

Comment on hess-2021-563

Anonymous Referee #1

Referee comment on "High-resolution (1□km) satellite rainfall estimation from SM2RAIN applied to Sentinel-1: Po River basin as a case study" by Paolo Filippucci et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-563-RC1>, 2021

This is a very interesting study to explore the Sentinel-1 soil moisture estimates and its potential usefulness in deriving the rainfall estimates at 1km resolution in the Po river basin areas in Italy, using the SM2RAIN algorithm. The study has compared the S1 estimates with ASCAT derived rainfall estimates, and also a gauge+radar derived estimates, with a calibrated version of algorithm and a parameterized version. While this study still presents many challenges in terms of accurately inverse rainfall from SM, especially for S1 with low temporal resolution, and remaining issues with certain geographic region where this algorithm will not apply by nature and parameters are difficult to get, I think the study itself is self-contained and interesting. So I'd suggest moderate to major revisions, before it can move forward.

- Major Comment:

By looking at Fig. 5 & Fig. 6, I cannot help asking what is the usefulness of the SM2RAIN products, because they are highly intermittent, and when they have estimates, the estimates are noisy too (zeros and high values are common). I understand the metrics are adequate (e.g., $R>0.6$ for subdaily scales), but since it is one of the goals of this study to provide inputs for the hydrologic modeling community for better inputs, I think it would be very critical for the authors to discuss the true usefulness of their estimates to hydrologic modeling, and if still ways to go, to step back on their motivation or concluding remarks.

- Places needing more clarifications:

L14: it is confusing with "1km resolution" and "500 m spacing" and "25 km spatial

resolution (12.5 km spacing)" throughout the paper. Could the authors provide explanations on what the bracket means? Or if it produces similar confusion among other readers, I suggest to remove what's inside the bracket.

L55 would require citations because readers would like to know which algorithms the authors are talking about and why SM2RAIN stands out.

L148: I am not sure how HESS handles citing unpublished articles. It seems the details on how S1 data were used to derive the 1km SM product (L134-147) is key to the overall conclusions. I believe in Quast et al., in preparation., authors should have concluded on the SM performances based on their RS processing procedures. I think it would be very helpful if the authors mention some of the major conclusions from Quast et al., if this unpublished paper needs to be here.

L173-181: it is not clear why ERA-5's precipitation data (and then derived rainfall data) are used to calculate the daily climatology, for the parameterized version of the SM2RAIN rainfall estimates. In my understanding, ERA-5's rainfall data were coarse and also not performing the best for Italy. Later, the authors also discussed the high bias may be also associated with the ERA-5 (Lin 278). Have the authors tried to use other rainfall estimates (with high spatial resolution and better fidelity in your study region) for this?

L194: how was the soil porosity derived? Which soil texture data was used?

Fig. 1: this is not a very typical figure commonly seen in an academic journal. I suggest the author to draw the Po river basin boundary, and overlay it with the country boundary maps, on top of topographic maps. This way, the information should be more clearly conveyed. The later analyses part can also have better reference information to the topography here (for example, I suggest when discussing about results in Fig. 4, topo in Fig. 1 can be used as a reference).

Fig. 2: figure caption: "30 days rainfall" should be which 30 days or which month?

- Minor style issues:

many acronyms have been defined multiple times such as DEM, MCM, etc. I suggest the

authors to check them throughout the paper and remove duplicate acronyms (only define them at the first appearance).

L291: note inconsistent citation style

L365: "slight" to "slightly"

L367: "extreme" to "extremely"

As also a non-native speaker, I found this paper difficult to follow at many places because of the use of non-native English. I suggest this paper to go through review or editorial processes with native speakers, before its final publication.