Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2021-273-RC1, 2021

Comment on hess-2021-273

Anonymous Referee #1

Referee comment on "Optimizing a backscatter forward operator using Sentinel-1 data over irrigated land" by Sara Modanesi et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-273-RC1, 2021

General comment:

Modeling irrigation in earth system models is facing different sources of uncertainties and utilizing satellite products via data assimilation could be an effective way to constrain and improve irrigation simulation and its effects on the terrestrial water, carbon, and energy cycles. This study evaluates the irrigation simulation in Noah-MP, identifies the potential of Sentinel-1 observations in containing irrigation signals and discusses the potential of assimilating this observation into Noah-MP in improving irrigation simulation. I found the study interesting and valuable as the exploration of high-resolution remote sensing products in improving model representation of agricultural activities could be valuable in improving modeling of hydrological and carbon cycles under human regulation and in providing info for water management in the future. However, I do think there are some sections need to be improved and clarified, and further discussion is needed regarding revealing the benefits of assimilating the observations into the model. Please see my specific comments below:

Specific comments:

- I found the abstract a bit misleading as the study is only exploring the potential of Sentinel-1 sigma-0 observations in containing irrigation signals and providing evaluations in preparation for data assimilation instead of a data assimilation paper. For instance, it is difficult to connect WCM calibration with optimizing Noah-MP by reading only the abstract. I would suggest the authors to reorganize the second paragraph of the abstract to avoid vague statement of the scientific goal and the content of the study.

- L 49-51: I didn't get the logistics using "either…or…". Are the authors trying to say one of the shortcomings of irrigation parameterization in existing studies is not specifying the source water (Ozdogan et al. 2010b, Evans and Zaitchik, 2008), and even if source water partitioning is considered in Nie et. al. (2018), it only includes groundwater irrigation, instead of dividing the source into different parts? Please clarify and rephrase.
- Why assuming a spatially distributed parameter sets (A, B, C, D) instead of a uniform distribution? I wonder whether the authors analyze the spatial pattern of the parameter distribution and is there any obvious patterns or stratifications of the parameters relating to soil types, climate types, or anything else? Showing this would help audience understand better the meaning of those parameters and relate that to why Natural and Irrigation runs lead to different calibration performance.
- Irrigation affects SSM and LAI, leading to different parameter distribution in WCM calibration process. However, there are mixed results when evaluating against observed SSM and LAI products. For instance, Irrigation run provides improved estimation of LAI magnitude, while degradation in LAI temporal variability. I wonder whether the authors can calibrate the WCM model using the observed SSM and LAI product, and compare the difference in parameter distribution. How does that look like and what could be the uncertainties in retrieving these parameters purely depending on Noah-MP or depending on observations? In other words, could the authors elaborate the discussion on the uncertainty of the calibrated parameters and for example quantify how capturing the LAI magnitude vs. LAI temporal variation would contribute to the calibration of WCM?
- L349-352: I didn't quite understand the rationale of "minimizing the impact of the irrigation signal already contained in sigma-0 observations". Why activating irrigation can minimize this impact? And if the impact is minimized, how you can utilize the irrigation related info in data assimilation if detectable in sigma-0 observations? Please clarify.
- The simulation is performed at 0.01 deg while part of the evaluation is conducted at field level, the area of which is much smaller than the model space. Could the authors discuss the uncertainties that might be associated with this evaluation due to the scale mismatch?
- Figure 7 (a): could the authors elaborate a bit why simulated soil moisture can be directly compared to the VV and VH data, and what might be the difference between the VV and VH data regarding the detection of soil moisture? What might be the reason for negative correlation between simulated SSM and VH for both Natural and Irrigation runs?
- L462-463: It is encouraging to see that the CR has a strong relation to the vegetation signal and could be potentially used to correct the simulated vegetation phenology. However, I was confused how exactly this calibration framework could be introduced to Noah-MP DA? Are you suggesting approximating CR to LAI and directly assimilating CR into the model? Or if you are using calibrated parameter to assimilate into Noah-MP, how does the CR information is going to be ingested? I would suggest the authors to clarify and provide more in detail how the current study is connected to assimilating sigma-0 observations into Noah-MP as I found it is unclear throughout the text.
- L486-491: Why a more uniform distributed C and D is more realistic? If so, why the calibrated parameters are designed to be spatially distributed?
- What is the benefit of assimilating sigma-0 observations instead of directly assimilating LAI or SSM products? I think the authors should discuss and highlight the benefit of assimilating sigma-0 observations in both introduction section and results section.

Technical corrections:

- L57: remove “to” after “from”.
- L102: “focussed” -> “focused”.
- L195: Add a space between and “observations”
- L528 & L530: “Table 3” should be “Table 2”?