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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Tributaries affect the thermal response of lakes to climate change" *by* Love Råman Vinnå et al.

Anonymous Referee #2

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This is an interesting paper examining the effect of climate change on alpine lakes. Climate change exerts a dual influence on alpine rivers: changes flow rate and temperature. River temperature and sediment load influence density, and hence the nature of river intrusion into lakes. Future river discharge rates, temperatures and SSC are all predicted in order to assess the future dynamic state of two lakes, Lake Biel (LB) and Lake Geneva (LG), out to the far-future of 2099. The work is interesting and certainly very appropriate for HESS.

There are two parts to the work, the prediction of inflow conditions of the two main inputs to LB and LG, respectively, and secondly the lake dynamics. I believe the assumptions and range of expected behaviors for the first part are well documented, but more discussion is needed for the lake dynamics part.

The paper uses the 1-D Lake model SIMSTRAT. There is very little discussion of SIMSTRAT and, given its key importance in the forecasting, some more details are needed here so that the paper is more self-contained. SIMSTRAT has eight numerical constants, and the assumed values are summarized in Table 3 for each Lake, and there is little explanation of what these constants represent. A key point is these constants are considered fixed, based on best estimates for current conditions. Why will these parameters also valid out to 2000?

Figures 7g and 7h shows increased stability, particularly in the far-future scenario for both LB and LG. This is particularly associated with predicted warming of the epilimnion. So estimating the downward transfer of heat and vertical mixing generally is key to model predictive performance. In future, why can we assume such key quantities, as the downward penetration of radiation into the water column will be unchanged? If the density stratification changes due to climate change, the internal wave climatology will also likely evolve, so can we assume the mixing is the same?

Also lake volumes can evolve, leading to potential changes in residence time as discussed in Figure 9 and text around lines 455 and following. So what is the uncertainly associates with the use of a 1D model like SIMSTRAT in some of these scenarios? The two lakes currently have very different residences times, and LG already has an 11.5 y residence time, so how accurate is a 1-D assumption even now, let alone into the future? These issues need to be clarified in the paper and their influence on the uncertainly of the predictions in the paper.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-337/hess-2017-337-RC2-supplement.pdf

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