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Interactive comment

Interactive comment on "Estimating irrigation water use over the contiguous United States by combining satellite and reanalysis soil moisture data" *by* Felix Zaussinger et al.

Anonymous Referee #1

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This article presents an assessment of passive microwave based soil moisture retrievals for irrigation detection. The manuscript is highly relevant and is written well. My comments are listed below.

MAJOR COMMENTS

Section 1.3: The obvious question here is why SMOS is not included in this list. After all, SMOS and SMAP use the L-band instrument, which is supposed to be more sensitive to soil moisture than C and X-band. I think it is essential that SMOS retrievals are included in this comparison for the sake of completeness. If SMOS does a poor job in detecting irrigation, that is also important to quantify and report.

Section 3.4: I am concerned about the use of the normal deviate based rescaling. As shown in Kumar et al. 2015 (HESS), when rescaling is performed relative to the model, it can lead to loss of information. I understand the need to have the datasets in a same space, but that can be done by scaling them using their own mean/standard deviations (see the strategy in Kumar et al. 2015). Using the model's standard deviation for scaling will have a significant impact on the anomalies of the rescaled time series. These analysis should be redone without rescaling to the model's mean/stdev.

The assumption of a reliable model background is very key to this analysis. Generally the NLDAS2 data products are considered to be the "gold standard" over the US where the models are forced with precipitation data informed by gauge+radar information. The choice of MERRA2 is sub-optimal in my opinion. Why not use NLDAS2 datasets that are freely available, instead of MERRA2 (which is also coarser in spatial resolution)?

Section 3.1.1: Since the article was submitted, SMAP released a new version of the data (including L3) that is supposed to have different bias characteristics, in particular. Normally I wouldn't advocate chasing after different versions, but in this case, it is important to use this new version. Since the SMAP data formats haven't changed, I assume this is relatively an easy thing to do.

MINOR COMMENTS:

Page 2, line 5: Correct the quotations – physically "ideal“amount

Page 5, line 16: It'll be good to briefly mention why the global maps differ.

Page 6: With regard to thermal remote sensing, it'll be good to include the Hain et al. JHM 2015 reference (https://journals.ametsoc.org/doi/full/10.1175/JHM-D-14-0017.1)

Page 7, lines 26-27, fix the quotations.

Figure 2 caption: Please change SJF to SJV, NP to NPS

Page 10, Line 30: MERRA2 used a surface soil moisture layer of 5cm and not 10cm.

Page 10, Lines 31-32: This statement is not strictly true. GLDAS for example, does not assimilate any screen level data.

Figure 3 is nice. Can you show a difference map so it is easy to see where there are significant differences between rdry and rwet? The caption says 'correlations are computed over agricultural areas only'. In that case, why is the map filled everywhere over CONUS?

Page 14, line 27: Is it a known fact that rice vegetation causes specular reflection? Any reference to back up this statement?

Section 5.2 and Figure 4: Can you attribute the rainfall seasonality as another reason why satellite data doesn't seem to detect irrigation. For SMAP, only about 2 years are included. Out of the two, 2016 is considered a wet year over the Midwest, which means there may not have been many days with differences between model and satellite data. Can you provide a figure that indicates the number of days that went into Figure 4, which could help to explain the role of rainfall seasonality.

Figure 5: The choice of the single point sounds a bit arbitrary. Why not, say, do an average of the pixels with irrigated area > 70% (Figure 1). That way you have some spatial representativeness in these time series comparisons.

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