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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Natural stochasticity vs. management effort: use of year-to-year variance for disentangling significance of two mutually confounding factors affecting water quality of a Norwegian cold dimictic lake" *by* A. T. Romarheim et al.

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In the responses below, please refer to the track-change manuscript produced by the difflatex utility. The page numbers reflect the page numbers on this track change PDF file.

RC:

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

1) Style: The figures are difficult to read, both on printed paper and on electronic devices, especially the combination of tiny axis annotations and the large number of sub-figures (esp. 4x7 for Fig. 2), but also the unnecessary small axis annotations of Fig. 3 and 4.

AR/Changes:

We hereby request the Fig. 2 to be on its own page full in A4. We hereby request also the Figures 3 and 4 to be placed as a large figure, but we have also increased the font size, and improved the axis labels.

RC:

2) I wonder, why a p-value based ANOVA was used and not a variance components analysis (cf. Crawley 2012, p 475). In my opinion, it would be preferred to measure the variance contribution of the different factors instead of (or at least in addition to) significance testing. Additional arguments can be found for example in Nakagawa & Cuthill (2007) and many other recent papers.

AR:

This has now been performed and variance contributions were now included in the Table. We have now used the suggested reference, except that we referred to page 524 for the variance components analysis. We have also conducted such that between-year error term can be factored out in the variance composition. We used the sum of squares as the variance term to decompose.

Changes:

Please refer to the new Table 4 and the caption. Furthermore, P13L3 corrects the sentence and the old sentence "All simulated output variables were influenced by external forcing to some extent as they varied inter-annually for all model scenarios." is now corrected to "All simulated output variables were influenced by external forcing as they varied inter-annually for all model scenarios (see variance decomposition in Table 4)."

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RC:

3) The approach of an average year as a reference sounds plausible at a first look, but averaging several years does not produce an "average year", because intra-annual stochasticity is lost. This well-known effect can lead to systematic bias, e.g. less turbulence due to the cut-off of extreme wind events. Therefore, hydrodynamic models are usually driven by stochastically generated time series (cf. Semenov et al. 1998 or Schlabing et al. 2012). How does this influence the results (-> Discussion)?

AR:

Despite the raised concern, due to the purpose of reducing the year-to-year variation and not to be particularly bound by a selected single year, we unfortunately need to suggest that we need to use the repeated synthetic year, although the problem of not accounting for naturally observable intra-annual stochasticity remains.

We have therefore added a new long paragraph explicitly elaborating on this issue at the end of Section 2.5 (original page 12497, line 3).

And in Results Section 3.3. p.12499, l 22. We added additional texts.

Changes:

P10L3. The following new paragraph is introduced: Combining the repeated average input together with actual stochastic input (such as in the scenarios B and C, Table 3) causes unrealistic input for two reasons. One reason is the inconsistency among variables on the daily basis. For example, because runoff is controlled by precipitation, the scenario C for instance (original weather + averaged runoff) on a daily basis may suffer from a potentially undesirable situation such as high precipitation with no cloud on a certain day. This is unrealistic, but from the lake ecosystem perspective, the runoff's role is mostly as the source of nutrient, and weather as the source of energy, and the fact that the lake water is accumulation of old water from runoff introduced many days ago, the influence of this inconsistency in combination is minimal. The second reason

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is that the intra-variability or within-year variability that naturally stochastic variables such as meteorological inputs should have is lost in the present study's design. This can cause problems such as not providing extreme wind events due to averaging despite such wind events may be crucial for the on-set of ice formation, or determination of thermocline. Hydrodynamic models are therefore usually driven by stochastically generated time series (Semenov et al. 1998 or Schlabing et al. 2012). Alternatively, most average looking year could have been chosen as in Jöhnk et al. (2008). However, the current study requires the average to be done on multiple criteria or variables, making choosing one example year will also be not average year on all the variables. Due to the purpose of reducing the year-to-year variation and not to be particularly bound by a selected single year or randomly generated year, repeated average year was used despite these potential problems. In the present study, year-to-year variation in outputs of these four scenarios will be discussed but not the actual values on the daily basis, and the results are interpreted with care that scenario A is the most variable year-to-year, that, either B or C is the next variable, and finally that D is the least variable year-to-year. Although this care does not safeguard the unrealistic intra-year variation, potential inconsistency is detected.

P13L16. The following new text is inserted: The year-to-year variation in these two variables from June to September under the scenario C was higher than scenario A, despite that scenario C is less variable year-to-year than scenario A in loading. This might be because scenario C may distribute the autumn runoff events that is still significant after spreading over the years, and this might have caused the light-related variables to be unstable on a day-to-day scale.

