Reply to reviewers

We would like to thank the editor Dimitri Solomatine and the two anonymous reviewers for their constructive comments, which have helped make this a better paper. Here, we reply to the latest round of comments. The reviewer's comment are in bold font.

Reviewer 1:

P3 l25 consider "…depth interval."

Done.

P4 l2 -the underlying mechanisms controlling what? It was not clear to me whether this sentence referred to heat fluxes or k_d

We meant the mechanisms controlling lake temperature, which in turn modulate heat fluxes. The sentence was changed to read:

"The mechanisms underlying the thermal structure of lakes are complex. From a purely mechanistic perspective water clarity affects lake hydrodynamics[...]. The thermal structure further depends on lake morphometry […] and is compounded by biogeochemical processes [...]"

P4 l5 –please list the relevant aspects of ecosystem function

We already list browning waters, and ecosystem functions. Details of this aspect are given in the provided references. For instance, plankton concentrations will affect light attenuation. Browning waters directly affect water color and hence light absorption characteristics.

P5 l22 "… using a krypton …"

Done.

P6 l6 "… evaluation data and computational…"

Done, but using Oxford comma.

P6 l6 "… 2006): different …"

Done.

P6 l12 – there is an incomplete sentence here, maybe "… state of the art." ?

Yes, the sentence is incomplet. Done.

P6 l24 "…criteria: the …"

Done.

P6 l29-30 – does GLUE always require uniform random sampling or this just a convention?

The rationale is that the distribution used for the sampling should reflect prior knowledge about the distribution of the parameter. Using an uniform distribution equates to assuming no prior knowledge about the parameter values beyond giving it a plausible range. GLUE can be used with other sampling schemes, such as membership functions.

P7 l13-14 – this sentence could be deleted as it effectively repeats p7l1-2

Done.

P7 l19-22 – please consider splitting this into two sentences.

Done.

P8 l16 "…framework: they …"

Done.

P8 l21 "… as was …"
Done.
P8 l21-22 – please expand on this sentence. How is robustness dependent on predictive capability?
A detailed explanation is given in the provided reference. Citing from it:

" The advantage of this method is that it is straightforward and simple to apply. However, it is not applicable when the relationship between the factors and model output is non-linear or non-monotonic and when there is a high level of interactions among factors. As such, regression analysis often performs poorly. For non-linear models, the rank transformation can be helpful since the rank transformation can cope with non-linear models and mitigate the detrimental effect of long tailed output distribution (Saltelli and Sobol', 1995). The rank transformation also has two drawbacks: firstly it fails with non-monotonic models, and secondly its main effect is a forced linearization of the system by an artificial increase in the relative weight of the first order terms (Saltelli and Sobol', 1995) so the result cannot be transformed back to the original model. In this study the rank transformation is also applied for reference purposes."
P9 l2 – extra line break after "…are:"
Done.
P9 l30 "… indices (Sobol…"
Done.
P10 l10 –consider rephrasing as "… summands are orthogonal …" or "Assuming orthogonality of all summands …"
Done.
P10 l11 – "allows" works but "makes it possible" works better
Done.
P10 l24 – missing close bracket "… Coxon et al. (2014)).
Done.
P11 l5 "… available for …"
Done.
P12 l14 – I've read Duan et al. (2006) and took it for granted that response surfaces are complicated, but my experience with high dimensional models suggests that response surfaces are often quite simple. As this submission is a relatively short paper, I would be interested in reading the authors' thoughts on Duan's assertion in light of their results, which seem to suggest a relatively simple response surface for a complex model
This is difficult to answer with finality.

For some models, exploring the response surface in its entirety is a practical impossibility. If only a few parameters are considered in the analysis then the response surface might become simple, but perhaps artificially so. When calibrating a large number of parameters, we have often found the calibration never to converge, which can be attributed to either a complex response surface and/or numerical issues.

It could be argued that the response surface for this lake model appears simple because it is dominated by the sensitivity to the light extinction coefficient, which shadows all other parameters. It might not be the case if other parameters proved themselves to be more sensitive.

