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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Simplified representation of runoff attenuation features within analysis of the hydrological performance of a natural flood management scheme" *by* Peter Metcalfe et al.

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Comment #1

I must admit I have some difficulties to follow the text in the first chapters (p. 2-12). Structure of the manuscript is a little bit confusing; it does not follow the classical IMRAD approach. Same information are repeated on several places, paragraphs are sometimes too long containing too many topics. Often I am not sure if the authors describe actual research or results from the previous studies (referred as Metcalfe at al., or Hankin et al.). Simplification of the text structure and rephrasing of long sentences would very much help to increase the readability and overall appeal.

Response #1

These are extremely useful suggestions and we will revise the introductory sections accordingly.

Comment #2

p.3, l. 9: I don't clearly understand which PROJECT you refer to. Is it related to Hankin et al. (2017) or another previous work? Or do you address actual research presented in this manuscript? Similarly, on the rest of p. 3, where several times "objectives of the project" are mentioned. At the moment the text reminds me more of a project proposal than an article. My suggestion is to move most of the chapter 1.1 directly to the Introduction. In Aims and Objectives simply state the "aims, objectives, hypotheses" (even the bullets will make it). I would also omit the hints of the used methods in Introduction (eg. different levels of leakiness through the walls, Dynamic TOPMODEL, Storm Desmond etc.) and leave it for the following chapters. Just to make the text easier to follow.

Response #2

These suggestions are very helpful in terms of improving the introduction and will be included. The project was the Rivers Trust IP project undertaken August - November 2016, whereas the initial study (Hankin et al., 2016) was the winning entry to the DEFRA flood modelling competition. We will attempt to clarify.

Comment #3

p. 4, ch 1.2 - I suggest to move the whole chapter before Aims and Objectives. This is still pure introduction.

Response #3

We shall do this.

Comment #4

p. 7, 1st paragraph: it was already stated before that distributed modelling is computationally demanding. You have already introduced the simplified approach that you use. This paragraph should be a part of Introduction.

Response #4

As above.

Comment #5

p. 12 l don't understand how 8 HRU units correspond to the JFLOW simulation. Was JFLOW used on 8 separate subregions? Or are the HRUs related to the TOPMODEL simulation? Please, clarify. What is approximate size of the HRUs (are they similar in size)? Can you include HRUs boundaries on Fig. 3?

Response #5

The spatial extent of the "RAF" HRU corresponds to the accumulation areas identified by the JFLOW simulation. Those of the others is determined by the Topographic Wetness Index (TWI, see later comment) as for TOPMODEL. The HRU boundaries can be included on the diagram as requested. The figure will be revised to show HRU boundaries and their areas given. The areas range from 2 to 101 km^2.

Comment #6

Figures need to be improved. The lines/dots have similar colours (eg. fig 5b - orange, pink). Yellow lines are not visible (fig. 6). Corresponding plots (fig. 4 and 6) have different starting and ending dates, precipitation is not consistent. Etc.

Response #6

The yellow lines in have been darkened to make clearer (see Figure 4). Consistent time intervals have been applied to all plots. Colours in the GLUE plots (Figure 3) have been revised to make clearer.

Comment #7

I don't understand to the description of the GLUE results (p.13, l. 13). Why the Ac around 65% gives the best NSE? It does not seem like that on Fig. 5.

Response #7

Due to the problem with the colouring (see response to comment 19) the Ac with the best NSE wasn't identified: it is in fact 75%.

Comment #8

In abstract and introduction you stress out that the unfortunate synchronization of the RAFs overtopping may cause serious problems downstream, therefore the RAFs network must be designed wisely. I do not see how you solved the desynchronization problem in the Results (slightly mentioned in Discussion). Can you please address this issue in more details in Results, Discussion and Conclusion?

Response #8

This is a potentially significant effect but the paper does not seek to address it as such, rather to provide a computationally-efficient modelling strategy that will allow investigation into the effect of hillslope storage on network flood wave timing. We will attempt to expand on this in the Results, Discussion and Conclusion sections.

Comment #9

There are many typos and grammatical mistakes in the text, units often follow the number without added space in between (eg. p.4, l. 13-14: 27000m3, 9%). Cited authors in the text sometimes do not agree with the list of references - check the years and Author's spelling please (eg. p. 4, l. 20: Pattison or Pattinson, l. 13: Ghmire, p. 10 l. 9: Binley Beven should be Beven Binley?, etc.). Sometimes decimal separator for thousands is used (p.4, l. 17), mostly not. p.1

Response #9

Thank you for pointing these out, we will endeavour to eliminate the mistakes.

