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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Improving soil moisture and runoff simulations over Europe using a high-resolution data-assimilation modeling framework" *by* Bibi S. Naz et al.

Anonymous Referee #2

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General:

The submitted manuscript of Naz et al. (2018) evaluates the effect of soil moisture assimilation (namely ESA-CCI product) into the CLM 3.5 over Europe during 2000-2006. The Ensemble Kalman Filter is used for the model analysis, the observations are sampled using 100 randomly located points across the entire domain, while the remaining locations are used for independent evaluation. The CLM model operates at 3km spatial resolution, while the assimilation product is available at coarser, approx. 25km (0.25degree) resolution. Additionally, the gridded (monthly) runoff product avail-

able at 0.5 degree is used for evaluation of the model runs. Results are presented for the open loop (OL) and data assimilation (DA) runs. Results are presented in terms of the RMSE and relative bias per nine PRUDENCE regions. I find this topic relevant for HESS, however, according to my opinion, the manuscript is not suitable for publication in the present form:

1. As correctly stated in Section 3.3, before applying any DA methods, the modeler should better parameterize and constrain the model parameters, reduce systematic biases etc. I am afraid you cannot apply DA after seeing those strong biases in the open loop estimates (Figures 6 or 10) at all. I encourage authors to pay attention to proper model calibration before DA analysis.
2. This is not much of surprise when soil moisture gets assimilated into a model that model simulations at the analysis step get more close to the "observation-based" product, as much as the prescribed observation errors allow (given there exists spatial correlation between the 100 assimilated locations and remaining "withheld" observations). By assimilating the ESA-CCI product, the authors claim to improve the initial conditions of the model. That's all . . . I would welcome then the added value/implications of the improved initial model (wetness) conditions (e.g. with respect to some longer lead-times): OL vs. DA.
3. Additionally, using EnKF the authors modify the internal model states and thus introduce some numerical instability (against internal physical constraints for the model), which was not discussed at all. How do you handle this issue after the analysis step?
4. Hardly any discussion for (OL and DA) results is done with respect to other SM data assimilation/modeling studies over Europe . . . which could be used as a benchmark(?) Applying CLM over EU is indeed challenging, but there are other models already able to simulate SM and the choice of CLM is not well described either.

5. The authors have “high-resolution” in their title. I strongly encourage them to eliminate this from the title, especially if they use such coarse scale data to assimilate.
6. Why the authors did not use “high-resolution” discharge data for independent model evaluation? There are thousands of gauges with daily time step over Europe, if the routing would be enabled. I am afraid that using monthly gridded runoff is not sufficient for a “high-resolution” study.
7. The authors could have easily run their model at the resolution of the data and save their larger efforts in computer resources.
8. Another limitation of this study is the limited ensemble size. 12 members are way too low (this number is stated on p. 7, l. 23). Also, the ad-hoc construction of the perturbations needs better reasoning and clarifications!
9. The uncertainty in the time series figures is for the 12 ensemble members?
10. Numerous papers mentioned in the text are not included in the reference list!!!

Technical:
Spell-out ESA-CCI in the abstract.
p.1, line 14: remove “and the . . . due to”
p.5, line 28: remove “In their study”
p. 6: “this product” => which product you refer to here?
p. 6, line 19: missing space after parenthesis
p.10, l. 13: “UK” => “BI”
p.12, line 9: runoff => “monthly runoff”
Figs. 5 and 9, caption: “a,c” => “a,b”

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