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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assessing parameter importance of the Common Land Model based on qualitative and quantitative sensitivity analysis" *by* J. D. Li et al.

Anonymous Referee #3

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Comments on Paper hessd-10-2243-2013 "Assessing parameter importance of the Common Land Model based on qualitative and quantitative sensitivity analysis" by Li et al.

This manuscript evaluate local and global sensitivity analyses (SA) methods to identify most sensitive parameters in the Common Land Model (CoLM), and compared the performances of these methods to provide guidance for future practices of screening or calibrating parameters. The SA methods are not new, which is fine since the focus is on the consistency and performances of existing methods. The results/conclusions, although maybe site- and model-specific, are useful for the community. The demon-

stration and summary of results are reasonable, although there are statements that need revision or more justifications.

1) In my opinion, it is a little confusing to use the terms "qualitative" and "quantitative" to categorize the two groups of SA methods. I think all of them are quantitative with quantitative measures of sensitivity, either locally or globally, based on gradient or interpreted output variability. If one cares about the overall uncertainty of output simulations, it is important to use global SA by evaluating the contributions of the explanatory variables (e.g., porosity, b) to the overall variability of simulation outputs (e.g., fluxes). However, if it is important to understand the parameter significance for extreme events, or the input-output relationships are nonlinear (e.g., parameter p1 may have negligible impact on simulated fluxes in the lower range, but dominate in the upper range), then local gradient SA is helpful or even critical.

2) It is important to discuss, or at least mention the impact of the initial parameter ranges (i.e., input uncertainty). Moreover, sensitivity is not equivalent to contribution. The response variable y can be the most sensitive to a parameter xi, that is dy/dxi is large, but if the uncertainty range for xi is narrow, we expect to have little contribution (interpreted variance/variability) of xi to the variations of y, and therefore xi is not important given the quantitative measure. A few more discussions in the text are helpful.

3) The conclusions might be site-specific. It is interesting to study, if possible, a few watersheds with different field/climate conditions.

Specific comments:

Page 2244, line 20: consistence-> consistency

Page 2244, line 24: ". . . a LSM. . ." should be ". . . an LSM. . ."

Page 2245, line 13: suggest to replace 10s and 100s with O(10) and O(100), respectively

Page 2245, line 21-22: "identify" a subset among a group, or "differentiate" a subset

from another subset. So it might be better to use “differentiate”

Page 2245, line 28-29: “(hundreds of fewer)” and (“tens of thousands or even more”). Remove. “hundreds” is not necessary a small number, it is dependent on the dimensionality of input parameter space as well as nonlinearity/nonuniqueness of input-output relationships.

Page 2249, line 23: it is only true when people are perturbing each variable/dimension at only two levels, with only a single baseline case for comparison.

Page 2251, line 8: equation (5) does not have quadratic terms? Nonlinearity are/can not be considered?

Page 2251, line 23: explain a little more on how a response surface model was developed. Consistency or convergence of such a model is another issue associated with parameter dimensionality.

Page 2253, line 7: “3” -> “three”. The small numbers, such as whole numbers smaller than ten, should be spelled out. There are many other occurrences.

Page 2253, line 11-12: use plural forms for “range” and “bound”. Duplicate word “types”.

Page 2253, line 11-12: the ranges are for all types of canopy/soil/snow types -> the ranges might be too wide to be used for a single site?

Page 2254, line 23: it is nice to conducted low-cost parameter screening before more expensive quantitative evaluations of parameter contributions. But again I don’t prefer the term “qualitative”.

Page 2257, line 5: inconsistencies between the SA methods are expected for a single site study, since they focus on different aspects of parameter sensitivities/contributions. Need to be careful in making statements such as “a method is not good since it is different from others”.

Page 2257, line 25: “training and testing errors” need a few more explanations here.

Page 2258, line 27: the sentence is to be revised. Theoretically, space will be filled with adequate number of samples, right?

Page 2260, line 9-13: add a few bullets on input uncertainty, nonlinearity, and nonuniqueness issues.

Page 2261, line 18: just curious what is computational cost of a typical CoLM forward model run? This is related to how much computational cost can be reduced using surrogates, the development of which can also be time-consuming.

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