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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Responses of soil water storage and crop water use efficiency to changing climatic conditions: A lysimeter-based space-for-time approach" *by* Jannis Groh et al.

Anonymous Referee #1

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The manuscript by Groh et al. aims primarily at evaluating if, and to what extent, changes in local climatic conditions among some German sites affect crop production and water use efficiency. The evaluation is carried out through a "space-for-time" (SFT) framework by moving soil monoliths contained in lysimeters in two locations subjected to different aridity index. Among the various outcomes of this study, the authors claim that a more efficient crop water use occurs under less optimal soil moisture conditions. The text reads well and is properly organized, although some parts are too wordy or seem going astray in describing the moving of the lysimeters. Figures and tables are satisfactory, but I suggest that the readability of Figs. 2 and 3 should be improved. As I will specify below, I have some concerns about the approach and modeling tool used,

and the discussion of some results. Therefore, while the topic is of current interest for the HESS readership, this paper should not be accepted in its present form, requires major revisions or should be rejected altogether.

1) About the SFT approach The authors employ the SFT approach in the context of moving the lysimeters from one location to another in Germany. SFT is not new, actually, and mostly used in Ecology, but some examples can be seen in the hydrologic literature (e.g. Scanlon et al., AWR 28:291-302; Troch et al., HESS 17:2209-2217). However, the way the authors have employed this approach does not seem to follow a standard (I guess), and therefore I think that an evaluation is required to test its soundness in the context of the submitted paper. The "long-term" concept exerts a key role when applying the SFT approach, but in this study only thirty years of weather data are exploited (just a minimum from a meteorological viewpoint) and then only six years are considered for the analysis (from 2012 to 2017). In view of this, I suggest that questions about "climate change" should be left out of this paper, whereas at least the authors might deal with possible changes, if any, in weather seasonality (e.g. a prolonged dry period or wet period, namely anomalies with respect to what observed during the 30 years of records). If longer time series of weather data were available (but 30 years could be used just like a threshold), plots of "Standardized Precipitation Index, SPI" or "Standardized Precipitation Evapotranspiration Index, SPEI" would definitely help. By the way, Walter and Lieth's climate diagrams for only six years is not a good practice.

2) About the modeling tool My view is that the topic coved in the paper is addressed more effectively if one looks at the derivative of the system dynamics and not at its integral behavior. In order to translate my comment in modeling terms, what I am suggesting is the use of a Richards-based model instead of the bucketing type approach expressed by Eq.(1). Giving a look at the paper by Pütz et al. (2016), I see that the lysimeters are fully equipped with soil water content and potential sensors, together with other sensing devices. Therefore, I am wondering why the authors did not exploit the potential of this information to use the Richards equation.

3) Concerns about determining ET My comment in this point 3) is linked somehow to the previous point 2). The use of ET, instead of making the partitioning of this variable in actual evaporation (Ea) and actual transpiration (Ta), can be something that may strongly limit the understanding of the ongoing processes and might yield erroneous outcomes. The use of the bucket model of Eq.(1) does not account for the important aspect of evaluating the possible onset of stress conditions in the crops and hence the computations of water use efficiency. The concept of “available water” or “readily available water” (as implied by Eq.(1), if I understood well) is definitely not adequate for the objectives of this paper. The plant can be under stress conditions due to the atmospheric demand even if a good amount of soil water is in the soil profile. Water transport resistances into the plant also play a key role. Moreover, what about possible physiological reactions of the vegetation when moving the lysimeter from one location to another? Did the authors check this aspect? Usually, vegetation shows some sort of resilience to its moving, at least during the initial stage of this moving. Can the authors comment on those points?

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