RC:

4) Replacing single (or groups of) forcing variables by others may lead to unrealistic cases, e.g. blue sky with strong rain. I admit that the proper treatment of such dependencies and cross-correlations is difficult, but it should at least be considered in the Discussion.

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AR:

The very discussion is now made in Section 2.5 (please see the previous comment response above). As written, we consider the problem of unrealistic combination of variables is in the context of the present manuscript to be negligible. And we keep the discussion in the methods section.

We do however feel that the problem of intra-year or day-to-day variation is lost and might have caused the autumn instability in light conditions (see also the previous comment).

Changes:

Please see the previous changes that also addresses this issue.

RC:

p 12492 L 09: 400 mg mËĘ-3 is indeed very high (comment only)

RC:

L 17: please mention name of model here (first occurrence)

AR/Changes:

P4L23. The model name and reference is now introduced.

RC:

L 22: the average of years is not an "average year"; averaging reduces intra-annual variability and autocorrelation structure of the time series

p 12493 dito

AR/Changes:

Please refer to the responses and changes to point (3)

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RC:

p 12495 L 15 Ruttner (no umlaut)

AR/Changes

The umlaut is now removed.

RC:

L 19... MCMC - I like this approach very much - which algorithm / software / package was used (citation?) - which priors have been used (non-informative?)

AR:

The MCMC algorithm here is based on Metropolis-Hasting sampling of parameters and Gibbs sampling on the error variances as parameters, and was programmed originally in Matlab, but was executed under Octave. The post-simulation statistical analyses are done in R.

Changes:

P8L7 A new reference is now included

Saloranta, T. M., Forsius, M., Järvinen, M., and Arvola, L.: Impacts of projected climate change 10 on the thermodynamics of a shallow and a deep lake in Finland: model simulations and Bayesian uncertainty analysis, Hydrol. Res., 40, 234–248, 2009.

RC:

p 12496 L 25: meteorological

AR/Changes:

P924. The word is now corrected to 'meteorological.

RC:

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p 12497 L 11: why statistical tests and not variance decomposition?

AR/Changes:

Please refer to the response and changes to comment (2).

RC:

L 25: "shallower", "deeper": not completely clear if this concerns vertical layers or the horizontal zones (littoral, pelagic zone) of the lake

AR/Changes:

P11L20. Now we corrected the sentence to be precisely what was modeled and what was predicted where. The sentence is corrected and now reads: The TP and SRP were better predicted by the model in pelagic surface water than in deep water where as the chlorophyll a showed the opposite pattern.

RC:

p 12498 L 16: _as expected_, "global radiation varied most during summer months" - because this is completely obvious.

RC:

p 12499 L 8: "some extent" - How much is "some"? Measurement instead of p-values!

AR/Changes:

Now the new Table shows the amount of variance it explains, and the sentence is corrected. Please see response and changes under comment (2) for the details.

RC:

p 12501 L 30: yes, dependency/covariance is not considered, see major point (4)

AR/Changes:

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Please see our response on this for the major point (4) which then was also addressed in resonse to (3).

RC:

In general: methodological deficits should be discussed more in detail, especially how they influence the conclusions. Simplifications are unavoidable, of course, but it should be discussed if the conclusions are still on the safe side, are "best case" resp. "worst case" approximations.

AR:

Please also refer to the newly introduced paragraphs (see responses to comments (3) and (4), which are relevant to the concern raised here. In addition, we have added the following paragraph at the end of the Results section (page 12500 line 11) to be clear on our opinion on this.

Changes:

P14L9. The new paragraph reads as the following: The methodological limitation in the present study about repeating averaged year (see Section 2.5, a paragraph newly added in this revision) caused little difference in interpretation or conclusion. The worst deviation in conclusion that the unrealistic input can cause is missing representation of critical changes in daily inputs in the system. But the result that the daily year-to-year variation for either scenario B or C was closely following scenario A, depending on the modelled variable (TP content, surface chlorophyll, light attenuation coefficient for scenario B, and ice thickness, thermocline depth, and epilimnion temperature for scenario C) provides confidence that the conclusions will not change due to the methodological limitation.

RC:

Fig. 2: much too small Fig. 3, 4: axis annotations too small Fig. 5: please add %of total variance to the PC axis

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AC/Changes:

Figures 2–4. We requrest the enlargement of the figures.

Figure 5. The new caption now reads as the following: Principal component analysis (PCA loadings for the new greatest components (explaining 39.0 % and 16.5 % of variance) and scores for the two components for 16 water years (letters). Black coding for PC loading indicates the weather input, brown the runoff input, and blue the lake simulation.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 12489, 2014.