Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-470-RC3, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Worldwide lake level trends and responses to background climate variation" *by* Benjamin M. Kraemer et al.

Anonymous Referee #3

Received and published: 22 December 2019

The manuscript analyses the water level variations for 117 globally-distributed lakes and surface air temperature in order to disentangle the effects of climate variation and anthropogenic activities on lake variations. The authors use boosted regression trees (BRTs) to model water level as a function of time and the PCs of temperature. Then those most influential PCs are correlated with climate indices. The topic is highly relevant and will provide important contributions to current climate and anthropogenic impacts on inland water bodies, e.g. lakes.

General Comments

In general, the manuscript is generally well organized and easy to read. But the method section is a bit redundant and needs to be clarified.

The main assumption is that the pattern of global lake changes is somehow driven by global patterns of earth surface air temperature. But the results (27% of water level variation was associated with background climate variation) do not support this assumption very well. In my opinion, a better re-designation of the study objectives is needed.

The authors stressed that a novel statistic method BRT is used, but in my opinion, more details are needed. On top of that, some justifications and clarifications are needed as pointed out below. I hope my comments are useful for authors to improve the manuscript.

Specific comments

P4L6: "... based on average annual water level..." why and how is annual water level used?

P4L13-21: Does this consider the nonstationary of time series induced by climate?

P4L15: Here the climate indices should be renamed or clarified to be distinguishable from those called climate index, e.g. ENSO, IOD, NAO, etc. It is a bit confusing.

P4L22-31: Why are the PCs detrended instead of temperature detrended? How can detrended PCs remove anthropogenic effect?

P4-P5: I think the overview of method should be simplified and move some of the description to specific methodologies.

P6, 2.3: Regarding PCA, a bit more details maybe help to reproduce the results presented in the manuscript. Why 100 PCs are used? Personally, I think those beyond 20 are very weak and probably mainly noises. Is a constant number of PCs used in the BRT for all lakes? I think that not all PCs are statistically significant in the regression. Does BRT take this into consideration?

P6L3: "the longest and highest resolution time series". How long are they? Do they

vary for different lakes? What does it mean when you say “highest resolution”? Be specific.

P6L5: “. . . is typically ∼3 cm for large lakes. . .”. This is a bit overstated. The best case is around 3 cm. Please double check and revise.

P6L9: “. . .linearly-interpolated each lake’s time series. . .”. Why not use a model considering annual and semi-annual variations given that you have quite long time series? I suggest using the approach used in previous studies, e.g. (Kleinherenbrink et al., 2015; Villadsen et al., 2014)

P7 2.4: The description of statistical method, BRT should be expanded instead of just saying some R packages are used given that you state this method is novel in your study.

P9L26: Lake water level definitely is an integrative metrics of regional water budget. I think this sentence should be rephrased.

P9L26: “significant effects . . . in most lakes”, is this overstated?

P11L28-29: As pointed above, I doubt that detrending the PCs helps to sperate background climate indices from ongoing climate change. Instead, I would first detrend the time series of temperature, and the perform PCA.

References

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Villadsen, H., Andersen, O. B. and Stenseng, L.: Annual cycle in lakes and rivers from CryoSat-2 altimetry - The Brahmaputra river, Int. Geosci. Remote Sens. Symp., 894–897, doi:10.1109/IGARSS.2014.6946569, 2014.

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470, 2019.