

Review of Oldham et al: Evidence-based requirements for perceptualising intercatchment groundwater flow in hydrological models.

RC1: 'Comment on egusphere-2022-529', Anonymous Referee #1, 02 Oct 2022 reply		
1.	The study uses an extensive dataset from the Thames catchment to find proof for (variations in) intercatchment groundwater flow (IGF). IGF is hard to quantify, but it is an important process to consider in hydrological modelling. The paper is very well written and well structured. A significant amount of data collection and processing work was done to enable a useful analysis of IGF at this scale.	<p>The authors would like to thank the reviewer for their detailed and constructive comments on our paper.</p> <p>In response:</p>
2.	On several places in the paper it is stated that both spatial and temporal variations of IGF were studied (e.g. L 19, 112, 605). The spatial variations of IGF are indeed well analyzed. I did not see much about temporal variations of IGF. There is Figure 7 with seasonal patterns in groundwater levels and water balance metrics, which are shortly described in chapter 5.2 and in L476-490. However, the link between this seasonality and the temporal variability in IGF was not described. In addition, there is probably more than just seasonality: what about year to year variations in IGF losses and gains? Do these year to year variations match between losing and gaining stretches (or is there a delay)? These temporal aspects could be either better covered or left out of this paper.	We acknowledge that the temporal analysis presented in the paper is limited to a short description of seasonal patterns in climate, groundwater level, runoff coefficient and water balance and does not report inter-annual variation in IGF. To address your comments, we have removed references to our claim of having studied both spatial <i>and temporal</i> variation of IGF. We have edited temporal analysis text (3.2.2 and 6.1 in particular). In addition, we have removed the monthly profiles for water balance from Fig 7 owing to the issues surrounding intra-annual analysis of water balance (in particular given the complexities surrounding intra-annual delays in storage). In the interest of paper length and scope, we have not added additional analysis, but rather re-focussed our temporal analysis section and made edits to the text to clarify that we are not quantifying IGF from this temporal analysis, but rather presenting information on the hydrological and hydrogeological characteristics of (and between) the different hydrogeological units that might be of interest and use to the hydrological modeller when considering IGF edits.
3.	Regarding the spatial analysis: would it be possible to connect losing and gaining stretches, compare the IGF fluxes and maybe combine catchments into larger scale conservative catchments? This may be possible for e.g. the Coln, Kennet, Colne and Mole catchments.	We discuss connecting losing-gaining reach in section 5.1 using the results from the River Kennet as an example. We made the research decision to concentrate on the highest resolution scale possible, i.e. the reach length scale. We have, however, reported the water balance for the Thames at Kingston as a whole in Section 5.1.

4.	L27: We found temporal as well as spatial variability of...? See above regarding temporal variability in IGF.	Please see the response to comment 2.
5.	L110-112: Consider to rephrase into an objective statement.	To make the statement more objective, we have reworded it to: "Quantifying the water balance using available national meteorological, hydrological, hydrogeological, geological and human influences datasets enabled us to develop a perceptual model of IGF".
6.	L190-198: Groundwater abstractions are not mentioned here. Later, this is covered and discussed. Still, I am curious whether the volumes of groundwater abstraction are significant enough to have impact on your analysis. Maybe some regional numbers are available?	<p>We have added quantification of groundwater (and surface water) abstraction rates at the Thames at Kingston catchment scale to section 2.</p> <p>In addition, we have further expanded on the challenges associated with naturalised river flows for groundwater abstraction to support our reasoning for not adopting this approach in our methodology (section 6.3.2)</p>
7.	L271: in->is?	Corrected.
8.	L302: is the->is in the?	Corrected.
9.	L338: it could save a lot of space to only show the naturalized results in fig 4,5,6. The difference is indeed not that large.	Agreed. We have moved all non-naturalised results to a new Supplementary Information document and our figures now only show naturalised results.
10.	L356-357: with the low amount of catchments (4 in LG, 11 in JL) these interquartile ranges are highly uncertain.	We have recognise the small sample sizes and associated uncertainties and have now acknowledged this more explicitly in the text in Section 5.1.
11.	You could also choose to plot the averages with error bars to show the (variable) uncertainty of the statistics.	We feel that the interquartile ranges shown on Figure 4 already illustrate the uncertainty of the statistics we have presented.

12.	Figure 5: the catchment boundaries are unclear in these maps. Would more legend colors be possible?	Legend colours have been changed to improve clarity for the reader. Thank you for this comment, we believe the Figure is improved.
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