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Interactive comment on "Linking big models to big data: efficient ecosystem model calibration through Bayesian model emulation" *by* Istem Fer et al.

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Fer et al present an approach to speed the inversion of parameters in ecosystem models via the construction of emulators. The methods are not novel, but application of the method in the field of biogeosciences is in its infancy and the example experiment provided here may be useful in designing further approaches. For this however, it would be important to have a deeper description of the results and a clearer link to the conclusions.

1) For example, the comparison between the results of the emulated and the real SIPNET show that the distributions and central moments of the posteriors are different. This is seen in:

a. Figure 3, where there is not "superior" approach across parameters: sometimes is R3, sometimes AAO, sometimes both R2 and R3 are equally good.

b. Figure 5, where 50% of the emulated SIPNET parameters are (statistically?) different from the central moment of the distribution of the "bruteforce" model calibrations and all of the emulated estimates have substantially higher ranges.

Both these results suggest that some further developments have to be investigated in order to rely on posteriors from emulators. It would be key to investigate why the emulators are overall inflating uncertainty and missing the optimum in particular parameters (equifinality? Non-linearities in model functions controlled by those parameters?).

2) Overall I miss quantitative statistical information about the fitness (model performance) stemming from the parameters obtained via the emulator and the "bruteforce" method against (1) synthetic data and (2) observations (e.g. Nash Sutcfliffe or the Kling Gupta Efficiency). This should also be illustrated by scatter plots and figures that show not only the subdaily but also the seasonal cycle in synthetic/real-world data against models.

Knowing the time it takes for the calculations to get done is indeed of technical relevance. But here the most relevant aspects (at least in the perspective of BGD) are centered on how the different model realizations stemming from the emulator approach against the traditional approach change the retrieval of optimal parameters (and posterior uncertainties) and in the eddy covariance flux predictions (for which many relevant information is mostly found in supplements). These are especially important to understand the limitations and caveats of the current proof-of-concept exercise (evaluation of the synthetic exercise). Another missing important aspect is to understand how the overall results change when contaminating the synthetic dataset with noise (with the same characteristics such as the real observations).

3) The argumentation behind the sufficient statistics is not sustained by the experiment. It is not analyzed how does the emulator performance changes by the inclusion of more

or less data streams.

Some minor points for attention and discussion:

-> Related to Equation 3, please see the analysis and discussion in Lasslop et al 2008.

-> There are a few uninformative visuals, like Figure 4 top 2 panels; Figure 3, the som_resp_rate; that could be replaced by more informative elements (new figures, or tables).

Finally, the results from ED2 seem to be encouraging regarding improving the parameterizations of very computationally expensive models. But the results on the uncertainties undermine its ability to provide a proper representation of the parametric uncertainties.

Last, I would like to express my appreciation to the Authors for providing the tools and following an open source philosophy. Thank you.

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