Han and Kim quantify geomorphic (elevation and grain size) change for levees in time and space and suggest a link of these to avulsion style. First, a 1D advection-settling model is presented. Given the parameters investigated, input grain size and discharges change the elevation and grain size trends the most. Next, a scaling analysis is used to find the correlations between levee topography and avulsion styles. Results suggest that the levee slope correlates with avulsion frequency. However, avulsion style is assumed to be tied to aggradation rates at and beyond the levee. Recent literature on connections between avulsion and levees has focused on the crevasse splay in already existing levees. This work highlights the connection between levee morphology and morphodynamic avulsions, where both the channel bed and levees aggrade. The discussion of levee building on morphodynamic avulsions, presented here, is important in developing tools to help predict avulsion potentials. I look forward to seeing this work published after revisions, including:

- Strengthening the connection between the 1D levee building model and scaling analysis/conceptual framework. Currently, these two components of the manuscript are not well connected. Two suggestions are 1) including a motivation for parameters investigated in the 1D levee building model. These motivations are revealed, in part during the discussion, and would be beneficial to learn about earlier i.e. Introduction and Test parameters; and 2) including a more complete introduction of the avulsion styles and expected floodplain aggradation. Additionally, the authors could base the 1D levee building model on one of the rivers discussed in the avulsions style section or highlight how the current setup is relevant to slopes and timescales of those rivers.
- Including additional figures to help the reader understand the 1D levee building model better. I would suggest including the spatial variations in velocities, sediment concentration, and slope on the levee. The velocity and sediment concertation plots can especially highlight the links between levee shapes and velocities and/or sediment availability.
- Timescales are addressed in both the 1D and scaling analysis. There is an opportunity to more clearly compare the findings of modeling durations in the 1D levee building model to the avulsion timescales.

Below are some more detailed major and minor comments:

Major comments:

Line 48-49: The motivation right now is to "analysis the effects of geometry and deposition rate of fluvial levees on the stratal association of channel complexes". However, the stratigraphy is not discussed again. Consider revising the text be more specific. This is again brought up in line 64 "comprehension of river avulsion associated with floodplain architecture", where floodplain architecture is not further described.

Line 138: The observation of channel and floodplain were based on (Wyżga, 1999) as stated in Line 135. A look at the cross-section of the Vistula River, reported there, has a maximum channel depth of 5m. Please specify or model how do varying channel depths affect the results? Furthermore, the floodplain water depth of 4m, reported there, is based on observation of the 1997 flood. It would be worth exploring what reoccurrence timescale this flood represents and how variations in water depth would affect the test results.

Line 138-139: Velocities for both in channel and floodplain were given in Wyżga, 1999. Do the values presented here reflect the values measured by Wyżga, 1999 on the floodplain and in the channel?

Line 141: Please state the assumption and limitation for only looking at a case when channel bed and levee crest aggrade simultaneously. For example, Ganti et al. 2016 show that levees can independently grow compared to channel bed elevation.

142-144: Please explain how the total suspended flux in the channel and grain size were chosen.

Section 2.3: Since the 1D modeling tests are introduced here, it would be beneficial to motivate the test cases either in this section, the previous section, or the introduction.

Line 158-160: I am not sure how velocities and flood water levels (hydraulic gradients) can be disentangled. What are the implications of changing velocities while keeping a constant water depth? For me, this means discharges in the river must increase. This increase in river discharge would have implications for the other parameters held constant in the river.

Line 189-191: Slope variation is a major component of the results and discussion. It would be useful to plot the slope in addition to the elevation.

Figure 3:

- It seems like the plots are cut off in the y-axis for levee width < 20m. It would be useful to show elevations for the levee closest to the river.
- Since the authors are not defining where a levee ends and the floodplain begins in this model, I would encourage relabeling the x-axis to distance from the river bank.
- It would also be useful to describe the tests in the caption since this is the first time the reader will see the results.

Section 3.2: I agree with the description in this section that results are strongly tied to the time of building deposit. Given the importance of tying levee slope and deposition time, it would be worth exploring and describing the relationship with slope and time to deposit, highlighted in lines 190-191.

Line 231: The upward coarsening in grain size for Test 2 is very interesting. I wonder if it hints at architectural style and therefore is still important to emphasize and incorporate even when elevation and mean grain size is not too different from Test 1. A comparison to the literature on grain size changes on levees (i.e. Bridge 2009) can strengthen this section.

Section 4:

- A summary of the expected results based on motivating studies and the differences between model results and previous work can strengthen the beginning of the discussion.
- Since the 1D model is based on dimensions of the Vistula River (Line 135), how do the grain sizes on the levee compare to those of Wyżga, 1999?

Line 272-273: Are the results presented here sensitive to the water depth on the floodplain? I would suggest looking at variations before drawing this conclusion here.

Line 274-277: This seems counterintuitive to me. Could the authors plot the velocities away from the river bank for both cases to support their argument? Do changes in concentration affect levee shape and grain size trends, especially given the constant sediment discharge?

