# Review for "Assessment of prediction skill of SEAS5 forecast using ERA5 soil moisture data and relation to crop production"


## Summary

The present study assesses the skill of seasonal forecasts of soil moisture over the entire Mediterranean and Northern Europe region, and seeks to identify any potential correlations between crop yield (maize and wheat) and the primary pattern of forecasted soil moisture. The authors of the present study found that the skill of seasonal forecasts is dependent on the specific region analysed and on the vertical soil layer. This finding is in agreement with previous literature on the same topic in the Central Mediterranean region [2]. However, this study offers a more comprehensive analysis of the skill degradation with lead time on the different soil layers, finding that this is mostly due to noise rather than intrinsic predictability. Therefore, an EOF-filtering approach is utilised on soil moisture data, thereby providing a more realistic field that is conducive to the development of early-warning systems. This methodology has the potential to enhance the reliability of hydroclimatic indicators derived from seasonal forecasts. In particular, this work presents a noteworthy finding regarding the correlation between maize yield and soil moisture anomalies in the Balkan region. This demonstrates the potential for their methodology to be utilised for drought monitoring and seasonal forecasting in summer cropping systems. The text goes on to provide some insights into the decoupling between yield and climate-driven moisture variability due to irrigation regimes. It is evident that the work requires refinement, particularly with regard to the elucidation of skill degradation and the presentation of data, as well as the enhancement of coherence. Notwithstanding these observations, it is deemed suitable for publication in HESS. It is my conviction that the paper would be improved by the implementation of one major comment and a number of minor comments that, in my opinion, could render it more robust.

# Major Comment

The primary concern pertains to Figure 3 (Section 4.2) and the underlying rationale for the observed degradation in skill level. As illustrated in Figure 3, there is a marked difference between this figure and the other figures (shown in the supplementary materials, S1 to S3) for the normalized PC time series in soil layers 1, 2 and 3. It is needed to ascertain why the transition from hindcasts to forecasts (as delineated in Lines 219-222) should exert an influence solely on the deepest soil layer. Furthermore, with the exception of the jump around 2015-2017, the PC1-SWVL4 time series demonstrate significantly divergent behaviour between SEAS5 and ERA5 between 1981 and 2015, indicating a distinct temporal evolution (in contradiction to the assertions made in Lines 220-222). This point requires further elucidation, for example through the presentation of comparative illustrations of soil moisture anomaly between SEAS5 and ERA5, in order to ensure a comprehensive investigation, given its status as the initial significant finding of the paper.

# Minor Comments

- In the introduction (Lines 47-50) the reader is also referred to [1] for a recent comparison of three different soil moisture reanalyses in Italy.
- Figure 1 (and also Figure 6): Why the correlation shows large negative values (dark blue) only in SWVL4 in the southern part of the domain? Maybe such negative values (which disappear when removing PC1), are linked to the skill degradation (see Major comment).
  Why there is a large region in Eastern Africa with white colours? Are there missing data? Moreover I would add statistical significance to such correlations in the Figure (e.g marking statistically significant areas with hatches).
- In Figure 5 percentages are related to SWVL3 and not to SWVL4 if I am not wrong. Please check this coherence.
- Table 3, Please express the number of pixels as percentage with respect to the total number of land grid cells to make the data more readable.
- Line 470 "Removing PC1 isolates mesoscale precipitation and root-zone moisture anomalies that directly affect crop growth." This sentence is too strong in my opinion and would require the introduction of rainfall variability in the study to check its validity. I would remove such sentence.

# Minor edits

- Line 124: Please check the symbol $k$

- Table 1: I suggest to remove it and keep description and source only in the data availability statement at the end of the paper.
- Line 186: Remove bold text Figure 1
- Figure 1: Remove Figure title, Caption is already enough
- Lines 206-207: Please complete the sentence.
- Line 214: Remove bold text Figure 3
- Table 2 is not adding any information about the results with respect to Figure 4, please consider to remove it
- Figure 7, please check caption

# References


[1] Paolina Bongioannini Cerlini et al. "Performance of three reanalyses in simulating the water table elevation in different shallow unconfined aquifers in Central Italy". In: *Meteorological Applications* 30.2 (2023), e2118.

[2] Lorenzo Silvestri et al. "Assessment of seasonal soil moisture forecasts over the Central Mediterranean". In: *Hydrology and Earth System Sciences* 29.4 (2025), pp. 925–946.