CC1: Giacomo Medici

General comments

Good research in the field of surface/groundwater interaction with angle on variations of the climate. Some detail is missing, please integrate my specific points.

We thank Dr. Giacomo Medici for his useful comments.

Specific comments

Lines 18-95. Any link between your research and transient groundwater flow models? I think so looking at the results Figure 9. Please, specify this point.

Most Land Surface Models, as HTESSEL that is used by ERA5 reanalysis, extend from the surface to a soil depth between 2 and 4 meters, constraining the flux at the bottom of the soil domain by applying a free-drainage condition, where the flow is only controlled by gravity. Our method, by using the strong correlation between such predicted bottom fluxes and the observed water table level [1] in shallow unconfined aquifers, avoid the use of additional transient groundwater model that are fully coupled with the land surface. Altough such groundwater models fully coupled with land surface models are found to generally improve the prediction of surface water fluxes (runoff and evapotranspiration) [2], they will also increase the computational cost. Therefore our method offer an easy-to-implement (where water table observations are already available) and low-cost alternative to the fully-coupling modeling option. We will include the above discussion in the introduction.

[1] Cerlini, P. B., L. Silvestri, S. Meniconi, and B. Brunone, 2021: Simulation of the Water Table Elevation in Shallow Unconfined Aquifers by means of the ERA5 Soil Moisture Dataset: The Umbria Region Case Study. Earth Interact., 25, 15–32, https://doi.org/10.1175/EI-D-20-0011.1

[2] Batelis S-C, Rahman M, Kollet S, Woods R, Rosolem R. Towards the representation of groundwater in the Joint UK Land Environment Simulator. Hydrological Processes. 2020; 34: 2843–2863. https://doi.org/10.1002/hyp.13767

Lines 59-60. “There is high confidence that the Mediterranean region will suffer from an increased aridity and an increase in hydrological droughts”. Please, specify that aridity can heavily impact the snowmelt recharge of the aquifers in the mountain ranges of the Mediterranean area. Insert relevant literature on this point:

- Lorenzi, V., Banzato, F., Barberio, M. D., Goeppert, N., Goldscheider, N., Gori, F., Lacchini, A., Manetta, M., Medici, G., Petitta, M. (2024). Tracking flowpaths in a complex karst system through tracer test and hydrogeochemical monitoring: Implications for groundwater protection (Gran Sasso, Italy). Heliyon, 10(2).

- Doummar, J., Kassem, A. H., & Gurdak, J. J. (2018). Impact of historic and future climate on spring recharge and discharge based on an integrated numerical modelling approach: Application on a snow-governed semi-arid karst catchment area. Journal of Hydrology, 565, 636-649.

We will insert such comments and relevant literature in the introduction.

Line 95. Clearly state the specific objectives of your research by using numbers (e.g., i, ii and iii).

We will modify this.

Line 153-154. “Mean depth of water table below 10 m”. Unclear, please revise.

The mean depth is calculated as the average of observed water table level over all the available observation period. We will clarify it in the text.

Line 303. Possible to disclose the areas of large correlation coefficient?

We will specify those areas: Provence, South eastern coast of Italy, Central and Northern Italy, internal areas of Balkan peninsula.

Lines 333-430. Please, integrate relevant literature on surface/groundwater interaction with links on climate variations in the Mediterranean region.

We will integrate the literature as suggested

Figures and tables

Figure 2. Difference in colour between the two types of green difficult to see. Possible to improve?

We agree with the referee, we will improve the colormap.

Figures 2 and 6, 7. All these maps should be larger.

Figure 7. What about the use of a dashed line?

Figure 9. Is it clear why the red lines are not continuous?

Figure 9. Insert reference to Figure 1 for the location of the 3 sites.

We will take care of all the above comments regarding the Figures’ formatting.