Comment on hess-2021-228

Anonymous Referee #2

The paper titled "Watershed zonation approach for tractably quantifying above-and-belowground watershed heterogeneity and functions" develops a watershed zonation approach for characterizing watershed organization and function. The authors use multiple high resolution spatial datasets available over the East River watershed to explore this relationship at the hillslope level. Their use of process-driven observations (Annual N export) is an important contribution as it shows that the zonation is indeed connected to the local processes. I recommend that this paper be accepted for publication after major revisions.

1. The steps used to delineate the watersheds is clear in the current manuscript. However, the step to delineate the hillslopes remains unclear. I am assuming it involves just splitting each watershed into a left/right hillslopes and a "headwaters" hillslope if it exists; however, this needs to be made more explicit. On a related note, the title is misleading since the clustering is performed at the hillslope level. I would suggest that the title be clarified so that it is clear that it is hillslope-level and not simply watershed-level.

2. "This is consistent with Wood et al. (2011), concluding that the order of 100 m is a sufficient resolution for representing hydrological fluxes" is a stretch. There is a lot more heterogeneity that will matter at scales finer than hillslopes even if it is not captured in your data; furthermore, the role of hillslope hydrology is variable depending on the topographic environment. This sentence is not necessary to show your point; I would remove it.

3. Line 180 - The reason why the hillslope-level correlations is better than pixel-to-pixel can be deceptive. This is probably a combination of the processes being more connected at 100 meter scales but also just simply because you are removing random noise from the higher resolution data by aggregating at the hillslope level. I think it would be useful to test how the correlations vary as you upscale the original regular grid maps (e.g., 50 m, 100 m, 250 m...). You would do a pixel-to-pixel comparison for these as well. It would be

a strong result if the hillslope approach still wins out. My hypothesis is that it won't and that they will be pretty close. This analysis would be useful within the paper or could be placed in the supplement.

4. The current discussion has a number of disjointed paragraphs and ideas. I would encourage to split it up into discussion and conclusion sections and then to subdivide the discussion section into subsections.

5. Figure 1 - The legend of NLCD is not comprehensive. There are developed/urban areas on the map but they are not referenced in the legend.

6. Figure 3 - The 10 on the colorbar is cut off