EGUsphere, referee comment RC1
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Comment on egusphere-2022-797

Anonymous Referee #1

Referee comment on "Multifidelity Monte Carlo estimation for efficient uncertainty quantification in climate-related modeling" by Anthony Gruber et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-797-RC1, 2022

Review Report on egusphere-2022-797

"*Multifidelity Monte Carlo Estimation for Efficient Uncertainty Quantification in Climate-Related Modeling*"

by Anthony Gruber, Max Gunzburger, Lili Ju, Rihui Lan, and Zhu Wang

In this paper, the authors extensively tested the multifidelity Monte Carlo (MFMC) method for accurately catching some quantities of interest in climate-related modeling. Compared to the widely used Monte Carlo (MC) method, they demonstrated that MFMC has superior properties over MC on this subject via three benchmark problems in the ocean, atmosphere, and ice sheet modeling. Since uncertainties exist almost everywhere in climate modeling and prediction, I think MFMC would greatly impact this area, especially in reducing the number of costly large-scale simulations in very fine resolutions. Hence, I would highly recommend the publication of this manuscript in GMD after the authors address the following minor issues.

- In line 67 on page 3, the statement is somehow confusing. The authors declare that they don't consider any possible alternate sampling schemes at the beginning. But their goal is to use a nontraditional MC sampling strategy. Doesn't the sampling strategy belong to the "alternate sampling schemes"?
- In Algorithm A, it mentions that F^k is removed from the list of surrogates if the second requirement is not satisfied. Will there be such a case all F^k will be removed from the

estimation? Secondly, will it obtain less accuracy compared to the MC method with all F^k included?

- For Figures 3 and 6, it is better to point out that the blue shading is the standard deviation of the MC prediction and the melon for MFMC. Moreover, being included in the blue shading indicates a smaller standard deviation.