<div align="center">**Cover letter to revision of hess-2020-65**</div>

Dear Editor, dear Referees,

We have completed a comprehensive revision of the manuscript – in fact we changed much more than announced in the replies to the referees. We hope the revised version is not just different from the previous, but conveys our message better. Before going into the details of the point-by-point replies to the referees, we would like to mention the main changes. Please note that due to the large amount of text changed, we refrained from providing a manuscript version with all changes tracked. Instead we highlight major changes by red text: If an entire section was largely re-written, we highlight the section header in red. Changes of particular words, sentences or passages are also highlighted in red.

Main changes

1. We have changed the title
2. The general focus of the manuscript is now on suggesting adaptive clustering as a tool for making distributed modelling more efficient. Using adaptive clustering as a tool for hydrological system analysis is still discussed, but not as prominently as before.
3. Throughout the text, we make better clear that the presented study serves as a proof-of-concept
4. We provide definitions of the most important terms in the introduction: Similarity, redundancy, time-invariant, static, time-variant, dynamic, adaptive.
5. We have checked the entire article for grammar and spelling. We replaced long sentences by shorter ones.
6. We have re-written the abstract
7. We have re-written most of the introduction and added a discussion of the HRU, REA, REW and GRU concepts. We also added a discussion about the effect of grid size and computational expenses.
8. We have re-written the explanation of the adaptive clustering method (new section 2.1) in a step-by-step manner.
9. We have shifted most of the sections about the SHM model to the new Appendices A1-A3.
10. We have re-written the implementation of adaptive clustering in a step-by-step manner (new section 2.3)
11. At the beginning of new section 2.4, and at the beginning of section 3, we establish a connection between similarity analysis (2.4.1 and 3.1) and adaptive clustering (2.4.2 and 2.3).
12. We have added short summaries at the end of sections 3.1 and 3.2
13. We have added to the summary and conclusion a paragraph about further work, and challenges of integrating adaptive clustering into more sophisticated models.

Point-by-point replies to referee comments

Please note that we provide page/line numbers and section numbers for the new manuscript version.

RC 1 and RC 3 (Shervan Gharari)

Comment 1: Please see point 5 in 'main changes. Also, the manuscript will undergo further copy-editing in the production process.

Comment 2: Please see point 7 in 'main changes'.

Comment 3: Please see point 9 in 'main changes'. In section 2, we now first provide the explanation of the adaptive clustering method (section 2.1), and then a brief introduction to the study area and the hydrological model (section 2.2), referring to the appendices where appropriate.

Comment 4: In the revised version of the manuscript, we replaced 'crop coefficient' by 'vegetation correction factor' in Table A1.

Comment 5: In the revised version of the manuscript, we mention that there are 147 river elements (p 22 line 8)

Comment 6: No changes made. Please see our replies to this comment from the discussion phase.

Comment 7: In Appendix A.2, explaining the Attert model setup, we now refer to Table 2 with the list of sub catchment geology and land use classes. We also added to Fig. 2 separation lines indicating the area of influence of each rain gauge as determined by the Nearest Neighbour method, and refer to it from Appendix A.2 (p 22 line 12).

Comment 8: No changes made. Please see our replies to this comment from the discussion phase.

Comment 9: No changes made. Please see our replies to this comment from the discussion phase.

Comment 10: We have moved the detailed explanation of the SHM structure and processes to Appendix A1. The description of set up, calibration and validation of the SHM model to the Attert basin is now in appendices A.2 and A.3. In section 2, we now first provide the explanation of the adaptive clustering method (section 2.1), and then a brief introduction to the study area and the hydrological model (section 2.2), referring to the appendices where appropriate.

Comment 11: We have changed most sub section titles. Sub section 2.2.1 is removed in the revised version.

Comment 12: Section 2.3.1 from the previous version of the manuscript is now section 2.4.1 titled 'Entropy as a measure of hydrological similarity'.

Comment 13: We have changed most sub section titles. Old section 2.2 is now section 2.1, titled 'Adaptive clustering'. Old section 2.3.2 is now section 2.4.2 titled 'Evaluation criteria and benchmark models for adaptive clustering'

Comment 14: Please see points 2 and 11 in 'main changes'.

Comment 15: In the revised version of the manuscript, we rephrased the text about the entropy results (p. 11 line 9 pp)

Comment 16: We have added a brief summary of the main findings of section 3.1 at the section end, and make a connection to the next section.

Comment 17: Please see our reply to comment 16 above, and our replies to this comment from the discussion phase.

Comment 18: We have completely re-written the abstract, and substantially revised the summary & conclusion section.

Comment 19: We have added at the end of the summary & conclusions a brief discussion about potential problems of including adaptive clustering in more advanced models.

Comment 20: No changes made. Please see our replies to this comment from the discussion phase.

Comment 21: No changes made. Please see our replies to this comment from the discussion phase.

Comment 22: We have added a few words to the abstract and the summary and conclusion stating that the main purpose of the paper is a proof-of-concept of adaptive clustering, and therefore the choice of the programming environment and the computational performance is not of major importance.

Comment 23: No changes made. Please see our replies to this comment from the discussion phase.

Comment 24: Please see point 8 in 'main changes'.

RC 2 (Anonymous)

Comment 1: No changes made. Please see our reply to this comment from the discussion phase.

Comment 2: Please see point 4 in 'main changes'.

Comment 3: No changes made. Please see our previous reply to this comment

Comment 4:

- We added to Fig. 2 separation lines indicating the area of influence of each rain gauge as determined by the Nearest Neighbour method.
- We completely re-wrote the abstract, and partly the summary and conclusion, adding comments that the main purpose of the paper is a proof-of-concept of adaptive clustering.

Comment 5: Please see point 4 in 'main changes'.

Comment 6: Please see point 5 in 'main changes. Also, the manuscript will undergo further copy-editing in the production process.

Comment 7: Please see points 8-10 in 'main changes'.

Comment 8: Please see points 8-10 in 'main changes'.

Comment 9: All figures in the manuscript are now in higher resolution.

Comment 10: We have replaced old Fig. 3 with a new one (now Fig. 1), and also changed the related explanation. We have removed old Fig. 4.

Comment 11: Please see point 9 in 'main changes'.

Comment 12: Please see point 12 in 'main changes'.

Comment 13: We have added to the manuscript (p 23 lines 5-9) a brief explanation about our choice of the weights for each component of the objective function.

Comment 14: We have added at the end of the summary & conclusions a sentence about how the choice of representatives can be improved in future versions of adaptive clustering

Comment 15: No changes made. Please see our reply to this comment from the discussion phase.

Yours sincerely,

Uwe Ehret, on behalf of all co-authors