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Discussions

Interactive comment on "Failure analysis of parameter-induced simulation crashes in climate models" *by* D. D. Lucas et al.

Anonymous Referee #1

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General Comments:

This is a very interesting and well-written paper, proposing the use of machine learning (in particular support vector machines - SVM) in predicting crashes of climate model simulation runs. The authors do an admirable job of straddling the fields of climate science and machine learning. The paper is clear and readable to a wide audience. The choice of machine learning for an interesting problem at the interface of climate modeling and software performance, is very promising.

It appears that the authors are primarily not from a machine learning background. Therefore, the extent to which this work is valid from a machine learning standpoint is praiseworthy. For example, it was an excellent choice (described on page 588) to treat "the problem as a black box in which we know only the values of the input param-

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eters and a binary outcome," of whether the simulation crashed or not. This matches a machine learning principle (Occam's razor) that an overly complex learning problem will be harder; a larger training set will be needed to reach a fixed prediction accuracy (in expectation, with respect to the data distribution).

However there are some caveats to the technical quality, from a machine learning perspective. The following are the most significant issues: - Tuning does not appear to have been done on a "hold-out set." In multiple places, the authors state that tuning was done on the training set itself (e.g. on page 597). This violates standard machine learning practice, as it can artificially improve the performance of an algorithm (including on the test set). - The quantitative results reported in the Conclusion are from "retrospective analysis." It would be more fair and valid to report the results which were purely predictive on the test set.

Moreover, it would have been informative to compare to other machine learning methods, or at least use SVM with various different kernels, and report a comparative evaluation.

Some additional caveats to the technical quality are listed under Specific Comments.

Specific Comments:

- "Latin hypercube design" is cited but never explained. This term appears throughout the paper, and is a critical aspect of the experiments. Therefore, at least a sentence or two should be included to explain this idea, as it is not a well-known term, e.g. in the field of machine learning. Additionally, the field of theoretical computer science has more recent results on sampling from a convex body of arbitrary shape etc., using random walks, that the authors may want to consult in future work. (See e.g. the following two citations):

1. Lovasz and Vempala: Hit-and-run from a corner. Proc. of the 15th Conf. Algorithmic Learning Theory, Padua, 2004.

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2. @inproceedings{DBLP:conf/nips/Gilad-BachrachNT05, author = {Ran Gilad-Bachrach and Amir Navot and Naftali Tishby}, title = {Query by Committee Made Real}, booktitle = {NIPS}, year = {2005}, ee = {http://books.nips.cc/papers/files/nips18/NIPS2005_0064.pdf}, crossref = {DBLP:conf/nips/2005}, bibsource = {DBLP, http://dblp.uni-trier.de} }

- The plots in Figure 8 are very hard to interpret since predictions and observations are superposed. Why do the positions of points (e.g. 2 and 6) change between plots with two different classifiers?

Technical Corrections:

In 4.1, in describing SVM classification, it is important to be precise, for the non-machine-learning audience. Therefore, the following revisions are suggested:

- In describing the margin, the current sentence should be modified to add the word "parallel" before "hyperplanes."

- Not that the support vectors need not only "lie on the hyperplanes of the optimized margin." They can also lie within the margin, e.g. in the unseparable case. Please revise accordingly.

Typo in title of Table 1: "Parmeters"

Interactive comment on Geosci. Model Dev. Discuss., 6, 585, 2013.

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