

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2  
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## Comment on hess-2022-76

Anonymous Referee #2

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Referee comment on "A robust gap-filling approach for European Space Agency Climate Change Initiative (ESA CCI) soil moisture integrating satellite observations, model-driven knowledge, and spatiotemporal machine learning" by Kai Liu et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-76-RC2>, 2022

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This manuscript explores a RF based approach to fill the spatial gaps in satellite SM observations. The paper is extensive and well organized. The literature review is also extensive, nevertheless it explores studies that are immediately similar to the study to a high degree (i.e. predicts SM from satellite sensors) that there might be some lessons learned in some related studies (i.e. predicts reanalysis SM from model outputs using observed predictors similar to those used in this study) that weren't discussed. Other specific comments are below.

L85 ElSaadani et al. 2021 "Assessment of a spatiotemporal deep learning approach for soil moisture prediction and filling the gaps in between soil moisture observations" discussed in detail the following issues that are relevant to this manuscript:

- Filling SM gaps spatio-temporally using a convlstm ML approach.
- The effect of the number of predictors and time step of prediction on the model performance.

In addition, Q Li et al "Improved daily SMAP satellite soil moisture prediction over China using deep learning model with transfer learning" built on the above work to apply it to SMAP observations while improving the ML convlstm accuracy.

Please include the above references for completeness of literature review and lessons learned regarding the predictors and their effect on ML model performance.

Table 5 Please separate the two sides of the table properly

L143 please check grammar and explain why regular DEM wasn't used

L335 (important comment) please explain the reasoning behind the separation percentage of 90 10 training testing and how this subset was extracted. Is it random undefined subset or is a certain defined period was extracted and why.

Figure 13: please reword the description of panel (a) regarding the text in the figure, does that describe the decrease in performance as a percentage of the original value?

Figure 15 please explain in writing the effect of the significance level on the accuracy of conclusions and interpretation of the results.

Figure 16 is difficult to interpret, please make sure to have a proper legend that makes the figures self explanatory, especially in the lower panels. Reading the figure caption to understand symbols adds difficulty to the interpretation.