P12 l19 – case agreement, either "… coefficients exert …" or "…coefficient exerts …"
Done. Coefficients.
P13 l8 "… indicative of effective …"

Done.

Reviewer 2:

I think that the authors have done a good job in addressing my earlier comments and the paper is now suitable for publication. I very much enjoyed reading the latest version and found the structure and flow of the manuscript much better. I'm confident that the limnological community will appreciate this research and the work will be well-cited.

Thank you for the kind comment.

Although I could not find any major issues with the paper, I did find areas where minor corrections are needed:

For example, Page 3 Line 14 there should be a space between 1.12 and km2

Done.

Page 2 Line 21 - Please don't start a new sentence with citations. It reads much better if you would say something along the lines of 'previous studies have illustrated the feedback between phytoplankton... (REFS)'

Done.

"Previous studies illustrate [...]"

Page 2 Line 30 - There is a paper recently published in GRL which demonstrates how the stability of the atmospheric boundary layer varies among lakes (latitude and lake size are important predictors of over-lake atmospheric stability by Wollway et al doi:10.1002/2017GL073941), which would be a very useful citation here, as it demonstrates how lakes can modify the boundary layer, thus strengthening your argument.

Added text:

"[...] and the latitude of the lake (Woolway et al., 2017)"

Page 7 Line 17 - 'as done by (Deacu et al., 2012) for large lakes'. Note that there shouldn't be any brackets around the entire citation here, so you will need to change the command in your latex file. Please check the entire manuscript for inconsistencies such as this.

Fixed.

Page 3 Line 8 - 'which can in turned...' -> replace with 'in turn'

Fixed.

Page 3 Line 30 - include Kd in the brackets along with m^-1

Fixed.

Page 10 Line 24 - (limits-of-acceptability... -> need to close the brackets here.

Fixed.

Page 11 Line 5 - 'that were available f for' -> remove extra 'f'?

Fixed.

Please take extra care when submitting the final version for publications as there may be other errors (such as above) still present in the paper.

The authors use different citation formats throughout the text. For example, sometimes 'et al.' is used and other times 'et al.,' is used. This is me being very picky but please try to be consistent throughout.

This is consistent withing the style file provided by HESS. It uses a comma when separating the year of publication.

The concluding paragraph is one of the most important parts of the paper. Please consider re-writing into a concise format (the short sentence on its own at the end should be merged with the previous paragraph, if possible).

Sometimes the authors use 'and' in citations and other times use '&' - please be consistent.

Done. Editor names left as is: e.g. “Taylor & Francis”

Page 8 Line 15 - need to close bracket... '(SRC: Galton (1886) share'

Fixed.

Table 1 - The brackets are pointing the wrong way in the column 'Range'. Please correct. Also, please prove a better description in the table caption (currently not sufficient).

They point in the right direction as they indicate a non-inclusive interval.

Figure 1 is currently very hard to see in detail. For example, the inset and text is too small. Please increase the figure size in the final version.

I believe the size of the figure is larger in the submitted file but as been scaled to fit in the pdf.

Many of the Figure captions need to be improved. Specifically, the reader should not have to look through the manuscript to understand the figures. In my opinion the reader should be able to see the figure, read the caption, and understand what is presented. Please include a more detailed description in each caption. This will help the reader and thus make the paper easier to digest and follow, especially for those who will glance the paper.

Changed captions for most figures.

Consider colorblind friendly colors for Fig. 6 and 7.

Replaced the jet colormap with the parula colormap. Hopefully this helps.

Table 2 - need space before bracket in references. Also, please ensure reference style is consistent with the remainder of the paper and include a fuller description in the caption.

Fixed.

Figure 9 - Include units on y and x-axis (not just in the caption). This is only necessary for the outer panels.

Fixed

Fig 10 (and throughout text) I would suggest replacing Mean Absolute Error with Mean Absolute Difference. Also, W/m2 needs to be in a consistent format to elsewhere in the text, currently Wm-2 elsewhere.

Changed to W.m-2. Mean Absolute Error and Difference are interchangeable.

Table 3 - include comma to separate the 1000s

We feel the order of magnitude is small enough as to not require thousands separation.