RC3: Referee #3

The main purpose of this study is to determine the predictive power of the SEAS5 system for seasonal soil moisture. The focus was the deepest soil layer at 289 cm in the central Mediterranean region. The accuracy of the SEAS5 (re)forecasts was compared against ERA5 reanalysis datasets, assuming that the ERA5 reflects realistic soil moisture conditions. The specific research question of the study was to predict recharge (stated as a flow toward groundwater – line 88,89) during dry and wet periods.

Improving our forecasting abilities for the water cycle components is a very important subject. The authors tackle this critical problem so that the subject is relevant and timely. The paper is well written. However, the main drawback of this manuscript is that the results were not adequately explained and discussed, leaving many unanswered questions. Therefore, the paper needs to be thoroughly revised, along with the inclusion of additional sections.

Dear referee,

We thank you for your suggestions. We will try to answer them in the revised version of the paper as follows:

My main comments are listed below:

- One of this study's findings is that the forecasted and simulated soil moisture values within the lowest layers were found to be higher than those in the other layers. This is an interesting finding, but the potential reason remains unexplained. Is it because the soil moisture variations in the deeper layers are significantly less than in the surface layers? I would be interested in seeing the monthly soil moisture variations in these deep soil layers.

We thanks the referee for her/his useful suggestions. We will examine both the monthly soil moisture variations and the memory time scale of each layer in the revised paper to investigate our findings more in detail.

- Extensive agricultural activities exist in all the examined regions (Veneto, Umbria, and Naples). However, irrigation was not mentioned in the manuscript. Considering that irrigation may significantly impact both soil moisture and groundwater levels, providing an explanation of the potential implications of irrigation for soil moisture and groundwater level changes might be useful.
- Moreover, in section 2.4, it was stated that groundwater observations are used as a direct proxy to differentiate dry and wet events. However, the dry and wet periods may be observed in water table levels within different time frames. For example, dry periods may have more immediate consequences as the water table declines due to direct water extraction from the aquifers for irrigation purposes. On the other hand, the water table may have a more muted response to wet periods due to the slow vertical movement of soil moisture. While water table observations include these signals, neither ERA5 nor SEAS5 account for irrigation and only indirectly account for them as a result of data assimilation. Further clarification is needed on such connections and the implications of irrigation on the findings of the study.

We thanks the reviewer for such observations about the influence of irrigation. We will certainly include some clarifications on the introduction and the conclusion of the revised work. However,

we want also to recall that the water table observations, were quality checked and selected in order to avoid any significant external pumping influence.

- Although it is important that ERA5 and SEAS5 are independent estimates (i.e., using different initial conditions, data assimilation methods, etc, as stated in lines 137-139), using different soil parameters might lead to very different soil moisture results even though all other forcings are comparable. Please compare the soil hydraulic parameter distributions of both model approaches and explain the potential implications of any existing differences.
- Moreover, in section 3 (line 165), it was stated that both datasets are interpolated over a common resolution (0.25 degrees). However, the way in which this resolution change was handled is missing. Were the soil parameters accounted for during the interpolation? The same moisture amount may lead to different volumetric water contents in different soil textures.

SEAS5 is based on cycle 43r1 of the Integrated Forecasting System of ECMWF. The land surface model of such system (H-TESSEL) does not differ from the one used by the ERA5 reanalysis (IFS cycle 42r1). Since the horizontal grid resolution is very similar (31 km of ERA5 against the 36 km of SEAS5) we expect that both system are consistent with respect to the distribution of soil hydraulic parameters across the entire domain. However the influence of the difference of soil hydraulic parameters (and eventually the effect of interpolation on the ERA5 grid) will be investigated in the revised paper, whenever the soil type is made available by Copernicus for the SEAS5 system. Moreover, a deeper explanation on similarities and differences between SEAS5 and ERA5 would be included in the Data section.

- There is a disconnection between the main objective stated at the beginning of the manuscript and the findings of this study. The main research question is, “Can seasonal soil moisture forecasts be used to predict the flow toward groundwater?” However, the study did not attempt to predict groundwater recharge; rather, it sought to find the relationship between soil moisture trends and groundwater level changes in dry and wet periods. Please reword the main objective of the paper.

We thank the reviewer for his/her suggestion. Indeed this paper is a step before the prediction of the flow toward groundwater. We will used the suggestion by the referee in order to modify the research question as “to investigate the relationship between soil moisture trends and groundwater level changes in dry and wet periods”.

- Finally, since both the title and the main objective mention managing water resources, I was expecting some discussion about how this study's findings can be utilized for water management purposes, but such a discussion is missing.

We agree with the referee. As also asked by referee #1, we will modify the conclusions in order to introduce some discussion about how the present study can be used for water management purposes.

All the minor changes below will be corrected in the revised paper.

Minor comments:

- Please include an explanation of dotted areas in the Figure 3 caption.
- Equation 1 is incorrect. Please add a parenthesis to the numerator to fix it.

- Figure 7 is missing legend and axis information.