Response to comments by Katherine Ratliff

We are grateful for the constructive comments by Katherine Ratliff (hereafter: reviewer) on our manuscript. Below we respond to all points raised in his review and outline how we changed our manuscript accordingly.

General Comments

"Network response to internal and external perturbations in large sand-bed braided rivers" by Schuurman et al. contains an interesting set of experiments using Delft3D. The 14 different model scenarios combine an extensive variety of initial conditions, hydrodynamic regimes, and morphodynamic manipulations; however, the breadth of the study may overshadow some of the key messages that the authors are attempting to convey. I believe that some restructuring of this paper, and perhaps the addition of a supplementary information/figures section, would help the authors to streamline the flow. Further development of the discussion and conclusions section is also critical, including more clarity on the new contributions of this paper.

I recommend that the authors select fewer of their model runs to present in the main text results that should be discussed in more detail, and the rest of the results could be included in a supplementary information section. One way to restructure would be to combine a results and discussion section, and then walk through the most important experiment results with a short discussion included in each of the subsections, where the authors can highlight the key points that they want to convey from each experiment. As of now, a large volume of results are presented but not really developed or discussed later, which makes it difficult to determine the most important and novel points of this study. If the information can be distilled down to the most important points, and then the discussion and conclusion flushed out (especially to point to novel contributions), I believe that this paper's scientific significance, quality, and readability would be greatly enhanced.

We restructured the Result chapter in order to highlight the main messages of this paper and we streamlined the paper. See also response to reviewer 1. We now focus more on the model runs with the internal disturbances and use runs 1-4 to justify the settings for runs 5-14. The scientific novelty is found in model runs 5-14. We adjusted the Discussion and Conclusions chapters accordingly.

Specific Comments

p. 198

The abstract does little to highlight new concepts brought forward by the work. Better development of discussion/conclusions section may help to hone the abstract, too.

We agree and rewrote the abstract.

l. 5: I would include that you are using the physics-based model "Delft3D" in the abstract

Done.

l. 12: “reshape” is a verb, not a noun. This word needs to be replaced with either “reshaping” or “shape” throughout the text and captions
Done.

ll. 20-22: This is a broad statement. Perhaps give examples of what sorts of challenges?
Examples and further specification of this statement are provided later in the introduction, for example in lines 22 and 25-27 on page 199.

p. 199
l. 23: “in and along the river”: do you mean rivers in general? Or one of the specific ones discussed above?
The specific ones discussed above, but it is also valid for other large braided rivers.

l. 28: “identifying morphological effects of a measure”: I do not know what you mean here. . . effects that arise from a manipulation or perturbation?
We now explain that we mean river training works and other human-induced disturbances in a river. For clarity, we changed the word ‘measure’ into ‘river training works’.

p. 200
Might make sense to move the paragraph beginning on l.6 (addressing braided river dynamics) before the previous paragraph (talking about the effects of human manipulations of the dynamics)
Done.

l.16: “back-water” should be changed to “the backwater effect”
Done.

ll.24-27: couldn’t downstream effects, such as large dams, be a player here? State that these are the three perturbations that you’ve chosen to address in this study
Clarified. We did not study effects of large (reservoir) dams which are distinct from the smaller disturbances that are perhaps much more common.

p. 202
l. 4: “predicted by theory”: briefly explain what the theory is here l. 12: “variable success” might be better stated as “variable results”
Done.

p. 203
l. 15: again, I would introduce Delft3D here (and also earlier in the abstract).
Done.

You state your research questions and then say that these can be addressed using basic engineering rules. So how does your study further the understanding of the field? A

comparison of your modeling results to the theoretical ones? More specificity would better direct your reader here. I'd also like to see citations for ll. 22-27.
Indeed, the comparison in the paper between the Delft3D results and the engineering rules was weak, and it is not part of the main message. Therefore, we removed these lines and the reference to 'engineering rules'. Furthermore, we removed most of section 2.5.

p. 204
I don't think you need to include eqns 1-4. The audience is likely familiar with Delft3D, and you could just state that you're using the shallow water equations.
We disagree with this, because it is important to make clear that we used a 'physics-based' model based on the 3D flow equations. Furthermore, it is important to show that the vertical flow is computed using the mass balance, which is often misunderstood (and even miss-cited from the Delft3D manual) in the community.

p. 206:
l. 19: you don't always use a constant discharge
Explained better now. We use a constant discharge in all disturbance scenarios and we used a variable discharge in a scenario to show that we do not need that for our present purposes.

l. 25: Makes me wonder why didn't you just use an aspect ratio of 2 for your cells?
To save computational time, but the cell size and aspect ratio is indeed a somewhat arbitrary choice within the safe limits indicated in the manual as developed from numerical theory.

p. 207
l.4: you state the morphological factor already above
Indeed, but for clarity we keep it here.

l. 13: "SD": spell it out the first time – I assume standard deviation?
Done.

p. 209
A better motivation for including section 2.5 would be useful. For example, the IP is introduced here (p. 210), and then it doesn't appear again in the results?
Indeed, and we now removed most of section 2.5. We only kept equation 10, which we moved to section 2.4.

eqn 6: should there be a citation for this equation or is this an original contribution? Unclear.
It is an original contribution, but was not part of the main message and we therefore removed it from the paper.