Line 288-289: It is important to acknowledge here that other tests (T5 and to a lesser extent T2) produce the same results.

Line 324 Could you clarify how the levee slope calculation is derived here? I am especially curious how the channel water depth is included in the calculation.

Line 335: A major assumption of this model is that the in-channel aggradation rate equals the aggradation rate of levees. I think v_a is traditionally expressed as the channel aggradation rate. Please elaborate on the implications and limitations of this assumption.

Equations 12 and 13: Please describe the implications of deriving avulsion frequency in two different forms and how they compare.

Line 348-349: To better assess this statement, it would be useful to know how avulsion frequency and levee slope were found in Figure 7.

363: The 1D levee building model results suggest that steeper sloped levees took longer to superelevate compared to the initial case. Please clarify how the ID levee building model results are supporting your point here.

364-366: This conceptual framework is not clear to me. Can you link this to the results in the 1D levee building model to clarify?

Section 4.5.3. To my understanding, a major assumption for this section is that floodplain building time scales are the main driver in aggradation across a floodplain. However, concentrations are equally as important. The implication for varying sediment concentrations needs to be discussed in greater detail. This might also clarify the linkages between levee building and floodplain aggradation throughout, especially beyond the initial 200m presented in the 1D levee build model.
Line 385: Could you please clarify how high levee gradients prevent the influx of floodplain deposits? Levee gradients mainly affect water depths associated with lower or higher elevations further away, assuming the same levee crest elevation is reached. I could see how higher levee crest elevations could change the sediment concentration and grain size distribution entering a levee based on decreasing concentrations associated with the in-channel Rouse profiles.

Section 4.5.4. This section could be significantly strengthened, including linking the 1D levee building model and results. One suggestion is to introduce modeling results specific to the upstream and downstream scenarios presented in Valenza et al. 2020. For example, the channel geometry and thus suspended sediment concentration might also be inherently different for these sections described which the model comparison can include.

Line 418-420: See comments to line 385. Please clarify the links between steep topography and floodplain deposition.

Line 438-539: This is counterintuitive to me. For example, Adams et al. 2004 mention that levee height is established relatively quickly, and width increases with time. How do these results compare with the levee modeling results presented earlier?

Minor comments:

Line 98-99: Please state the implications for the channel total sediment flux and near-bed concentration being kept equal. Are there any studies that can support this in-channel trend?

Line 106: Please describe the part of the model and subsequent results that rely on the assumption that deposition takes longer than flood inundation.

Line 131-132: Please describe the implications for assuming porosity is zero for stratal architecture and mass calculations made later.

Line 160-161: What are the motivations for choosing 2m as a crest height to reach. Are there links to the deposition measured on the Vistula River?

Line 163-164: I am confused if equations 7 and 8 are used in all test cases and incorporated in Eq 9. Please specify here when these equations are used.

Figure 4:

- Comparing results between tests is not straightforward in this layout. Is it possible to plot all test cases on one plot for proximal and another for distal?
- I would encourage plotting the entire run time for all tests cases. This can nicely highlight the run time variations for different cases.
- The comparison between normalized ratio of elevation difference shows an interesting nonlinear change in normalized elevation difference over time that also seems to be different between proximal and distal. How do these results compare to other test cases? It would be interesting if the authors described the implication of these in the discussion.

Line 199: “suggests that the local surface elevations increase linearly”. This also means that no equilibrium is achieved. Is the conclusion from this model that there is no equilibrium form that levees achieve or is it a result of the model set up?

Figure 5: Please specify the time of run these results represent.

Line 324-325: Since the levee slope is defined by total sediment volume, does assuming a porosity of 0 affect these results?

Line 325-326: What is the motivation behind using a different sediment flux from initial levee modeling?

Line 326-327: Is this the same flood recurrence interval related to the flooding depth that was used in the initial levee modeling? Please elaborate on changes if there are any. Would it be possible to calculate the flood duration from station data or how much does flood intermittency affect the results given the uncertainties/variations?

Line 376-378: The statements here are currently hypotheses. Please describe how are they supported by the results of this paper.

Line 401-402: In addition to deposition duration, does sediment availability and concentrations at the distal part also affect more distal floodplain deposition patterns. Maybe this is where re-entrainment becomes important since the bypass of sediment, especially for d50 sediment, is occurring at the distal ends (Line 260-261). This could be a reason to keep re-entrainment in the modeling for this section.

Line 435-436: Please specify which processes investigated here are affected by channel mobility.

Line 469: Based on the findings presented here, is there anything in particular related to levees that could help better predict avulsions?

Line 463-470: The statements here seem more like an outlook for future work than conclusions of the modeling and scaling work presented here. I would present the information accordingly.

Throughout the text: Alluvial ridges and levees are used interchangeably here. However, I think they can be associated with different timescales and processes. It would be good to define each and use them consistently.