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Geoscientific Model Development Discussions

Interactive comment on "Land surface model parameter optimisation using in-situ flux data: comparison of gradient-based versus random search algorithms" *by* Vladislav Bastrikov et al.

Anonymous Referee #1

Received and published: 17 August 2018

This study digs deep into parametric uncertainty in the ORCHIDEE land surface model, using data assimilation to integrate FLUXNET observations. The authors provide a useful primer for future work on land surface model parameter optimization. This paper could use some reorganization and clarification, as well as adding additional points of discussion to some of the key results. I recommend publication after these and other comments are addressed.

General comments:

There are a couple of key results that could use more discussion (either in the appropriate place in Section 3 or at the end in Section 4). For example, why do certain

parameters have different responses to different optimization methods? What are the limitations of multiple-site optimizations? Adding some discussion could really solidify the take home points of this paper and provide relevance to other land surface models and parameter optimization studies.

Though the focus is parametric uncertainty, I think the paper would also benefit from a brief discussion of model structural uncertainty, with relevant details specific to ORCHIDEE. This addition would provide useful context for discussing the results (e.g., Page 10, Line 25).

I think it would be useful to include some background on choice of model parameters and how their sensitivity was assessed, as this is a key step to narrowing the parameter space.

Minor note, but it would be preferable to have the line numbers continuously increasing throughout the document so identifying page numbers in the specific comments is not necessary.

Specific comments:

Page 3, Line 2: "probability distribution function"

Page 3, Line 6: What are the limitations of the Gaussian assumption? Could some parameters have different PDFs?

Page 3, Line 19: What defines "excessive" here? Can you give examples of the number of parameters explored in these studies, and how they compare to the dimensionality of your problem?

Page 3, Line 33: L-BFGS_B should be L-BFGS-B?

Page 4, Line 9: Word choice "exploited" could be changed to "utilized".

Page 4, Line 13: Change to "a few".

Page 4, Line 16: ORCHIDEE should be defined at first mention (Page 3, Line 23 and in abstract).

Page 4, Line 19: Why “possibly”? Has the use of ORCHIDEE on thousand-year timescales not been proven?

Page 5, Line 5ff: A few lines about the choice of parameter ranges and sensitivity assessment would be useful here (even if in the supplemental to go along with Table S1).

Page 5, Line 13: Repetitive here to again mention land use change in parentheses.

Page 5, Line 20: How useful is 1 year of station data? Only one observed seasonal cycle, especially relevant as optimization is on seasonal/annual time scales. Relevant also at Page 10, Line 23.

Page 5, Line 27: Please add a sentence explaining why you would expect the Bowen ratio to be constant.

Page 6, Line 19: Should be Tables S3-S4.

Page 6, Line 23: L-BFGS-B acronym should be defined at first mention, in introduction Page 3, Line 30 (and abstract).

Page 7, Line 1: Change “to threshold” to “with threshold”.

Page 9, Line 13: Would be nice to include the equivalent of Figure 1 for LE flux. Figure S1 has it broken out by PFT but not a summary figure.

Page 10, Line 25: This is a key point – how do model structural uncertainties get in the way of multiple site optimizations? What are the limits to finding an optimal parameter set across multiple sites? (Also "degrade" should be "degrades"?)

Section 3.1.3: This section could be moved earlier in the paper as it is referenced in earlier parts of the results. Overall the flow of the results section could be improved.

Page 11, Line 32: First use of “SG” – replace with S_Genetic? That is the abbreviation used in other parts of the text.

Page 12, Line 27: Why does the pseudo-observation experiment perform poorly for Z_crit,litter? Why does it perform better for other parameters?

Page 13, Line 8ff: What drives different parameters to respond better or worse to different optimization methods?

Page 13, Line 12: The error in Z_crit,litter was mentioned on the previous page as 29%, please clarify.

Page 13, Lines 27, 33: Same question as previous section; what drives different responses in different parameters?

Page 14, Line 20ff: Some grammar issues in the bullet points, and throughout this section (e.g., Page 15, Lines 5, 16 and 23).

Page 15, Line 18: I think you should mention this point in Section 2.4.3.

Figure 1: In legend, use dots instead of lines to help guide the reader.

Figure 3: Add error bars here, the uncertainty on the RMSD reduction is referenced in the text (e.g., Page 11, Line 28).

Table S1: Missing units for parameters, as applicable.

Tables S3, S4: PFTs are numbered but not specified by name.

Figure S1: Have the legend in one panel and get rid of them elsewhere, they are just distracting/overlapping data points.

Figures S2, S3: Where in the main text are these figures referenced?

Figure S3: Add error bars, same comment as Figure 3.

Figure S4: If some parameters do not apply to certain PFTs (e.g., K_pheno,crit), why

are they optimized for that PFT? Is this an error in Table 1 and/or Table S1?

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