p. 210
l. 21: "Theory predicts" citation? What theory?
Linear analyses can be used to predict downstream amplification of a disturbance. Because we hardly refer to equation 8, we removed it from the paper. We explain this extensively in

another paper ('Dynamic meandering in response to upstream perturbations and floodplain formation, paper accepted by Geomorphology')

p. 211
l. 9, 15: are the predicted celerity and bed level adaptation length for the model experiments in this study?
Yes, the predicted celerity and bed level adaptation length are for the initial settings of the model simulations in this study. We now make this more clear.

l. 14: "BI": do you mean "ABI"?
For clarity, we changed all 'BI' to 'ABI'.

l. 18: "later, the situation changed": can you be more specific about what situations and what changed?
This line refers to bed level changes in the simulations in general, as the bed level changes from the initial situation into a new bed level with bars and branches, which is stated in line 18-19. It should be noted that this is part of the Methods section and not the Results section.

p. 212
l. 14: would be useful to explain briefly how you know that the system has reached a dynamic equilibrium. . . ABI plateaus?
Correct, and we added more description of what we consider to be equilibrium.

l. 18: "the channel network statistics": here, are you only talking about runs 3 and 4?
In fact, we only talk about run 4. However, section 3.1 was partly rewritten. Runs 2-4 are now used to justify the application of a constant discharge and non-erodible banks, and Run 1 is now used as reference case without disturbances.

l. 26: "Fig. 5a" – maybe better to say feature A in Fig. 5? My first instinct was to look for panel A.
Indeed, we corrected this.

p. 214
l. 2: "floodplain erosion distance": is this an average?
Yes, this is a spatially average value. Clarified in the text.

l. 4: what is the width increase along the Brahmaputra? Useful to include the value and a citation
We agree and added a reference.

p. 214
l. 13: "Now": you mean at 6 months?
Indeed, we mean at 6 months. We made this clear now.

ll. 25-26: briefly explain that the backwater effect causes enhanced deposition upstream
Done.

l. 28 (to next page): "indication of the bifurcation instability" – why is it an indication?
Run 9 started with symmetrical bars and bifurcations. Asymmetrical, complicated bars usually form due to asymmetrical partitioning of flow and sediment at upstream bifurcations. Before this, symmetrical bifurcations change into asymmetrical bifurcations due to bifurcation instability or due to upstream changes. Therefore, we can state that asymmetrical, complicated bars are an indication for bifurcation instability.

p. 215
l. 4: usually a dam is constructed across an entire river rather than just a branch. Can you develop the relevance of this scenario or give an example?
We refer to small engineering construction works within the river, not to hydropower dams.

P. 216
l. 6: you state that the results from run 12 are "more realistic" than run 8. Perhaps you should just include the results from run 12 in your results and include the run 8 results in a supplementary document?
We rephrased. The model runs with droplet bars (runs 5-9) are much more idealized than runs 10-14. Because of this we can isolate effects of disturbances starting from entirely regular patterns, showing network responses in a more clear way than the less idealized runs. Therefore, we think runs 5-9 must remain part of the main text.

l. 7: specify that it's a water "impoundment"
Done.

p. 218
l. 1: "diverse": you mean diverge?
Indeed, corrected.

l. 15: again, you say that runs 10 and 1 are more realistic than run 7 – could run 7 results be included in supplementary info?
See above response.

l. 20: "long-distance effects exceeded the medium-distance effects": this is really hard for me to see. The bars all look fairly similar to me in the bottom 3 panels of Fig. 11a at x > 50 km. Are there specific features that you can point to in order to demonstrate the differences?
Although the bars at x > 50 km might look fairly similar at first glance, they are different. The location of the bars and branches differs hundreds of meters, which is a much larger change than close to the disturbance.

p. 220

l. 2: “many similarities”: can you state what the similarities are?
We added some of the similarities, although the differences between the model results might be more interesting (see previous comment).

l. 22-23: “This merging of bars fast much more pronounced. . .” not clear what you’re saying here
We corrected this sentence.

p. 221
The first two paragraphs of the discussion feel like they are the start of a conclusion section.
We disagree with this. The first paragraph is a generalizing summary of the model scenarios, whereas the second paragraph introduces a new generic model for the downstream propagation of a disturbance in a braided river. We clarify this now.

p. 222
l. 19: “according to theory”: what theory? Citations?
We added references to linear theory for bar dimensions and celerity.

Figure 17 is quite interesting and serves to unify the results from some of the model experiments. I’d like to see this part more developed – what sorts of morphological differences arise from these different types of perturbations? Clearly they don’t all have the same effects. This could be a place where you could work to develop the novel contributions of this study.
We moved Figure 17 to a separate paragraph of the Results part, as it is a model result rather than a conceptualizing of the model results. In that paragraph, we elaborate on Figure 17 in more detail, among others on the differences between the model scenarios.

p. 224
l. 3: what about the bank erosion procedure in Delft3D could be improved? Or briefly state what it lacks
Clarified in the text now.

p. 225
ll. 9-10: the effects of the perturbations that you explored in these scenarios did not have a big backwater effect, but that’s not to say that the backwater effect wouldn’t play a larger role in other situations. For example, a large dam constructed across the entirety of a river would have a huge backwater effect (if creating a large reservoir), or if a river had a lower gradient, or lower Froude number, this effect might be more important.
Indeed, therefore we now explain the specific conditions in which our statement is valid.