Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-626-RC3, 2019


Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Groundwater influence on soil moisture memory and land–atmosphere interactions in the Iberian Peninsula" *by* Alberto Martínez-de la Torre and Gonzalo Miguez-Macho

**Anonymous Referee #3**

Received and published: 4 April 2019

This paper discusses the role the water table plays in the terrestrial water cycle through the provision of vertical fluxes it provides for crops to evapo-transpire. The authors apply a Land Surface Model LEAFHYDRO that also simulates the dynamics of water table. They present results that show the difference between the simulated soil moisture values with and without the inclusion of the water table. I think this paper addresses relevant scientific questions within the scope of HESS, it represents interesting tools and ideas; however, the presented methodology and data fall short from supporting the reached conclusions.

It is clear that significant work has been undertaken to produce the results; however,



I think because the authors are dealing with many processes including land surface, unsaturated zone, and saturated processes, the paper as it stands lacks a lot of information that are necessary to convince the reader with the applied methodology and possibly the repeatability of the experiment. In addition, there are concerns related to the structure of the paper where introduction, results, and discussions are all mixed together. My points below make these comments clear:

At the beginning of the introduction, the authors state that "groundwater exchanges with the land surface occur via vertical fluxes through the water table surface, and horizontal water redistribution via gravity driven lateral flow". The authors must be specific regarding the type of the lateral flows. Are these flows in the saturated zones only? Are they in the main aquifers or perched aquifers? Or do they also include what is called through flows, i.e. lateral movement of infiltrated due to the existence of low permeability materials above the water table?

The scale the authors are dealing with is a national scale. It is expected that many types of hydro-geological conditions will be met at this scale. It is not expected that they will deal with all possible hydro-geological settings, however, the paper must clearly state the selected hydro-geological condition the model is applied to. A diagram showing a conceptual model of this hydrogeological setting is needed. All the results to be presented and discussed has to be put always within the context of this conceptual model.

The introduction must be more focused. The paper states the aim of the paper in the first paragraph of the paper. The introduction then tries to explain the reasons for undertaking the work afterwards. I think the argument should be built the other way round. In addition the introduction includes description of the methodology applied (Page 3 Lines 5 to 12) and site description (paragraph starting from Line 20 on Page 3). I have difficulties with some of the definitions and terminology used. For example, on Line 34 Page 3, the authors write "reflecting the importance of groundwater memory". Why do they need to call it memory? It is the groundwater storage that reduces the

impact of extreme weather events. The use of positive and negative recharge is also confusing (although clearly defined) and not intuitive.

Section 2 must be split into two sections one describing the study area including the information that are presented in the “Introduction”, in addition to the conceptual model. The other section must be dedicated to the Methodology, which must include a lot more information than what is already presented. For example:

- Equation 1 shows the temporal variations of groundwater storage as a response to recharge. What about the soil moisture temporal variations?

- How does the model calculate evapotranspiration? Does it calculate runoff? Does it account for overland routing? Is overland water added to the groundwater flows emerging in the rivers to calculate total flows at the gauging station?

- How is the capillary flux calculated? Is it dependent on the position of the water table? (It is clear it is but at least it must be described in the methodology)

- How capillary forces are presented in the model? When a water table exists, the water is available to evapo-transpire wherever the water table depth is?

- It is not clear how the high resolution steady state simulation results are used in the low resolution time variant results (This is explained later, but what is mentioned in Section 2 is not enough to clarify this approach.

- It is stated that the shallow water table slows down drainage. If the soil is not fully saturated and the water does not pond on the surface, how the shallow water slows down drainage?

- It must be explained here that rivers could be influent and effluent

- Are the groundwater flows also driven using Darcy’s law or is it based on hydraulic gradient only? What is the calibration procedure used to find the spatially distributed hydraulic conduct values?



Section 2.2 provides information about the source of data but no information about the data are provided. For example information about the spatial distribution of landuse is important to understand the amount of water extracted by evapo-transpiration from the soil store. Nothing is mentioned about the hydrogeological data used in the model such as the values of the hydraulic conductivity and storage coefficient of the aquifer, river bed conductance values, etc.

In Section 2.4, can you state please which groundwater model is used with the Mosaic LSM recharge model to calculate the initial EWTD? On Lines 10 to 18 (Page 6) it is unclear which model has the high resolution and which one has the low resolution. A diagram that shows the steps followed in methodology will be helpful. Text from Line 18 onward in this section are results. Why are they included in this section?

In Section 3 the authors dip into discussing the validation of a model while no information about the hydraulic parameters used in the model are provided. These include parameters controlling overland, subsurface, and unsaturated flows as well as soil and landuse data. They claim that the temporal variabilities are reproduced. However, with the lack of the parameter values and the definition of the context (assumptions and conceptual model) within which the model is built, this conclusion is easily challenged.

In Section 4.1 (Lines 25 to 30 on Page 9), the authors define positive and negative recharge in an unintuitive way since in groundwater, recharge is referred to as inflow to the groundwater reservoir and the opposite is a discharge from the water store and that could be in any direction (like the upward capillary fluxes). The sentences on Lines 10 to 14 on Page 10 are not very well formulated and together with the comment above, it is difficult to understand the point the authors are trying to make. On Line 15, the argument “this cycle is more pronounced the shallower the water table” is not very strong since Figures 6c to f all show seasonal variations across the whole peninsula.

In Section 4.3: can you please state how annual anomalies are calculated? Is it a difference from a long term average value or the difference from an average calculated

on the date the anomaly is determined?

Line 28 Page 11: are anomalies in precipitation and anomalies in soil moisture correlated or are the anomalies in soil moisture correlated with precipitation. Please clarify

Section 4.4 Line 21: “water table depth (red lines)” are observed or simulated? If simulated is it from the model with water table or with free drainage?

Figure 9: Please correct the caption for the left figure which should be related to the free drainage (FD)

In Figure 11, I expect the soil moisture anomalies calculated from the simulation with a water table to be lower in absolute value than those calculated from the simulation with free drainage. This appears to hold true for all hydrological years except Years 8 and 9 (Compare row 3 to row 2). Why?

Finally, I think the paper has to include a Discussion section where the analysis of the results has to be aligned with the assumptions listed in the conceptual model together with the hydraulic characteristics of the studied domain and the landuse controlling the amount of evapotranspiration from the soil zone. While the amount of work that has been taken and presented must be recognised and appreciated, I think the addition of a discussion section and rewriting the conclusion section to address the main findings concisely will greatly improve the presentation of this work

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-626, 2019.