Comment #10

Abstract: The abstract is very well written, I enjoyed reading it! Only the last sentence is misleading. At the moment "ways in which features could be grouped more strategically" are not given in the manuscript (there are general hints which are not supported by the simulation results). This sentence should be excluded or (preferably) the information included in the manuscript.

Response #10

We shall reword or remove this sentence. The ability to group features better (spatially and / or according to their morphology and topographic context) would improve the fidelity of the model but although discussed has not been undertaken in this study. It will make up part of future work.

Comment #11

p.2, l. 25: If JFLOW analysis and the workshop were used for this study, the information should be moved to Methods, rather than to state it in Introduction. The workshop and its outcomes are not further mentioned.

Response #11

The JFLOW analysis was presented at the workshop in order to select subcatchments for detailed modelling and refine the location of the enhanced hillslope storage, so this, as the reviewer points out, belongs in Methods rather than the discussion.

Comment #12

p.2, l. 30: The sentence repeats the information from the previous sentence (as RAF is also flood mitigation measure).

Response #12

Will be removed.

Comment #13

P3, l. 11: word repetition (would) p.4, l. 14: word repetition (in)

Response #13

Will be corrected.

Comment #14

p. 5, l. 22: Can you please specify why subsurface routing allows more flexible HRU aggregation in this case? How is it related to this study where the surface runoff is of the primary interest? Is this information related to the following sentence "Of particular relevance. . ."?

Response #14

In the original TOPMODEL the response units must be defined strictly in terms of the TWI in order to establish a relationship between the storage deficit in individual units relative to the mean deficit over the catchment. In the later Dynamic model, any landscape characteristic may be used as the routing is undertaken explicitly with a kinematic wave formulation. In the case study the TWI was applied to subdivide the catchment, but the RAF areas were then introduced as an additional unit overriding any previous landscape classification. This allowed simulation of the effect on the storm runoff of these areas intercepting overland flow redistributed from upslope areas. This would not have been possible in TOPMODEL.

Comment #15

p.7, l. 29: Which "study case"? The case study area has not been introduced yet. The chapter 2.3 mixes introduction and methods together.

Response #15

These ambiguities will be addressed.

Comment #16

p. 8: Can you justify or discuss how multiple RAFs are lumped into single RU? I don't think that the weir equations are necessary to be presented here.

Response #16

The equation are not necessary, it is true, and can be removed. The lumping of RAFs into a single unit is clearly a radical simplification that averages across all features the distribution of upslope input and downslope outputs, and applies the same "leakiness" and maximum storage capacity to each. It is argued later, however, that a much more fine-grained classification system could easily be applied, with the limiting case where each feature is associated with a single HRU. We shall attempt to make this clearer at this stage in the paper.

Comment #17

p.11, Study site: describe the instrumentation that provides the validation data, please. How the discharge is monitored (what kind of flume/weir, what capacity)? P.11, l 22. - the other gauge should be already mentioned together with the GM Bridge gauge.

Response #17

These details shall be included.

Comment #18

p. 12, l. 20: can you also include the lambda factor values?

Response #18

OK.

Comment #19

p. 13, l. 10: 7 distinct values of Ac are mentioned in the text, only 3 are on Fig. 5.

Response #19

Unique colours were not being applied to the unique values. This has been rectified: see Figure 3.

Comment #20

p. 13, l. 18: This paragraph belongs to Methods

Response #20

Will be moved.

Comment #21

Some literature is missing in the references: Dadson et al. (2017), Beven Blazkova (2004), EA (2009), Marsh (2016), Beven Wood (1983), Chappell et al. (2006)

Response #21

Thank you for bringing these omissions to our attention; they will be addressed.

Comment #22

Fig. 3: I suggest to include the HRUs boundaries. Position of the NFMs would be also interesting, but there are maybe too many of them.

Response #22

As for Comment 4. It may be that putting both the HRU boundaries and the RAF positions is confusing. Our inclination would be to show only the RAFs. We include a revised figure (Figure 1) with these boundaries included.

Comment #23

Fig. 4: Why are there more red lines? I would think that there is only one observation

in the single gauge.

Response #23

Thank you for pointing this out. The display of the observed values are indeed in error as the colours had been incorrectly applied; every other time series was being displayed in red. This has been fixed: see Figure 2.

