosystem services provided by biocrusts in Mediterranean cork oak woodlands. Land Degradation & Development, 28(4), 1345-1353.

Kidron, G. J., Yair, A., & Danin, A. (2000). Dew variability within a small arid drainage basin in the Negev Highlands, Israel. Quarterly Journal of the Royal Meteorological Society, 126(562), 63-80.

Kidron, G. J., & Starinsky, A. (2019). Measurements and ecological implications of non-rainfall water in desert ecosystems—A review. Ecohydrology, 12(6), e2121.

Kidron, G. J., & Lázaro, R. (2020). Are coastal deserts necessarily dew deserts? An example from the Tabernas Desert. Journal of Hydrology and Hydromechanics, 68(1), 19-27.

Kidron, G. J., & Kronenfeld, R. (2020a). Atmospheric humidity is unlikely to serve as an important water source for crustose soil lichens in the Tabernas Desert. Journal of Hydrology and Hydromechanics, 68(4), 359-367.

Kidron, G. J., & Kronenfeld, R. (2020b). Microlysimeters overestimate the amount of non-rainfall water–an experimental approach. Catena, 194, 104691.

Monteith, J. L. (1957). Dew. Quarterly Journal of the Royal Meteorological Society, 83(357), 322-341.

Perez-Priego, O., El-Madany, T. S., Migliavacca, M., Kowalski, A. S., Jung, M., Carrara, A., ... & Reichstein, M. (2017). Evaluation of eddy covariance latent heat fluxes with independent lysimeter and sapflow estimates in a Mediterranean savannah ecosystem. Agricultural and Forest Meteorology, 236, 87-99.

Uclés, O., Villagarcía, L., Moro, M. J., Canton, Y., & Domingo, F. (2014). Role of dewfall in the water balance of a semiarid coastal steppe ecosystem. Hydrological Processes, 28(4), 2271-2280.