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Comment on hess-2021-508

Anonymous Referee #2

Referee comment on "Exploring the combined use of SMAP and Sentinel-1 data for downscaling soil moisture beyond the 1 km scale" by Rena Meyer et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-508-RC2, 2021

The manuscript by Meyer et al., 2021 presented an interesting study in estimating high-resolution soil moisture via the combination of SMAP L3 soil moisture and Sentinel 1 backscatter data. I recommend that the authors address the following comments before considering the paper for publication.

1. Soil moisture at sub-kilometre is indeed in high demand by many regional and local applications. Combination of radiometer and SAR data is definitely valuable and provides a promising way to improve spatial resolution. One major concern is the strong combined effects of incidence angle, biomass and surface roughness on the backscatter. The studies applied a simple methods to calibrate the incidence angle and made a key assumption that ð□□½ is invariant in time and space. What impacts of such assumption can influence on the downscaled soil moisture? Furthermore, is that possible to conduct a sensitivity analysis to investigate such impacts?

2. CRNS data was used as a reference to evaluate satellite-based soil moisture. Since CRNS neutron is also influenced by vegetation water content, did you calibrate such impacts in deriving volumetric soil moisture? The CRNS also has variable spatial and vertical footprints. Not sure if the direct comparison with satellite surface soil moisture is appropriate. Is that possible to consider such representative errors in your evaluation?

3. Another comment is regarding the validation of your downscaled soil moisture. As authors described, small modifications to the downscaling approach can induce significant changes in spatial patterns, it is therefore challenging to identify the best approach. I agree with such statement, but also want to ask how to distinguish noise and real soil moisture patterns? Direct comparison with CRNS might not sufficient due to the scale mismatch and high diversity of soil properties. In addition, can you give some practical advice or outlook on how to generate sub-kilometre soil moisture products, which can be used for fine-scale applications?

4. In cluster analysis, 20m, 100m, 1000m were selected and analysed. What is the criterial to choose these scales? For the downscaled soil moisture, 100 m is presented as "the downscaled sub-kilometre" product. Does it mean it is the tradeoff between quality and resolution?

5. Remote the comma in the title.

6. Caption figure 4: c is backscatter and d is db.