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Interactive comment on "Influence of multi-decadal land use, irrigation practices and climate on riparian corridors across the Upper Missouri River Headwaters Basin, Montana" *by* Melanie K. Vanderhoof et al.

Anonymous Referee #2

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HESS Reviewer Comments

Line 28: would be helpful to specify what "non-center pivot irrigation" includes earlier in the paper (perhaps including in the abstract). There is some discussion of this on lines 321-325. The lack of distinction between gravity fed irrigation and non-center pivot sprinkler irrigation seems significant. Authors should indicate what is known about the efficiency/consumptive water use rates of non-center pivot sprinkler vs. center-pivot vs. flood. It is my understanding that non-center pivot sprinkler would be much more similar to center-pivot (than to flood) in terms of efficiency/consumptive water use. If

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non-center pivot sprinkler is not separated out from flood irrigation, authors need to be very clear and specific about what this study tells us about flood/gravity fed irrigation.

Line 50: what is “ditching”? Please re-phrase or clarify

Line 129-131: These citations might be as good or better to make the point that there is increased interested in river resiliency:

Montana Drought Demonstration Partners, 2015: A Workplan for Drought Resilience in the Missouri Headwaters Basin: A National Demonstration Project. http://dnrc.mt.gov/divisions/water/management/docs/surface-water-studies/workplan_drought_resilience_missouri_headwaters.pdf (Accessed May 20, 2019).

Montana DNRC, 2014: Upper Missouri Basin: Water Plan 2014. http://dnrc.mt.gov/divisions/water/management/docs/state-water-plan/upper-missouri/river-basin-plan/upper_missouri_basin_report_final.pdf (Accessed May 29, 2019). Montana DNRC, 2015: Montana State Water Plan: A Watershed Approach to the 2015 Montana State Water Plan. 80. The citation for McEvoy et al 2018 which is used later in the paper also supports this point – specifically for UMH - and summarizes the goals of the MT Drought Demonstration Project Table 2 & Lines 225-228. As a social scientist familiar with the issue and study region, my strength is not in the technical aspects of remote sensing or hydrology, so please take this comment/question with a grain of salt. I am a bit confused as to why authors report the “average NDWI” and “average NDVI” in table 2 given that they are more interested in trend over time (not average). The text on lines 225-228 perhaps explains this – but the paragraph focuses on the per summer “anomaly” rather “average”. Also this text does not refer back to figure 2. Greater explanation of why authors report the average in Table 2 would be helpful. In general, the description of the use the anomaly seems more complicated than it needs to be (?). Lines 321-325: please see my earlier comment re: lack of distinction between non-center pivot sprinkler and flood

irrigation. Authors should include a comment on line 325 about whether/how this lack of distinction effects the results – and more importantly what it allows the authors to conclude about flood/gravity fed irrigation practices. Line 328: the use of the "∼" symbol in "NDWI ∼ Year" is not clear to me. If the use of "∼" is standard in the field, then ignore my comment, otherwise please specify what that means. This comment might be related to my previous comment about use of "average NDWI" and "average NDVI" in Table 2 and the explanatory text re: use of "anomaly" on Lines 225-228. Line 374: the phrase "differences in agriculture" seems to be missing a modifier or unit. Is it difference in "agricultural area" or in "agricultural practices"? Please specify what this difference is within agriculture that is referred to. Line 515: the phrase "total amount of agriculture was relatively stable" – should specify the ag unit authors are referring to (I assume this is acres of land in agricultural production? But could be ag output/yield, which could mean an increase in ag productivity on same amount of land or stable output, but on fewer acres). Line 554: same comment as above for phrase "decrease in total agriculture over they study period" – specify unit of ag (acres? Or production/output/yield?) Line 667 – same comment "..total amount of agriculture [add units]" Line 519-520. Would be helpful if authors can explain how center-pivots get implemented on the ground. If center pivots increase by 506%, but non-center pivots only decrease by 39% where are these newly added center pivots going? Are they not replacing non-center pivot? Are they replacing flood irrigation at a rate of greater than 1:1? Are they being added to newly expanded agricultural fields (this is not allowed under MT DNRC's water rights laws, which require irrigators to specify place of withdrawal – and specifies that there should not be an expansion of irrigated acreage when irrigators switch to new irrigation system – though this most certainly happens.) Figure 7: I believe the headings in c&d should read "Change to reach-scale pivot irrigation" (not "agriculture"). Figure 7: use of term "built-up" and "building area" in both figure and the associated text is confusing. I assume authors are referring to urbanization, but that is not clear. Line 618: why use the word "crop management"? I expected authors to state: "complexities of ag water use and irrigation practices (or

methods)". In my mind, "crop management" refers to things like change which type of crop is grown, fallowing, use of cover crops, timing of planting and harvesting, etc. Line 636: phrase "total water-use for irrigation across the US" should be more specific. Following Perry et al's 2017 recommendation, authors should specify whether they are referring to water withdraws or water consumption (the following discussion illustrates this point using ET, but it seems like the authors could be more careful/specific with their use of the word "water-use" in line 636. Line 670 "water use" – again, authors should be more specific. Is this "water withdraws"? or irrigation methods? Or general water use – if so, specify some examples of what this includes Line 636-650 Perry et al 2017 make this same point at the global scale. Seems like their paper should be cited in this part of the discussion.

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