Comment #24

The Precipitation bars are too thick. In the given scale the daily precipitation amount on 13th Nov would be app 240 mm.

Response #24

This has been addressed: see Figures 2 and 4.

Comment #25

Fig. 5: What are the thin lines with max excess storage around 0.2 m, visible after Desmond storm? Why are they so different from most of the simulation results (for all the RAFs)?

Response #25

These were the results of simulations that encountered numerical errors and should have not been included in the set identified as behavioural. We will try to pin down what is causing this anomalous behaviour. The corrected figure is included here as Figure 4.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-398, 2017.

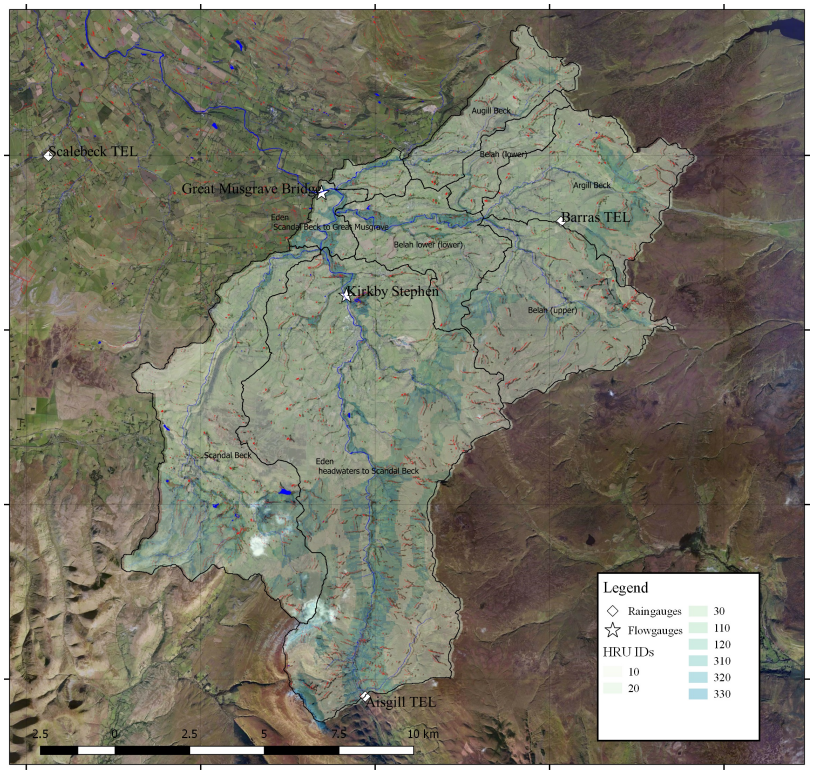

Fig. 1. Eden headwaters to Great Musgrave Bridge (223km^2), showing context within Cumbria, UK, rain gauges and gauging stations, and hillslope storage sites identified through JFLOW screening.

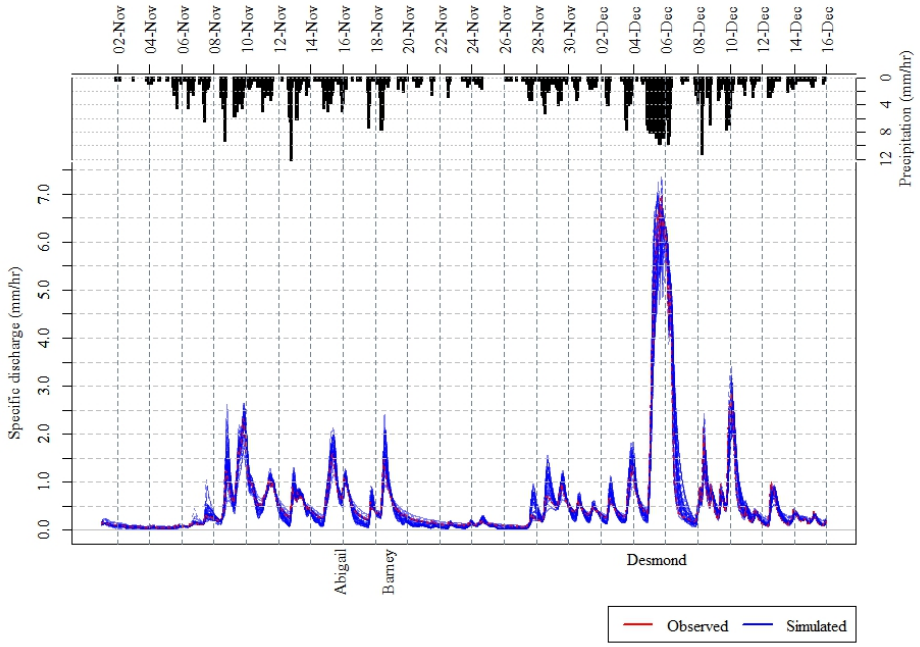

Fig. 2. Simulated discharges at Great Musgrave Bridge across the calibration period described in the main text for behavioural realisations alongside rated observed discharges.

