29.11.2021

Answer R1:

Thank you very much for the detailed and well worked out review. Your comments, questions and remarks are very valuable for our revision of the preprint. We are pleased to discuss your points of the review in more details to make our paper and statements more clear. For that purpose we cite your comments in the review (with *“”, italic, underlined*) and answer each comment thereafter.

- Reviewer Comment 1:

  “Common remarks

  The contribution is in line with the aims and scope of GMD. The paper represent a sufficiently substantial advance in modelling science? The consideration of backwater effects like realized is a novel aspect of modelling. The methods and assumptions are valid and clearly outlined. Nevertheles some additional remarks could be useful (see detailed comments). Alltogehter a minor revision is recommended. The structure of the paper and the figures are appropiate. Partly the figures have a high information density. Therefore it is difficult to recognize all details. But it is due to the nature of the subject. “

  Answer to comment 1:

  Thank you for your positive comment. We are pleased to tell you that we will add another chapter about a more nuanced discussion of the applicability and limitation of our proposed conceptual method.

- Reviewer Comments 2: “*Remarks about content-related aspects:”*

- *“Line 28 I would say that (1) is part of (2)”*

  Answer: Thank you for the remark. We distinguish here between the (1) compartment of the surface-atmosphere interaction and (2) the compartment of the soil-vegetation-atmosphere. In (1) the evaporation and in (2) for example, the transpiration is regarded. Because of a differentiation if vegetation is present or not, we think it is reasonable to distinguish between these compartments.

- *“116 /117 & 120 / 121 this words are the identic, perhaps both models can be evaluated togehther”*
  Answer: Thank you for the remark. We agree in merging the sentences as follows:

  “The hydrological model ‘ArcEGMO’ takes into account backwater effects by hindering the downstream flood routing when the water level at the downstream segment is higher than the upstream one (Pfützner, 2018). ~~This method calculates a retained flood rooting, but neither computes backwater volume being routed into upstream segments by a reverse flow direction~~

~~nor the backwater induced flooding of adjacent areas.~~ The method presented by National Hydrological Forecasting Service in Hungary (Szilagyi and Laurinyecz, 2014) applies a discrete linear cascade model to account for backwater effects in flood routing by adjusting a storage coefficient of the cascade. The ArcEGMO and NHFS method calculate a retained flood rooting, but neither computes backwater volume being routed into upstream segments by a reverse flow direction nor the backwater induced flooding of adjacent lowland areas."

- *"171 such structures control more the local and regional water levels than the flow of whole catchments, the influence on the discharge is rather short-term after operations "*

  Answer:
  Thank you for the remark. We agree to describe the effect of these control structures more precisely. Revised sentence: "Backwater effects in river sections are often caused at obstacles like weirs, (tide) gates, retention or detention reservoirs, which also function as control structures in streams".

- *"221 / 222 precipitation as part of subcatchments sounds a little bit strange, perhaps the following is better: "while precipitation time series are related to subcatchments as spatial units"*

  Answer:

  Thank you for the remark and suggestion. We revised the sentence in the following way: "Operative criteria of control structures are defined for three types of driver time series which are precipitation intensity, water level stages and discharge values. Hydrographs of water level stages and discharges are results given at junction nodes, while precipitation time series are related to subcatchments as spatial input data."

- *"274 "changed differences" sounds not clear enough, would be the words" decreased volume" better?"*

  Answer: Thank you. We agree in this change.

- *"386 compared to other passages the results are not discussed here"*

  Answer:

  The paragraph is as follows: "An interactive backwater system is present for the control structures 'Reitschleuse" (blue, Fig. 11) and 'Dove-Elbe Schleuse" (green, Fig. 11) which depend on thresholds of the downstream water levels in the Dove-Elbe stream segments (black, Fig. 11). In this case, the method to model interactive control systems is applied and evaluated."

  We agree in completing the sentence with a statement about the evaluation result:

  "An interactive backwater system is present for the downstream Dove-Elbe river section, which is influenced by the control structures 'Reitschleuse" (blue, Fig. 11) and 'Dove-Elbe Schleuse" (green, Fig. 11). Both control structures depend on thresholds of the downstream water levels in the Dove-Elbe stream segments (black, Fig. 11). In this case, the method to model interactive

control systems is applied. The evaluation results show a good performance of the model: The closing and opening times of the sluices according to the thresholds are met."

