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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Improving simulation of soil moisture in China using a multiple meteorological forcing ensemble approach" *by* J.-G. Liu and Z.-H. Xie

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Dear HESS Editorial Board and Reviewers,

The authors would like to thank you for your time spent in reviewing our manuscript "Improving simulation of soil moisture in China using a multiple meteorological forcing ensemble approach (hess-2013-103)" submitted to Hydrology and Earth System Sciences. Because of your constructive comments and suggestions, the revised manuscript was improved greatly. It is appreciated very much.

Sincerely,

Zhenghui Xie (On behalf of all authors).

Response to Referee # 2:

We thank the referee for the constructive comments and suggestions, which are in plain text below. Our response is bold text.

General comments:

This study investigates the use of 4 different meteorological forcing datasets on the CLM3.5 model over China for improving the representation of soil moisture. The four resulting soil moisture datasets are then merged together using either a simple arithmetical averaging or a Bayesian model averaging. It is mostly written in good English (although I am not a native English speaker), the abstract is clear and the title describes well the content of the manuscript. My main criticism is that I found the science content of the manuscript to be a little modest. I believe that some points could be enhanced before it deserves publication. It would be of interest to have a proper analysis or at least more discussions on the 4 different meteorological forcing used (e.g., known problems, consistency over time...). Also, as illustrated on figure 3 (do correct me if I am wrong), it seems that without CLM3.5_JRA you BMA would be completely different (the mean also) and very far from the observations (?) In this case how confident are you about the quality of your BMA (if it is mainly driven by one simulation)?

Response: In present work, our main aim is how to reduce the land surface simulation uncertainty arising from meteorological forcings, and how to improve soil moisture simulation. Since none of individual simulation by a forcing do the best at all subregions, and multiple forcing ensemble approach can reduce the uncertainty arising from individual forcing, we applied BMA method to improve the simulation further and to investigate the role of forcing in the soil moisture simulation by a land surface model, which can provide a reliable description of the modeling uncertainty, and can reduce

the uncertainty. We will do it as suggested by including a proper analysis (Figures) and more discussions on the used meteorological forcings in the revised manuscript. From figure 3, we can see that CLM3.5_JRA showed a smaller bias than the other three, but performed somewhat worse in capturing the temporal evolution of soil moisture. The BMA predictive PDF is a weighted average of PDFs centered on the bias-corrected forecasts from a set of individual ensemble members, in other words, there are have two steps in BMA method, first we get bias-corrected forecasts from a set of individual ensemble members, and then we get a weighted average of PDFs centered on the bias-corrected forecasts. So without CLM3.5_JRA, the BMA results would be similar. The BMA ensemble approach applied to the ensemble simulation reproduced anomalies and seasonal variations in observed soil moisture values, and simulated the mean soil moisture. In this study, we only consider the deterministic forecast of BMA method for the soil moisture, i.e., the mean of BMA posterior PDF.

1. Introduction

P. 3468, L.25, 'that trigger', How? Would it be more correct to say that these events are forced over time by the land surface conditions (and not triggered by the land surface conditions)?

Response: This sentence has been changed to "It is also a crucial variable for monitoring land surface conditions that force extreme events such as drought and flood"

3 Experiment design and ensemble approach

3.1 Experiment Design, P.3474, Although I do not have the correct answer, I am not sure if it is the best way to initialize your model. Maybe it could be done for each atmospheric forcing data set (?)

Response: The spin-ups and initializations on the simulations were not described clearly in the section 3.1. We will revise it in the revised manuscript. Here, we spin-up in order to achieve an equilibrium state of the CLM3.5 and get reasonable initial field.

Due to the four different forcings spanned different time periods, we first did a long run from ITP forcing from 1979 to 2010, and then applied the balanced output to initialize all four simulations at the initial time of four different forcings (1 January 1979 for ITP and JRA; 1 January 2004 for TIAN; 1 July 2005 for FY), not in 2005 for all four simulations. We chose the common time periods (July 2005 – December 2010) to study. We think that the drifts in the first place of Fig. 5 are caused by different forcings.

3.2 Ensemble approach, P. 3475, L.11-15: Please rephrase sentence

Response: This sentence has been rephrased to "In the BMA we develop and use, we assume that the conditional PDF from each ensemble member at the specific time and location was approximated as the gamma distributionïijŽ"

P. 3475, Eq.(8): Please explain symbol between the shape and the scale parameters

Response: We added the explaination of the symbol between the shape and the scale parametersïijŽit is the gamma function.

4 Results

4.1 Spatial distribution and temporal variation, P. 3476, L.9-13: Please rephrase first paragraph

Response: The first paragraph has been rephrased to "The soil moisture was observed only for the 0–10 cm, 10–20 cm and 70–100 cm soil layers, and the soil layer depths in CLM3.5 do not match the depths at which the in situ observations were made, so the multiple soil layers in CLM3.5 were adjusted to the three observed soil layer thicknesses by the weighted averages of soil layer thicknesses in CLM3.5."

P. 3476, L.23-24: Would it be possible to refer to the regions defined in Table I and figure 2 instead?

Response: The regions defined in Table I are too big and can not describe the area very well.

P. 3477 L.29-30 & 3478 L.1: Please rephrase sentence

Response: This sentence has been rephrased to " In this study, the observational stations are sparse, and the area average of simulated volumetric soil moisture only count grid cells nearest to the available observation stations. "

P. 3478, Soil moisture variability represents the time-integrated impacts of antecedent meteorological forcing on the hydrological state of the soil system within your model. The fact that the model overestimates the observations of soil moisture should be more related to model deficiencies (soil texture, structure...). A quantitative description of the 4 datasets used to force the model might help the reader to understand this overestimation.

Response: Based on the comments, we will add a proper analysis (Figures) and more discussions on the precipitation, temperature and radiation in four meteorological forcings and their relationship with soil moisture in the revised manuscript.

4.2 Statistical differences [...] First paragraph: also, the distance between the point recorded 'REF' and the others points representing the model is the centered normalized RMS difference between the model and in situ patterns.

Response: We added the sentence"The distance between the point recorded 'REF' and the others points representing the model is the centered normalized RMS difference between the model and in situ patterns."in first paragraph of section 4.2 in the revised manuscript.

Figure 1: Please refer to Table 2 in the caption for a description of the 8 subdivisions (subdivision III is not easily readable).

Response: We added a description of the 8 subdivisions in the caption of Fig.1 and revised the Fig.1.

Figure 2: Please add a), b) [...] g) on the figure for a better comprehension.

Response: We added a), b) [...] g) on the figure 2.

Figures 3-4-5: Please simplify x- and y-axis for a better readability.

Response: We simplified x- and y-axis of Figures 3-4-5.

Figure 10: Please increase the maximum value of the SDV axis so all the symbols are within the Taylor diagram (e.g. for Fig.10.c)

Response: We revised Fig.10.c.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C2504/2013/hessd-10-C2504-2013-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3467, 2013.