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Comment on gmd-2021-251

Anonymous Referee #2

Referee comment on "Earth system model parameter adjustment using a Green's functions approach" by Ehud Strobach et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-251-RC2>, 2021

In this work the authors used Green's function approach to optimize parameters in an earth system model. This optimization was achieved by minimizing a weighted least-squares distance. The numerical results demonstrated that the Green's functions estimation approach can be a good fine-tuning step in the model development process to adjust uncertain parameters of the model considered in this work. Also, sensitivity analysis results were presented to further investigate the effectiveness of the Greens's function approach. In general, as an application work, the manuscript is well organized and technical details are clear.

I have a few comments on the approach itself although this work is focused on application.

1. Eq(5) is the combination of Eq (1) and Eq (3), and G seems like a composite of M_i and H. How do we understand it as an "convolution of observation operator H and M_i "?
2. Eq(4) and Eq (9) are similar to some formulas in Kalman filter. Indeed, Eqs (2) and (3) are also the starting point of Kalman filter. What is the main difference between the Green's function method and Kalman filter? Or are they equivalent to each other to some extent or in some cases?
3. The impact of choosing different Q was discussed using $Q=\infty$ and $Q=I$. How about the influence of R? Here R is a diagonal matrix, which indicates that the errors for different observables are independent (which is a quite standard setup in Kalman filter). How about the errors are not independent? Any comments or intuitions?