- *"421 – 425 this are detailed results and not usual in a summary, partly they are a repeat Discussion of 4.2: Three functions are dicussed and their operative criteria are mentioned (Line 223). If the reviewer has not overlooked anything, than is not clear what this criteria are and and how they are used to choose one of the three functions? It it is true, some additions would be useful. Besides in figure 4 on the left side 4 functions with Q1 to Q4 are listed. What is their meaning compared to the 3 function on the right side. A explanation is *function . . ., but there is not an additional star * in the picture."*

  Answer: Thank you for the comment. The text is as follows: "The differences in peak water levels are in the range of 0.01 m to 0.10 m. This corresponds to a variation of 1 to 10 % in the streams with a backwater affected water level variation larger than 1 m. The RMSE (< 0.12 m) and R^2 (> 0.9) of the flood event analysis confirm the good result evaluation." We agree to reduce the details in the summary and give a reference to the results in paragraph 6.2 (not 4.2 as mentioned by the reviewer).

  To paragraph 4.2: The question of the reviewer refers to the following text: "The status of control structures is checked per time step during the execution of the numerical model. A differentiation between three functions of control structures is done according to their operative criteria depending on pre-set (external pre-processed) or on-the-fly (internal processed) driver time series. The three functions of control structures and operative criteria are listed in Fig. 4."

  Answer: We agree to describe the functions and criteria in a more nuanced way. The figure 4 and the text will be revised.

- *"Line 269 / 270: If the reviewer has not overlooked a special remark, than it is not discussed how the retention quantity is calculated. Perhaps GIS is used or similar? "*

  Answer: Thank you for the question. The sentence is: "The backwater quantity derived from an afflux at the downstream segment, is routed to the upstream segments." The "routing" of backwater in upstream direction is calculated in a simplified way not taking into account the roughness up to now. Taking into account the roughness parameters in a conceptual way is an outlook of the proposed method.

- *"Finally: In the text I have found some remarks which are repeats of remarks in other chapters, for example line 243 to 245. Therefore the impression is, that curtailments are possible. But it is not mandatory.*

  Answer: Thank you for the comment. We agree in this and revised the sentences.

"English language: The reviewer is not expert for English. Possibly the following recommendations could be useful:

- *Line 8 / 9 "constrol structures" instead of "drainage structures"* (Answer: We agree! Thank you!)

- *16 "simulating" for "modeling"* (Answer: We agree! Thank you!)
- *41 "will be faced by higher pressures" for "will face"* (Answer: We agree! Thank you!)
- *62 / 63 "impact on flow regime"* (Answer: We agree! Thank you!)
- *64 "outlook on" for "outlook of"* (Answer: We agree! Thank you!)
- *89 "like by the frequently used"* (Answer: We agree! Thank you!)
- *314 is "are extendable" better?* (Answer: Don't agree. We extended the code already.)
- *317 are the words "integrated as extensions" better suited?* (Answer: Thank you! The sentence is shortened as follows: "Both approaches are integrated in the source code of Kalypso-NA (4.0) as illustrated in Fig. 9."
- *321 "given by" instead of "given in"* (Answer: We agree! Thank you!)
- *344 the second "is" is not necessary* (Answer: We agree! Thank you!)
- *384 "concordance" instead of "result"* (Answer: We agree! Thank you!)
- *415 "The use of" instead of "Using"* (Answer: We agree! Thank you!)
- *Editorial corrections*
- *96 cancel ":" after models* (Answer: We agree! Thank you!)
- *164 "change" for "changes"* (Answer: We agree! Thank you!)
- *206 perhaps n should be used already here: between n supporting points* (Answer: We agree! Thank you!)
- *225 "depends" for "depend"* (Answer: We agree! Thank you!)

- *Some passages are very long wherefore a subdivision is recommended, for example: beginning with line 245 or line 343 to line 363 (21 lines)*

  (Answer: Thank you for the comment! We will take a separation of paragraphs into account during the revision of the preprint.