Hydrology and Earth System Sciences

Discussions

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Interactive
comment

Interactive comment on "Satellite soil moisture data assimilation for improved operational continental water balance prediction" *by* Siyuan Tian et al.

Anonymous Referee #1

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The paper "Satellite soil moisture data assimilation for improved operational continental water balance prediction" investigates the application of satellite soil moisture for improving a water balance model. While this study can be useful for modelling objectives there are several issues that need to be addressed.

Major comments:

The paper lacks novelty. The applied methodology that is simplified data assimilation (i.e. nudging approach) does not properly take model and data uncertainties into an account. Several more sophisticated approaches have already been published for soil moisture data assimilation.

Discussion paper

The term "prediction" does not add much since every model-data integration will affect initial states and correspondingly a few time steps of forecasting. Showing that soil moisture assimilation led to different state estimates than the open-loop results, which is very obvious, does not prove anything. Authors may put more efforts in validating the results against various independent data over the forecasting period. This could more interesting if a calibration scheme was used to improve the model parameters.

The two-step method should be better explained, especially for the second step that deals with the mass conservation constraint. This part is very unclear and requires more details. It is not clear how authors check for water balance after the first step. I am not sure how accurate is to simply distribute the correction (which is not clear how it can be estimated) to other states (and why only these states?).

The paper lacks thorough background research. There are several other highly related manuscripts to the topic that seem to be missed. These sources could provide a better background and existing knowledge.

Line 105-110: Please explain how did you interpolate soil moisture observations into 0.05 degree scale.

Line 115-120: "we derived a set of coefficients for the rescaling by sampling modelled and SSM data from cells surrounding the gaps", How? Details are required.

Line 135-140: Is not more appropriate to use NDVI to evaluate top layer soil moisture than root-zone? NDVI supposedly better reflects surface soil variations than the root-zone.

Line 155-160: How one can derive Q for different datasets? More details are needed.

Line 170: Very unclear, please revise. Is not $S0$ the top soil layer? If yes, what do you mean by "soil water storage in $S0$ for shallow-rooted vegetation and deep-rooted vegetation at surface layer"?

Equation 3 should be better explained when it comes to having more than one obser-

vation.

Line 185-190: Do you mean that instead of calculating and correcting water balance residuals, you distribute S0 increments? I am not sure if this is a correct approach.

For Section 4.2 authors could use independent evaporation and runoff data to better validate the results.

Minor comments:

I am not sure whether this is the journal policy or authors' decision but it'd much easier if every line of the manuscript has a line number for the sake of review.

Lines 225-230: Can you think of any reason behind "missing or underestimated rainfall events", which seems to be large.

Line 255-260: Have you applied any tests of statistical significance?

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