

Response to Reviewer #1 Comments on Manuscript gmd-2018-327

We would like to express our sincere gratitude to Dr. Xiankui Zeng for his insightful and constructive comments and suggestions. All comments have been addressed in the revised manuscript as highlighted in red. Below is an item-by-item response to the comments.

General Comments:

The heavy model evaluation time is always the burden of simulation and prediction of complex earth system. This study developed a technique to build surrogate models for a large-scale Earth system model (ESM) with many output variables. This study uses singular value decomposition to reduce the output dimensions, and then use Bayesian optimization techniques to generate an accurate neural network surrogate model based on only 20 ESM simulation samples.

This research problem is of interest in ESM field. The manuscript is well organized and easy to read, the results and discussion are sufficient to support the conclusion. However, this paper may be improved after clearing following few questions, and a minor revision is recommended to this paper.

Response:

We appreciate the reviewer for the positive evaluation. The comments have been addressed in detail below and corresponding revisions have been highlighted in red in the revised manuscript.

Specific Comments:

Comment 1:

Line 367: For the 800 epochs to train NN model, are these epochs have the same 20 training data? and they are different at the choosing of the 6 validation data?

Response:

Yes. As explained in lines 352-359 of the original manuscript, we consider 20 training data and the validation data is chosen as 0.3 fractions of the training data. In each epoch, the training data is shuffled, and the validation data is always selected from the last 0.3 fraction.

Comment 2:

Personally, I want to see how complex is the ESM, it would be nice if the authors can present the response surfaces or contour maps of the ESM, such as the zero GPP zones.

Response:

Figure 1 of the manuscript shows schematic of the sELM which includes five major processes. In this study, we consider 8 uncertain parameters. Since it is a high-dimensional problem, we are unable to visualize the GPP response surface on the entire parameter space. The following Figure 1 shows the response surface of averaged annual GPP over 30 years at location 1345 based on parameters *leafcn* and *slatop* using 1000 samples. The figure indicates that the response surface is rather rough, and the most zero GPP values are caused by large *leafcn* samples.

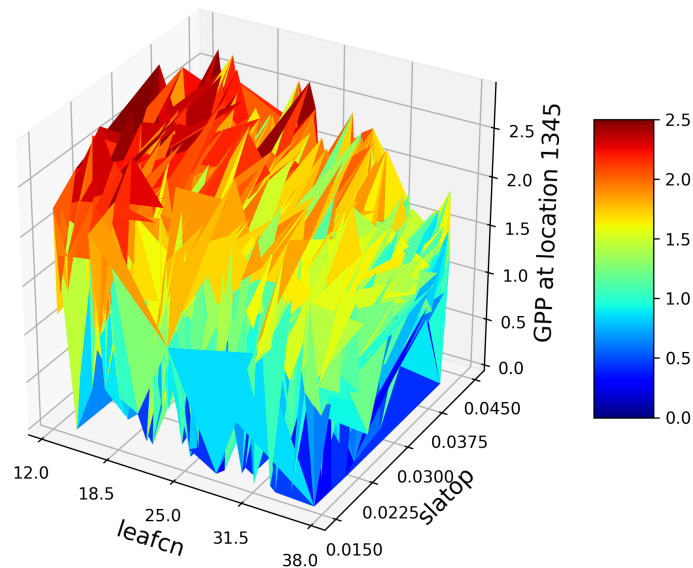


Figure 1. Response surface of averaged annual GPP over 30 years at location 1345 based on parameters *leafcn* and *slatop* using 1000 samples.

Comment 3:

Line 335, Please give a short description to the TPE method.

Response:

We thank the reviewer for the suggestion. A detailed description of the TPE method has been added in Section 2.2.3 of the revised manuscript.

Comment 4:

Line 555, May be some references are needed to support this statement “NNs, attribute to the layered architecture and the nonlinear activation function, usually show better performance compared to other surrogate approaches.”

Response:

We thank the reviewer for the suggestion. References have been added in the revised manuscript.

Comment 5:

The plots of Figure 6 is not clear, please revise it.

Response:

Figure 6 has been updated for a clear presentation.