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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluation of ORCHIDEE-MICT simulated soil moisture over China and impacts of different atmospheric forcing data" *by* Zun Yin et al.

Anonymous Referee #1

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General Comments

The paper systematically explores the impact of four different atmospheric forcing datasets on soil moisture simulations across China, computed by the ORCHIDEE-MICT land surface model.

Studies such as this one are important to understand the considerable differences caused by different forcing datasets prior to interpreting model output of a specific forcing / land surface model combination. The paper is well written and presented in good English. The graphics are very well designed.

The choice of the four different datasets seems reasonable, namely the GSWP3, PGF,

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CRU-NCEP and WATCH dataset, and the choice of these datasets seems to show that the authors want to base the validation statistics on multi-year / decadal analysis.

Some criticism:

The comparison against CCI soil moisture only for 2007 until 2009 is a odd choice. CCI is a unique soil moisture dataset in being based on observations and covering a long time period. This makes it different to other available long-term soil moisture datasets based on model output and other observation based datasets which are usually much shorter. Therefore it should be taken as what it was designed for without cherry-picking the best period. Also, these long time periods will be likely much more interesting for most readers as a limited amount of specific years.

Also, the comparison is not too meaningful if the other datasets / experiments are not compared for the same time period.

Please make the choice of GLEAM clearer. It uses a lot of observations but it essentially is also model output. So you are comparing your model output to another model (which uses a different precipitation forcing?) Possibly give a little more literature on other soil moisture datasets, why specifically GLEAM, e.g. long time period?

Describe why you specifically chose those four forcing datasets. Are they being frequently updated? Also usable for global studies?, etc.

The motivation of carrying out the study specifically over China is in my view lacking a little. Also, are there no locally optimised forcing datasets available? Why run a land surface model specifically over China using global input data? Again, just make the motivation of the study a bit clearer. Why was this specific model used for the experiments, does it have any advantages specifically for China (this is actually mentioned in the model section but might be also helpful in the introduction with a little more detail)?

Concerning the validation as a whole, the model outputs for the four experiments are compared to, in addition to in-situ measurements, GLEAM and CCI soil moisture. How-

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ever, these datasets (CCI and GLEAM) should also be compared to the in-situ measurements since the mere comparison does not result in any helpful answer on which of these datasets performs any better when compared to the actual ground measurements. Both GLEAM and the CCI dataset will likely have their own problems with accurately simulating soil moisture within certain areas. At the current state of the study they are used as a kind of additional ground-truth, which they most certainly are not (and in fact, as correctly noted, GLEAM shares some of the same input data with the forcing data used for the experiments).

Given these shortcomings I advise for a major revision.

Specific Comments

1 Introduction

P2L21-32: Possibly add a sentence on soil moisture (products or raw data) data assimilation in the introduction, since the advantage / disadvantages of satellite based soil moisture products and land surface models are discussed. Data assimilation exactly tries to combine the strengths of these different types of data, such as in the GLEAM dataset.

Dataset description

2.1. Atmospheric forcing

P3L22-29: GSWP3 is very coarse, but downsampled. Could this be especially problematic in areas within China with complex terrain?

P4L2-8: Is PGF still being updated? Maybe add this information to the other datasets too, or to the motivation of choosing these specific datasets.

P4L18-22: WFDEI, why only available until 2009? Both corrected with GPCC v5 and v6?

2.2 Soil moisture datasets

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P5L20: GLEAM has 0.5° resolution? I thought 0.25. It's 0.25° in Table 2, please recheck.

P5L28 GLEAM assimilates GLDAS? I'm not so sure about this. I think it's somehow used for the background error estimation within the assimilation scheme, but please check this.

3) Land surface model, ..

P6L26: 13 PFTs are grouped, did not understand. Only three land cover classes?

P7L10. Why aggregate results to 1 degree? This likely deteriorates the impact of "high resolution" forcing datasets, such as WFDEI. Rather upsample coarser data by simply multiplying grid cells?

P7L15: "distributed to the first half of the forcing time step.." why the first half.

3.3) Model-data comparison methodology and metrics

Comparison protocol

Metrics

P8L1-3: Which time shift was used? Between UTC and local time (several time zones) between model and in-situ measurements. Not vital but good to know.

P8L24: What is the exact motivation for the lag analysis? It does not seem to give any added value. How do you know one or the other are better in temporal terms? You are comparing two models.

3.4) Correlation of uncertainties between SM and meteorological factors

P9L12: Monthly values of other variables also considered . . . How?

4 Results

4.1. Spatial patterns of precipitation and simulated soil moisture

P9L23: These two rivers are the main ones? How much of China do these two watersheds cover? Maybe obvious for some but more background on the study region could be valuable (here and / or in the introduction).

This seasonality is computed across the boundaries depicted in Figure 1? A little more geographically distributed information would be helpful.

P10L3: The soil moisture patterns do not necessarily match the annual mean precipitation patterns, maybe mention something about obvious monthly differences, or stronger evaporation using a specific forcing dataset? Soil moisture is not just the result of precipitation but also the other input data and model internal mechanics. No in-depth analysis is needed but some additional maps or statistics for the most important other water balance variables, e.g. evapotranspiration, or at least some sentences on the issue would be helpful. The GLEAM model you are comparing to is actually primarily developed for evapotranspiration.

4.2. Soil moisture evaluation against multiple datasets, etc..

This part could benefit from some restructuring:

“Comparison with ISMN and PKU in-situ data” seems to be a summary of the model performance for all four forcing datasets when compared to in-situ measurements. It should be noted that these are the average statistics for all carried out experiments. Instead of the next section being “Comparison with GLEM ...” I as a reader would expect a more detailed analysis to follow (or the other way round), which now seems to be in section 4.3 and 4.4. Thus I would recommend to first do the in-depth comparison to in-situ measurements, followed by a comparison to other datasets thereafter. As stated at the beginning, I strongly believe that GLEAM and the CCI dataset should be validated against the in-situ measurements if you want to quantify which model actually performs better in which geographical area.

The main finding that WFDEI performs best among forcing data is not so surprising

when compared to some other studies. Again, more emphasis should be put on why this study is important specifically for China. Maybe compare the outcome of the study to other studies.

Figures:

Table 2: Correlations are stated as being significant. Was the autocorrelation of the datasets taken into account? Also valid for the correlation at the individual stations.

Figure 10: Should include description of variable names. Use same variable names in Figures 9 and 10.

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