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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Using satellite observations of precipitation and soil moisture to constrain the water budget of a land surface model" *by* Ewan Pinnington et al.

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General comments: A lot of remote sensing products of hydrometeorological variables are available today for the scientific community. There are numerous studies check remote sensing data consistency with ground-based observations, evaluate their efficiency as forcing to LSM or more specific models, investigate a possibility for using this data as an additional source for making our models more realistic. At first glance (looking at title and abstract), the reviewed article tries to show a benefit of including remote sensing soil moisture data to enhancing JULES model realism in modeling various water budget components, but during the reading, my impression was changing



from positive to indifferent. The main reason for this transition is a discrepancy between the title (which sounds novel) and the content. In my humble opinion, a title such as "Top-layer soil moisture prediction based on JULES model and remote sensing data using 4D-Var inspired cost function for soil content parameters calibration" would fit this content best. The only (and minor) difference of classical approaches for water balance modeling using LSM models (e.g. in Zulkafli et al., 2013; Le Vine et al., 2016) here is using the only soil moisture as a target variable. There is no real procedure for water budget constraining (e.g. as in Kelleher et al., 2017). Obviously, there is no discussion about water budget components except soil moisture. In my opinion, the presented article needs a major revision to be published in HESS.

Specific comments: P1L1-2, P1L10, P2L29: There are direct links of presented research to the problem of drought assessment for the agricultural sector, but there is no place in the article for any drought index calculation or introducing a transition from better soil moisture estimates to better decision making in crops cultivation. Authors need to eliminate this part from an abstract or complement Results, Discussion, and Conclusions part of respective information. P1L5-6: Rough estimations of data sources assimilation contribution based on spatially averaged data – need to be reconsidered for the North and the South part separately. P10: There is no reason to write about soil moisture forecasting, because of an experimental design setting is build around non-operational forcing (WFDEI). P2L13-14: What is the novelty of presented research in comparison with Bolten et al., 2010? P3L4-5: Model was driven only by TAMSAT reanalysis products, there was no observational (measured on a station) forcing included. P4L31: Strictly speaking authors updated only two parameters of soil texture, not three. P6L9: "In Figure 2 we show the results of a data assimilation and forecast for a single grid cell in the north of Ghana", but Figure 2 caption is "Soil moisture data assimilation results for a north Ghana grid box". Please, unify this parts (the same in Figure 3 and P6L17). P6L13-14: For me, it is obvious that an amplitude of modeling results is decreasing from 2010 to 2014 (maybe insignificant). Is there any pattern in precipitation of other forcing variables corresponding with this behavior? P6L16-17: It would be great to show a skill of JULES over daily averages of ESA CCI data for 2009 which can be used as "climatological" soil moisture scenario for long-term predictions and forecasting. The same for Figure 3 (results for the south part). P6L20-21: "Although we do improve the fit to the observations after data assimilation in Figure 3..." – not so clear statement without a reference to quantitative metric. P6L30-31: It would be great to see an additional figure of spatial differences between TAMSAT versions for clearer understanding drivers of soil moisture patterns. P6L32: The choice of yearly root-mean-square error (despite considering wet/dry seasons) significantly reduces results understanding in seasonal dynamics. Transfer to monthly (or even weekly) can help both authors and readers to understand dynamic patterns. P7L12-15: Is there another global database of soil properties for comparison with HWSD and JULES-DA results? P8L5-12: Calculation of summary statistics over the whole of Ghana can corrupt obtained results and conclusions – it is a clear pattern (shown in Figure 4) for both different amplitude and direction of bias between southern and northern parts of Ghana. It is better (and will be consistent with results presented in Figures 2, 3, 5) to calculate summary statistics separately for southern and northern parts and presented results as a figure. Maybe it will cause different results and further discussion. P12L5-8: It would be great to describe in details why "updating of soil parameters" (= updating all of the parametrization of water cycle processes in JULES) sometimes works worse than precipitation forcing updating. P12L12-14: True for any calibration approach. But it is not possible to improve anything without a forcing data. P12L15-22: This part is too technical and looks out of context for the Discussion section. P13L9-19: Conclusions are too technical and do not provide any information about the progress in "the understanding of hydrological systems, their role in providing water for ecosystems and society, and the role of the water cycle in the functioning of the Earth system." (quote from the HESS aims and scope).

Typos: P12L11: "after after".

References: Kelleher, C., McGlynn, B., and Wagener, T.: Characterizing and reduc-



ing equifinality by constraining a distributed catchment model with regional signatures, local observations, and process understanding, Hydrol. Earth Syst. Sci., 21, 3325-3352, https://doi.org/10.5194/hess-21-3325-2017, 2017. Le Vine, N., Butler, A., McIntyre, N., and Jackson, C.: Diagnosing hydrological limitations of a land surface model: application of JULES to a deep-groundwater chalk basin, Hydrol. Earth Syst. Sci., 20, 143-159, https://doi.org/10.5194/hess-20-143-2016, 2016. Zulkafli, Z., Buytaert, W., Onof, C., Lavado, W., and Guyot, J. L.: A critical assessment of the JULES land surface model hydrology for humid tropical environments, Hydrol. Earth Syst. Sci., 17, 1113-1132, https://doi.org/10.5194/hess-17-1113-2013, 2013. critical assessment of the JULES land surface model hydrology for humid tropical environments, Hydrol. Earth Syst. Sci., 17, 1113-1132, https://doi.org/10.5194/hess-17-1113-2013, 2013.

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