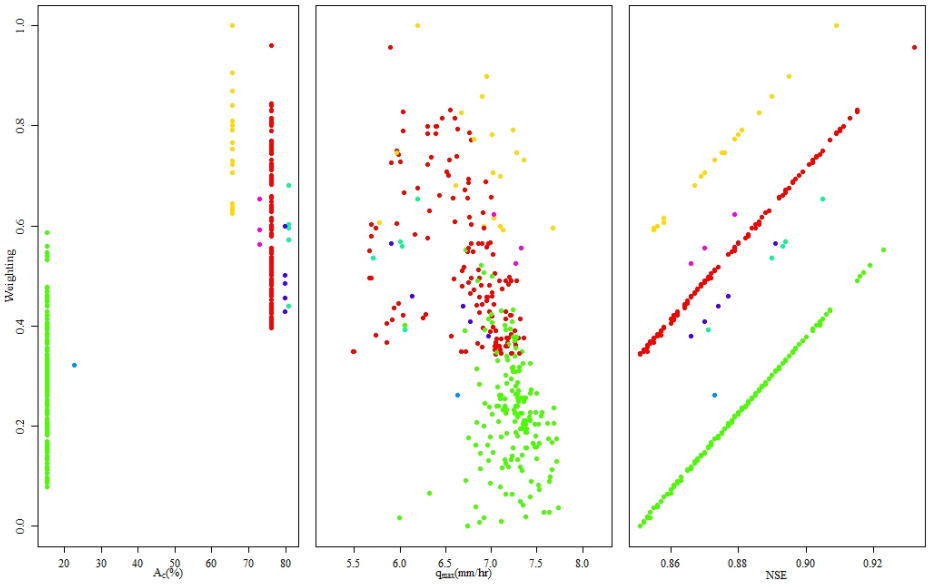

Fig. 3. GLUE "dotty" plots showing overall weighting (likelihood) scores for each of the 348 behavioural runoff simulations identified against the three model outputs described in the text.

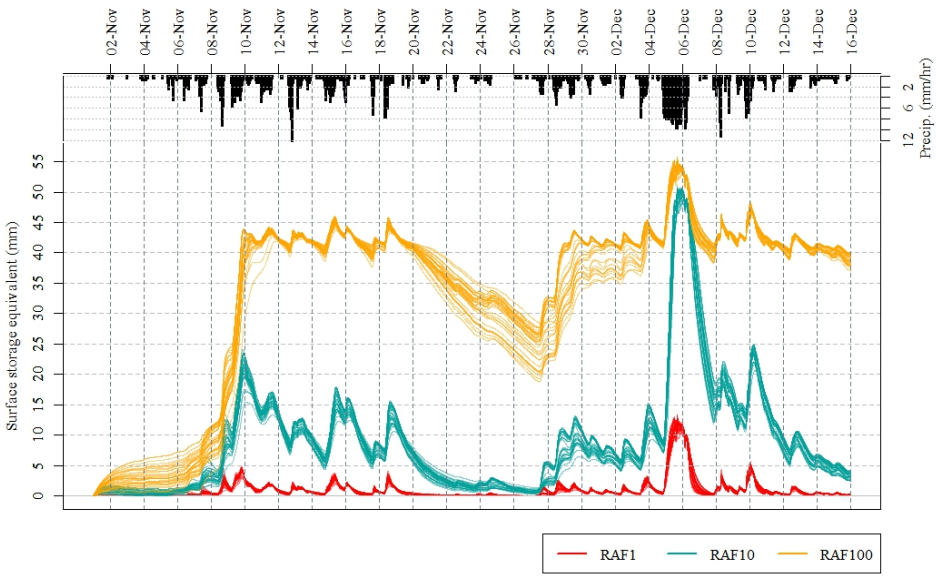

Fig. 4. Surface excess storages across the lumped RAF unit with maximum storage set to 1m, applying each of the three mean residence time scenarios considered.