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Interactive comment on "High dimensional decision dilemmas in climate models" *by* A. Bracco et al.

Anonymous Referee #1

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The manuscript studies a meta-modeling approach (also known as emulator or surrogate model based estimation/optimization) to nonlinear model parameter estimation. Due to prohibitive computational cost of geophysical simulation models, alternatives for gauging model response to parameter variations are needed to tune the model performance as measured with some objective criteria. The research is very relevant for this journal, discusses a potentially powerful technique, and covers the topic generally with merit. I have a few critical comments, as follows.

First, the manuscript contains about 70 figure panels, hampering the readability of the manuscript. Please move a considerable fraction of the panels to supplementary material. At the same time, please synthesize the main findings more clearly from examples and illustrations into generic results and conclusions.

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Second, smoothness of error metric vs. parameter value is assumed. Evidence contradicting this assumption is not presented. It is argued, for instance in doi:10.5194/npg-19-127-2012 that the response is not smooth, and that use of summary statistics (as in this manuscript) can lead to biased parameter estimates. Please discuss the validity of the basic assumption behind the research.

Third, model response to parameter variations is only covered from the point-of-view of performance metrics. Please elaborate how parameter variation in a trade-off situation changes the model response in terms of model physical processes, and what is the physical reason behind the improvements in error metrics. Without this information it is hard to judge whether a dilemma in trade-off situation can be resolved by a physically justified manner.

Fourth, tuning a global model for regional details is questionable since model physics and parameters therein are designed as global representations of sub-grid scale processes. Guidance on varying parameter values based on regional details should come from physical justification by model developers rather than from estimation procedures. Please discuss the justification of tuning the model to regional details.

Finally, Conclusions state that a strategy (p. 2747, l. 13) is presented. Such a strategy does not explicitly appear in the text. Please present the strategy Conclusions refer to.

Interactive comment on Geosci. Model Dev. Discuss., 6, 2731, 2013.